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INSTITUTIONS, GROWTH AND COMPARATIVE ECONOMIC DEVELOPMENT: GEOGRAPHICAL AND METHODOLOGICAL PERSPECTIVES

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Abstract

This dissertation examines the role of institutions in economic growth and comparative development, a topic that has attracted much attention in mainstream economic research. Although there is now a general consensus on the overall importance of institutions, the literature continues to investigate the particular role of each institutional dimension on economic growth and development. This thesis aims to contribute to this area by empirically analyzing different dimensions of institutions in various geographical contexts, using diverse econometric methods. After an introduction that revisits the literature on economic growth and institutions, emphasizing the multidimensional nature of institutions, **Chapter 1** investigates the role of natural resource endowments in economic growth in a cross-country setting under heterogeneous growth paths. It then characterizes this heterogeneity and analyzes it by extending the classical role of institutional quality to a wider range of institutional factors, apart from other well-known transmission channels. **Chapter 2** unravels the specific roles of national and regional institutions in regional economic development in the European context. Considering the multilevel nature of institutions, this analysis is approached through multilevel econometric techniques. **Chapter 3** explores the impact of two significant exogenous changes within the Spanish financing system on regional economic development. This analysis is conducted through case studies in the Basque Country and the Valencian Community, utilizing counterfactual approaches . Finally, the dissertation concludes by analyzing the individual contribution of each chapter and the overall thesis contribution.

Resumen

Esta tesis examina el papel de las instituciones en el crecimiento económico y el desarrollo comparado, un tema que ha atraído mucha atención en la investigación económica dominante. Aunque en la actualidad existe un consenso general sobre la importancia global de las instituciones, la literatura sigue investigando el papel particular de cada dimensión institucional sobre el crecimiento económico y el desarrollo. Esta tesis pretende contribuir a esta área analizando empíricamente diferentes dimensiones de las instituciones en varios contextos geográficos, utilizando diversos métodos econométricos. Tras una introducción en la que se revisa la literatura sobre crecimiento económico e instituciones, haciendo hincapié en la naturaleza multidimensional de las instituciones, **el Capítulo 1** investiga el papel de las dotaciones de recursos naturales en el crecimiento económico en un contexto transnacional bajo trayectorias de crecimiento heterogéneas. A continuación, caracteriza esta heterogeneidad y la analiza ampliando el papel clásico de la calidad institucional a una gama más amplia de factores institucionales, aparte de otros canales de transmisión bien conocidos. **El Capítulo2** desentraña las funciones específicas de las instituciones nacionales y regionales en el desarrollo económico regional en el contexto europeo. Teniendo en cuenta la naturaleza multinivel de las instituciones, este análisis se aborda mediante técnicas econométricas multinivel. **El Capítulo 3** explora el impacto de dos cambios exógenos significativos en el sistema de financiación español sobre el desarrollo económico regional. Este análisis se lleva a cabo a través de estudios de caso en el País Vasco y la Comunidad Valenciana, utilizando enfoques contrafactuales . Finalmente, la tesis concluye analizando la contribución individual de cada capítulo y la contribución global de la tesis.

Contents

List of Tables

List of Figures

Institutions, economic growth and comparative development: an overview

> "Once you start thinking about (growth and development), it's hard to think about anything else."
>
> — Robert E. Lucas

The causes of disparities in economic growth and development between different units is possibly the oldest and most pressing question in economics (Acemoglu et al., 2008b). Why are some countries so much richer than others? What allows certain countries to embark on a path of continuous economic growth while others remain stagnant? Why is there such a large contrast between the prosperity of the West and the poverty of other regions? Even within the same nation, what leads some regions to prosperity and others to underdevelopment?

The neoclassical growth model, based on Solow (1956), postulated that economic growth and differences in per capita output could be explained by capital accumulation and technological progress, where the latter was treated as an exogenous factor. Subsequently, the first modern advances in growth theory came from the work of Romer (1986) and Lucas Jr (1988), who provided a new perspective, suggesting that externalities associated with the accumulation of physical and human capital could lead to continuous steady-state growth. These models, although innovative in their approach, remained within the neoclassical framework, attributing variations in growth rates to differences in preferences and initial resource endowments. Later models, such as those proposed by Romer (1990), Grossman and Helpman (1993), and Aghion

and Howitt (1992), offered a way to internalize steady-state growth and the process of technological innovation within the growth model itself, thereby offering a mechanism for sustained growth driven by endogenous factors. The explanations for disparities in countries' income levels offered by these models were not drastically different from those of the neoclassical models (Acemoglu et al., 2005).

It was not until the seminal contribution of North (1989, 1990) that the role of institutions became the cornerstone for understanding economic growth and comparative development. North's central argument was that capital accumulation, education and innovative capacity were not causes of growth, but growth *per se*, meaning that those factors were the *output* rather than the *input*. According to him, the fundamental driver of differences in comparative development was precisely differences in institutions (Acemoglu et al., 2005). Since North's contributions, the field of institutional economics has experienced exponential growth, leading to a consensus that institutions have a significant influence on economic performance. However, this new approach gave rise to a more complex question: what exactly are institutions?

North describes institutions as follows: *"Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction"* (North, 1990, p.3). These humanly devised constraints, which encompass both formal laws and regulations (such as constitutions, property rights, or political regimes) as well as informal norms (like sanctions, taboos, customs, traditions, and codes of conduct), act as the foundation upon which economic activities are built and conducted (North, 1991). The endogenous nature of institutions reveals the inherent difficulty of empirically capturing their essence and impact. As a product of a society's historical trajectory, cultural context and idiosyncratic circumstances, institutions are deeply embedded in the social tapestry, so unraveling *which* institutions matter, how to capture them and how to attribute their impact on economic growth and development has become a central theme in the empirical economics literature.

A fundamental area of research on the impact of institutions on economic growth is the distinction between economic and political institutions (Flachaire et al., 2014). Economic institutions are those that play a crucial role in the governance of economic activities, i.e., those in charge of facilitating transactions, supporting entrepreneurship, ensuring the proper allocation and distribution of resources as well as that property rights are enforced. Some of the most relevant empirical work in this area highlights

the importance of institutions in protecting property rights and upholding the rule of law, essential factors for economic growth (e.g., Haggard and Tiede, 2011; La Porta et al., 1997, 2008). On the other hand, political institutions, which encompass government structures and political regimes, establish the general framework in which economic agents operate. They shape economic policies and have a profound impact on the distribution of resources. The nature and stability of these political institutions, whether democratic or authoritarian, decisively influence the design and implementation of economic policies (e.g., Colagrossi et al., 2020; Acemoglu et al., 2019).

Another vital area of research concerns the analysis, differentiation and conceptualization of formal and informal institutions (Ahlerup et al., 2009). Formal institutions, characterized by codified and officially sanctioned rules and structures, such as laws and regulations, provide a predictable and structured environment for economic activities. In contrast, informal institutions encompass unwritten social norms, customs, traditions and codes of conduct. These institutions, deeply rooted in the social environment, play a vital role in shaping economic behavior. They include aspects such as social capital, trust, community norms and unwritten business practices. The interaction between formal and informal institutions is a central field of study, as it can significantly enhance or hinder economic development (Casson et al., 2010)

Furthermore, there is a growing body of literature on the differentiation between institutions and policies. Institutions, which represent the frameworks of a society, deeply rooted in historical, cultural and social contexts, evolve very gradually, reflecting the unique trajectory and idiosyncrasies of a society. In contrast, policies are the more dynamic elements, representing specific actions or strategies adopted within this institutional framework, which are inherently more fluid. The attempt to capture and empirically measure the specific impact of both concepts is a hugely significant issue. Some well-known works on this matter are, among others, Ahlerup et al. (2021); Glaeser et al. (2004); Acemoglu et al. (2003); Chang (2010).

Lastly, increasing attention is being paid to the distinction between centralized and decentralized institutions and their impact on economic development, both nationally and regionally.[1] This distinction refers to the location of decision-making power. Centralized institutions consolidate authority at a higher, often national level, while

[1]This categorization of institutions into political and economic, formal and informal, institutions and policies, as well as between centralized and decentralized structures, represents an author-specific classification. It should be noticed that numerous other categorizations can exist.

decentralized institutions distribute decision-making among several levels, including local or regional authorities (Tiebout, 1956; Oates, 1993). Decentralization can increase local participation and responsiveness to local needs, while centralization can ensure uniformity and coordination at the national level. Although the literature has explored in depth the impact of decentralization on growth and development, the analysis of institutions within a *multilevel governance* structure and their effect on economic development is an area that is still relatively nascent Michalopoulos and Papaioannou (2014); Luca (2021); Mitton (2016).[2]

Following the extensive literature on the evaluation of different dimensions of institutions in relation to economic growth and comparative development, this thesis aims to deepen the empirical analysis of how institutions, particularly at different scales of government (national or regional), affect economic outcomes such as growth and economic development, proposing broader ways of analyzing and capturing them empirically through a series of state-of-the-art econometric methods.

Chapter 1 investigates the possible presence of heterogeneous regimes in the natural resource-growth nexus and explores the relative importance of a wide range of institutional factors —such as political, economic, historical and informal institutions— in addition to other well-known transmission channels, that may explain such heterogeneity. To do so, it employs Bonhomme and Manresa (2015) Group Fixed Effect estimator to endogenously identify groups of countries with different time-varying patterns of economic growth that, in addition, exhibit heterogeneous economic response to changes in natural resource wealth. Subsequently, it employs an ordered probit to characterize the identified heterogeneity. The objective is to assess how a number of institutional factors and other key transmission channels influence the likelihood that a country belongs to a group with positive growth outcomes derived from natural resource wealth . This approach represents a departure from previous studies that have typically focused on the empirical examination of a limited number of transmission channels. The results indicate that the effect of natural resources on economic growth is neither exclusively negative nor positive, but varies significantly depending on country characteristics and a complex interplay of multiple factors, especially related to a wide range of institutional frameworks.

This study aims to enrich the understanding of how institutions influence economic

[2]My reference to "multilevel governance" refers to the limited research available on how various institutional levels interact, particularly in the context of regional/local development.

growth in the context of natural resources. It moves beyond the traditional focus on institutional quality, employing a two-stage analysis that considers a wider array of institutional dimensions including political, economic, informal, and historical aspects. This approach allows for a nuanced understanding of which specific institutional factors are crucial in transitioning from a resource curse to a resource blessing, offering a more comprehensive view of the institutional impact on economic development.

Chapter 2 explores the role of institutions in economic development in the European context, focusing on how the quality of government at both the national and regional levels influences economic development. The study recognizes that while institutions are key drivers of long-term comparative development, it is not clear whether national or regional institutions have a more significant impact, especially given the hierarchical structure of regions and countries. The paper proposes a novel approach using multilevel econometric techniques to analyze the relative contributions of national and regional quality of government to regional economic development. It argues that not taking into account the multilevel structure of governance could lead to overemphasizing the influence of regional governance quality, underestimating the impact of national governance quality. The study aims to provide empirical evidence that the overall framework provided by national institutions has a more significant effect on a region's economic development than lower-level government linkages. The research addresses the gap in literature that typically focuses on the links at the same level of government, such as country-country or region-region, without considering the multilevel nature of decentralized governance. It seeks to understand the impact of the quality of government at both the country and regional levels on regional GDP, differentiating between the institutional framework of the state and the implementation of policies at the regional level, in line with the literature of fiscal decentralization.

Chapter 3 examines the institutional design of Spain's asymmetric fiscal decentralization process and its potential contribution to regional disparities. It considers two important changes in the Spanish regional financing system, i.e., the approval of the 2001 model within the *common regime*, and the formalization of the so-called Basque Economic Agreement (BEA) in 2002, as exogenous variations that allow us to identify some of their unintended consequences on regional economic development. From these exogenous changes, we explore two counterfactual scenarios. The first explores the economic trajectory that the Basque Country could have followed if it had been

integrated into the "common regime" instead of operating under the differentiated framework of the BEA. It seeks to assess the cumulative effect of the BEA, together with the region's exclusion from the 2001 model. The second scenario investigates the potential economic development of the Valencian Community under the hypothesis that it received average funding, akin to its peers under the same 'common regime'. This is particularly insightful considering the Valencian Community's position as an underfunded region within the 2001 model. The study employs synthetic control methods and difference-in-differences regression to assess the counterfactual of these changes. It finds that if the Basque Country had been part of the 'common regime' during the evaluation period, its GDP level would have seen a significant decline. In contrast, the analysis indicates that the Valencian Community's status as a notably underfunded region under the 2001 model corresponded with a marked decrease in its GDP per capita.

This study contributes to a deeper understanding of the various impacts that different institutional decisions can have on regional financing models within a decentralized fiscal framework. It highlights how fiscal decentralization policies can lead to significant regional disparities in economic performance. The experiences of the Basque Country and the Valencian Community serve as an example of how regional policies, even within a uniform national institutional framework, can produce diverse economic outcomes. It is an example of how empirical research can isolate the direct effects of policy changes from the broader institutional context, an effort that has been highlighted as difficult but crucial in the existing literature.

I conclude the dissertation with some concluding remarks that outline the individual contributions of each chapter and reflect on how the dissertation as a whole contributes to the literature. It also outlines some of the limitations of the dissertation, as well as policy implications and future lines of research.

This thesis aims to provide empirical evidence on the intricate and multidimensional role of institutions in economic growth and development across diverse geographic scales. To do so, it uses modern econometric methods, such as clustered fixed effects, ordered probit, multilevel techniques, and a quasi-experimental design applying the synthetic control method and differences-in-differences. The focus is on disentangling these effects and placing special emphasis on the role of institutions at different levels of government. This highlights the importance of understanding

governance not only linearly, but also in a multilevel context.

Chapter 1

Disentangling the heterogeneous effect of natural resources on economic growth: widening the role of institutions

1.1. Introduction

The critical role of natural resources in explaining cross-country differences in economic development has always attracted considerable attention in the field of social sciences. The classical economists believed that natural resources abundance brings prosperity (Robinson et al., 2006). However, in the second half of the twenty century, early cross-country analyses began to mount empirical evidence against this notion, suggesting that some resource-rich countries experienced relatively slower economic growth on average than resource-poor ones (e.g., Auty, 1993; Sachs and Warner, 1995, 2001). This phenomenon was seminally coined by Auty (1993) as the "resource curse" hypothesis, which refers to the observation that countries abundant in natural resources, such as oil, gas or coal, tend to perform worse for economic development than countries with limited or no resources. This is, for example, the case of Nigeria, which has remained among the poorest nations in the world, despite enjoying important oil windfalls since the 1960s (Sala-i Martin and Subramanian, 2013).

The literature has identified different transmission channels through which the

resource endowments could operate in the country's economic development to be a curse or a blessing. So, for example, on the negative side, resources booms could appreciate the real exchange rate, resulting in reduced competitiveness and the de-industrialization of other export-oriented sectors (e.g., Corden and Neary, 1982; Corden, 1984). Additionally, windfall gains from natural resources could lead to civil conflicts in fractionalized societies (e.g., Hodler, 2006). On the positive side, good institutional quality could mitigate the negative effects of the resource curse by ensuring that natural resources are managed sustainably and equitably (e.g., Mehlum et al., 2006; Bhattacharyya and Hodler, 2010).

Although substantial research has been devoted to the issue, nowadays there is still no general empirical consensus concerning the resources-growth nexus and the relative importance of the specific transmission channels. Indeed, according to the recent meta-analysis conducted by Havranek et al. (2016), which is based on 43 econometric studies, approximately the 40% of the analyzed studies empirically support the ”resource curse" hypothesis, the 20% finds the opposite, and the remaining 40% of the studies does not find a significant relationship between natural resources and economic development.

We can distinguish three main strands of empirical research on the resource-growth nexus (Badeeb et al., 2017). The first strand mainly involves cross-country analyses, in line with Sachs and Warner (1995) and Sachs and Warner (2001). This type of studies tends to support the "resources curse" hypothesis. The second strand examines the impact of natural resources wealth on certain factors that might be related to growth, such as export diversification (e.g., Tabash et al., 2022), financial development (e.g., Rongwei and Xiaoying, 2020), or different dimensions of institutional quality (e.g., Boschini et al., 2007, Kolstad, 2009, Boschini et al., 2013). The third strand of research comprises studies that question the validity of the "resource curse" hypothesis, addressing the drawbacks of certain econometric approaches and/or highlighting the results' sensitivity to the sample (e.g., Alexeev and Conrad, 2009; James, 2015).[1] Within the two last strands of literature, some recent studies recognise that resources-growth nexus could depend on idiosyncratic characteristics of countries and/or regions. Most of them are focused on examining the relevance of one or few factors that could act as catalysts

[1]For a detailed review of the resource curse literature, see, for example, the surveys conduced by Ross (2015), Badeeb et al. (2017) and Alssadek and Benhin (2023).

or inhibitors of the resources blessing, or investigate the economic impact of natural resources under heterogeneous growth paths (e.g., Cavalcanti et al., 2011; Clootens et al., 2017; Lee and He, 2022; Haseeb et al., 2021).

In this paper we attempt to contribute to the literature by re-investigating the possible presence of heterogeneous resources-growth regimes and jointly exploring the relative relevance of a wide range of factors that may explain such heterogeneity. Specifically, we consider the possibility that countries may present time-varying grouped growth patterns of heterogeneity, and test the hypothesis of whether natural resources endowments are a blessing or a curse depending on the identified grouped growth patterns. To do so, we exploit a panel data of 97 countries over the period 1990-2019 to estimate an augmented version of the Solow growth model by using the Group Fixed Effect (GFE) approach developed by Bonhomme and Manresa (2015). This approach constitutes a flexible estimation procedure that can be useful to endogenously identify groups of countries that have dissimilar time-varying patterns of economic growth and heterogeneous economic responses to natural resources endowments. Later, in a second phase of analysis, we will use an ordered probit to characterize the identified groups of countries from the earlier phase by assessing the extent to which various institutional factors and other transmission channels could affect the likelihood of a given country belonging to the blessed growth groups. Unlike other previous studies focused on empirically examining the relevance of one or a few transmission channels behind the resources-growth nexus, our two-phased approach will enable us to assess and compare the relevance of multiple factors in a simultaneous way. Therefore, within our specific context, characterized by considerable ambiguity surrounding the association between natural resources and economic growth, we believe that our proposed analysis can offer a more comprehensive evaluation of the issue by holistically encompassing the multidimensionality of factors that could explain the heterogeneity in the resources-growth nexus.[2]

The rest of the article is structured as follows. Section 1.2 briefly discusses the relevant literature. Section 1.3 presents the econometric specification and describes the empirical strategy. Section 1.4 presents the data and variables used in the empirical

[2]The methodology followed in this paper has also been applied to control and/or study the cross-country heterogeneity in other economic relationships, such as the debt-growth nexus (Gomez-Puig et al., 2022), the trade-health nexus (Oberlander et al., 2017), or the democracy-growth nexus (Bonhomme and Manresa, 2015), among others.

analysis, and Section 1.5 discusses the estimation procedures and results. Finally, Section 1.6 includes the main conclusions.

1.2. What can drive heterogeneity in the resource-growth nexus?

The relationship between a nations resource abundance and its economic growth can be mediated through complex channels (Papyrakis and Gerlagh, 2004). These channels can either facilitate the conversion of natural wealth into sustained economic growth or, conversely, give rise to the resource curse.

A critical channel through which resource endowments affect the economy is known as the "Dutch disease," a term first coined in the seminal works of Corden and Neary (1982) and Corden (1984). This phenomenon describes how significant earnings from natural resource exports can strengthen a nation's currency, subsequently diminishing the competitiveness of its other export sectors. The economy thus becomes disproportionately dependent on resource industries, leaving the economy vulnerable to commodity price fluctuations, thereby constraining growth, as outlined by Aghion et al. (2009) and van der Ploeg (2011).

The level of development of a country's financial institutions and financial system is pivotal in understanding the resource curse phenomenon. In resource-rich nations, underdeveloped financial institutions can impede the effective management of resource revenues, leading to fiscal imbalances and debt overhang (Manzano and Rigobon, 2001). Weak financial systems also exacerbate corruption and rent-seeking behavior, diverting resource revenues away from public welfare (Bhattacharyya and Hodler, 2014). The lack of financial diversification leaves the economy vulnerable to volatile commodity prices, hindering economic growth (Aghion et al., 2009; van der Ploeg, 2011).

Ethnic fractionalization within a country can also predict whether natural resources are a curse or a blessing. As posited by Hodler (2006), in societies with high levels of ethnic division, resource wealth can fuel conflict among rival groups. This, in turn, undermines productive activities and investment incentives due to weakened property rights and increased uncertainty.

Rent-seeking behaviors present another crucial channel. In nations with fragile institutional frameworks, the influx of resource revenues may induce rent-seeking rather than productive activities, leading to economic inefficiencies (Torvik, 2002).

Institutional strength plays a crucial role in the nexus between resource wealth and economic growth. Political institutions, such as the nature of the political regime (e.g., democracy), indirectly influence economic outcomes by shaping the policies and governance that guide economic activities (Flachaire et al., 2014). These influences are complemented by economic institutions like the rule of law and property rights, which directly impact economic transactions and the utilization of resources (Kolstad, 2009). The interaction between these types of institutions, particularly in managing challenges like rent-seeking and ethnic fractionalization, is vital for understanding how a nation's resource abundance can translate into sustainable economic development[3].

The transmission channels described above are not isolated mechanisms, but are deeply intertwined and often interact in intricate and complex ways. This interaction poses significant challenges in empirically isolating the effects of each channel. In particular, measuring institutional quality is far from trivial, as it embodies a balance shaped by a confluence of historical events, cultural nuances, and even chance occurrences, all of which contribute to the diverse ways in which natural resource abundance influences economic growth trajectories (Voigt, 2012, 2017). In this context, Oded Galor's Unified Growth Theory (UGT) offers a valuable perspective, viewing economic progress within a rich historical, institutional, and cultural web, suggesting that variations in these underlying forces can significantly influence economic trajectories. (Galor, 2011). [4]

In line with this view, Glaeser et al. (2004) argues that most of the indicators of institutional quality used to establish this proposition are conceptually inadequate

[3]According to Kolstad (2009), two principal model types stand out in the context of the resource curse. Rent-seeking models stress the importance of institutions governing the private sector, focusing on how private entities and individuals can exploit resources for economic gain without contributing to overall productivity. In contrast, patronage models emphasize the role of public sector institutions, examining how political figures may use state resources for personal gain and to maintain power. This distinction highlights the diverse institutional approaches necessary for averting the negative impacts of natural resources and underscores the crucial role of both private and public sector institutions in fostering sustainable economic development.

[4]For example, Acemoglu et al. (2001) examine the impact of different types of institutions—extractive versus inclusive—on economic development, illustrating how diverse institutional settings from the outset can lead to substantial long-term disparities. In another vein, Becker et al. (2010) explore how cultural or social norms, such as the concentration of Protestantism in the Wittenberg region, contrasted with its neighbors, contributed to unique socioeconomic developments. This divergence can be partly attributed to the influence of the Protestant ethic, a set of values and beliefs associated with Protestantism, particularly Calvinism, that shaped economic behavior and facilitated the rise of capitalism. These instances exemplify the enduring and intricate influence of institutions and cultural norms, underscoring the challenge in establishing empirical proxies for such multifaceted variables.

for this purpose.[5] Building on this, we argue that, from an empirical point of view, including institutional quality variables without a clear method of capturing other aspects such as informal structures, social capital (Peiró-Palomino and Tortosa-Ausina, 2013, 2015), and enduring historical factors (Lange et al., 2006; Nunn, 2020) makes it difficult to confidently attribute the captured effect solely to institutional quality. The challenge lies in justifying that the effect observed is genuinely due to the influence of institutional quality, rather than inadvertently capturing another factor.

This discussion leads us to a crucial consideration: the measure of institutional quality cannot be effectively isolated without accounting for broader factors such as social capital (culture) historical legacies (different colonial legacies) or even chance. These elements are deeply intertwined with institutional structures, shaping and being shaped by them in complex ways. For instance, Nunn (2007) or Acemoglu et al. (2001) underscore the long-lasting impacts of historical factors, such as colonial rule , on current development, highlighting how past events create path dependencies that shape present institutions. Acemoglu et al. (2008a) challenge the assumption of a direct causal relationship between economic growth and democracy, suggesting that factors influencing both variables are often overlooked, thus complicating the measurement of institutional quality. Alesina and Giuliano (2015) delve into the intricate relationship between culture and institutions, indicating that institutional quality is not only an outcome but also a shaper of cultural elements, including social capital (Bjørnskov and Méon, 2013). Finally, Nunn (2020) reinforces this view by connecting historical events and cultural factors to contemporary economic conditions, suggesting that what might be measured as 'institutional quality' could very well be the end product of a complex interplay of social capital, chance, and deeply ingrained historical legacies.

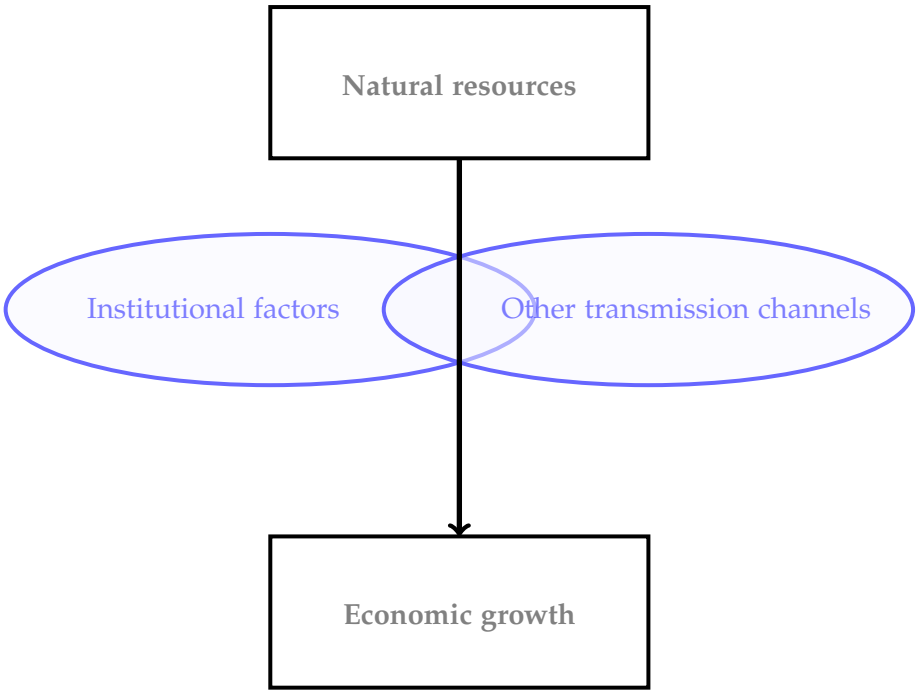
1.3. Empirical strategy

In this paper, we seek to contribute to the empirical literature by revisiting the resources-growth nexus, classifying and characterizing a diverse set of countries based on their potential heterogeneous responses to natural resources rents. To do so, we comprise two sequential stages. In the first stage, we estimate a growth model with the GFE estimator to reexamine the relationship between natural resources and economic growth,

[5]For instance,Balaguer-Coll et al. (2022a) consider efficiency at local level as an alternative proxy for institutional quality.

by exploiting and accounting for the time-varying grouped patterns of unobserved heterogeneity, thereby circumventing the need of dealing with challenging-to-control statistical data. Later, in a second stage, we employ an ordered probit model to delve deeper into the drivers behind the identified heterogeneity. This will enable us to consider various indicators that could serve as proxies for the most widely recognized transmission channels of the resource curse or blessing. We will place particular emphasis on evaluating the role of institutions, aiming to represent their influence from a broader perspective. By recognizing that institutional factors could be multi-faceted, we consider different indicators that reflect the complex nature of institutions ——including aspects of economic institutions, political institutions, cultural influences and historical legacies——. Following this empirical strategy, we strive to provide a more comprehensive understanding of how institutional dynamics contribute to the resource-growth nexus. Figure 1.1 provides an overview of our two-stage empirical strategy.

Figure 1.1: Mechanisms



Black patterns represent the first analysis stage (i.e., resource-growth nexus), while blue patterns denote the second stage (i.e., drivers of the heterogeneous resource-growth nexus).

1.3.1. The resources-growth nexus

The empirical analysis of the resource-growth nexus is traditionally characterized by a high level of heterogeneity in its results Havranek et al. (2016). To overcome this challenge, we begin our analysis by employing the GFE approach proposed by Bonhomme and Manresa (2015) on a Solow growth model augmented with natural resources, aiming to control for grouped time patterns of unobserved heterogeneity that are common within groups of countries. More specifically, in a baseline model we express the annual economic growth rate for a given country i and year t (GR_{it}) as follows:

$$GR_{it} = \beta\ RES_{it-1} + X'_{it}\delta + \theta_i + \lambda_{g_it} + u_{it} \tag{1.1}$$

where RES_{it-1} represents the share of total natural resources rents in GDP, which has been lagged one year to account for the possibility of delayed effects of resources, as highlighted by Havranek et al., 2016; Williams, 2011). Moreover, X'_{it} is a vector of control covariates, including some conventional variables considered in the economic growth literature in a Solow framework (e.g., Forte et al., 2015,Arribas et al., 2020, Papyrakis and Gerlagh, 2004): population growth, physical capital investment, human capital, trade openness, and the inflation rate. Our model also includes time-invariant country effects θ_i and time-variant group effects λ_{g_it}, where countries with the most similar growth patterns, net of covariates, will be endogenously classified into different groups $g_i \in \{1, ..., G\}$, according to an iterative algorithm proposed by Bonhomme and Manresa (2015) that integrates cluster and regression analyses. Finally, u_{it} represents the error term.

In Equation (1.1), the time-invariant country effects θ_i will allow us to control for persistent unobservable heterogeneity across countries, which could result from, for instance, different climatic or geographical conditions that may shape the nation's economic performance. Furthermore, the inclusion of time-variant group effects λ_{g_it} will help us to additionally capture time-varying unobservable heterogeneity that are shared among countries belonging to specific groups. Potential sources of such heterogeneity could be, for instance, underlying processes that are shared among groups of countries, such as the specific decolonization processes (e.g.,Nunn 2007, the expansion of Communism (e.g., Alesina and Fuchs-Schündeln 2007), the rise of totalitarian movements (e.g., Acemoglu et al. 2022), the process of democratization (e.g., Acemoglu and

Robinson 2000), government policies (e.g., Lim, 1994), or shared cultural features in certain countries, such as the prevalence of individualism (Gorodnichenko and Roland 2017; Ang 2019), religious dominance (e.g., McCleary and Barro 2006), or the relevance of family ties (e.g., Alesina and Giuliano 2010).

Therefore, the GFE approach facilitates a more comprehensive assessment of the resource-growth nexus, which is able to alleviate some the limitations associated with using conventional proxy indices and/or a basic fixed effects estimator. Moreover, and more importantly, after identifying groups of countries with specific time-varying patterns of growth, the approach also allows us to evaluate potential cross-group differences in the impact of natural resource abundance on economic growth. To do so, we extend the baseline model from Equation (1.1) by allowing for specific β_{g_i} coefficients by incorporating interaction terms between the explanatory variable of interest, RES_{it}, and a set of group dummy variables (taking the value 1 when the country belongs to the corresponding group and zero otherwise). Interestingly, this extended model will be particularly useful to test the null hypothesis of cross-group homogeneity in the resources-growth nexus, $H_0 : \beta_1 = ... = \beta_G$.

1.3.2. Exploring the potential drivers of the group membership

After evaluating the potential cross-group differences in the influence of natural resource abundance on economic growth, in a next stage we proceed to explore the underlying drivers that could explain the observed group differences in the resources-growth nexus. To do so, we employ the following ordered probit model:

$$g_i^* = Z_i'\alpha + \epsilon_i \tag{1.2}$$

$$g_i = \begin{cases} 1 \text{ if } g_i^* \leq r_0 \\ 2 \text{ if } r_0 < g_i^* \leq r_1 \\ ... \\ G \text{ if } g_i^* > r_{J-1} \end{cases}$$

where g_i^* represents an unobservable latent variable underlying the discrete values

g_i from 1 to G, which have been ordered depending on the ranked list of estimated specific coefficients $\hat{\beta}_{g_i}$ for each identified group including the country i, according to the results obtained from the GFE procedure. The parameters $r_0, r_1, ..., r_{J-1}$ are unknown thresholds in the distribution of g_i^*, which will be estimated with the remaining parameters in Equation (1.2), subject to the constraints that $r_0 < r_1 < ... < r_{J-1}$. Regarding the independent variables, Z_i represents a vector of country characteristics that could drive the group membership. Specifically, we will consider proxy indicators that may help to explore the relevance of multiple transmission channels through which the resource abundance could operate in the country's economic growth, such as the economic, political , and informal institutions, as well as historical legacies, the export concentration, financial development, the degree of ethnic fractionalization or the initial level of development. Finally, ϵ represents the error term.

1.4. Variables and data sources

In the first stage of our analysis, to empirically examine the resources-growth nexus we use annual balanced panel data for 97 countries over the period 1990-2019. The list of the sampled countries, which is displayed in Table B1 from Appendix A, is based on the data availability for the variables considered in the baseline model in Equation (1.1). On the one hand, we have drawn from the World Bank the data for the annual growth rate of real GDP per capita, the total natural resources rents in GDP, the population growth, and the inflation rate. On the other hand, the information on private investment, the human capital index, and the trade openness index has been collected from the Penn World Table (version 10) based on Feenstra et al. (2015). All continuous variables used in Equation (1.1) are expressed in natural logarithms except those that could take negative or zero values. Their definition and their corresponding data sources are summarized in Table 1.1.

In the second stage of the analysis, to evaluate the potential drivers of the group membership, we collect information from the following sources:

We apply a comprehensive approach to understand how various institutional factors interact with natural resources to influence economic growth. This approach is crucial because the relationship between natural resources and economic development is not straightforward and is often mediated by a complex interplay of institutional dy-

Table 1.1: Variables and data sources used in Equation (1.1)

Variable	Definition	Source
GR_{it}	Economic growth rate, measured as the first difference of the logarithm of real GDP of country i at time t (expressed in annual %).	World Bank
RES_{it}	Aggregate country's rents (as a % of GDP) derived from oil, natural gas, hard and soft coal, minerals, and forests.	World Bank
N_{it}	Growth rate of the working age population (annual %) plus a fixed coefficient equal to 5% (representing technological advances and depreciation, in accordance with Mankiw et al., 1992).	World Bank
$log(INV_{it})$	The natural logarithm of the private investment (expressed as % of GDP).	Penn World Table
$log(HC_{it})$	The natural logarithm of the human capital index (annual %), based on the years of schooling from Barro and Lee (2013) and an estimated rate of educational return.	Penn World Table
$log(OPEN_{it})$	The natural logarithm of the trade openness index, defined as the total sum of exports and imports (expressed as % of GDP).	Penn World Table
INF_{it}	Inflation rate (annual %), based on the GDP deflector.	World Bank

namics (Nunn, 2020; Glaeser et al., 2004). By incorporation both formal and informal institutional along with the historical context of colonial legacies in the empirical analysis, we aim to provide a more nuanced understanding of how these diverse elements collectively shape the interaction between natural resources and economic growth, as indicated in section 1.2.

Firstly, to quantify the quality of formal institutions, two measures commonly employed in the literature are used. Specifically, we employ the standardized score of the rule of law from the Worldwide Governance Indicators (RL_i), normalized to a range from 0 to 100, as published by the World Bank (Kaufman and Kraay, 2019). This score reflects the quality of economic institutions in terms of legal frameworks and property rights. Additionally, a standardized democracy index from Polity V (D_i), also normalized to a range from 0 to 100, is utilized to assess the quality of political institutions, capturing the degree of democratic governance and political freedoms within a country. It is reasonably expected that these variables will have a positive impact

on the relationship between natural resources and economic growth, acting as positive mediators in this dynamic. [6]

Secondly, following Bjørnskov and Méon (2015), we measure the level of informal institutions (SC_{it}) as the percentage of respondents in each country who believe that *most people can be trusted*. This data is derived from various waves of the World Values Survey, LatinoBarometro, Asian and East Asian Barometers, and AfroBarometer. It reflects the level of social trust and cooperation, which are vital aspects of informal institutional frameworks.

The work of Ostrom (1990) underscores the horizontal dimension of social capital, emphasizing its critical role in fostering networks of trust and cooperation that are essential for economic transactions and natural resource management. These insights highlight the necessity of considering both formal structures and informal structures/ social dynamics to capture the whole meaning of institutions. Furthermore, this approach also aligns with North's Theory of Institutional Change, highlighting the co-evolution and interdependence of these institutions (Casson et al., 2010). Social trust fosters community cooperation and collective action, underpinning the effectiveness of institutional structures. High levels of trust not only reflect strong informal institutions but are also indicative of effective formal institutions (Alesina and Giuliano, 2015; Bjørnskov and Méon, 2013).[7] Consequently, we expect to find a positive effect of this variable on the relationship between natural resources and economic growth.

Lastly, while our measures for current institutional environment, such as the rule of law, the democracy index and social capital, primarily capture the contemporary framework, we argue that these indicators may not fully reflect the deeper, structural institutional frameworks (Glaeser et al., 2004). These frameworks are often shaped by historical legacies, which exert a lasting influence. Consequently, we have incorporated a set of dummy variables from Barro (1999) to differentiate the impacts of various colonial legacies:

- $SCOL_i$: This variable is used for former Spanish colonies. Historically, Spanish

[6] As previously, discussed, there is a well-established consensus in the literature regarding the pivotal role of institutional quality in altering the relationship between natural resources and economic growth. See, for instance, van der Ploeg (2011)

[7] Alesina and Giuliano (2015) challenge the notion of informal institutions being subordinate to formal ones, emphasizing their complementary and interactive nature. This perspective aligns North (1990), which posits that formal institutions crystallize from informal ones, evolving together through organizational dynamics. These insights highlight the necessity of considering both formal structures and informal cultural and social dynamics to capture the whole meaning of institutions.

colonialism focused heavily on resource extraction and centralized governance. This approach has been noted to significantly influence and economic paths in these nations (Lange et al., 2006). The expected sign might be negative, since these colonies are typically characterized by institutional frameworks that are less conducive to equitable resource distribution and diversified economic development.

- $BCOL_i$: Assigned to former British colonies, this variable helps in examining the impacts of British colonial policies, which were often characterized by trade orientation and the establishment of strong property rights. The British colonial system's relatively less hierarchical structure compared to the Spanish and its emphasis on market-friendly policies and property rights have been observed to lead to different economic outcomes (Acemoglu et al., 2001). We anticipate an ambiguous impact on economic growth and resource management. While British colonialism often emphasized trade orientation and property rights, there is an inherent dichotomy in its approach. In certain regions, British policies prioritized investment in institutions and infrastructure. However, in other areas, the colonial focus was more extractive, concentrating on immediate resource exploitation for the colonial power's benefit (Lange et al., 2006).

- $OCOL_i$: For colonies under other European powers. This category allows us to explore the varied influences of other colonial models, recognizing that each had its unique approach to administration and economic policies. (Nunn, 2007).

Moving beyond institutional variables, our analysis also delves into other potential channels of the resource curse. We use the Theil index of export concentration (EXC_{it}), sourced from the International Monetary Fund, to assess export diversity. Higher values in this index indicate greater concentration, and in line with the Dutch disease hypothesis (van der Ploeg, 2011), we anticipate a negative effect from this variable. Additionally, we consider financial development (FD_i), measured by the standardized volume of domestic credit to the private sector as a percentage of GDP, which is expected to show a positive effect (Damette et al., 2023).

Furthermore, following Hodler (2006) we incorporate the historical index of ethnic fractionalization (Drazanova, 2020) to assess internal conflicts and societal diversity within countries. This variable is expected to have a negative effect. Finally, a dummy

variable for countries in the lowest quartile of GDP per capita in 1990 is also included, serving as a proxy for initial low development. We expect negative impact, since these countries often struggle with inadequate infrastructure and market access limitations, which hampers efficient exploitation and management of natural resources, leading to sub-optimal economic benefits (Auty, 2001).

In this second stage, it is necessary to work with a cross-sectional data structure since the group membership, which constitutes our dependent variable in Equation (1.2), is time-invariant. To address this, longitudinal independent variables are converted to cross-sectional data by averaging over time, which also helps in handling incomplete time series. Furthermore, all independent variables with continuous values in Equation (1.2) are standardized to facilitate comparability and enhance interpretability of the outcomes. Table 1.2 provides an overview of variables and data sources used in this last stage.

1.5. Estimation procedures and results

1.5.1. The resources-growth nexus

To estimate Equation (1.1), we firstly swipe off the time-invariant country effects by expressing the model in deviations with respect to the temporal means, considering $\ddot{GR}_{it} = (GR_{it} - \overline{GR}_i)$, $\ddot{RES}_{it} = (RES_{it} - \overline{RES}_i)$, $\ddot{X}_{it} = (X_{it} - \overline{X}_i)$, and $\ddot{\lambda}_{g_it} = (\lambda_{g_it} - \overline{\lambda}_{g_i})$. Then, the GFE estimator in the transformed model is defined as follows:

$$F(\hat{\beta}, \hat{\delta}, \hat{\lambda}, \hat{\gamma}) = \underset{(\beta,\delta,\lambda,\gamma)\in\Theta\times\mathcal{A}^{GT}\times\Gamma_G}{\arg\min} \sum_{i=1}^{N}\sum_{t=1}^{T} \left(\ddot{GR}_{it} - \beta\, \ddot{RES}_{it-1} - \ddot{X}'_{it}\delta - \ddot{\lambda}_{g_it}\right)^2 \tag{1.3}$$

where the minimization of the function is taken over all possible groupings $\gamma = \{g_1, ..., g_N\} \in \Gamma_G$ of the N countries into G groups, time-variant group effects $\lambda_{g_it} \in \mathcal{A}$, and parameters $\{\beta, \delta\} \in \Theta$. Under this framework, the best group assignment for each country is then given by minimizing the following least-squares function:

$$\hat{g}_i(\beta, \delta, \lambda) = \underset{g_i\in\{1,...,G\}}{\arg\min} \sum_{t=1}^{T} \left(\ddot{GR}_{it} - \beta\, \ddot{RES}_{it-1} - \ddot{X}'_{it}\delta - \ddot{\lambda}_{g_it}\right)^2 \tag{1.4}$$

where $\hat{g}_i$ represents the estimate of the group membership for each country which is time-invariant. Later, we apply the simple iterative algorithm proposed by Bon-

Table 1.2: Variables and data sources used in Equation (1.2)

Variable	Definition	Source
RL_i	Standardized score of rule of law.	World Bank
D_i	Standardized democracy index.	Polity V
SC_i	Standardized percentage of respondents in each country who claim that *most people can be trusted*.	World Values Survey, LatinoBarometro, Asian and East Asian Barometers, Afro-Barometer, and Danish Social Capital Project
$SCOL_i$	Dummy variable for former Spanish colonies.	Barro (1999)
$BCOL_i$	Dummy variable for former British colonies.	Barro (1999)
$OCOL_i$	Dummy variable for other former colonies.	Barro (1999)
EXC_i	Standardized Theil index of export concentration in each country.	International Monetary Fund
FD_i	Standardized volume of domestic credit to private sector, as a percentage of of GDP.	World Bank
EF_i	Standardized historical index of ethnic fractionalization.	Drazanova (2020)
LD_i	Dummy variable for countries in the first quartile of GDP per capita in 1990, as a measure of initial low development.	World Bank

In Equation (1.2), the longitudinal independent variables have been constructed by collapsing the corresponding available data at the country level between 1990 and 2019, by using the temporal means.

homme and Manresa (2015) to estimate the parameters β, δ, and λ_{g_it} by minimizing the following expression:

$$F(\hat{\beta},\hat{\delta},\hat{\lambda}) = \underset{(\beta,\delta,\lambda)\in\Theta\times\mathcal{A}^{GT}}{\arg\min} \sum_{i=1}^{N}\sum_{t=1}^{T}\left(\ddot{GR}_{it} - \beta\, \ddot{RES}_{it-1} - \ddot{X}'_{it}\delta - \ddot{\lambda}_{\hat{g}_i(\beta,\delta,\lambda)t}\right)^2 \tag{1.5}$$

We have selected the optimal number of groups based on the Akaike information criterion (AIC), which suggests $G = 6$ in our sample. Table 1.3 presents the corresponding GFE estimated results from different versions of Equation (1.1). The first

column of the table reports the estimates generated from our baseline specification (with common parameters β), while we present in the second column those derived from the extended specification (considering idiosyncratic parameters $\beta_{g_i t}$). In both cases, the GFE estimates use the six identified groups of countries (in Table B2 from Appendix A we present the detailed list of countries that have been endogenously classified in each group by using the approach proposed by Bonhomme and Manresa (2015)). According to the baseline model estimates, the annual growth rate of real GDP per capita is positively associated with the natural resources abundance. Specifically, we find that, holding constant other factors, a 1% raise in the share of total natural resources rents to GDP increases the economic growth rate by 0.023%. This effect is statistically significant at the 10% level, which provides empirical evidence against the natural resource curse hypothesis for the whole panel of countries. With regard to the estimated coefficients associated to the control covariates, we can observe that most of them are statistically significant and exhibit reasonable signs as expected by the economic growth literature. Indeed, we find that the private investment share, the openness index, and the human capital index are positively related with the economic growth, with the two former variables being statistically significant at least at the 5% level. In contrast, our results suggest that the population growth and the inflation rate are negatively related to the economic growth, being their corresponding linkages statistically significant at the 1% level.

According to the estimates from the extended version of Equation (1.1), the results presented in the second column of Table 1.3 indicate that there exists certain degree of heterogeneity in the economic growth response to natural resources abundance. As can be seen, we can reject the null $H_0 : \beta_1 = ... = \beta_6$ at any conventional level of significance. Then, the economic impact of natural resources could critically depend on the group to which each country in the sample belongs. To be more precise, according to the estimated coefficients $\hat{\beta}_{gi}$, we find that a 1% raise in the share of total natural resources rents to GDP leads to the following changes in the economic growth rates for each identified group of countries: -0.571% for Group 1, -0.040% for Group 2, -0.012% for Group 3, 0.052% for Group 4, 0.071% for Group 5, and 0.179% for Group 6. Finally, regarding the estimated outcomes related to the control covariates, they are overall consistent with those obtained in the baseline approach.

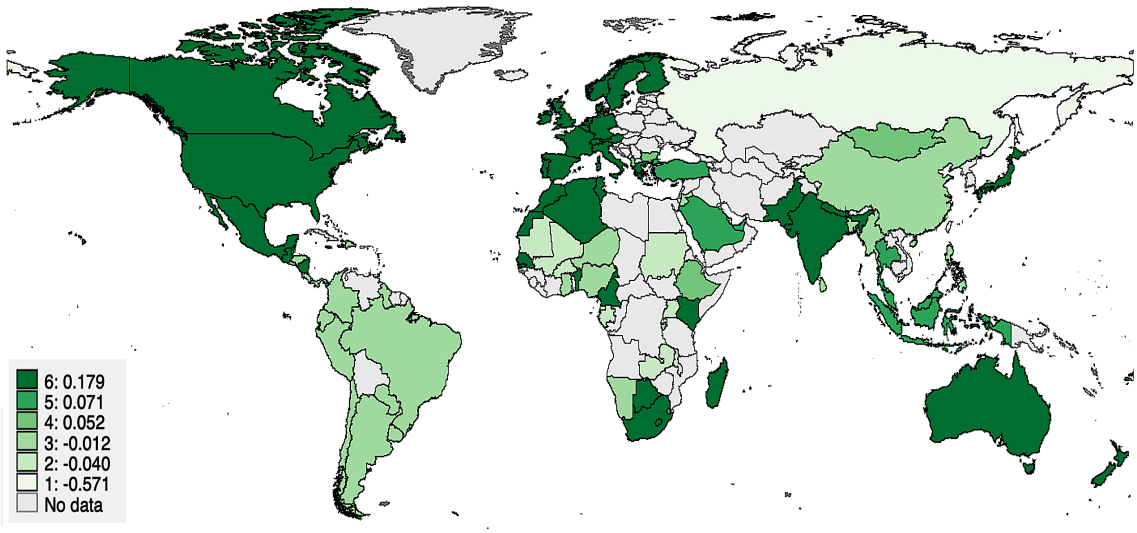
Table 1.3: GFE results from different versions of Equation (1.1)

Variable	(I) Baseline model	(II) Extended model
RES_{it-1}	0.023*	
	(0.014)	
$RES_{it-1} \times Group1$		-0.571**
		(0.008)
$RES_{it-1} \times Group2$		-0.040***
		(0.004)
$RES_{it-1} \times Group3$		-0.012*
		(0.006)
$RES_{it-1} \times Group4$		0.052***
		(0.004)
$RES_{it-1} \times Group5$		0.071***
		(0.006)
$RES_{it-1} \times Group6$		0.179***
		(0.004)
N_{it}	-0.779***	-0.806***
	(0.086)	(0.145)
$log(INV_{it})$	2.116***	2.258***
	(0.214)	(0.213)
$log(HC_{it})$	0.270	0.057
	(1.274)	(2.461)
$log(OPEN_{it})$	0.679**	0.612**
	(0.211)	(0.213)
INF_{it}	-0.0009***	-0.001***
	(0.0003)	(0.001)
Time-invariant country effects (θ_i)	Yes	Yes
Time-variant group effects (λ_{g_it})	Yes	Yes
Observations	2909	2909
AIC	13732.21	13691.92
Adj. R-sq	0.4849	0.4909
Joint significance of θ_i	6.37 [0.000]	6.38 [0.000]
Joint significance of λ_{g_it}	9.83 [0.000]	9.74 [0.000]
$H_0 : \beta_1 = ... = \beta_6$		7.28 [0.000]

The regressions have been obtained with the algorithm 1 proposed by Bonhomme and Manresa (2015). Clustered standard errors by groups of countries are presented in parentheses, while p-values are in brackets. * p<0.10, ** p<0.05, *** p<0.01.

Figure 1.2 displays on a world map the magnitude of the estimated coefficients $\hat{\beta}_{g_i}$ from the extended version of Equation (1.1) by the identified groups of countries, which represents the heterogeneous impacts of natural resource abundance on economic growth. Specifically, we have ranked the six identified groups of countries based on their respective estimated impacts, ordering from the most negative effect (i.e., Group 1), encompassing intermediate effects, to the most pronounced positive effect (i.e., Group 6). As can be seen, the estimated groups appear to exhibit certain degree of spatial clustering. For instance, the abundance of natural resources tends to have a negative impact on the economic growth of those countries located in Northeastern Asia, Central Africa and South America. In contrast, the group characterized by a positive economic impact of natural resources abundance (i.e., $g_i = 6$) predominantly consists of more developed countries, specially involving those from Europe, Southeastern Asia, North America, South Oceania, and both Northern and Southern Africa [8].

Figure 1.2: The estimated impact of natural resources rents on economic growth by groups of countries



Own elaboration based on the GFE estimated coefficients $\hat{\beta}_{g_i}$, according to the extended version of Eq. (1.1).

[8] The membership of the group is not presumed to exhibit a specific spatial pattern, and the geographic relationship evident on the map is solely a byproduct of the estimation process (Bonhomme and Manresa, 2015)

To maintain conciseness, the estimated coefficients for the time-invariant country effects (θ_i) and the time-variant group effects (λ_{g_it}) have not been presented in Table 1.3. However, according to the diagnostic test results at the bottom of the table, both effects are jointly significant at any conventional level, in both the baseline and extended specifications from Equation (1.1). This justifies the use of the GFE estimator, over other approaches.[9] Additionally, in Figure 1.3 we display the estimated coefficients of the time-varying group heterogeneity, along their corresponding 90% confidence bands, considering the results from the extended version of Equation (1.1).

Overall, the results from the first stage of our analysis strongly indicate that employing GFE is particularly adept at capturing the heterogeneity inherent in the resource-growth relationship. This model's major strength lies in its dual capability of controlling both time-invariant country effects and time-variant group effects. It enables us to account for country-specific influences while simultaneously managing within-group variations. This two-level approach is essential for unraveling the intricate impacts of natural resources across diverse economic contexts.

Furthermore, the GFE model is pivotal in identifying the heterogeneous responses to natural resource abundance among different country groups. This identification challenges the often-implied 'one-size-fits-all' notion prevalent in the literature on natural resources and economic growth . More than a mere statistical categorization, the grouping of countries based on their resource-growth response serves as a critical foundation for the second phase of our analysis. In this subsequent stage, we delve deeper into understanding the unique characteristics and underlying factors that drive the divergent responses observed among these groups. By doing so, we aim to uncover the reasons behind the varying impacts of natural resources on economic growth.

[9]For comparative purposes, in Table B3 from Appendix A we present additional results derived from the baseline model described in Equation (1.1) by using the ordinary least squares (OLS) and the fixed effects (FE) estimators. The AIC values of these two estimates are higher than those associated with the GFE estimator, indicating a better model fit for our data using this latter estimator. Additionally, both OLS and FE estimates, which do not account for the potential presence of time-varying group heterogeneity, fail to provide evidence of a significant resource-growth nexus. This outcome underscore the critical importance of employing an appropriate estimator like GFE, which controls for time-varying group characteristics that may be unobserved when investigating the economic impact of natural resources in a multi-country context.

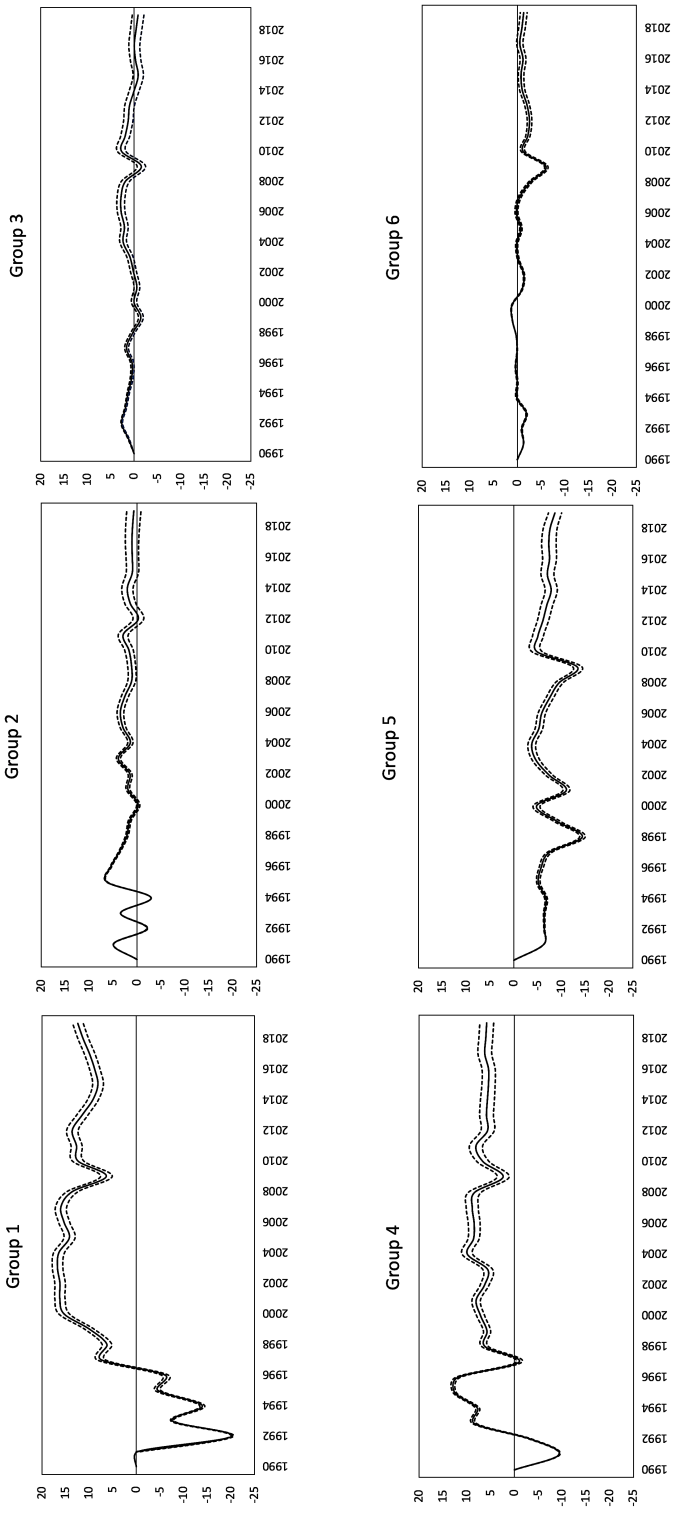


Figure 1.3: Estimated coefficients of the time-variant group effects, $\hat{\lambda}_{g,t}$, according to the extended version of Equation (1.1)

The solid lines represent the estimated coefficients, while dashed lines denote the corresponding 90% confidence bands.

1.5.2. Exploring the potential drivers of the group membership

Table 1.4 presents the maximum likelihood estimated coefficients from different versions of the ordered probit model from Equation (1.2). The first ten columns of our results table presents the estimated coefficients for restricted models, where each specific independent variable has been individually considered. Remarkably, all these coefficients exhibit the expected sign, indicating a consistent alignment with our theoretical predictions. Starting from the variables that capture a broad understanding of institutional settings, we find that the different coefficients associated to rule of law, democracy, and social capital display a positive association with the groping order, suggesting that higher values in these areas correspond to a movement towards groups with a more positive impact of natural resources on economic growth. Conversely, the coefficients associated to the countries' colonial past are not statistically significant.

Table 1.4: Results from the ordered probit considering different versions of Equation (1.2)

	Restricted models										Unrestricted model
	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)	(X)	(XI)
RL_i	0.852***										0.378**
	(0.148)										(0.173)
D_i		0.502***									0.266***
		(0.148)									(0.084)
SC_i			0.379***								0.163**
			(0.052)								(0.07)
$SCOL_i$				-0.545							-0.323
				(0.427)							(0.612)
$BCOL_i$					-0.013						0.243
					(0.190)						(0.411)
$OCOL_i$						-0.454					0.674
						(0.317)					(0.657)
EXC_i							-0.586***				-0.296**
							(0.156)				(0.129)
FD_i								0.741***			0.159***
								(0.205)			(0.059)
EF_i									-0.351**		-0.186
									(0.197)		(0.135)
LD_i										-0.807*	-0.015
										(0.456)	(0.495)
Observations	97	88	82	94	94	97	93	94	84	97	75
Countries in group 1	2	2	1	2	2	2	2	2	2	2	1
Countries in group 2	9	8	6	8	8	9	8	8	8	9	6
Countries in group 3	27	25	23	26	26	27	25	26	26	27	23
Countries in group 4	4	3	3	3	3	4	3	3	3	4	3
Countries in group 5	8	7	7	8	8	8	8	8	7	8	6
Countries in group 6	47	43	42	47	47	47	47	47	38	47	36
Pseudo R2	0.142	0.069	0.035	0.012	0.001	0.01	0.088	0.109	0.034	0.036	0.198

Clustered standard errors by groups of countries are presented in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

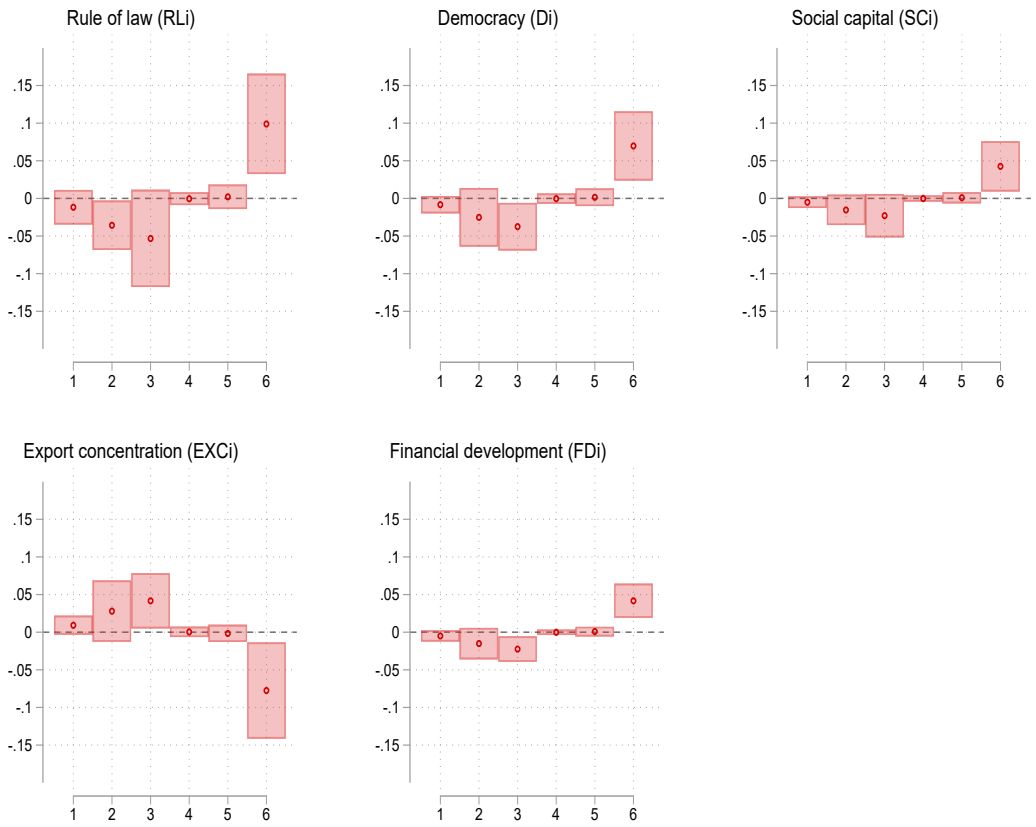
Moving beyond the initial variables related to institutional settings, our analysis extends to other key transmission channels. Our findings reveal varied impacts also aligned with our theoretical predictions. The negative effect of export concentration aligns with the concept of Dutch Disease, where reliance on resource exports can harm other economic sectors. Financially developed countries exhibit a positive effect, supporting the view that underdeveloped financial institutions can hinder effective resource revenue management. In contrast, countries with high levels of ethnic division display negative effects, suggesting that resource wealth in such contexts may exacerbate conflicts among rival groups. Lastly, we observe negative association with being classified as a low-income country in the 1990s. This finding underscores the persistent challenges these economies face in effectively utilizing natural resources for growth, largely due to their developmental stages and structural constraints, such as inadequate infrastructure and market access limitations .

Finally, column (XI) displays the unrestricted version of Equation (1.2) to assess the joint relevance of potential drivers of group membership. By including all the independent variables in the model, their conditional impact can be assessed holistically. According to our findings, the rule of law, democracy index, social capital, export diversification and level of financial development are statistically significant at the 5% and in line with theoretical expectations. This offers a robust perspective on the determinants of group categorization, highlighting the multifaceted nature of these influences in the context of economic growth and natural resource utilization.

Although the sign and statistical significance of the estimated coefficients in an ordered probit are similar to the linear regression interpretation, the magnitude of the coefficients cannot be straightforwardly interpreted. Then, to provide a scale interpretation of the estimated results from the unrestricted version of Equation (1.2), we compute and report in Figure (1.4) the corresponding average marginal effects for each of the statistically significant explanatory variables at the 10%. As can be seen, a one standard deviation rise in the country's rule of law leads to a 11.2% increase in the probability of belonging to the group $G = 6$, characterized by the most favorable impact of natural resource rents on economic growth. Conversely, it significantly decreases by 4% the country's probability of belonging to the group $G = 3$, where natural resources rents have exhibited a moderately adverse effect on economic growth. Similar patterns are found for the democracy index, where an equivalent change in

this variable is associated with a significant increase of 7% (decrease of 4%) in the probability of belonging to the group $G = 6$ ($G = 3$). The same is true for social capital and financial development, where a one standard deviation increase in that variable significantly raises by 4% the probability of being in the group $G = 6$. Finally, regarding the remaining significant transmission channels, it is found that one standard-deviation increase in the export concentration (financial development) is associated to a 7% decrease (4% increase) in the probability of belonging to the group $G = 6$, while it increases by 4% (decreases by 2.5%) the probability of belonging to the group $G = 3$.

Figure 1.4: Average marginal effects from the unrestricted Equation (1.2)



Values on the vertical y-axis represent the average marginal effects (red dots) with their 90% confidence intervals (red boxes), while values on the horizontal x-axis correspond to the groups of countries G.

Our results suggest that both economic and political institutions play a crucial role

in transforming the resource curse into a potential blessing. Economic institutions establish the necessary conditions for effective resource management, while political institutions lay the groundwork for these economic structures to function optimally. In this line, we also observe a significant role of social capital in the efficient allocation of natural resources to stimulate growth. This fact, stress the coevolution between formal and informal institutions. Interestingly, our results also indicate that, the impact of long-lasting colonial legacies on the relationship between natural resources and economic growth is insignificant.

In examining transmission channels beyond the institutional framework, we find that export diversification and private sector financial development are instrumental in reversing the resource curse. Contrary to initial expectations, neither ethnic fragmentation nor the initial low-level of development significantly influences this relationship. This aligns with previous literature emphasizing the importance of strong institutions in managing fractionalized societies. Once the multifaceted institutional dimensions are accounted for, factors such as ethnic fragmentation and initial development levels do not materially impact the effective management of natural resources. This underscores the primacy of a robust institutional setting in harnessing natural resources for economic prosperity.

1.6. Conclusions

This study undertook an empirical investigation to unravel the complex relationship between economic growth and natural resources, a topic that has long attracted the attention of both economists and policymakers. In the first stage of our analysis, leveraging a panel dataset of 97 countries from 1990 to 2019 and employing the GFE estimator (Bonhomme and Manresa, 2015), we endogenously identify different groups of countries with distinct growth patterns and heterogeneous responses to natural resource endowments. This categorization lays a fundamental groundwork for the second phase of our analysis, where we explore with an ordered probit model the distinct characteristics and potential driving factors behind the heterogeneous groups' responses observed in the earlier stage. Unlike prior studies on the issue focused on a limited set of driving factors, the two-stages approach adopted in this work enables the simultaneous evaluation and comparison of the relevance of multiple potential influences. By doing so, we aim to provide a more comprehensive understanding of

the resource-growth relationship.

Our results suggest that the impact of natural resources on economic growth is not unilaterally negative or positive but varies considerably based on a country's unique characteristics and an array and the interplay of various factors. Specifically, we find that both economic and political institutions and social capital are vital in transforming the potential resource curse into a blessing. While the economic institutions are crucial for establishing the right conditions for resource management, the political institutions create an environment where these economic structures can operate effectively. Additionally, the role of social capital in resource allocation further reveals the importance of accounting for both, formal and informal institutions. Notably, our results also suggest that the impact of long-standing colonial legacies on the relationship between natural resources and economic growth is negligible.

Finally, beyond the realm of institutions, we also find that export diversification and financial development within the private sector play pivotal roles in mitigating the resource curse. Conversely, neither ethnic fragmentation nor initial levels of development significantly affect this relationship, once institutional factors and other transmission channels are accounted for. This aligns with the broader literature, highlighting the overriding importance of strong institutional frameworks in managing diverse societies and leveraging natural resources effectively for economic prosperity.

Chapter 2

On the relative contributions of national and regional institutions to economic development

2.1. Introduction

Institutions are recognized as a fundamental driver of economic growth and long-term comparative development (Acemoglu et al., 2005; Economides and Egger, 2009). However, the crucial influence of good institutions on the economic development of a state was largely overlooked until the 1990s, when North (1990) developed his seminal definition of institutions.[1]. Since then, scholars have attempted to clarify the relationship between good governance and economic development, as the often high residuals from growth regressions led many scholars to look for other drivers of economic performance (Tabellini, 2010; Rodríguez-Pose, 2013; Persson and Tabellini, 2021).

Despite this current broad consensus on the importance of institutions, it is less clear which institutions matter the most (Rodríguez-Pose, 2013). Is it the rules of the game[2] or the actual policies that matter? Are national or regional institutions more relevant? Does the answer to the last question vary according to the level of decentralization?

[1]North defines institutions in the following way: "Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction" (North, 1990, p.3).

[2]According to North (1990), the rules of the game are the social mechanisms that shape and limit the behavior of economic agents and define how power is exercised and distributed.

From a theoretical standpoint, there exists some consensus that not all institutions contribute uniformly to economic growth and development (Acemoglu et al., 2003; Klomp and de Haan, 2009). According to Tylecote (2015), "variations in macroeconomic performance among economies are more convincingly and durably explained by (for example) the institutions of the financial system and of corporate governance, than by the choice of monetary policy". Based on this premise, it seems plausible to posit that (for instance) the institutional framework within which a regional authority legislates is heavily influenced by the national administration's framework, suggesting that although policies may differ across regions, they share the same institutional framework i.e. democracy versus dictatorship, security of property rights, similar transaction costs and equivalent welfare state. This consideration naturally leads to the question of the particular impact of each level of government and its quality (in a context in which governance is increasingly being organized on multiple levels across countries Hooghe and Marks, 2003) on the economic development of a given territorial level.

However, the literature evaluating the effect of institutions on economic development has to date generally focused on the links at the same level of government, namely, country-country (national institutions $\rightarrow$ national output), or region-region (regional institutions $\rightarrow$ regional output). Notable examples exist not only at the country (e.g., Rodriguez-Pose and Ezcurra, 2010) and regional levels (e.g., Rodríguez-Pose, 2013), but also at the municipal level (e.g., Balaguer-Coll et al., 2022b; Rodríguez-Pose and Zhang, 2019). But for a more precise evaluation of how the quality of institutions at different levels of government affects GDP, ideally we should explicitly consider the multilevel nature of decentralized governance. This means that while sub-national level institutions can impact sub-national output through their policies, the fact that they operate within a larger institutional framework makes it challenging to determine which institutions, whether regional or national, have a greater impact on overall output

Accordingly, in this work, we consider two levels of government, the country level and the regional level, to understand the impact of each level's quality of government on the GDP of the regions. We understand that, in our context, the quality of government at the country level is proxied by the institutional framework of the state (i.e., the rules of the game referred to above), and the quality of government at the regional level

by the (successful) implementation of policies[3], in line with the literature of fiscal federalism (Tanzi, 2008). We develop this conceptualization in the following paragraphs to shed light on our understanding of what each governance indicator—national and regional—represents in the model.

We consider that this comprehensive view of the effect of government quality on regional economic development, in which the impacts of both national and sub-national factors are intertwined, calls for a different empirical strategy that explicitly takes into account the multilevel organization of government. We rely on *multilevel* econometric methods (Lago-Peñas and Lago-Peñas, 2010; Schilpzand and de Jong, 2021) to offer a natural and integrative approach to model the *multilevel* impact of quality of government. We consider that these methods can be particularly appropriate in our context for both econometric and economic theory reasons.

On the econometric point of view, since quality of government at the regional level can be highly dependent on government quality at the country level and, consequently, there is a possibility that the residuals will be correlated, the regression model needs to be modified accordingly since the likely existence of heteroskedastic errors implies that OLS is no longer the estimator with the smallest variance (Wooldridge, 2010). Figures 2.1a, 2.1b, 2.1c and 2.1d, corresponding to the Worldwide Governance Indicators (countries) and the European Quality of Government Index (regions) offer an illustrative example of this correlation. Visually, the quality of national government shows similar results when measuring institutional quality at the regional level, even when different moments of time are considered, therefore supporting the idea of high correlation between a given level of national government quality and the level of government quality at the regional level. One potential methodological solution could be to include fixed effects in a single-level regional regression to account for country and regional idiosyncrasies (i.e., unobserved heterogeneity).[4] However, this does not provide enough information about the effect of national quality of government on regional economic performance, since this approach omits relevant information about the intertwining of these two levels of government.[5] This is because in a fixed effect

[3]Although, ideally, a third level corresponding to municipalities would also be welcome, the difficulties in finding relevant and comparable data across countries for this level of government has prevented us from doing so for the moment.

[4]See Corrado and Fingleton (2011).

[5]Should we be interested in the role of some national variable apart from the regional ones (as in our case), the inclusion of fixed effects would cancel out their effect in a given year, since a given value of,

model at the regional level, the inclusion of a given country-level variable would result in its effect being canceled out for a specific year. This is due to the fact that the quality of the central government has the same value for all regions within the country, thus rendering the model unable to capture the within-cluster variability.

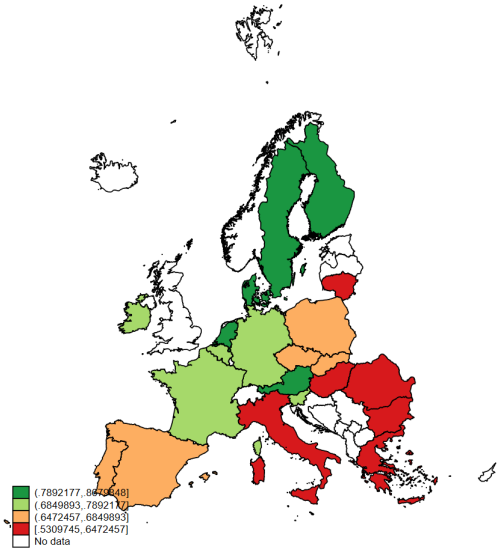
On the other hand, from an economic theory point of view, the motivation for this approach lies in previous studies such as, for instance, Luca (2021), who considers that "while many national states have lost part of their powers and authority with globalization and devolution, they yet frequently remain powerful actors in shaping sub-national economies" (Luca, 2021, p.830).[6] In addition, and motivated by some strands of the institutional economics literature, we should also bear in mind that it is the collective choice process driven by political institutions that may determine economic differences in the long run (Acemoglu et al., 2003; Rodrik et al., 2004; Colagrossi et al., 2020), i.e., it is not the actual policies that matter in the economic development of a state/region but rather the institutional framework in which economic actors operate—rules of the game, transaction costs etc.

for example, the quality of government at the national level is common for all regions in the country in that same year.

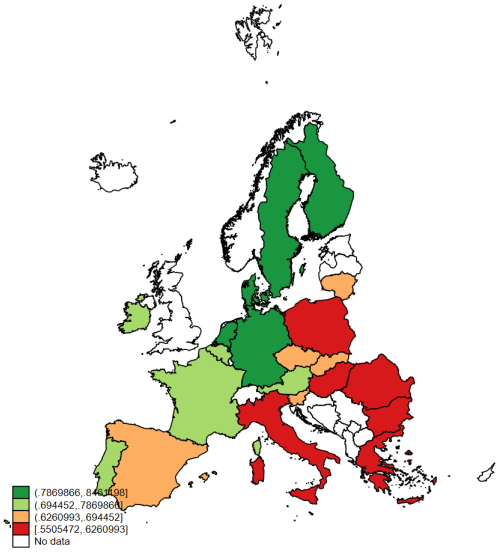
[6] See also Coyle and Sensier (2020).

Figure 2.1: Institutional Quality at National and Regional Level

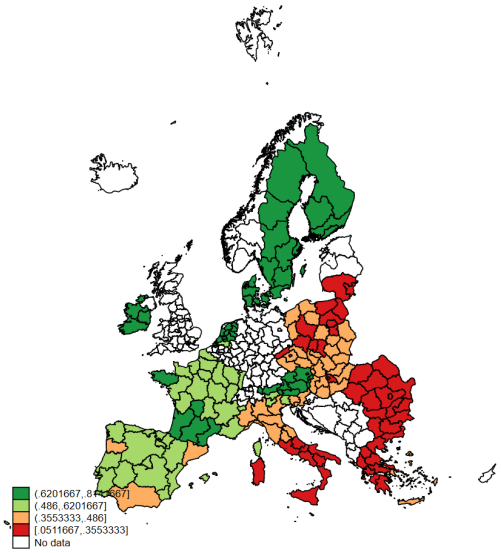
(a) Worldwide Governance Indicators. NUTS0 (European countries), 2010



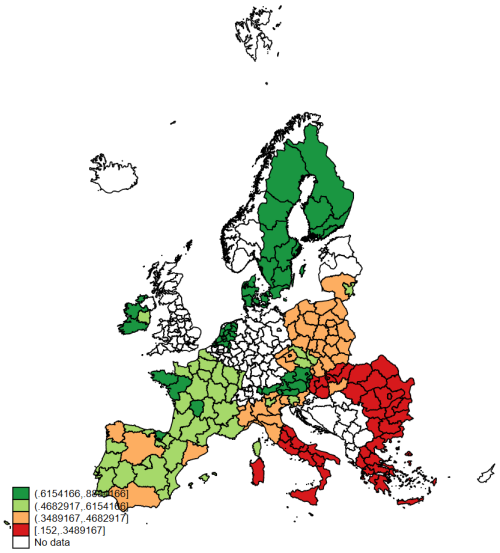
(b) Worldwide Governance Indicators. NUTS0 (European countries), 2010



(c) European Quality of Government Index. NUTS2 European regions in 2010



(d) European Quality of Government Index. NUTS2 European regions in 2019



Following these strands in the literature, and assuming that regional regulations are part of the same country legislative framework where the collective choice,[7] informal institutions and rules of the game are already established, the inclusion of more aggregated indicators of government quality will cancel out the effect of a more disaggregated unit of government, since the more aggregated indicator would be proxying the institutional framework and the more disaggregated institutions might reflect the effect of actual policies. In this scenario, the former effect would correspond to North's (1990) rules of the game, whereas the latter would be capturing the role of public goods providers, which is strongly emphasized in the devolutionist discourse of fiscal federalism. In essence, our point is that, although the territorial structure and powers attached to each level of government differ greatly across countries, lower levels usually emerge as the best providers of public goods (Balaguer-Coll et al., 2010a,b; Rodríguez-Pose and Bwire, 2004; Oates et al., 1972; Ezcurra and Rodríguez-Pose, 2013; Tiebout, 1956), whereas national governments are the guarantors of the rules of the game (Hooghe and Marks, 2003; Ahlerup et al., 2021; Luca, 2021).

In this scenario, in which we highlight the relevance of a multilevel setting to understand modern governance (Hooghe and Marks, 2003; Hooghe et al., 2016; Geys and Vermeir, 2014), we also consider the role of decentralization to explore whether the predominance of one level of governance over the other may be influenced by the degree of decentralization of the country, since devolution of powers from upper to lower levels of government varies greatly from country to country. As such, the relevance of decentralization has usually been factored into evaluations of the relationship between the quality of government and economic growth (Muringani et al., 2019; Rodríguez-Pose and Muštra, 2022).[8] However, the way the multilevel structure of governments can moderate the links between quality of government, decentralization, and regional economic development has yet to be examined.

In this study, we focus on the case of the European Union which, according to Barbero et al. (2023), has been the focus of most research analyzing the role of government quality as a driver of economic growth and development at the sub-national level. (Charron et al., 2014, 2019, 2021). According to our results, the impact of gov-

[7] As indicated by Mora-Sanguinetti and Spruk (2022), in some European countries such as Spain, regional governments pass far more laws than central government.

[8] See also Rodríguez-Pose and Ezcurra (2009); Rodriguez-Pose and Ezcurra (2010) for studies examining the specific links between decentralization and growth.

ernment quality on economic development is greater at the national level than at the regional level. However, it is important to note that government quality at the regional level also plays a role in economic development. Broadly, it appears that factors related to a country's general rules and regulations (such as the national quality of government) have a greater influence on regional economic development than institutions whose main focus is the provision of specific services (such as the regional quality of government).

The rest of the article is structured as follows. After this introduction, Section 2.2 provides background and conceptualization of the necessity to go beyond the single-level analysis to understand the relationship between institutions and economic development. The empirical strategy and data are presented in Sections 2.3 and 2.4, respectively. Section 2.5 presents the main results of the study. The relevance of our results is discussed in Section 2.6, and some conclusions are drawn in Section 2.7.

2.2. Background and conceptualization: from single-level to multilevel

Over the last three decades, a growing number of scholars have attempted to measure and develop reliable indicators of government quality. Two of the most noteworthy contributions are Kaufmann et al. (2009) and Charron et al. (2019). Many scholars have used such indicators to shed light on the relationship between quality of government and economic performance (Efendic et al., 2011). However, despite the wealth of institutional quality indicators available at country and regional level, to date no research has explored the role of institutions in economic development by specifically considering the multilevel structure of decentralized governments, that is, how institutional quality may affect economic development not only in a linear way but at multiple levels.

As Rodríguez-Pose (2013) notes, social scientists have been examining the role of institutions since the 19^{th} century (see, for instance Weber, 2019), it was not until the 1990s that mainstream economic theory began to explore their links with economic growth and development. The seminal study by North (1990) and the contributions it spawned (e.g. Acemoglu et al., 2001; Rodrik et al., 2004; Eichengreen, 1994) concluded that institutions were at least as important as classical factors such as physical and human capital, trade, and technology. Since then, the literature analyzing these links has grown rapidly, in both volume and relevance (see Barbero et al., 2023; Balaguer-

Coll et al., 2022b; Rodríguez-Pose and Muštra, 2022; Muringani, 2022; Rodríguez-Pose and Ganau, 2021, for some recent contributions to the field).

However, while the interest in the role of institutions in economic development grew rapidly at the country level, it took much longer to become an established research stream at sub-national government level. According to Rodríguez-Pose (2013), regional development policies were mainly top-down replications, and little attention was paid to the heterogeneity across regions. This situation changed with the 1989 Reform of the EU Structural Funds, since when the role of regions has attracted notable interest. Indeed, as Barbero et al. (2023) point out, most research on the topic has focused on the EU (e.g., Ketterer and Rodríguez-Pose, 2016; Vita, 2017; Muringani, 2022; Aristizábal and García, 2020; Balaguer-Coll et al., 2022b; Forte et al., 2015), to the point that some consider quality of government as the main explanatory factor behind regional growth (Rodríguez-Pose and Garcilazo, 2015).

Because forms of governance have shifted toward the dispersion of decision making across multiple centers of authority (Hooghe and Marks, 2003), the issue of decentralization should also be factored into this analysis. Although there is no consensus as to what the optimal territorial structure should be (Narbón-Perpiñá et al., 2021), the economic benefits of decentralization (the so-called economic dividend of devolution; see Rodríguez-Pose and Gill, 2005) is still a relevant issue in the public administration and public economics literature, especially since the widespread decentralization process in the 1950s (Martinez-Vazquez et al., 2017). Given its importance, relevant contributions have examined the relationship between decentralization and economic performance, both at national (Rodríguez-Pose and Ezcurra, 2009; Carniti et al., 2018; Baskaran et al., 2016; Baskaran and Feld, 2012) and regional Rodriguez-Pose and Ezcurra (2010); Ezcurra and Rodríguez-Pose (2013); Filippetti and Sacchi (2016); Rodríguez-Pose and Bwire (2004) levels.

In this paper, we aim to go one step further by not only analyzing the economic effects of institutions on regional performance while controlling for the level of decentralization, but also by considering the hierarchical structure between national and sub-national governments. This novel approach allows us to distinguish the specific effects of both regional and national institutional qualities on regional economic outcomes, providing insights into the combined quality of government effect. By exploring this aspect, we hope to offer new insights into the relationship between institutions

and regional development that have not been studied before. Our goal is to provide a more comprehensive understanding of the drivers of cross-regional comparative development through a broader perspective.

We also contend that the multilevel econometric modeling specification we propose offers a superior fit to the data, and presents more comprehensive information than single-level regressions in understanding the significance of institutions in regional economic development i.e., it provides a broader picture of the complex relationship between institutions and regional economic outcomes.

2.3. Empirical strategy

In contrast to previous approaches, which have mainly been based on static panel data models (i.e., fixed effect estimators, see Kovač and Spruk, 2015; Ahlerup et al., 2016; Muringani et al., 2019) or dynamic panel data models (i.e., GMM, see Ketterer and Rodríguez-Pose, 2016; Madsen et al., 2015; Crescenzi et al., 2016), we base our analysis on multilevel modeling techniques (van Oort et al., 2012; Aslam and Corrado, 2011; Bell et al., 2014). These techniques offer a much better fit than classical approaches for modeling the hierarchical data structure corresponding to the territorial organization of a country. As indicated above, this new approach becomes particularly relevant in our context, since previous studies have evaluated the impact of quality of government on economic performance at different administrative levels *separately*, without considering their nested structure.

The main advantage the multilevel modeling approach used in this study has over single-level models (e.g. GMM or fixed effects) is that we can include government quality variables at both levels without the need to add region/country fixed effects (dummies) to control for the unobserved heterogeneity of the regions (Corrado and Fingleton, 2011). Specifically, the multilevel modelling allow us to include government quality variables at both levels (i.e., regional and country level) without adding region/country fixed effects to control for unobserved heterogeneity. In a single-level model with fixed effects, including country-level variables would cancel out their effect in a specific year, as a given value of quality of the central government is the same for all regions in the country, which would imply that the researcher fails to capture the within variability happening within clusters. Conversely, multilevel modeling allows for the modeling of within-group variability at the lower level of analysis and

between-group variability at the higher level of analysis, which enables the disentanglement of the particular role that each level plays in regional economic development. We argue that, by fully exploiting the variability of both regional and national quality of government indicators, we can disentangle the effects of each level on economic development more accurately than with single-level models.

2.3.1. The model

Multilevel modeling techniques are commonly used in other fields such as education, medicine or psychology, but comparatively less so in economics. However, some studies by prominent researchers in the field have highlighted the potential of this methodology (Lago-Peñas and Lago-Peñas, 2010; Pieroni and d'Agostino, 2013; Bell et al., 2014), particularly for economic growth studies.[9] These techniques are based on hierarchical data structures that assume the data variability arises from two sources: (i) *within* variability, i.e., a level 1 variable (regions) that varies between and within the units (countries) it belongs to; and (ii) the *between* variability, i.e., a level 2 variable (countries) that varies only between level units. In contrast to single models, which assume observations are independent of each other, multilevel models can accommodate nested data structures, thus allowing researchers to deal with the problem of correlated errors (Srholec, 2010).

Based on this methodology, we explore whether the effect shown by the quality of government on the economic development of a given region may be offset by the quality of government of its *nesting* cluster—i.e., the country. We argue that ignoring the multilevel logic may lead to an over-weighting of the real influence of regional governance quality and an under-weighting of the effect of the country's quality of government on the economic development of a given region. By considering multilevel modeling methods, it is possible to disentangle with certain precision the relative contributions of each government layer to the overall institutional quality in the country. The links among the different layers of government can be intricate, particularly in decentralized scenarios (Rodríguez-Pose and Muštra, 2022) and, as stated throughout the paper, any methodological effort to single out each effect (local, regional, national) is welcome.

Consider the following specification, in which we assume that a multilevel model

[9]For a review of the application of multilevel models to economic growth, see van Oort et al. (2012).

has a two-level structure, with regions corresponding to level 1, and countries corresponding to level 2. In this context, we consider a random intercept model (RIM), a standard two-level linear model, and the baseline model, which is described as follows:

- Level 1 equation:

$$logGDPpc_{ij} = \beta_{0j} + \beta_{1j} EQoG_{ij} \begin{cases} Quality_{ij} \\ Corruption_{ij} + \delta_{1j} x_{ij} + eij \\ Impartial_{ij} \end{cases} \tag{2.1}$$

- Level 2 equation:

$$\beta_{0j} = \gamma_{00} + u_j \tag{2.2}$$

Rearranging terms, we obtain the following specification:

$$logGDPpc_{ij} = \gamma_{00} + \beta_{1j} EQoG_{ij} \begin{cases} Quality_{ij} \\ Corruption_{ij} + \delta_{1j} x_{ij} + u_j + e_{ij} \\ Impartial_{ij} \end{cases} \tag{2.3}$$

At **level 1**, the equation refers to the regional level relationship that is defined separately for each country. In the absence of **level 2** equations, the **level 1** relationship could be estimated as standard OLS. Nevertheless, a random intercept model arises if the intercept β_{0j} is allowed to become random. This means that the intercept of the group regression is allowed to vary across groups, but the slope is constant across them, implying that the explanatory variable of interest has a constant effect on every group. Intuitively, e_{ij} refers to the individual residuals, corresponding to regions, and u_j as the group-level residuals, corresponding to countries.

An extension of the RIM is the random slope model (RSM, henceforth) which has the advantage of allowing the **level 1** explanatory variables to vary across groups. Formally, it can be described as follows:

$$\beta_{1j} = \gamma_{10} + u_{1j} \tag{2.4}$$

Rearranging terms and substituting Equation (2.4) in (2.3), we obtain the following

specification:

$$logGDPpc_{ij} = \gamma_{00} + \gamma_{10} EQoG_{ij} \begin{cases} Quality_{ij} \\ Corruption_{ij} \\ Impartial_{ij} \end{cases} + \delta_1 x_{ij} + EQoG_{ij} \begin{cases} Quality_{ij} \\ Corruption_{ij} \\ Impartial_{ij} \end{cases} u_{1j} + u_{0j} + e_{ij} \tag{2.5}$$

In a simple Random Slope multilevel model, γ_{10} is the slope of the average regression line and therefore, the $\gamma_{10} + u_{1j}$ is the slope of group j, which implies that the marginal effect of the explanatory variable (in our case, quality of government at regional level) on the outcome of interest (i.e., GDP per capita of the regions) is no longer constant across groups. This implies that the RSM allows the relationship between regional institutional quality and economic development to vary across different countries, while a single-level model accounting fixed effects, assumes a constant effect of the explanatory variable of interest across all clusters (i.e., countries).

Finally, to account for group-level characteristics, individual-level characteristics and the time dimension, we end up with this final expression:

$$logGDPpc_{ijt} = \gamma_{00} + \gamma_{10} EQoG_{ijt} \begin{cases} Quality_{ijt} \\ Corruption_{ijt} \\ Impartial_{ijt} \end{cases} + \gamma_{20} WGI_{jt} \begin{cases} VOAC_{jt} \\ POLSTAB_{jt} \\ EFFECTIV_{jt} \\ CORRUPCONT_{jt} \\ RULE_{jt} \\ REGQUAL_{jt} \end{cases} +$$
$$\delta_1 x_{ijt} + \delta_2 x_{jt} + TIME_t + EQoG_{ijt} \begin{cases} Quality_{ijt} \\ Corruption_{ijt} \\ Impartial_{ijt} \end{cases} u_{1jt} + u_{0jt} + e_{ijt} \tag{2.6}$$

where $logGDPpc_{ij}$ is the logarithm of the purchasing power GDP per capita of region i in country j at period t. As before, γ_{00} is the constant of the model and γ_{10} is the slope of the average regression line (the quality of government at regional level and its decomposed indicators), implying that $\gamma_{10} + u_{1jt}$ is the slope of group j—i.e., the effect of the quality of government indicators on growth may be different across countries. The γ_{20} parameter is the level-2 variable, corresponding to the quality of government at the country level, and its disaggregated indicators. Likewise, $\delta_1 x_{ijt}$ is a set of the

standard neoclassical Solow-Swan growth variables (Solow, 1956; Mankiw et al., 1992; Barro and Sala-i Martin, 1995),[10] and $\delta_2 x_{jt}$ is a set of level-2 control variables.[11] $TIME_t$ stands for year fixed effects and, as indicated earlier, u_{1jt} is the residual of each country capturing the discrepancies of the effect of the regional quality of government with respect to the mean. Finally, u_{0jt} is the country error term (level-2) and e_{ijt} is the regional (level-1) error term.

To more accurately measure the impact of institutions on economic development within the relatively short period of 10 years that we are analyzing, we have followed recent relevant contributions(Muringani, 2022; Muringani et al., 2021; Rodrik et al., 2004; Tabellini, 2010; Acemoglu et al., 2001) by using GDP in levels rather than growth rates. This is a more appropriate choice as GDP growth rates can be influenced by temporary fluctuations in the economy, which may obscure the true impact of institutions. Institutions have a more stable nature and their impact on economic development can be more lasting. Furthermore, our primary focus is to determine whether national or regional governance has a greater impact on promoting cross-regional comparative development, rather than identifying which one is a stronger short-term driver of growth.

2.3.2. Endogeneity problems

Despite the attention to the impact of institutions on economic performance has received over the last 20 years, the hegemonic discourse on their role has assumed they play a prominent role in growth, ignoring the relevance of the economic development *per se* on the institutional process (Chang, 2010). That is, institutional change may be highly correlated with the economic situation of the country/region, which may suggest that wealthier economies will tend to prefer better institutions (Acemoglu et al., 2001).

Unlike many studies that have used lagged variables as a means to deal with endogeneity, we follow Reed (2015) to instrument our potential endogenous variables in the absence of better instruments for the quality of government indicators.[12] Therefore, we use lagged variables of the endogenous variables to instrument our suspected

[10] These variables will be explained in detail in the data section.

[11] See Table 3.4 for definitions of the variables included in the estimations.

[12] The literature has not clearly identified a proper set of instruments other than historical ones. For an overview, see Vieira et al. (2012).

endogenous variables by exploiting the panel data structure (Ripollés and Martínez-Zarzoso, 2021). We use the control function approach (CFA) to perform this strategy, following Wooldridge (2015). We consider the CFA to be the best tool in this context, rather than traditional instrumental methods, such as 2SLS, since the multilevel models are estimated through maximum likelihood, which precludes the use of the standard linear instrumental variables techniques (Wooldridge, 2010).

To illustrate our strategy, consider a baseline econometric equation as follows:

$$Y_1 = \beta_1 + \beta_2 X + \beta_3 Y_2 + \varepsilon \tag{2.7}$$

where Y_1 is the dependent variable, X is the set of exogenous variables, Y_2 is the set of endogenous variables and ε is the error term. In order to correct the possible existence of endogeneity issues, we apply a two stage empirical strategy. In a first step, we regress each of the potential endogenous variables independently—in this case, the different indicator of quality of government—on the remaining exogenous variables of Equation (2.7), plus the set of instruments we are considering:

$$Y_2 = \beta_1 + \beta_2 X + \beta_3 Z + v \tag{2.8}$$

In this case, due to the difficulties in finding valid instruments for our quality of government indicators (Forte et al., 2015), we follow Reed (2015) and use as instruments for the endogenous variables (Z) their two own lagged values.

Finally, in a second step, we obtain the estimated residuals $\widehat{v}$ from (2.8) and we include them in the main equation as an additional regressor in the main equation:

$$Y_1 = \beta_1 + \beta_2 X + \beta_3 Y_2 + \beta_4 \widehat{v} + \varepsilon \tag{2.9}$$

The level significance of $\widehat{v}$ will indicate if Equation (2.9) suffers from bias, with a significant coefficient pointing to a bias problem, and a non-significant one implying its absence.

2.4. Data

We use regional-level panel data for the NUTS2 European regions (Tabellini, 2010) for the 2010–2019 period.[13] The descriptive statistics can be found in Table 2.1 and the definitions an data sources of the variables in Table 2.2

Table 2.1: Descriptive statistics, relevant variables

	Mean	SD	Min	Max	N
$logGDPpc$	10.063	0.40	8.748	11.224	2,010
$GFCF$	0.206	0.04	0.070	0.489	2,005
$EDUCATION$	34.579	10.47	9.600	71.000	1,944
$POPGROWTH$	1.486	6.93	−19.95	54.85	1,948
$POPULATION$	2,186,419	2,332,575	27,734	17,932,651	1,948
$INFLATION$	1.433	1.32	−1.600	6.100	2,010
$EQI_{(region)}$	0.501	0.17	0.051	0.970	2,010
$QUALITY_{(region)}$	0.503	0.16	0.000	1.000	1,960
$CONTCORR_{(region)}$	0.501	0.17	0.055	0.927	2,008
$IMPARTIAL_{(region)}$	0.502	0.16	0.000	0.940	2,010
$VOAC_{(country)}$	0.718	0.07	0.562	0.838	2,010
$POLSTAB_{(country)}$	0.620	0.08	0.436	0.785	2,010
$EFFECTIV_{(country)}$	0.713	0.12	0.459	0.948	2,010
$REGQUALITY_{(country)}$	0.725	0.09	0.530	0.910	2,010
$CONTCORR_{(country)}$	0.692	0.16	0.434	0.981	2,010
$RULE_{(country)}$	0.717	0.12	0.474	0.926	2,010
$WGI_{(country)}$	0.695	0.10	0.515	0.871	2,010
$SELFGOV$	0.594	0.27	0.078	1.000	1,809

[13] NUTS stands for *Nomenclature des unités territoriales statistiques* (in French), or Nomenclature of Territorial Units for Statistics, a geocode standard for referencing the subdivisions of countries for statistical purposes in the European Union. NUTS level 0 corresponds to the country level, whereas NUTS level 2 corresponds to regions. In our sample, we removed from our data-set all countries that constitute single-region countries, as they would not include information for multilevel modeling. We also removed Croatia because the Eurostat NUTS classification for that country changed during the studied period.

Table 2.2: Definitions and sources for the relevant variables

Variable	Description	Source
$log(GDPpc)$	Gross domestic product per capita (in logs) at current market prices, NUTS2 regions	EUROSTAT
$GFCF$	Gross fixed capital formation at current market prices as a share of GDP, NUTS2 regions	EUROSTAT
$INFLATION$	Annual inflation rate, NUTS0 (country level)	EUROSTAT
$EDUCATION$	Share of population below 35 years old with higher education, NUTS2 regions	EUROSTAT
$POPGROWTH$	Crude rate of total population growth, NUTS2 regions	EUROSTAT
$POPULATION$	Total population, NUTS2 regions	EUROSTAT
$EQI_{(region)}$	European Quality Index, NUTS2 regions	European Quality of Government Institute
$QUALITY_{(region)}$	Quality pillar, NUTS2 regions from the European Quality Index (EQI)	European Quality of Government Institute
$CONTCORR_{(region)}$	Control of corruption pillar, NUTS2 regions from the European Quality Index (EQI)	European Quality of Government Institute
$IMPARTIAL_{(region)}$	Impartiality pillar, NUTS2 regions from the European Quality Index (EQI)	European Quality of Government Institute
$VOAC_{(country)}$	Voice and Accountability: participation in selecting the government and general freedom, NUTS0 (country level)	WGI[a], World Bank
$POLSTAB_{(country)}$	Political Stability and Absence of Violence/Terrorism: probability of experiencing political instability, NUTS0 (country-level)	WGI[a], World Bank
$REGQUALITY_{(country)}$	Regulatory Quality: the capacity of the national administration to implement policies and regulations, NUTS0 (country-level)	WGI[a], World Bank
$CONTCORR_{(country)}$	Control of corruption: Capability of the government to combat all types of corruption, NUTS0 (country level)	WGI[a], World Bank
$RULE_{(country)}$	Rule of law: security of property rights, contract enforcement, fairness and independence of justice, NUTS0 (country level)	WGI[a], World Bank
$EFFECTIV_{(country)}$	Effectiveness: policy implementation, credibility and efficient and effectively provision of services, NUTS0 (country level)	WGI[a], World Bank
$WGI_{(country)}$	The overall index constructed based on the 6 WGI indexes, NUTS0 (country level)	WGI[a], World Bank
$SELFGOV$	How much authority is shared between the regional and national government-Regional Authority Index[b], NUTS0 (country level)	Regional Authority Index[a]

[a] WGI stands for Worldwide Governance Indicators.
[b] See Hooghe et al. (2016) for details.

European Quality of Government Index (EQI): to date, the EQI is the largest survey on perceptions of the quality of administration at the regional level. Specifically, it covers a total of 208 NUTS2 regions corresponding to the 27 EU countries (NUTS1).[14] The EQI index is based on three main pillars, namely the corruption pillar ($CONTCORR$), the impartiality pillar ($IMPARTIAL$) and the quality pillar. These pillars, although highly correlated,[15] represent a measure of different aspects of institutional quality, thus providing more comprehensive information from which to disentangle various facets of quality of government. Because the European Quality of Governance index is not reported annually but in four different waves—2010, 2013, 2017 and 2021—in order to be able to exploit our panel, we perform a linear interpolation based on the specification below:

$$y = y_1 + (x - x_1)\frac{y_2 - y_1}{x_2 - x_1} \tag{2.10}$$

where y_1 and y_2 are the known values of the European Quality of Government indicators, for instance, 2013 and 2017, and x_1 and x_2 are the positions that these known values occupy in the 2010-2021 period.[16]

Worldwide Governance Indicators (WGI): the seven indicators obtained from the Worldwide Governance Indicators (WGI) are: (i) voice and accountability ($VOAC$), which measures participation in selecting the government in addition to general freedom, i.e., freedom of association, expression, etc.; (ii) political stability and absence of violence/terrorism ($POLSTAB$), which measures the probability of experiencing political instability or politically motivated violence; (iii) effectiveness ($EFFECTIV$), corresponding to measures of policy implementation, credibility, and efficient and effectively provision of public goods and services; (iv) the rule of law ($RULE$), related to the security of property rights, the quality of contract enforcement, the fairness and independence of the judiciary, as well as the likelihood of crime; (v) regulatory quality ($REGQUALITY$), which measures the capacity of the national administration to implement policies and regulations that allows dynamism in the private sector; (vi) control of corrup-

[14] See Charron et al. (2014, 2019, 2021) for details of the European Quality of Government Indicators. As the UK is no longer included in the EQI Database, for this reason, it has been excluded from the analysis. The Index ranged from [-3,+3] and has been re-scaled from 0 to 1.

[15] About 0.80, according to Charron et al. (2014, 2019, 2021).

[16] If we give position 1 to 2010 and position 12 to 2021, 2013 would be position 4 and 2017 position 8.

tion (*CORRUPCONT*), which covers governments' capability to combat different types of corruption; and finally, (vii) an overall index (*WGI*), based on an unweighted combination of the six aforementioned indicators.[17]

Economic growth variables (controls): we include as controls the standard Solow (1956) variables, which correspond to: (i) investment (proxied by gross fixed capital formation, *GFCF*); (ii) population growth (*POPGROWTH*), where an extra 0.05 has been added following Mankiw et al. (1992); (iii) tertiary education, which represents the share of population below 35 years old with higher education (*EDUCATION*); (iv) total population(*POPULATION*) to control for size of regions (Lago-Peñas and Ventelou, 2006; Alesina et al., 2005; Kelley and Schmidt, 2005); and (v) the inflation rate (*INFLATION*), since we use nominal GDP per capita.

Regional Authority Index: we use the regional authority index (RAI) (Hooghe et al., 2016) as a proxy for the level of decentralization. Specifically, we take the dissagregated indicator corresponding to the extent to which the authority is shared between the regional and national governments (*SELFGOV*)[18].

2.5. Results

Results are presented in three subsections. The first one reports those corresponding to our standard multilevel specification with aggregated and disaggregated values of European governance quality, together with the complete set of national quality of government indicators. The second subsection presents a robustness extension of our specification by controlling for the level of decentralization in the countries. We perform this to see whether this variable plays any role in the interrelation between regional and national quality of government, factoring in the heterogeneity of decentralization patterns across the EU (European Commission, 2017). Finally, in the third subsection we present our estimates following the strategy to correct for the potential endogeneity problems discussed above. All regressions correspond to random intercept models.

[17]The seven indexes lie in the $[-2.5, 2.5]$ range. For interpretation reasons, we have re-scaled the values from 0 to 1.

[18]The variable has been re-scaled from 0 to 1. original variable ranged from 0 to 25.72

The lower panels of Tables 2.3–2.6 report the likelihood ratio test statistic (LR Test), calculated as twice the difference in the log likelihood values for the multilevel model *vis-à-vis* its linear counterpart. Their values indicate that, under all specifications, there is evidence that the multilevel model is suitable. Results for the control variables are also reported in Tables 2.3–2.7, which are included in line with the economic growth literature (Solow, 1956; Barro and Sala-i Martin, 1995; Mankiw et al., 1992).

2.5.1. Main results

Table 2.3 and Table 2.4 display the results for our main specification as described in Section 2.3. As indicated earlier, the analysis was been carried out through a hierarchical model in order to account for the nested structure of the data, which enables us to include country-level and region-level variables, as well as to account for correlated errors.

Seven different specifications are presented in Table 2.3. In these models, the European Quality Index ($EQI_{(region)}$), which proxies for overall regional institutional quality, is compared with the seven different national quality of government indicators provided by the Worldwide Governance Indicators database. These are: voice and accountability ($VOAC_{(country)}$), political stability and absence of violence ($POLSTAB_{(country)}$), regulatory quality ($REGQUALITY_{(country)}$), control of corruption ($CONTCORR_{(country)}$), rule of law ($RULE_{(country)}$), effectiveness ($EFFECTIV_{(country)}$), and $WGI_{(country)}$, which represents for the overall country-level quality of government indicator. See Table 2.2 for the definition of the different indicators considered.

The coefficients corresponding to the quality of government indicator at the regional level, $EQI_{(region)}$, are reported in the upper row of Table 2.3, whereas the results for the indicators at the country level are reported in the lower rows. We include the different components of country-level quality of government separately in order to more precisely disentangle not only the relative importance of national institutions *vis-à-vis* their regional counterparts, but also whether results hold for each country-level indicator considered.

Overall, and regardless of the country-level indicator of quality of government considered, $EQI_{(region)}$ has a positive albeit not significant effect on regional GDP per capita. In contrast, for five out of the seven specifications, the national indicators of quality of government have both positive and significant impacts on regional economic

development. This joint effect, which has not been empirically investigated previously, is consistent with some strands of the institutions literature, which argues that the real drivers of economic success are more related to the *rules of the game* than to specific policies (Acemoglu et al., 2003; Rodrik et al., 2004; Acemoglu and Robinson, 2015; Ahlerup et al., 2021). This is especially relevant when observing how each indicator behaves in the regressions. Although the results for the different coefficients must be interpreted with caution (since the seven indicators are very close to each other), we cannot overlook the remarkably positive effect of the regressions reporting estimations for the rule of law variable ($RULE_{(country)}$) which is, precisely, the closest proxy for the *rules of the game*, show a remarkable positive effect. Other variables, however, such as regulatory quality ($REGQUALITY_{(country)}$), which is more closely related to the efficient and effective provision of public services, shows no significant effect on regional economic development.

Table 2.3: Regional-level (overall effect) vs country-level quality of government effect on GDP per capita

	(1) *logGDPpc*	(2) *logGDPpc*	(3) *logGDPpc*	(4) *logGDPpc*	(5) *logGDPpc*	(6) *logGDPpc*	(7) *logGDPpc*
$EQI_{(region)}$	0.192	0.230	0.238	0.167	0.111	0.108	0.110
	(0.67)	(0.81)	(0.84)	(0.59)	(0.39)	(0.39)	(0.39)
$VOAC_{(country)}$	0.585***						
	(2.04)						
$POLSTAB_{(country)}$		0.0834					
		(0.63)					
$REGQUALITY_{(country)}$			−0.0762				
			(−0.36)				
$CONTCORR_{(country)}$				0.345**			
				(1.86)			
$RULE_{(country)}$					0.969***		
					(4.41)		
$EFFECTIV_{(country)}$						0.821***	
						(3.60)	
$WGI_{(country)}$							1.082***
							(3.21)
GFCF	0.156	0.168	0.163	0.162	0.135	0.204	0.174
	(1.30)	(1.39)	(1.36)	(1.35)	(1.12)	(1.69)	(1.45)
EDUCATION	0.0214***	0.0214***	0.0214***	0.0213***	0.0214***	0.0213***	0.0213***
	(35.32)	(35.32)	(35.31)	(35.13)	(35.49)	(35.39)	(35.34)
POPGROWTH	0.00761***	0.00757***	0.00764***	0.00767***	0.00752***	0.00766***	0.00748***
	(10.23)	(10.11)	(10.24)	(10.31)	(10.13)	(10.32)	(10.05)
POPULATION	$8.39e-09$***	$8.43e-09$***	$8.38e-09$***	$8.33e-09$***	$8.37e-09$***	$8.45e-09$***	$8.49e-09$***
	(4.15)	(4.16)	(4.14)	(4.12)	(4.15)	(4.19)	(4.20)
INFLATION	−0.00597	−0.00503	−0.00519	−0.00448	−0.00766	−0.00468	−0.00504
	(−1.06)	(−0.90)	(−0.92)	(−0.80)	(−1.36)	(−0.84)	(−0.90)
LR Test: Multilevel vs Linear Model							
χ^2_3	1,338.27	1,461.13	1,468.91	1,477.52	1,491.11	1,486.29	1,473.38
$H_0 : u_{0j} = 0$	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)
YEAR FE	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Groups	21	21	21	21	21	21	21
Observations	1,902	1,902	1,902	1,902	1,902	1,902	1,902

z-scores in parentheses
*, ** and *** indicate significance at 0.10, 0.05 and 0.01 levels, respectively.

In Table 2.4 we report analogous estimations to those in Table 2.3, but allowing the quality of government indicator at the regional level ($EQI_{(region)}$) to be decomposed into its three pillars: (i) quality, $QUALITY_{(region)}$; (ii) control of corruption, $CONTCORR_{(region)}$; and (iii) impartiality, $IMPARTIAL_{(region)}$. Overall, results present similar trends to those observed in Table 2.3. Specifically, none of the three indicators shows a significant impact on regional economic development. Instead, and analogously to results reported in Table 2.3, most of the national indicators (6 out of 7) of government quality show a positive and significant impact on regional economic development.

Alongside the results reported in Tables 2.3 and 2.4, we ran a series of regressions in which the combination of quality of government indicators at the country and regional levels changes.[19] In all these cases, in qualitative terms, the outcome of the analysis held. We decided to present these tables and not others to demonstrate that the predominance—in general terms—of national institutional variables over regional ones is robust whichever indicator is chosen to capture the quality of national government.

[19]We tried several combinations, including the entire set of national indicators in each of the regressions but including only one regional indicator at a time. Similarly, we ran another series of regressions including only one of the national and regional indicators at a time.

Table 2.4: Regional-level (decomposed effect) vs country-level quality of government effect on GDP per capita

	(1) *logGDPpc*	(2) *logGDPpc*	(3) *logGDPpc*	(4) *logGDPpc*	(5) *logGDPpc*	(6) *logGDPpc*	(7) *logGDPpc*
$QUALITY_{(region)}$	−0.214	−0.207	−0.265	−0.192	−0.198	−0.185	−0.250
	(−0.87)	(−0.92)	(−1.07)	(−0.83)	(−0.81)	(−0.72)	(−0.99)
$CONTCORR_{(region)}$	0.163	0.171	0.135	0.140	0.110	0.244	0.183
	(0.32)	(0.33)	(0.24)	(0.27)	(0.21)	(0.43)	(0.33)
$IMPARTIAL_{(region)}$	0.434	0.475	0.440	0.478	0.444	0.310	0.371
	(1.01)	(1.11)	(0.95)	(1.12)	(1.00)	(0.65)	(0.81)
$VOAC_{(country)}$	0.745***						
	(2.59)						
$POLSTAB_{(country)}$		0.251*					
		(1.75)					
$EFFECTIV_{(country)}$			1.059***				
			(4.66)				
$REGQUALITY_{(country)}$				0.0106			
				(0.05)			
$CONTCORR_{(country)}$					0.422**		
					(2.10)		
$RULE_{(country)}$						0.956***	
						(4.41)	
$WGI_{(country)}$							1.393***
							(4.19)
GFCF	−0.115	−0.0833	−0.0697	−0.101	−0.111	−0.149	−0.105
	(−0.97)	(−0.70)	(−0.59)	(−0.86)	(−0.94)	(−1.26)	(−0.89)
EDUCATION	0.0204***	0.0204***	0.0204***	0.0204***	0.0203***	0.0204***	0.0204***
	(34.34)	(34.39)	(34.64)	(34.29)	(34.06)	(34.50)	(34.47)
POPGROWTH	0.00776***	0.00772***	0.00788***	0.00783***	0.00783***	0.00770***	0.00763***
	(10.61)	(10.51)	(10.82)	(10.68)	(10.70)	(10.56)	(10.43)
POPULATION	$8.13e-09$***	$8.08e-09$***	$8.34e-09$***	$7.93e-09$***	$8.10e-09$***	$8.12e-09$***	$8.45e-09$***
	(3.96)	(3.93)	(4.08)	(3.85)	(3.94)	(3.97)	(4.12)
INFLATION	−0.00839	−0.00747	−0.00742	−0.00763	−0.00670	−0.00991	−0.00733
	(−1.49)	(−1.33)	(−1.32)	(−1.35)	(−1.19)	(−1.76)	(−1.31)
LR Test: Multilevel vs Linear Model							
χ^2_{10}	1,277.33	1,442.93	1,440.73	1,421.05	1,440.59	1,434.86	1,403.67
$H_0 : u_{0j} = 0$	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)
YEAR FE	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Groups	21	21	21	21	21	21	21
Observations	1,850	1,850	1,850	1,850	1,850	1,850	1,850

z-scores in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$

2.5.2. How does decentralization affect this outcome?

In this subsection, we present an extension to test the robustness of our previous results taking into account the level of decentralization in the countries to see whether the effect of the national administrations on the regions' economic development still predominates over that of the regional administrations. Intuitively, the more decentralized a country is (fiscally, economically or politically), the more we should begin to observe that lower administrative units (e.g., regions) behave as independent units of government, and are less dependent on higher tiers of government and more self-sufficient.

In this regard, Tables 2.5 and 2.6 report analogous estimations to those in Tables 2.3 and 2.4, but controlling for the level of decentralization in the countries. The results point to a certain reduction in the relevance of government quality at the country level in the economic development of the regions, and to an increase in the importance of the impartiality pillar ($IMPARTIAL_{(region)}$), which is now significant (see Table 2.5).

The variable included to capture decentralization is $SELFGOV$ which, as indicated above, represents how much authority is shared between the regional and national governments (Hooghe et al., 2016): the higher the $SELFGOV$, the more authority is shared with the sub-national governments.[20] We selected this variable because it does not constrain the type of decentralization we are measuring (fiscal, political, etc.); rather, we can measure the extent to which authority is shared with sub-national governments. The fact that impartiality ($IMPARTIAL_{(region)}$) becomes significant before the other regional government indicators ($CONTCORR_{(region)}$ and $QUALITY_{(region)}$) when a country is decentralized in terms of authority sharing, reveals that the impartiality pillar is capturing the rules of the game that the national government shares with the regional government in a decentralized scenario.

Indeed, this is particularly accurate in our context since, as noted in the literature, by definition, impartiality implies that for the rule of law—that is to say, procedural impartiality—to work in practice, there must be a set of rules regulating specific behaviors that, ultimately, reflect the effective rule of law (Rothstein and Teorell, 2008; Gutmann and Voigt, 2020). This indicates that anti-discrimination and impartiality powers, which by definition are associated with equal opportunity guarantors, pre-

[20] See Kyriacou et al. (2015) or Muringani et al. (2019) for recent applications of the aforementioned indicator

dominate ones in any political institution as far as fostering economic development is concerned, as opposed to other governmental attributes such as the effective implementation of specific policies of control of corruption.

These results contribute to clarify further the relative contributions of national institutions *vis-à-vis* regional institutions for economic development. National institutions eliminate the direct effect of regional institutions on economic output in a multilevel econometric setting because they capture the effect of the rules of the game. We can therefore deduce that the more decentralized a country is, the more relevant regional government impartiality—captured by $IMPARTIAL_{(region)}$, the closest proxy for the rules of the game at the regional level—will be for economic development. In turn, this would confirm that it is the common framework in which economic agents operate that fosters economic development rather than the specific policies implemented by governments.

Another relevant conclusion of this section is the fact that, the more decentralized a country is, the better its economic performance will be at regional level, i.e., the $SELFGOV$ variable becomes positive and significant, no matter the specification considered. As discussed throughout this paper, the effect of decentralization on economic development has yielded mixed results in the literature. However, our results are consistent with the idea that decentralization is expected to be able to bring better economic performance when a country exceeds a certain size (Rodriguez-Pose and Ezcurra, 2010). We consider this to be especially relevant in our scenario, in which EU countries, such as Luxembourg and Malta, are not included. As a consequence, and following the literature on fiscal federalism (Tiebout, 1956; Oates et al., 1972; Baskaran and Feld, 2012), our findings would support the idea that more sub-national government capability and authority may boost better allocation of public goods and services (over a certain size threshold), which will ultimately lead to more economic development (Rodríguez-Pose et al., 2009).

Finally, one last conclusion can be drawn following Rodríguez-Pose and Ezcurra (2009): if on the one hand, institutional quality at the country level positively affects the economic development of regions and, on the other hand, decentralization also shows positive effects on regional development, this would imply the (plausible) existence of a strong national government with distributive capabilities (Hooghe et al., 2008) that acts as a buffer against what are sometimes argued to be the negative effects of

decentralization. This implies that large countries would benefit from decentralization in terms of economic economic performance only if the institutional quality at the national level is strong enough to preserve the *rules of the game*, even while transferring power to sub-national governments.[21]

[21] See Baskaran and Feld (2012) for examples of negative association between decentralization and economic growth.

Table 2.5: Decentralization as a moderator of the regional-level (overall) vs country level quality of government effect on GDP per capita

	(1) *logGDPpc*	(2) *logGDPpc*	(3) *logGDPpc*	(4) *logGDPpc*	(5) *logGDPpc*	(6) *logGDPpc*	(7) *logGDPpc*
$EQI_{(region)}$	0.234	0.342	0.338	0.298	0.176	0.173	0.174
	(0.85)	(1.27)	(1.23)	(1.09)	(0.65)	(0.66)	(0.64)
$VOAC_{(country)}$	1.100***						
	(3.59)						
$POLSTAB_{(country)}$		0.0929					
		(0.65)					
$REGQUALITY_{(country)}$			0.0174				
			(0.08)				
$CONTCORR_{(country)}$				0.164			
				(0.88)			
$RULE_{(country)}$					0.861***		
					(3.88)		
$EFFECTIV_{(country)}$						0.836***	
						(3.70)	
$WGI_{(country)}$							1.051***
							(3.12)
SELFGOV	0.650***	0.718***	0.713***	0.684***	0.637***	0.652***	0.645***
	(5.47)	(5.90)	(5.81)	(5.43)	(5.21)	(5.41)	(5.32)
GFCF	0.130	0.150	0.146	0.145	0.125	0.192	0.154
	(1.03)	(1.18)	(1.15)	(1.14)	(0.99)	(1.51)	(1.22)
EDUCATION	0.0215***	0.0215***	0.0215***	0.0215***	0.0215***	0.0215***	0.0214***
	(33.81)	(33.74)	(33.73)	(33.56)	(33.84)	(33.79)	(33.71)
POPGROWTH	0.00815***	0.00807***	0.00811***	0.00813***	0.00801***	0.00815***	0.00798***
	(10.32)	(10.14)	(10.20)	(10.26)	(10.14)	(10.32)	(10.08)
POPULATION	$8.51e-09$***	$8.55e-09$***	$8.49e-09$***	$8.48e-09$***	$8.52e-09$***	$8.62e-09$***	$8.63e-09$***
	(4.05)	(4.05)	(4.03)	(4.02)	(4.06)	(4.10)	(4.10)
INFLATION	−0.0220***	−0.0196***	−0.0196***	−0.0189**	−0.0213***	−0.0186**	−0.0194***
	(−3.70)	(−3.30)	(−3.31)	(−3.16)	(−3.59)	(−3.15)	(−3.27)
LR Test: Multilevel vs Linear Model							
χ^2_3	1,115.49	1,071.38	1,175.02	1,191.17	1,205.98	1,206.78	1,178.74
$H_0 : u_{0j} = 0$	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)
YEAR FE	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Groups	21	21	21	21	21	21	21
Observations	1,708	1,708	1,708	1,708	1,708	1,708	1,708

z-scores in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$

Table 2.6: Decentralization as a moderator of the regional-level (decomposed) vs country level quality of government effect on GDP per capita

	(1) *logGDPpc*	(2) *logGDPpc*	(3) *logGDPpc*	(4) *logGDPpc*	(5) *logGDPpc*	(6) *logGDPpc*	(7) *logGDPpc*
$QUALITY_{(region)}$	−0.194	−0.138	−0.232	−0.136	−0.153	−0.174	−0.215
	(−0.72)	(−0.56)	(−0.87)	(−0.54)	(−0.60)	(−0.68)	(−0.82)
$CONTCORR_{(region)}$	0.0598	0.0965	−0.0292	0.0832	0.0357	0.0849	0.0249
	(0.14)	(0.22)	(−0.06)	(0.19)	(0.08)	(0.19)	(0.06)
$IMPARTIAL_{(region)}$	0.564*	0.606*	0.617*	0.611*	0.608*	0.516	0.555*
	(1.82)	(1.87)	(1.94)	(1.87)	(1.87)	(1.51)	(1.72)
$VOAC_{(country)}$	1.098***						
	(3.62)						
$POLSTAB_{(country)}$		0.226†					
		(1.49)					
$EFFECTIV_{(country)}$			0.951***				
			(4.36)				
$REGQUALITY_{(country)}$				0.0204			
				(0.09)			
$CONTCORR_{(country)}$					0.259		
					(1.31)		
$RULE_{(country)}$						0.786***	
						(3.73)	
$WGI_{(country)}$							1.164***
							(3.61)
SELFGOV	0.664***	0.718***	0.633***	0.710***	0.677***	0.640***	0.642***
	(6.11)	(6.71)	(5.91)	(6.44)	(5.99)	(5.74)	(5.92)
GFCF	−0.0996	−0.0637	−0.0414	−0.0739	−0.0798	−0.110	−0.0816
	(−0.79)	(−0.51)	(−0.33)	(−0.59)	(−0.63)	(−0.87)	(−0.65)
EDUCATION	0.0205***	0.0205***	0.0205***	0.0205***	0.0204***	0.0205***	0.0204***
	(32.94)	(32.89)	(33.09)	(32.81)	(32.52)	(32.90)	(32.89)
POPGROWTH	0.00826***	0.00822***	0.00830***	0.00832***	0.00832***	0.00820***	0.00812***
	(10.56)	(10.43)	(10.64)	(10.58)	(10.62)	(10.49)	(10.37)
POPULATION	$8.58e-09$***	$8.43e-09$***	$8.79e-09$***	$8.29e-09$***	$8.44e-09$***	$8.43e-09$***	$8.78e-09$***
	(4.01)	(3.93)	(4.13)	(3.86)	(3.94)	(3.95)	(4.11)
INFLATION	−0.0196**	−0.0177**	−0.0164**	−0.0181**	−0.0171**	−0.0196**	−0.0172**
	(−3.28)	(−2.94)	(−2.75)	(−3.02)	(−2.82)	(−3.28)	(−2.89)
LR Test: Multilevel vs Linear Model							
χ^2_{10}	1,084.42	1,095.96	1,193.51	1,153.90	1,193.63	1,181.36	1,133.37
$H_0 : u_{0j} = 0$	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)	($P = 0.00$)
YEAR FE	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*	*YES*
Groups	21	21	21	21	21	21	21
Observations	1,657	1,657	1,657	1,657	1,657	1,657	1,657

z-scores in parentheses
$p < 0.13$ †, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$

2.5.3. Dealing with potential endogeneity

As indicated above, the reverse causality problem is a common concern in the literature on the impact of institutions on economic development since the causality has been found in both directions, i.e., from development to institutional quality (Paldam, 2021) and from institutional quality to development (Acemoglu et al., 2005). Thus, it is highly likely that not only do institutions foster economic development, but also that more developed economies would tend to demand better institutions (Acemoglu et al., 2001).

For this reason, as explained in subsection 2.3.2, we addressed the (potential) endogeneity problem using the control function approach (Wooldridge, 2015). The findings from this analysis are presented in Table 2.7, which displays only the results for the second step of the method, not the first part in which we obtain the residuals. However, the lower part of the table shows that the selected instruments met the requirements of the joint F-test for exogeneity. In addition, note that we only provide regression results for columns 7 of Tables 2.3 and 2.5, which include the two main quality of government indicators at national and regional level, ($EQI_{(region)}$ and $WGI_{(country)}$). The results of this analysis are qualitatively similar to the other selection of quality of government indicator; we opted to present these because both ($EQI_{(region)}$ and $WGI_{(country)}$) represent the most general approximations of our indicators of government quality at the regional and national levels. We consider that this table sufficiently illustrates our reasoning, and avoids the need for additional tables.

The upper part of the table displays the same variables explained in the previous subsections, with the particularity that the residuals of the first stages of the CFA correction were included to test for potential endogeneity. As can be seen in both columns, the one that does not control for decentralization and the one that does, the coefficients for the residuals are not statistically significant, neither individually nor jointly. Given this, and noting that it remains observable that it is national, not regional, institutional quality is still seen to have a positive and significant effect on economic development, even after the application of the CFA, there seems to be no evidence of a reverse causality problem. This is supported by the consideration that, although it may be possible for the reverse causality problem to arise when the two variables are considered at the same level, i.e. measuring the impact of quality of government at the regional level on the economic development of the regions and vice

versa, it is less likely that the evolution of the economy of one region conditions the institutional quality of the whole country.

Table 2.7: Regional vs. national quality of government. Control function approach with Reed's (2015) instrumental variables

	(1) *logGDPpc*	(2) *logGDPpc*
$EQI_{(region)}$	-0.0557	0.0166
	(-0.34)	(0.12)
$WGI_{(country)}$	0.981**	1.155***
	(2.37)	(3.27)
$Residual_{(EQI)}$	-0.357	-0.213
	(-0.77)	(-0.44)
$Residuals_{(WGI)}$	-0.563	-1.110
	(-0.89)	(-1.70)
SELFGOV		0.608***
		(4.89)
GFCF	0.189	0.196
	(1.09)	(0.98)
EDUCATION	0.0215***	0.0217***
	(23.58)	(23.77)
POPGROWTH	0.00685***	0.00728***
	(5.57)	(5.09)
POPULATION	6.84e-09**	7.10e-09***
	(3.20)	(3.33)
INFLATION	-0.00466	-0.0257**
	(-0.55)	(-2.82)
Time FE	YES	YES
Joint test for exogenous instruments	YES	YES
Observations	1,539	1,345

Bootstrap errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$

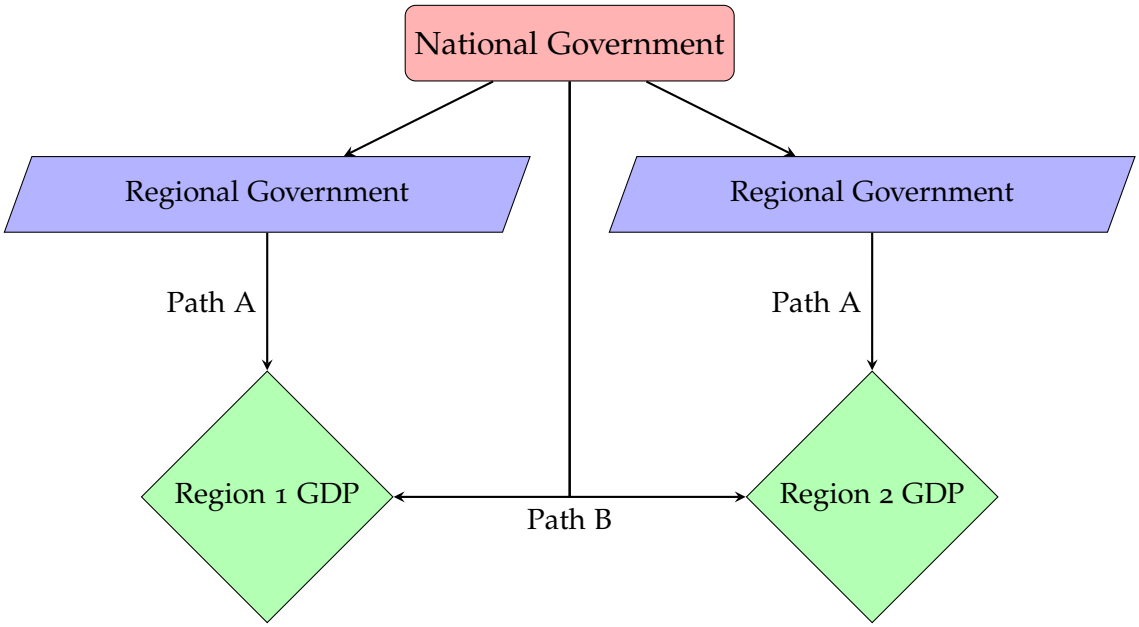
2.6. Discussion

In the field of economic geography, several relevant studies have documented the importance of regional institutional quality for regional economic development, particularly in Europe (Rodríguez-Pose and Garcilazo, 2015; Vita, 2017; Muringani et al., 2019; Muringani, 2022; Ketterer and Rodríguez-Pose, 2016; Aristizábal and García, 2020), by applying classical econometric techniques such as fixed effects estimators or GMM models. Most of these studies conclude, overall, that regional economic development can be achieved by improving the quality of regional government. We argue that this conclusion—although sensible in intuitive terms—was drawn using models that omitted the hierarchical structure of the data. Specifically, the national government quality variables were not usually included. Therefore, in our view, although the conclusions reached to date, based on single-level settings, are important, they could be more precise when our approach is adopted. What we have shown is that in a single-level analysis in which the hierarchical structure of the data is not modeled, researchers do not gain an accurate picture of what is being captured by the government quality variable in their regression. Consequently, the positive and significant effect of the regional government quality, consistently reported in the literature, may be capturing something other than the precise effect of regional institutional quality on regional economic development.

This can be conceptualized by observing Figure 2.2. In a single-level analysis where a fixed effects approach is applied, the researcher can only observe *path A*, i.e., since the role of the national government is canceled out because of the fixed effects approach, the positive and significant effect (which is already a stylized fact in the literature) of the quality of regional government on the region's economic development may be capturing both the effect of regional institutions *per se* and the indirect effect that national institutions impose on regional government. In contrast, our framework allows us to also disentangle *path B*, which is the direct effect of national institutional quality on regional economic development. Thus, this methodology allows us to attribute the specific role both levels of government play in the economic development of the regions.

We argue that our specification—multilevel econometric modeling—provides a better fit to the data and more information than single-level regressions for understanding the importance of institutions in regional economic development. Our claim

Figure 2.2: Mechanisms governing multilevel quality of government and regional output



is that our modeling shows a broader picture that allows us to disentangle the specific role of the two levels of government in regional economic development. We derive from our specifications that the national dimension of quality of government is more dominant than the regional dimension in fostering economic development—which does not preclude the existence of a relevant regional quality of government effect as well. We consider that broader perspective offered by this scenario indicates that variables more associated with the rules of the game (the country framework) are more prominent in regional economic development than institutions whose main purpose is to provide services (the regional government framework).

The control variables used are generally in line with the existing literature. Regarding *GFCF*, the coefficient is non-significant across all models. This result is consistent with the theory, and also with empirical analysis for Europe. In the case of the theory, according to Solow (1956), economic growth cannot be achieved through investment (savings)—*GFCF* is usually used to proxy investment—in the long-run. From the empirical perspective, Crespo Cuaresma et al. (2012) have shown that *GFCF* in not relevant for economic growth in European regions. The coefficients corresponding to education (*EDUCATION*) show that they have a positive and significant effect on eco-

nomic development for all specifications. This is consistent with the economic theory literature, since human capital is included in the Solow's (A)—technological change—and is already a stylized fact in the empirical literature (see, for instance Forte et al., 2015). In turn, the population variables ($POPGROWTH$ and $POPULATION$), they show both positive and significant small average effects on regional economic development. The former is consistent with Mankiw et al. (1992), and the latter aligns with Lago-Peñas and Ventelou (2006) and Alesina et al. (2005).[22] The variable $INFLATION$ displays a negative sign as expected, since our dependent variable is measured nominally (although its significance is not fully consistent across specifications).

2.7. Concluding remarks

Over the last three decades, the analysis of institutions and their impact on economic development has taken off both in terms of number and relevance of contributions to the field, which is still growing (Henriques and Palma, 2023). Although the first studies came from economics and focused on country-level institutions, some years later, the economic geography and regional science literature began to ask whether sub-national institutions, and their quality, could also be considered a fundamental cause of differences in economic development at the regional level. As a result, to date studies have focused separately on either country or regional levels, but no contributions have evaluated the combined effect. We consider it is important to evaluate the effect of institutions at several levels of government simultaneously since modern governance is now organized across multiple levels with powers dispersed across multiple centers of authority, which implies that, ideally, an integrative approach should be taken to evaluate their impact.

This is precisely our approach in this study. Specifically, we considered the advantages of establishing a parallel between decentralized governance, which assumes a multilevel governance structure (Benz et al., 2021), and several multilevel models in statistics and econometrics (Goldstein, 2011). These modeling strategies are relatively common in several social science fields where data is structured in multiple levels such as, for instance, education (with data at the student, class or school levels). However,

[22] More precisely, they argue that size is dependent on many other variables. However, since we are obtaining average effects for all regions of Europe, we cannot provide more insightful information about the implications of absolute population on economic development.

to date they have rarely been adopted to evaluate issues related to multilevel governance, its quality, and the impact on growth. Although some recent contributions have been innovative from a methodological perspective (e.g., Barbero et al., 2023), they also focus on a single (regional) level of government.

Our proposed empirical strategy enabled us to identify which level of government has the greatest impact on regional economic development, namely, the quality of national institutions (which proxies for the common framework in which economic agents operate and the rules of the game), or the quality of regional institutions (which proxies for the provision of public goods and execution of policies). In addition, we considered how this balance may be influenced by the degree of decentralization of the country, and dealt explicitly with the potential endogeneity issues that could arise due to reverse causality bias.

Overall, the paper makes three contributions. First, we show empirically that the aggregate framework (and its quality) provided by the most aggregated level of institutions outweighs the effect that lower government ties may have on the economic development of a region. We argue that in our framework, the aggregate indicators capture the rules of the games and the regional indicators capture the actual policies and that the resulting omission of countries' hierarchical structures may lead to an omitted variable bias problem. Second, we show that this also holds after taking into account the level of decentralization, but with nuances. For instance, some quality of government indicators at the country level (such as the impartiality pillar, $IMPARTIAL_{(region)}$) turn out to be relevant and positive for regional economic development, the more decentralized the country is. This once again suggests that the rules of the game prevail over the policies implemented, since impartiality is by definition strictly linked to the exercise of authority—it does not refer to the content of policies, nor to the way in which policies are executed. Third, we show that our estimation results do not suffer from reverse causality bias since it is very unlikely that a region's economic development can influence the quality of government at the country level.

Therefore, our empirical investigation contributes to the literature by shedding light on the different roles institutions play in economic development. We assessed two of the main problems in the institutional literature, concluding that, although the effect of institutional quality at different government levels is critical, the rules of the game plays a more prominent role—i.e., the country—level effect prevails. This would

ultimately imply a dominance of the country institutional framework over the policies implemented at the sub-national levels of government.

We focused on the context of the European Union, in which there has been a long-standing debate as to the effects of cohesion policies (introduced in 1989) on promoting regional economic and social development (Ehrlich and Overman, 2020). Some pioneering works on European regional convergence identified the prominent role of country (and spatial) effects (Quah, 1996), since when the literature has persistently focused on analyzing the effectiveness of cohesion policies in terms of long-run GDP growth. In this regard, our study could provide some answers in this field, since recent contributions have posited a relationship between the effectiveness of cohesion policies and specific national and regional factors such as the level of national development or the quality of regional institutions (Di Caro and Fratesi, 2022). Our research provides some insights in this direction, but also specifically answers the question of which institutions matter most.

Chapter 3

Institutions, decentralization, and regional financing in Spain

3.1. Introduction

Decentralization is a relevant issue from several points of view and has therefore been approached by political science, public administration and economic geography scholars. Specifically, the issue is important from three main perspectives: (i) organization of the state, i.e., how many levels of government should exist, which historical, political and cultural reasons matter in this organization; (ii) fiscal and public service provision, discussed in the literature on devolution and decentralization (Rodríguez-Pose and Ezcurra, 2009) concerning which services and infrastructures should be provided by each level of government; and (iii) the macroeconomic perspective, as national fiscal targets (particularly when considering contexts such as the European Union) must be compatible with coordination across government levels; this aspect should be carefully engineered through, for example, market forces, co-operation arrangements or fiscal rules.

Yet there are no clear-cut boundaries between these three issues and, therefore, the rationale underlying the adoption of more federal or more unitary territorial organization models derives from multiple sources. From political, cultural or historical points of view, more territorial autonomy (in terms of powers for sub-central levels of government) is actually a powerful tool for handling secessionist conflicts and even for protecting minorities. As Barter (2018) indicates, enhanced devolution "allows

self-government and some degree of self-determination for the first-order minorities without redrawing international borders". From the point of view of public administration and public economics, not only is the decision to devolve important, but also how to implement it, i.e., number of levels, and which services and infrastructures should be provided either regionally or locally—or even be kept under central government control (Prud'homme, 1995; Rodríguez-Pose and Gill, 2005).

However, although the traditional view is that intergovernmental grants (and, in general, programs on taxes, expenditures and transfers between government levels) are motivated by efficiency and equity considerations, there is also a tactical (electoral politics) dimension. As Johansson (2003) points out, although welfare-maximizing policies might be designed to transfer funds from richer to poorer regions using, for instance, lump-sum grants, there might be other motivations, and there is compelling evidence that "politics matter for the allocation of government resources across regions" (Johansson, 2003, p.884). The literature refers to this as tactical redistribution and, more generally, distributive politics. Relevant contributions—from both theoretical and empirical perspectives and in different contexts—include, among others, Boadway (2015), Brollo and Nannicini (2012), Gehring and Schneider (2020), Borck and Owings (2003), Huang and Chen (2012), Veiga and Veiga (2013), Roberson (2008), Volden (2007), Solé-Ollé and Sorribas-Navarro (2008), and Bracco et al. (2015), to cite a few. See Golden and Min (2013) for a relevant and relatively up-to-date survey.

Nevertheless, in these important literatures, the assumption that finance follows function has generally been disregarded. Under this assumption, if some powers are transferred from higher to lower subnational levels of government, there should be a proportionate transfer of resources (Bahl and Martínez-Vazquez, 2013). These are the so-called "unfunded mandates" (Rodríguez-Pose and Vidal-Bover, 2023), reflecting the underfunding experienced by some regions when the resources received from central governments are insufficient to adequately fulfill their mandates. The existence of these "gaps" thwarts the effectiveness of any devolving initiative, and can result in comparative grievances among regions—as some of them might be effectively *underfunded*, whereas others could end up being comparatively *overfunded*. However, as indicated by Rodríguez-Pose and Vidal-Bover (2023), the research attention devoted to this issue is limited, particularly from an empirical point of view, due to the shortage of adequate data for analysis at subnational level (Martinez-Vazquez et al., 2017).

We deal with these issues in the context of Spain, one of the countries where devolution has advanced most rapidly over the last four decades. This makes it a particularly interesting case study for three main reasons: (i) related to the previous comment, historically, Spain went from being highly centralized in the 1970s to becoming one of the world's most decentralized countries at the beginning of the twenty-first century; (ii) the Spanish Constitution allows for a high degree of openness, with flexibility in the speed and symmetry in which regional decentralization takes place (see section two for details); and (iii) the devolution process was closely related to the need to accommodate regional social demands that were also highly asymmetric (Lago-Peñas et al., 2017). The fact is that today, Spain is a quasi-federal state and one of the most decentralized countries in the world.[1] However, the evolution of its federalized system, the so-called "autonomy system" or *estado de las autonomías* (regions)[2] has triggered a complex inter-territorial equilibrium as a consequence of its asymmetries, where the degree of decentralization, the fiscal regime, and the amount of resources each of the regions receives from the central administration have been highly dependent on historical circumstances and influences that have led to situations of comparative grievance (Moreno, 2002; Harguindéguy et al., 2020). In this particular context, several contributions have dealt with issues related to the territorial organization of the country and its devolutionary process, including relevant work by González Alegre (2010), Balaguer-Coll et al. (2010b) and, more recently, Lago-Peñas et al. (2017). Fewer authors have dealt explicitly with the issue of regional financing and the possible existence of "unfunded mandates", however.

We consider two major changes in the Spanish regional financing system, namely, the approval of the 2001 model, and the formalization of the so-called Basque Economic Agreement (BEA) in 2002 (described in detail in the following section), as exogenous variations that enable us to identify some of their unintended consequences (in terms of "unfunded mandates") on regional economic development. Specifically, our aim is to analyze the differential impact that these changes on regional funding

[1] As indicated by Gómez Reino and Herrero Alcalde (2011), by the beginning of the 2010s regional governments in Spain managed approximately 35% of consolidated public expenditure; if social security payments were excluded this ratio increased to 50%. According to this indicator, Spain is one of the most decentralized countries in the world.

[2] As we will see in the next paragraphs, the *autonomías*, *comunidades autónomas* or regions correspond to NUTS2; NUTS stands for *Nomenclature d'Unités Territoriales Statistiques* and is a geocode standard developed by the European Union for referencing the administrative divisions of countries for statistical purposes.

might have had on regional economic development by exploring two scenarios. On the one hand, we examine the counterfactual scenario resulting from the implementation of an alternative financing regime (the so-called "common regime") on the Basque Country's economy. To do so, we measure the combined impact of the Basque Economic Agreement (BEA) approved in 2002, along with the exclusion of the Basque Country from the 2001 model. On the other hand, we evaluate the counterfactual scenario for a given region's economic development (the Valencian region, for reasons explained below) if it had received the average funding received by its peers—i.e., by other regions under the same regional financing scheme ("common regime").[3]

In terms of methodology, we consider that synthetic control methods are particularly suited to our context. As Abadie (2021) points out, unlike traditional regression analysis synthetic control methods do not require large samples and many observed instances of the policy intervention. An alternative would be to use time series methods, but they perform less well when evaluating medium- and long-run effects, due to the likely existence of other shocks (Abadie, 2021). However, despite the advantages of synthetic control methods in policy intervention scenarios, they have rarely been used in studies on decentralization and regional financing.

We find that if the Basque country had been under the common regime during the evaluation period—i.e., under the 2001 model—its level of GDP would have decreased sharply. Conversely, we also find that the Valencian region's status as the most unfunded region under the 2001 regional financing model coincides with a considerable reduction in its level of GDP per capita. That is, if the region had been as well funded as the average region, its level of GDP might have increased considerably. These results hold using our benchmark method—the synthetic control method—but also when we apply the canonical difference-in-differences analysis as a robustness check.

The rest of the article is structured as follows. After this introduction, Section 3.2 provides some insights into Spain's decentralization process and its regional financing

[3]As we shall see in Section 3.2, the Basque Country offers a unique case for study the impact of the 2001 model, as it was exempted from the common financing regime established by Organic Law 7/2001. Moreover, almost contemporaneously, the Basque Economic Agreement was implemented in 2002, which granted it formal fiscal autonomy and powers to collect its own taxes. These circumstances accentuate the unique position held by the Basque Country, providing a valuable opportunity to analyze how its economic development may have been influenced by these two interconnected factors—the exexmption from the common regime, and its formalization as a *foral* region (see Section 3.2). In contrast, the Valencian Community serves as a counterexample, as it was included in the common financing regime, yet it is considered the most unfunded region (see Table 3.1 and de La Fuente et al., 2019). For a deeper discussion on the choice of these two regions, see Tables 3.2 and 3.3, and Figure 3.2.

system. The empirical strategy and data are presented in Sections 3.3 and 3.4, respectively. Section 3.5 outlines and discusses the main results of the study and, finally, Section 3.6 concludes.

3.2. Institutional framework and theoretical discussion

After the end of Franco's dictatorship (1939-1975), and with the start of the democratic era under the new constitution (Spanish Constitution 1978, SC henceforth), Spain underwent an intense but asymmetric decentralization process, beginning with the so-called *Estado de las Autonomías* ("state of the regions"). Today, Spain has 17 *Comunidades Autónomas*[4] (Autonomous Communities, ACs hereinafter), which correspond to NUTS level 2 in European terminology,[5] and 2 *Ciudades Autónomas*[6] (autonomous cities). The 17 regions encompass 50 provinces, corresponding to NUTS3 in European terminology and, despite European Union initiatives (such as the European Regional Development Fund and the European Committee of the Regions), income inequalities are large and persistent. Although inequalities peaked between the mid-nineteenth century and the early twentieth century, the regions converged until the 1980s (Tirado et al., 2016; Martínez-Galarraga et al., 2015). Since then, the process has not been robust to the macroeconomic indicator considered (e.g., GDP per capita, labor productivity, TFP or capital intensity), or the relative population size of each territory (Tortosa-Ausina et al., 2005; De la Fuente, 2002).

These 17 Spanish regions reflect different identities and sensibilities that have always coexisted in Spain, all with their own wide ranging linguistic and historical backgrounds. Some of these sought recognition in the SC. In this process, two regional financing regimes were created: the *foral regime*, and the *common regime*. The former was implemented in the Basque Country and Navarre, whereas the latter was applied in the remaining ACs. Over the years, both regimes have taken major steps toward fiscal decentralization. However, there are crucial differences in terms of fis-

[4] Andalusia, Aragon, Asturias, Balearic Islands, Cantabria, Catalonia, Castile-La Mancha, Castile-León, Canary Islands, Extremadura, Galicia, La Rioja, Madrid, Murcia, Navarre, Basque Country and Valencian Community.

[5] NUTS stands for European Commission's nomenclature of territorial units for statistics (*Nomenclature des Unités Territoriales Statistiques*). NUTS level 2, or NUTS2, would be the European regions, which correspond to Spanish autonomous communities (*comunidades autónomas*) and we therefore use the terms interchangeably.

[6] Ceuta and Melilla.

cal autonomy and level of financing, which provide favorable conditions for the *foral* regions. The main difference lies in the very limited fiscal autonomy enjoyed by the regions under the common regime, which implies a high degree of dependence on transfers from central government (Almendral, 2003). In addition, the evolution of the common regime has also been highly asymmetric, which has led to significant imbalances and inequalities among the regions under this system.

From this historical perspective, the decentralization process initiated in 1978 arose out of an increasing demand for regional self-government after the highly-centralized dictatorship. In the case of the common regime, the SC recognizes the right to claim increased powers according to changing circumstances, i.e., the degree of decentralization depends on the will of the inhabitants of each region or autonomous community (*comunidad autónoma* Moreno, 2002). Thus, the SC allows each region to apply for increased self-government, but provides no standard procedure through which to do so. During the 1980s and 1990s, different models—and their corresponding modifications—were implemented to deal with the asymmetry of the decentralization.[7] The crucial point came with the approval of the so-called 2001 model, where, for the first time, the common regime was elevated to a legal category, all regions were symmetrically in charge of education and health, and all regions were subject to the same ceilings on competences (Gómez de la Torre del Arco et al., 2010)—i.e., the same powers were devolved, with no substantial differences among regions. In contrast, the fiscal arrangement for the *foral* regions (the Basque Country and Navarre) was much closer to that of a confederal state, with almost full control of all their taxes in their jurisdictions (Lago-Peñas et al., 2017). Although the *foral* system dates back many centuries, it was most critically affected by recent laws in 2002 for the case of the Basque Country and in 1990 for the case of Navarre, when the so-called *Concierto Económico Vasco* (or "Basque Economic Agreement", BEA) and *Convenio Económico de Navarra* (or "Navarre Economic Agreement") were approved.

Reaching a comprehensive understanding of the full nature and complexity of the Spanish decentralization process is a challenging task (Lago-Peñas et al., 2017). However, considering that, on the one hand, there are substantial differences between the *foral* and the *common* regimes and, on the other hand, there are important asymmetries among the regions within the common regime, we can evaluate part of their economic

[7]The four successive models corresponded to periods 1978–1986, 1987–1991, 1992–1996, and 1997–2001.

consequences in the GDP per capita of the Valencia Community and the Basque Country by exploiting the exogenous variation implied by the implementation of the 2001 model in the common regime in the former, and the combined impact of the BEA approval and exclusion from the 2001 model in the latter.

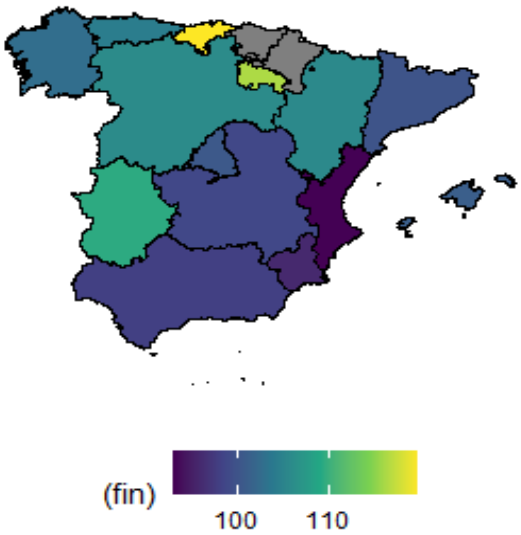
The Basque case: The historical anomaly of the Basque Country within the Spanish legal framework is an old conflict that goes back more than a century: the first economic agreement approved between the region and the contemporaneous Spanish government was signed in 1878. More recently, the critical point came with the approval of the economic agreement, the *Concierto Económico Vasco* (Basque Economic Agreement, BEA), in 2002. According to de la Fuente (2010), the BEA has led to a notable reduction in the tax revenues—the "cupo" or "quota"—that the Basque Country would have been expected to pay to the state. Similarly, there is also a fairly widespread consensus that *foral* status in general, and the BEA in particular, might imply a level of over-financing in the vicinity of 50-60% compared to the regions under the common system (Gray, 2015). This simultaneous exclusion of the Basque Country from the 2001 model applied to the common regime regions and the modification of the Basque Economic Agreement in 2002, which reinforced the Basque Country's status as a *foral* region, may have led to an increase in the Basque Country's level of GDP compared to the control units (the common regime regions), analogous to the effects modeled by the literature on local and regional fiscal multipliers (Brueckner et al., 2023; Chodorow-Reich, 2019).

The Valencian case: The Valencian region or *Comunitat Valenciana* accounts for 10.6% of the total Spanish population (similar to the population of Denmark, for example) and 9.3% of the total Spanish GDP. In addition, there is widespread consensus that it is the common regime region most adversely affected by the 2001 financing model. According to de La Fuente et al. (2019) and Pérez-García et al. (2017), among others, in almost every fiscal period the Valencian region has been the most underfunded region within the system since the 2001 model was approved. According to these reports,[8] there are systematic asymmetries in the

[8]de La Fuente et al.'s (2019) comparison is based on the *población ajustada a competencies homogéneas* index, which measures what each individual in each region receives from the system. It offers an realistic homogenization based on the adjusted population and any small differences in competences that each

level of financing of the regions. These differences can easily be observed by comparing regions in the *población ajustada a competencias homogéneas* index. Figure 3.1 and Table 3.1 show how the system yields clear "winners" and "losers" according to this index, with Valencia being the most severely treated region. Ultimately, this position might suggest that this comparative regional disadvantage (in terms of lack of financial resources) could have had an impact on the region's economic performance.[9]

Figure 3.1: Effective financing per inhabitant, common system regime (2002–2018)



This index measures what each individual in each region receives from the system, making a proper homogenisation based on the adjusted population ("población ajustada a competencias homogéneas") and, any small difference in competencies that each region may enjoy (Source: de La Fuente et al. (2019)). The mean reference is 100. Grey color indicates no information, as the Basque Country and Navarre are not ruled by the common system. As shown, the Valencian Community is the last in the row.

region may enjoy.

[9]During the period of study, there were two financing models, the 2001 model and the 2009 model. Although the mechanics of the two models changed, the relative position of Valencia as the most underfunded region remained the same under both of them. Therefore, as we focus on the likely economic effects of regional underfunding, rather than the specific effect of a regional financing model, we will refer to the 2001 model effect as the joint effect of both models.

Table 3.1: Effective financing per inhabitant adjusted to homogeneous competences over the period 2002–2018

Catalonia	Galicia	Andalusia	Asturias	Cantabria	La Rioja	Murcia	Valencian Community
99.7	102.5	97.7	104.1	119.8	116.3	95.5	92.7
Aragon	**Castile-La Mancha**	**Canary Islands**	**Extremadura**	**Balearic Islands**	**Madrid**	**Castile-León**	**Mean**
105.5	98.5	100.2	109.3	100.9	100.3	105.7	100.0

[a] Source: de La Fuente et al. (2019).

Figure 3.2 illustrates the mechanism that governs the design of the evaluation framework (see Tables 3.2 and 3.3). The implementation of the 2001 model is expected to result in a divergence in Basque Country GDP per capita when compared to the control group. The 2001 model established the common regime system for the control group regions, which provided a much less advantageous financing system than the *foral* and placed the Basque country in a privileged position. This position is significant, considering that the Basque Country's *foral* status was established almost simultaneously with the implementation of the Basque Economic Agreement (BEA). This coincidence makes the Basque Country an especially interesting research scenario, as it offers insights into the implications that these two systems may have.[10]. Put another way, the application of the 2001 model to the common regime regions might have implied a *de facto* advantage for the Basque Country over the regions under the umbrella of the 2001 model—an advantage that was furthermore reinforced with the approval of the Basque Economic Agreement in 2002.

As for the remaining regions, the homogeneous system created by the 2001 model allows them to be properly compared. Within this system, and according to the adjusted population index (see Table 3.1 and Figure 3.1),[11] the Valencian Community seems to have received less funding with respect to its mandates. Taking into consideration the existing "gaps" in funds received and competencies transferred across the common regime regions after the approval of the 2001 model, we leverage these variations in our analysis, and investigate whether the apparent *"unfunded"* mandates that might be affecting the Valencian region have an adverse effect on economic development—ultimately having the opposite effect to a local fiscal multiplier (Nakamura and Steinsson, 2014).[12]

[10]Note that the evaluation framework we are considering neither fully encompasses the impact of *foral* region status for the Basque Country, nor the potential historical comparative grievance for the Valencian Community. This is because the *foral* condition precedes the scope of our evaluation framework, and neither can we determine if the Valencian Community was previously underfunded, since the common regime was not widespread before the implementation of the 2001 model. Thus, although a provisional BEA agreement had been in place since 1980, the fact that the financing system of the remaining (common regime) regions, which act as control units, was modified through the approval of the 2001 model means the Basque Country is the *de facto* treated region.

[11]This adjusted index ("población ajustada a competencias homogéneas index") did not exist before the approval of this model, since the competences and the funding system for each region within the common financing regime were asymmetrical.

[12]As a robustness check to evaluate the strength of our results, we run a placebo analysis in Appendix C, reassigning the onset of the treatment to different legislation changes.

Figure 3.2: Mechanisms

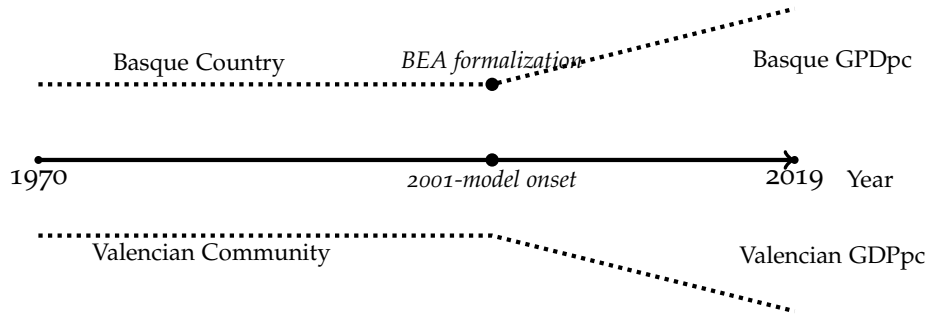


Table 3.2: Evaluation framework

	Basque Country	Valencian Community
Treatment	Organic Law 7/2001, of December 27, 2001, amending Organic Law 8/1980, of September 22, 1980, on the Financing of the Autonomous Communities (LOFCA) (*Ley Orgánica 7/2001, de 27 de diciembre, de modificación de la Ley Orgánica 8/1980, de 22 de septiembre, de Financiación de las Comunidades Autónomas, LOFCA*)	Organic Law 7/2001, of December 27, 2001, amending Organic Law 8/1980, of September 22, 1980, on the Financing of the Autonomous Communities (LOFCA) (*Ley Orgánica 7/2001, de 27 de diciembre, de modificación de la Ley Orgánica 8/1980, de 22 de septiembre, de Financiación de las Comunidades Autónomas, LOFCA*)
Counterfactual	Exogenous change in the financing model (i.e the 2001.model) of all common regions results in the Basque Country being treated *de facto*. The counterfactual scenario is: what the impact on the Basque economy would have been if it had been under the common regime during the treatment period.	According to the Index of Population adjusted to Homogeneous Competencies, the Valencian Community has experienced the greatest level of underfunding within the framework of the Common Regime. The counterfactual scenario is: what would have been the implications for the Valencian economy if it had received funding comparable to the average level within the Common Regime?
Controls	The common regime regions	The Non-unfunded regions in the common regime

Table 3.3: Evaluation framework and devolved powers

Region affected	Treatment-Law	Legislative characteristics
Foral regime (Basque Country)	Law 12/2002, of May 23, which approves the Economic Agreement with the Basque Country	• Fiscal autonomy: the Basque Country has the right to collect and manage its own taxes, giving it greater control over its economy. • Resource distribution: the law establishes a system of resource distribution between the central government and the Basque Country region, ensuring that the region receives an equitable amount of funding. • Economic development: the law aims to promote economic development in the region by granting fiscal and financial incentives to companies that invest in the Basque Country. • Competitiveness: the law also promotes the competitiveness of the region by allowing for the creation of a more favorable fiscal and economic regime for companies.
Common regime (Valencian region)	Organic Law 7/2001, of December 27, amending Organic Law 8/1980, of September 22, on Financing of the Autonomous Communities (LOFCA)	• Financing system: the law establishes a regional financing system based on the distribution of resources between the state and the Autonomous Communities. These resources come mainly from taxes and other state revenue. • Compensation funds: the existence of compensation funds is expected to correct economic inequalities between the different autonomous communities. • Participation in state's tax revenues: rules are established for the participation of the autonomous communities in state revenues.

3.3. Empirical strategy

Although Spanish fiscal decentralization is an ongoing, unfinished process (Lago-Peñas et al., 2017) that started more than 40 years ago, we attempt to illustrate some of its dynamics by exploiting the exogenous variation implicit in the implementation of the 2001 model for the common regions with reference to the Valencian Community, and the combined impact of BEA approval and exclusion from the 2001 model on the Basque Country. To this end, we base our analysis on the synthetic control method (SCM, hereinafter) for comparative case studies, as developed by Abadie and Gardeazabal (2003) and Abadie et al. (2010), to exploit the differences between the treated unit and the control units in the two cases. In addition, we extend our empirical strategy by also using the canonical difference-in-differences analysis as a robustness check.[13]

We consider that both the Basque Country and the Valencian Community face exogenous factors that affect their economic performance. The Basque Country's unique tax regime gives the region significant autonomy over its tax revenues, but this regime is largely determined by political and legal factors unrelated to the region's economy. In other words, the decision to attribute this condition to the Basque Country was driven not by economic reasons but by its role as a historical territory (Jiménez-Rubio and García-Gómez, 2017). We can therefore consider that the foral condition is related to cultural or historical factors rather than to economic ones (Jacques et al., 2022). Similarly, the level of funding to the Valencian Community from the Spanish central government is largely influenced by political factors and policy considerations, which are unrelated to economic performance. Because its status as the most "underfunded" region can be attributed to political rather than economic reasons (i.e., an unwillingness, for a variety of reasons, to redesign the existing regional financing model), the implication is that the relative position as the worst financed region can be assumed to be exogenous.

A fundamental characteristic of event-study techniques is the need to find a suitable control group that does not confound the effect of the treatment. For that reason, no region evaluated as a treated unit was used as a control unit in the alternative evaluation, since that could distort the results. For instance, when estimating the effect of underfunding on the Valencian Community, neither *foral* region was included in the

[13] Since the difference in the time trends is identified using only a single observation for the treated group in each year, the reported confidence intervals must be treated with caution.

control group and *vice versa*. Similarly, we also excluded out the Canary Islands from the estimations, since its particular fiscal situation as an isolated territory may affect the validity of the overall results. Finally, in the case of the Valencian Community, we eliminated Murcia as a control region in the evaluation of the 2001 model, since it is the second most underfunded region and it could therefore lower the real consequences of the policy change. Nevertheless, we perform a robustness exercise that includes Murcia as a control region to test the validity of the control group—i.e., if the inclusion of Murcia lowers the effect of the 2001 model for the Valencian community, this would imply that the specifications are correctly capturing the effect of the law.

Although our empirical strategy is based on the synthetic control method, we also include a difference-in-differences analysis as a robustness check. We consider that the synthetic control method is the most appropriate method to use in this context for two main reasons: (i) it is suitable when one or only a few units are exposed to the treatment, and (ii) it is appropriate when the number of observations is relatively limited. The hypothesis to be tested are as follows:

Hypothesis 1 *The counterfactual scenario of the Basque economy, namely, being under the 2001 model, would have reduced its current level of GDP; thus, a share of its actual level of GDP is driven by its foral status.*

Hypothesis 2 *The counterfactual scenario of the Valencian Community, namely, being as well funded as the average for the common regime regions, would have increased its actual level of GDP. Thus, being comparatively underfunded implies a reduction in the potential level of Valencian GDP.*

Hypothesis 2a *The effect of the 2001 model in Valencia is robust when the second most underfunded region (Murcia) is included in the control group.*

These hypotheses are supported theoretically and empirically in the literature analyzing the impact of decentralization on growth. Several contributions to the field are theoretical (starting with Oates et al., 1972; Martínez-Vázquez and McNab, 2003), but many others provide relevant empirical applications for both cross-country (Davoodi and Zou, 1998; Rodriguez-Pose and Ezcurra, 2010) and single-country (Xie et al., 1999; Zhang and Zou, 1998) samples, as well as developed (Thornton, 2007) and developing (Zhang and Zou, 2001) countries. As indicated by Iimi (2005), although the theory

clearly establishes that decentralization leads to efficient provision of public services and results in rapid economic development, the links from an empirical viewpoint are less clear.

Baskaran et al.'s (2016) meta-analysis showed that, although results are sometimes "widely diverging", single-country studies tend to find a positive effect of decentralization on growth. This would provide support for Hypothesis 1, but not Hypotheses 2 and 2a. However, we should take into account that the Spanish decentralization process is asymmetrical, with spending and revenue decentralizations not taking place homogeneously across the territory. In this regard, Gemmell et al. (2013) found that revenue decentralization tends to be associated with higher economic growth, whereas spending decentralization is associated with lower economic growth, lending empirical support to Hypotheses 2 and 2a. Therefore, although *a priori* our hypotheses may seem crude, we should bear in mind that a relevant (and inconclusive) literature provides an adequate theoretical and empirical framework.

We should also take into account that approval of a given regional financing model can be understood as a *de jure* decentralization. However, if the regional financing model does not adapt to the changing socioeconomic circumstances, we could consider that devolved powers could *de facto* be reverted—due to insufficient transfers to lower levels of government.

The above rationale is related both to the literature on decentralization and growth and to the (relatively recent) literature on geographic cross-sectional fiscal spending multipliers. The number of contributions to this literature is now relatively high (see Chodorow-Reich, 2019, for a review), and some of them deal with issues connected to ours. For instance, Brueckner et al. (2023) evaluate the effect of the degree of local government autonomy (considering the "Local Autonomy Index", LAI) on the geographic cross-sectional fiscal multiplier (see also Coelho, 2019). This enables the authors to estimate the effect that regional government spending has on regional gross value added. Therefore, a natural extension for our research would be to link the decentralization-growth and "unfunded mandates" literatures with the local fiscal multipliers literature, in order to provide even more precise measures of the losses (not only in terms of GDP per capita but also welfare), and the implications of these gaps between transferred powers and funds received.[14]

[14] Examples of these potential mechanisms are multiple and varied. As the bulk of transfers correspond to competencies in education and health (which, as indicated in Ministerio de Economía y Hacienda,

3.3.1. Synthetic Control Method

The synthetic control method (SCM) has proved to be an extremely useful tool when a few (usually one) aggregate units (school, region, country) are exposed to a treatment, policy intervention or event.[15] Essentially, the method is based on the idea that a weighted combination of untreated units may provide a better comparison group when the number of units is small. Specifically, similarly to Abadie and Gardeazabal (2003), who construct a synthetic Basque Country based on a combination of two Spanish regions, we construct our corresponding synthetic regions based on a weighted combination of the remaining non-*foral* regions in the case of the Basque Country and non-underfunded regions in the case of the Valencian region. By doing this, we aim to trace the trajectory that our variable of interest (GDP per capita) would have taken in the absence of the event.

Formally, building on Abadie (2021), let us assume that we observe $J+1$ regions: $j = 1, 2, \ldots, J+1$. Without loss of generality, we also assume that the first region is the only one exposed to the event $j = 1$—i.e., the treated unit (we will use the terms "treatment", "event", "status" and "intervention" interchangeably). Consequently, the remaining J regions correspond to the "donor pool". In the same line and, for the sake of simplicity, let us assume that the treated unit $j = 1$ is exposed to the treatment without interruption.[16] Suppose our dataset comprises T periods, with T_0 corresponding to the periods before the onset of the event; we therefore have $1 \leq T_0 \leq T$. Let Y_{jt} be the outcome of interest for each unit j and time t. Following the same notation, we define Y_{jt}^N as the potential outcome without intervention for region j and period t. Consequently, we characterize Y_{jt}^I as the potential outcome under intervention. The latter outcome is the case only for the unit affected by the treatment $j = 1$ during the post-intervention period $t > T_0$. Finally, if we want to evaluate the effect of the event

2004, are responsible for most of the deficit in the case of the region of Valencia), the indirect effects may involve opting for either private and subsidized schools (in order to avoid public schools with fewer resources), or opting for private health (to avoid long waiting lists), which might diminish households' disposable income. However, many other effects could exist apart from education and health, such as the transfers received from provincial councils (Narbón-Perpiñá et al., 2021) for implementing programs in small municipalities, etc.

[15] In the words of Athey and Imbens (2017), "the synthetic control approach developed by Abadie et al. (2010, 2014) and Abadie and Gardeazabal (2003) is arguably the most important innovation in the policy evaluation literature in the last 15 years".

[16] Although in the Valencian case, there were two different financing models in this period, the region lies in the same relative position in both of them, and consequently there is no methodological problem.

in the treated unit, we arrive at the following equation:

$$\tau_{1t} = Y_{1t}^{I} - Y_{1t}^{N} \tag{3.1}$$

where τ_{1t} is the effect of the treatment for the affected unit in period t, satisfying $(t > T_0)$. Notice that in Equation (3.1), the intervention effect may change over time, and could therefore lead to different values for each different t period. This equation gives rise to what Holland (1986) refers to as "the fundamental problem of causal inference", namely, the impossibility of observing the outcome of an event and, at the same time, what would have happened in the absence of that event. Obviously, we can only observe one of those, and here lies the core of the problem. In our case, we only observe the evolution of the GDP per capita of our two regions of interest under their current status. Consequently, we need to develop a proper comparison unit to see what would have been the result in the absence of the event. Basically, we need to estimate Y_{1t}^{N}.

As indicated above, the SCM solves this problem by estimating the counterfactual Y_{1t}^{N} as a weighted average of the untreated units, which are intended to best reproduce the characteristics of the treated unit prior to the intervention period. Mathematically, our "synthetic" Basque Country and our "synthetic" Valencian Community are defined by a $J \times 1$ vector of weights $\mathbf{W} = (w_2, \ldots, w_{J+1})$, where $\mathbf{W}$ is the selected combination of non-*foral* and non-unfunded regions, respectively. Note also that weights are restricted to be non-negative, and to sum to one to avoid extrapolation.[17] Given this selection, the potential synthetic outcome is represented by:

$$\widehat{Y}_{1t}^{N} = \sum_{j=2}^{J+1} w_j Y_{jt} \tag{3.2}$$

Consequently, the estimator for the effect of the treatment displayed in Equation (3.1) is:

$$\widehat{\tau}_{1t} = Y_{1t} - \sum_{j=2}^{J+1} w_j Y_{jt} \tag{3.3}$$

Additionally, we need a set of k potential predictors of the corresponding outcome to conduct the SCM. Thus, on the one side we have $\mathbf{X}_1$, which is the $k \times 1$ vector

[17] It is possible to relax this assumption assuming the cost of extrapolation. See Abadie (2021).

containing values of the pre-intervention covariates of the treated unit. On the other side, we have $\mathbf{X}_0$, which is the $k \times J$ matrix containing the values for the same covariates for the non-treated regions. Typically, those predictors include outcome lagged values as well as well-known determinants of the outcome variable.

The main challenge of this methodology lies in selecting the optimal combination of weights $\mathbf{W} = (w_2, \ldots, w_{J+1})$. Our selection criterion is based on Abadie and Gardeazabal (2003) and Abadie et al. (2010), who choose the optimal weight $\mathbf{W}^*$ that minimizes the following expression:

$$\|\mathbf{X}_1 - \mathbf{X}_0\mathbf{W}\| = \left(\sum_{h=1}^{k} v_h \left(X_{h1} - w_2 X_{h2} - \ldots - w_{J+1} X_{hJ+1}\right)^2\right)^{1/2} \tag{3.4}$$

Since the optimal weights $\mathbf{W}^*$ minimizing Equation (3.4) depend on $\mathbf{V} = (v_1, \ldots, v_k)$, the criterion to choose $\mathbf{V}$ corresponds to the decision about the relative importance that each covariate is assigned (predictor) to minimize Equation (3.4), which ultimately involves the measurement of the discrepancy between $\mathbf{X}_1$ and $\mathbf{X}_0\mathbf{W}$. That said, the optimal $\mathbf{V}$ was selected following Abadie's (2021) recommendations, and we chose the one which most closely reproduces the pre-intervention trajectory of the treated unit (region). Consequently, we selected the $\mathbf{W}(\mathbf{V})$ that minimizes the root mean squared predicted error ($RMSPE$), which formally measures the lack of fit between the trajectory of the outcome variable (GDP per capita) in the treated region and in its counterfactual (Abadie et al., 2014). Indeed, this is the main objective of the method, since, the lower the $RMSPE$ before the intervention, the better the fit of our synthetic regions and, therefore, the more reliable the potential effect shown as a consequence of the intervention.

3.3.2. Difference-in-Differences

In the last decades difference-in-differences regression has become one of the most popular research designs to assess the causal effects of policy interventions. In its most widely used form, there are two groups and two time periods. In the first period no group is treated, whereas in the second one some units (in our case, regions) are treated (the treated group), and some units (regions) are not (the comparison group). In the case that there is no treatment and the average outcomes for treated and comparison groups follow parallel paths, it is possible to estimate the average treatment

effect for the treated subpopulation (Callaway and Sant'Anna, 2021). To do this, the average change in outcomes experienced by the treated group is compared to the average change in outcomes experienced by the comparison group. Therefore, it provides a fundamental tool that facilitates causal inference, controlling for any possible time-invariant heterogeneity across units that may confound the effect of the treatment (Villa, 2016).

Part of the popularity of the difference-in-differences method derives from its relative simplicity. As indicated above, the main factor to consider when applying this methodology is that treated and control units (regions) display parallel paths before the implementation of the event, which supports the so-called parallel trends assumption, otherwise the estimated effect would lose its credibility. We estimate the following equation:

$$Y_{jt} = \alpha + \beta_0 D_j + \beta_1 Post_t \times D_j + \gamma X_{jt} + Region_j + Time_t + \varepsilon_{jt} \tag{3.5}$$

where Y_{jt} stands for nominal GDP per capita in region j at period t, D_j is a dummy variable which equals 1 for the treated region and 0 otherwise while $Post_t$ is a dummy variable which equals 1 for observations in the post-treatment period and 0 otherwise. If the assumption of parallel trends is met, the coefficient β_1 on the interactive term $Post_t * D_j$ represents the treatment effect, capturing the impact of the event in the post-treatment years. We also include a set of covariates, X_{jt}, typically associated in the literature with GDP growth, to ensure that any possible variability between regions not caused by the event has been "netted out" (see Tables 3.4 and 3.5 for a list of variables and descriptive statistics).

3.4. Data and variables

To undertake our empirical strategy, we use regional level panel data for the 17 autonomous communities (regions) during the 1971–2019 period. We use GDP per capita as the dependent variable to explore the effect of the corresponding laws (regional financing models) on each of the treated regions. To ensure that the potential effect seen after the approval of the laws is not driven by other factors, we control for well-known determinants of GDP growth (Barro and Sala-i Martin, 1995). The data are taken from two reputable Spanish institutions, FEDEA (*Fundación de Estudios de Economía Apli-*

cada) and Ivie (*Instituto Valenciano de Investigaciones Económicas*), to obtain some of the necessary variables for our research.

Table 3.4 presents the selected variables and their descriptive statistics are reported in Table 3.5. We include the inflation rate and population density as regional controls. We include sector weights (Gross Value Added) accounting for the primary, secondary and tertiary sectors, which allows us to differentiate between the public and private sector in the tertiary sector, in addition to construction. Educational level is also included, following Barro (2001). The investment to GDP ratio is included (to control for the evolution of investment weight in the economy in each region), as well as the proportion of real estate over GDP (since the evaluation period coincided with the real estate bubble in Spain). Finally, we control for level of employment and unemployment, to proxy for the evolution of the labor market. Our choice of variables was guided by relevant previous contributions using the same methodologies, including Abadie and Gardeazabal (2003), Abadie et al. (2014), Born et al. (2019), and Lago-Peñas et al. (2019), among others.[18].

[18]For a deeper examination of the determinants of growth, there is a vast related literature, as noted by Sala-I-Martin (1997)

Table 3.4: Definitions and sources for the relevant variables

Variable	Description and source(s)[a,b]
GDP per Capita	Nominal GDP in euros (regional level)/Population (regional level), from Fedea
Population Density	Population (regional level)/Km^2 (regional level) (Fedea)
Inflation Rate	Annual Inflation rate (regional level) (Fedea)
Employment	Total Employment (regional level)/Population (regional level) (Fedea)
Unemployment	Total Unemployment (regional level)/Population (regional level) (Fedea)
Primary Sector	Nominal agriculture weight in euros (regional level)/Nominal GDP in euros (regional level) (Fedea)
Industry Sector	Nominal manufacturing industry weight(regional level)/Nominal GDP in euros (regional level) (Fedea)
Cunstruction Sector	Nominal construction weight in euros (regional level)/Nominal GDP in euros (regional level) (Fedea)
Market Services	Nominal market serviceswithout health and education (regional level) (Fedea)/ Nominal GDP in euros (regional level) (Fedea)
Public Services	Nominal public Services with Education and Health (regional level)/Nominal GDP in euros (regional level) (Fedea)
Illiterates	Proportion of population over 25 years old which is Illiterate (regional level) (Fedea)
Primary Education	Proportion of population over 25 years old with primary education as maximun (regional level) (Fedea)
1^{st} Level Secondary Education	Proportion of population over 25 years old with 1^{st} level secondary education as maximum (regional level) (Fedea)
2^{nd} Level Secondar Education	Proportion of population over 25 years old with 2^{nd} level secondary education as maximum (regional level) (Fedea)
1^{st} Level Higher Education	Proportion of Population over 25 years old with 1^{st} level superior education as maximum (regional level) (Fedea)
2^{nd} Level Higher Education	Proportion of population over 25 years old with 2^{nd} level superior education as maximum (regional level) (Fedea)
Investment	Nominal Investment in euros (regional level) (Ivie)/Nominal GDP in euros (regional level) (Fedea)
Real State Investment	Nominal Real State investment (regional level) (Ivie)/Nominal GDP in euros (regional level) (Fedea)

[a] Fedea: Fundación de Estudios de Economía Aplicada, https://fedea.net/.
[b] Ivie: Instituto Valenciano de Investigaciones Económicas, https://www.ivie.es/en_US/.

Table 3.5: Descriptive statistics, relevant variables

Variable	# Obs.	Mean	Std. Dev.	Min.	Max.	Source
GDP per capita	833	12,322.150	9,185.501	280.492	35,875.571	Fedea
Population Density	833	141.6227	153.4344	20.77201	832.884	Fedea
Inflation Rate	833	6.580	5.917	−4.93	24.354	Fedea
Employment (%)	816	56.444	7.882	38.618	77.629	Fedea
Unemployment (%)	816	7.798	4.695	0.071	25.072	Fedea
Primary Sector (%)	833	6.430	5.113	0.053	26.840	Fedea
Industry Sector (%)	833	17.477	8.508	2.345	45.885	Fedea
Construction (%)	833	8.382	2.127	4.116	15.981	Fedea
Market Services (%)	833	41.690	8.274	26.809	64.176	Fedea
Public Services (%)	833	14.598	3.388	6.553	25.883	Fedea
Illiterates (%)	782	4.834	4.606	0.513	20.712	Fedea
Primary Education (%)	782	54.587	18.831	17.687	86.914	Fedea
1^{st} Level Secondary Education (%)	782	16.312	8.219	1.148	32.986	Fedea
2^{st} Level Secondary Education (%)	782	12.789	8.162	0.954	29.259	Fedea
1^{st} Level Higher Education (%)	782	5.677	2.495	1.690	13.540	Fedea
2^{st} Level Higher Education (%)	782	5.801	4.055	0.879	23.736	Fedea
Investment/GDP	782	26.132	5.633	13.966	55.900	Ivie
(Real State Investment)/GDP	782	7.901	3.434	.785	24.545	Ivie

All variables are measured at regional level. GDP per capita, Inflation Rate, Population Density and GVA variables contain information over the period 1971–2019. Employment and Unemployment contain information over the period 1971-2018. Level of Education Variables, Investment and Real State Investment contain information over the period 1971–2016.

3.5. Results

3.5.1. Synthetic control method results

In this subsection, we provide results for the synthetic control method (SCM) estimations. As mentioned in Section 3.3, similarly to difference-in-differences, the SCM method exploits the differences between treated and untreated units alongside the evaluation period. However, the SCM has a fundamental advantage over difference-in-differences, in that it does not assign the same weight to all control units, but it generates a weighted average of a selected number of controls that better reproduce the pre-intervention characteristics of the outcome (Galiani and Quistorff, 2017).

After selecting the weights W^*, which minimizes Equation (3.4), we now turn to the evolution of the GDP per capita after the corresponding laws were enacted in each region. Figure 3.3 displays the trajectory corresponding to the Basque GDP per capita for the 1971–2019 period. We can infer from the graph that the combination of the reinforcement of the Basque Country's *foral* status (with BEA approval) and the exclusion from the 2001 model caused a significant divergence between the real and the synthetic Basque Country. This shows what could have happened to the Basque economy if it had been subject to the 2001 model rather than the BEA. Analogously, Figure 3.4 also displays the consequences for the Valencian economy of the 2001 model approval. The synthetic Valencia allows us to observe the hypothetical scenario illustrating how the Valencian economy might have evolved if it had not been an underfunded region.

The evolution of the outcome in both regions is reported numerically in Table 3.6, where the GDP per capita impact is measured year by year. In both cases, the effect is statistically significant with 99% probability in almost every post-treatment period. In the Basque Country, in both Figure 3.3 and Table 3.6, the results suggest a more than 10% gain from not being under the 2001 model, i.e. if the 2001 model would have been applied to the Basque country, its level of GDP per capita might have experienced a decline—about 4,544.02€ difference in 2019 relative to the *synthetic* Basque Country. In contrast, according to Figure 3.4 and Table 3.6, the implementation of the 2001-model might have led to a reduction of the Valencian level of per capita GDP of about 2,258€ in 2019 relative to its *synthetic* counterpart, which constitutes almost a 10% loss of the effective level of Valencian GDP per capita in that year. Figures 3.5 and 3.6 also provide graphical visualizations for the magnitude of the effects in each of the regions. Based

on the information provided in this section, we can confirm Hypotheses 1 and 2.

The magnitude of the findings shown in this study is consistent with previous work by other authors. Specifically, the gap between the real data and the synthetic control (as a consequence of the BEA and the exclusion from the 2001 model in the case of the Basque Country and of the 2001 regional financing model in the case of the Valencian Community) seems reasonable if other effects shown by related works using GDP as a dependent variable are taken into consideration. (see Mora-Sanguinetti and Spruk, 2022; Mora-Sanguinetti et al., 2021, among others). However, the most interesting case is that of Abadie and Gardeazabal (2003), who found a 10% loss of GDP for the Basque Country as a consequence of ETA terrorism from the early 1970s to the late 1990s. Our findings show that implementing the BEA had the opposite effect, since it would have resulted in a 10% GDP premium for the Basque country during the first two decades of the 21st century.

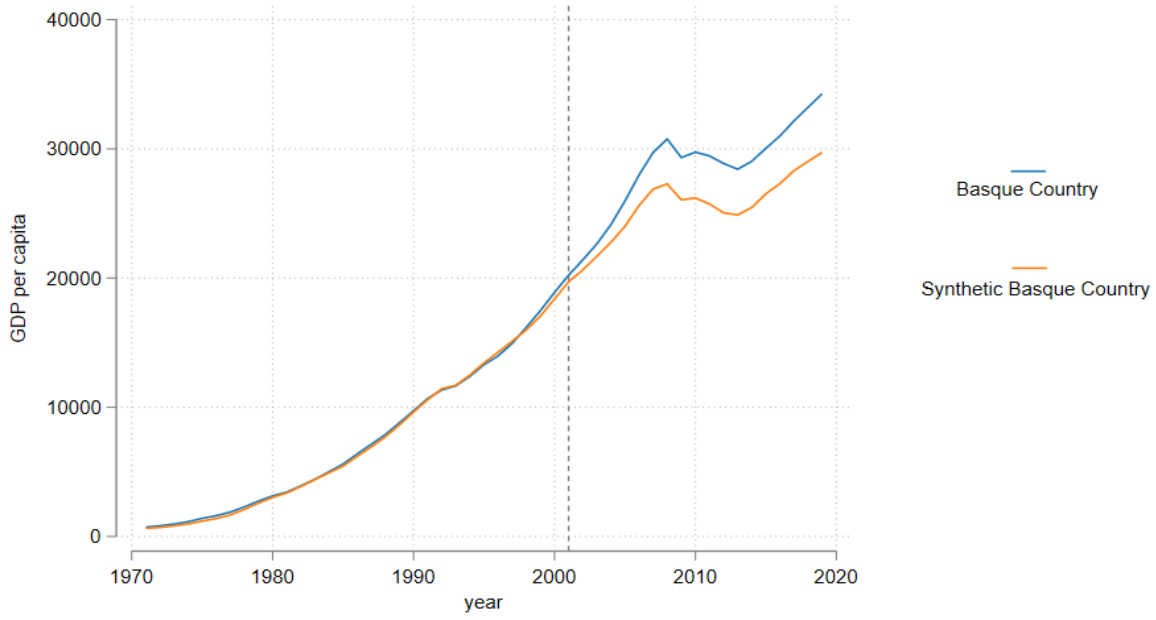
The above analysis assumes that the fiscal deterioration of one region does not necessarily imply that another region's fiscal situation improves, and vice versa. If this were the case, it would be a violation of the stable unit treatment value assumption underpinning the analysis, as the impact of the treatment would spill over (with the opposite sign) to the regions which we consider to be untreated. This would lead to a downward bias in the estimate of the treatment effect in the case of Valencia (i.e. the estimated impact would be more negative than the true effect), since the estimate would reflect not only the impact of the fiscal deterioration of the treated region but also the fiscal improvement of the control regions. Analogously, in the case of the Basque Country the estimate would be biased upwards.

Table 3.6: Synthetic Control Method for the Basque Country and the Valencian Community

	Basque Country	Valencian Community
Leads	*Foral* gains	Underfunding costs
2002	775.79^{***}	-15.05
2003	951.73^{***}	-211.27
2004	$1,366.25^{***}$	-451.26^{*}
2005	$1,958.13^{***}$	-709.11^{***}
2006	$2,364.06^{***}$	-855.96^{***}
2007	$2,838.68^{***}$	$-1,203.47^{***}$
2008	$3,475.56^{***}$	$-1,358.40^{***}$
2009	$3,263.51^{***}$	$-1,665.17^{***}$
2010	$3,554.37^{***}$	$-1,810.50^{***}$
2011	$3,718.70^{***}$	$-1,792.56^{***}$
2012	$3,815.07^{***}$	$-1,996.13^{***}$
2013	$3,540.69^{***}$	$-1,865.88^{***}$
2014	$3,574.44^{***}$	$-1,773.67^{***}$
2015	$3,514.10^{***}$	$-1,889.31^{***}$
2016	$3.695.16^{***}$	$-2,020.00^{***}$
2017	$3,851.70^{***}$	$-2,044.95^{***}$
2018	$4,189.67^{***}$	$-2,225.10^{***}$
2019	$4,544.02^{***}$	$-2,258.15^{***}$

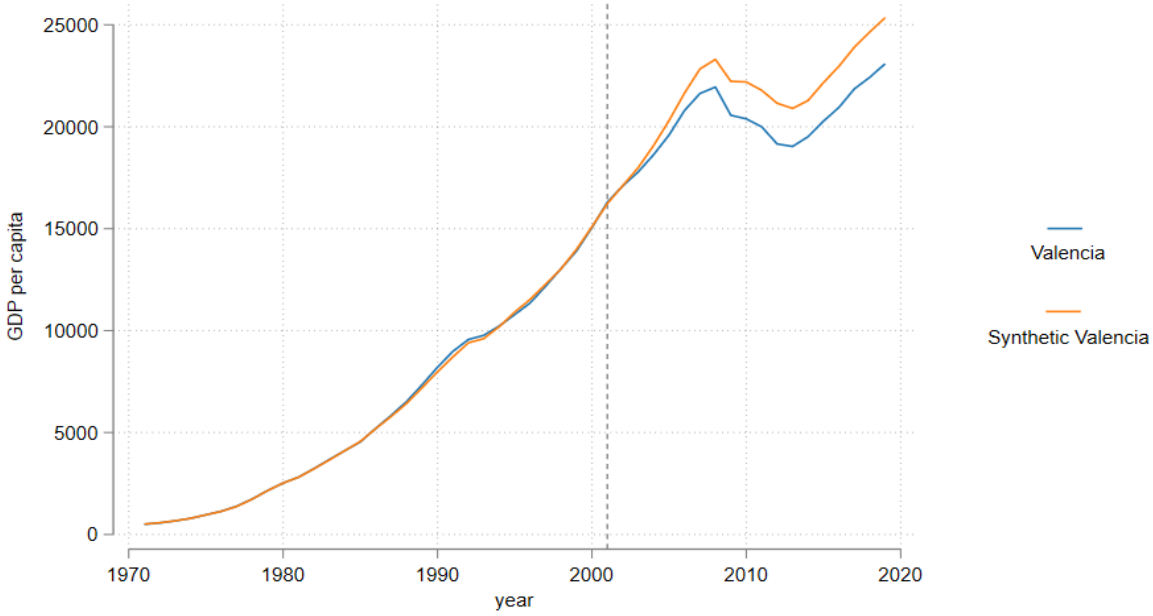
[a] Leads column stands for all the periods under treatment. *** standarized p-values <0.01 (Abadie et al., 2010). It implies that no region in the donor pool displays an effect at least as large as the treated unit.

Figure 3.3: Synthetic Basque country



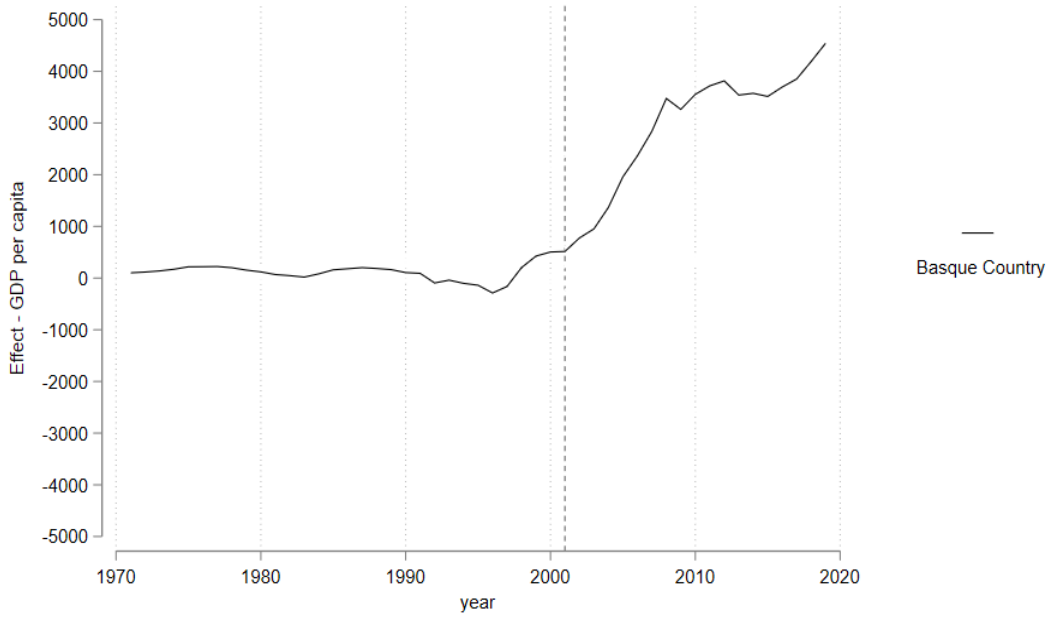
Trends in Basque Country GDP per capita. Actual Data (blue line) vs Doppelganger (orange line)

Figure 3.4: Synthetic Valencian Community



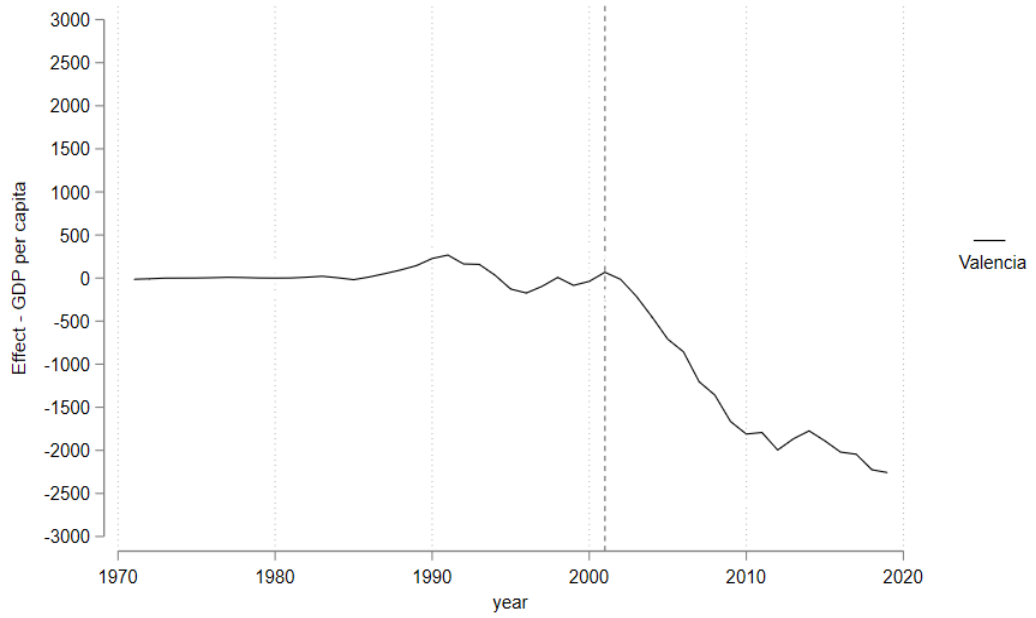
Trends in Valencian Comunity GDP per capita. Actual Data (blue line) vs Doppelganger (red line)

Figure 3.5: Synthetic Basque Country : *Foral* gains effect in GDP per capita



GDP per capita gap between Basque Country and its synthetic counterpart

Figure 3.6: Synthetic Valencian Community: Underfunding costs effect in per capita GDP



GDP per capita gap between Valencian Community and its synthetic counterpart

Inference in synthetic control methods

Conducting inference when the number of units is small constitutes one of the major challenges in policy evaluation techniques. However, since the publication of Abadie and Gardeazabal's (2003) paper, a remarkable number of contributions, both theoretical and empirical, have shed some light on this question (see Abadie, 2021, for a methodological guide). Although many options are available, we chose two of the most well-known approaches in this methodology.

The first inference procedure consists of the standardized p-values (Galiani and Quistorff, 2017; Abadie et al., 2010), which are displayed by default in Table 3.6. The interpretation of this exact in-time non-parametric test is the proportion of control units that show a comparable effect on the post-treatment estimation, as in the case of the treated unit (Galiani and Quistorff, 2017). Intuitively, it reassigns the same model to each of the control units, checking afterwards if any of them shows a comparable effect. Our results show that the effect for both regions is significant and unique—i.e., no other region shows as large an effect as the treated region with 99% probability.

In the same line but from a different perspective, we also conduct an additional robustness exercise, previously implemented by Abadie et al. (2010, 2014). We construct a ratio between post-intervention RMSPE and pre-intervention RMSPE, which has the advantage of ensuring that the potential effect shown by the post-intervention RMSPE was not driven by the lack of fit in the pre-intervention outcome. In other words, observing a large post-intervention RMSPE is not informative of a large effect of the intervention, since it might also be caused by the lack of fit prior to the intervention—i.e., in the pre-intervention RMSPE (Abadie et al., 2014).

If our treated regions have a sufficiently good fit (i.e., they are able to mimic the pre-intervention trajectory of the outcome variable), we would expect to see the largest ratio in both cases with regard to the remaining control units. Figures 3.7 and 3.8 confirm that for both regions we obtain the largest ratio in each of the cases. This finding therefore further corroborates both Hypotheses 1 and 2.

Figure 3.7: Synthetic Basque Country: Ratio of pre-effects and post-effect. Basque country and 13 control regions

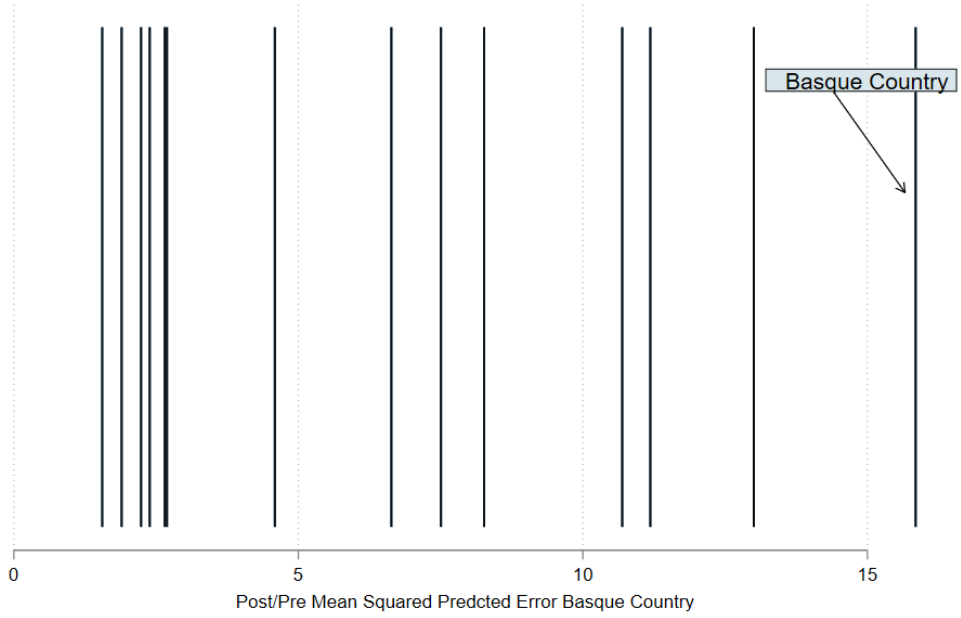
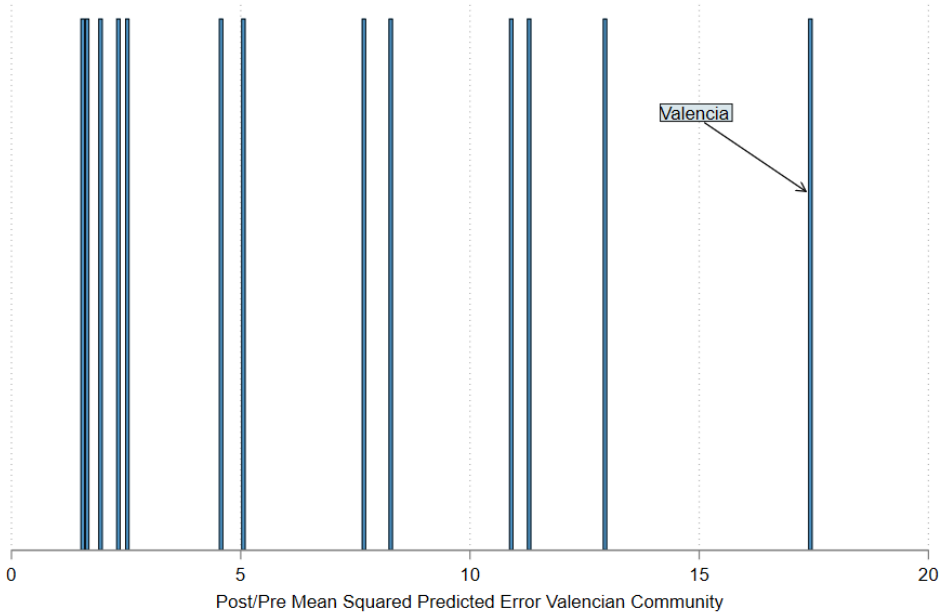


Figure 3.8: Synthetic Valencian Community: Ratio of pre-effect and post-effect. Valencian Community and 12 control regions



3.5.2. Including-one-in: testing hypothesis 2a

As previously discussed, the treatment assigned to the Valencian Community is not because it falls under the common system—which governs the majority of the autonomous communities, or regions—but because it is consistently ranked as the most underfunded region. However, as shown in Figure 3.1, the level of financing is quite heterogeneous among the regions, and the Valencian Community is not the only underfunded region. The region of Murcia is the second most underfunded region and for this reason it was excluded from the first term of our estimation, since its inclusion might be convoluted with the real consequences of the 2001 model for the Valencian Community.

Therefore, in this subsection we carry out exactly the same estimations for the Valencian Community as before but with Murcia as a control unit. If our previous results for the Valencian Community were obtained because it is the most underfunded region, in this second stage we might expect that result to be less clear, as a consequence of including the region of Murcia. This additional exercise can therefore be regarded as the inverse version of the leaving-one-out placebo study implemented by Abadie et al. (2010).[19]

Table 3.7 reports the 2001-model effect for the Valencian Community GDP per capita with the inclusion and exclusion of Murcia as a control region. As shown, although still significant, the effect of the 2001-model diminishes after the inclusion of Murcia, therefore confirming Hypothesis 2a.

[19]This exercise was based on leaving out one control unit to verify the stability of the result, the so-called leaving-one-out test. However, in this case we include Murcia as an inverse version.

Table 3.7: Effect in Valencian GDP per capita, with and without the Region of Murcia as a control unit

	Valencian community	
Leads	Murcia included as control 2001-model effect	Murcia not included as control 2001-model effect
2002	21.22	−15.05
2003	−142.42	−211.27
2004	−338.90*	−451.26***
2005	−561.33*	−709.11***
2006	−657.41***	−855.96***
2007	−933.30*	−1,203.47***
2008	−1,088.71***	−1,358.40***
2009	−1,354.92***	−1,665.17***
2010	−1,465.59***	−1,810.50***
2011	−1,449.53***	−1,792.45***
2012	−1,697.84***	−1,996.13***
2013	−1,643.48***	−1,865.88***
2014	−1,506.23*	−1,773.67***
2015	−1,706,99***	−1,889.31***
2016	−1,828.67***	−2,020.00***
2017	−1,851.10***	−2,044.95***
2018	−1,954.81***	−2,225.10***
2019	−1,948.23***	−2,258.15***

Leads column stands for all the periods under treatment. *** standarized p-values <0.01, * standarized p-values <0.1 (see Abadie et al. 2010). It implies that no region in the donor pool displays an effect at least as large as the treated unit.

3.5.3. Difference-in-Differences results

The results for the Basque Country and the Valencian Community are reported in Tables 3.8 and 3.9, respectively. In the lower panel of both Tables 3.8 and 3.9, there are four different sets of control variables, in addition to region and year fixed effects. We display the results for four sequential combinations of these control variables, to guarantee they are sufficiently robust. In all of the estimations, we report cluster-robust standard errors at the regional level to allow for potential correlation in unobservables among the regions (Bertrand et al., 2004).

In column (1) of both Tables 3.8 and 3.9, we include inflation and population density as the first set of controls. They are included as our baseline results because our dependent variable is the nominal GDP per capita and, therefore, omitting the inflation rate could distort the results considerably, and because the population structure in Spain has changed remarkably over the last 50 years. Column (2) contains the above mentioned set of controls, plus a second set, which includes the gross value added regional distribution as well as region and year fixed effects. Column (3) contains all of the previously mentioned controls plus level of education, which is a recognized determinant of economic growth (Barro, 2001). Finally, column (4) also includes the relative weight of investment and real estate investment, in addition to employment and unemployment.

The upper panels in both Tables 3.8 and 3.9 report estimated coefficients and standard errors for the variable of interest, $Post_{st} \times D_s$. The estimated coefficient on this variable is an estimate of the treatment effect. As shown, the effects are statistically significant under all the specifications, and display the expected sign in both cases, thus confirming Hypotheses 1 and 2.

Specifically, Table 3.8 shows that being under the BEA instead of the 2001-model might have led to an increase in the Basque Country GDP per capita of between 2,288€ (corresponding to the post×treatment effect in column 4) and 5,813€ (corresponding to the same effect in column 1) over the period 2003–2016.[20] Analogously, and according to the results in Table 3.9, the underfunded condition for the Valencian region implied a reduction in the Valencian GDP per capita between 1,276€ (corresponding to the post×treatment effect in column (4)) and 1,953€ (corresponding to the same

[20]Due to the lack of information for some relevant predictors from 2017 onwards, with this methodology we are only able to report results up to 2016. This will not be the case for the SCM results, where the characteristics of the method allow us to provide results up to 2019.

effect in column (1)), over the 2002–2016 period.

To investigate the plausibility of the parallel trends assumption we re-estimated the most conservative estimations, i.e. the ones reported in column (4) in Tables 3.8 and 3.9, adding a full set of interactions between the time fixed effects ($Time_t$) and the treatment group dummy (D_j) to the model (and dropping the $Post_t \times D_j$ interaction to avoid perfect collinearity). The interactions, which represent the difference between the time fixed effects for the treated and control regions, are plotted in Figures 3.9 and 3.10. The figures confirm that adopting the new regional financing models resulted in a significant deviation in the evolution of GDP per capita. Importantly, they also show that prior to the introduction of the new regional financing models the evolution in GDP per capita was similar in the treatment and control regions in both cases, thus lending support to the parallel trends assumption. A limitation of this analysis is that there is only one treatment region observation in each time period. As an alternative test for parallel pre-treatment trends we therefore re-estimated the models including cubic pre- and post-treatment time trends instead of time fixed effects, including interactions between the time trends and the treatment group dummy (D_j). The pre-treatment interactions were jointly insignificant in both cases, with an F-statistic (P-value) of 0.14 (0.93) for the Basque Country and 0.97 (0.44) for the Valencian Community.

Finally, Table 3.10 displays results for the diff-in-diff regression as in Table 3.9, but with the inclusion of Murcia in the control group (we display here, again, the same robustness exercise as in the case of the SCM section). A closer inspection of the results reveals that neither the direction of the coefficients of interest nor their significance has changed from those of Table 3.9. Nonetheless, the estimated effect for the $Post_{st} \times D_s$ has declined in three out of four specifications, suggesting that the inclusion of Murcia acts as a buffer, by mitigating the real consequences of the 2001 model for the Valencian Community.

Table 3.8: Diff-in-diff analysis. Effect on the Basque Country GDP per capita

	(1)	(2)	(3)	(4)
Post × Treatment	$5,813^{***}$	2.608^{***}	$3,095^{**}$	$2,288^{**}$
	(1038.1)	(474.2)	(334.2)	(307.5)
# observations	686	644	644	644
R^2	0.856	0.977	0.993	0.994
1st control set	*YES*	*YES*	*YES*	*YES*
2nd control set	*NO*	*YES*	*YES*	*YES*
3rd control set	*NO*	*NO*	*YES*	*YES*
Region FE	*NO*	*YES*	*YES*	*YES*
Year FE	*NO*	*YES*	*YES*	*YES*
4th control set	*NO*	*NO*	*NO*	*YES*

[a] Dependent variable is Basque Country Nominal GDP per capita. Post × Treatment: treated region in years after the intervention (treatment effect). Clustered (by region) robust standard errors in parenthesis *p<0.10, **p<0.05 ***p<0.01.

[b] 1st control set includes Population Density and Inflation Rate. 2nd control set includes GVA shares. 3rd control set includes levels of education in percentage .4th control set includes Investment over GDP, Real State Investment over GDP, Employment and Unemployment. Region FE are dummy variables for each regions and Year FE are dummy variables year for each time period

Table 3.9: Diff-in-diff analysis. Effect on the Valencian Community GDP per capita

	(1)	(2)	(3)	(4)
Post × Treatment	$-1,953^{**}$	$-2,050^{***}$	$-1,400^{**}$	$-1,276^{**}$
	(696.9)	(430.8)	(567.6)	(540.5)
# observations	637	598	598	598
R^2	0.862	0.975	0.993	0.995
1st control set	*YES*	*YES*	*YES*	*YES*
2nd control set	*NO*	*YES*	*YES*	*YES*
3rd control set	*NO*	*NO*	*YES*	*YES*
Region FE	*NO*	*YES*	*YES*	*YES*
Year FE	*NO*	*YES*	*YES*	*YES*
4th control set	*NO*	*NO*	*NO*	*YES*

[a] Dependent variable is Valencian Community Nominal GDP per capita. Post × Treatment: treated region in years after the intervention (treatment effect). Clustered (by region) robust standard errors in parenthesis *p<0.10, **p<0.05 ***p<0.01.

[b] 1st control set includes Population Density and Inflation Rate. 2nd control set includes GVA shares. 3rd control set includes levels of education in percentage .4th control set includes Investment over GDP, Real State Investment over GDP, Employment and Unemployment. Region FE are dummy variables for each regions and Year FE are dummy variables year for each time period

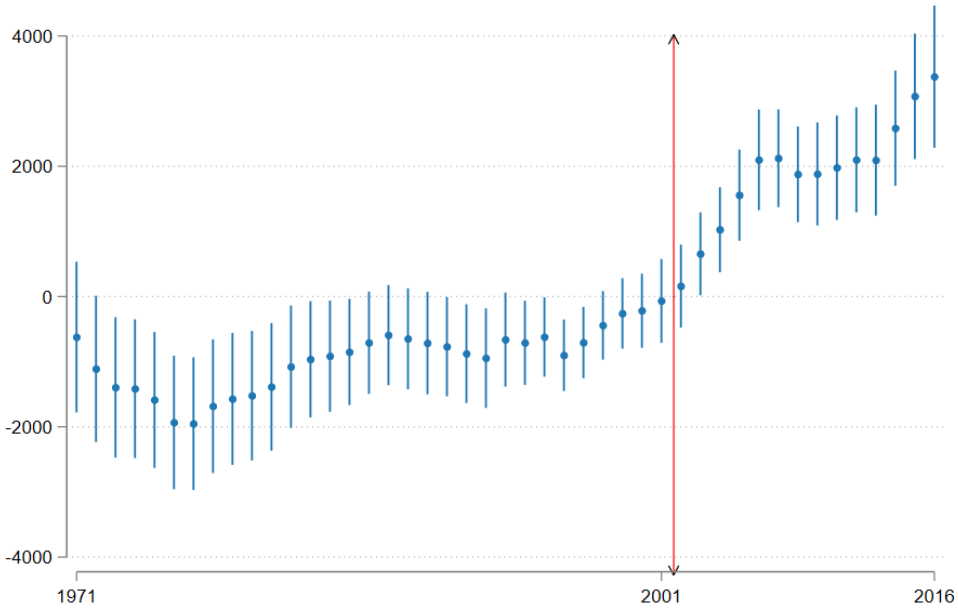
Table 3.10: Diff-in-diff analysis: Effect on the Valencian Community GDP per capita. Murcia included as a control region

	(1)	(2)	(3)	(4)
Post × Treatment	$-1,771^{**}$	$-2,098^{***}$	$-1,302^{**}$	$-1,162^{**}$
	(666.2)	(431)	(519.5)	(502.9)
# observations	686	644	644	644
R^2	0.862	0.975	0.993	0.994
1st control set	*YES*	*YES*	*YES*	*YES*
2nd control set	*NO*	*YES*	*YES*	*YES*
3rd control set	*NO*	*NO*	*YES*	*YES*
Region FE	*NO*	*YES*	*YES*	*YES*
Year FE	*NO*	*YES*	*YES*	*YES*
4th control set	*NO*	*NO*	*NO*	*YES*

[a] Dependent variable is Valencian Community Nominal GDP per capita. Post × Treatment: treated region in years after the intervention (treatment effect). Clustered (by region) robust standard errors in parenthesis *p<0.10, **p<0.05 ***p<0.01.

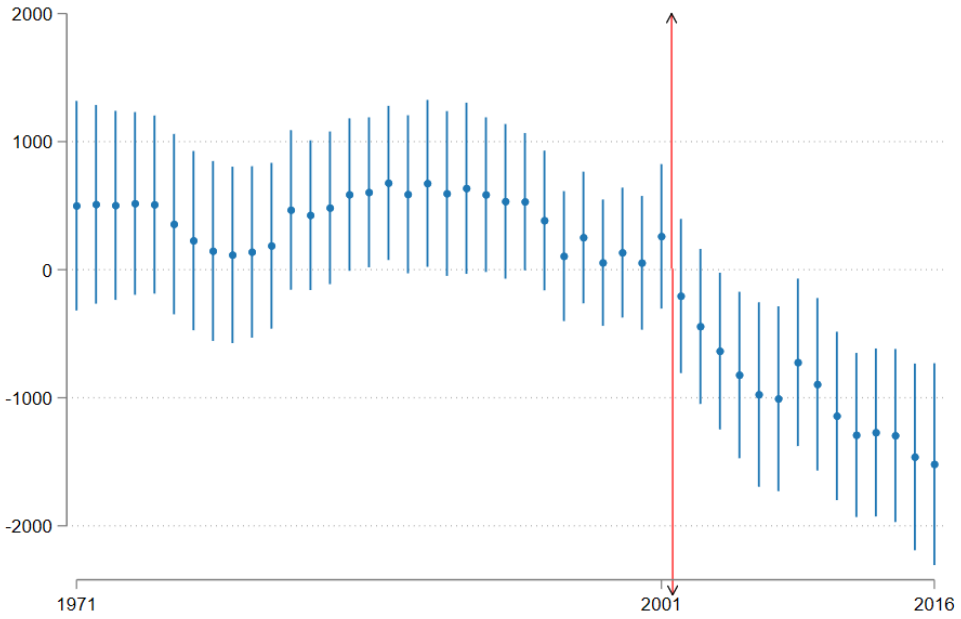
[b] 1st control set includes Population Density and Inflation Rate. 2nd control set includes GVA shares. 3rd control set includes levels of education in percentage .4th control set includes Investment over GDP, Real State Investment over GDP, Employment and Unemployment. Region FE are dummy variables for each regions and Year FE are dummy variables year for each time period

Figure 3.9: Differences in time fixed effects between the treatment region (Basque Country) and control regions, 1971–2016: *Foral* gains effect in GDP per capita



The red line divides pre- and post-treatment periods. Year 2002 has been omitted to avoid perfect collinearity. The vertical axis is measured in GDP per capita

Figure 3.10: Differences in time fixed effects between the treatment region (Valencian Community) and control regions, 1971–2016: Underfunding costs effect in per capita GDP



The red line divides pre- and post-treatment periods. Year 2002 has been omitted to avoid perfect collinearity. The vertical axis is measured in GDP per capita

3.6. Conclusions

In multilevel government, fiscal redistribution from richer to poorer regions is often a contested issue. Although, intergovernmental transfers should ideally be driven by equalization and efficiency considerations, it is frequently the case that political interests play a critical role (Khemani, 2007; Padovano, 2012). Specifically, in contentious states (e.g., Canada, Belgium, Italy, the UK, or Spain), preferences for interpersonal redistribution associated with welfare are not the only elements taken into account; other elements such as social identity and place-based resentment are also often considered, either implicitly or explicitly, when designing interregional fiscal redistribution mechanisms (Jacques et al., 2022). In this regard, several studies have shown that citizens' subjective ties to either the central state or their home regions imply stronger or weaker support for redistribution toward other territories. These studies focus on some of the "contentious" states referred to above, including Henderson et al. (2014) for the UK, Jacques et al. (2022) and Geloso and Grier (2022) for Canada, and Balcells et al. (2015) and Galais and Serrano (2019) for the country in our study, Spain.

In this paper, we have focused on Spain, which represents a particularly relevant case for a variety of reasons, including the speed at which decentralization took place, the fact that the central state retained the capacity to set basic legislation, and the need to accommodate several regional identities. Combining these three prominent features has resulted in an "unfinished" process (Lago-Peñas et al., 2017), to the point that some important elements that should result from this process, such as the regional financing mechanism (the *modelo de financiación autonómica* or "regional financing model"), are flawed, leading to the chronification or even exacerbation of economic regional differences. This might ultimately imply that the actions of different authorities might be having the opposite effects from what they intended, perhaps thwarting the success of the cohesion policies designed to flatten out economic disparities in the European regions (Di Caro and Fratesi, 2022).

Whereas numerous non-academic reports have acknowledged the deficiencies of the model and potential economic consequences in terms of persistent or exacerbated inequalities among regions (Pérez-García et al., 2017), there is a general lack of academic research applying econometric methodologies to examine this issue, a gap that we have attempted to bridge in this paper. Thus, although there is a relatively long-term debate in the literature on the inequalities among the Spanish regions deriving

from fiscal treatment, which has reached a certain consensus on which regions benefit the most and which are most disadvantaged, much less is known about the real economic consequences of these inequalities. In this regard, our study has provided, for the first time, quantitative evidence on the causal economic consequences of such inequalities in the two extreme case regions (benefited/harmed) because of this asymmetric policy.

Specifically, we considered what might be regarded as one of the most important innovations in the policy evaluation literature in the last 20 years (Athey and Imbens, 2017), corresponding to one of the main developments in the difference-in-differences approach, namely, the synthetic control method developed initially by Abadie and Gardeazabal (2003) and later refined in successive contributions (Abadie et al., 2010, 2014). We employ these methods by exploiting the differences between the treated and the untreated units in each of the two regions, in order to explore the consequence of the BEA for the GDP per capita in the Basque Country and the consequence of the 2001-model for the GDP per capita in the Valencian Community.

The empirical findings reveal that the Basque Country might have experienced positive impacts in terms of GDP resulting from two factors: its exemption from the 2001 model, and the implementation of the Basque Economic Agreement. Specifically, our benchmark specification, based on the synthetic control method, points to an overall increase of about 10% in GDP per capita—confirmed through a robustness check via diff-in-diff regression analysis. In contrast, the implementation of the 2001 model in the Valencian Community might have had an opposite effect since the application of the synthetic control method points to a significant decrease of almost 10% in the current level of GDP per capita. The diff-in-diff analysis also confirms this finding. Finally, the results obtained by the two methodologies for the case of the Valencian Community are robust and consistent when Murcia was included as a control unit, implying that including the second most underfunded region (Murcia) in the control group contributes to lowering, but not eliminating, the real consequence of the 2001 model in terms of GDP per capita for the Valencian Community.

These results provide deep insights into the dangers of an asymmetric and unequal devolution process if its corresponding financing mechanism either presents deficiencies in its design from the beginning, or cannot accommodate changing regional disparities—particularly in demographic terms. Therefore, although the issue of how

much central government should tax wealthier regions to redistribute to poorer ones is often contested and polarized, the ultimate economic consequences might not be sufficiently understood unless we measure them precisely. It is essential to factor this information into the design of regional financing models, since otherwise, the preferences for redistribution across regions might be largely influenced by factors other than efficiency or equalization, contributing to an unintended perpetuation, or even exacerbation, of regional economic disparities.

Concluding remarks

- This dissertation began by reviewing in the **introduction** key aspects of the understanding of the role of institutions in economic performance. Starting from the neoclassical model of growth, it has traced the evolution of economic thought up to the seminal contributions of North, which highlight institutions as key drivers of economic growth and comparative development. Then, the thesis delves into the intricate complexity of understanding institutions in the growth process, recognizing their endogenous nature. To this end, the existing literature has been reviewed to understand and differentiate various institutional dimensions—economic versus political, formal versus informal institutions, institutions versus policies, and centralized versus decentralized governance, including the growing importance of multilevel governance structures in modern institutional analysis. This picture underscores the need for further analysis and empirical conceptualization of how different institutional dimensions influence economic performance.

- **Chapter 1** presented a comprehensive investigation of the complex relationship between economic growth and natural resources. In the first stage of the analysis, drawing on a panel data set of 97 countries from 1990 to 2019 and employing the Group Fixed Effect (GFE) estimator (Bonhomme and Manresa, 2015), different groups of countries with distinct growth patterns and heterogeneous responses to natural resource endowments are identified endogenously. This categorization laid the foundation for the second phase of our analysis, in which we explored with an ordered probit model the different characteristics and possible drivers of the responses of the heterogeneous groups observed in the previous phase. Specifically, we found that both economic and political institutions and social capital are vital in transforming the potential resource curse into a bless-

ing. While economic institutions are crucial in providing the right conditions for resource management, political institutions create an atmosphere in which these economic structures can work effectively. Moreover, the role of social capital in resource allocation reveals the importance of taking into account both formal and informal institutions. Finally, we also found that export diversification and private sector financial development play a key role in mitigating the resource curse. In contrast, neither ethnic fragmentation nor initial levels of development significantly affect this relationship, once institutional factors and other transmission channels are taken into account.

- **Chapter 2** presented a detailed multilevel empirical analysis of how the quality of regional and national governments influences comparative regional development. Previous studies have typically focused on either the national or regional level, but rarely on both. This chapter argues for the importance of a comprehensive analysis that takes into account institutional effects at multiple levels of government. Our analysis has aimed to identify which level of government—national or regional—has a more significant impact on regional economic development. National institutions are examined in terms of their role in setting the overall operational framework and rules for economic agents, while regional institutions are analyzed in relation to their provision of public goods and policy implementation.

  In addition, the chapter explores the influence of a country's level of decentralization on these dynamics, while addressing concerns about possible endogeneity and reverse causality. The chapter makes three key contributions: First, it empirically demonstrates that the quality of the overall institutional framework is more influential on regional economic development than lower-level government structures. It postulates that national indicators capture the fundamental "rules of the game", while regional indicators are more indicative of the implementation of specific policies, suggesting that not taking into account the hierarchical nature of countries could lead to omitted variable bias. Second, the chapter maintains that these findings are consistent even when considering varying degrees of decentralization, albeit with certain nuances. For instance, specific indicators of government quality at the regional level, like the impartiality pillar, have a positive effect on regional economic development in countries with higher

decentralization. This finding highlights the predominance of general rules over specific policies, given that impartiality relates more to the exercise of authority than to the specifics of policy content or implementation. Lastly, the chapter asserts that the research results are not compromised by reverse causality bias, arguing that it is unlikely for a region's economic development to influence the quality of government at the national level.

- **Chapter 3** explored the economic impacts of Spain's fiscal decentralization, specifically on the Basque Country and the Valencian Community. It analyzed the effects of the 2001 model within the common regime and the establishment of the Basque Economic Agreement (BEA) in 2002. The chapter assessed the Basque Country's economic trajectory under the common regime, and its exclusion from the 2001 model due to the BEA. It also investigated the Valencian Community's potential economic development had it received average funding like its peers in the common regime. The study used synthetic control methods and difference-in-differences regression to analyze these hypothetical scenarios.

  Our baseline analysis using the synthetic control method indicated an increase of approximately 10% in GDP per capita for the Basque Country, a finding supported by the difference-in-difference regression analysis. In contrast, the Valencian Community, according to the 2001 model, showed an opposite trend, with a decrease of almost 10% in GDP per capita according to the synthetic control method, confirmed by the difference-in-differences analysis. The robustness of these results for the Valencian Community was confirmed by including Murcia as a control, which slightly attenuated, but did not eliminate, the negative impact of the 2001 model on its GDP per capita.

Several policy implications emerge from the results of this thesis. The extension of the concept of institutional quality in **Chapter 1** to historical, economic, political and informal dimensions, thanks to Group Fixed Effect (GFE) modeling, allows for more precise targeting of key areas to transform the resource curse into a blessing. From **Chapter 2** it can be drawn that, while improving regional institutions is valuable, it should ideally occur in a context of strong national institutions. This could inform policies that prioritize the establishment of strong national institutional frameworks as the basis for regional development initiatives. In addition, the findings in **Chapter**

3 indicate that Spain's current financing system may be contributing to significant regional disparities, in contradiction with the European Union's regional cohesion policies. These results seem to suggest the need for policy reforms to address regional disparities caused by the Spanish financing system.

As for possible areas of future research, it should be noted that, despite the virtues of this thesis, no local analysis has been carried out on the role of institutions in economic development, which would be more than beneficial, considering the importance of multilevel governance. As far as **Chapter 1** is concerned, a natural step would be to decompose natural resources into their main components to explore whether the same institutional dimensions and the other transmission channels also operate in that context. This would help to guide specific measures for oil-rich countries, mineral-rich countries and coal-rich countries, in addition to natural resource-rich countries in general. Also, the results of **Chapter 2** should be extended to other non-European countries, to explore whether the prevalence of national over regional institutions is still valid. To this end, it would be important to obtain comparable regional data worldwide on the quality of governance outside Europe, a task that, to the best of my knowledge, remains to be done. Finally, regarding **Chapter 3** there is still not much literature on the impact of unfunded mandates Rodríguez-Pose and Vidal-Bover (2023); Rodríguez-Pose and Vidal-Bover (2023), i.e., beyond decentralization or non-decentralization. Thus, it is necessary to explore further whether lower levels of government are getting sufficient resources for their competencies or not.

In an era of rapidly increasing data availability, the need for data-driven analysis becomes increasingly important. This thesis aimed to be a response to this changing landscape. To this end, this dissertation employed state-of-the-art econometric methods to unravel the multifaceted role of institutions in economic growth and comparative development across diverse geographic scales. The scope of this analysis ranges from a country-level examination in the second chapter, through European regions, to specific Spanish regions in subsequent chapters. To do so, we have used some of the most advanced econometric methods available, including the Grouped Fixed Effects by Bonhomme and Manresa (2015), the ordered probit, multilevel econometric techniques, and a quasi-experimental design framework applying Synthetic Control and Differences-in-Differences. These methodologies, recognized as cutting-edge in panel data analysis (see Arkhangelsky and Imbens, 2023), have allowed for a nuanced and

comprehensive exploration of institutional impacts in diverse settings. Beyond the geographical dimension and the econometric specifications, this work has put extra effort in trying to further conceptualize and differentiate diverse institutional dimensions as well as trying to understand how they affect economic growth and comparative development.

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Appendices

Appendix A. Groups of countries and alternative estimated results

Albania	China	Honduras	Morocco	South Africa
Algeria	Colombia	India	Myanmar	Spain
Argentina	Costa Rica	Indonesia	Namibia	Sri Lanka
Australia	Cyprus	Ireland	Nepal	Sudan
Austria	Denmark	Italy	Netherlands	Sweden
Bahrain	Dominican Republic	Jamaica	New Zealand	Switzerland
Bangladesh	Ecuador	Japan	Nicaragua	Tajikistan
Barbados	El Salvador	Jordan	Niger	Thailand
Belgium	Eswatini	Kenya	Nigeria	Trinidad and Tobago
Belize	Ethiopia	Lesotho	Norway	Tunisia
Benin	Fiji	Luxembourg	Pakistan	Turkiye
Botswana	Finland	Madagascar	Panama	Uganda
Brazil	France	Malawi	Paraguay	United Arab Emirates
Brunei Darussalam	Gabon	Malaysia	Peru	United Kingdom
Bulgaria	Germany	Mali	Philippines	United States
Burkina Faso	Ghana	Malta	Portugal	Uruguay
Burundi	Greece	Mauritania	Russian Federation	Zambia
Cameroon	Guatemala	Mauritius	Saudi Arabia	
Canada	Guyana	Mexico	Senegal	
Chile	Haiti	Mongolia	Singapore	

Table B1: List of sampled countries

Table B2: Composition of identified groups, ordered by the estimated impact of natural resources on economic growth in accordance with the GFE estimation of Equation (1.1)

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6
Russian Federation	Burkina Faso	Argentina	Albania	Eswatini	Algeria
Tajikistan	Gabon	Bahrain	Bulgaria	Indonesia	Australia
	Haiti	Bangladesh	Ethiopia	Malaysia	Austria
	Malawi	Brazil	Mongolia	Saudi Arabia	Barbados
	Mali	Burundi		Singapore	Belgium
	Mauritania	Chile		Thailand	Belize
	Sudan	China		Turkiye	Benin
	Uganda	Colombia		United Arab Emirates	Botswana
	Zambia	Costa Rica			Brunei Darussalam
		Dominican Republic			Cameroon
		Ecuador			Canada
		El Salvador			Cyprus
		Ghana			Denmark
		Guyana			Fiji
		Honduras			Finland
		Jordan			France
		Lesotho			Germany
		Myanmar			Greece
		Namibia			Guatemala
		Niger			India
		Nigeria			Ireland
		Panama			Italy
		Paraguay			Jamaica
		Peru			Japan
		Philippines			Kenya
		Sri Lanka			Luxembourg
		Uruguay			Madagascar
					Malta
					Mauritius
					Mexico
					Morocco
					Nepal
					Netherlands
					New Zealand
					Nicaragua
					Norway
					Pakistan
					Portugal
					Senegal
					South Africa
					Spain
					Sweden
					Switzerland
					Trinidad and Tobago
					Tunisia
					United Kingdom
					United States

The countries have been endogenously classified by using the algorithm 1 proposed by Bonhomme and Manresa (2015) on our Equation (1.1).

Table B3: Alternative estimated results with the baseline model from Equation (1.1)

Variable	**(I) OLS**	**(II) FE**
RES_{it-1}	-0.057	0.044
	(0.019)	(0.037)
N_{it}	-0.647***	-0.755***
	(0.130)	(0.164)
$log(INV_{it})$	2.104**	2.015***
	(0.415)	(0.521)
$log(HC_{it})$	-2.267***	-4.338***
	(0.617)	(1.430)
$log(OPEN_{it})$	-0.120	1.480***
	(0.228)	(0.511)
INF_{it}	-0.002**	-0.002**
	(0.001)	(0.001)
Time-invariant country effects (θ_i)	No	Yes
Time-variant group effects ($\lambda_{g_{it}}$)	No	No
Observations	2909	2909
AIC	15688.79	15186.31
Adj. R-sq	0.088	0.0513
Joint significance of θ_i		5.49 [0.000]

Clustered standard errors at country level are presented in parentheses, while p-values are in brackets. * p<0.10, ** p<0.05, *** p<0.01.

Appendix B. Effective financing per inhabitant adjusted to homogeneous competences

The *effective financing per inhabitant adjusted to homogeneous competences* ("financiación efectiva por habitante ajustado a competencias homogéneas") is an index used to compare the allocation of financial resources to each of the Spanish autonomous communities within the common regime system, based on their respective adjusted populations. The index is designed to account for various factors that can affect the cost of delivering public services within a region, including urbanization, economic development, and the prevalence of elderly or disabled individuals. It is developed and published annually by FEDEA (*Fundación de Estudios de Economía Aplicada*) and is described in more detail by de La Fuente et al. (2019)[21].

We use the index as preliminary evidence to investigate whether a region may be relatively disadvantaged or advantaged in the allocation of resources. In the case of the Valencian region, the index appears to suggest—according to FEDEA's annual report—that this region has been comparatively disadvantaged in terms of financial resource allocation. This finding serves as a starting point for further investigation, to explore to what extent this comparative disadvantage may have had a causal impact on the evolution of the region's GDP per capita.

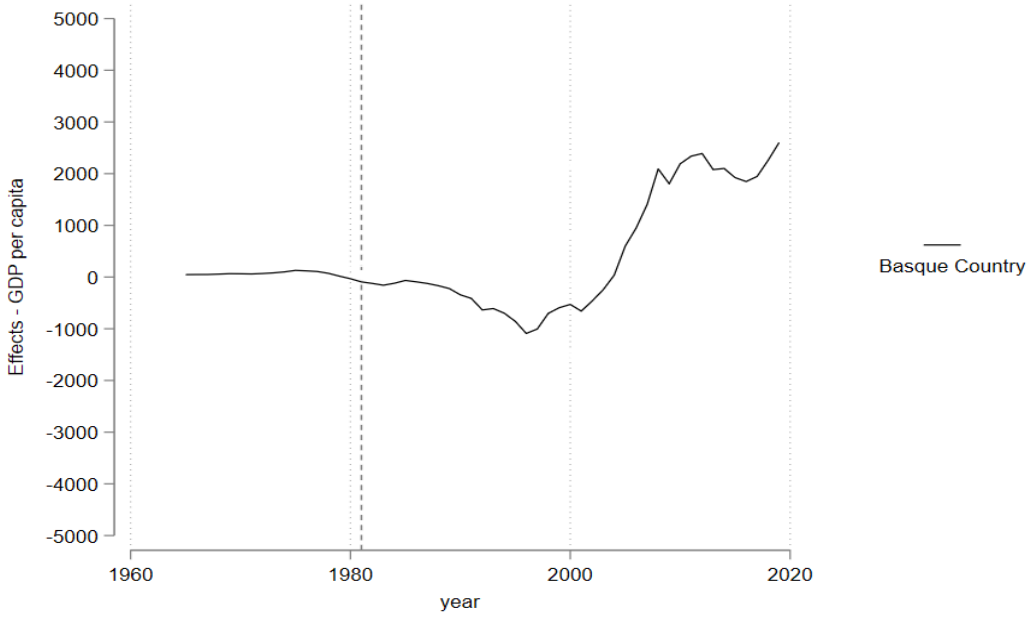
Appendix C. Placebo Analysis: No anticipation effects

In this appendix, we conduct a placebo analysis to provide a fuller evaluation of the timing of the treatment in our analysis. To do so, we reassigned the potential onset of the treatment to two different laws affecting the *foral* condition of the Basque Country and the way the Valencian Community was funded at that time. Specifically, we considered the temporary agreement made between the Basque Country and the central government in 1982, which regulated their fiscal relationship, and the devolution of education and health powers to the Valencian region in 1988, which implied an important transfer of public services to the region. By doing this, we aim to examine whether the timing of the treatment, as measured by the actual onset in 2001 when the common regime was homogenized across all regions, was critical for our results.

[21] The specific mechanisms for calculating this index are beyond the scope of this study. For a more in depth understanding of the mechanisms of the index refer to de La Fuente et al. (2019)

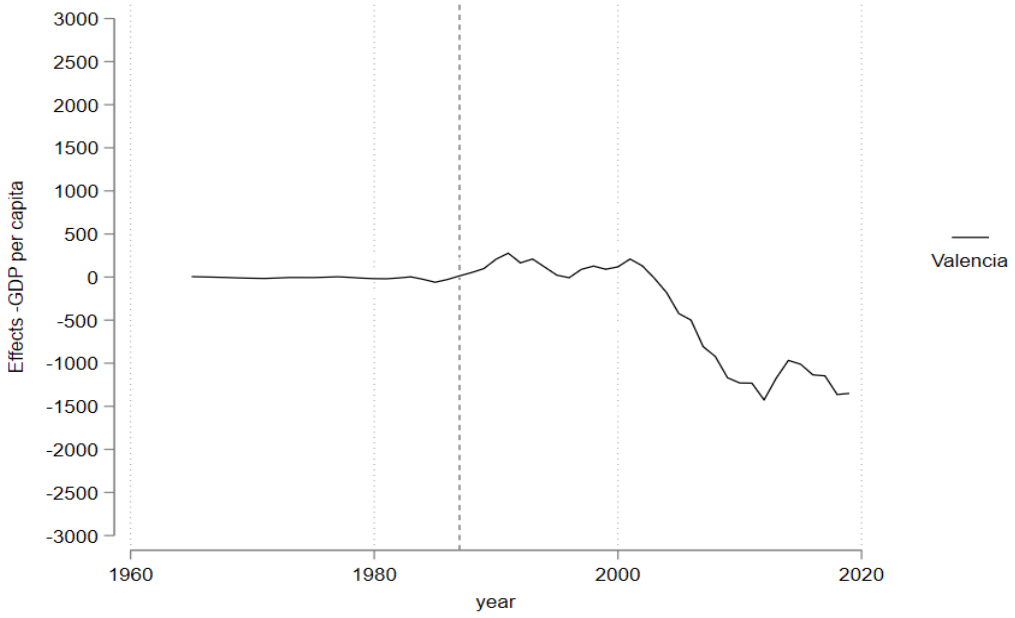
The results from this placebo analysis (see Figure A1 for the Basque Country and A2 for the Valencian region) indicate that there is no anticipation effect neither for the Basque Country—reassigning the onset of the treatment to 1982—nor for the Valencian Community—resigning the onset of the treatment at 1988. This finding implies that the homogenization of the common regime in 2001, as a consequence of the 2001 model, and the BEA aproved in 2002 were crucial factors in driving the changes we observe in the evolution of the GDP per capita in both regions. As commented through this work, the application of the 2001 model exacerbated the divergence among the Spanish regions through two primarily avenues: (i) In the case of the Basque country, its exemption from common financing regime in 2001 and the subsequent implementation of the Basque Economic Agreement (BEA) in 2002 contributed to create increase the gap between the *foral* system and the common system; and (ii) in the case of the Valencian community, the introduction of the 2001-model further intensified the divergence in regional GDP evolution, even within the same framework (the common regime), as the "finance follows function" principle was not fulfilled (Rodríguez-Pose and Vidal-Bover, 2023).

Figure A1: Placebo Basque Country: *Foral* gains effect in GDP per capita



GDP per capita gap between Basque Country and its synthetic counterpart

Figure A2: Placebo Valencian Region: Underfunding costs effect in GDP per capita



GDP per capita gap between Valencian Community and its synthetic counterpart