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UNIVERSIDADE DO PORTO

The Role of Institutions in Productivity Dynamics Across the Business Cycle

Francisca Cunha Pinto

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Supervised by
Álvaro Pinto Coelho de Aguiar
Filipe Macedo Pinto Grilo

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Abstract:

This dissertation investigates how total factor productivity responds to business cycle fluctuations and how institutional frameworks conditions this relationship. It addresses two key research questions: (i) "How does the business cycle affect total factor productivity?"; (ii) "How do institutions influence productivity dynamics across the business cycle?". The analysis is grounded in macroeconomic theories such as Real Business Cycle (RBC), New Keynesian, and Schumpeterian creative destruction, and integrates institutional analysis to enhance the understanding of macroeconomic performance.

To empirically assess these questions, the study employs an Interactive Panel Vector Autoregression model using data for 36 OECD countries from 2000 to 2019. The model incorporates Total Factor Productivity, the cyclical component of GDP, and a set of institutional indicators capturing labour market rigidity, financial development, and regulatory quality. By estimating impulse response functions the analysis reveals how institutional environments amplify or dampen productivity responses to cyclical shocks.

The findings suggest a procyclical pattern of Total Factor Productivity across the business cycle. They also contribute to the literature by showing that more flexible and efficient institutional settings can improve productivity's behaviour during business cycles.

JEL codes: D24; E32; O43

Keywords: Business cycles; Institutions; Productivity

Table of contents

1. Introduction 1

2. Literature review 3

2.1. Key Concepts: Business cycles, productivity and institutions 3
2.2. Business cycle theories 4
2.3. Productivity behaviour across the business cycle 7
2.4. Institutions and productivity behaviour across the business cycle 10

3. Methodology 14

3.1. Variables 14
3.2. IPVAR model 16
3.3. Transformations and model specification 18

4. Data 20

4.1. Data Sources 20
4.2. Variables Description 21
4.3. Data transformations 23

5. Results 25

5.1. Productivity behaviour across the cycle 25
5.2. The role of institutions on the cyclicality of productivity 27
5.3. Comparative Analysis of IRF Outcomes and Institutional Frameworks: Country analysis 30

6. Robustness analysis 35

7. Conclusion 36

List of figures

Figure 1: Business cycle representation 3
Figure 2: Visual representation of the relationship between the variables 14
Figure 3: Impulse Response Function resulting from a positive shock on the cycle and TFP 25
Figure 4: Productivity Response to Shocks by EPL Level 28
Figure 5: Productivity Response to Shocks by FDI Level 29
Figure 6: Productivity Response to Shocks by RQ Level 29
Figure 7: Cumulative TFP responses 31
Figure 8: Institutional variable means by country 32
Figure C1: Variance decomposition 48

List of tables

Table 1: Summary of how productivity behaves across the business cycle 9
Table 2: Summary of productivity behaviour across the business cycle, with an institutional explanation.....12
Table 3: Variables description and main references 16
Table 4: Data sources summary table.....20
Table 5: Descriptive statistics of the sample.....22
Table A1: Stationarity tests.....46
Table B1: Variance decomposition.....47

1. Introduction

Much has been studied over the years about business cycles and their effect on economic and productivity growth. More recently, works such as "Institutions, Institutional Change and Economic Performance" (North, 1990) and "Why Nations Fail" (Robinson & Acemoglu, 2012) have emphasised the importance of institutions in explaining economic growth and development across different countries. It is believed that economies with higher-quality institutional frameworks perform better and operate at higher productivity levels. This dissertation aims to apply this new institutional perspective to the analysis of business cycle dynamics and their impact on productivity.

The relationship between business cycles and productivity has significant implications for theory and policy. The main objective of this research is to determine whether and how economic institutions influence productivity behaviour during business cycle phases such as expansions and recessions.

Taking this into consideration, this dissertation addresses two main research questions:

i) "How does the business cycle affect total factor productivity?"
ii) "How do institutions influence productivity dynamics across the business cycle?"

Examining the existing literature reveals various theories linking productivity and business cycles. On one hand, the Real Business Cycle theory highlights strong procyclicality in productivity and defends that real shocks (technological changes) are the main drivers of business cycle fluctuations (Kydland & Prescott, 1982, 1990; Hall, 1987; Bernanke & Parkinson, 1991; Dufourt, 2005). On the other hand, the New Keynesian theory highlights the role of demand-side shocks on product variations and how rigidities in the economy influence productivity behaviour (Hairault & Portier, 1993; Clarida et al., 1999; Galí, 2015). Furthermore, it is also interesting to dive into the Creative Destruction view of the business cycle that with arguments about the cleansing effects of recessions on the economy that incite productivity growth via resource reallocation and exit of low-productivity firms (Caballero & Hammour, 1994; Malley & Muscatelli, 1999; Malley et al., 2000; Van den bosch & Vanormelingen, 2022, Haltiwanger et al., 2025).

It is also essential to account for cross-country differences in institutional frameworks, as these can lead to significant variation in how the business cycle impacts productivity. Institutions play a key role in shaping both the magnitude and direction of productivity

fluctuations, potentially enhancing or constraining productivity dynamics throughout the cycle. For example, Van Zandweghe (2010) and Heil (2017) discuss the positive effects of a flexible labour market and strong financial institutions, respectively, on productivity behaviour across a business cycle.

This research is motivated by the growing need to understand how productivity evolves throughout the business cycle, not only during severe downturns, such as the Global Financial Crisis, but also during more typical cyclical fluctuations. Yet, the existing literature remains limited, especially in connecting institutional factors with productivity dynamics across the cycle. To the best of my knowledge, the few studies that do explore this link are mostly focused on the United States and examine a narrow set of institutional variables, lacking a broader, cross-country and multidimensional perspective.

To address this gap, this dissertation contributes to the literature by examining the relationship between business cycles and productivity across a broad set of countries, using a comprehensive institutional framework that includes labour market, financial, and regulatory institutions. This analysis is conducted using an Interactive Panel Vector Autoregression (IPVAR) model, which incorporates Total Factor Productivity, the cyclical component of GDP, and a diverse set of institutional indicators.

Applying this methodology to 36 OECD countries over the period 2000–2019 reveals a procyclical pattern in productivity. The results show that flexible labour markets and well-developed financial institutions enhance productivity following a positive cyclical shock, whereas higher regulatory quality appears to hinder productivity growth in such contexts. These finding aim to offer valuable insights for policymakers seeking to design more effective counter-cyclical strategies and to ensure that expansionary policies actively support, rather than constrain, short-term productivity growth.

This dissertation is structured as follows. Section 2 reviews the relevant literature on business cycles and productivity, beginning with the definition of key concepts – such as business cycles, productivity, and institutions – and then examining theoretical perspectives on how both cycles and institutions influence productivity dynamics. Section 3 outlines the methodology, with a focus on the Interactive Panel Vector Autoregression (IPVAR) model. Section 4 describes the data, detailing the variables used and presenting descriptive statistics. Section 5 discusses the main empirical results, and Section 6 concludes with a summary of key findings and their implications.

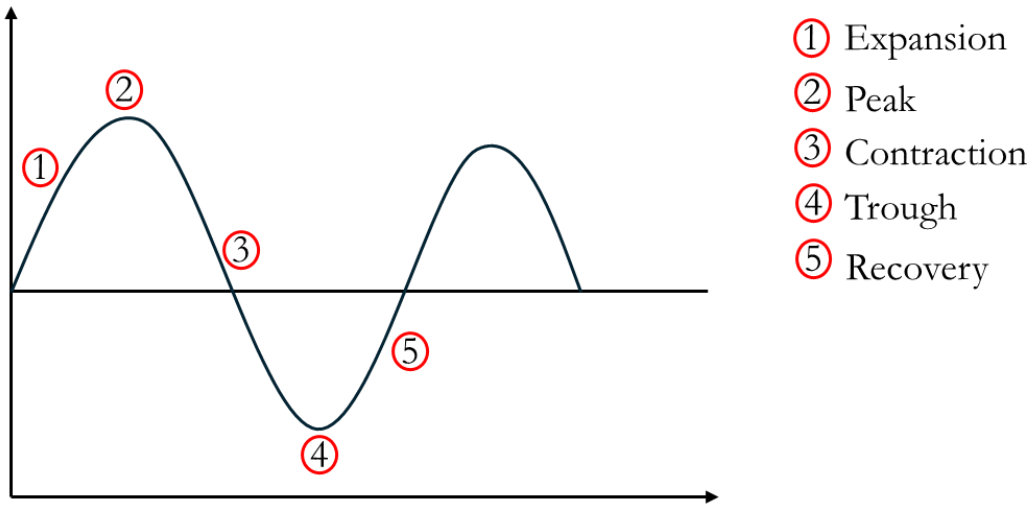
2. Literature review

2.1. Key Concepts: Business cycles, productivity and institutions

In order to assess how different phases of the business cycle affect productivity and how institutions mediate these effects, we begin by briefly defining the three core concepts.

Burns and Mitchell (1946) – the foundation for most subsequent studies on business cycles – refer to business cycles as recurring fluctuations in economic activity that economies experience over time. These business cycles are defined by recurrent, but not strictly periodic, movements in aggregate economic activity, encompassing phases of expansion, peak, contraction, trough and recovery as represented in Figure 1. During expansions, economic output, employment, and income rise, culminating in a peak that marks the highest point of economic activity before a downturn. Contraction follows, characterized by declining output and rising unemployment, eventually bottoming out at a trough, which signals the start of recovery (Burns & Mitchell, 1946).

Figure 1: Business cycle representation



This figure shows a simple representation of the business cycle, with numbered labels indicating its phases.
Source: Own elaboration

Moreover, Schumpeter (1939) emphasized the role of innovation and "creative destruction" in driving business cycles, proposing that economic fluctuations are intrinsic to the capitalist system. According to his view, innovations disrupt economic equilibrium,

leading to periods of rapid growth. However, over time, as these innovations become widely adopted, their returns diminish, and a downturn follows.

Business cycles influence several economic variables, one of which is productivity. Productivity is a critical indicator of economic performance that measures the efficiency with which inputs, such as labour and capital, are transformed into outputs (Tangen, 2002). Early studies of productivity focused on labour productivity[1], as highlighted by classical economists like Adam Smith and David Ricardo. Over time, the concept expanded to include broader measures, such as Total Factor Productivity (TFP), also known as the "Solow residual." TFP captures the efficiency of all inputs, accounting for factors beyond labour and capital, such as technological progress. According to Solow's growth model, TFP growth is the primary driver of long-term economic expansion (Solow, 1956). In this dissertation, productivity is measured using TFP.

Being crucial to productivity growth, economic institutions also influence productivity fluctuations over the business cycle. According to North (1990, 1991), institutions are the human-made constraints that shape political, economic, and social interactions. These include informal elements such as customs, traditions, taboos, sanctions, and codes of conduct, as well as formal rules like laws, constitutions, and property rights. Acemoglu et al. (2005) expand on this topic by explaining the importance of economic institutions for economic outcomes, highlighting how they shape incentives and enable the efficient allocation of resources. Examples include property rights, the rule of law and contract enforcement, market-creating and market-regulating institutions, financial institutions, and labour market institutions.

2.2. Business cycle theories

This section briefly explores theoretical perspectives of the business cycle and its relationship with productivity. These theories – Real Business Cycle (RBC) theory, New Keynesian theory, and Schumpeterian theory – offer distinct yet interconnected insights into the mechanisms underlying economic fluctuations. It is also important to recognize that,

[1] Labour productivity is normally defined as output per worker or per hours worked (Chernousov et al., 2009)

although this study focuses on how business cycles affect productivity, the reverse relationship also exists and will be highlighted in the following theories.

Real Business Cycle

The Real Business Cycle (RBC) is a leading theory in the literature on business cycles. This theory explains that variations in output across business cycles result from real shocks – such as technological changes – that impact Total Factor Productivity (TFP). Within this framework, productivity is procyclical, increasing during economic expansions and decreasing during recessions (Kydland & Prescott, 1982, 1990; Hall, 1987; Bernanke & Parkinson, 1991; Dufourt, 2005).

Crucially, the RBC theory views productivity shocks as one of the main drivers of business cycle fluctuations. This exogenous perspective on technological changes makes productivity the central causal force behind expansions and contractions in output. Thus, RBC theory focuses more on how productivity impacts economic cycles than on the reverse relationship (Kydland & Prescott, 1982). While the theory successfully explains many empirical observations, its reliance on technology shocks as the sole driver of business cycles has drawn criticism for neglecting demand-side factors (McCallum, 1988).

New Keynesian

New Keynesian theory, in contrast, emphasizes demand-side shocks and market imperfections such as price and wage rigidities. These rigidities can prevent productivity from fully adjusting to economic fluctuations. For example, during a downturn, firms may retain excess labour due to sticky wages, resulting in lower productivity. Similarly, underutilization of capital during recessions can reduce productivity, even if technology remains constant (Hairault & Portier, 1993; Clarida et al., 1999; Galí, 2015).

At the same time, productivity changes can influence macroeconomic outcomes in these models, particularly through inflation and monetary policy responses. For instance, a positive productivity shock may lower inflation, prompting central banks to adjust interest rates in ways that affect output and employment, generating a bidirectional relationship between productivity and the business cycle (Hairault & Portier, 1993; Clarida et al., 1999). Accordingly, Clarida et al. (1999) argue that productivity dynamics in the New Keynesian framework are shaped by the interaction between monetary policy, demand fluctuations, and adjustment costs.

Schumpeterian

Building on the Schumpeterian theory of creative destruction, Aghion and Howitt (1992) extend Joseph Schumpeter's (1939) insight that business cycles are intrinsically linked to innovation-driven growth. In their endogenous growth models, technological progress occurs through the entry of new innovations that displace older technologies, generating cyclical patterns of expansion and adjustment. Although Aghion and Howitt do not directly model business cycles, productivity growth can be interpreted as both a cause and consequence of economic fluctuations: while innovation fuels economic expansions, the disruptive effects of creative destruction can induce temporary downturns as displaced workers and firms adjust.

This dual role of productivity is particularly relevant during recessions. As argued by Saint-Paul (1993), downturns may incentivize firms to engage in productivity-enhancing activities, such as R&D (Research and Development) and training, due to lower opportunity costs, aligning with the opportunity cost (OC) view of the cycle. Additionally, recessions may have a "cleansing effect," as inefficient firms exit the market and resources are reallocated toward more productive uses (Caballero & Hammour, 1994; Malley & Muscatelli, 1999; Malley et al., 2000; Van den Bosch & Vanormelingen, 2022; Haltiwanger et al., 2025). However, these gains depend critically on the efficiency of reallocation. When financial frictions (e.g., credit constraints) or labour market rigidities are present, recessions may instead result in persistent productivity losses (Barlevy, 2002). Ouyang (2009) further warns that downturns can have scarring effects, eliminating young, high-potential firms and lowering long-run average productivity.

Taken together, these theoretical perspectives provide a multifaceted understanding of the relationship between productivity and the business cycle. While RBC theory positions productivity shocks as the primary source of economic fluctuations, New Keynesian models emphasize the role of demand-side factors and rigidities that influence how productivity evolves across distinct phases. Endogenous growth models, particularly those rooted in Schumpeterian innovation, highlight a bidirectional relationship in which productivity both affects and responds to cyclical dynamics.

2.3. Productivity behaviour across the business cycle

In the context of the relationship between business cycles and productivity behaviour, we consider now the literature that examines how productivity evolves across the various phases of the business cycle: expansion, peak, recession, trough, and recovery.

In general, across numerous studies, productivity historically behaves in a procyclical manner, meaning it rises during expansions and declines during contractions (Zell, 1979; Gordon & Clark, 1984; Basu et al., 2006; Field, 2010; Van Zandweghe, 2010). However, more recent findings suggest that this pattern is changing over time, with TFP becoming less procyclical (Fernald and Wang, 2016) and labour productivity turning acyclical (Field, 2010) or even countercyclical (Van Zandweghe, 2010; Fernald and Wang, 2016; Galí and Van Rens, 2020). The key factors driving this behaviour will now be discussed in more detail by examining the phases of the business cycle.

We begin by examining economic expansions. There is some consensus in the literature that productivity rises during expansions. According to traditional macroeconomic models, this upward trend in productivity is mainly due to increased capital utilization, technological adoption, and labour efficiency, as described by Basu et al. (2006) and Comin and Gertler (2006). Chernousov et al. (2009) also point out that during expansions, the combination of longer hours worked, and output growth leads to greater labour productivity growth. Investment in new technologies and R&D also contributes to productivity growth during expansions, as shown by Anzoategui et al. (2019).

However, as expansions come to an end and the peak approaches, productivity growth begins to slow down. Gordon (1980) and Neftci (1981) describe the "end-of-expansion" phenomenon, which refers to the tendency for firms to overhire in the late phases of expansion, reducing productivity gains. Uncertainty about the next downturn also plays an important role in hindering productivity, as it can lead to misallocation of resources (Gordon, 1980; Neftci, 1981). Furthermore, as Zell (1979) notes, in the later stages of an expansion – when the economy approaches its peak – efficiency begins to decline, and labour productivity growth slows. This can be attributed to factors such as the hiring of less-skilled workers, reduced cost-consciousness, and increased resistance to labour demands.

When the economy enters a recession, firms often retain excess labour instead of laying off workers immediately, due to expectations that contractions are temporary and the high costs of firing and rehiring – a phenomenon known as labour hoarding. This behaviour,

combined with the sharp decline in output, leads to a fall in labour productivity (Zell, 1979; Burnside et al., 1993). This aligns with the New Keynesian theory, which attributes the procyclicality of labour productivity and TFP to factor hoarding (Fernald & Wang, 2016). However, from the RBC perspective, productivity declines during downturns are driven by negative technological shocks.

Alternatively, according to some literature, productivity is becoming less procyclical, meaning it decreases less or even increases, during recessions. Fernald and Wang (2016) attribute this change to reduced variation in factor utilization, which reflects greater flexibility in the economy or a shift away from manufacturing toward sectors where utilization is a less important mechanism of adjustment.

Additionally, focusing on productivity growth during economic contractions, López-Gárcia et al. (2013) study how firms may shift their focus to productivity-enhancing activities such as R&D and training, since the opportunity cost of these activities falls, leading to countercyclical innovation and rises in productivity. However, this study also explains that credit constraints can limit such investments, making productivity-enhancing activities procyclical for financially constrained firms.

From a Schumpeterian perspective, creative destruction can explain why recessions lead to productivity increases, as inefficient firms are removed during downturns. This process can result in long-term productivity gains, and increased bankruptcy rates may force resource reallocation, sometimes causing short-term productivity spikes in deep recessions (Montomery & Wascher, 1988).

Finally, at the end of recessions (the trough) and during recovery, output and labour productivity tend to rise, according to Zell (1979) and Chernousov et al. (2009). Zell (1979, p. 25) explains that this occurs because "less efficient plants have been closed and less efficient workers laid off."

To summarize these dynamics, Table 1 outlines how the literature conceptualizes the relationship between business cycle phases and productivity, highlighting key explanations and relevant references.

Table 1: Summary of how productivity behaves across the business cycle

Business Cycle Phase	Productivity Behaviour	Key Explanations	Key References
General Trends	Historically procyclical; recent trends show TFP becoming less procyclical and labour productivity turning acyclical or countercyclical	Changes in factor utilization, sectoral shifts, and innovation responses	Zell (1979); Gordon & Clark (1984); Basu et al. (2006); Field (2010); Van Zandweghe (2010); Fernald & Wang (2016); Galí & Van Rens (2020)
Expansion	Productivity rises	Increased capital utilization, technological adoption, labour efficiency, R&D investment	Basu et al. (2006); Comin & Gertler (2006); Chernousov et al. (2009); Anzoategui et al. (2019)
Peak	Productivity growth slows	Overhiring, misallocation of resources, reduced efficiency, hiring of less-skilled workers	Zell (1979); Gordon (1980); Neftci (1981)
Recession	Productivity typically declines (but may rise in recent trends)	Labour hoarding, factor hoarding (New Keynesian view), negative technology shocks (RBC view), reduced variation in factor utilization, countercyclical innovation, creative destruction	Zell (1979); Montomery & Wascher (2018); Burnside et al. (1993); López-Gárcia et al. (2013); Fernald & Wang (2016);
Trough & Recovery	Productivity rises	Closure of inefficient firms/plants, improved resource allocation	Zell (1979); Chernousov et al. (2009)

This table summarises how productivity behaves across the different phases of the business cycle, along with the key explanations and references.
Source: Own elaboration

2.4. Institutions and productivity behaviour across the business cycle

Institutions exert a direct influence on business cycle fluctuations, as demonstrated by Altug et al. (2013), Canova et al. (2012), and Gnocchi et al. (2015). While this relationship is well established, it is not the primary focus of this dissertation. Instead, the analysis focuses on how institutions shape productivity dynamics throughout economic cycles.

Beyond their influence on business cycles, institutions also play a crucial role in determining both the magnitude and direction of productivity fluctuations. Dreher et al. (2014) and Rodríguez-Pose and Ganau (2022) emphasize that institutional quality is a key driver of productivity growth, reinforcing its importance in shaping productivity cyclicality.

This section examines the mechanisms through which labour market institutions, financial systems, and regulatory structures influence productivity dynamics across the business cycle. These institutional categories were selected due to their prominence in the literature concerning productivity behaviour over the cycle.

Labour market institutions – particularly employment protection and wage bargaining arrangements – play a key role in shaping productivity cyclicality through their impact on labour hoarding (Van Zandweghe, 2010; Radlinska et al., 2020). These institutional rigidities, by raising firing costs, constrain firms' ability to adjust employment in response to economic fluctuations. As a result, firms tend to retain excess labour during downturns, reinforcing labour hoarding practices and leading to more pronounced productivity declines (Dietz et al., 2010; Radlinska et al., 2020). Notably, Van Zandweghe (2010) shows that structural labour market reforms have reduced such rigidities, thereby modifying productivity patterns over the business cycle.

Financial institutions also play an important role enabling or hindering productivity adjustments during economic cycles. As per Bekaert et al. (2011) financially developed economies experience stronger productivity growth due to improved allocative efficiency. Similarly, Alfaro et al. (2009) suggest that financial markets contribute to productivity by efficiently allocating foreign capital. Regarding cyclical dynamics, weaker financial institutions, characterized by greater financial frictions, can alter both the magnitude and direction of productivity responses (Heil, 2018). From a Schumpeterian perspective, Caballero and Hammour (2000) highlight how poor transparency and limited investor protection in financial markets obstruct the process of creative destruction, which, as previously discussed, influences the cyclical behaviour of productivity.

Political and legal institutions can also play a significant role in shaping the process of creative destruction. As Caballero and Hammour (2000) demonstrate, politicized and uncertain regulatory environments hinder this process, thereby obstructing productivity recovery during economic downturns. Bankruptcy laws and insolvency regimes represent another key institutional dimension influencing productivity dynamics over the cycle. When well-designed, these frameworks help minimize productivity losses stemming from financial distress (Georgekapoulos, 2002). Conversely, inefficient insolvency systems may delay firm exit and trap resources in low-productivity enterprises, leading to resource misallocation and lower aggregate productivity.

Considering these findings and Figure 1 above, Table 2 presents a summary of how productivity evolves across different phases of the business cycle according to the literature and highlight the institutional factors that shape this cyclical behaviour.

Table 2: Summary of productivity behaviour across the business cycle, with an institutional explanation.

Business cycle Phase	Labour Productivity behaviour	TFP behaviour	Institutional factor
1 - Expansion	↑	↑	Institutional quality; financial development
2 - Peak	↘	↘	Rigidity of the labour market
3 - Contraction	↑ or ↓	↓	Rigidity of the labour market; institutional quality; financial development; Regulatory environment; Insolvency regimes
4 - Trough	↗	-	Financial development; Transparency and investor protection; Insolvency regimes
5 - Recovery	↗	-	Financial development; Transparency and investor protection; Insolvency regimes

This table presents a summary of how productivity behaves across the business cycle and what institutions mediate that relationship

Note: The arrows represent the deacceleration or acceleration of productivity. The upward arrow signifies an acceleration of productivity, while the downward arrow represents a deacceleration. The tilted arrows signify the dynamic of transition of those phases. The lack of arrows in the TFP behaviour column is due to lack of literature.

Source: own elaboration

Altogether, this contributes to understanding how institutions influence productivity dynamics and through which mechanisms this occurs. However, it is important to note that these institutional effects are not independent. Countries with rigid labour markets but well-developed financial systems may experience different productivity patterns relative to those with both rigid labour markets and underdeveloped financial sectors. This institutional complementarity suggests that the overall institutional configuration – not just individual institutions – determines the cyclicality of productivity.

Despite extensive literature on institutions and macroeconomic outcomes, important gaps remain. For example, Altug et al. (2013), Canova et al. (2012), and Gnocchi et al. (2015) focus on the role of institutions in shaping business cycle fluctuations across countries but

do not address how these institutions influence productivity. Conversely, studies such as Dreher et al. (2014) and Rodríguez-Pose and Ganau (2022) analyse the impact of institutional quality on productivity growth across countries but do not incorporate the cyclical dimension.

A few exceptions, such as Van Zandweghe (2010), Dietz et al. (2010) and Radlinska et al. (2020), explore productivity behaviour across the cycle in connection with labour market institutions, but are either focused on a single country or restricted to specific institutional areas (e.g., labour hoarding). Similarly, Heil (2018) analyses the impact of financial development on productivity cyclicality, but only from the perspective of financial frictions. While Caballero and Hammour (2000) link regulatory and legal factors to the creative destruction process during downturns, their emphasis remains on firm dynamics during crises rather than on broader productivity behaviour across the full cycle.

These studies, although valuable, share two main limitations: they either focus on individual institutional domains or restrict their analysis to narrow country samples. Moreover, they typically adopt methodologies that treat institutions as static or background conditions, rather than explicit moderators of productivity responses to macroeconomic shocks.

Over the following sections, this dissertation addresses these gaps empirically, by applying an IPVAR (Interactive Panel Vector Autoregression) model with institutional interaction terms, allowing for a more nuanced understanding of how different institutional configurations modulate productivity over the cycle. In doing so, it introduces a methodological contribution that directly responds to the second research question: "how do institutions influence productivity dynamics across the business cycle?". By analysing a comprehensive set of institutional variables (including labour, financial, and regulatory domains) and their joint influence in shaping productivity cyclicality, this study moves beyond fragmented or single-country analyses to offer a broader, comparative, and dynamic perspective.

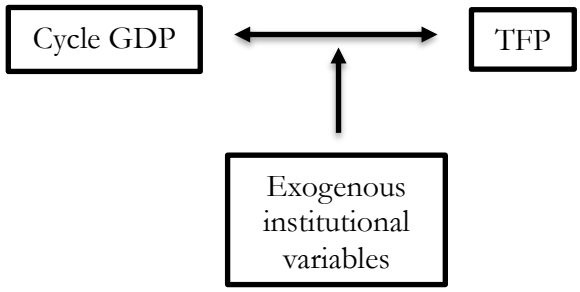
3. Methodology

3.1. Variables

This subsection presents and justifies the selection of variables used in the empirical analysis. The aim is to examine the dynamic relationship between business cycles and productivity, and how this relationship varies across institutional settings. To capture these dynamics, the model includes two endogenous variables: Hamilton-filtered GDP[2] and TFP. These variables track cyclical economic movements and the corresponding changes in productivity.

In addition, the model includes a set of exogenous variables that represent cross-country differences in institutional settings. By treating institutions as exogenous, and productivity and GDP as endogenous, the model can explore how institutional frameworks shape the relationship between business cycles and productivity, rather than being shaped by it.

Figure 2: Visual representation of the relationship between the variables



Source: Own elaboration

Formally, the vector of endogenous variables is defined, for country *i* in quarter *t*, as:

$$Y_{it} = [CycleGDP_{it}; TFP_{it}] \quad (1)$$

where $CycleGDP_{it}$ represents the cyclical component of GDP obtained using the Hamilton filter (Hamilton, 2018) and serves as a proxy for the business cycle. TFP_{it} denotes total factor productivity, which captures how efficiently inputs are converted into outputs, and is used as a measure of productivity.

The Hamilton filter method isolates the short-term fluctuations in GDP from its long-term trend, providing a more accurate measure of cyclical activity compared to raw GDP or

[2] See section 4.3 for extend information on the Hamilton filter transformation

trend-based detrending. The decision to use the Hamilton filter to proxy business cycle fluctuations is supported by studies such as Luvsannyam et al. (2019) and Miranda-Pinto et al. (2023). Similarly, the use of TFP as a measure of productivity follows the approach adopted in Barnichon (2010) and Fernald and Wang (2016).

Given the relatively stable nature of institutional frameworks over time, we treat them as exogenous variables in the model. These variables are grouped into three broad categories: Labour Market Institutions, Financial Institutions, and Regulatory Institutions. The selection of these specific institutional dimensions is grounded in the extensive literature (e.g., Caballero & Hammour, 2000; Van Zandweghe, 2010; and Heil, 2018) that links these institutions to the behaviour of productivity over the business cycle.

Formally, the vector of exogenous institutional variables is defined as:

$$I_{i,t} = [LMI_{it}; FDI_{it}; RI_{it}] \quad (2)$$

where LMI_{it} refers to labour market institutions, FDI_{it} captures financial development and represents RI_{it} regulatory institutions.

For the labour market institutions LMI_{it}, three alternative variables are considered, each reflecting distinct dimensions of labour market rigidity: (1) Employment Protection Legislation (EPL), (2) Union Density (UD), and (3) the Tax Wedge (TW). The financial development variable FDI_{it} corresponds to the Financial Development Index, which proxies the quality and depth of financial institutions. Finally, regulatory institutions RI_{it} are captured using two conceptually similar variables, namely, Regulatory Quality, from the World Governance Indicators (WGI), and Business Freedom, from the Economic Freedom Index (EFI).

Table 3: Variables description and main references

	Variables	Definition	Reference
		Endogenous Variables	
	Hamilton-Filtered GDP	Cyclical component of real GDP obtained via the Hamilton filter	Hamilton (2018); Miranda-Pinto et al. (2023)
	TFP	Measure of the efficiency with which inputs are transformed into outputs	Angelopoulos et al. (2009); Barnichon (2010)
		Exogenous Variables	
Labour market institutions	Employment Protection Legislation (EPL)	Strictness (between 0 and 6) of regulation on individual and collective dismissals.	Gnocchi et al. (2015);
	Tax Wedge (TW)	Measure of the difference between labour costs to the employer and the net take home pay of the employee	Abbritti and Weber (2018); Attinasi et al. (2016)
	Union density (UD)	The degree of unionization as measured by the percentage of workers affiliated with a union	Abbritti and Weber (2018); Gnocchi et al. (2015);
Financial institutions	Financial development (IMF index)	The Financial Development Index (between 0 and 1) is a composite index to measure the depth, access, and efficiency of financial institutions and financial markets in a country.	Aluko and Ibrahim (2020); Destek et al. (2020)
Regulatory institutions	Regulatory Quality (RQ)	Regulatory Quality estimate gives the country's score on the aggregate indicator, in units of a standard normal distribution, i.e. ranging from approximately -2.5 to 2.5.	Daude and Stein (2007); Altug and Canova (2013); Zámborský et al.(2021)
	Business Freedom (BF)	Business Freedom reflects the regulatory efficiency of a country's business environment and ranks it from 0 to 100	Hussain and Haque (2016); Pawęta (2021)

This table presents and defines the main variables used in the analysis
Source: Own elaboration

3.2. IPVAR model

Structural vector autoregression (SVAR) models have played a significant role in empirical macroeconomic research on business cycles, particularly in identifying the dynamic effects of technology shocks on output, productivity, and labour market outcomes. Building on the identification strategy of Blanchard and Quah (1989), Galí (1999) introduced a widely

influential approach employing long-run restrictions to isolate technology shocks as those with permanent effects on labour productivity.

However, despite their empirical richness, SVAR models impose strong identifying assumptions and typically assume a homogeneous structure across countries, limiting their capacity to analyse how institutional differences shape macroeconomic dynamics. In contrast, this study adopts an Interactive Panel Vector Autoregression (IPVAR) framework (Towbin & Weber, 2013) to explore how productivity responds to business cycle fluctuations across countries with varying institutional characteristics.

The panel structure of the IPVAR model leverages data from multiple countries over time, improving estimation precision and capturing both cross-country heterogeneity and temporal dynamics. It also includes country and time fixed effects to control for unobserved factors and global shocks.

This model allows for interactions between lagged macroeconomic variables and slowly changing institutional factors, capturing the notion that different institutions or varying institutional quality may amplify or dampen the effects of business cycles on productivity dynamics. This feature is particularly important for examining whether, for example, productivity reacts more or less strongly to output shocks in countries with higher labour market rigidity or stronger legal frameworks.

Accordingly, the model is specified as:

$$\boldsymbol{Y_{it}} = \sum_{\boldsymbol{k=1}}^{\boldsymbol{p}} \boldsymbol{A_k Y_{i,t-k}} + \sum_{\boldsymbol{k=1}}^{\boldsymbol{p}} \boldsymbol{B_k}\left(\boldsymbol{I_{it}} \cdot \boldsymbol{Y_{i,t-k}}\right) + \boldsymbol{C I_{it}} + \mu_i + \gamma_t + u_{it} \qquad (3)$$

where:

- $\boldsymbol{A_k}$**:** matrix) Baseline autoregressive coefficients for lag *k*
- $\boldsymbol{B_k}$**:** (matrix) Interaction coefficients scaling the effect of $\boldsymbol{Y_{i,t-k}}$ by $\boldsymbol{I_{it}}$
- $\boldsymbol{C}$**:** Direct effects of $\boldsymbol{I_{it}}$ on $\boldsymbol{Y_{it}}$
- μ_i: Country fixed effects
- γ_t: Time fixed effects
- u_{it}**:** Error term (u_{it}~i.i.d.)

In this model, $\boldsymbol{Y_{it}}$ is a 2×1 vector of endogenous macroeconomic variables, namely the Cycle and the TFP. The vector $\boldsymbol{I_{it}}$ always includes three institutional variables: one related to labour market institutions (selected from Employment Protection Legislation, Tax Wedge,

or Union Density), the Financial Development Index, and one proxy for regulatory institutional quality (either Regulatory Quality or Business Freedom).

To estimate the IPVAR model, each equation will be estimated via Ordinary Least Squares (OLS) while accounting for cross-equation correlation in the residuals. By including both country fixed effects (μ_i) and time fixed effects (γ_t) in the model, we control for time-invariant country-specific heterogeneity as well as global common shocks that affect all countries in a given period. This ensures that the remaining variation used for identification reflects true within-country cyclical dynamics rather than structural differences or synchronized global events.

In the empirical implementation, lag length ρ was selected based on the Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC). Panel unit root tests (Levin-Lin-Chu and Im-Pesaran-Shin) were conducted to assess the stationarity of the macroeconomic variables[3]. Both tests pointed to non-stationarity in the Cycle GDP and TFP variables. However, due to issues found in the TFP variable while running the model a series of transformations were applied. First, TFP levels were log-transformed to stabilize variance and account for exponential growth patterns. Then, first differences of the log-transformed values were taken, effectively capturing the quarterly growth rate of TFP and ensuring stationarity.

3.3. Transformations and model specification

Impulse response functions (IRFs) were estimated using a one-period lag structure. Confidence intervals were derived through Monte Carlo simulation with 1,000 replications, employing a Bayesian inference framework as outlined in Sá et al. (2014) and Koop et al. (1996).

To isolate the effect of each institutional dimension on productivity's response to the business cycle, the Entropy Balancing technique, proposed by Hainmueller (2012), was applied. This method is particularly useful when comparing treatment and control groups while ensuring covariate balance across all relevant dimensions, except for the treatment variable itself.

Focusing on three institutional variables, two groups were constructed for each: a "High" institutional quality group (treatment), consisting of observations above the 75th percentile,

[3] See annex A1

and a "Low" quality group (control), consisting of observations below the 25th percentile. Observations within the interquartile range were excluded from the balancing procedure to ensure a clear distinction between groups. Entropy Balancing was implemented separately for each institutional variable to estimate its unique effect.

More formally, let $\boldsymbol{X} = [X_1, X_2, ..., X_n]$ be a vector of exogenous variables used in the construction of interaction terms in the IPVAR model. Suppose that the variable of interest is X_i. A treatment indicator is created such that it takes the value 1 for observations in the upper quartile of X_i and 0 for those in the lower quartile, while the observations in between are discarded. Entropy Balancing is then applied to the control group (X_i low), with the goal of making it as similar as possible to the treatment group in all other exogenous variables, except X_i. Specifically, the method assigns weights so that the average values of the remaining variables are the same across both groups. This ensures that the only meaningful difference between them lies in X_i, the variable being analysed.

These weights were then incorporated into the empirical analysis. The IPVAR model was estimated, and IRFs computed for each observation. Subsequently, a weighted average of the IRFs was calculated separately for the High and Low institutional quality groups using the Entropy Balancing weights. Finally, a Monte Carlo simulation with 1000 replications generated confidence bands to assess the statistical significance of differences in dynamic responses across groups.

4. Data

4.1. Data Sources

This dissertation employs a panel dataset encompassing quarterly observations for 36 OECD countries over the period 2000-2019 [4]. This timeframe was selected for three key reasons. First, it is sufficiently long to capture at least one complete business cycle. Second, it includes major economic events, most notably the Global Financial Crisis of 2007–2008, which is likely to have had significant impacts on productivity and institutional dynamics. Third, there remains a relative scarcity of empirical literature examining the interplay between business cycles, productivity, and institutions over this specific period.

To construct the dataset, variables were sourced from well-established international databases. GDP and all labour market institution indicators – namely Employment Protection Legislation (EPL), Tax Wedge, and Union Density – were obtained from the OECD databases. Annual TFP data were collected from the Penn World Table (PWT). Indicators related to financial institutions, such as the Financial Development Index, were retrieved from the International Monetary Fund (IMF). Regulatory institutional variables, including Regulatory Quality and Business Freedom, were obtained from the World Bank and the Heritage Foundation, respectively.

Table 4: Data sources summary table

Variables	Source
GDP*	OECD
TFP	PWT
EPL	OECD
TW	OECD
UD	OECD
FDI	IMF
RQ	WB
BF	Heritage Foundation

This tables presents the sources where each variable was retrieved
Note: *GDP used in the application of the Hamilton filter
Source: Own elaboration

[4] Colombia and Mexico were excluded from the analysis due to lack of data

4.2. Variables Description

The main variables in the analysis can be grouped into two categories: Macroeconomic variables and Institutional variables.

The macroeconomic variables consist of Cycle GDP and TFP. The underlying GDP series, used to extract the cyclical component via the Hamilton filter, is measured according to the expenditure approach and national currency. TFP captures the efficiency with which all inputs are used in the production process, providing a comprehensive measure of productivity beyond labour and capital alone.

The institutional variables are decomposed into three categories: Market labour institutions, financial institutions and Regulatory institutions. In the market labour institutions, Employment protection legislation represents the regulations on the dismissal of workers on regular contracts covering both individual and collective dismissals and is measured in a scale from 0 to 6 (where 0 indicates less strictness and 6 more strictness); Tax wedge measures the ratio between the amount of taxes paid by an average single worker and the corresponding total labour cost for the employer where a lower tax wedge represents more labour market flexibility; Union density corresponds to the trend in union density (based on administrative and/or national household or lab) and measures labour market rigidity (higher union density equals higher labour market rigidity).

The Financial Development Index is the variable connected to the financial institutions and represents a composite index developed by the International Monetary Fund (IMF) to measure the depth, access, and efficiency of financial institutions and financial markets across countries and over time, where 0 equals very low financial development and 1 equals very high financial development. Moreover, the Regulatory Quality variable is retrieved from the World Governance index (World bank) and reflects perceptions of the government's ability to formulate and implement sound policies and regulations that permit and promote private sector development and is measured in a scale that typically ranges from –2.5 (weak) to +2.5 (strong).

Business Freedom measures the ease of starting, operating, and closing businesses on a scale from 0 to 100. Higher scores indicate fewer regulatory barriers and more efficient business procedures.

Table 5 presents the descriptive statistics of the dataset. To provide a deeper understanding of the sample, we report the mean, standard deviation, minimum and maximum values, as well as the quartiles.

Table 5: Descriptive statistics of the sample

Descriptive Statistics	Mean	S.d.	Max	Min	1º Q	2º Q	3º Q
Cycle_GDP	0,0007	0,0127	0,1695	-0,1385	0,0043	0,0016	0,0070
TFP	0,996	0,017	1,058	0,914	0,990	0,998	1,003
EPL	2,332	0,692	4,095	0,488	1,933	2,459	2,827
TW	36,750	10,225	57,104	7,000	30,910	38,249	42,979
UD	27,591	19,984	93,300	4,500	13,975	20,500	32,600
FDI	0,623	0,212	1,000	0,150	0,470	0,660	0,783
RQ	1,302	0,405	2,082	0,016	0,988	1,306	1,651
BF	79,353	10,158	100	53,7	70	79,65	87,6

This table shows the descriptive statistics for all the variables defined on table 3.
Note: S.d.= Standard deviation; 1º Q= First Quartile; 2ºQ = Second Quartile (Median); 3ºQ = Third Quartile

We can draw some interesting conclusions about our dataset from the descriptive statistics of the main variables. Starting with the Cycle_GDP, which represents the cyclical component of GDP, we can observe a mean extremely close to 0 (0.0007). This confirms that cyclical fluctuations properly centre around the trend line over time. Additionally, the standard deviation (0.0127) suggests notable macroeconomic volatility across countries. The variable ranges from -13.85% (Lithuania, 2009Q1), reflecting the severe impact of the Global Financial Crisis, to +16.95% (Ireland, 2015Q1), driven by the so-called "leprechaun economics" – an artificial GDP spike linked to multinational tax strategies, as noted by Paul Krugman in 2016. TFP displays a high degree of consistency[5], with a mean around 0.99 and very low standard deviation (0.02), indicating relatively stable productivity levels across countries and over time in the sample.

As for the institutional variables, we can see that on average OECD countries show moderate employment protection levels.[6] However there are still countries with a relatively large EPL such as Portugal between 2000 and 2003. Regarding Tax Wedge, on average 36.75% of the total labour cost of the employer corresponds to taxes, which means that the average OECD country has moderately high tax wedge. However, the values ranging from 7% to 57.10% reflect a wide variation in labour tax burdens across the OECD. The Union

[5] These results might be related to the fact that the quarterly values of TFP were interpolated from an annual dataset.
[6] OECD considers countries with EPL levels above 2.5 high regulatory protection countries (OECD, 2020).

Density variable shows a mean of 27.59%, but high variation (standard deviation of 19.98 – nearly equal to the mean), indicating diverse labour market structures, from highly unionized systems (i.e. Iceland) to relatively flexible ones (i.e. Estonia).

FDI has a mean value of 0.2, suggesting moderately developed financial systems across the sample, with Switzerland obtaining the highest possible value in this index in 2007. In the Regulatory institutions element, we can observe that the RQ, ranging from 0.016 to 2.082, has a mean of 1.30, showing that most countries are perceived as having relatively strong regulatory environments. The same can be said of BF, given that, with a minimum value of 53.7, none of the countries in this sample have poor regulatory structures.

To gain a better understanding of this data, particularly the institutional variables, a variance decomposition was conducted (see Annex B1). The results show that most institutional indicators exhibit greater variation between countries and minimal variation within countries over time, which supports the notion that institutions evolve slowly. This empirical pattern reinforces their classification as structural characteristics and justifies the use of a panel VAR framework, which exploits cross-sectional heterogeneity when estimating dynamic effects across countries.

4.3. Data transformations

To enable quarterly empirical analysis, annual TFP data was interpolated using quarterly real GDP as an indicator. The interpolation was carried out for a set of OECD countries, applying the Chow-Lin method (Chow & Lin, 1971), with maximum likelihood estimation. This method estimates quarterly TFP values from annual TFP data by exploiting the co-movement with quarterly GDP, assuming an autoregressive structure in the residuals. The procedure involved transforming the series into logarithmic form, estimating the model, and converting the results back to their original scale (Elstner & Rugin, 2023; Christofzik et al., 2024). Institutional variables were also converted to quarterly frequency. However, given their slow-moving nature, annual values were simply repeated across quarters.

To isolate the cyclical component of GDP, the Hamilton filter (Hamilton, 2018) was applied to seasonally adjusted GDP data. This approach identifies the cyclical component as

the forecast error from a four-quarter-ahead regression, avoiding the end-point bias and spurious cycles associated with HP filtering.[7]

To handle missing values in the panel dataset, tailored imputation methods were used for each variable. For Union Density, missing values were filled using linear interpolation for intermediate years and trend extrapolation for endpoints, preserving its gradual evolution over time. Regulatory Quality had only one missing value (2001), which was imputed as the average of 2000 and 2002, ensuring continuity in the series. For the EPL variable, which lacked data in the early 2000s, a last-observation-carried-forward approach was applied, where for example, the 2009 value was used for 2001–2008, reflecting the typically stable nature of labour regulations.

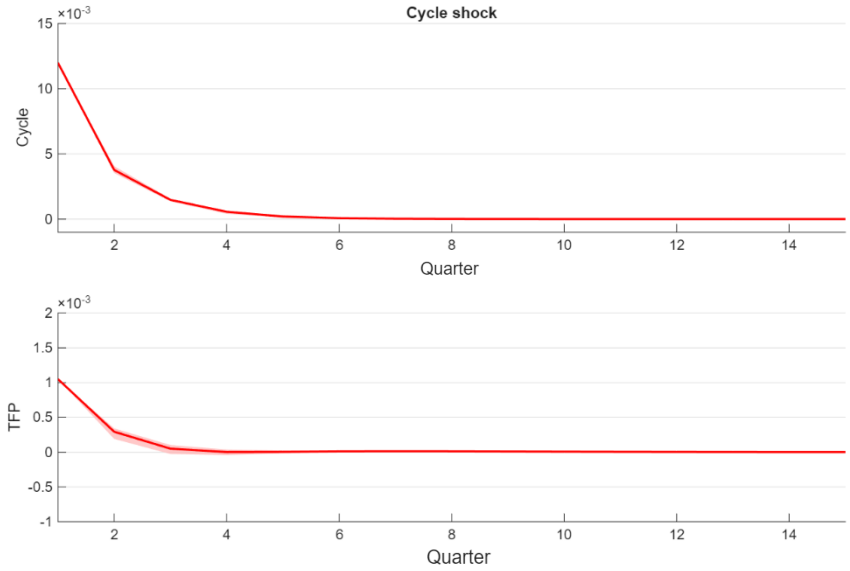
[7] Following Hamilton (2018), the cyclical component of GDP is obtained from the regression $y_{i,t+4} = \alpha_i + \sum_{j=1}^{8} \beta_j y_{i,t-j} + \varepsilon_{i,t+4}$ where $\varepsilon_{i,t+4}$ capture the cyclical component of GDP as extracted by the Hamilton filter.

5. Results

5.1. Productivity behaviour across the cycle

This section examines how productivity responds to business cycle fluctuations using impulse response functions from the baseline IPVAR model. Specifically, we examine, through Figure 3, how TFP and the cyclical component of GDP (Cycle) respond over time to a positive shock to the business cycle. This directly addresses the first research question: *"How does the business cycle affect overall productivity?"*.

Figure 3: Impulse Response Function resulting from a positive shock on the cycle and TFP



This figure shows the IRFs from the baseline IPVAR model, illustrating the dynamic responses of TFP and the cyclical component of GDP to a business cycle shock.
Note: TFP is shown in log-differences ×10³; the GDP cycle component is presented on the same scale for ease of visualisation
Source: Own elaboration

The upper panel in Figure 3 displays the business cycle dynamic following a positive shock. As expected, the effect is strongly positive in the first period with the cycle peaking immediately after the shock (circa 1.3 percentage points above trend). This suggests a robust short-term amplification mechanism, as expansions in GDP significantly push output above its trend. However, this effect is transitory. The magnitude of the response decays rapidly, approaching zero by approximately the fourth quarter. Beyond that point, the response remains economically insignificant, indicating that cyclical fluctuations quickly return to the trend path.

The lower panel depicts the dynamic response of TFP to the same cycle shock. TFP shows a clear positive response immediately following the shock, with productivity increasing slightly during the first period (around 0.15%). This indicates that short-term expansions may generate marginal productivity gains, potentially through improved operational efficiency. However, this effect is short-lived, since by the second period, the magnitude of the response diminishes sharply. From approximately the third quarter onward, the TFP response becomes statistically indistinguishable from zero, stabilizing. These results imply that the productivity gains from cyclical upturns are not persistent and fade over time. Notably, the increase in the TFP variable falls behind the increase in the cycle component of GDP and lasts significantly less time.

These empirical findings are consistent with the economic literature that suggests TFP is procyclical. From a New Keynesian perspective, output increases during expansions are not immediately followed by adjustments in firms' inputs (Capital and Labour). This happens due to price and wage rigidities and has a direct positive effect on TFP, since output has increased but factor utilization remains similar. During a contraction in the economy the same dynamic takes place. The wage and price rigidities lead to factor hoarding (i.e. firms maintain an excess of Labour and Capital) which aggregated with a decrease of output, diminishes TFP levels.

Eventually, firms begin adjusting their levels of labour and capital utilization according to the economic environment. In an expansion firms will ultimately increase their inputs, lowering productivity back to its trend path. This adjustment dynamic offers a plausible explanation of the behaviour of the TFP variable observed in the figure above: while productivity rises following a cyclical shock, the effect dissipates (as firms gradually realign their inputs) quicker than the shock itself.

Moreover, even though TFP presents clear procyclical behaviour these results contrast with RBC theory and its defence of stronger procyclicality of TFP, i.e. a more robust and sustained TFP dynamic. Additionally, when looking at this figure from the point of view of the creative destruction hypothesis (Schumpeter, 1939; Aghion and Howitt, 1992) and assuming that the positive shock is innovation driven, the procyclicality shown is directly linked with more efficient reallocation of resources (from less to more productive firms, for example), and increases in entry rate of more innovative firms. However, the relatively short-

lived nature of this effect, as both variables return to trend, indicates that the innovation response was temporary or insufficient to trigger sustained creative destruction.

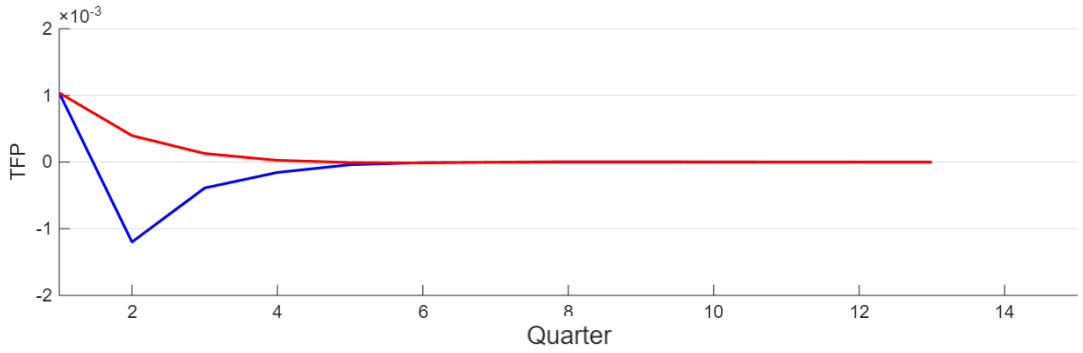
5.2. The role of institutions on the cyclicality of productivity

After assessing how productivity responds to business cycle shocks in the baseline model, this section focuses on understanding how different institutional settings, specifically EPL, FDI, and RQ, shape the dynamics. As outlined in the methodology section, to isolate the effects of each institution, entropy balancing was applied. This procedure allowed for the construction of comparable groups of observations with High and Low levels of the respective institutional variable.

In this framework, Figures 4 to 6 display the IRFs of TFP following a positive cycle shock. Each figure includes two lines to distinguish the responses under different institutional settings: the blue line represents countries with high institutional values, while the red line corresponds to those with low institutional values.

Figure 4 shows that low-EPL countries present a stronger positive response of TFP to positive business cycle shocks, while high-EPL countries exhibit a negative response, due to lower labour market flexibility. These results are in line with the existing literature, which suggests that rigid labour market institutions can hinder reallocation mechanisms, limiting efficiency gains during both expansions and contractions. Specifically, in low-EPL environments, firms can more easily hire or lay off workers, enabling the reallocation of labour toward more productive activities. This flexibility supports creative destruction, whereby less productive firms exit, and resources shift to more dynamic ones. In contrast, high-EPL settings increase adjustment costs, reducing firm dynamism and responsiveness to cyclical opportunities. This finding is particularly consistent with Schumpeterian theories, which highlight reallocation efficiency as a key driver of productivity growth.

Figure 4: Productivity Response to Shocks by EPL Level

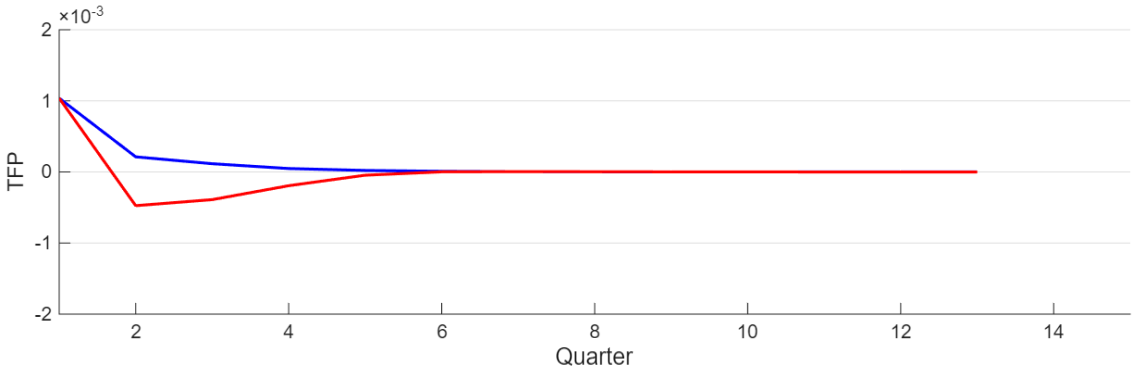


This figure presents the IRF showing the differential response of productivity to business cycle shocks between countries with High (blue) and Low (red) levels EPL
Note: TFP is shown in log-differences ×10³
Source: Own elaboration

In relation to the financial institutions, results presented in figure 5 suggest that countries with higher financial development exhibit more amplified and persistent positive TFP responses to business cycle shocks, while low-FDI countries show a significantly worse TFP response. This suggests that financially developed systems are better at allocating capital during expansions and cushioning firms during downturns. his aligns with the view that efficient financial markets improve the transmission of business cycle effects to firm productivity.

When breaking down the mechanisms behind these findings, we find that more developed financial institutions facilitate investment in technology, innovation and firm growth. Moreover, access to credit during downturns allows firms to cushion temporary revenue losses, maintaining productive capacity and avoiding layoffs or inefficient downsizing. In low-FDI environments, financial frictions – such as credit rationing or poor investor protections – limit firms' ability to respond to cyclical opportunities, reducing the translation of macroeconomic momentum into productivity growth. Furthermore, as mentioned in the literature review, financial frictions are one of the main reasons why the positive effects (cleansing effects) of recessions are overshadowed by their negative ones.

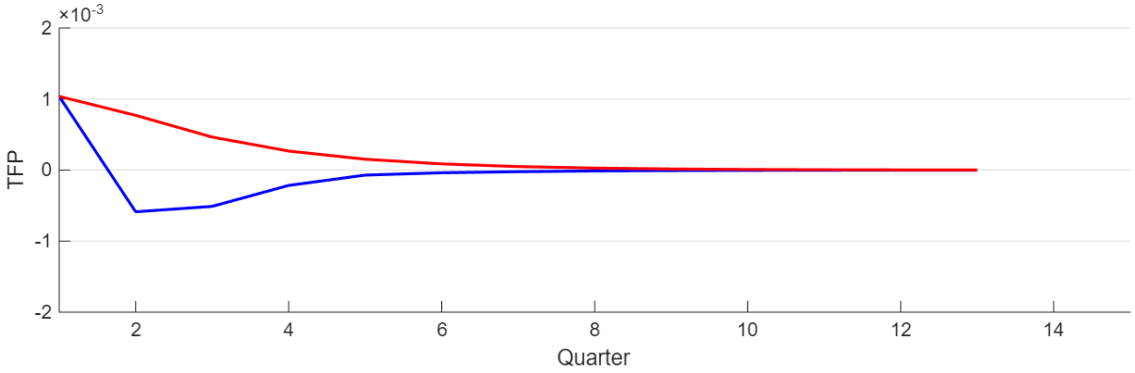
Figure 5: Productivity Response to Shocks by FDI Level



This figure presents the IRF showing the differential response of productivity to business cycle shocks between countries with High (blue) and Low (red) levels of FDI.
Note: TFP is shown in log-differences ×10³
Source: Own elaboration

Figure 6 presents the impulse response of TFP to a business cycle shock, distinguishing between countries with high and low levels of Regulatory Quality. Contrary to initial expectations, the response is stronger in countries with low-RQ, where TFP initially increases and then gradually converges back to baseline. In contrast, high-RQ countries experience a sharp negative impact on TFP immediately after the shock, followed by a slow recovery. From a theoretical standpoint, higher levels of Regulatory Quality are expected to facilitate a more effective and balanced response of productivity to business cycle fluctuations. Strong regulatory institutions ensure a stable, transparent, and predictable policy environment, which reduces uncertainty and enables firms to make better-informed decisions. Furthermore, given the strong link between the variable used and the promotion of private sector development it was expected that countries with high-RQ would have better TFP performance than countries with low-RQ.

Figure 6: Productivity Response to Shocks by RQ Level



This figure presents the IRF showing the differential response of productivity to business cycle shocks between countries with High (blue) and Low (red) levels of RQ
Note: TFP is shown in log-differences ×10³
Source: Own elaboration

To further investigate this relationship, we examined the raw correlation between TFP responses and regulatory quality, which revealed a positive correlation[8]. This finding initially appears counterintuitive given our balanced analysis results. This positive raw correlation is misleading because it fails to control for other institutional factors. Countries with high regulatory quality often simultaneously possess developed financial markets or flexible labour institutions, which are the actual drivers of superior productivity performance. This discrepancy highlights exactly why entropy balancing is essential. Without proper controls, we would erroneously conclude that higher regulatory quality enhances productivity responses. The balancing technique reveals that once we isolate regulatory quality from other institutional factors, higher RQ constrains productivity responses within comparable country groups.

It should be noted that the 36 OECD countries used in this analysis, do not have observations below zero in this variable, which means that all the 36 countries present strong regulatory environments. This might help understand the unexpected result regarding the regulatory quality impact on the behaviour of TFP across the business cycle, since the positive pattern between RQ and TFP is more easily perceived when analysing countries with a more distinct difference in this institution.

5.3. Comparative Analysis of IRF Outcomes and Institutional Frameworks: Country analysis

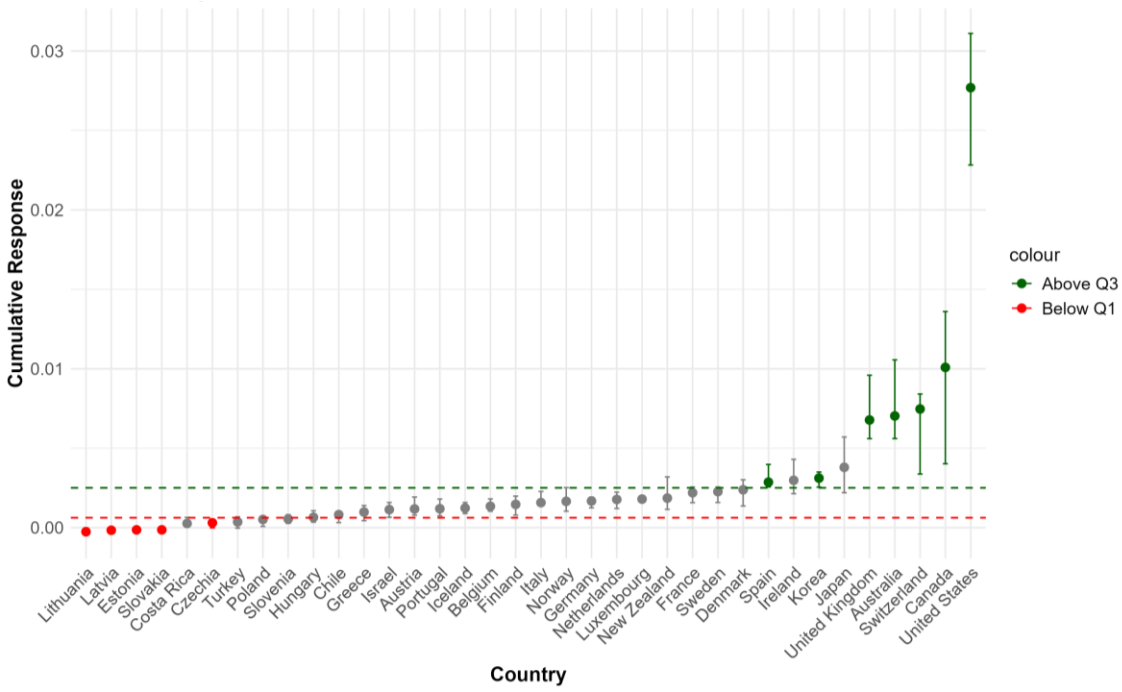
To further explore the effects of business cycle shocks on productivity, we analyse the TFP cumulative impulse responses (CIRFs) of individual countries. To better understand these results, we classified them into two groups based on the median magnitude of their TFP responses. The first group is represented by the colour red and consists of countries with a TFP response fully below the first quartile of the cumulative TFP median. The other group is represented by the colour green and consists of countries fully above the third quartile.

Figure 7 shows which countries are in which groups. The red group, which has the lowest TFP responses, consists of Lithuania, Latvia, Estonia, Slovakia and Czechia. Notably, the first four countries exhibit negative or near-zero responses, suggesting some countercyclicality on TFP. At the other end of the spectrum, the green group consists of

[8] The graph representation of the correlation is found on annex C1

seven countries: Spain, South Korea, the United Kingdom, Australia, Switzerland, Canada, and the United States. The United States is a notable outlier in this group, with TFP responses significantly stronger than other countries in the sample.

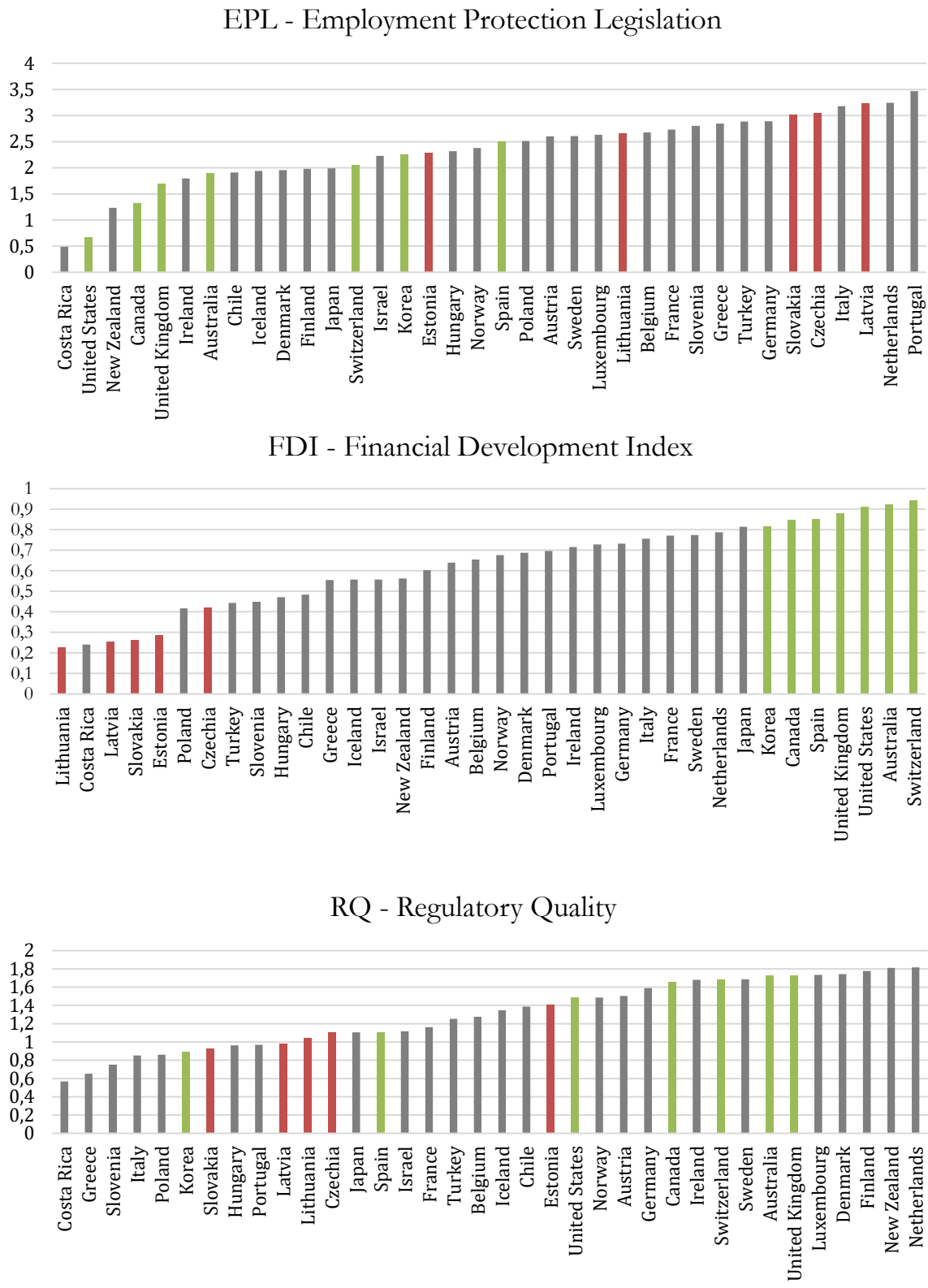
Figure 7: Cumulative TFP responses



This figure displays the cumulative response of TFP to a positive business cycle shock for each country in the sample. Countries are sorted in ascending order based on their cumulative TFP response. The red dots indicate countries whose responses fall below the first quartile (Q1), while the green dots represent countries above the third quartile (Q3). Error bars represent 95% confidence intervals. The dashed horizontal lines indicate the values of Q1 (red) and Q3 (green).
Source: Own elaboration

Considering this, it is crucial to analyse these countries in relation to their institutional frameworks to better understand why their TFP responses behave in this way and to corroborate the results found in the last section. Figure 8 helps with this task by presenting the average value for each main variable of the model (EPL, FDI and RQ) for every country in the sample.

Figure 8: Institutional variable means by country



This figure shows the average values of the three institutional indicators (EPL, FDI and RQ) across countries. Those highlighted in green are below Q1, and those in red are above Q3, as shown in Figure 7.
Source: Own elaboration

All five red-group countries exhibit EPL values above 2.0, with Lithuania, Latvia, Slovakia and Czechia exceeding 2.5, indicating moderate to high labour market rigidity. This rigidity is accompanied by underdeveloped financial systems, as evidenced in the FDI analysis where all five countries fall within the lower spectrum of financial development. Additionally, these countries demonstrate relatively low regulatory quality scores, with the notable exception of Estonia, which ranks closer to the sample median.

These results generally align with the previous section's findings where rigid labour markets and less developed financial systems may constrain firms' ability to respond efficiently to cyclical improvements, thereby dampening or even reversing the expected productivity gains. However, most of these countries stand in contrast to the pattern observed in Figure 6. While the figure suggests that high levels of Regulatory Quality are associated with weaker productivity responses, these countries exhibit low RQ yet still display negative TFP responses.

This apparent contradiction occurs because labour market rigidity and financial underdevelopment create such significant constraints that they override any potential benefits from lower RQ levels. This provides evidence that the institutional framework operates as an interconnected system.

Estonia provides a particularly illuminating case study. Despite having the most flexible labour market among the red-group countries – an unusual characteristic within this set – these advantages are negated by its higher regulatory quality levels, demonstrating how institutional interactions can neutralize individual strengths.

As we progress to the green group, it becomes evident that these countries share similarly high levels of financial development but exhibit greater institutional diversity than the previous group. This variation is most apparent when examining South Korea and Spain's EPL and regulatory quality scores. Both countries demonstrate how institutional trade-offs can work in favour of productivity growth, since their rigid labour markets (high EPL) appear to be fully offset by the benefits of lower regulatory quality. Consequently, their strong TFP responses stem from a combination of robust financial development and this favourable institutional balance. The remaining green-group countries behave similarly to the red group, but in the opposite way. Here, the negative effects of a high RQ are offset by higher financial development and greater labour market flexibility.

Shifting the focus to the United States, the country clearly stands out in the sample due to the magnitude of its productivity response. Analysing the institutional framework of the United States, we find that it exhibits one of the most favourable institutional environments: the second-lowest EPL score, the third-highest FDI, and a Regulatory Quality level that although placed comfortably within the high-RQ group (15th out of 35) is still lower than its closest "rivals" (e.g. Canada).

This institutional configuration creates a particularly powerful synergy. Unlike countries that excel in one dimension while struggling in others, the United States demonstrates how balanced institutional strengths can compound to produce outsized productivity gains. The combination of labour market flexibility, financial development, and moderate regulatory quality appears to create conditions for the United States to have higher productivity growth in a positive shock scenario.

These country-level results suggest that there is indeed a strong relationship between a country institutional framework and how productivity behaves across a cycle. Countries with more flexible labour markets and more developed financial systems tend to exhibit stronger cumulative TFP responses to economic upturns, while more rigid or underdeveloped institutional settings appear to hinder these gains. In relation to the RQ variable, this analysis made it even clearer that, counterintuitively, higher regulatory quality does not lead to high TFP response.

6. Robustness analysis

To ensure the robustness of the main results, we conducted several complementary analyses focusing on two key dimensions: different entropy balancing schemes and alternative institutional variables.

Firstly, using EPL, FDI and RQ as institutional variables, we tested two alternative entropy balancing weights: the ones shown in Figures 4 through 6 (25/75%) and a 33/67% specification. The results obtained with the latter were very similar to those of the former, indicating consistency even with smaller, more restrictive group sizes

Additionally, as presented in the methodology section, other variables were considered to measure the rigidity or flexibility of the labour market. The remaining institutional variables, namely Tax Wedge (TW) and Union Density (UD), were tested together with FDI and RQ. These variables capture different aspects of labour market rigidity and labour cost structures. Still, the results confirm the main pattern. Countries with more flexible institutional environments, characterised by lower UD and TW, tend to display stronger productivity responses across the business cycle.

Finally, to better understand the results surrounding the RQ variable, a different proxy for regulatory quality was used to verify whether the findings hold. For this purpose, the World Bank's Regulatory Quality index was replaced with the Business Freedom index from the Heritage Foundation. This alternative indicator reflects the efficiency of business regulation and the ease of entrepreneurial activity, following a similar logic to the RQ variable in its emphasis on private initiative. The results remain consistent with previous tests using RQ, where the Low group consistently performs better than the High group, which reinforces the robustness of a result that might otherwise seem contradictory.

7. Conclusion

This dissertation has examined the dynamics between business cycles and productivity, with particular emphasis on how institutional frameworks shape this relationship. By addressing two fundamental research questions – how business cycles affect total factor productivity and how institutions influence productivity dynamics across the cycle – this study contributes to our understanding of the mechanisms underlying macroeconomic fluctuations and their implications for economic performance.

This research makes an empirical contribution to the existing literature through its use of an IPVAR model combined with entropy balancing techniques, in a panel sample of 36 OECD countries, with various institutional frameworks, from 2000 to 2019. Prior research has tended to focus either on single-country analyses (e.g., the United States) or on isolated institutional dimensions (e.g., labour market institutions).

The findings suggest that TFP responds positively to a positive business cycle shock, indicating procyclical productivity behaviour. However, this effect is short-lived, dissipating by the third quarter, suggesting that the marginal productivity gains are temporary. Notably, the increase in the TFP variable falls behind the increase in the cycle component of GDP and lasts significantly less time. This answers the first research question directly.

The behaviour of TFP following a positive cyclical shock varies depending on the institutional framework in place. In particular, countries with low employment protection legislation (EPL) exhibit stronger positive TFP responses, while those with high EPL show negative responses—indicating that more flexible labour market institutions may facilitate productivity gains during upswings.

Financial institutions also play a role in shaping productivity dynamics across the cycle. Countries with higher Financial Development Index scores demonstrate more robust positive TFP responses, suggesting that well-developed financial systems support productivity growth in the aftermath of a positive shock.

Interestingly, the results for Regulatory Quality appear counterintuitive. Contrary to theoretical expectations, higher regulatory quality is associated with more constrained TFP responses when controlling for other institutional factors.

Moreover, the individual country analysis reinforces the existence of a strong relationship between institutional frameworks and productivity dynamics over the business cycle.

Countries with more flexible labour markets and well-developed financial systems tend to exhibit stronger cumulative TFP responses to economic upturns, whereas less developed institutional environments appear to dampen these gains. Regarding Regulatory Quality, the country-level results further confirm the counterintuitive pattern observed earlier: higher regulatory quality does not necessarily translate into stronger productivity responses.

These findings also highlight that institutions do not operate in isolation. Rather, the institutional framework functions as an interconnected system, where the combined effects of various institutional dimensions shape macroeconomic outcomes.

Nevertheless, there are some limitations to consider, as they can have an impact on the results presented. First, due to data availability constraints, missing values in the TFP series were interpolated. Although necessary to maintain the panel structure and temporal consistency, such interpolation introduces a degree of estimation uncertainty that may influence the accuracy of the dynamic responses.

Second, several institutional variables underwent transformation procedures to ensure no missing values and suitability for interaction terms. While these transformations were methodologically justified, they may obscure some of the underlying variation or distort the interpretation of institutional effects, particularly in cases where non-linearities or threshold effects are present.

Third, the IPVAR model was estimated with a single lag to preserve degrees of freedom and maintain estimation stability across the relatively short panel. However, this choice may limit the model's ability to fully capture longer-term dynamics or delayed effects, particularly in the case of productivity responses that may unfold over several periods.

Fourth, while this study successfully quantifies the effects of institutions on productivity dynamics across the business cycle, the empirical methodology employed does not allow for the identification of the specific channels or mechanisms through which institutions exert their influence.

Lastly, the analysis primarily focuses on positive cyclical shocks and does not offer a comprehensive assessment of productivity behaviour during recessions. As a result, the asymmetry of responses across different phases of the business cycle remains underexplored.

Future research could build on this study by developing a more comprehensive analysis of productivity dynamics during economic downturns. While this dissertation primarily

focused on positive cyclical shocks, recessions may elicit asymmetric productivity responses. Exploring how different institutional settings influence productivity during periods of contraction could offer important insights into resilience and recovery mechanisms.

Another promising direction lies in gaining a deeper understanding of the role of Regulatory Quality in shaping productivity outcomes. The counterintuitive results observed in this study suggest that the relationship may be more complex than previously assumed.

Furthermore, future empirical research should move beyond quantifying institutional effects to uncover the specific channels through which institutions shape productivity across the business cycle. This requires methodological approaches that can capture the theoretical transmission mechanisms highlighted in the literature – such as resource reallocation, innovation incentives, firm entry and exit, and capital allocation efficiency – and assess their empirical relevance.

This dissertation offers relevant insights for policymakers seeking to enhance productivity across the business cycle. Labour market reforms that promote flexibility should be prioritised to enable more dynamic responses during economic upturns. Strengthening financial systems through expanded credit access is also essential. More broadly, institutional reforms must be approached holistically. Labour, financial, and regulatory policies should be developed in coordination, as part of an integrated strategy, to ensure their combined effect supports productivity growth.

In sum, this dissertation successfully addressed both research questions posed at the outset. It demonstrated that productivity, as measured by TFP, responds positively but temporarily to business cycle upswings, confirming the procyclical nature of productivity. It also showed that institutional frameworks play a significant role in conditioning the magnitude and persistence of these responses.

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Annexes

Annex A

Table A1: Stationarity tests

Variable	Test	p_value	Observations
Cycle_GDP	Levin-Lin-Chu	3,04321E-48	2880
Cycle_GDP	Im-Pesaran-Shin	2,12938E-55	2880
TFP	Levin-Lin-Chu	1,14937E-09	2880
TFP	Im-Pesaran-Shin	1,82826E-05	2880

This table presents the results of applying the two stationarity tests (Levin-Lin-Chu and Im-Pesaran-Shin) to the exogenous variables. All p-values are below the 1% level of significance.
Source: Own elaboration

Annex B

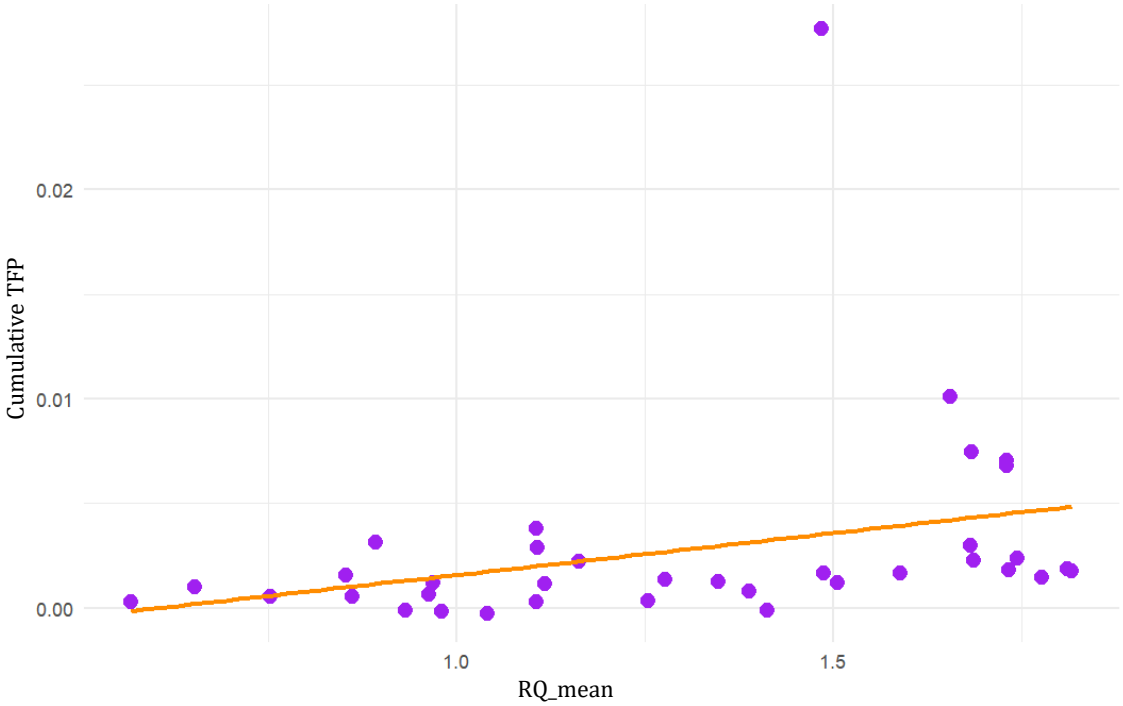
Table B1: Variance decomposition

Variable	Total_Variance	Between_Country	Within_Country
EPL	0,49196	0,47202	0,01994
TW	107,339	104,6498	2,68922
UD	410,022	398,4934	11,5286
FDI	0,04594	0,04394	0,002
RQ	0,16759	0,1371	0,03049
BF	45,2314	39,15991	6,07149

This table shows how the total variance of institutional variables is decomposed into within-country and between-country variation.
Source: Own elaboration

Annex C

Figure C1: Correlation between TFP and RQ



This scatter plot illustrates the relationship between the average Regulatory Quality (RQ_mean) and the cumulative impulse response function (IRF) of Total Factor Productivity (TFP) following a positive business cycle shock. Each dot represents a country, with the x-axis capturing the average Regulatory Quality index between 2000 and 2019 and the y-axis showing the median cumulative IRF of TFP. The orange line represents the fitted linear trend.
Source: Own elaboration