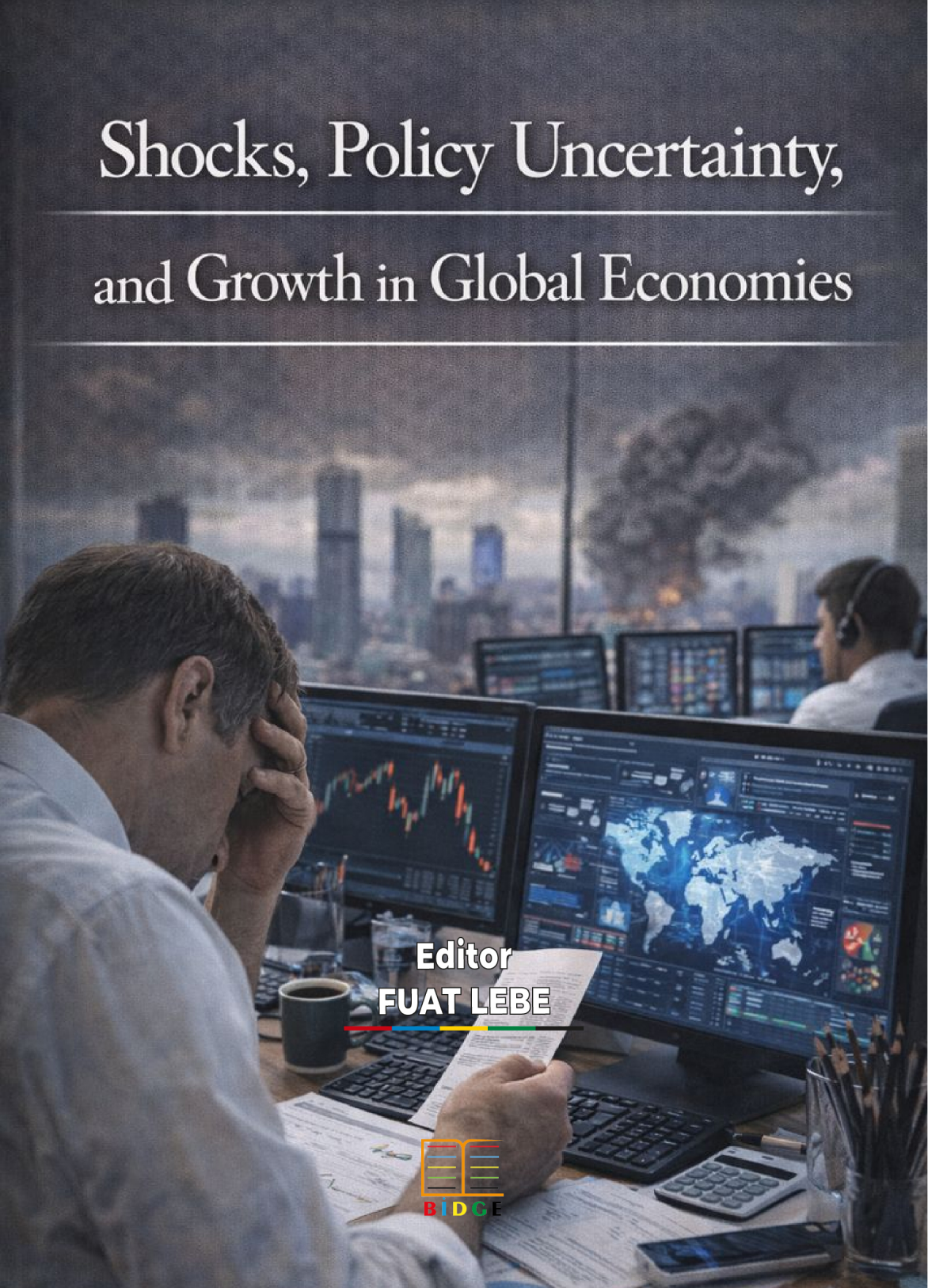
Shocks, Policy Uncertainty, and Growth in Global Economies



Editor
FUAT LEBE

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Preface

In an era characterized by heightened uncertainty, recurrent shocks, and profound structural transformations, understanding the complex interactions between economic forces has become more critical than ever. Global economies today are shaped not only by traditional growth determinants but also by supply-side disruptions, labor market dynamics, energy-security linkages, health investments, and strategic responses to policy uncertainty. This volume, *Shocks, Policy Uncertainty, and Growth in Global Economies*, brings together a collection of empirical and analytical studies that collectively aim to shed light on these multifaceted dynamics.

The central motivation of this book is to explore how various types of economic shocks and uncertainties influence inflation, growth, productivity, investment decisions, and strategic behavior across different institutional and geographical contexts. By combining country-specific analyses with cross-national perspectives, the chapters offer valuable insights into both advanced and emerging economies, emphasizing the interconnected nature of global economic systems.

Several chapters focus on inflationary dynamics and their underlying drivers. In particular, the role of supply constraints and shortage shocks in shaping inflation outcomes is examined within the context of the United States, highlighting how disruptions to production and distribution channels can propagate price pressures. Complementing this perspective, the interaction between real wages, labor productivity, and inflation is analyzed in the case of Türkiye, offering evidence on how labor market mechanisms and productivity trends influence macroeconomic stability.

Beyond inflation, the book addresses long-term growth dynamics and structural relationships. The link between health investments and economic growth is investigated through advanced econometric techniques that account for structural breaks, underlining the importance of human capital and public health as engines of sustainable growth. Energy and security considerations are also incorporated through an examination of the relationship between hydroelectricity consumption and military expenditures across major global economies, reflecting the growing relevance of energy resources in strategic and defense-related decision-making.

Finally, the volume explores how economic policy uncertainty shapes institutional and strategic behavior, particularly within the financial sector. The analysis of large European banks' strategic choices under uncertain policy environments highlights how uncertainty influences risk-taking, organizational decisions, and long-term planning in highly regulated and interconnected markets.

Taken together, the contributions in this book underscore the importance of adopting an integrated and multidisciplinary approach to economic analysis. By examining shocks, uncertainty, and growth through diverse lenses—ranging from inflation and labor markets to health, energy, defense, and finance—this volume aims to contribute to the broader academic and policy-oriented debate on how economies adapt and respond to an increasingly volatile global environment. It is hoped that this book will serve as a valuable resource for researchers, policymakers, and practitioners seeking to better understand the forces shaping economic outcomes in the modern world.

Assoc. Prof. Dr. Fuat LEBE
Adıyaman University

İÇİNDEKİLER

CHAPTER 1

SHORTAGE SHOCKS AND INFLATION DYNAMICS IN THE U.S.

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Introduction

Inflation can move from quiescent to acute with surprising speed when the real economy runs into binding constraints. In the United States (U.S.), consumer price inflation reached 9.1% year-on-year in June 2022, a magnitude that refocused macroeconomic debate on supply bottlenecks, delivery delays, and input scarcity as first-order determinants of price dynamics. This paper is motivated by the premise that shortage shocks are not merely sectoral disturbances, but can propagate into aggregate inflation and expectations in ways that are quantitatively meaningful and potentially persistent.

A growing body of research provides the intellectual scaffolding for this view. Micro price evidence highlights that staggered adjustment and heterogeneous repricing can convert cost pressures into hump-shaped inflation dynamics rather than one-off

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price level jumps (Nakamura and Steinsson, 2008). Production-network perspectives emphasize that disruptions to specific inputs can cascade through supplier–customer linkages, amplifying and prolonging aggregate effects (Barrot and Sauvagnat, 2016). In parallel, empirical work on commodity and macro shocks underscores the importance of distinguishing supply-type disturbances from demand-driven forces when interpreting inflation responses (Kilian, 2009). Finally, research on expectations formation shows that informational frictions can yield delayed yet persistent movements in inflation expectations, making belief dynamics a central part of the transmission mechanism (Coibion and Gorodnichenko, 2015).

Despite these advances, the empirical literature still faces important challenges when the object of interest is shortage-driven inflation. First, identification is difficult because scarcity indicators often co-move with policy actions, demand conditions, and global disturbances, complicating causal interpretation and encouraging sensitivity to specification choices (Ramey, 2016). Second, crisis episodes such as Covid-19 highlight that aggregate inflation can reflect an intricate interaction of sectoral supply constraints and shifting expenditure patterns, making clean decompositions and stable propagation assumptions especially fragile (Baqaee and Farhi, 2022). Third, standard inference may be strained at medium and long horizons if persistence and sampling uncertainty interact, elevating the importance of robust procedures for impulse-response estimation (Montiel Olea and Plagborg-Møller, 2021).

The aim of the study is to quantify how shortage shocks affect aggregate inflation, its demand- and supply-driven components, and inflation expectations, while allowing the transmission to vary across time. The motivation is straightforward: if shortages operate as Keynesian supply shocks, the inflationary consequences may depend on the broader state of the economy,

including the extent to which constrained supply induces demand shortfalls or reallocations that re-map price pressures across sectors. The paper's core contribution is to document, within a unified empirical framework, both the conventional impulse responses and their time variation, thereby clarifying when and why shortage disturbances translate into unusually pronounced inflation dynamics.

The U.S. provides a particularly informative laboratory for this analysis. It operates at the centre of the international monetary system, with the U.S. dollar accounting for roughly 57.8% of allocated official foreign exchange reserves in 2024Q4, which elevates the global relevance of U.S. inflation developments and policy reactions. Domestically, the monetary policy regime is organized around a longer-run inflation objective of 2%, a feature that shapes the interaction between realized inflation, expectations, and policy credibility. Moreover, a large literature links systematic monetary policy behaviour to macroeconomic stability, providing a natural benchmark for interpreting shortage-driven inflation episodes against the backdrop of rule-like policy conduct (Clarida et al., 2000).

The findings also matter beyond academic diagnosis. For central banks and fiscal authorities, the results bear on how to separate transitory bottleneck pressure from inflation processes that risk becoming embedded via expectations and second-round dynamics. For portfolio managers and investors, the evidence that shortage-driven inflation can be state contingent implies that inflation risk premia, duration exposure, and hedging effectiveness may vary across regimes rather than being well summarized by an unconditional average inflation process (Ang et al., 2008). For the broader research community, the paper's decomposition and time-variation results provide disciplined empirical moments that can be used to evaluate models of inflation under real constraints.

Empirically, the paper employs the local projections approach developed by Jordà (2005) to trace dynamic responses horizon by horizon, which offers transparency and robustness by avoiding strong assumptions about the full system dynamics. In addition to constant-parameter impulse responses, the analysis recovers time-varying responses, developed by Inoue et al. (2024), that reveal episodic amplification, most notably during Covid-19, thereby directly assessing whether shortages are transmitted differently in periods characterized by unusually binding constraints.

The remainder of the paper is as follows. Section 2 describes the dataset and empirical methodology. Section 3 presents the empirical findings, followed by concluding remarks in Section 4.

Data and Methodology

The Data

The dataset covers March 1969 to May 2025. We use monthly observations, which provide a more granular view of the pass-through of shortage shocks to inflation-related variables. The sample period is dictated by data availability, as the inflation-related variables do not extend reliably before 1969. Inflation measures are taken from Leiva-León et al. (2025). They develop an econometric framework for identifying latent factors that provide real-time estimates of supply and demand conditions shaping goods- and services-related price pressures in the U.S. economy. We use the shortage index from Caldara et al. (2025), which is constructed by scanning over 25 million newspaper articles for cases in which shortage-related terms appear within five words of sector-specific terms for energy, food, industry, or labour and include an economics-related keyword, and then computing the monthly share of such articles in the total news volume. The macro-financial factors are from Ludvigson and Ng (2009), and the trade policy uncertainty from Caldara et al. (2020).

Empirical Methodology

We implement a three-stage empirical strategy designed to (i) identify shortage shocks in a manner consistent with standard structural time-series method, (ii) trace their dynamic effects with minimal functional-form restrictions, and (iii) allow those dynamics to vary over time without imposing a parametric law of motion for instability.

In the first stage, we extract shortage shocks from a monthly SVAR with 12 lags. Identification is achieved via a recursive (Cholesky) scheme with ordering (SI, TPU, F_i, INF), where INF denotes the inflation-related variable under consideration—aggregate inflation (INF), demand-driven inflation ($INFD$), supply-driven inflation ($INFS$), or inflation expectations ($INFE$)—$F_i = 1, \dots, 8$ are the U.S. macro-financial factors, TPU is the trade policy uncertainty, and SI is the shortage index. Under this ordering, inflation is allowed to respond contemporaneously to shortage and trade uncertainty shocks and macro-financial conditions. Therefore, we estimate four separate SVARs, yielding four shortage-shock series tailored to each inflation measure.

In the second stage, we quantify the dynamic responses using local projections, following Jordà (2005). At each horizon (h), we estimate a single-equation regression by OLS, which directly delivers horizon-specific impulse-response coefficients. This approach is attractive in the present context for three reasons. First, it avoids the strong cross-equation restrictions implicit in VAR-based impulse responses. Second, inference is transparent because each horizon is estimated separately. Third, the framework is naturally extensible to nonlinearities and rich control structures while retaining a straightforward interpretation of the estimated responses as local to the horizon of interest.

The third stage extends the local-projections framework to a time-varying-parameter specification using the TVP-LP approach of Inoue et al. (2024). This step is motivated by the possibility that the shortage–trade transmission mechanism is not stable across regimes, particularly around episodes of acute disruptions. The TVP-LP methodology is well suited to this objective because it permits impulse responses to drift flexibly over time without requiring the researcher to pre-specify a particular parametric form for coefficient instability. Intuitively, the procedure produces a time-indexed sequence of horizon-specific response estimates, allowing the effects of shortage shocks to be tracked continuously through the sample.

Formally, for horizons $h = 0,1, \dots , 24$, we estimate:

$$INF_{t+h} = c_{t+h} + \beta_{h,t+h}\epsilon_t^{SS} + \sum_{j=1}^{12} a'_{j,t+h}\, z_{t-j} + v_{t+h} \qquad (1)$$

where INF is a vector of the dependent variables with $INF = \{INF, INFD, INFS, INFE\}$, respectively. z is a vector of control variables, i.e., $z = (INF, F_i, TPU, SI)'$, $\beta_{h,t+h}$ is the time-varying impulse responses to shortage shocks. This specification delivers a direct estimate of how a one-unit identified shortage shock translates into inflation adjustments at each horizon, while permitting both the magnitude and timing of the response to evolve across time.

Empirical Findings

The impulse-response functions evidence portrays shortage shocks as a quantitatively meaningful and statistically well-identified driver of U.S. inflation dynamics. Across the panels, the 95% confidence intervals remain on one side of zero over substantial portions of the horizon, indicating that the estimated responses are not merely economically interpretable but also statistically distinguishable from no effect. The resulting profiles are internally consistent: inflation reacts promptly, builds toward a medium-run maximum, and then recedes only gradually, a configuration

suggestive of propagation mechanisms and sluggish adjustment rather than a purely transitory disturbance.

Local Projections Model

In Figure 1, aggregate inflation increases immediately following the shortage shock and evolves along a distinctly hump-shaped path. The response strengthens over the early horizons, reaches its maximum around step 20, and remains statistically significant until roughly step 36. The magnitude at the peak—approximately 0.3 percentage points for a one–standard deviation shortage shock—underscores that the effect is not only statistically detectable but also macroeconomically nontrivial. The delayed peak is particularly informative: it aligns with an environment in which firms adjust prices intermittently, marginal cost pressures are transmitted with lags, and inflation reflects an accumulation of price revisions rather than an instantaneous jump in the aggregate price level (Galí and Gertler, 1999).

Figure 1 Response of the aggregate inflation to shortage shocks

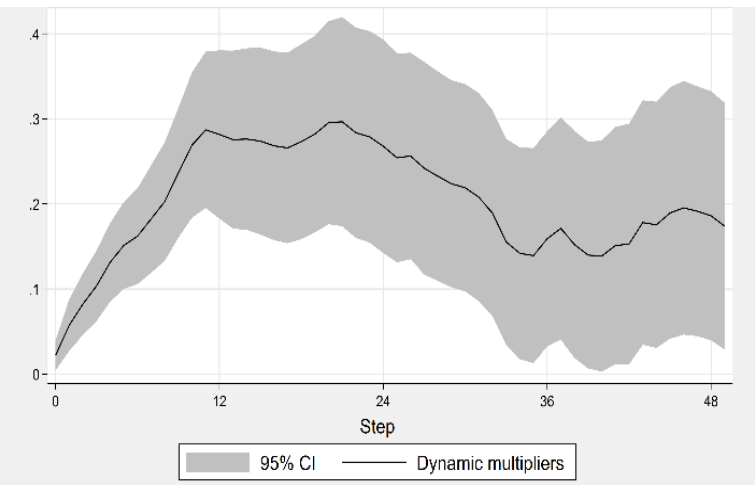


Figure 2 indicates that the demand-driven component of inflation also rises after a shortage shock, although the estimated

response appears more modest and becomes less precisely estimated at longer horizons. This pattern is economically plausible because shortages can reshape expenditure toward available items, generate precautionary purchasing, and induce substitution that elevates prices in unconstrained segments of the consumption basket. Accordingly, the demand-driven response should not be read as inconsistent with a supply-side origin; instead, it suggests that shortages may trigger endogenous demand reallocation and general-equilibrium feedbacks that amplify inflationary pressure beyond the direct cost channel. The widening confidence band at later horizons appropriately cautions against over-interpreting the longer-run persistence of this demand component, even if its medium-run contribution is clearly positive.

Figure 2 Response of the demand-driven inflation to shortage shocks

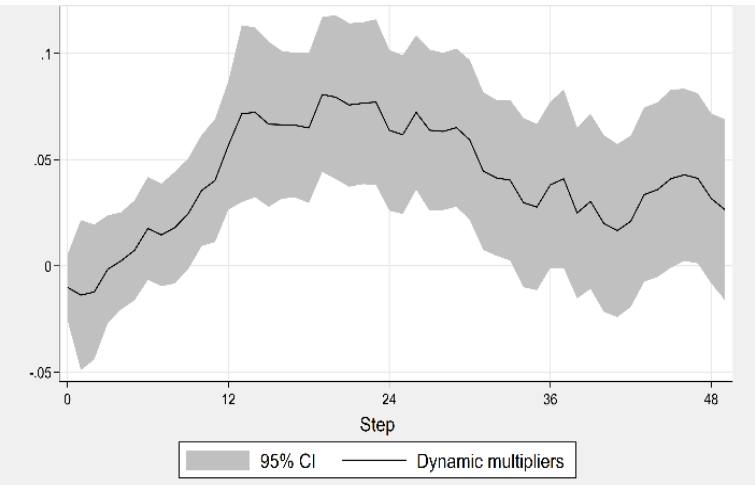


Figure 3 offers the clearest mapping from shortages to inflation through supply-side mechanisms. Supply-driven inflation increases to a pronounced medium-horizon peak—broadly contemporaneous with the aggregate peak—and then declines, remaining positive thereafter. The persistence of a positive response,

alongside intervals of statistical significance, implies that shortages operate as more than short-lived relative-price disturbances; they function as constraints that sustain cost pressures and impede the speed with which the economy returns to its pre-shock inflation path. This interpretation is consistent with the broader insight that inflation outcomes depend critically on the nature of the underlying disturbance, and that supply-type shocks can produce enduring inflationary consequences when real constraints interact with nominal adjustment frictions (Kilian, 2009).

Figure 3 Response of the supply-driven inflation to shortage shocks

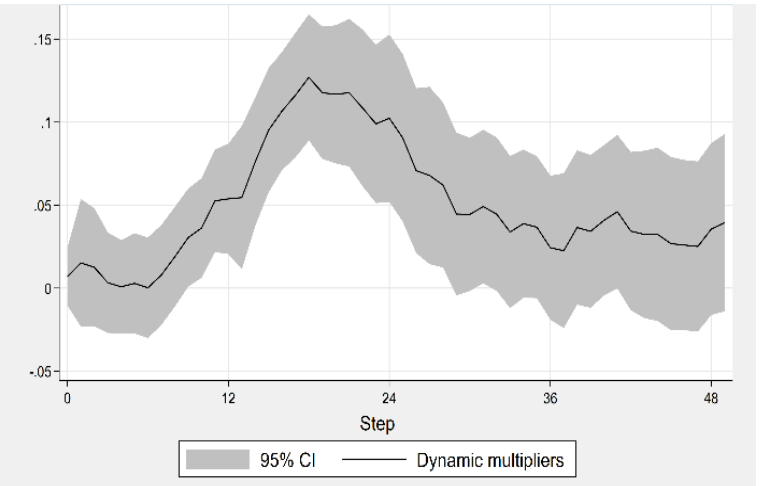
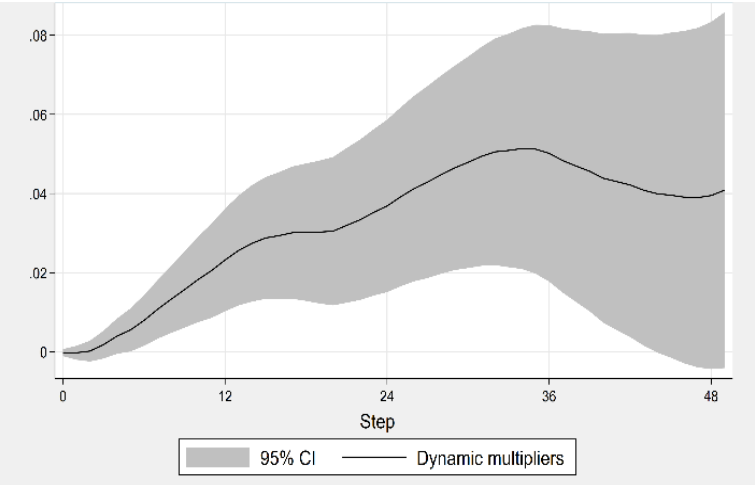


Figure 4 demonstrates that inflation expectations respond more gradually and smoothly than realized inflation. Expectations rise with a delayed onset, peak later than the inflation response, and exhibit persistence thereafter. The comparatively smaller amplitude, i.e., between 0.04 and 0.05, combined with slow adjustment is consistent with partial, not destabilizing, re-anchoring: agents appear to revise beliefs upward in response to sustained inflationary news, yet they do so incrementally rather than abruptly. Such dynamics align with evidence that expectation formation is characterized by informational rigidities and infrequent updating, which naturally

generate delayed and persistent responses in measured expectations (Coibion and Gorodnichenko, 2015). The expectations results are particularly consequential because medium-run expectations dynamics can reinforce inflation persistence through wage bargaining and price-setting decisions, even when the initial disturbance is real rather than monetary.

Figure 4 Response of the inflation expectations to shortage shocks



Taken together, the four responses motivate a coherent narrative: shortage shocks generate immediate inflationary pressure, the effect intensifies to a medium-run maximum of economically meaningful size, and statistical significance persists well beyond the initial impact window. The decomposition further indicates that the aggregate effect reflects both direct supply-side inflation and a non-negligible demand-driven component, consistent with reallocation and feedback channels operating alongside cost pressures. Finally, the slow yet persistent rise in inflation expectations underscores the policy relevance of credibility and systematic stabilization, because the prevention of sustained upward drift in expected inflation remains central to macroeconomic stability under modern policy regimes (Clarida et al., 2000).

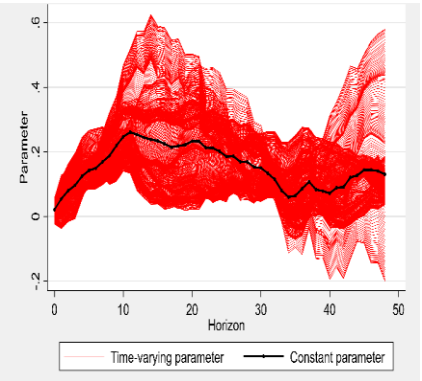
Time-Varying Local Projections Model

The time-varying impulse responses indicate that the inflationary consequences of shortage shocks are markedly state dependent. Relative to the constant-parameter benchmark (black line), the cloud of time-specific responses (red trajectories) displays substantial dispersion in both amplitude and persistence, implying that an average response can mask episodic amplification when constraints bind and propagation mechanisms intensify. This empirical motivation is consistent with the broader macroeconometric rationale for allowing coefficients and shock variances to drift over time in order to capture regime change and episodic instability (Primiceri, 2005).

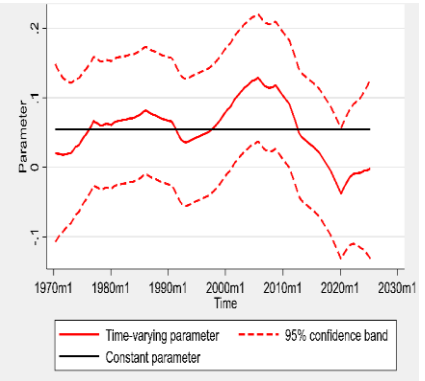
In the Figure 5, the constant-parameter response of the aggregate inflation is positive and hump-shaped, peaking at a modest level around the short-to-medium horizon and then gradually tapering. The time-varying responses, however, reveal that in particular episodes the peak effect is substantially larger—rising well above the constant-parameter profile—especially over horizons roughly between 10 and 20. Interpreting your dating, the Covid-19 period appears to coincide with these upper-envelope responses at medium horizons, which is economically plausible in an environment where shortages propagate through production networks and pricing decisions with lags, yielding an inflation peak after the initial disruption rather than entirely on impact. This temporal pattern aligns with micro-founded evidence on infrequent and uneven price adjustment, which naturally produces hump-shaped aggregate inflation dynamics when cost pressures are persistent (Nakamura and Steinsson, 2008).

Figure 5 Time-varying response of the aggregate inflation to shortage shocks

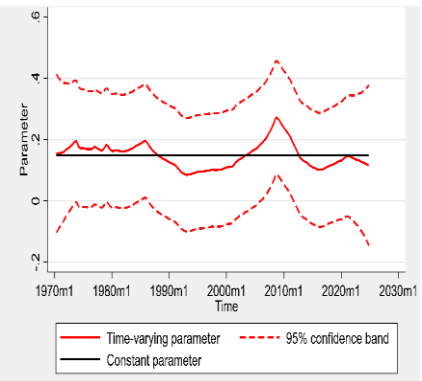
a) Aggregate inflation



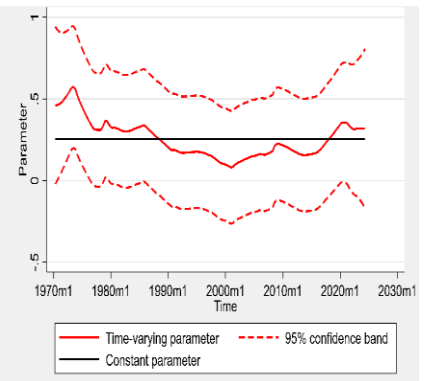
b) 1-month ahead



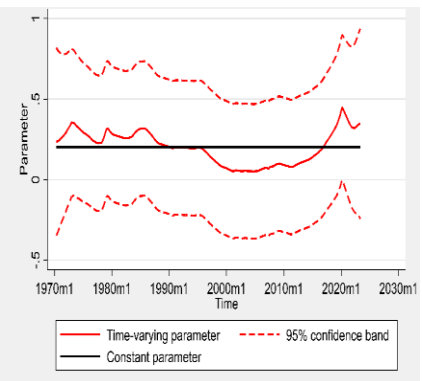
c) 6-month ahead



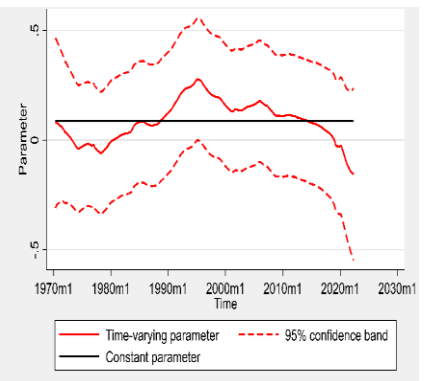
d) 12-month ahead



e) 24-month ahead



f) 36-month ahead

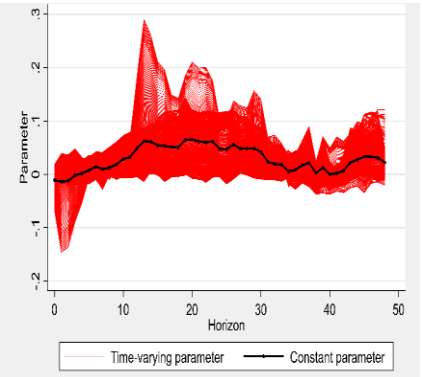


In the Figure 6, the constant-parameter estimate of the demand-driven inflation remains relatively small and close to zero compared with the other panels, whereas the time-varying responses display pronounced medium-horizon amplification in certain periods, including a visible spike around the early-to-mid horizons. Your interpretation that demand-driven inflation responds most strongly during Covid-19 at medium horizons is consistent with mechanisms whereby shortages induce reallocation of expenditure toward available goods, amplify congestion and markups in less-constrained sectors, and interact with macroeconomic conditions that sustain nominal spending despite supply constraints. In this sense, the figure supports the view that shortage shocks can behave as "Keynesian supply shocks," in which an initial supply restriction generates broader demand spillovers and compositional effects that become most evident after some delay (Guerrieri et al., 2022).

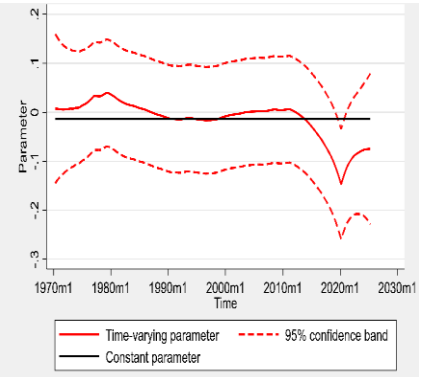
Figure 7 provides the response of the supply-driven inflation to shortage shocks. The clearest evidence is that shortages transmit primarily through a cost/quantity constraint channel, and it also most directly supports your statement about Covid-19: the time-varying responses show that the largest effects can materialize immediately in certain episodes, with sizable short-horizon movements relative to the average response. That configuration is what one would expect when supply bottlenecks are sudden and binding—e.g., disruptions to logistics, intermediate inputs, or capacity—so that upstream price pressure emerges quickly and then propagates downstream. The episodic nature of the largest responses is consistent with network-based amplification, which predicts stronger pass-through when inputs are specific and substitution possibilities are limited (Barrot and Sauvagnat, 2016).

Figure 6 Time-varying response of the demand-driven inflation to shortage shocks

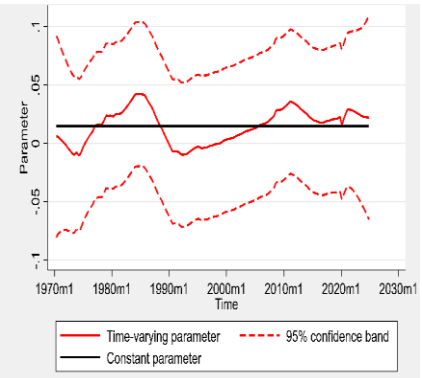
a) Demand-driven inflation



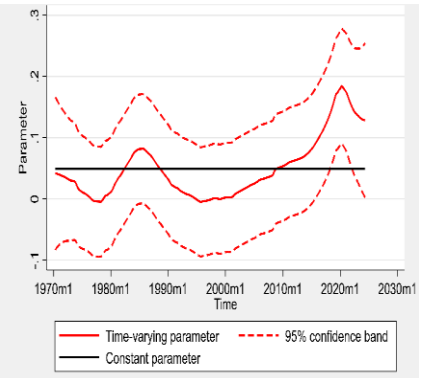
b) 1-month ahead



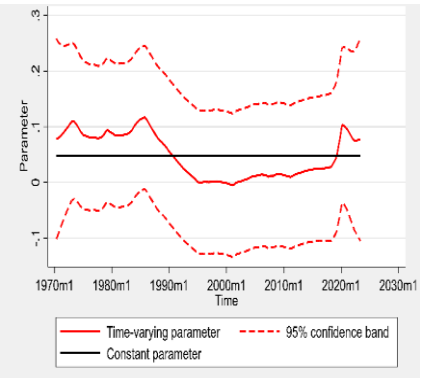
c) 6-month ahead



d) 12-month ahead



e) 24-month ahead



f) 36-month ahead

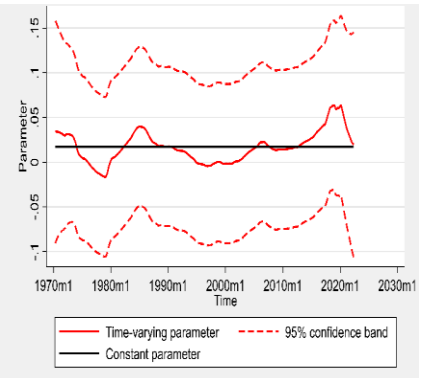
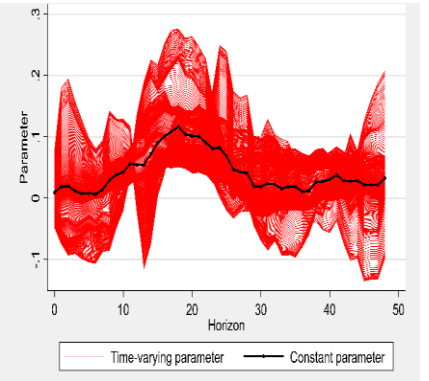
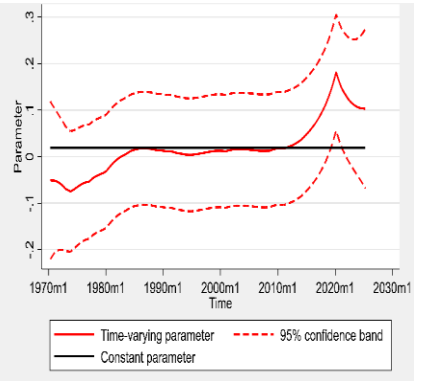


Figure 7 Time-varying response of the supply-driven inflation to shortage shocks

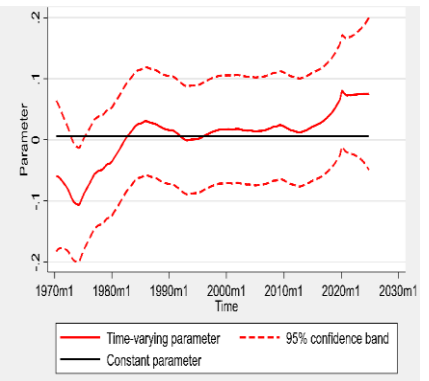
a) Supply-driven inflation



b) 1-month ahead



c) 6-month ahead



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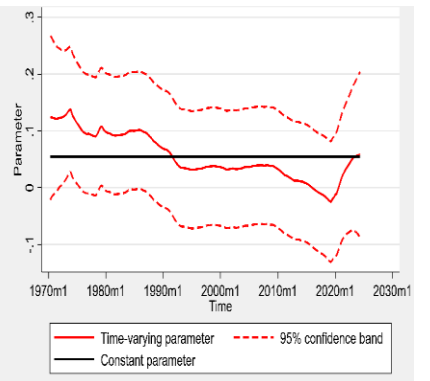
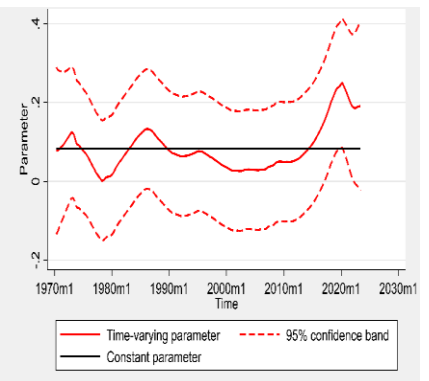


e) 24-month ahead



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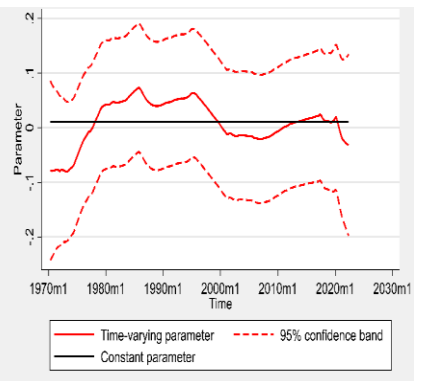
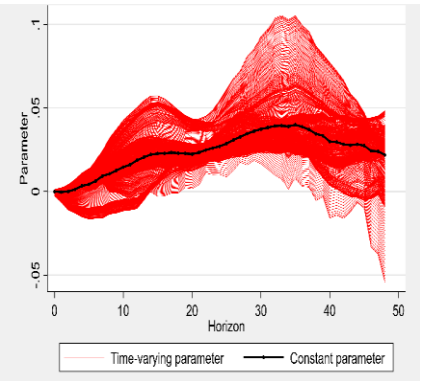


In the Figure 8, the constant-parameter response of the inflation expectations rises smoothly and peaks later than the realized inflation responses, while the time-varying trajectories show that some periods produce substantially larger and more persistent expectation adjustments, with the upper envelope peaking around medium horizons. This delay is economically informative: expectations typically respond to a shortage episode not only through contemporaneous inflation prints but also through beliefs about persistence, policy reaction, and the perceived duration of constraints. A gradual, medium-term strengthening of expectations during Covid-19 is consistent with informational rigidities and infrequent updating, which can produce sluggish yet persistent movements in measured expectations even when inflation responds quickly (Coibion and Gorodnichenko, 2015).

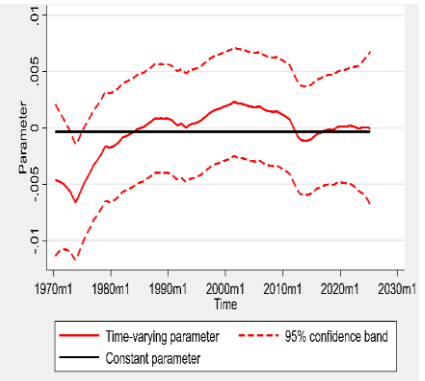
Methodologically, these figures strengthen the manuscript because they show that the shortage–inflation transmission is not well summarized by a single stable impulse response. The constant-parameter estimates remain useful as an average object, but the time-varying evidence indicates that the macroeconomic relevance of shortage shocks is concentrated in particular regimes—most prominently, in your interpretation, the Covid-19 period—when the economy features binding real constraints and heightened propagation. This is precisely the environment in which flexible impulse-response estimation is valuable, because it avoids imposing a fixed global dynamic structure that may be inappropriate in crisis episodes.

Figure 8 Time-varying response of inflation expectations to shortage shocks

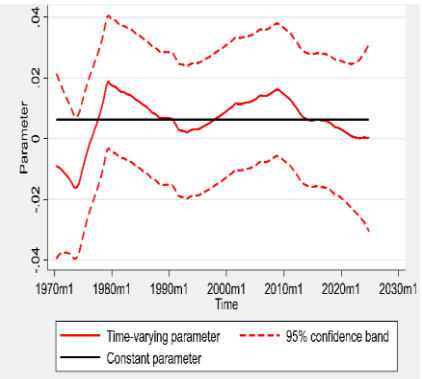
a) Inflation expectations



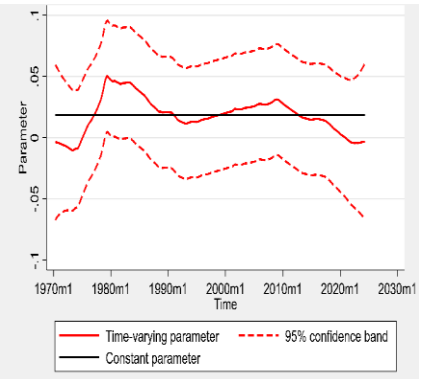
b) 1-month ahead



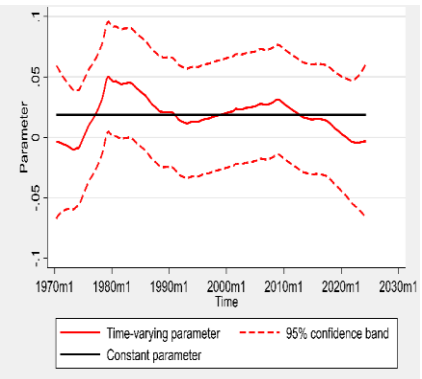
c) 6-month ahead



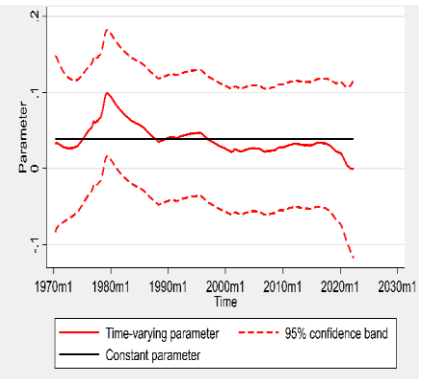
d) 12-month ahead



e) 24-month ahead



f) 36-month ahead



Concluding Remarks

This paper investigates how shortage shocks shape U.S. inflation dynamics, with particular emphasis on the timing, persistence, and composition of inflationary responses. To that end, the analysis employs the local projections framework to estimate impulse responses at each horizon directly, thereby tracing the dynamic effects of shortages without imposing a restrictive global law of motion on the data. The empirical design further allows for time variation in the transmission mechanism, enabling the estimates to differentiate between average responses and episodic amplification during periods when constraints are plausibly more binding. Together, these features provide a transparent mapping from identified shortage innovations to subsequent movements in aggregate inflation, its demand- and supply-driven components, and inflation expectations.

The results yield a coherent set of empirical regularities and a clear contribution to the literature on inflation in the presence of real constraints. First, shortage shocks are inflationary on impact and generate a hump-shaped response in aggregate inflation that peaks at medium horizons and remains persistent over economically meaningful intervals. Second, the decomposition indicates that the aggregate effect reflects both a direct supply-driven component, consistent with binding input and capacity constraints, and a non-negligible demand-driven component that becomes most prominent at medium horizons, consistent with reallocation and general-equilibrium spillovers. Third, inflation expectations rise more gradually than realized inflation yet exhibit persistence, suggesting that shortages can influence not only current price setting but also the medium-run formation of inflation beliefs. The central contribution is to document that the shortage–inflation linkage is materially state dependent: the magnitude and timing of responses intensify during the Covid-19 period, with the supply-driven

component reacting most sharply at short horizons and broader inflation measures displaying their largest effects at medium horizons. By establishing these patterns within a unified empirical framework, the paper clarifies why shortage episodes can produce inflation dynamics that are both persistent and heterogeneous across regimes.

These findings have several implications for policy and market participants. For central banks, the evidence underscores the importance of disentangling shortage-driven inflation from purely demand-driven overheating, because the appropriate policy response depends on whether inflationary pressure is predominantly a manifestation of real constraints or excess spending. At the same time, the expectation responses highlight that persistent shortages can affect inflation beliefs, implying that communication and credibility are not ancillary concerns even when the initial impulse is real-side. For portfolio managers and investors, the state dependence documented in the estimates implies that inflation risk is likely to be regime contingent: in periods characterized by binding supply constraints, the inflation process may become more persistent and more sensitive to scarcity indicators, with implications for duration exposure, inflation-hedging strategies, and sectoral allocation toward industries with stronger pricing power or less input vulnerability. For fiscal and regulatory stakeholders, the results suggest that interventions that alleviate bottlenecks by improving logistics, expanding capacity, or reducing input rigidities may yield macro-stabilization benefits by attenuating the propagation of shortage shocks into broad inflation and expectations.

The paper is subject to limitations that naturally motivate further research. First, any empirical identification of shortage shocks depends on the measurement of scarcity and on the assumption that the identified innovations are orthogonal to other structural disturbances; residual confounding with demand, policy,

or global supply conditions remains a concern in observational settings. Second, time-varying responses are descriptive of changing transmission but do not, by themselves, isolate the specific mechanisms, such as shifts in markups, network propagation, or policy reaction functions, that generate regime dependence. Third, the analysis focuses on aggregate and decomposed inflation measures, leaving open the question of how shortages transmit across sectors, across income groups, and through labour-market adjustment. Future work could therefore (i) integrate richer micro price and quantity data to identify the precise channels of pass-through, (ii) embed the empirical responses in a structural framework with production networks and nominal rigidities to map the reduced-form patterns to interpretable parameters, (iii) explore nonlinearities and interactions with monetary–fiscal policy regimes, and (iv) evaluate cross-country evidence to assess external validity and the role of institutional features in shaping the inflationary impact of shortages.

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Real Wages, Labor Productivity, and Inflation in Türkiye

CHAPTER 2

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Abstract

This study aims to analyze the long-term trajectory of real wage and salary incomes in Türkiye over the period 2006–2024 and to examine the extent to which economic growth has translated into social welfare. The main point of departure of the study is the decisive role of real income growth in determining the quality of economic growth, income distribution, domestic demand, and social stability. Particularly during periods of high inflation, wage increases that are not aligned with labor productivity weaken the purchasing power of workers and limit the inclusiveness of economic growth. The findings reveal that real income growth in Türkiye has been insufficient to support sustainable and inclusive

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growth. The study emphasizes that increasing real wages in line with labor productivity and inflation targets constitutes a critical policy priority for economic stability and social welfare.

Keywords:

Real income, real wages, labor productivity, income distribution, inflation, Turkish economy

JEL Codes: E24, J30, J31, D31, O40

1. Introduction

The wage determination process in the labor market is based on a delicate balance between the welfare of workers (labor suppliers) and the cost, profitability, and productivity expectations of employers (labor demanders). Maintaining this balance is critical not only for preserving industrial peace but also for ensuring the sustainability of long-term economic growth. While classical and neoclassical economic literature largely explains wages through labor productivity (Solow, 1956; Lucas, 1988), Keynesian and post-Keynesian approaches emphasize that wages also play a

decisive role in aggregate demand, income distribution, and macroeconomic stability (Keynes, 1936; Kalecki, 1971; Stockhammer, 2017).

The alignment between wage levels and labor productivity directly affects firms' competitiveness, employment sustainability, and distributive justice. International literature provides strong evidence that when real wages do not move in parallel with productivity growth in the long run, labor's share of national income declines and income inequality deepens (OECD, 2018; ILO, 2020; Piketty, 2014). Especially during high-inflation periods, delays in wage adjustments lead to erosion of real wages and trigger redistribution processes against workers (Blanchard, 1986; Akerlof, Dickens & Perry, 1996).

The recent high-inflation environment in Türkiye has further increased the fragility of wage-setting mechanisms and labor market equilibrium. In this context, public sector workers have been at the center of debates regarding wage increases, job security, and social rights. Approximately 1.1 million public workers are

employed primarily in municipalities, universities, transportation, energy, and infrastructure services—sectors that are strategically vital for continuity of public services. The literature frequently emphasizes the stabilizing role of public employment in wage stability and income distribution, while also noting that this role weakens under inflationary conditions (IMF, 2022; OECD, 2023).

From the perspective of workers, the fundamental expectation is the provision of a fair wage level that does not erode against inflation and allows the maintenance of a decent standard of living. The International Labour Organization (ILO) stresses that wages should be evaluated not only in nominal terms but also in terms of real purchasing power, and that the concept of "decent wages" should be addressed within this framework (ILO, 2019). Secure and formal employment, trade union rights, and social protection mechanisms are also recognized in the literature as core components of industrial peace (Freeman & Medoff, 1984; Rodrik, 1997).

From the employers' perspective, wage increases are evaluated alongside rising tax burdens, financing costs, and cost inflation. Particularly in developing countries, low labor and total factor productivity are often cited as key justifications for suppressing wage growth (Eichengreen, Park & Shin, 2017). However, empirical studies show that systematically keeping wages below productivity growth may lead in the long run to insufficient demand, declining investment appetite, and weakened growth performance (Bhaduri & Marglin, 1990; Storm & Naastepad, 2012).

Within this framework, the question of how much wages and salaries—more broadly, real income—should increase gains importance. A widely accepted approach in international literature suggests that real wage increases should at least equal the sum of "labor productivity growth + target inflation" (OECD, 2018; ILO, 2020). In developing countries, this benchmark typically ranges between 5–8%, while in developed countries it is around 2–3%.

Moreover, it is emphasized that real welfare gains require wage increases above these thresholds.

This study aims to analyze the real trajectory of wages and salaries in Türkiye together with labor productivity and inflation indicators and to assess the welfare effects of wage increases. Drawing on theoretical and empirical findings in international literature, the study evaluates the structural problems of Türkiye's labor market and discusses the necessity of a sustainable and inclusive wage policy.

2. Labor Productivity, Wages, and Inflation

Using data from the Turkish Statistical Institute (TURKSTAT), developments in labor productivity, wages, and inflation rates for the period 2006–2024 are analyzed. Annual average main job incomes are examined by educational attainment, employment status, economic activity sectors, and occupational groups, as presented and analyzed in Tables 1–5.

Table 1. Annaul Changes in the Labor Productivity Index and Gross Wage–Salary Index (2006–2023)

Year	Labor Productivity Change (%)	Gross Wage–Salary Change (%)	Realized Inflation + Productivity %
2006	3.79	-	13.80
2007	2.44	-	12.04
2008	3.57	-	13.97
2009	3.45	3.2	9.70
2010	2.22	4.2	1079
2011	2.17	5.0	8.64
2012	2.13	4.3	11.02
2013	2.08	3.9	9.57
2014	2.04	3.6	10.89
2015	2.00	4.2	9.67
2016	1.96	4.4	9.71
2017	1.92	3.8	13.06
2018	1.89	3.1	18.12
2019	1.85	4.8	17.03
2020	1.82	6.0	14.01
2021	1.79	10.5	21.39
2022	1.75	19.7	73.96
2023	1.75	20.8	60.04

As shown in Table 1, labor productivity exhibits a declining trend over the 2006–2024 period, with an average annual growth rate of 2.28%. The average expected inflation rate is 5%, while the average annual increase in the gross wage–salary index is 6.77%. For real wage growth to generate welfare gains, it should exceed the sum of expected inflation and productivity growth. However, wage growth remains below the required 7.28% threshold,

averaging approximately 6.7%. This indicates that wage increases have failed to generate welfare gains and that workers have not been able to preserve their purchasing power against inflation. When realized inflation rather than target inflation is considered, wage and salary increases appear highly inadequate, leading to a clear impoverishment of workers.

Table 2. Annual Average Main Job Incomes by Educational Attainment (2006–2024)

Education Level	**Real Income Growth (%)**	**Nominal Income Growth (%)**
No formal schooling	1.79	18.63
Below high school	1.24	17.99
High school or equivalent	1.2	17.94
Higher education	0.58	17.21

Between 2006 and 2024, real income growth is highest among individuals with no formal education and lowest among higher education graduates. Although this pattern suggests a relative improvement in income distribution in favor of less-educated groups, the stagnation of real incomes among highly educated workers risks undermining productivity, motivation, and incentives for higher education, rendering the situation unsustainable in the long run.

As a result, while nominal incomes increased across all education levels, real income gains were minimal and uneven, with lower-educated groups relatively better protected against inflation. This pattern suggests wage compression and a weakening education wage premium in real terms, raising concerns about incentives for human capital accumulation and the long-term implications for productivity and skill formation.

Table 3. Annual Average Main Job Incomes by Employment Status (2006–2024)

Employment Status	Real Income Growth (%)	Nominal Income Growth (%)
Wage and salary earners	1.23	17.97
Daily-paid workers	3.0	20.03
Employers	4.11	21.33
Self-employed	2.64	19.62

Employers experienced the highest real income growth **,** alongside the strongest nominal growth. This suggests greater pricing power, profit margins, or flexibility in adjusting incomes in response to inflation. Daily-paid workers recorded relatively strong real income growth, possibly due to frequent wage adjustments, labor shortages, or minimum wage effects. Self-employed individuals

achieved moderate real gains, indicating partial inflation compensation but less protection than employers. Wage and salary earners faced the lowest real income growth**,** despite notable nominal increases, implying that fixed contracts and delayed wage adjustments limited their ability to keep pace with rising prices.

As a result, the lowest real income growth is observed among wage and salary earners, while employers experience the highest increase. This explains the deteriorating economic conditions of workers and civil servants and helps contextualize recent labor disputes and strikes.

*Table 4. Annual Average Main Job Incomes by Economic Activity Sector (2006–2024***)**

Sector	**Real Income Growth (%)**	**Nominal Income Growth (%)**
Agriculture	2.04	18.92
Industry	1.95	18.81
Construction	3.55	20.68
Services	1.46	18.24

Table 4 shows that construction stands out with the highest real income growth (3.55%)**,** supported by the strongest nominal increase (20.68%). This may reflect labor shortages, high demand

for construction activity, or stronger wage bargaining in this sector. Agriculture shows moderate real income growth **(**2.04%**),** suggesting some resilience, possibly due to policy support or price adjustments in agricultural output. Industry records similar but slightly lower real growth **(**1.95%**),** indicating limited real wage improvement despite notable nominal increases.**Services**, the largest employment sector in many economies, has the lowest real income growth (1.46%)**,** implying that workers in this sector faced the greatest erosion of purchasing power. As a result, although all sectors experienced notable nominal wage growth, real income gains remained modest, underscoring that inflation absorbed much of these increases. The relatively stronger performance of construction contrasts with weaker real income growth in services and industry, highlighting sectoral disparities in wage dynamics and inflation exposure**.**

Table 5. Annual Average Main Job Incomes by Occupational Groups (2012–2024)

Occupation	**Real Income Growth (%)**	**Nominal Income Growth (%)**
Managers	3.88	23.24
Professionals	0.18	24.43
Technicians and vice technicians	1.96	22.96
Clerical workers	0.94	21.87
Service and sales staff	1.88	22.25
Skilled workers in agriculture and forestry and fisheries	1.68	22.68
Craftsmen and those working in related trades	2.73	23.62
Plant and machine operators, assemblers	1.65	22.65
Elementary occupations	2.98	24.37

It seen taht real income growth **is** very modest and uneven, ranging from 0.18% to 3.88%**,** indicating that most of the nominal wage gains were absorbed by inflation. Accordint to professions, managers experienced the highest real income growth (3.88%)**,** implying better protection against inflation and stronger bargaining power. Elementary occupations also show comparatively higher real gains, possibly reflecting minimum wage adjustments or policy-driven wage floors. Professionals recorded the lowest real income growth, despite the highest nominal increase , suggesting significant real income stagnation. Technicians and clerical workers fall

in between, with real growth below 2%, indicating limited improvement in purchasing power.

3. Conclusions and Recommendations

This study demonstrates that real wage and salary growth in Türkiye has remained insufficient to convert economic growth into social welfare. Empirical findings confirm that the widely accepted principle that real wages should increase at least in line with labor productivity and inflation has not been met for an extended period. This has led to a declining labor share, deteriorating income distribution, and weakened inclusiveness of growth.

Significant disparities in real income growth across education levels, sectors, occupations, and employment status indicate structural imbalances in the labor market. Particularly low real income growth among wage and salary earners and highly educated professionals suggests underutilization and undervaluation of human capital, increasing long-term productivity loss and brain drain risks.

To achieve sustainable and inclusive growth, wage policies in Türkiye must be comprehensively restructured. Establishing an institutionalized real wage indexation mechanism linked to productivity and inflation, redesigning minimum wage policy, strengthening productivity-enhancing reforms, empowering trade unions, and ensuring coordination between wage and anti-inflation policies are essential.

In conclusion, a growth model that fails to raise real incomes is neither economically nor socially sustainable. A predictable, institutional wage policy aligned with productivity and inflation will not only enhance worker welfare but also strengthen domestic demand, economic stability, and long-term growth performance.

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CHAPTER 3

THE RELATIONSHIP BETWEEN HEALTH INVESTMENTS AND ECONOMIC GROWTH: STRUCTURAL BREAK COINTEGRATION ANALYSIS FOR TURKEY

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HÜSEYİN ÇELİK[2]

Introduction

Economic growth is the ultimate economic goal of every country. In every period, countries try to reach their growth target with various economic policies they pursue. However, in order for realization of economic growth, economic factors have to perform their functions properly. The economic factors that will ensure economic growth differ from period to period. For example, the importance and weight of the inputs that will realize economic growth in the agricultural periods and in the industrial periods, may change. However, from this point forth, it can be stated that the most basic input of economic activities in every period is the human capital. However, after the 1980s, the importance of human capital has been understood with the endogenous growth theories based on the studies of Romer (1986), Lucas (1988) and Rebelo (1991).

It is observed that countries with high human capital stock are generally developed countries. Increasing the human capital stock is extremely important especially for developing and less developed countries. In countries with high human capital stock, the content and diversity of economic activities and the sustainability of

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economic growth will be achieved. There are many studies in the literature in terms of increasing the human capital stock. Some of these studies are in the form of increasing the human capital stock by improving educational conditions and indicators (Kim & Lee, 1999; Ergen, 1999; Türkmen, 2002; Gupta et al. 2002; Kar & Taban, 2003; Benos, 2005; Kar & Ağır, 2006; Yaylalı & Lebe, 2011; Akçacı, 2013). It is seen that some other studies have been carried out on health investments and expenditures (Gerdtham & Löthgren, 2000; Yumuşak & Yıldırım, 2009; Bakare & Olubokun, 2011; Mehmood et al. 2014; Aydemir & Baylan, 2015; Murthy & Okunade, 2016; Kızıl & Ceylan, 2018).

It can be stated that realization of health services strictly beside or even before a good education system is important for the increase of labor productivity, production amount and quality and therefore the increase of the level of welfare in the country depending on thelevel of income. In other words, it can be said that educational services will contribute more to the human capital stock in a society consisting of healthy individuals. In this respect, the importance of investments in healthcare field and health expenditures becomes evident.Considering the studies dealing with the impacts of health services or expenditures on economic growth, as can be seen also from the literature part, it is seen that while some studies are carried out on country groups, some studies are carried out for a single country and the policies are developed accordingly. Also in this study, the impact of health investments on economic growth for Turkey have been examined using methods that allow economic fractions.

In line with this purpose, previous studies concerning this issue have been given after the introduction part. The data set, model and method have been discussed in the third part. The obtained empirical findings have been given in the fourth part, and the evaluation and suggestions have been given in the conclusion part.

Literature Review

When investments and expenditures in healthcare field are dealt as an investment in the human capital stock, it can be stated that it is

extremely important for the economy. As a matter of fact, there are many studies in the literature dealing with health expenditures and investments. Some of the previous studies that dealt with the relationship between health expenditures and economic growth are shown in Table 1.

Table 1: Summary of Literature Review

Author(s)	Scope	Method	Result
Sağır & Kaplan (2024)	Turkey 2000–2018	ARDL Cointegration	Positive
Kutval & Demir (2024)	Turkey 1980–2022	ARDL Cointegration	Positive
Ürüt Saygın & İşler (2024)	D8 Countries 2000–2020	Panel Data Analysis (Fixed Effects, Driscoll–Kraay)	Positive
Kapçak (2025)	Turkey 1980–2020	ARDL Bound Test & Granger Causality	Positive
Şen & Bingöl (2018)	Turkey 2006Q1:2017 Q4	Causality	Bi-directional causality
Selim et al. (2014)	Turkey ve AB 2001-2011	Cointegration PMGE	Positive
Tıraşoğlu& Yıldırım (2012)	Turkey 2006:Q1-2012:Q3	Cointegration	Positive
Demirgil et al. (2018)	Turkey 2010:1-2016:12	ARDL	Positive
Kızıl & Ceylan (2018)	Turkey 1979-2015	ARDL	Positive
Kesbiç & Salman (2018)	Turkey 1980-2014	VAR	Positive
Başar et al. 2018	Turkey 1998:Q1-2016:Q1	ARDL	Positive
Akar (2014)	Turkey 2004:1-2013:3	Cointegration	Positive

Çalışkan et al. (2013)	Turkey 1998:Q1-2016:Q2	Cointegration	Positive
Erçelik (2018)	Turkey 1980-2015	ARDL	Positive
Dreger &Reimers (2005)	OECD-21 1970-2001	Cointegration	Positive
Halıcı-Tülüce et al. (2016)	Low and high income countries 1995-2012 1997-2009	Causality	Bi-directional causality
Paibou & Tieguhong (2017)	Selected African countries	OLS	Positive
Balaji (2011)	States of South India 1960-2009	Cointegration Causality	No relationship
Odubunmi et al. (2012)	Nigeria 1970-2009	Cointegration	Positive
Nasiru & Usman (2012)	Nigeria 1980-2010	ARDL Causality	Positive
Wang (2011)	31 countries 1986-2007	Regression	Positive
Yazdi & Khanalizadeh (2017)	MENA countries 1995-2014	ARDL	Positive
Zaidi & Saidi (20128)	Sub-Saharan African Countries 1990-2015	ARDL Causality	Positive
Mehrara et al. 2012	MENA-13 1995-2005	Cointegration Causality	Positive
Tang & Ch'ng (2011)	ASEAN-5 1970-2006	ARDL	Positive
Mehrara & Musai (2011)	Iran 1970-2007	ARDL	No relationship
Ağır and Tıraş (2018)	Country groups by income level 1995-2014	Causality	Bi-directional causality
Yardımcıoğlu (2012)	OECD-25 1975-2008	Cointegration Causality	Bi-directional causality

Taban (2006)	Turkey 1968-2003	Causality	Positive
Baltagi & Moscone (2010)	OECD-20 1971-2004	Context control method	Positive
Tang (2010)	Malaysia 1970-2009	ARDL	Positive
Kılıç & Özbek (2018)	OECD 1995-2013	Cointegration Causality	Positive
Uslu (2018)	OECD 1995-2017	Cointegration Causality	Positive
Kamacı & Yazıcı (2017)	OECD 2000-2014	Cointegraton	Positive
Bhargavavd et al. (2001)	92 countries 1965-1990	Panel regression	Positive
Chaabouni & Abednnadher (2010)	Tunisia 1961-2008	ARDL	Bi-directional causality

Considering the studies given above, it is seen that the effect of health expenditures on economic growth is generally positive. In the table of summary of literature review, the studies about Turkey has been given initially. Also in the studies about Turkey, a positive relationship has been found between health indicators and economic growth. Also in this study, which has been carried out for Turkey, health indicators are expected to effect the economic growth positively.

Data Set and Model

In this study, the effects of developments in the healthcare field on economic growth in Turkey is examined. For this purpose, developments in the healthcare field of are dealt as health investments and expenditures. The number of public health institutions is taken as an indicator of health investments. For the indicator of health expenditures, the share of health expenditures in GDP (Gross Domestic Product) is taken. As for the indicator of economic growth, real GDP based on 2010 is taken. The data set covers the annual frequency and the period 1975-2023. The study will be estimated with the model in Equation 1.

$$\ln GDP_t = \beta_0 + \beta_1 \ln HI_t + \beta_2 \ln HE_{it} + \mu_1 \quad (1)$$

Table 2: Definitions of Variables

Variable	Abbreviation of Variable	Data Source
Real GDP	GDP	World Bank
Health Expenditures	HE	OECD
Number of Health Institutions	HE	Turkish Statistical Institute

Method

Time series have been used in the study. The model has been examined by unit root and cointegration tests, which take structural breaks into account. Kapetanios (2005) has been used as unit root test, and Maki (2012) has been used for Cointegration test. Then, the coefficient estimation has been performed with FMOLS, DMOLS and CCR.

In econometric applications, when conventional unit root and cointegration tests are used, it may cause deviating results in case of structural breaks in the series.

To prevent this, firstly Perron (1989) stated that some economic shocks caused fractions in the economy and revealed the unit root test which takes structural breaks into account. Afterwards, Zivot-Andrews (1992) developed the unit root test allowing for one break and Narayan & Popp (2010) developed the unit root test allowing for two breaks. Kapetanios (2005) test allows up to five breaks.

Kapetanios (2005) is an improved version of a fractional unit root test developed by Zivot-Andrews (1992) and a two fractional unit root test developed by Lumsdaine & Papell (1997). The breaks are determined internally with the fractional unit root test. Kapetanios (2005) determines breaks equal to or less than the maximum number of breaks determined in the fractional unit root

test. Similar to the methodology of Zivot-Andrews (1992), Kapetanios (2005) also three structural break models is presented in the fractional unit root test. The first model is suggested as break occuring at constant, second as break occuring at trend and third as structural break occuring both at constant and trend (Çalışkan et al. 2018; 84-85).

Similar to the development of fractional unit root tests, Gregory and Hansen (1996) presented a single break cointegration test as cointegration structural break. Later, Hatemi-j (2008) developed the cointegration tests allowing for two structural breaks. However, in some series, especially in series with a large time dimension, the number of breaks may be more than two. Maki (2012) developed the cointegration test that allows up to five breaks (Maki, 2012; 2). Thus, the series, whose number of breaks is more than two, enabled the breaks not to be ignored and therefore the achievement of more reliable results.

The structural break cointegration test of Maki (2012) allows up to five structural breaks internally. When examining the cointegration relationship between the series, if the number of structural breaks is three or more, structural break cointegration tests of Gregory and Hansen (1996) and Hatemi-j (2008) may be insufficient to explain the model properly. At this point, it can be stated that Maki (2012) cointegration test with multiple structural breaks remedies an important deficiency. In this structural break cointegration test, all variables have to be cointegrated in the first difference. The cointegration relationship between series under multiple structural breaks gives results in four models, which are; model with break in constant term, model with break in constant term and slope, model with trend break in constant term and slope, and model with break in constant term, slope and trend (Maki, 2012). Moreover, FMOLS, DMOLS and CCR estimation methods have been used for long term coefficient estimates.

Empirical Findings

The stationarity levels of the series have been examined by the structural break unit root test of Kapetanios (2005). The results of fractional unit root test are shown in Table-3. Due to the insufficient time interval of the series, Kapetanios (2005) unit root test with structural break has been applied for model 1 and model 2. According to the findings, all series are unit rooted at 5% significance level. In other words, the effects of an economic shock have a permanent effect on the series. However, it has been observed that when the first difference is taken, all series became stationary according to 1% and 5% significance level. It can be stated that the series were stationary at the level of I (1). In addition, the break dates of the series are observed in the table, and the unit root test with structural break has achieved a break in each series.

Table 3: Results of Kapetanios (2005) Unit Root Test with Structural Break

Models	Variables	Appropriate Lag Length	t-Statistics	Break Dates
Model 1	lnGDP	2	-3.114	2002
	lnHI	2	-3.730	1988
	HE	2	-4.064	2009
	d(lnGDP)	2	-7.484***	2007
	d(lnHI)	2	-5.361***	2000
	d(HE)	2	-6.313***	1994
Model 2	lnGDP	2	-3.636	2013
	lnHI	2	-4.280*	1994
	HE	2	-3.214	2001
	d(lnGDP)	2	-7.348***	2004
	d(lnHI)	2	-4.579**	1987
	d(HE)	2	-6.035***	1998

- Critical values of Model 1: -5.338 (1%), -4.930 (5%), -4.661 (10%).
- Critical values of Model 2:-5.014 (1%), -4.495 (5%), -4.144 (10%).
- ***, ** and * represents 1%, 5% and 10%, respectively.

In Table 4, results of Maki (2012) Cointegration Test with Multiple Structural Break are given. Predictions have been made for the models “break in constant term and break in constant term and slope” of Maki (2012) test, which proposed four models. Three breakpoints have been determined for each model. According to the

results, it has been determined that it is statistically significant at 1% significance level in model 0 representing the break in constant term, and at 5% significance level in model 1 representing the break in constant term and slope. In other words, cointegration relationship with multiple structural breaks has been determined between the series. Our results parallel with Tıraşoğlu & Yıldırım (2012).

Table 4: Results of Maki (2012) Cointegration Test with Multiple Structural Breaks

Models	Appropriate Lag Length	t-Statistics	Break Dates
Model 0	3	-6.797*	1984, 1994, 2003
Model 1	3	-5.924**	1985, 1989, 2000

- Critical values of Model 0: -5.943 (1%), -5.392 (5%), -5.125 (10%) (Maki, 2012).
- Critical values of Model 1: -6.169 (1%), -5.691 (5%), -5.404 (10%) (Maki, 2012).
- *, and** present %5 and %10 significance level, respectively.

The long-term coefficient estimates of the series have been made by FMOLS, DMOLS and CCR methods, which are shown in Table 5. According to the results, it has been observed that there is parallelism between the coefficient estimation methods in terms of results. It is seen that the results are significant at 1% significance level. In long-term coefficient estimation of FMOLS, an increase of 1% in the number of health institutions increases the economic growth by 2.716; according to DMOLS it is by 3.607 and according to CCR it is by 2.823. Moreover, according to FMOLS, DMOLS and CCR, an increase of 1% in health expenditures increases the economic growth by 0.466, 0.296 and 0.452, respectively. Our results Parallel Selim et al. (2014), Hayaloğlu & Bal (2015) Boussalam et al., (2014), Brempong & Wilson (2004).

Table 5: Results of Long Term Coefficient Estimates

	FMOLS		DMOLS		CCR	
	Coeff.	**Prob.**	**Coeff.**	**Prob.**	**Coeff.**	**Prob.**
lnHI	2.71*	0.004	3.607*	0.000	2.823*	0.0002
HE	0.46*	0.000	0.296*	0.000	0.452*	0.0000

- *, presents 1% significance level, respectively.

Discussion and Conclusion

In the study, the effects of developments in healthcare field on economic growth in Turkey have been investigated. Changes and developments in the healthcare field have been discussed in terms of health expenditures and the number of health institutions. In economic series, breaks may occur due to various reasons such as economic, social, political and similar factors. The unit root test with structural break and the cointegration test have been used in order to determine these breaks and to obtain correct results if there are structural breaks in the series.

According to the findings, it has been found that the series were stationary at the first level. Moreover, it has been observed that the series were cointegrated under multiple structural breaks, that is, they were related in the long term. According to the results of long-term coefficient estimates, it has been found that the investments and expenditures made in the healthcare field effect the economic growth positively.

It would not be wrong to say that human, in other words, human capital is both object and subject in economic activities. That is to say, it is an asset that performs economic activities and is affected by the results of economic activities. Therefore, it can be stated that the human factor is extremely important for realization of an economic growth in real terms. A healthy population in a country will enable economic activities to be carried out more effectively and efficiently.

Turkey is a country which has dynamic population structure. Healthcare infrastructure services have an important place in terms of continuation of economic growth increasingly, increase in income and increase in the level of welfare accordingly. Making necessary investments in regions where health services are insufficient in our country will contribute to the achievement and sustainability of economic targets.

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CHAPTER 4

THE RELATIONSHIP BETWEEN HYDROELECTRICITY CONSUMPTION AND MILITARY EXPENDITURES

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Introduction

The climate crisis, which has significantly impacted ecological life particularly in recent years, has emerged as one of the most important issues of many developed and developing countries, and the consequences of climate change are discussed on various platforms. Environmental degradation, a consequence of climate change, impacts countries in many ways, such as social, demographic, etc. Furthermore, it leads to remarkable economic problems, especially with the increase in costs it creates at the point of achieving development goals.

While discussions on reducing the problems and causes of environmental degradation are continuing, on the one hand, it also brings the question of how to increase environmental quality to the agenda, on the other hand. Using renewable energy sources to meet

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energy needs is one of the leading suggestions for improving environmental quality and reducing environmental degradation. Renewable energy sources such as wind, solar, geothermal, and hydro energy come to the forefront in reducing environmental deformation, and many academic studies have evaluated the renewable energy sources listed as a whole, not considering the difference in efficiency between these sources. As specified by Masiha, Abdulazeez, and Saedd (2021: 156), taking into account the total renewable energy consumption without adequately evaluating the different characteristics of its components may not adequately reveal the different impacts of various types of renewable energy consumption, which may lead to wrong policy outcomes for hydroelectricity, which especially differs characteristically from other renewable energy types, for each energy component.

The impacts and effectiveness of renewable energy sources are discussed, and the impact of military expenditures with a significant share in the total expenditures of most countries on the environment has also been discussed in various aspects in the environmental literature. The relationship between the environment and military expenditures is evaluated from two perspectives within the theoretical framework. First, Schnaiberg (1980) theoretically put forward the idea that military expenditures increase environmental pollution for the first time. With the concept called "The Treadmill of Production," it is stated that the military activities arising from the capitalist system caused environmental degradation after the Second World War. Nevertheless, Hooks and Smith (2004) argued that this theory could not be applied in all cases of environmental inequality. Hence, depending on the treadmill of production theory, the "Treadmill of Destruction" theory, introduced to the literature by Hooks and Smith (2004), was put forward. According to the authors, the treadmill of production and destruction theories display some differences in their basic logic. According to the treadmill of

destruction theory, arms races and geopolitical competition fuel the increasing environmental impacts of militarization. Consequently, as countries attempt to maintain and further increase their power, the damage caused by military forces on the environment in the form of pollution gradually increases. Therefore, military expenditures directly or indirectly increase environmental pollution. As indicated by researchers, wars, nuclear bomb tests, and military actions are dramatic examples of ecological degradation. However, the environmental impacts of militarization are not limited to the above-mentioned examples. Military institutions have developed large-scale social infrastructures to maintain and support the coercive power of nations in the name of national security. Militarization, both in peace and wartime, has also increased environmental degradation. Especially capital-intensive armies use resources, such as oil and land, more to carry out their operations. Therefore, the environmental degradation caused by military institutions reaches considerable levels (Clark & Jorgenson, 2012; Jorgenson, Clark & Givens, 2012; Bradford & Stoner, 2014; Isiksal, 2021).

In line with the second perspective, the technological innovation brought about by national armies develops Information and Communication Technology (ICT) through the dematerialization of production/manufacturing processes. Investments and developments in ICT reduce environmental pollution by promoting a less energy-intensive society (Özcan & Apergis, 2018: 4185; Solarin, Al-mulali & Ozturk, 2018). In the context of this perspective, as stated in the study by Erdoğan et al. (2022), environmentally friendly technologies must be used in the defense industry to minimize environmental degradation arising from military expenditures. Although advancements that both save energy and increase efficiency have been experienced through innovation, it will take a long time for these advancements to be reflected in the defense industry because in order to achieve the net

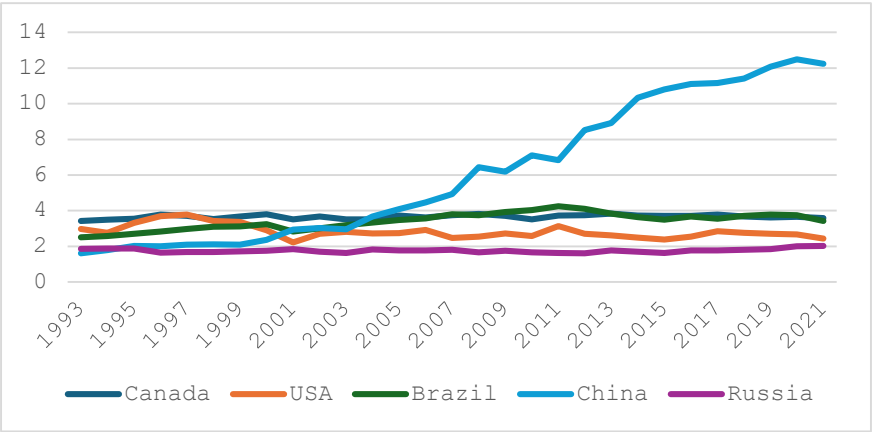
zero carbon emission target set by the IEA by 2050 , existing technologies should spread faster, and technologies that are not yet on the market should be widely used. Hence, many countries have still not been able to reflect this level of technological development in all areas of the economy. As a result, although many studies report that military expenditures increase environmental pollution, there is no widespread opinion that military expenditures reduce environmental pollution through innovation.

Many studies state that renewable energy sources are environmentally desirable since it is stressed that they emit zero or reduced carbon emissions into the atmosphere. Renewable energy sources are expected to increase sustainable economic development since the production of clean energy resources has fewer externalities (Sohag, Taşkın & Malik, 2019: 1). The interest in hydroelectricity has gradually increased in recent years among renewable energy sources such as wind, solar, geothermal energy, etc. Hydroelectric energy provides both the lowest greenhouse gas emissions per unit of energy generated and numerous environmental benefits (IEA, 2021: 8).

Graph 1 shows the trend for the top five countries with the highest hydroelectricity consumption in 2021. Whereas the USA, Brazil, Russia, and Canada displayed approximately the same increase in the period between 1993 and 2021, China showed a significantly higher increase than these countries. According to the 2022 Hydropower Status Report prepared by the International Hydropower Association (IHA), 391 GW of the total hydroelectric capacity of 1360 GW in 2021 belongs to China. China has great potential to contribute to global hydropower generation due to its large amounts of rivers and hydro resources. China, with the highest capacity in the world, is followed by Brazil with 190.4 GW, the USA with 101.9 GW, Canada with 82.3 GW, and Russia with 55.7 GW (Zheng et al., 2021; IHA, 2022). China is the country with the

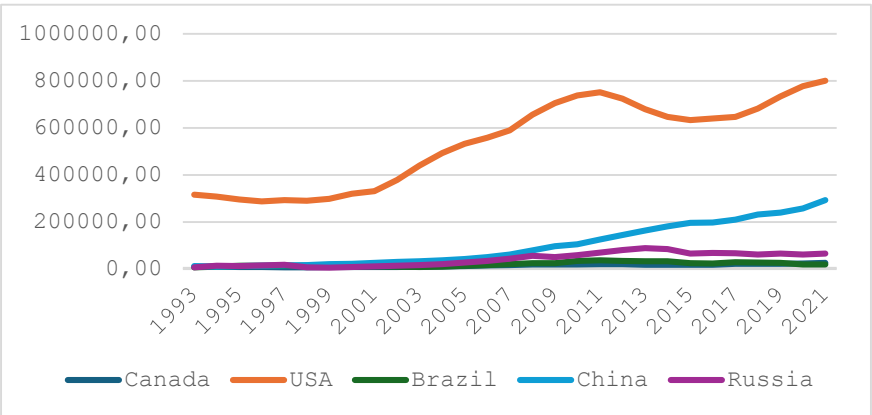
highest hydroelectricity consumption in parallel with its hydroelectricity capacity. While Canada ranks second in terms of consumption, it is followed by Brazil, the USA, and Russia, respectively.

Graph 1. Hydroelectricity Consumption (Exajoules (input-equivalent))



Source: BP Stats, 2023.

Graph 2. Military Expenditures ($)



Source: SIPRI (2023), https://www.sipri.org/databases/milex

The USA is the country with the highest military expenditures during the 1993-2021 period. Whereas the USA made approximately $316 billion of military expenditures in 1993, it spent approximately $800 billion in 2021. China is the world's second-largest military spender after the USA. China has achieved a very high military spending trend over the years. Military expenditures, which averaged approximately $153 billion in the period between 1993 and 2021, reached their highest level in 2021. During the 1993-2021 period, Russia's military expenditures were approximately $50 billion on average. Military expenditures, increasing in parallel with high oil and natural gas prices in Russia, amounted to approximately $66 billion in 2021. As stated in the SIPRI (2022) report, North American countries such as the USA and Canada cover about 94% of total regional expenditures.

The aim of the present study is to investigate the impact of military expenditures on hydroelectricity consumption. The study covers the top five countries with the highest hydroelectricity consumption in 2021 (Canada, the USA, Brazil, China, and Russia) and the period between 1993 and 2021. In the econometric model, long-term coefficients were estimated using the Augmented Mean Group (AMG) method developed by Eberhardt and Teal (2010). The second section of the study summarizes studies in the literature on the subject. The data set and method are explained in the third section, and the analysis results are presented in the fourth section. Finally, the study is completed with the conclusion section.

Literature

Studies investigating the relationship between militarization and the environment have received little attention in the literature until recent times. However, the number of these studies has increased significantly in recent years. A significant part of these

studies accept the assumption of the “Treadmill of Destruction” theory. More clearly, results supporting the view that militarization increases environmental degradation have been obtained (Bildirici, 2019; Eregha, Vo & Nathaniel, 2022; Kwakwa, 2022; Asongu & Ndour, 2023; Zhu et al., 2023). Jorgenson and Clark (2016) conducted one of these studies. This study examined the relationship between the environment and military expenditures within the framework of the treadmill of destruction theory with data from 81 nations and the period of 1990-2010. According to the two-way fixed effects model estimation results, the positive impact of military expenditures on environmental pollution is greater in developed OECD nations compared to developing non-OECD nations. Therefore, this study accepts the perspective of the treadmill of destruction theory. Another study was carried out by Bildirici (2017a). The study researched the relationship between CO2 emissions, militarization, economic growth, and energy consumption for the US economy and the period between 1960 and 2013. The analysis found a positive relationship between militarization and CO2 emissions. In another study on G7 countries, Bildirici (2017b) investigated the relationship between CO2 emissions, energy consumption, economic growth, and militarization. This is the first study that attempted to analyze possible relationships between these variables using panel cointegration and causality methods. In parallel to a previous study, environmental pollution increases with the increasing defense expenditures. The study by Isiksal (2021), which investigated the 10 countries with the highest military expenditures, found that military expenditures increase CO2 emissions. In their study on Türkiye, Gokmenoglu, Taspinar, and Rahman (2021) investigated the relationship between military expenditures, financial development, energy use, economic growth, and environmental degradation. According to the results of the analysis conducted using the FMOLS method with data for the period between 1960 and 2014, military

expenditures increase environmental degradation. The study by Erdoğan (2022) on Türkiye obtained parallel findings. The treadmill of destruction theory was also accepted in this study. The cross-sectional ARDL method was applied in the study by Ahmed et al. (2023), which covered 22 OECD countries and the period between 1971 and 2020. Accordingly, militarization is among the most important causes of environmental degradation. Militarization further increases environmental degradation. In the study by Beşel, İnal, and Aydın (2022), which expanded the scope of the study by Isiksal (2021) and addressed the top 20 countries with the highest military expenditures, no statistically significant relationship was found between military expenditures and CO2 emissions, contrary to the study by Isiksal (2021). In the study performed by Türedi and Yıldız (2022) on MENA countries, the model was estimated using the two-stage system GMM method. As a result of the analysis, a positive relationship between environmental pollution and militarization was revealed. On the other hand, according to the results of the study by Uddin et al. (2023) arguing that there are studies that investigate the relationship between variables without considering various econometric problems methodologically, environmental pollution increases with increasing military expenditures.

Contrary to the widely accepted view that military expenditures adversely affect the environment, a study was carried out by Solarin, Al-mulali, and Ozturk (2018). This study on the US economy suggested that environmental pollution could be reduced by reducing the amount of energy needed by military expenditures with research and development (R&D) and technological innovation activities in the military sector. Another one of the limited studies supporting this view was conducted by Özcan and Apergis (2018). The common view of both studies is that the increasing technological

innovation performance of countries in the military sectors will also reduce environmental pollution.

There are relatively few studies in the literature on the relationship between military expenditures and the environment. Whereas most of these studies used CO2 emissions data as an indicator of environmental pollution, some used ecological footprint data. Nevertheless, while many studies have focused on environmental pollution, studies on environmental quality are more limited. There is no study that specifically addresses hydroelectricity consumption among renewable energy consumption components and investigates the impact of military expenditures on hydroelectricity consumption. It is thought that the present study will fill the gap in the literature.

Data Set and Method

Hydroelectricity consumption (hy), military expenditures (ml), GDP per capita (pcgdp), and gross fixed capital investments (gfc) data were used in the empirical analysis. The data set used in the study covers the top five countries with the highest hydroelectricity consumption in 2021 (Canada, the USA, Brazil, China, and Russia) and the period between 1993 and 2021. The hydroelectricity consumption data were obtained from the BP Statistical Review of World Energy database. Data on military expenditures were acquired from the SIPRI database. Data on GDP per capita (constant, US $) and gross fixed capital formation (US, $) used as control variables were obtained from the World Bank-World Development Indicators database.

The present study focused on the relationship between military expenditures and hydroelectricity consumption within the framework of income and investment. The relationship between the above-mentioned variables was estimated through the function below:

$$hy_{it} = f(ml_{it},\ pcgdp_{it}, gfc_{it})$$

The econometric regression equation created and estimated in light of studies in the literature is as follows:

$$lnhy_{it} = \beta_0 + \beta_1 lnml_{it} + \beta_2 lnpcgdp_{it} + \beta_3 lngfc_{it} + \varepsilon_{it} \qquad (1)$$

In equation (1), i refers to countries, t refers to time, and ε refers to the error term.

Cross-sectional dependence is defined as the interaction between cross-sectional units (e.g., households, firms, states, etc.), and it may emerge due to macroeconomic shocks or unobservable common factors (Baltagi, Feng & Kao, 2012: 164). Ignoring cross-sectional dependence can create serious consequences in panel data analyses. Cross-sectional dependence in panel data analyses on economic issues is a frequently encountered situation rather than an exceptional one. The correlation between units in panels can also cause significant disadvantages in commonly used panel unit root tests because most existing tests ignore it (Chudik & Pesaran, 2013: 2). Therefore, cross-sectional dependence tests were applied in the first stage of the analysis. The Lagrange multiplier (LM) test developed by Breusch-Pagan (1980) is the pioneering cross-sectional dependence test. This test is applied when T>N. Since the current study covers 5 countries and 29 years, the LM test was applied to research whether there was cross-sectional dependence. This test statistic is as follows:

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij}^2 \qquad (2)$$

The literature recommends a series of panel unit root tests that use orthogonalization type procedures to asymptotically eliminate the cross-sectional dependence of the series and allow cross-sectional dependence before applying standard panel unit root tests to the transformed series (Baltagi & Pesaran, 2007: 229). These tests yield

more consistent results since they consider the different effects of a shock arising from one of the cross-sectional units on other units. In this respect, the CIPS (Cross-Sectional IPS) panel unit root test developed by Pesaran (2007) was applied in the study. The CIPS test statistic, which yields effective results when T>N, is presented below (Pesaran, 2007:276):

$$CIPS(N,T) = t - bar = N^{-1} \sum_{i=1}^{N} t_i\,(N,T) \qquad (3)$$

After the stationarity degrees of the series are determined, the presence of a cointegration relationship between the series can be tested. However, whether the slope coefficients of cointegration tests are homogeneous or heterogeneous impacts the validity of the results. In the literature, Swamy's (1970) model was developed for the first time to investigate whether slope coefficients are homogeneous or not. Swamy's test statistic can be employed when T>N:

$$\hat{S} = \sum_{i=1}^{N} (\hat{\beta}_i - \hat{\beta}_{WFE})' \frac{X'_i M_t X_i}{\hat{\sigma}_i^2} (\hat{\beta}_i - \hat{\beta}_{WFE}) \qquad (4)$$

The Durbin-Hausman (Durbin-H) test, which is one of the second-generation cointegration tests and was developed by Westerlund (2008), is performed to investigate whether there is a cointegration relationship between the series. This test considers cross-sectional dependence. It allows the independent variables to be I(0)/I(1), provided that the dependent variable is I(1). The calculated group and panel test statistics are presented below (Westerlund, 2008: 203):

$$DH_g = \sum_{i=1}^{n} \hat{S}_i (\tilde{\varphi}_i - \hat{\varphi}_i)^2 \sum_{t=2}^{T} \hat{e}_{it-1}^2 \qquad \text{ve} \qquad DH_p = \hat{S}_n (\tilde{\varphi} - \hat{\varphi})^2 \sum_{i=1}^{n} \sum_{t=2}^{T} \hat{e}_{it-1}^2 \qquad (5)$$

The null hypotheses of the tests are as follows:

Panel test: $H_i^p : \varphi_i = \varphi$ and $\varphi < 1$ for all is. (There is no cointegration)

Group test: $H_i^g: \varphi_i < 1$, for at least one i (There is no cointegration)

After determining that there was a cointegration relationship between the variables, the AMG (Augmented Mean Group) estimator was used to estimate the long-term coefficients. This method, developed by Eberhardt and Teal (2010), considers both heterogeneity and cross-sectional dependence.

The AMG procedure is implemented in two stages (Eberhardt & Teal, 2010:7):

Stage (i): $\Delta y_{it} = b'\Delta x_{it} + \sum_{t=2}^{T} c_t \Delta D_t + e_{it} \implies \hat{c}_t \equiv \hat{\mu}_t$

Stage (ii): $y_{it} = \alpha_i + b_i' x_{it} + c_i t + d_i \hat{\mu}_t + e_{it} \qquad \hat{b}_{AMG} = N^{-1} \sum_i \hat{b}_i$

In the first stage (i), the regression model obtained by including the differenced dependent and independent variables and dummy variables is estimated with the First Differenced-OLS (FD-OLS) method. In the second stage (ii), the N standard country regression model is estimated by including a linear trend term in the model.

Empirical Results

Table 1 contains the results concerning cross-sectional dependence and slope homogeneity. According to the results of the LM test statistic, hypothesis H_0 was rejected at the 1% significance level. Hence, it was revealed that there was cross-sectional dependence. According to the results of the Swamy S test, which tests the homogeneity of the cointegration model, hypothesis H_0 was rejected at the 1% significance level. It was found that the slope coefficients were heterogeneous.

Table 1. Cross-Sectional Dependence and Homogeneity Test Results

Tests	t-stat.	Prob.
LM (Breusch, Pagan 1980)	31.860***	0.000
Swamy S	3826.18***	0.000
Note: *** indicates the 1% significance level.		

Table 2 shows the results of the panel CIPS unit root test, which considers cross-sectional dependence. Accordingly, the level series contain unit roots. When the first differences of the variables series are taken, it is seen that all series are stationary.

Table 2. Panel Unit Root Test Results

Variables	t-stat.
lnhydro	-1.681
Δlnhydro	-4.037***
lnml	-2.002
Δlnml	-3.133***
lnpcgdp	-1.711
Δlnpcgdp	-3.407***
lngfc	-1.792
Δlngfc	-3.447***
Critical values: 1%=-2.57, 5%=-2.33, 10%=-2.21	

After determining that all series were I(1), in other words, stationary of the same order, the Durbin-H cointegration test developed by Westerlund (2008) was conducted. Table 3 contains the results obtained.

Table 3. Cointegration Test Results

Tests	t-stat	p-value
dh_g	-1.962**	0.025
dh_p	-1.863**	0.031
Note: ** indicates the 5% significance level.		

As seen in Table 3, both group and panel statistics were rejected at the 5% significance level. In other words, there is a cointegration relationship between the series in the long run.

The long-term coefficients were estimated using the AMG method. Table 4 shows the results obtained.

Table 4. Long-Term Coefficient Estimation Results

Countries	lnml		lnpcgdp		lngfc	
	Coeff.	Prob.	Coeff.	Prob.	Coeff.	Prob.
Canada	-0.0932**	0.031	0.0835	0.254	-0.0130	0.949
USA	-0.0776	0.584	-1.2223***	0.000	0.5029	0.175
Brazil	-0.0641	0.764	0.1894	0.370	0.0222	0.911
China	0.2978*	0.078	0.3026*	0.085	0.1922	0.476
Russia	-0.1969***	0.004	0.0708	0.251	0.3976***	0.011
Panel	-0.0783***	0.000	0.1599***	0.008	0.2187**	0.050
Constant	0.6551	0.146				
Wald chi2	71.03	0.000				
Note: *** and ** indicate the 1% and 5% significance level, respectively.						

In line with the long-term estimation results, military expenditures (lnml) on a panel basis have a statistically significant and negative effect on hydroelectricity consumption (lnhy). GDP per capita (lnpcgdp) and gross fixed capital formation (lngfc), included in the model as control variables, impact hydroelectricity consumption statistically significantly and positively.

Upon evaluating the findings on a country basis, it was found that the coefficient of the military expenditures variable was statistically significant only for Canada, China, and Russia. Whereas military expenditures and hydroelectricity consumption are negatively correlated in Canada and Russia, they are positively correlated in China.

Conclusion

The present study investigated the impact of military expenditures on hydroelectricity consumption within the framework of economic growth and gross fixed capital formation. The study addressed the top 5 countries with the highest hydroelectricity consumption in 2021 (Canada, the USA, Brazil, China, and Russia) and the period between 1993 and 2021. According to the results of the analysis using the AMG estimator, hydroelectricity consumption decreases when military expenditures increase at the panel level. To express it more clearly, a 1% increase in military expenditures reduces hydroelectricity consumption by approximately 8%. This finding supports the studies by Bildirici (2018), Noubissi Domguia and Poumie (2019), Ahmed et al. (2022), and Chang, Chen, and Song (2023), stating that military armament is based on high amounts of energy consumption, the most important energy source for defense industries is non-renewable energy resources, and this situation creates pressure on the environment.

Upon evaluating long-term relationships between the variables on a country basis, it was found to be statistically significant for Canada, China, and Russia. Of these countries, military expenditures were found to positively affect hydroelectricity consumption only for China. According to the IEA's (2023) statistics, the share of hydroelectricity among China's renewable electricity generation sources has displayed an increasing trend in the last 30 years and is the source with the highest share. Although China is one of the world's leading countries in the field of clean energy, it is also one of the countries with the highest energy consumption, considering both its population and trade potential. The study conducted by Bildirici (2016) on China emphasized that China's defense sector has experienced rapid change since the 1990s and that a large amount of energy is consumed by aircraft, ships, and tanks belonging to the defense sector. In parallel with the study by

Bildirici (2016), it can be understood from the findings obtained in this study that the vehicles used in the defense sector of China are produced with an environmentally friendly innovative method.

Canada is one of the countries with a negative relationship between military expenditures and hydroelectricity consumption. Emissions arising from the Department of National Defense and the Canadian Armed Forces represented approximately 59 percent of the federal government's total in the period between 2019 and 2020. The Department of National Defense and the Canadian Armed Forces have one of the country's largest equipment and infrastructure employers and maintenance personnel, including 2.1 million acres of land and more than 20,000 buildings in Canada alone. Hence, reducing the environmental footprint of military operations, in other words, increasing the environmental sensitivity of these operations, plays an essential role in climate change goals. The Canadian Forces School of Military Engineering, where combat engineers affiliated with the Ministry of National Defense are trained, is the first net-zero building. This building is part of a broader movement to go green by the Canadian military. The goal here is to reach the net zero carbon emission target by 2050, as specified in the Canadian Renewable Energy Association (CanREA) (2021) report. The Canadian military is one of the first militaries to commit to such a goal (Canadian Renewable Energy Association, 2021; Graney, 2023). Nevertheless, according to the CanREA (2021) report, Canada is far behind its net zero carbon emission targets. Therefore, although it has decided to implement environmentally friendly policies in the defense industry, it has not yet made a positive development.

Russia is another country where military expenditures have been determined to have a negative effect on hydroelectricity consumption. The Soviet Union's emphasis on industrial production and apparent disregard for the environment left Russia faced with

numerous environmental problems, from air pollution to radioactive contamination, after the collapse of the Soviet Union in 1991. Moreover, the Soviet Union left Russia an economic legacy based on a highly energy-intensive military-industrial complex. Although numerous factories and heavy industrial facilities were closed due to the economic contraction following Russia's independence, the country still has an economic structure largely based on underground resources. Additionally, the government's focus on promoting economic growth rather than protecting the environment drives Russia's ongoing transition to a market-based economy (EIA, 2004).

The coefficient of the GDP per capita variable used as a control variable in the model was found to be statistically significant and positive. According to the aforesaid finding, a 1% increase in GDP per capita increases hydroelectricity consumption by about 16% for the period and country sample discussed. There is a direct relationship between the environment and economic growth in the context of the environmental Kuznets curve[3] hypothesis. It is thought that the world's carbon cycle was balanced in the period before the Industrial Revolution. However, with the Industrial Revolution, the burning of fossil fuels caused a significant increase in greenhouse gas (GHG) emissions. The over-dependence of society on fossil fuels originates from the necessity of meeting the increasing energy demand. In this regard, a country's wealth creation and energy consumption, in other words, its per capita income and the amount of energy used have become inseparable (Leal & Marques, 2022: 2).

[3] The Kuznets curve was introduced by Simon Kuznets in 1955. Accordingly, there is an "Inverted U" shaped relationship between income inequality and economic growth. Afterward, the aforesaid hypothesis was developed by Grossman and Krueger (1991, 1995) and Panayoutu (1999) by considering the environmental dimension, and it was asserted that there is an "Inverted U" shaped relationship between environmental degradation and economic growth. Accordingly, environmental degradation increases with increasing income. However, after the peak, environmental degradation starts to decrease in response to income increase, which is called the “Environmental Kuznets Curve” hypothesis.

According to Jack (2022), stating that there is a tight correlation between energy and economic growth in support of this relationship, a higher GDP level indicates more electricity use, access opportunities, reliability, and low costs.

A statistically significant and positive relationship was identified between hydroelectricity consumption and gross fixed capital formation included in the model as another control variable. Accordingly, fixed capital formation, which usually increases through technological innovation for the military sector, further increases the advantages of renewable energy sources over time. The aforesaid finding supports the study by Abbas et al. (2020) and shows that gross fixed capital formation in the countries included in the sample is sustainable.

As a result, the increased energy demands of the countries included in the study also bring about the use of high-tech weapons, vehicles, and equipment. To meet these needs, policymakers should invest in more efficient and effective energy sources for the military sector, develop renewable energy-based policies, and attach importance to a more environmentally friendly attitude in military activities.

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CHAPTER 5

ECONOMIC POLICY UNCERTAINTY AND THE STRATEGIC CHOICE OF LARGE EUROPEAN BANKS

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Introduction

The business model of European banking has undergone a major transformation over the past few decades, moving away from the traditional interest-based intermediation model and increasingly relying on market-based and service-oriented activities. This structural business model change, characterized by the rise of non-interest income, has been a central and enduring feature of global financial evolution since the 1990s. This shift is particularly pronounced and significant among large European banks, which operate as pillars of the continent's economy and financial stability. Following the global financial crisis (GFC), large European banks faced pressure from shrinking net interest margins (driven by persistently low or negative interest rates), stricter capital requirements (Basel III), and increased regulatory oversight. In this environment, strategic pursuit of earning noninterest income from fees and commissions, and trading activities has become a vital but

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complex strategic response to maintaining profitability and competitiveness.

However, the bank's diversification brings with it significant risks. Although the initial academic premise suggested that diversifying income sources by adding non-interest income streams would reduce overall bank risk and volatility, subsequent literature has provided counter-examples showing the opposite. Studies by Stiroh and Rumble (2006), Lepetit et al. (2008a), and Mercieca et al. (2007), among others, find that diversification often increases, rather than decreases, the total risk profile of banks. This phenomenon is rooted in the inherent characteristics of non-interest income: Fee and commission income is generally more stable, though it can be cyclical; however, the greatest source of volatility and risk comes from trading income, which is sensitive to market movements, complex financial instruments, and often requires less transparency or specialized expertise. Consequently, a bank's choice regarding its share of non-interest income is not only a revenue decision but also a fundamental determination of the bank's overall risk exposure.

This study focuses on a critical but under-researched determinant of this strategic business model choice: economic policy uncertainty. Measuring the frequency with which economic policy uncertainty is addressed in newspaper articles, Baker et al. (2016) capture both political and economic instability by reflecting the uncertainty surrounding fiscal, monetary, and regulatory policies. In the European context, the EPU is particularly crucial given the complex regional environment, persistent sovereign debt problems, and the unpredictable nature of integrated policymaking often ends with political instability. Increasing EPU introduces a risk and reduces the information necessary for effective decision-making. Faced with policy uncertainty, banks may adopt a more conservative stance, moving away from riskier, market-oriented activities, or conversely, attempt to capitalize on volatility through aggressive

trading. Understanding which of these two approaches is more dominant is critical to assessing the impact of the policy environment on financial stability and requires empirical examination.

This study is important and interesting for several reasons. First, this study goes beyond traditional macro-level controls and adds EPU, an uncertainty measure that better reflects the environment in which strategic decisions are made. Second, by focusing specifically on large European banks, this study addresses a gap in the literature that often aggregates banks or focuses solely on the US. Given the systemic importance and unique regulatory context of large European banks, their reaction to uncertainty has continental and potentially global implications. Third, decomposing NII into trading and fee income makes a critical contribution by providing a more detailed analysis of the risk management channel.

The analysis of large European banks for the period between 2010 and 2019 reveals a statistically significant and consistent negative link between EPU and the total non-interest income share. This indicates that as EPU rises, large European banks strategically reduce their reliance on non-interest income and shift their focus back toward the traditional interest income. Crucially, by decomposing the non-interest income, I identify trading income as the primary driver of this negative relationship, while fee and commission income remains statistically insignificant in explaining non-interest income. Furthermore, I show that this negative impact is robust across different uncertainty dimensions and external policy uncertainty factors. Both economic policy uncertainty in the rest of Europe and the rest of the world also reduce the non-interest income share.

In sum, this book chapter contributes to the fields of banking strategy and financial stability by providing robust evidence that the strategic choice of large European banks in times of high economic policy uncertainty is to adopt a more defensive and traditional

business model. This behavior, focused on reducing trading income exposure, highlights the sensitivity of market-based bank activities to the policy environment and offers important implications for regulators aiming to maintain financial stability in volatile periods.

Literature Review

The literature examining the relationship between economic policy uncertainty and banks' revenue structure has grown significantly, emphasizing the role of uncertainty in shaping banks' risk-taking, profitability, and diversification decisions. EPU reflects the unpredictability surrounding fiscal, monetary, and regulatory policies, and increased uncertainty can shift banks' strategic orientation between traditional intermediation activities and non-interest income activities. Theoretically, increased policy uncertainty increases income volatility and risk aversion, leading banks to reassess the composition of their revenue.

Several studies establish that EPU affects banks primarily through profitability and credit channels. Higher uncertainty discourages lending and reduces credit growth as banks adopt a more cautious stance (Tran, Hoang, & Nguyen, 2021), tighten lending standards (Bassett et al., 2014) and implement a wait-and-see approach (Alessandri & Bottero, 2020). This contraction in lending income may lead banks to shift toward alternative, less capital-intensive sources of income.

Empirical evidence shows that banks respond to tighter margins and macroeconomic volatility by expanding fee-based and trading activities (Stiroh & Rumble, 2006; Lepetit et al., 2008b). These forms of non-interest income, such as commissions, asset management fees, and trading income, help reduce the cyclicality of loan-based earnings but may also introduce new forms of risk.

From a business model perspective, the diversification into non-interest income is often motivated by the search for income

stability. However, the stabilizing effect of non-interest income under uncertainty remains contested. Stiroh and Rumble (2006) and DeYoung & Roland (2001) discuss that while diversification may temporarily offset declines in net interest margins, it also increases exposure to volatile market-based income streams. Thus, during periods of high policy uncertainty, the relative benefits of non-interest activities depend on banks' ability to manage these risks effectively.

Recent contributions have begun to integrate EPU directly into analyses of bank business models. For example, Ozili and Arun (2023) find that high EPU increases profitability in Asia. On the other hand, Ashraf and Shen (2019) show that EPU increases loan price, while Chi and Li (2017) report that EPU influences banks' risk-taking incentives. Nonetheless, few studies explicitly examine how EPU alters the composition between interest and non-interest income. Ozili and Arun (2023) find that high EPU reduces non-interest income. However, Tran et al. (2021) reveal that high EPU leads US banks to non-interest income, while Boungou and Mawusi (2022) find a statistically insignificant effect of EPU on non-interest income.

Overall, the literature suggests that EPU affects not only the level of bank profitability but also its structure. However, the direction and magnitude of the change between interest and non-interest income remain empirically open questions. Investigating this relationship contributes to understanding how banks adjust their business models in response to policy uncertainty and whether such adjustments enhance or weaken financial stability. This relationship is particularly important for large, systemically important European banks.

Emprical Analysis

Hypothesis

Drawing upon the literature that suggests non-interest income diversification, particularly trading activities, can increase bank risk and volatility (Stiroh and Rumble, 2006; Mercieca, Schaeck, and Wolfe, 2007), I hypothesize that increasing uncertainty leads large European banks to adopt a defensive posture. This strategic shift is expected to a reduction in non-interest income activities, moving the business model towards safer, interest-based income streams. We test this core assumption by examining the overall non-interest income share and its primary components: Fees and commission income and trading Income. I further examine the role of political instability and alternative measures of policy uncertainty to ensure the robustness of the strategic response.

The following hypotheses guide our empirical investigation:

- **Hypothesis 1: Income Diversification:** Increased economic policy uncertainty is inversely linked with the share of total non-interest income in total income for large European banks.
- **Hypothesis 2: Political uncertainty:** Measures of political instability, such as election periods and political polarization, are negatively associated with the bank's share of non-interest income.
- **Hypothesis 3: Channel of Effect (Fee and commission income):** The share of fee and commission income is not significantly affected by changes in economic policy uncertainty.
- **Hypothesis 4: Channel of Effect (Trading income):** The negative relationship between EPU and noninterest income

is primarily driven by a significant negative effect on the bank's share of trading income.

Data

The empirical analysis is based on an unbalanced panel dataset covering 40 large European banks over the period 2010–2019. Bank-level data are collected by the author from the annual financial statements of individual banks, which provide detailed information on their income composition, balance sheet items, and performance indicators. This dataset allows for the construction of variables capturing bank-specific characteristics.

To capture macroeconomic conditions, economic policy uncertainty is measured using the country-specific indices developed by Baker et al. (2016), obtained from the Policy Uncertainty website: https://www.policyuncertainty.com. The Country-Level Index of Financial Stress (CLIFS) from the European Central Bank (ECB) is used to account for financial stress in the banking system of the home country. Additional macroeconomic control variables, including inflation and GDP growth, are sourced from theWorld BankWorld Development Indicators (WDI) database.

The sample includes banks from nine countries, including Belgium, Denmark, France, Germany, Italy, the Netherlands, Spain, Sweden, and the United Kingdom. These countries represent a broad cross-section of the European banking sector in terms of size, structure, and financial integration. All monetary values are expressed in euros.

Variables

My empirical strategy is designed to isolate and measure the effect of economic policy uncertainty on the strategic business model choices of large European banks over the 2010 to 2019 period. The variables utilized are drawn from bank-level financial statements and

Tablo 1: Variables and definitions

Variable Name	Definitions
Dependent Variable	
TNII	Total non-interest income over total income
Fee income	Fee and commission income over total income
Trading income	Total income minus fees and commissions over total income
Independent Variables	
LLP	Loan loss provision over total loans
Personnel	Bank staff costs over total assets
GDP growth	Annual GDP growth of the bank's home country
Regulation quality	The logarithm of the regulation quality
Efficiency	Operational expenses to total gross income
Inflation	Annual inflation rate of the home country
Cash	Cash and due from banks over total assets
ROA	Total income over total assets
Loan-to-deposits	Total loans over total deposits
Bank size	Logarithm of total assets
Election	Dummy for the election period
Polarization	Political polarization by votes
Polarization, seats	Political polarization by parliamentary seats
EPU weighted	Logarithm of the EPU index, where the EPU is weighted with 1 for the first six months and 2 for the last six months of the year.
EPU Europe	GDP-weighted EPU of European countries, excluding the home country's EPU.
EPU global	GDP-weighted EPU of world countries, excluding the home country's EPU.

country-specific macroeconomic and political data. The analysis employs three dependent variables, all of which measure a bank's non-interest income strategy by normalizing income components by total income. The primary dependent variable is total non-interest income (TNII), which captures the overall degree of income reliance on non-traditional sources. To understand the mechanism driving the effect, I also decompose this measure into its constituent parts: Fee income, which represents serviceoriented, customer-relationship

activities, and trading income, which captures the more volatile, market-sensitive component of non-interest income.

The independent variables include the key policy uncertainty measures and a comprehensive set of bank-specific, macroeconomic, and political control factors. The key independent variables are four distinct measures of economic policy uncertainty: the standard EPU index for the home country for the baseline scenario; weighted EPU, which emphasizes uncertainty in the latter half of the year; EPU Europe, capturing external uncertainty across the continent; and EPU Global, which accounts for worldwide policy uncertainty. The bank-specific control variables, LLP (loan loss provision), Personnel, Efficiency, Cash, ROA (return on assets), Loan-to-deposits, and Bank size (logarithm of total assets) account for the intrinsic financial health, operational efficiency, and scale effects that influence strategic decisions. Financial conditions, which help isolate the effect of political uncertainty, are measured by the financial stress of the country. Finally, the external environment is captured by macroeconomic and political controls, including GDP Growth, Regulation quality, Inflation, and measures of political instability such as the election dummy, polarization by votes, and polarization by seats in parliament.

Methodology

This study uses an unbalanced panel dataset of large European banks observed annually over the period 2010–2019. Bank-specific accounting and financial data are combined with country-level data on macroeconomic, regulatory, and political uncertainty. Given the nature of the data, repeated observations for the same set of banks over time, and the aim of analyzing the impact of time-varying variables such as the EPU while controlling for unobserved heterogeneity, I employ a fixed effects (FE) regression model. This methodology is necessary to address potential

endogeneity issues arising from bank-specific, time-invariant characteristics (such as institutional culture, country-specific differences, or internal management quality) that may be correlated with both the dependent variable (TNII) and the key independent variable (EPU). By including bank-specific fixed effects, the model effectively isolates the impact of the EPU by comparing within-bank variations over time, thus providing more reliable estimates of the causal relationship between economic policy uncertainty and a bank's strategic income choice.

Furthermore, to ensure the validity of the hypothesis testing in the presence of serial correlation and potential heteroskedasticity inherent in panel data, the standard errors in all regressions are corrected for heteroskedasticity and clustered at the bank level. This conservative approach ensures that the statistical significance of the estimated coefficients, particularly that of the EPU measures, is not overstated. While the primary regression uses the non-interest income share as the dependent variable, the following models decompose it into fee and commission income and transaction income to identify specific channels through which EPU affects the bank's business model.

Results

Table 2 presents the results of the FE regression models where the primary dependent variable is TNII (non-interest income share in total income), measuring the overall income diversification strategy of large European banks. Models 1 through 5 represent an increasing level of control, systematically introducing bank-specific financial ratios (Cash, ROA, Loan-to-deposit, and Bank size) to test the stability and robustness of the core relationship for different specifications. Model 1, the baseline scenario, includes the key independent variable (EPU), standard macroeconomic factors, and year fixed effects. Across all five models, the core finding remains

Tablo 2: The effect of EPU on banks' business models

*This table presents the results for the effect of determinants of large European banks' business models. Variables are defined in Table 1. Standard errors (in parentheses) are corrected for heteroskedasticity and clustered at the bank level. ***, **, and * denote significance at less than 1%, 5%, and 10% levels (two-sided), respectively.*

	Model 1	Model 2	Model 3	Model 4	Model 5
EPU	-0.185**	-0.184*	-0.189**	-0.185**	-0.185*
	(0.091)	(0.092)	(0.089)	(0.091)	(0.095)
LLP	0.643**	0.647**	0.600*	0.655**	0.645**
	(0.277)	(0.281)	(0.298)	(0.268)	(0.296)
Personnel	1.032***	0.483	5.716	0.947***	1.068
	(0.158)	(0.976)	(12.908)	(0.201)	(3.072)
Financial stress	1.242*	1.241*	1.234*	1.245*	1.242*
	(0.714)	(0.716)	(0.696)	(0.718)	(0.710)
GDP growth	-0.005	-0.005	-0.005	-0.005	-0.005
	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)
Regulation quality	-0.129	-0.139	-0.134	-0.133	-0.129
	(0.116)	(0.119)	(0.116)	(0.122)	(0.141)
Efficiency	-0.057***	-0.057***	-0.057***	-0.057***	-0.057***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Inflation	-0.048*	-0.049*	-0.048*	-0.049*	-0.048*
	(0.027)	(0.027)	(0.026)	(0.027)	(0.027)
Cash		0.245			
		(0.420)			
ROA			-0.997		
			(2.749)		
Loan-to-deposits				0.004	
				(0.006)	
Bank size					0.002

					(0.146)
Constant	1.251***	1.251***	1.267***	1.247***	1.227
	(0.442)	(0.447)	(0.431)	(0.440)	(2.298)
Year FE	Yes	Yes	Yes	Yes	Yes
No of obs	356	356	356	353	356
R-square	0.287	0.288	0.288	0.289	0.287

remarkably consistent, validating the robustness of the primary result. The consistency of coefficients and significance levels across these specifications confirms that the measured effect is not spurious and is valid regardless of controlling for various bank balance sheet characteristics.

The central finding of this analysis is the statistically significant negative relationship between EPU and the non-interest income share. Specifically, the coefficient for EPU is consistently negative and significant at the 5% level across Models 1 through 4, and it is statistically significant at the 10% level for the last model. This implies that as EPU increases, large European banks strategically reduce their reliance on non-interest income activities, shifting their business focus towards traditional, interest-based income generation. This observed defensive strategy suggests that large European banks perceive non-interest income streams, particularly those sensitive to market volatility, as being riskier during times of high policy uncertainty. Banks appear to be prioritizing the stability and predictability typically associated with net interest income, rather than pursuing diversification gains that are potentially diminished by uncertainty-related risks.

Turning to the control variables, several factors display significant relationships with the TNII:

Efficiency is consistently and highly significant with a negative sign. This indicates that more efficient banks, those that manage to convert their gross income into lower operational expenses, tend to rely less on non-interest income sources,

suggesting efficiency may be a substitute for, or a precondition to focusing on core lending activities. LLP shows a positive and significant relationship with TNII. This finding suggests that banks with higher provisions for loan losses also tend to have a greater share of non-interest income, potentially indicating that banks engaging in riskier, higher-margin activities (which necessitate greater provisioning) are also those that actively pursue income diversification. Another explanation is that they offset the losses on the lending side with the non-interest income activities.

Personnel exhibits a strong positive relationship in most specifications, particularly the base model, suggesting that more complex, diversified business models that generate non-interest income may require a larger, more specialized human capital base relative to total assets. The effect of Inflation is negative and marginally significant, implying that higher inflation rates may slightly reduce a bank's preference for non-interest income sources. Higher inflation periods imply the uncertainty, and the bank may shift to the lending side, as in the case of a higher EPU.

Among the remaining control variables, GDP growth, Regulation quality, Cash, ROA, Loan-to-deposits, and Bank size are generally found to be statistically insignificant in explaining the variation in the non-interest income share across banks. It suggests that EPU and bank-specific operational factors are more effective determinants of revenue diversification strategy.

Political uncetainty

This section extends the analysis by examining the influence of both political uncertainty and EPU on the specific components of non-interest income, as shown in Table 3. The first three models of Table 3 reinforce the findings on overall uncertainty by showing that the variabke Election and both measures of political polarization (by votes and by seats) also have a statistically significant negative

Tablo 3: The effects of political factors and breakdown of non-interest income

*This table presents the results for the effect of political uncertainty factors and non-interest income components. Variables are defined in Table 1. Standard errors (in parentheses) are corrected for heteroskedasticity and clustered at the bank level. ***, **, and * denote significance at less than 1%, 5%, and 10% levels (two-sided), respectively.*

	TNII	TNII	TNII	Fee income	Trade income
LLP	0.576**	0.692**	0.664**	0.272***	0.371
	(0.282)	(0.290)	(0.275)	(0.091)	(0.315)
Personnel	0.909***	0.586***	0.644***	-0.098*	1.130***
	(0.138)	(0.198)	(0.180)	(0.058)	(0.168)
Financial stress	1.102	1.037	0.966	-0.345*	1.587*
	(0.736)	(0.716)	(0.697)	(0.200)	(0.896)
GDP growth	-0.005	-0.005	-0.004	-0.002	-0.003
	(0.006)	(0.006)	(0.007)	(0.002)	(0.008)
Regulation quality	-0.091	0.011	-0.055	0.014	-0.143
	(0.110)	(0.125)	(0.112)	(0.038)	(0.129)
Efficiency	-0.059***	-0.058***	-0.058***	0.001	-0.058***
	(0.018)	(0.017)	(0.017)	(0.004)	(0.021)
Inflation	-0.048*	-0.050**	-0.049*	0.012	-0.061*
	(0.025)	(0.025)	(0.024)	(0.008)	(0.031)
Election	-0.034*** (0.012)				
Polarization vote		-0.101*** (0.035)			
Polarization seats			-0.070*** (0.023)		
EPU				0.016	-0.201**
				(0.018)	(0.092)
Constant	0.373***	0.755***	0.648***	0.168*	1.083**
	(0.127)	(0.168)	(0.143)	(0.095)	(0.450)

Year FE	Yes	Yes	Yes	Yes	Yes
No of observations	356	356	356	356	356

relationship with TNII, confirming that political instability, like economic uncertainty, pushes banks toward core interest income activities.

The final two models in Table 3 decompose the response of TNII by testing variables Fee income and Trading income separately as dependent variables. This decomposition reveals the specific channel through which EPU impacts the bank business model. The coefficient for EPU on Fee Income is small and statistically insignificant. This suggests that income generated from fee-based services, which often involve stable, client-driven activities such as payment services and asset management, remains unaffected by fluctuations in economic policy uncertainty.

On the other hand, the coefficient for EPU in explaining Trading income is negative and statistically significant. This result confirms the observed overall negative relationship between EPU and TNII is predominantly driven by the trading activities component. Trading income, which is inherently market-sensitive and volatile, is the first casualty of high economic policy uncertainty. Banks appear to be strategically reducing market-making and proprietary trading activities, the riskiest and most discretionary components of NII, in an effort to reduce exposure to unpredictable market movements and regulatory changes associated with the EPU.

Robustness checks

To ensure the robustness of the primary findings, Table 4 explores the impact of one alternative uncertainty measure on the bank's non-interest income share: EPU Weighted. The study also tests the effects of EPU in Europe and the world, by the variables

Tablo 4: Different EPU measures

*This table presents the results for the effect of different EPU measures on large European banks' business models. Variables are defined in Table 1. Standard errors (in parentheses) are corrected for heteroskedasticity and clustered at the bank level. ***, **, and * denote significance at less than 1%, 5%, and 10% levels (two-sided), respectively.*

	Model 1	Model 2	Model 3
LLP	0.649**	0.659**	0.659**
	(0.279)	(0.284)	(0.284)
Personnel	1.015***	1.002***	1.002***
	(0.149)	(0.142)	(0.142)
Financial stress	1.216*	1.249*	1.249*
	(0.709)	(0.723)	(0.723)
GDP growth	-0.005	-0.005	-0.005
	(0.007)	(0.007)	(0.007)
Regulation quality	-0.132	-0.129	-0.129
	(0.114)	(0.114)	(0.114)
Efficiency	-0.057***	-0.057***	-0.057***
	(0.017)	(0.017)	(0.017)
Inflation	-0.050*	-0.051*	-0.051*
	(0.027)	(0.027)	(0.027)
EPU Weighted	-0.179**		
	(0.085)		
EPU Europe		-0.001**	
		(0.000)	
EPU Global			-0.001**
			(0.000)
Constant	1.314***	0.341**	0.365***
	(0.448)	(0.126)	(0.124)
Year FE	Yes	Yes	Yes
No. of obs	356	356	356
R-square	0.287	0.284	0.284

EPU Europe and EPU Global. The alternative uncertainty measures consistently show a statistically significant negative relationship with TNII across all three models in Table 4. Specifically, the EPU Weighted measure (Model 1) confirms the original finding with a significant negative coefficient, suggesting that assigning higher importance to policy uncertainty in the latter half of the year does not change the defensive strategy of banks. Furthermore, both EPU Europe (Model 2) and EPU Global (Model 3) also exhibit significant negative coefficients, indicating that regional and worldwide policy uncertainty are also deterrents to income diversification. The finding that all three measures exert a signif icant and negative influence on TNII strongly reinforces the central thesis of this study: Large

European banks systematically derisk their business models in response to any form of increased uncertainty, whether it originates domestically, regionally, or globally. Since the European Union and the Eurozone are highly integrated economic areas, and given the nature of global financial markets, it is expected that these different EPU measures are likely highly correlated. The consistency of these results, therefore, is not surprising but rather confirms that the adverse effects of uncertainty. This reduction in risky trading activities is a fundamental feature of the strategic decision-making process for large, globally operating European banks. The negative impact on income diversification is a reaction not just to local political ambiguity, but to the generalized increase in economic volatility transmitted across borders.

Conclusion

The empirical results consistently demonstrate that large European banks strategically adjust their business models in response to economic policy uncertainty. Across all measures of policy and political instability, including the core EPU index value,

various political uncertainty indicators (Election and Polarization), and alternative EPU metrics, the impact on the non-interest income share is significantly negative. This systematic reduction in income diversification highlights a defensive, risk-averse posture adopted by systemically important financial institutions in Europe during times of ambiguity.

The most critical finding lies in the decomposition of non-interest income. The negative relationship between EPU and TNII is exclusively channeled through trading income, while fee income remains statistically unaffected. Trading income, derived from market-making, proprietary trading, and derivative activities, is inherently exposed to volatility and rapid market shifts. During periods of high EPU, banks appear to prudently restrict these highly discretionary and capital-intensive activities to mitigate potential losses from sudden policy changes or regulatory uncertainty.

Conversely, the resilience of fee income implies that income streams tied to stable, client-driven services, such as asset management, payment systems, and advisory services, are perceived as fundamental and less susceptible to the immediate, reactionary risk-off maneuvers triggered by uncertainty. This distinction provides a granular understanding of how uncertainty impacts the banking sector, targeting the riskiest, market-facing components of income while preserving stable, relationship-based fee income.

The robustness checks confirm that this risk-reducing strategy is not merely a response to local, country-specific EPU but to a broader environment of instability. The EPU Weighted, EPU Europe, and EPU Global measures all reinforce the core conclusion by showing a statistically significant negative impact on the non-interest income share. Given the high integration and interconnectedness within the European financial landscape and global markets, the high correlation between these EPU measures is expected. The consistent findings across all proxies underscore that

for large European banks, uncertainty is a holistic, multi-jurisdictional phenomenon. Banks cannot isolate domestic risks; they must adjust their strategies to account for the contagion and systemic risk transmitted regionally (EPU Europe) and internationally (EPU Global). This highlights the necessity for European banks to maintain strategic flexibility to navigate global macro-financial volatility. These findings carry significant implications for both banking management and regulators.

Firstly, concerning regulatory stability, the results suggest that uncertainty, whether political or economic, effectively acts as a disincentive for banks to engage in market-based, non-interest activities. Regulators should recognize that policy consistency and clear future guidance can encourage.

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