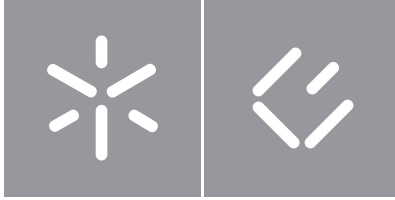


University of Minho

School of Economics and Management

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Too much or too little? Assessing the optimal size of government in inclusive development



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size of government in inclusive development**

Master's Dissertation in Economics

Dissertation supervised by

Professor Francisco José Alves Coelho Veiga

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Statement of Integrity

I hereby declare having conducted this academic work with integrity.

I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration.

I further declare that I have fully acknowledged the Code of Ethical Conduct of the University of Minho.

University of Minho, Braga, march 2025

Francisco Tomaz Cabeleira

Abstract

This article aims to contribute to the growing body of research on the optimal size of government when examining non-traditional economic development metrics, specifically by being the first to depict evidence of the Armey Curve for the [Inequality-adjusted Human Development Index \(IHDI\)](#). Furthermore, the evidence, or the variation of optimal government size according to metrics of development, is scarce, and as such this study attempts to test an undermining of the role of government present in the literature, a direct consequence of wrongly proxying welfare by normative economic indicators.

The study also attempts to avoid the incorrectly ignored effects of governance by composing a variable of institutional quality through the use of world governance indicators. The results provide evidence of an optimal size of government ranging from 27.22% to 32.54% for [Gross Domestic Product \(GDP\)](#), 33.34% to 42.20% for [Human Development Index \(HDI\)](#), and lastly, 31.23% to 40.69% for [IHDI](#). The results imply that the dependent variable used makes a considerable difference in the optimal size of government computed, nonetheless, it exhibits that while worldwide government size is not overgrown, the broad sentiment of overbearing government presence is factual, at least for the Western World.

The results also imply a stronger connection between government size and economic prosperity for developing countries, which contradicts the current literature. Additionally, findings suggest that it is possible that the more disadvantaged a country is in terms of development, the more easily it can derive utility from development policies related to interventions in government size. A study of expenditure components was also conducted, in which public consumption was inferred to report higher evidence of the Armey Curve than public investment. Results also exhibited that for the [Classification of the Function of Government \(COFOG\)](#) components, expenditure in public order and safety emerged as the most fundamental element in the promotion of economic growth ([GDP](#)), development ([HDI](#)), and even inclusive development ([IHDI](#)).

Keywords Optimal size of government, Inclusive economic development, Economic development, Economic growth, Composition of public expenditure

Resumo

Este artigo pretende contribuir para o crescente corpo de investigação sobre a dimensão ótima do estado quando se examinam métricas de desenvolvimento económico não tradicionais, especificamente por ser o primeiro a apresentar provas da Curva de Armey para o [IHDI](#). Além disso, a evidência, ou a variação da dimensão ótima do estado de acordo com as métricas de desenvolvimento, são escassas e, como tal, este artigo tenta testar a subvalorização do papel do estado presente na literatura, uma consequência direta de uma representação falaciosa do bem-estar através de indicadores económicos normativos.

O estudo também tenta evitar os efeitos erradamente ignorados da governança, compondo uma variável de qualidade institucional através da utilização dos indicadores de governança global. Os resultados fornecem provas de uma dimensão ótima do estado que varia entre 27,22% e 32,54% para o [GDP](#), 33,34% e 42,20% para o [HDI](#) e, por último, 31,23% e 40,69% para o [IHDI](#). Os resultados implicam que a variável dependente utilizada faz uma diferença considerável na dimensão ótima do estado calculada, no entanto, mostra que, embora a dimensão do estado a nível mundial não seja excessiva, o sentimento geral de uma presença exagerada do estado é factual, pelo menos para o Mundo Ocidental.

Os resultados também sugerem uma ligação mais forte entre o peso do estado e a prosperidade económica nos países em desenvolvimento, o que contraria a literatura atual. Além disso, os resultados sugerem que é possível que quanto mais desfavorecido for um país em termos de desenvolvimento, maior facilidade terá em extrair utilidade de políticas de desenvolvimento relacionadas com alterações no tamanho do estado. Foi também efetuado um estudo das componentes da despesa, em que se inferiu que o consumo público apresenta maior evidência da Curva de Armey do que o investimento público. Os resultados também mostram que, para os componentes [COFOG](#), as despesas com ordem e segurança pública emergem como o elemento mais fundamental na promoção do crescimento económico ([GDP](#)), do desenvolvimento ([HDI](#)) e mesmo do desenvolvimento inclusivo ([IHDI](#)).

Palavras-chave Dimensão ótima do estado, Desenvolvimento económico inclusivo, Desenvolvimento económico, Crescimento económico, Composição da despesa pública

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Acronyms

COFOG Classification of the Function of Government. [iv](#), [v](#), [20](#), [62](#), [76](#)

EU European Union. [71](#), [72](#), [75](#), [76](#)

FE Fixed Effects. [36](#), [38](#), [39](#), [41](#), [43](#), [48](#), [58](#), [62](#), [68](#), [75](#)

GDP Gross Domestic Product. [iv](#), [v](#), [viii](#), [1](#), [2](#), [4](#), [5](#), [6](#), [7](#), [8](#), [11](#), [12](#), [13](#), [14](#), [15](#), [16](#), [17](#), [18](#), [20](#), [21](#), [24](#), [25](#), [27](#), [28](#), [29](#), [30](#), [31](#), [33](#), [34](#), [35](#), [39](#), [41](#), [43](#), [44](#), [45](#), [48](#), [50](#), [52](#), [54](#), [56](#), [58](#), [60](#), [62](#), [63](#), [68](#), [71](#), [73](#), [75](#), [76](#), [77](#), [88](#), [89](#), [90](#), [91](#)

GMM Generalised Method of Moments. [36](#), [38](#), [39](#), [41](#), [44](#), [48](#), [58](#), [62](#), [68](#), [75](#)

GNI Gross National Income. [22](#)

HDI Human Development Index. [iv](#), [v](#), [viii](#), [x](#), [2](#), [11](#), [12](#), [13](#), [15](#), [18](#), [21](#), [22](#), [24](#), [25](#), [27](#), [28](#), [29](#), [30](#), [31](#), [36](#), [37](#), [41](#), [43](#), [44](#), [46](#), [48](#), [50](#), [52](#), [54](#), [56](#), [58](#), [60](#), [62](#), [68](#), [71](#), [73](#), [75](#), [76](#), [88](#), [89](#), [90](#), [91](#), [92](#)

IHDI Inequality-adjusted Human Development Index. [iv](#), [v](#), [viii](#), [x](#), [2](#), [12](#), [15](#), [16](#), [21](#), [22](#), [24](#), [25](#), [27](#), [28](#), [29](#), [30](#), [31](#), [36](#), [37](#), [41](#), [43](#), [44](#), [47](#), [48](#), [50](#), [52](#), [54](#), [56](#), [58](#), [60](#), [62](#), [68](#), [71](#), [73](#), [75](#), [76](#), [88](#), [89](#), [90](#), [91](#), [92](#)

IMF International Monetary Fund. [6](#), [20](#), [21](#), [28](#), [30](#), [31](#), [89](#), [90](#), [91](#), [92](#)

ISO International Organization for Standardization. [24](#)

PPP Purchasing Power Parity. [22](#)

TFP Total Factor Productivity. [8](#)

UNDP United Nations Development Program. [21](#), [30](#), [31](#), [88](#), [89](#), [91](#), [92](#)

VIF Variance Inflation Factor. [23](#)

WB World Bank. [16](#), [21](#), [22](#), [24](#), [28](#), [30](#), [31](#), [88](#), [89](#), [90](#), [91](#)

1 Introduction

Many may ask why the debate about government intervention is still going, even after extensive research regarding its optimal size. The reason partly relies on the substantial divergence in the methodologies and metrics used (Bergh and Henrekson, 2011)¹. For various decades, most academics have focused on employing the GDP to represent the prosperity of nations worldwide, which has proven useful in unveiling crucial insights about the importance of a central government in establishing a solid foundation for economic prosperity (Mahler 1992; Berry and Lowery 1984).

The size of government macroeconomically supports itself through the implications that various models suggest. Many development and growth models, such as the Solow-Swan (Solow, 1956), establish that given diminishing returns of production factors, countries would have a harder time continuing to grow after some benchmark. Governments would need some level of presence in economic activity to escape this curse of decreasing marginal returns to growth. Accordingly, other models, such as Romer (1986), depict that at the aggregate level, diminishing marginal returns can be avoided, allowing growth to be self-sustaining through the proliferation of positive externalities that the exchange of know-how (“learning-by-doing”) may permit.

In this context, the government appears essential, given that it represents the entity responsible for providing the services, such as basic infrastructure and education, that allow for the transfer and proliferation of that know-how. Nonetheless, other models, such as Barro (1990) and Barro and Sala-i-Martin (1995), refer to the fact that there are optimal taxation levels, and by association, optimal government presence, in which the positive externalities are augmented relative to the economic distortions that the required taxes impose. This relationship is similar to that of the Armey Curve, which depicts that there is a point at which the size of government is optimal to promote economic growth, given that after a certain point, augmented governmental presence would only have detrimental effects on growth (Vedder and Gallaway, 1998).

This research aims to help solve that dilemma, not in the context of optimal taxation, but for a proxy,

¹ The author also depicts that literature is full of contradictory findings that are not explained just because of the variation in the definitions but also due to the heterogeneity in the countries studied.

which is the size of government. Most literature on this topic points to [Gross Domestic Product \(GDP\)](#) as the determinant fact to be maximised, but given the amount of criticism that it received from many Nobel laureates, such as [Kuznets \(1941\)](#), [Hicks \(1948\)](#), and [Nordhaus and Tobin \(1972\)](#)², as a flawed measure of standard of living, I argue that a more useful goal would be to attempt to assess the government size that maximises a more inclusive measure of economic development.

A metric that addresses aspects beyond the monetary would present itself as more adequate to overcome the possible bias that may arise when assessing the optimal size of government with normative metrics such as the [GDP](#), since it greatly overlooks nonconventional interventions that the government enacts, namely in treating social issues and dealing with inequality ([van den Bergh, 2009](#)).

The [Human Development Index \(HDI\)](#) could be an alternative to solve this issue, serving as an improvement from the previous methodologies, with some works such as [Martins and Veiga \(2014\)](#) and [Davies \(2009\)](#) already using it as a benchmark to more adequately improve the computations of the optimal size of government. Nonetheless, as suggested by [van den Bergh \(2009\)](#) and [Sagar and Najam \(1998\)](#), given various measurability problems, it still fails to include some relevant dynamics, with greater emphasis on inequality, a growing concern in modern times.

During various years the issue remained unresolved, however, [Alkire and Foster \(2010\)](#) addressed this shortcoming by attempting to reinforce the metric of [HDI](#) by discounting inequality in all its sub-components (health, education, and standard of living). The resulting new metric is designated as the [Inequality-adjusted Human Development Index \(IHDI\)](#). This is the main metric this study attempts to use to enhance the lack of evidence on optimal government size for measures of economic development.

Additionally, given the broad evidence regarding the relevance of the quality of government in promoting economic growth and development, such as [Acemoglu et al. \(2001\)](#) and [Nirola and Sahu \(2019\)](#), this dissertation also strives to disentangle the possible mixed-up effects that previous academia may have overlooked through the incorporation and analysis of governance.

After this introduction, I present Part 2, which reflects the literature review, where the academic foundations related to the measurement of government size are depicted, alongside any theory necessary for a better understanding of the relationship between government size and economic prosperity, coupled with previous empirical evidence exhibited by other authors.

Then, Part 3, the methodology and data, displays how the databases were constructed alongside their data sources. Additionally, this section also describes any database dynamics while trying to assess preliminary results. It also reports the econometric models used to extrapolate the results, coupled with

² The economic study has been blindly obedient to aggregate material progress, neglecting the distortion of national priorities, the worsening of the income distribution, and the environmental damages that it poses.

the rationale for the variables used.

Following, Part 4, the results, are presented, where any relevant finding is reported, while also trying to compare how it relates to the hypothesis made and to the previous evidence. Here a robustness analysis is also carried out to guarantee the strength of the conclusions, while also using the results to infer adequate policymaking decisions and advocating for further academic research on appropriate topics. Finally, Part 5, the conclusion, wraps up the significant and novel inferences, depicting how they serve to enhance the present scholarship.

2 Literature review

2.1 The measurement and historical dynamics of government size

2.1.1 How should we measure the size of government?

Economic underperformance and political instability, namely in the *"old world"*, have created an emergence in the discussion of governmental presence in the economy, with different electorates advocating for distinct government approaches as well as pushing narratives that are better aligned with the interests of their class-defined core political constituencies (Hibbs, 1977). Disregarding ideological biases, those political narratives still present some logical reasoning for their statements, given that the government not only has the purpose of sustaining social cohesion but also, at the same time, guaranteeing stable economic growth in the long term (Aranson and Ordeshook 1981; Tanzi and Schuknecht 1997).¹

Consequently, I argue that the government's real objective should be determining the optimal equilibrium of governmental presence that maximises both social and economic conditions. Nonetheless, although the broad concept of government size is common, there is no standard framework to compute it since there are numerous indicators and methods to do so (Di Matteo 2013; Vedder and Gallaway 1998). Moreover, the reason why scholarship related to government size is quite heterogeneous, frequently producing conflicting results, derives substantially from the distinct measurements and definitions of government size employed by the different authors (Bergh and Henrekson, 2011).

There is no definitive answer to which measurement of government size is the most accurate one, with many authors using, for instance, the total number of government employees, other nominal expenditures, and even revenues as a percentage of GDP (Labonte, 2010). Nonetheless, Labonte (2010) states that there are two main ways by which we can measure government that are commonly accepted to be more

¹ Aranson and Ordeshook (1981) state that few can deny the beneficial effects of government intervention in domains such as national defence, police protection, and common-law courts.

prominent. More specifically, measuring government size according to expenditures (outlays) or revenues (receipts). Both ways are methodologically valid, although some authors suggest that the differences exhibited by the two approaches can still be substantial, and thus it is crucial to only opt for one (Labonte, 2010).

We can exhibit two main motives as to why expressing government size as expenditures is more appropriate than by revenues. The first relates to the higher volatility of revenue levels, which can only be indirectly influenced by legislators. Revenues depend a lot on economic conditions and are very prone to changes in the short term due to unexplained or uncontrollable factors. Consequently, using it as a proxy for the size of government would, by association, reflect a false perception of a heterogeneous and volatile nature of government size (Labonte, 2010).

The second reason concerns the possible divergence that may arise in terms of government size when measuring it by revenues compared to outlays, particularly in the context of budget deficits. In this framework, given that budget deficits cannot last forever and need to reach a neutral state sooner or later, a reduction in taxes that is not accordingly matched by a cut in spending does not lead to any reduction of the size of government. Consequently, what takes place is a temporal manipulation of the tax incidence, and the measurement by revenues ends up providing a misleading reference that the size of the government is smaller than it is (Labonte, 2010).

Accordingly, this work makes use of government spending as its proxy for government size, given that it exhibits an apparent edge when compared with other metrics, especially when it is measured as a percentage of GDP, as depicted by Vedder and Gallaway (1998) and Labonte (2010)².

2.1.2 The history of government intervention

The size of government is rather volatile, given that it changes according to society's needs in each period. Before World War 1, most economists advocated for a minimal government ("*Laissez-faire*") in which its only functions would be the maintenance of law enforcement, administration, and national defence, given the assumed ability of the market to self-regulate.³ As depicted in Figure 1, at that time, the average share of public expenditure worldwide was no more than 10% of GDP. Nonetheless, the impact of the 1st World War, in 1914, proposed incremental government intervention both during, due to war efforts, but also after the conflict, given the requirement for public measures and policies to solve poverty, instability,

² Labonte (2010) also exhibited that government expenditures have distinct impacts on the economy, more specifically, in the case of government transfers and government purchases of goods and services.

³ The ideology of self-regulating markets, or, in other words, the market economy, was an economic thought that originated in England, which depicted that prices must be allowed to regulate themselves in a system of minimal outside interference.

and unemployment (Mueller, 2003).

Consequently, after the conflict, even though downward pressures of governmental presence were reported, government expenditures did not fall to pre-war levels and consistently continued to grow. The Great Depression, from 1929 until 1939, also presented an important mark in the relevance of government presence in the economy, given the required public incentives that the crisis made imperative (Bernanke, 2000).⁴

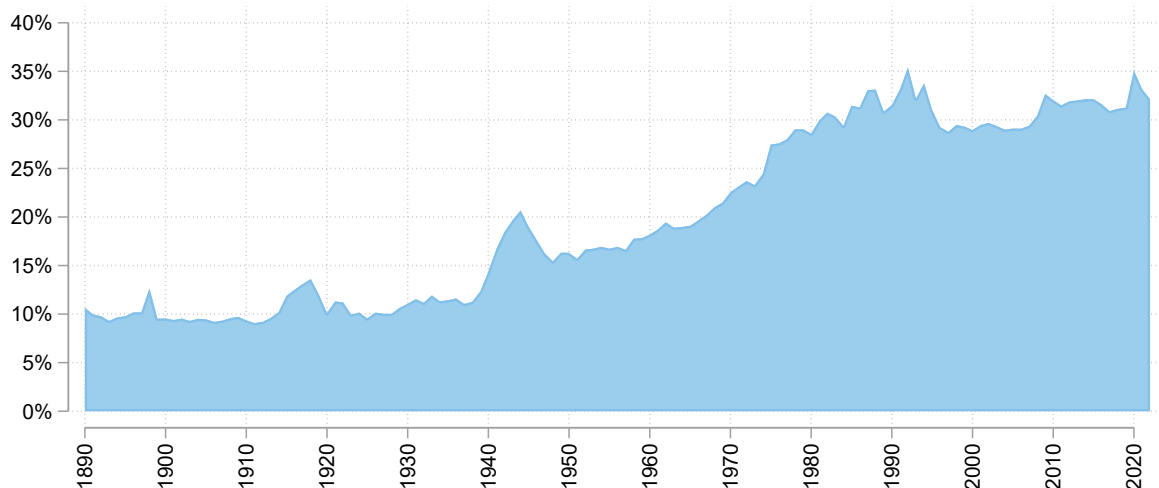


Figure 1: World average government size (% of GDP).

Source: International Monetary Fund (IMF)/Own Computations.

The 2nd World War proposed a similar phenomenon to that of the first one, in which war efforts increased the size of government, and by its end in 1945, the global average weight of government had already surpassed 20% of GDP, which, although suffering a short-term downturn in the following years, kept expanding until the nineties. One foundational factor for that growth appears in the form of the partial emergence of social insurance programs, which Dryzek and Goodin (1986) found to be linked to the events of the 2nd World War, at least for Great Britain. Another reason that partially explains that upsurge derives from the incremental distrust of the idea of a self-regulating market proposed by Adam Smith (Smith, 1776), which was losing relevance to the ideas of other esteemed scholars, more particularly, to those of John Maynard Keynes (Mueller 2003; Bernanke 2000).

As Keynes commonly used to state, given the unreasonable long period markets require to self-regulate, governmental intervention is essential to solve issues such as low growth and high unemployment, given that *"in the long run, we are all dead"* (Keynes, 1923).⁵ Furthermore, given the growing ubiquity of social

⁴ The augmented government intervention during this time was an evident signal that the public was losing confidence in the self-correcting mechanisms of a market economy.

⁵ Keynes suggested that both wages and prices were *"sticky"*, in the sense that they were not capable of efficiently responding to market demand, at least in a

security systems and non-monetary programs (Mueller, 2003), the average size of public expenditure peaked in 1992, when the world average government expenditure was more than 35% of GDP.

At the time, there were strong beliefs that most developed nations, particularly in Europe and North America, were in unsustainable tax brackets and had government presence that endangered economic flourishing. Additionally, scholarship criticising the adverse effects of oversized governments became common, with many academics suggesting that the negative externalities exhibited by the public sector could be as bad as those of the private (Gwartney et al. 1998; Mueller 2003).

Some of the critiques derive from the economic distortions that the associated income tax burdens originate, namely in the context of loss of efficiency and the blurring of price signals (Mueller, 2003). This effect alters the choice between work and leisure, and as exhibited by Alesina and Perotti (1997), the increment of tax brackets in labour can cause an artificial increase in labour costs, which, by association, causes higher unemployment and an overall loss of competitiveness.

Overtaxing can also have corruptive effects on the economy by promoting economic activity in the shadow economy and underreporting of revenues. Instead of being influenced to work less, taxes can induce individuals to simply report that they gain less by attempting to receive their income through the underground economy (Mueller, 2003). For instance, Andreoni et al. (1998) suggest that this problem is substantial, at least in the United States, where roughly 17% of all potential tax revenue from income tax (federal) is lost due to tax evasion.

A large governmental presence can also instigate corruption, given that the provision of public goods and services can have both direct and indirect benefits for individual entities. In this sense, corruption emerges due to the temptation of the private sector to interfere in public decision-making by bribing bureaucrats, which will sacrifice the public interests to those of their own and their corruptors (Mueller, 2003).

Nonetheless, corruption can be substantially dealt with by endowing higher compensations, as proposed by Goel and Nelson (1998), who found corruption to be inversely related to the wages paid to the employees of the public sector. However, the affiliated costs of increasing wages to eliminate all corruption are too high and not justifiable for the gains that result from reduced corruption, and in this sense, there will always be a trade-off between bureaucrats' wages and corruption standards.

Subsequently, all these critiques led most nations to undertake slight decreases in the sizes of government in the late nineties, dropping to values similar to those of the early eighties. Nonetheless, the emergence of the global financial crisis made it unreliable for governments to become less present in the

reasonable amount of time.

economy (Laeven et al., 2010), even when knowing of the dangers of over-interventionism. As of the second decade of the 21st century, although the idea of reducing government still prevails, most nations have been incapable of substantially doing so, even more so with the manifestation of the COVID-19 pandemic (World Bank, 2022).⁶

2.2 The role of governments: A review of the literature

2.2.1 The economic and social role of government

Even though the role of government in dealing with shocks, such as crisis and instability, was previously exhibited, it is important to focus on its relevance from a macroeconomic standpoint. To fully explain the macroeconomic role of government per se, we need to first understand the determinants of growth (GDP). The Solow (1956) model is one of the most fundamental frameworks in this context, and it describes that GDP levels are determined by three main factors: capital stock (equipment and buildings available for production), labour (hours worked), and technology.

The share of GDP growth that is not explained by labour or capital is what we refer to as the Solow Residual or Total Factor Productivity (TFP), which relates to the effect of technology.⁷ One assumption that this model proposes is economic convergence, given that those production factors, particularly capital and labour, present diminishing returns, thus, without any exogenous change in TFP, all countries conditionally converge (they converge to the same point if they possess the same populational growth rate, savings rate, and capital depreciation rate) to the same GDP per capita in the long run.

The proposition for convergence, particularly for absolute convergence, is not homogeneous as of the late 20th and early 21st centuries, given that the evidence worldwide is not broadly supportive and commonly presents opposite implications. The scholarship is substantially divided, with many authors suggesting that convergence holds, even absolutely (Nahar and Inder, 2002), and others suggesting the opposite relationship (Quah, 1993, 1997), and there are even some cases where absolute convergence is dependent on the time frame and set of countries that are used in the analysis (Mathur, 2005).

The nature of absolute convergence is undoubtedly ambiguous, nonetheless, that relation does not seem to transpose to conditional convergence. Although some authors, such as Nell (2020), exposed no conditional convergence for the post-1989 globalisation era, and Boldrin and Canova (2001) and Canova

⁶ During the pandemic period, there was unprecedented government intervention and regulatory forbearance, with great emphasis on the financial sector, where those policies aided banks in maintaining capital levels and liquidity.

⁷ Increases in TFP are commonly attributed in their entirety to technological progress, nonetheless, it can also be influenced by education and government regulation.

and Marcet (1995) provide evidence suggesting that it either is non-existent or simply not substantial enough to strongly affirm its widespread presence, these views are relatively isolated. Most of the growth literature, in contrast, finds empirical evidence of conditional income convergence.

The wide bulk of empirical evidence suggests that economies that are placed at lower initial income levels tend to grow at faster rates than those established with higher initial incomes, after controlling for saving and population growth rates, corroborating the commonness of conditional convergence (Barro et al. 1991, 1992; Cho and Graham 1996; Kaitila 2004; Nonneman and Vanhoudt 1996; Murthy and Chien 1997).

Considering this conflicting reality, one might ask oneself which other factors can help explain growth, as Romer (1986) learning-by-doing model exhibits. His work depicts that even though at the individual level diminishing returns still hold, at the aggregate level, that issue can be dealt with through the proliferation of positive externalities. Those arise due to the exchange of know-how between enterprises, which makes it possible to overcome the problem of diminishing returns, enabling growth to be self-sustaining. This dynamic proposes the relevance of governmental economic presence since the public sector serves as the entity responsible for providing basic research, infrastructure, and education that allows for the proliferation of that know-how and associated positive externalities⁸.

Despite that, those services must be funded by taxes, which on their own can also create economic distortions. Following this rationale, Barro (1990) and Barro and Sala-i-Martin (1995) propose that there is an optimal taxation level for investing in those services, given that there is a point at which the net benefit in terms of economic growth that derives from providing those public services is maximised.⁹ By proxy, the existence of optimal taxation levels to maximise growth implies that governmental presence is highly beneficial for augmenting economic performance, nonetheless, only until a threshold.

The rationale for governmental interference is also shared with Vedder and Gallaway (1998), who state that the effect of government size on economic growth behaves as the Armey Curve proposes, in a quadratic form (inverted U-shape), where too little government prevents the creation of an optimal layout for growth, while too much government punishes the private sector. “Why?” is what one might ask.

Vedder and Gallaway (1998) state that it partially relates to the fragility that a lacking government would create, namely in lack of property rights (rule of law), which would put forward a disincentive to both save and invest, given that expropriation would be real and common. The Armey Curve, depicted in Figure 2,

⁸ In the case of network externalities, there is a lack of private incentive to develop them, and in this sense, public policy plays a crucial role in both the implementation and distribution of the associated infrastructure and “know-how”.

⁹ All and any public expenditure must be financed by tax in present or future private wealth, which reduces the net return on investment while also slowing down private capital accumulation.

also shares with [Barro \(1990\)](#) and [Barro and Sala-i-Martin \(1995\)](#) the relationship of diminishing returns, given that after a certain point, incremental governmental interference only leads to unproductive effects. This does not imply that government is neither “good” nor “bad”, but rather that it follows the rationale of most things, in which too much of one thing can become harmful ([Vedder and Gallaway, 1998](#)).

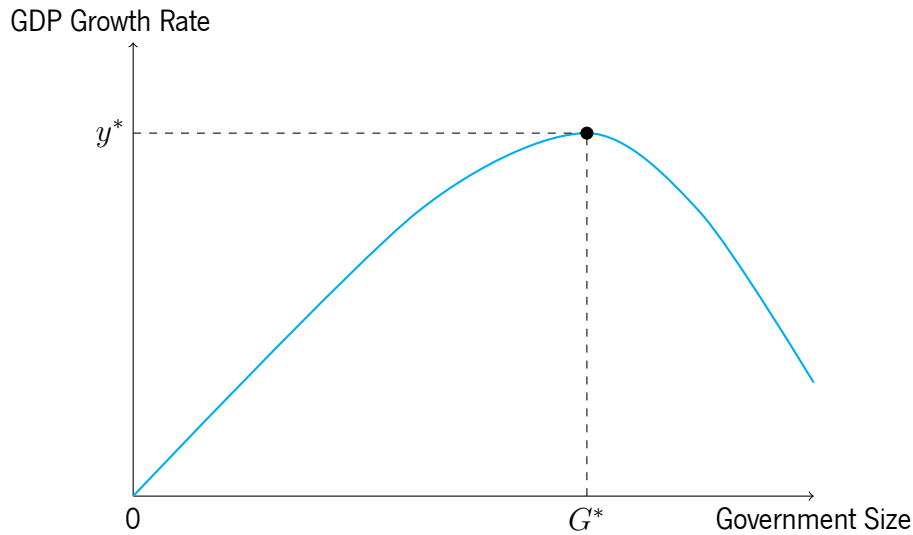


Figure 2: The Armey Curve.

Source: Own computations.

Previously, the economic standpoint for government presence was displayed, nonetheless, as widely accepted, a substantial part, or even the majority, of public intervention is not targeted at monetary issues, given that governments play a major role in addressing social problems. Some even state that the central governments exist to provide public services and alleviate externalities, with its main purpose being a redistributor of income and wealth ([Mueller, 2003](#)). This idea is shared by [Aranson and Ordeshook \(1981\)](#), who emphasise the intrinsic redistributive nature of all governmental expenditures.¹⁰ Evidence also exhibits this phenomenon in the framework that many of today’s economies display substantial outlays in social programs and policies. For instance, in 2022, data suggested that the mean proportion of social expenditure in the OECD was more than one-fifth of all spending, with some member states even reporting proportions of almost one-third ([OECD, 2024](#)).

2.2.2 Development and economic growth

In this article, I argue that using economic growth may lead to a bias when assessing the role of government, more specifically, in the sense that it represents a benchmark that is not the metric that

¹⁰ [Aranson and Ordeshook \(1981\)](#) state that all government activity is selfishly and redistributively motivated, given that the production of public goods always has distributional effects that may significantly affect the collective decision to provide the good.

society attempts, or should attempt, to maximise, but rather a means to an end, with [Ayres \(1996\)](#) even putting forward that growth is not, nor has it ever been, the most important contributor to augmented human welfare. As depicted by [Streeten \(1994\)](#), one could even suggest that normative metrics, although relevant in technical analysis, have nonetheless obscured the long-term goal, which is to improve human conditions. For this purpose, I aim to discover the size of government when addressing a more inclusive metric of prosperity, namely using economic development measures, given that, as exhibited by [Streeten \(1994\)](#), economic development, contrary to its technical counterparts, puts people back at the centre stage.

Both economic growth and economic development differ in their nature and purpose, with economic growth being an objective and direct metric of aggregate economic welfare, while economic development refers to a nation's growth in quantitative macroeconomic aspects as well as qualitative properties ([Shearer, 1961](#)). Broadly speaking, economic growth refers to objective content, while development has more subjective criteria, with information that tries to depict more social aspects.

It is widely accepted that economic growth is best and most commonly measured by [GDP](#) since it depicts the monetary value of the output of goods and services and is generally used as a proxy for social welfare and standards of living ([Aitken 2019](#); [Mahler 1992](#); [Berry and Lowery 1984](#)). Although essential for academia, that metric has received substantial backlash due to its various shortcomings. Many Nobel laureates, such as [Kuznets \(1941\)](#), [Hicks \(1948\)](#), [Nordhaus and Tobin \(1972\)](#), and [Samuelson \(1961\)](#), were some of the most illustrious figures in the criticism of the use of [GDP](#) as a proxy for social welfare and standards of living.

There is even survey evidence¹¹ of cases where it inversely represented the actual welfare or happiness of citizens, given that in specific but long-lasting periods the mean welfare stagnated or even mitigated, despite the continuous and steady pace of [GDP](#) growth ([van den Bergh, 2009](#)). Other authors also exhibit similar relationships, suggesting a commonness in the dis-alignment of happiness and [GDP](#) growth ([East-erlin, 2001, 2015](#)). Some of its other major flaws derive from its disregard for externalities, both positive and negative, as well as other non-monetary elements that in today's societies are considered essential to the bulk of the populace, such as health conditions, education, and environmental sustainability ([van den Bergh, 2009](#)).

In this context, the [HDI](#), a measure of economic development, appears to be a more appropriate metric to characterise actual welfare levels ([van den Bergh, 2009](#)), with some works such as [Martins and Veiga \(2014\)](#) and [Davies \(2009\)](#) already using it as a benchmark to assess optimal government size, in an

¹¹ The Eurobarometer surveys are one of the most commonly used resources by both economists and sociologists to empirically exhibit the detachments between [GDP](#) and indicators of welfare/happiness.

attempt to shift the focus of the discussion by utilising social development as the criterion for government size. This metric represents a stepping stone from the use of GDP, given that it addresses some of the flaws of its counterpart, namely by incorporating metrics of health, education, and economic growth through the implementation of a life expectancy index, an education index, and a GDP index in its computation (Davies, 2009).

Despite that, it still presents flaws, some similar to that of its peer, such as the disregard for environmental sustainability. Nonetheless, the most problematic is that it ignores one of the major growing concerns of today's world, inequality (Sagar and Najam, 1998). This critique is widespread, with many authors such as Sagar and Najam (1998), Hicks (1997), and Seth (2009) suggesting that the HDI should be reformed to address the issue of inequality in the provision of all its three components. Regardless, the problem remained unresolved for various years since its first scrutiny.¹²

Ultimately, Alkire and Foster (2010) addressed this major matter by attempting to discount the inequality in the allocation of the components of the HDI, with the resulting metric being designated as the IHDI. The subsequent metric does not only care about nominal values of structural conditions, but it also takes into consideration how well the distribution of those resources is made across its citizens. As stated by Hicks (1997), if the HDI helps to put people back at the centre of development, then the IHDI encourages addressing which type of people.

In this context, given the lack of a widely acknowledged way of depicting inclusive economic development¹³, I define it as the economic development that accounts for how well the resources created are equitably distributed, which I argue is relatively well depicted by the IHDI¹⁴ (Whajah et al., 2019). In this particular framework, it relates to how well prosperity is felt by the "common folk", both in income, education, and health services. Although inclusive economic development is still not formally established as a concept, some authors follow a relatively like-minded approach, defining it as the development or growth that must be accompanied by equal opportunities in both monetary and non-monetary aspects (McKinley 2010; Rauniyar and Kanbur 2010).

As depicted by Asongu and Nwachukwu (2016), the current shift in the policy debate towards inclusive development resulting from recent critiques of the inadequacy of GDP has also made preponderant the realignment of traditional metrics by substituting their usage with alternative ones such as the IHDI.

Based on this reasoning, the usage of the IHDI should play the role of the benchmark metric and should

¹² The Human Development Report from 1991 until 1994 attempted to address the criticisms of the disregard for income inequality in the HDI computation, nonetheless, it was discontinued for methodological reasons.

¹³ Inclusive development, inclusive social development, and inclusive growth are in recent literature used as umbrella terms that depict overlapping and extremely equivalent concepts, which are commonly used to illustrate the exact subsection of prosperity growth.

¹⁴ Asongu and Nwachukwu (2016) were the first, and at the time, the only authors to adopt the IHDI to represent the concept of inclusive human development.

be capable of ensuring that using an adequate and up-to-date measure of development provides a more fitting and robust estimate of the optimal size of government, avoiding possible biases and consequential unrealistic policy recommendations of standards for governmental proportions.

2.2.3 Prior scholarship

Even though the government has a primary role in guaranteeing a free and open society, the idea of overgrown governments is widespread, with esteemed figures, such as Milton Friedman, suggesting that the marginal gain from going from 15% of national GDP to 50% has been, overall, negative (Vedder and Gallaway, 1998).

Disregarding the popular sentiment, it might be enquired what the actual empirical evidence seems to suggest in terms of optimal sizes of government.¹⁵ Nonetheless, as we know, those results greatly differ according to the methodology used (Bergh and Henrekson, 2011), with most literature focusing on economic growth metrics, particularly GDP. For that variable, academics suggest relatively low values of government size, although commonly heterogeneous. Some authors, such as Vedder and Gallaway (1998), depict 17% of national GDP, with others suggesting similar values, such as Karras (1996), who describes 23% of GDP, Hajamini and Falahi (2018), who suggest 16.63%, Karras (1997), who depict 16%, and lastly, Asimakopoulous and Karavias (2016), who report 18.04%.

It is important to note that the latter found evidence that optimal government size may also depend on the current level of development. Particularly, they found larger optimal government sizes for developing nations than for developed ones, more particularly, 19.12% as opposed to 17.96% of GDP. The idea is fairly shared by Davies (2009), who used HDI as the benchmark, which also depicted heterogeneity in the size of government according to the clusters of income, particularly low-income and high-income countries. Several authors even suggest the possibility of divergent effects of the size of government on growth according to whether we are addressing developed or developing countries (Terasawa and Gates, 1998)¹⁶.

Similarly, further evidence of high heterogeneity in optimal government size, specifically when it is analysed for particular or for sets of countries, also partially corroborates the importance of addressing the current situation in terms of the development of the countries that are assessed (Altunc and Aydin 2013; Makin et al. 2019; Aly and Strazicich 2000). The finding of optimal government sizes is implicitly

¹⁵ The general public, as of the 21st century, tends to criticise the excessive interference and presence of governments, commonly blaming the heavy tax burdens by which it is directly associated, particularly in the developed world.

¹⁶ Terasawa and Gates (1998) also depicted that for high-income OECD countries, government activity has a statistically significant negative impact, a relation that turns positive for low-income countries, while middle ones depict an ambiguous relationship.

accompanied by the empirical evidence of the Armey Curve, at least for economic growth, with the broader chunk of academic work depicting the existence of that inverted U-shaped relationship ([Karras 1997](#); [Chen and Lee 2005](#); [Chiou-Wei et al. 2010](#); [Altunc and Aydin 2013](#)).

It is important to acknowledge that there is no substantial ambiguity in the belief in the existence of that relationship, however, there are still some authors that report different results than what the leading theory and evidence depict, more particularly, that increases in government expenditure as a share of GDP always have detrimental repercussions on growth ([Landau 1983](#); [Guseh 1997](#); [Tanninen 1999](#); [Dar and AmirKhalkhali 2002](#)).

In this context, by association, they also depict the inexistence of the Armey Curve and optimal size of government, given that larger governments are significantly associated with the creation of economic distortions that tend to always overweight any potential benefit that augmented government sizes could put forward ([Chiou-Wei et al., 2010](#)). Several pieces of that evidence have nonetheless been heavily debunked, with the reason primarily relying on the commonly used wrong assumption that the relationship is linear, rather than non-linear or quadratic ([Hajamini and Falahi, 2018](#)).

The prominent belief that government presence is relevant to promoting growth is already empirically supported. Nonetheless, that does not imply that the leading perception of overgrown governments is factually true. Several scholars already addressed this topic by computing the optimal sizes of government and comparing them with the actual reported sizes.

[Altunc and Aydin \(2013\)](#), for instance, for their set of countries, Turkey, Romania, and Bulgaria, depicted optimal sizes of government of 25.21%, 20.44%, and 22.45%. Overgrown governments seem to be present in this case, given that those values are significantly lower than what they reported at the time, more specifically, weights of 36.75%, 37.88%, and 35.64%, respectively. [Makin et al. \(2019\)](#) also depicted the same dynamic for Australia, where the optimal government size was only 31%, yet the actual size was positioned at 37%. Similarly, [Aly and Strazicich \(2000\)](#) exhibited that for their set of Gulf countries (Bahrain, Kuwait, Oman, Saudi Arabia, and the United Arab Emirates), the actual government size was roughly double the optimum.

[Afonso and Jalles \(2016\)](#)¹⁷ also propose that most countries may already be on the “slippery” side of the Armey Curve, where government excess implies detrimental effects on growth, with [DiPeitro and Anoruo \(2012\)](#) also displaying comparable outcomes, stating that economies have long crossed the optimal levels of government size.

¹⁷ [Afonso and Jalles \(2016\)](#) findings differ from most approaches in the sense that instead of computing its results according to a single proxy, it did so using four main prominent proxies for government size (public consumption, government expenditure and revenue, and public debt), which all depict parallel relationships and results, more particularly, of overgrown governments.

The empirical evidence seems to fall under the proposition that governments are overgrown, regardless, by shifting the focus to new metrics, such as the [HDI](#) or the [IHDI](#), the results could differ notably. I ultimately propose and argue that by utilising distinct and more inclusive metrics, the results will differ profoundly from earlier findings, namely by putting forward larger optimal government sizes. [Davies \(2009\)](#) could slightly sustain this statement, given that he found an uncommonly larger government size. Nonetheless, when applying [HDI](#) as the maximising metric, [Martins and Veiga \(2014\)](#) unveil an optimal government size of 17%, which somewhat contradicts the previous rationale, given that it reports a size that is very similar to the results depicted by scholars that use [GDP](#) as the benchmark.

Relatively to [IHDI](#), the literature that makes use of that metric is extremely scarce, with [Whajah et al. \(2019\)](#), at the date of the publication, being the sole author making use of it to assess dynamics related to the size of government. His findings for 54 African countries depict the inexistence of the Arme y Curve, more specifically, he exhibits a linear and positive relationship between the size of government and inclusive growth, which, contrary to this work, was depicted by an aggregate measure constituted by various indicators, while [IHDI](#) was considered as an explanatory variable.¹⁸ Although [Whajah et al. \(2019\)](#) findings differ in methodology, one could assert a parallelism with the present study, and consequentially one could predict that the relation between [IHDI](#) and government size will be similar to that of its findings for inclusive growth and government size.

That is, if its methodological approach was appropriate, which it doesn't seem to be. [Whajah et al. \(2019\)](#) state that given that government sizes are already overgrown, the depiction of a quadratic effect of government size does not need to be applied. Nonetheless, as suggested by [Hajamini and Falahi \(2018\)](#), overlooking the quadratic relationship is one of the most common fallacies in studying the effect of government size. Additionally, [Whajah et al. \(2019\)](#) flawed and relatively exaggerated reasoning for linear relationships makes it primordial to take a step back and continue the analysis using quadratic interactions.

In any case, given that empirical evidence for development metrics is meagre, it is challenging to discern if optimal government size will be larger when utilising [HDI](#) than when using [GDP](#), and following the same rationale, if it will be larger when utilising [IHDI](#) than when using [HDI](#) (and by association, a larger government when employing [IHDI](#) than when adopting [GDP](#)).

The present methodology aims to implement all three previous metrics ([GDP](#), [HDI](#), and [IHDI](#)) to estimate the dynamics of the size of government, given the evidence-based scarcity for [HDI](#) and the existence of a single, parallelistic reference point for [IHDI](#). Consequently, this work seeks to evaluate the optimal

¹⁸ [Whajah et al. \(2019\)](#) argue that since inclusive growth is viewed in a multifaceted perspective, they performed a principal component analysis (PCA) where a measure of inclusive growth was assembled using indicators representative of the pillars of inclusive growth.

government size in inclusive development (IHDl) as a primary result while also striving to determine if the results showcased by the alternative metrics could propose a possible under-representation of the role of government in the present literature.

2.3 The influence of governance and the importance of expenditure allocation

2.3.1 Government quality

As previously established, governmental involvement is relevant to support and facilitate both economic growth and development. Even so, the existence of extremely successful nations that have not only commonly reported higher growth rates than the world average but also depicted much higher GDP per capita levels, such as Ireland, South Korea, Singapore, Qatar, and even Switzerland, that have relatively low public sectors (21.23%, 28.68%, 15.39%, 24.25%, and 31.53% as of 2022), might drive us to scrutinise what other factors may be at play.

One contributing factor is the quality of government, which we can define as governance, a concept that depicts how well a nation manages its resources and how transparent and accountable its institutions are (Baland et al., 2010). Governance is of dire importance to promote economic prosperity, with Wolfowitz (2006), former President of the World Bank (WB), even suggesting that dysfunctional governance is the largest threat to development in most of the underdeveloped world.

The relevance of governance is not necessarily recent, with Acemoglu et al. (2001)¹⁹ and North and Thomas (1973) depicting that there is a causal effect of economic institutions and governance on development, with the heterogeneity in their quality being a major explanation for the contemporary discrepancy between rich and poor countries. Recently, however, economists started to jointly tackle the dynamics and effects of size and quality of government on growth, with Nirola and Sahu (2019) suggesting that to enhance both state-level and national-level economic growth, nations should accentuate their efforts on promoting the quality of institutions, alternatively to blindly employing too much attention to the size of governments.

There is also empirical evidence of a seemingly interactive relationship between government size and quality, given that in some cases, incrementing both can have positive effects on growth outcomes, despite that, countries with higher governance make more effective use of incremental government size than those

¹⁹ Acemoglu et al. (2001) showcase the example of British colonies compared to those of the French, Spanish, and Portuguese, which, due to good economic and political institutions that they inherited from Britain, exhibit much superior prosperity than the latter.

with lower governance (Cooray, 2009). Afonso and Jalles (2016) also portray that the study of the optimal level of government falls under the interaction of size and governance, depicting that institutional quality has a positive and significant impact on the level of real GDP per capita and that the supposedly negative impact of government size on growth is more significant for nations in a setting of low quality of governance.

Kim et al. (2018) also exhibit similar relationships, stating that both the size and quality of governments serve as fundamental tools to promote productivity and, hence, economic growth. More precisely, their results suggest that better governance facilitates countries in benefiting from enlarged government size, given that they act as complements in promoting efficiency and output growth²⁰.

In this context, my last research topic attempts to disentangle the possible mixed-up effects of government size and quality on growth and development, to suggest policy recommendations in terms of governmental resource allocation, and to guarantee that any bias is avoided in the computation of the optimal size of government. Following this premise, coupled with Goh and Mohd Aznan (2023) recommendations²¹, this study incorporates governance indicators as variables of control.

There is a possibility that previous literature may have wrongly estimated the size of the government, potentially due to the correlation of the government size with an unobserved variable, governance. This problem is what we refer to as endogeneity, and the omission of government quality could partially explain why government size tends to be so highly relevant in most empirical studies, even though, punctually, some empirical works still find evidence of inexistent effects of government size on both growth and development.

The greater bulk of academic studies imply the foundational role that good governance has in endorsing growth, nonetheless, there are still authors that contradict the leading wave by suggesting other dynamics. For instance, Sachs et al. (2004) exhibit that poor countries are not poor due to bad governance, but rather because they lack the economic resources to afford good governance in the first place, and that surprisingly, many underdeveloped nations report relatively favourable levels of governance. Furthermore, Hausmann et al. (2008) argue that governance is indeed a relevant issue, nevertheless, it represents only one of many other factors that may sabotage development.

²⁰ Kim et al. (2018), by dividing their sample into high- and low-resource countries, identify that this relationship is relatively more pronounced for countries with an abundance of natural resources.

²¹ Goh and Mohd Aznan (2023) stress the pertinence of incorporating governance in the methodology while also exhibiting that different regions may unveil distinct results.

2.3.2 Expenditure components. Do they all matter?

When assessing the optimal size of government, a substantial number of academics rely on the assumption that all government expenditures behave similarly, ignoring any possible heterogeneous effects that distinct components of expenditure could have on growth ([Vedder and Gallaway 1998](#); [Asimakopoulou and Karavias 2016](#); [Altunc and Aydin 2013](#); [Makin et al. 2019](#); [Aly and Strazicich 2000](#)). Nonetheless, one might question the validity of that assumption, given that, for instance, investment and consumption expenditures could lead to distinct results, both in absolute terms and in terms of temporal incidence.

Other scholars have attempted to address this dynamic, namely by decomposing government size into adequate components and computing the optimal size of government accordingly. [Hajamini and Falahi \(2018\)](#)²² for instance, use distinct metrics and components to make their computations, more particularly by decomposing government size into final consumption expenditure and current expenditure other than final consumption.

Similarly, [Chen and Lee \(2005\)](#) also decompose the overall government size, expressed as government expenditure (as a % of GDP), into two categories, specifically government consumption expenditure and government investment expenditure. His idea derived from [Lin \(1994\)](#) hypothesis that while both components could have beneficial repercussions on growth, the impact of government consumption will be less significant than the contribution of government investment, given that the latter has an uplifting effect on private investment. Likewise, [Barro \(1991\)](#) found that public investment tends to be positively correlated with both growth and private investment, nonetheless, contrary to the previous case, he exhibited that public consumption spending has adverse effects on growth and private investment.

[Davies \(2009\)](#), in his attempt to use HDI to compute the optimal size of government, follows a similar methodology, namely by assessing the optimal size of government separately to government consumption and government investment expenditures and reporting the optimal size of government as the summation of the precedent optimal sizes. Accordingly, his results address not only the distinct effects of the expenditures' components but also their optimal allocation. Similarly, [Afonso and Furceri \(2010\)](#) also decompose government sizes according to expenditures, however, contrary to [Davies \(2009\)](#), they find that government investment has statistically significant negative effects on growth.

[Martins and Veiga \(2014\)](#) decompose the size of government to an even further level, specifically according to defence, health, education, social protection, and a clustered group of the remaining expenditure subcomponents. This disaggregation made it possible to reach findings slightly different from previous academia, explicitly in the context that although non-linear relationships were found for HDI growth

²² [Hajamini and Falahi \(2018\)](#), in contrast to other studies, use government gross fixed capital formation as their proxy for government size.

in all subcomponents, the impact was heterogeneous according to the component analysed. Defence, education, and social protection expenditure had relationships similar to that of the Armeij Curve (inverted U-shape), where increments would lead to augmented growth prospects until a benchmark. Health and the rest of the subcomponents display opposite dynamics, given that they behaved oppositely to the Armeij Curve, or in a U-shaped relationship, where increases in expenditure always lead to detrimental effects, nonetheless, after a baseline, all and any incremental expenditure would have beneficial effects on growth outlooks.

[Devarajan et al. \(1996\)](#) even suggest that an optimal mix of public spending could lead to higher steady states of economic growth, given that seemingly productive expenditures could become pointless when used in excess. Their findings put forward that, for its set of developing countries, increments in capital expenditure have negative effects on growth prospects, and contrary to the standard sentiment²³, developing nations have been misallocating public resources in favour of capital expenditures at the expense of current expenditures.

Nevertheless, [Bose et al. \(2007\)](#), in a similar analysis of developing countries, found conflicting results, reporting positive effects on growth for capital expenditure and insignificant effects for current expenditure. Additionally, at a disaggregated level, [Bose et al. \(2007\)](#) uncovered that the only components to have a constructive impact on growth are the investment in education and total expenditure in education²⁴.

Distinguishing the different components of expenditure is highly relevant to acquiring robust results, given that the absence of decomposition may explain why the heterogeneity in empirical evidence is still strong. The traditional assumption that all the effects of government expenditure are the same might be creating noise that disturbs the accurate effect of government size, obstructing the optimal computation of the size of government, and consequently, damaging the discussion of the role of government.

²³ At the time, scholars believed that overspending in current expenses was damaging growth in developing countries, nonetheless, [Devarajan et al. \(1996\)](#) exhibited that the bias was in the opposite direction.

²⁴ [Bose et al. \(2007\)](#) conclusions were paradoxical to those of [Devarajan et al. \(1996\)](#) not only on the relevance of current expenditure but also on the effects of education, which the latter depicted to be negative.

3 Methodology and data

3.1 Data source and descriptive statistics

3.1.1 Dataset construction

Referencing subsection 2.1.1, my primordial indicator reflects the size of the government, which was argued to be more precisely represented by government expenditure as a percentage of GDP (Vedder and Gallaway, 1998; Labonte, 2010). Such an indicator was employed according to data made available by the IMF, which, although not the only source of information for government sizes, is the one that depicts more robust and long-lasting data, which can go back as early as two centuries.

Commonly, the data for government size tends to range from zero to 100 percent of GDP, nonetheless, issues such as foreign aid can bring forward anomalies in terms of that size, with punctual cases where the range is breached. The few outliers that fall outside that scope were excluded from the dataset to avoid bias and miscomputations.

Additionally, considering the hypothesis of the heterogeneous nature and relevance of distinct expenditure components made in subsection 2.3.2, data from the Governance Finance Statistics of the IMF is also incorporated to depict the allocation of expenditure components, more particularly to depict government intervention according to Classification of the Function of Government (COFOG) components. Contrary to many authors' procedures, such as Hajamini and Falahi (2018) and Chen and Lee (2005), which only aggregate government expenditure in a considerable few clusters, this information allows for a more particular analysis of the impact of government expenditure by decomposing it at a more in-depth level.

More specifically, such data portrays, as a percentage of GDP, government expenditure in general public services; defence; public order and safety; economic affairs; environmental protection; housing and community amenities; health; recreation, culture, and religion; education; and lastly, social protection. This disaggregation should be sufficient to address the heterogeneity of the component level and, similarly to Lin (1994), enable the distinguishment between productive and unproductive government intervention.

The extreme disaggregation, although beneficial in some respects, can limit the robustness of the results, giving their higher dependence on randomness, contrary to broad government expenditure, which is better at providing broad structural changes in the government's approaches to economic intervention. As such, and considering the different impacts of government consumption and investment depicted by Lin (1994), a broader aggregation of government components is also used, more particularly for government expenditure in consumption and government expenditure in investment.

Given calculation misadjustments from different data sources, the government investment as a percentage of GDP was retrieved from the IMF at the similarity of the overall government expenditure, and the government consumption was proxied by subtracting the investment from the overall government expenditure (in % of GDP).

The study of optimal values of government size tends to address heterogeneity at the level of both development and income levels, and as such, data was retrieved for both indicators. A dummy variable was constructed (=1 if developed, =0 if developing) representing the country's development status in the year 2023 according to the IMF. The time variation of development status was ignored due to two basic reasons, the first being a lack of data to accompany the development dynamics over time, and secondly, with the relatively small time dimension, is plausible to state that the change in development status is too small to effectively damage the consequential results that derive from this indicator.

For income levels, a categorical variable was constructed for the cluster of income levels according to data from the WB for 2022 (=0 if low income, =1 if lower medium income, =2 if upper medium income, =3 if high income). Similarly to the previous case and, for the same reasons, the time dynamics of the variable are also ignored.

To assess the impact of the size of government expenditure on economic growth, information from the WB for GDP in constant 2015 US\$ was retrieved. Additionally, from the same source, the population depicted by the total number of individuals was also incorporated into the dataset, and coupled with the previous indicator, it was possible to construct an indicator of real GDP per capita in constant US\$.

This indicator is later incorporated as one of the variables that I attempt to explain, given that it is in the study of the optimal size of government, considered by many to be the most used and appropriate metric to measure the increment in welfare that results from intrinsic changes in government structures.

The United Nations Development Program (UNDP) makes available most data related to development metrics, more particularly HDI and IHDI, which are both used in this work. As represented in section 2.2, the HDI is computed by the geometric mean of normalised indices for three key dimensions of human development: a long and healthy life (health index), access to knowledge (education index), and decent

standards of living (income index). The health index is calculated using information about the life expectancy at birth and education by using a mix of data for expected years of schooling and mean years of schooling, and the latter is estimated using data for the [Gross National Income \(GNI\)](#) per capita in constant 2017 [Purchasing Power Parity \(PPP\)](#).

Table 1: Dimensions of [HDI](#) and [IHDI](#).

Dimension	Indicator
Health	Life expectancy at birth (years)
Education	Expected years of schooling (years)
	Mean years of schooling (years)
Standard of living	GNI per capita (2017 PPP\$)

$$\text{Dimension index} = \frac{\text{Actual value} - \text{Minimum value}}{\text{Maximum value} - \text{Minimum value}}$$

$$\text{HDI} = \sqrt[3]{\text{Income index} \cdot \text{Education index} \cdot \text{Health index}}$$

The [IHDI](#), similarly to its predecessor, can only vary between zero and one, with higher values corresponding to higher levels of development, nonetheless, the [IHDI](#) tends to present lower values given that it follows the same computations as the [HDI](#) but is later discounted according to the within-country inequality (A) at each of the key components of development.

$$\text{IHDI} = \sqrt[3]{\text{Income index}^* \cdot \text{Education index}^* \cdot \text{Health index}^*}$$

$$= \sqrt[3]{(1 - A_{\text{Health}}) \cdot (1 - A_{\text{Education}}) \cdot (1 - A_{\text{Income}})}$$

The inequality function (A) represents the inequality or discount factor for each of the underlying development factors, which will lead to higher divergence between the [HDI](#) and the [IHDI](#) the higher its value. For interpretation purposes, the values of both [HDI](#) and [IHDI](#) were rescaled to range from zero to 100.

$$A_x = 1 - \frac{\sqrt[n]{X_1 \cdots X_n}}{\bar{X}}$$

The current database, following [Goh and Mohd Aznan \(2023\)](#) suggestions, also incorporated [WB](#) world governance indicators to appraise the development and growth dynamics more accurately. Such

indicators are essential to proxy for management and institutional competencies, given that they describe broad patterns in the perceptions of the quality of governance over time.

More particularly, they are comprised of six metrics that attempt to depict certain crucial factors of governance, such as voice and accountability, an indicator that captures the perceived extent to which citizens can select their government as well as freedom of speech; political stability and absence of violence/terrorism, which measures the perceived likelihood of political instability or associated violence; and lastly, government effectiveness, which captures perceptions related to the quality of public services along with its independence from political influence.

The other three indicators correspond to regulatory quality, the perception of the ability of governments to formulate and implement policies and regulations to promote and regulate the private sector; rule of law, which depicts the perceived confidence in abiding by the rules of society by law enforcement, more particularly property rights, police, and courts; and lastly, control of corruption, which reflects the perceived extent to which public power is exercised for private gain.

All governance indicator estimates are bound to a range of values of -2.5 and 2.5, with higher values corresponding to better governance. The rule of law in particular has commonly been cited as particularly relevant to address according to [Vedder and Gallaway \(1998\)](#) and [Goh and Mohd Aznan \(2023\)](#), nonetheless, the implementation of all governance indicators is econometrically invalid, given that they are prone to replicate and represent similar aspects of governance, and, as a direct consequence, they tend to be highly vulnerable to multicollinearity issues.

Accordingly, the econometric guidelines of the [Variance Inflation Factor \(VIF\)](#) only allow for the implementation of a certain amount of world governance indicators, and as such, a new variable is constructed to allow for the implementation of the full amount of world governance indicators.

Using the data for the six governance indicators, an overall governance indicator is constructed by making use of the principal component analysis. The objective of principal component analysis is to reduce the number of variables in a dataset while preserving as much information as possible. Broadly, this technique transforms a set of highly correlated variables into a smaller set of uncorrelated variables, which we refer to as principal components, without losing the broad statistical relevance and significance of the original variables.

$$Governance_{it} = f(Voice_{it}, Law_{it}, Regulatory_{it}, Stability_{it}, Efficiency_{it}, Corruption_{it})$$

In this approach, only the first principal component is used to represent governance, given that it is capable of explaining up to roughly 80% of the variance of the original governance indicators.

Given the distinct nature of growth and development dynamics, a bipolar econometric approach will later be implemented, and accordingly, also different data. For economic growth dynamics, additional data from the [WB](#) is incorporated, more particularly the gross capital formation as a percentage of [GDP](#), trade openness, which reflects the proportion of the monetary value of exports and imports on the [GDP](#), and lastly tertiary school enrolment (% gross).

For development metrics, the data employed slightly differs, although most of it also derives from the [WB](#). In this case, complementary information for the infant mortality rate (per 1000 births) is also incorporated. The data incorporated was standardised to depict values in percentages, and as such, most data was, when appropriate, multiplied by 100 at the similarity of development indicators.

Additionally, it is relevant to refer to the lack of a uniform designation for country names and country codes, which made it essential to opt for a uniform approach to depict the individuals being addressed, as such, this database also makes use of information retrieved from the [International Organization for Standardization \(ISO\)](#) to uniformly designate countries.

After merging the data and transforming it to ensure safe specifications of the variables, it was later divided into three separate databases, which are used to address the difficult interplay between statistical relevance and econometric adequacy, which is common within the study of optimal expenditure due to a consistently low number of observations.

The first dataset corresponds to an annual database that ranges from 1960 to 2023 for a set of 228 countries, which will later be useful to assess predictive and preliminary dynamics, as well as some additional estimations.

The second corresponds to a database with econometric usefulness, in which the years were dropped and were transformed into non-overlapping 3-year period averages for most variables, except [GDP](#) per capita, [HDI](#), [IHDI](#), population, and tertiary school enrolment.

$$X_T = \frac{x_t + x_{t-1} + x_{t-2}}{3} \quad \text{or} \quad X_T = x_t, \quad T = \{1, \dots, 21\}, \quad t = \{1962, \dots, 2023\}$$

The latter database depicts information for twenty-one non-overlapping 3-year periods (1962-1964, 1965-1967, 1968-1970, 1971-1973, 1974-1976, 1977-1979, 1980-1982, 1983-1985, 1986-1988, 1989-1991, 1992-1994, 1995-1997, 1998-2000, 2001-2003, 2004-2006, 2007-2009, 2010-2012, 2013-2015, 2016-2018, 2019-2021, 2022-2023), and, similarly to the annual database, it is also for a set of 228 countries.

The rationale as to why this technique was carried out and the motive to only estimate averages for certain variables are related to economic theory and econometric implementation, and as such will only

be exhibited in the accordant section. Additionally, the third database corresponds to the same approach, but only for 5-year periods.

As for GDP per capita, HDI, IHDI, population, and tertiary school enrolment, the values are not averages since the values represent the observations of the last year of the respective 3-year or 5-year periods. Additionally, using such variables, except for school enrolment, logarithmic growth rates were constructed.

$$\begin{aligned}\log Y_t &= \log Y_0 + g_Y \cdot t \\ g_Y \cdot t &= \log Y_t - \log Y_0 \\ g_Y \cdot 100 &= \frac{1}{t} \cdot (\log Y_t - \log Y_0) \cdot 100\end{aligned}$$

Given that we use periods, the growth rates were constructed by using the logarithmic change between periods for those variables, divided by the number of years of the periods. Such a procedure allows for the computation of the average annual growth rates of such indicators. Lastly, when multiplied by 100, it is possible to depict the percentage growth rate in continuous time.

3.1.2 Descriptive statistics and preliminary results

In this section, it is possible to address any issue that might be present in the data used in the empirical methodology. Table 2 presents the joint descriptive statistics for the non-overlapping 3-year period averages database, which will be used to compute the optimal government expenditure estimates for growth and development metrics. The first notable dynamic is the number of observations for different economic indicators, which are notably sparse. As mentioned above, the country's dynamics for optimal government expenditure suffer from data availability issues, a phenomenon similar to most of the previous literature.

Although such data is macroeconomically fundamental to uncovering relationships related to government size, one must account for its nature, as a low number of observations can introduce delicacy when working with such data.

The roughly 800 observations for GDP per capita and HDI do not present the biggest issue, as this is common in this field of study, and when correctly addressed, should not pose risks to the validity of the results. Davies (2009), Martins and Veiga (2014), and Asimakopoulou and Karavias (2016), for instance, present a similar or even lower number of observations.

Nonetheless, given the recent tenure of IHDI, this metric raises the most pressing concern, especially as it is central to this study, with only 355 observations. While other works occasionally use similar sample sizes, careful interpretation is crucial to mitigate potential small sample bias.

Table 2: Joint descriptive statistics for 3-year periods

Variable	Obs	Mean	Std. dev.	Min	Max
Δ GDP	838	2.2036	2.8157	-13.071	13.0063
Log GDP	838	8.7347	1.4698	5.3802	11.5931
Δ HDI	820	0.7415	0.7430	-1.7688	5.0833
Log HDI	820	4.2397	0.2590	3.2108	4.5654
Δ IHDI	355	0.6848	0.8054	-2.2355	4.0591
Log IHDI	355	4.0678	0.3731	2.9124	4.5098
Education	838	38.0456	26.9184	0.4426	142.3881
Size	838	31.8973	12.0027	2.4900	68.0113
GCF	838	24.6865	7.2688	4.3781	68.4307
Governance	838	0.4124	2.1684	-4.6247	4.8038
Δ Population	838	1.1972	1.4446	-5.2443	15.3218
Trade	838	85.6000	49.4009	18.1684	431.6811
Infant	820	21.5425	22.4855	1.5667	132.9333
Voice	834	0.1454	0.9434	-2.0961	1.7463
Law	834	0.1465	0.9686	-1.8975	2.0618
Regulatory	834	0.2539	0.8875	-1.9264	2.1252
Stability	834	-0.0167	0.9103	-2.7653	1.7587
Efficiency	834	0.2240	0.9341	-1.7439	2.2287
Corruption	834	0.1368	1.0229	-1.5323	2.3916
Developed	838	0.3019	0.4594	0	1
Income	838	2.0465	1.0061	0	3
Consumption	701	27.3298	12.4644	-8.0178	54.0971
Investment	701	4.2701	2.6734	0.0062	20.6428
Defense	424	1.4790	1.1741	0	9.5056
Safety	420	1.8766	0.6410	0.2908	5.6939
Social	427	12.8657	5.5817	0.0080	25.9204
Public	419	6.1151	3.0163	1.0147	42.4222
Health	418	5.0938	2.1506	0.3805	10.4420
Economic	207	5.1932	3.7194	1.7506	50.1934
Gov.Education	203	4.7812	1.2497	1.3796	7.7714
Environment	207	0.5839	0.3697	0	1.6185
Housing	203	0.8198	0.5705	-0.4649	3.3133
Culture	207	1.0400	0.5952	0.1003	3.6076

Notes: Statistical data is presented only for the larger dataset used with the variable, with joint descriptive statistics calculated for 3-year periods.

The descriptive statistics also highlight an interesting inequality dynamic, particularly the drop in mean values from the logarithm of [HDI](#) to [IHDI](#), especially for minimum values, which decline more sharply than maximum values. This may partially reflect the historically higher inequality in developing countries compared to developed ones ([Derviş and Qureshi, 2016](#)).

Government size remains highly heterogeneous, even after addressing outliers, with some countries reporting values as low as 3% of [GDP](#), while others disclose values as high as 68%. Other variables present similar patterns, particularly regarding inequality and heterogeneity between countries, with most indicators showing high standard deviations.

Although the 3-year average database serves as the study's econometric foundation, this section uses the annual database due to its higher statistical power in uncovering preliminary mechanisms before factoring in any quantitative methods. Consequently, [Figures 12, 13, and 14](#) depict trend lines illustrating correlations between growth and development metrics to assess whether the indicators diverge significantly or exhibit a similar behaviour.

[Figures 12 and 13](#) suggest that while higher economic growth generally correlates with higher development, both in terms of [HDI](#) and [IHDI](#), the relationship is not strictly linear. Moreover, when comparing growth rates, higher economic growth does not consistently align with higher development growth. Though some positive correlation exists, historical data shows that countries often experience economic growth without corresponding development gains, and vice versa.

[Figure 14](#), in particular, conveys that while [HDI](#) and [IHDI](#) growth still differ, particularly in logarithmic terms, they exhibit stronger alignment than when comparing themselves with [GDP](#). However, their dynamics remain slightly detached, with many cases where country-level development growth does not resemble inclusive development expansion.

Such extrapolations make it doable to expect a greater divergence between economic growth and development metrics than between different development indicators.

Additional trend lines can help assess optimal government expenditure for different metrics and preliminarily infer the existence of an Armey Curve relationship. [Figures 3, 4, 15, and 16](#) illustrate these associations, with the first two depicting the relationship between government size and logarithmic values and the latter two exhibiting the relationship between government size and growth rates for both growth and development metrics. Notably, the trend lines in [Figures 3 and 4](#) suggest an Armey Curve relationship.

Historical data indicate that countries with government sizes below 50% of [GDP](#) have generally reported lower levels of development and economic prosperity. However, exceeding this threshold is also associated with diminished prosperity. In this regard, [Figures 3 and 4](#) suggest turning points at approximately 50% of

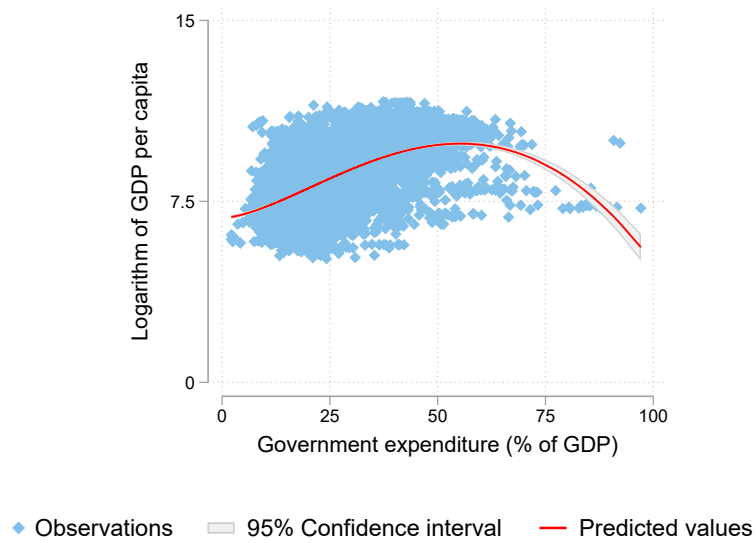


Figure 3: Trend line of government size and the logarithm of GDP per capita.

Source: WB/IMF.

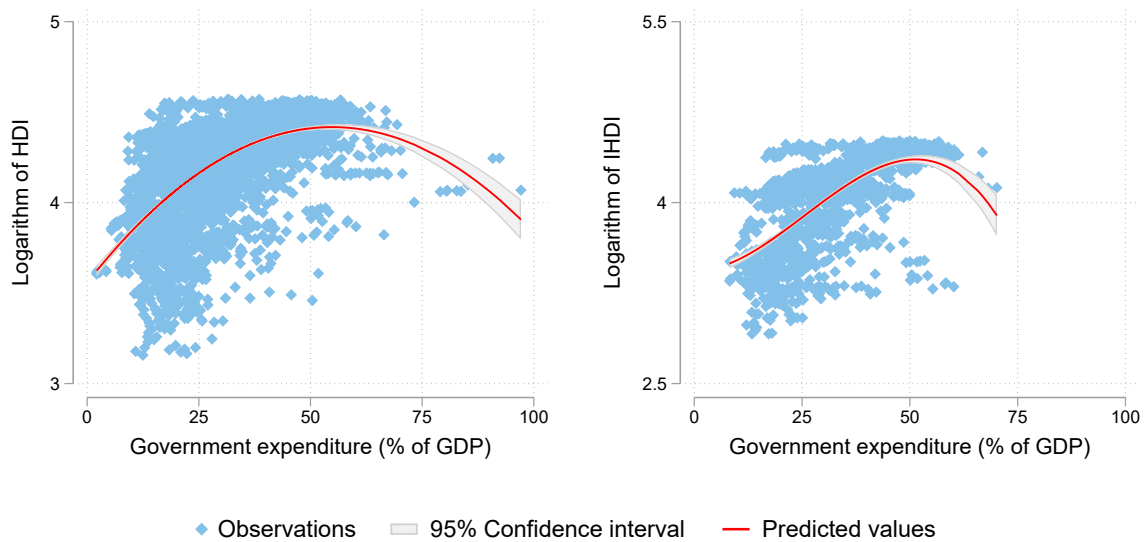


Figure 4: Trend lines of government size and the logarithms of HDI/IHDI.

Source: WB/IMF.

GDP.

The relationship between government size and growth rates, exhibited in Figures 15 and 16, follows a somewhat different pattern, especially regarding the turning point. In Figure 15, while the quadratic effect is weaker, a perceptible turning point appears around 10% of GDP for GDP per capita growth. For HDI and IHDI growth rates, the quadratic effect is less pronounced, but the turning point still emerges at approximately 4-7% and 15% of GDP, respectively.

Building on Asimakopoulou and Karavias (2016) and their findings on the heterogeneous effects of government size according to development status, the following figures illustrate these relationships across all growth and development metrics. Figures 5, 6, 17, and 18 specifically focus on developed countries, with the first two displaying logarithmic values and the subsequent depicting growth rates.

The most notable takeaway regarding the Armey Curve for developed countries is its ambiguity, absence, or at best, extreme weakness. In Figure 5, GDP per capita shows no correlation with government size, and if anything, the relationship appears inverse to the Armey Curve. In contrast, Figure 17 suggests a possible turning point at around 5-7% of GDP, though the effect remains weak.

For development metrics, Figures 6 and 18 further highlight the lack of a clear relationship. In Figure 6, the logarithmic value of development metrics shows no discernible pattern with government size, while in Figure 18, the trend lines appear nearly random, often being entirely flat, indicating a near-total disconnect between government size and development prospects.

For developing countries, the evidence for the Armey Curve is stronger, in stark contrast to the case of developed countries. Figures 7, 8, 19, and 20, where the first two depict logarithmic values and the latter show growth rates, illustrate this inference. Specifically, there is no strong evidence for the Armey Curve in the logarithmic values for all three metrics of prosperity and moderate evidence for the growth rates.

For the logarithmic values of GDP per capita, HDI, and IHDI, turning points occur at around 50% of GDP for the first two and 40% for IHDI. Regarding their growth rates, the optimal values are approximately 5% of GDP for the first two indicators and 10% for the latter.

The most noteworthy dynamic related to the segmentation between developed and developing countries concerns their heterogeneous relationships with government expenditure. Such contrasting associations have been noted by many authors, including Asimakopoulou and Karavias (2016). However, unlike their findings, the Armey Curve seems almost non-existent for developed countries in this case. As for developing countries, the relationship appears nearly perfect, regardless of the method or metric used in the analysis.

These seemingly conflicting effects regarding development might make it essential, similar to previous

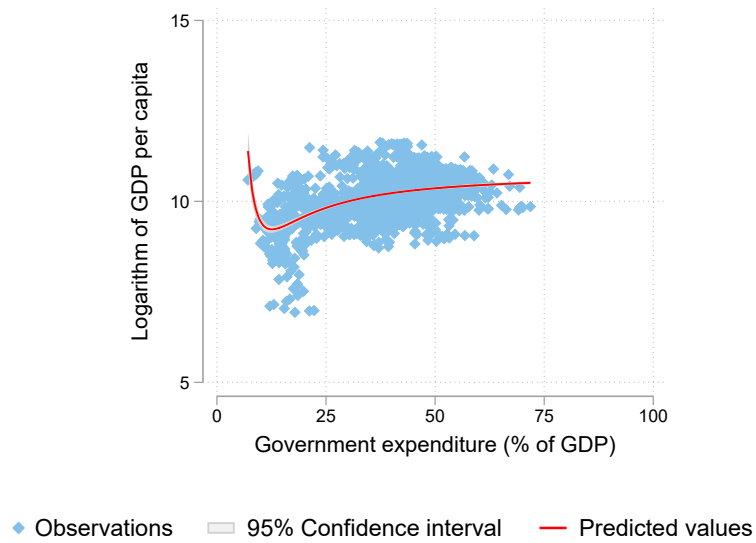


Figure 5: Trend line of government size and the logarithm of [GDP](#) per capita for developed countries.

Source: [WB/IMF](#).

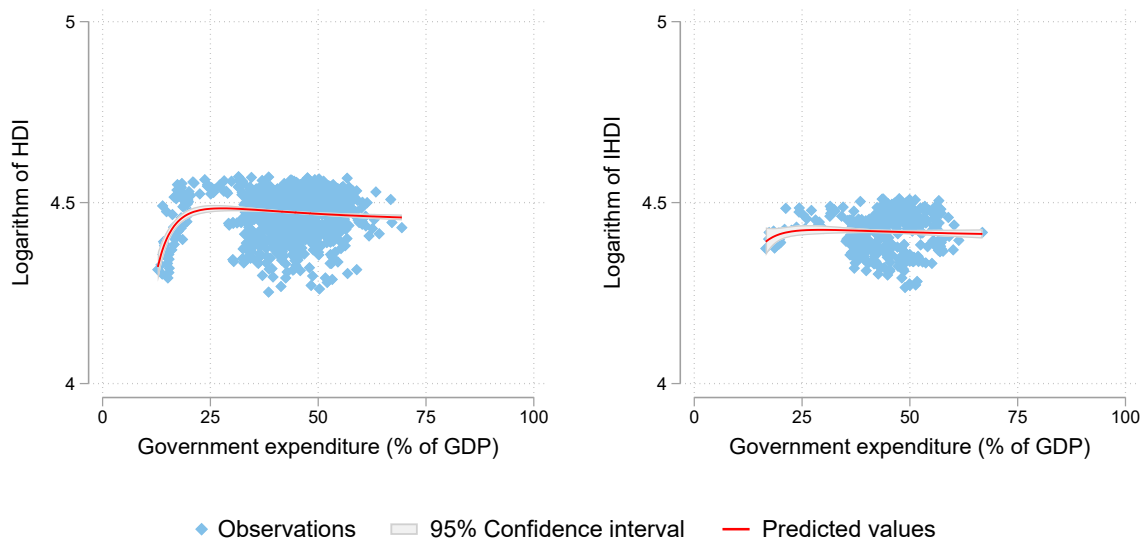


Figure 6: Trend lines of government size and the logarithms of [HDI/IHD](#) for developed countries.

Source: [UNDP/IMF](#).

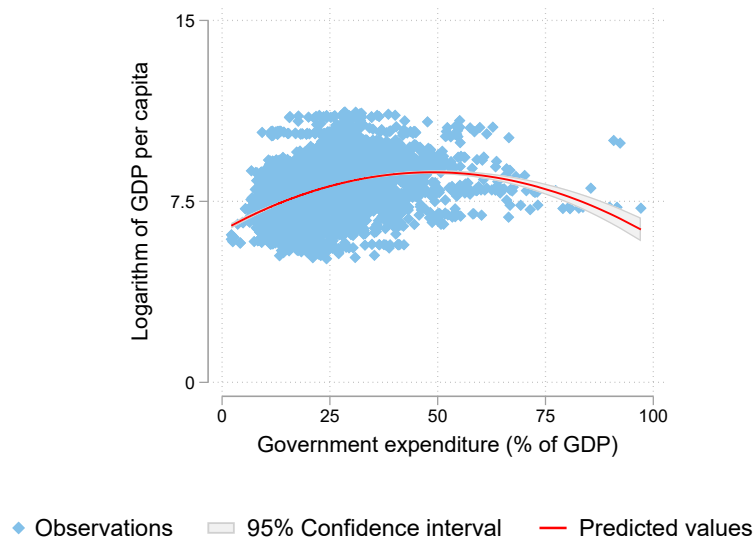


Figure 7: Trend line of government size and the logarithm of GDP per capita for developing countries.

Source: WB/IMF.

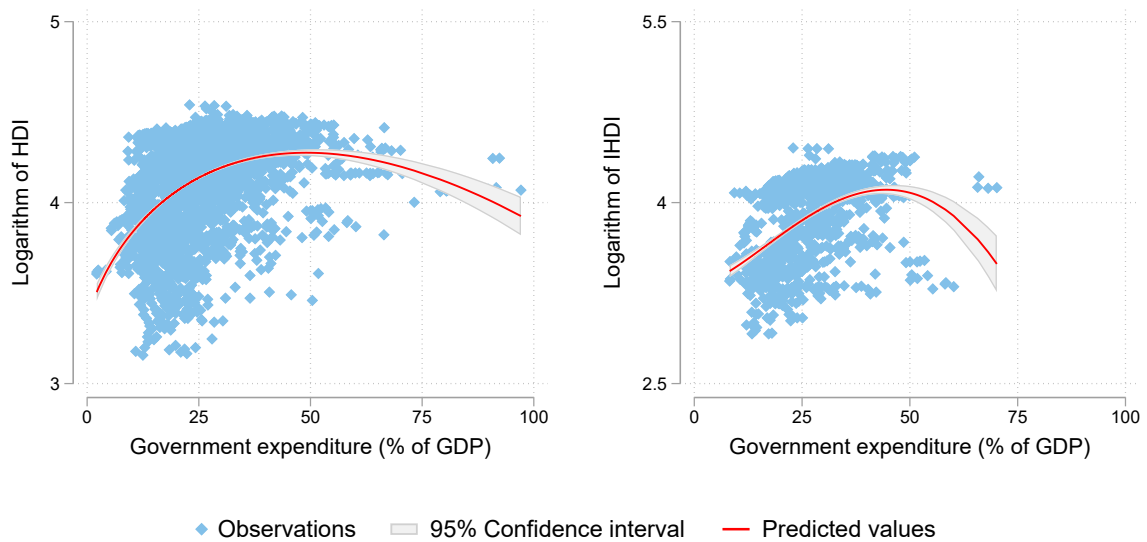


Figure 8: Trend lines of government size and the logarithms of HDI/IHD for developing countries.

Source: UNDP/IMF.

literature, to conduct a disaggregated scrutiny. A unified analysis that ignores such heterogeneity could obscure the Armey Curve relationship.

It is important to note that the previous assessment only shows trend lines, which are useful for making predictions and preliminary assumptions about potential future relationships. They do not, however, provide robust or statistically significant tools for extrapolating empirical inferences on the optimal size of government.

Their applicability lies in guiding expectations regarding relationships and challenges that may arise. Overall, they suggest that future evidence may support the existence of the Armey Curve or that aggregation of developed and developing countries may obscure such relationships. Furthermore, these preliminary findings suggest that conclusions may vary depending on the metric used, with particular alienation for economic growth.

3.2 Econometric methodology

3.2.1 Econometric approach for economic growth indicators

As previously exhibited, the substantial contrast between economic growth and economic development can imply heterogeneity in the conclusions inferred, and as such, distinct econometric approaches are imperative. Consequently, a dual regression methodology is applied, one for economic growth and the other for development indicators, although both share particular characteristics in their estimation.

For instance, as referred to in subsection [3.1.1](#), the data is averaged over 3-year periods for most variables, and accordingly, lags and logarithmic growth rates are implemented to construct appropriate dependent and explanatory variables.

What hasn't been discussed nonetheless is the rationale for such a procedure. The main motive for such a technique relies on controlling for the effects of business cycles in cross-country and time-series studies and emphasising the relevant variables' impacts on long-term economic or development growth ([Sturn and Epstein, 2021](#); [Beck and Levine, 2004](#)).

Broadly, the use of non-overlapping periods allows for smoothing out short-term fluctuations and focusing on the impact of structural changes by reducing the noise from such anomalies and emphasising long-term economic dynamics. As cited by [Beck and Levine \(2004\)](#), averaging annual data into non-overlapping 5-year periods allows for the purging of cyclical bias and consequently depicts more accurate conclusions.

The literature, however, stresses the dilemma of how many years should be used to construct the

non-overlapping periods, with some even suggesting that averaging in 5-year periods may not be enough to effectively control for such cycles, given that they can commonly be persistent for larger durations (Schularick and Solomou, 2011; Loayza and Rancière, 2006).

Even so, in the current framework, smaller periods of only 3-year periods were exercised, considering the vulnerability and the necessity of counterbalancing econometric suitability with statistical relevance. Such judgement relates to the fact that the increment in the robustness of results resulting from incremental observations from changing from 5-year periods to 3-year periods might likely compensate for the loss in robustness that derives from not controlling as accurately the business cycles.

Accordingly, given this limitation, it is of foremost concern to approach carefully resulting computations, and as such, future results will commonly be computed also for 5-year periods to ensure the sturdiness of the causal inference.

Additionally, most literature focuses on economic growth and its probably quantitatively important connection with business cycles, which may also reinforce economic growth (Kaihatsu et al., 2019; Pedersen and Elmer, 2003). Nonetheless, evidence on business cycle dynamics with development indicators is lacking, and thus, the assumption that averaging for 5-year periods for both growth and development is unfounded.

Consequently, adopting the same non-overlapping periods might imply fallacies, given that it assumes that both indicators of economic and development performance are prone to the same duration of business cycles. By rationale, given that development implies more structural changes, while economic growth has more fast-paced dynamics, it might be relevant to appraise if longer averages may be more appropriate for the development indicators, while for growth shorter averages might be sufficient, thus further validating the use of different periods to address business cycles incidence and its mechanisms.

With this topic sorted, the construction of the econometric estimation can be assembled. [Model 1](#) depicts the current estimation, which is used to assess the benchmark results for dynamics relating to the size of government and economic growth. At the similarity to most literature, this model attempts to estimate an optimal government expenditure level or turning point, if existent, according to the maximisation of economic growth, which, in this scenario, is represented by the [GDP](#) per capita annual average growth rate for a country i at period t (Δ [GDP](#)), and as stated in the previous section, is computed using the logarithmic change rate between two consecutive periods.

$$\begin{aligned}\Delta GDP_{i,t} = & \alpha_i + \beta_0 \log GDP_{i,t-1} + \beta_1 Education_{i,t-1} + \beta_2 Size_{i,t} + \\ & \beta_3 Size_{i,t}^2 + \beta_4 GCF_{i,t} + \beta_5 Governance_{i,t} + \beta_6 \Delta Population_{i,t} + \\ & \beta_7 Trade_{i,t} + \gamma_t + \epsilon_{i,t}\end{aligned}\quad (\text{Model 1})$$

Given the literature on economic convergence, which tends to support the existence of conditional convergence, it is expected that the present level of economic advancement might explain a considerable amount of future growth, given that countries tend to end in a country-specific steady state that is dependent on their specific labour force and savings specifications (Barro et al., 1991, 1992; Cho and Graham, 1996; Kaitila, 2004; Nonneman and Vanhoudt, 1996; Murthy and Chien, 1997).

Consequently, the logarithm of the last year of the 3-year periods of GDP per capita for country i at period $t - 1$ ($\log GDP$) was implemented as a control variable. As suggested by Barro (2016), this variable is anticipated to have a negative coefficient if conditional convergence holds, since with increasing economic prosperity, decreasing marginal returns to growth start to take form, making it increasingly harder to sustain high rates of growth. Additionally, the inclusion of such a variable allows the econometric model to be dynamic and, as such, depicts the past values of the dependent variable to influence its present value, which helps capture the serial persistence of economic mechanisms of growth (Bhargava and Sargan, 1983; Arellano and Bond, 1991).

As previously referred to, however, that variable only tests conditional convergence if controlled for country-specific labour and saving settings, given that if that does not hold, what is being tested is absolute convergence. In this sense, to control for the labour force, the population annual average growth rate for country i at period t (Population) computed by the logarithmic change is also included, giving Ram (1986) suggestions that it serves as a proxy for labour force growth. Although a stable and robust labour force is an essential foundational tool to sustain a consistent tax base and working force, an abusive incremental population might make it harder to keep up with a fast-tracked demand for jobs and central services, and therefore we can project such a variable to be non-significant or even to stifle growth.

Analogously to Asimakopoulou and Karavias (2016), the average gross capital formation as a percentage of GDP for country i at period t (GCF) is also incorporated, for mainly two main reasons. The first relies on the necessity of controlling for the savings dynamics to infer conditional convergence, given the proposal of Hajamini and Falahi (2018) that investment as a percentage of GDP can be used as a substitute for the savings rate.

Additionally, capital formation is also relevant to factoring in the relevance of private investment and

its multiplying impact on economic growth.¹ Consequently, it is foreseen that it will have an encouraging and significant impact on the growth prospects.

The main explanatory variable under analysis refers to government size, which is represented here as the average government expenditure as a percentage of GDP for country i at period t (Size), which is also incorporated in its quadratic form (Size²). The quadratic approach is implemented as a default considering that most recent academics confronted the traditional approach of linear relations and found the statistical pertinence of carrying out non-linear relationships (Hajamini and Falahi, 2018).

As a result, for the relationship of the Armeý Curve, which is expected, the government size should depict a positive coefficient while its square should exhibit a negative effect, with the resulting turning point where increases in government expenditure no longer imply marginal enhancements in economic growth, conveying the optimal government size.

Furthermore, trade openness, the share of the monetary value of exports and imports on the overall GDP in country i at period t (Trade), is also included, following the econometric methodology of both Afonso and Furceri (2010) and Asimakopoulos and Karavias (2016), to account for the effect that the insertion in international trade or even trade liberalisation policies exert on economic growth. Therefore, we might anticipate a positive and significant impact of that variable similar to Afonso and Furceri (2010), or at least for developing countries alike Asimakopoulos and Karavias (2016).

Given the relevance to control for the impact of education on growth, the tertiary school enrolment, expressed as a percentage of the population of tertiary education age, of the last year of the 3-year periods for country i at period $t - 1$ (Education) was also integrated. Contrary to other scholarship, such as Martins and Veiga (2014), secondary school enrolment was not used, given that nowadays it lacks heterogeneity according to the level of economic prosperity given the recent worldwide improvement in basic levels of education prospects. Given the probable beneficial impact of a qualified workforce on growth, it is expected that the variable will provide a positive coefficient.

Lastly, as depicted in subsection 2.3.1, governance is of dire relevance in explaining most of the heterogeneity in economic prosperity between rich and poor countries (Acemoglu et al., 2001; North and Thomas, 1973). Hence, the indicator of broad governance for country i at period t (Governance), constructed using principal component analysis, was also incorporated. According to inferences from the literature, it should have a positive and statistically significant effect on economic growth.

Given the substantial endogeneity present in dynamic models of economic growth, particularly due to the correlation between the lagged dependent variable and the error term, a two-step System-

¹ Gross capital formation is used as a proxy for private investment, given that public sector investment represents only a negligible share of total investment.

Generalised Method of Moments (GMM) estimator with time Fixed Effects (FE) is used to reduce bias and increase the estimation precision (Bond, 2002).²

The use of System-GMM is most appropriate when the panel units, such as countries, are large, while the periods are relatively small, a characteristic shared by the present 3-year and 5-year period database. Additionally, the Difference-GMM has been found to have poor finite sample properties, particularly in cases where the time series are highly persistent (Blundell and Bond, 1998; Bond et al., 2001).

Furthermore, applying the Bond rule of thumb suggests that System-GMM is likely more appropriate than Difference-GMM. In Model 1, all explanatory variables are treated as endogenous, except for the period dummies, which serve as exogenous instruments. For endogenous variables, lagged values from at least two periods are used as instruments. Moreover, to ensure the robustness of my empirical inferences, I compute the results using robust standard errors to correct for heteroskedasticity and potential serial correlation in the error terms.

The integration of System-GMM is also highly relevant because it helps address a multitude of sources of endogeneity, such as unobserved, simultaneity, and dynamic endogeneity (Ullah et al., 2018). Tackling endogeneity deriving from simultaneity is of special importance in this particular model, given that although government size might theoretically affect growth, there is also evidence that growth can also affect government size (Peacock and Scott, 2000).

3.2.2 Econometric approach for economic development indicators

In the estimation used to assess development and inclusive development, the econometric methodology is similar, as a direct consequence of the parallel nature of HDI and IHDI, and as such are explained by the same variables (except for their lags). Similar to the methodology referred to in economic growth modelling, the dynamics related to business cycles imply the main use of 3-year periods but also 5-year periods due to robustness issues and business cycle duration.

Model 2 exhibits the construction of the econometric model for development indicators, which is similar to Model 1 given the structural similarities between economic growth and development. Consequently, similarly to Model 1, this new model also attempts to compute the turning point of the government size, although presently for both development and inclusive development, the first represented here by the HDI annual average growth rate for country i in period t (Δ HDI) and the latter depicted by the IHDI annual average growth rate for country i at period t (Δ IHDI), both computed by logarithmic growth rates.

² Given the potential lack of statistical significance in System-GMM estimates, individual and time FE regressions are also used to ensure robustness.

$$\begin{aligned}\Delta \text{HDI}/\text{IHDI}_{i,t} = & \alpha_i + \beta_0 \log \text{HDI}/\text{IHDI}_{i,t-1} + \beta_1 \text{Education}_{i,t-1} + \\ & \beta_2 \text{Size}_{i,t} + \beta_3 \text{Size}_{i,t}^2 + \beta_4 \text{GCF}_{i,t} + \beta_5 \text{Governance}_{i,t} + \\ & \beta_6 \text{Infant}_{i,t} + \gamma_t + \epsilon_{i,t}\end{aligned}\quad (\text{Model 2})$$

Given the similarity of both economic growth and development indicators, corroborated by other authors' econometric approaches to development such as [Davies \(2009\)](#) and [Martins and Veiga \(2014\)](#), we could expect that certain explanatory variables should remain relevant when applied to assess development dynamics.

In this sense, the tertiary school enrolment, gross capital formation, governance, and surely government expenditure in its quadratic form are all explanatory variables that were also implemented in [Model 2](#). Given the similarity of both models, we could anticipate the statistical relevance and the direction of the impact of such indicators to be a close reflection of their anticipated behaviour in [Model 1](#).

Building on this argument, we could anticipate that tertiary school enrollment, governance, and gross capital formation would have a positive and statistically significant impact on both metrics of development. As for government size, the effect should be quadratic, similar to that of the Armey Curve, with [Davies \(2009\)](#) and [Martins and Veiga \(2014\)](#) reinforcing such plausibility due to their findings of quadratic impacts of government size on [HDI](#).

Only the variables of trade openness and population growth were dropped in the present model. The trade openness was removed due to the intrinsic monetary relevance of trade, which does not transpose as well to development indicators as one should expect. Given that increments in development are often a result of structural changes in a country, the too-diluted effect of trade on development leads to a lack of statistical relevance for that variable.

Given that trade impacts economic prosperity, which is only one of many components of development, its impact would only be observed through indirect mechanisms, and consequently, the inclusion of trade would imply more noise in the estimation than actual empirical robustness.

Similarly, this partially holds for population growth, given that economic growth accounting often displays population growth as an important foundational factor for economic growth, nonetheless, that does not convert well for development, in which said variable seems to lack explanatory power. The feasibility of a too overly vague transmission mechanism between population and development and its overfitting in [Model 2](#) ultimately led to its withdrawal.

To also apply dynamic models, along with the theory of conditional convergence, the logarithms of the last year of the period of both [HDI](#) and [IHDI](#) for country i at period $t - 1$ ($\log \text{HDI}$, $\log \text{IHDI}$) were also

incorporated as control variables.

Although population growth is now lacking in the model, the theory of conditional convergence should still be able to hold, and therefore, it is anticipable that the lags of the metrics of development provide a negative coefficient, given that as development grows, decreasing marginal returns start to punish development prospects, ultimately leading countries to their own steady states.

The practice is also implemented by [Davies \(2009\)](#) and [Martins and Veiga \(2014\)](#), in which the latter found evidence of convergence. Given the health component of the development indicators, a new variable is added to [Model 2](#) which was not present in [Model 1](#). That variable is the average infant mortality rate for country i at period $t - 1$ (Infant), which is expected to exhibit a negative and statistical impact on development, given that the worse the health conditions of a country, the worse its development outcomes.

The econometric dilemmas and the critical obstacle of endogeneity are still present in the current model of economic development, and as such, the same approach of [Model 1](#) is implemented here, particularly by running a two-step System-GMM with time FE.³ [Model 2](#) also treats all variables as endogenous and uses for instrumental variables the period dummies as well as at least the two-period lags of the explanatory variables. The results are also expressed with robust standard errors to guarantee higher accuracy.

³ Similarly to the previous case, the potential lack of statistical relevance in System-GMM estimations also prompts the use of individual and time FE estimations to ensure robustness.

4 Results

4.1 Main analysis

4.1.1 Benchmark results

Table 3 reports the benchmark results derived from the baseline econometric models for 3-year periods. The notes describe the econometric specifications, particularly their autocorrelation validity, the Hansen test, the number of instruments, and an additional number of statistical specifications.

In column (1), we can observe that the government size is highly related to increments in the GDP growth rate in a quadratic form. Consequently, the augment in government expenditure provides high and significant bonuses to economic growth prospects at its first stages but later tends to provide lower and lower incentives, even ultimately reaching hazardous impacts on GDP, similar to the Armey Curve.

Column (2), which also tests GDP growth but uses FE depicts similar relationships. Consequently, by deriving the equation on government size, we can infer the optimal government size according to economic growth maximisation.

Consequently, we can depict that for the System-GMM estimation, the results indicate that the optimum government size or expenditure should be allocated at roughly 32.54% of GDP, while for FE that size is substantially similar, situated at roughly 27.22% of GDP.

For both columns, the rest of the explanatory variables seem to behave as expected, with higher values of past GDP implying lower growth rates in the present, similar to the rationale of conditional convergence. The gross capital formation also exhibits a substantial and positive impact on economic growth. The beneficial and closely related impact of trade on growth is also exhibited by its positive coefficient. The population growth negative effect was also anticipated.

Education also seems to behave similarly to what was previously projected, with a beneficial impact on growth prospects, nonetheless, only for the System-GMM. Governance behaves contrarily, given that it provides a substantial positive impact on growth, nonetheless, only on the FE regression.

Table 3: Government size, growth, development, and inclusive development for 3-year periods

Variables	(1) Sys-GMM	(2) FE	(3) Sys-GMM	(4) FE	(5) Sys-GMM	(6) FE
Log GDP _{<i>t-1</i>}	-2.393*** (0.850)	-5.478*** (0.838)				
Log HDI _{<i>t-1</i>}			-8.406*** (3.038)	-10.174*** (1.038)		
Log IHDI _{<i>t-1</i>}					8.483** (3.342)	-18.145*** (2.467)
Education _{<i>t-1</i>}	0.043** (0.020)	0.012 (0.011)	0.016** (0.007)	0.002 (0.003)	0.006 (0.016)	0.002 (0.005)
Size	0.621*** (0.218)	0.304*** (0.098)	0.026 (0.049)	0.053** (0.021)	-0.223** (0.103)	-0.058 (0.059)
Size ²	-0.010*** (0.003)	-0.006*** (0.001)	0.000 (0.001)	-0.001** (0.000)	0.003** (0.001)	0.001 (0.001)
GCF	0.225*** (0.047)	0.145*** (0.027)	0.002 (0.013)	0.015*** (0.005)	0.049* (0.029)	0.019 (0.014)
Governance	0.256 (0.608)	0.739** (0.288)	0.328* (0.175)	0.059 (0.067)	-0.470* (0.274)	0.315 (0.218)
Population	-0.682** (0.279)	-0.446*** (0.160)				
Trade	0.029** (0.012)	0.017* (0.009)				
Infant			-0.021 (0.021)	-0.025*** (0.006)	0.141** (0.067)	-0.060 (0.037)
Observations	838	834	820	814	355	343
Countries	130	126	130	124	112	124
AR(1)	0.000267		0.00884		0.00267	
AR(2)	0.947		0.136		0.996	
Hansen test	0.408		0.458		0.440	
Instruments	122		102		44	
Adj. R ²		0.498		0.699		0.586

Notes: Two-step System-GMM and Fixed effects regressions, including 3-year period dummies. GMM estimations use robust standard errors. FE estimations use standard errors clustered by country and robust to heteroskedasticity. All variables are treated as endogenous in System-GMM estimations with the exception of period dummies. The dependent variable is the average annual growth rate of GDP per capita for (1) and (2), of HDI for (3) and (4), and of IHDI for (5) and (6). Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Columns (3) and (4) display HDI dynamics for System-GMM and FE, respectively, with a noticeable reduction in the statistical relevance of such a model, at least for 3-year periods. Column (3) does not even depict a statistical effect of government size, with the only variables reporting statistical significance being the lagged dependent variable, with a negative impact, and education and governance with a positive one.

Using FE, the statistical significance seems to be augmented, with the quadratic effect of government size being displayed here. Therefore, by decomposing it, we can detect that the optimal government size for HDI, at least in this case, is situated at around 42.20% of GDP. As for the rest of the variables, at least the significant ones, they all seem to behave as anticipated in the previous section.

For columns (5) and (6), we can also infer the mechanisms of IHDI, however, as displayed previously, with caution given the lacking number of observations. For both System-GMM and FE, it is first visible that conditional convergence applies, given that the lags of the dependent provide a hazardous impact on inclusive development growth. We can observe, however, that probably due to small sample bias, the effects of most variables appear as rather peculiar in System-GMM. Although the gross capital formation appears as positive, as anticipated, the governance displays a negative impact on IHDI, with government size also displaying an awkward relationship.

Particularly, government size, although providing a quadratic effect, is in the opposite direction, where size increments always imply negative effects on IHDI until a certain point, from where any increment always leads to beneficial effects. Not only does this effect contradict most theories, but it also implies that there is no maximisation point for IHDI.

Contradictorily, it provides a minimising point where the negative effect of government size on IHDI growth peaks, corresponding in this case to 44.10% of GDP. As for FE, the results provide almost null statistical relevance, except for the lag of IHDI, which implies a negative impact of the present level of IHDI on future IHDI growth prospects.

As previously depicted, the business cycle incidence of economic growth and development might differ, and as such, results for 5-year periods are also exhibited in Table 4, in an attempt to assess more robust results, given the commonly slippery and statistically mediocre resilience of this type of data.

Columns (1) and (2) depict the 5-year periods results for economic growth, where, for both, the statistical implications of conditional convergence also seem to be present. The System-GMM regression appears as statistically weaker than when computed for 3-year periods in Table 3. Except for the lag of GDP, only the gross capital formation provides statistical and positive effects on economic growth. The FE, however, seems statistically significant, with all statistically significant variables providing results that were previously anticipated. As for government size, we can also derive that the government size is quadratic

Table 4: Government size, growth, development, and inclusive development for 5-year periods

Variables	(1) Sys-GMM	(2) FE	(3) Sys-GMM	(4) FE	(5) Sys-GMM	(6) FE
Log GDP _{<i>t</i>-1}	-2.059* (1.105)	-5.781*** (0.769)				
Log HDI _{<i>t</i>-1}			-4.444*** (1.674)	-11.293*** (1.097)		
Log IHDI _{<i>t</i>-1}					6.114 (5.117)	-18.282*** (2.900)
Education _{<i>t</i>-1}	0.036 (0.038)	0.032*** (0.011)	0.013*** (0.004)	0.005** (0.002)	-0.001 (0.017)	0.012** (0.005)
Size	0.222 (0.262)	0.331*** (0.096)	0.077* (0.040)	0.065*** (0.025)	0.006 (0.092)	-0.011 (0.088)
Size ²	-0.001 (0.004)	-0.006*** (0.002)	-0.001 (0.001)	-0.001*** (0.000)	-0.000 (0.001)	-0.001 (0.001)
GCF	0.204*** (0.056)	0.151*** (0.032)	0.022** (0.010)	0.012** (0.005)	0.061 (0.047)	0.005 (0.022)
Governance	-0.377 (0.548)	0.808*** (0.260)	0.134 (0.097)	0.014 (0.051)	-0.298 (0.369)	0.423 (0.301)
Population	-0.697 (0.521)	-0.229 (0.222)				
Trade	0.014 (0.011)	0.015* (0.009)				
Infant			-0.000 (0.013)	-0.032*** (0.007)	0.113 (0.080)	-0.055 (0.038)
Observations	573	565	563	553	263	247
Countries	129	121	129	119	109	93
AR(1)	0.00224		0.000622		0.0828	
AR(2)	0.149		0.726			
Hansen test	0.213		0.215		0.569	
Instruments	30		81		41	
Adj. R ²		0.548		0.719		0.457

Notes: Two-step System-GMM and Fixed effects regressions, including 5-year period dummies. GMM estimations use robust standard errors. FE estimations use standard errors clustered by country and robust to heteroskedasticity. All variables are treated as endogenous in System-GMM estimations with the exception of period dummies. The dependent variable is the average annual growth rate of GDP per capita for (1) and (2), of HDI for (3) and (4), and of IHDI for (5) and (6). Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

with an optimal size of 29.97% of GDP.

Columns (3) and (4) exhibit the results for HDI, where we can observe that all control variables that have statistical meaningfulness appear similar to what was projected. As for government size, the quadratic just appears relevant in the FE, where we can depict that the optimal government size for HDI is around 33.34% of GDP.

Additionally, in columns (5) and (6), the statistical substance is still lacking for IHDI dynamics, with only the lag of the dependent and the education providing statistical significance, although at least in the appropriate direction.

Although there is some heterogeneity in the statistical impact between Table 3 and Table 4, without any clear indication of which opting for longer periods or a higher number of observations is more appropriate, there are some clear inferences that can be deduced from the similarities between them.

The parallels between both induce compelling arguments that conditional convergence holds through most economic indicators, being either those related to economic growth, development, or even inclusive development. Although the literature on conditional convergence was already commonly supported, at least for GDP growth, it is interesting to observe that there is some empirical evidence that in terms of development that same mechanism holds, and as such it appears that countries appear to converge to the their own HDI or IHDI levels and steady-state prosperity growth in the long term if certain features are accounted for.

As for other variables, we can also steadily assert that good educational foundations are a key mechanism to guarantee any type of economic or development prosperity, although that finding in itself is not necessarily nothing new.

Gross capital formation also appears as a fundamental tool to promote the encouragement of economic growth, nonetheless, such a transmission mechanism appears strong enough to provide positive impacts even on development metrics.

As for population growth, it appears precarious to grow, independently of the period setting. The effects of both trade and infant mortality are also recurrent, with the first being beneficial to GDP growth and the second being harmful to development.

Lastly, our main variable, the government size, the dynamics are not so clear, particularly in the context of the optimal size. At least in terms of GDP and HDI, the existence of a quadratic effect closely related to that of the Arme y Curve is indisputable, thus suggesting that a setting of a balanced private-public sector is more appropriate.

However, the hypothesis that bias may be recurrent in the current literature due to an underestimation

of government size by using inappropriate metrics is not as clear. Particularly in the context that the optimal government size according to [HDI](#) and [IHDI](#) should be higher than that of [GDP](#) per capita, given that computing the optimal government size according to the latter metric undermines the important social impact of the central government, given that it only considers broad welfare, which may very well depict wrong reflections of the living conditions of the average working households.

Although the relationship may not be immediately clear, this does not imply that the hypothesis cannot be inferred, on the contrary, it suggests the opposite. The optimal government size for [GDP](#) computed appears to range from 27.22% to 32.54% of [GDP](#), while the optimal government size for [HDI](#) ranges from 33.34% to 42.20%, obviously displaying that implementing social indicators to the study of optimal government size implies a larger central presence. The bounds of both are, nonetheless, not as far apart as some would guess, thus we can only depict slight evidence of an undermining of the central role of government by only looking at normative classical economic indicators such as [GDP](#).

Table 30 of the Annex, however, marginally reduces this doubt, because although theoretically and econometrically slightly deficient, annual data provides a much larger number of observations, in which it can be depicted that the optimal government size is only 22.54% for [GDP](#) and 37.39% for [HDI](#).

It is also interesting that, although optimal government sizes have commonly been heterogeneous in the literature, the present results appear to report higher values than what was previously depicted. For example, [Asimakopoulos and Karavias \(2016\)](#) 18%, [Hajamini and Falahi \(2018\)](#) 16.63%, [Karras \(1997\)](#) 16%, [Vedder and Gallaway \(1998\)](#) 17%, are all substantially below the range found here. For the 30% of [Davies \(2009\)](#), the lower bound of [HDI](#), although higher, is somewhat close, nonetheless, the results differ a lot from the 15% reported by [Martins and Veiga \(2014\)](#).

In Figure 9, we can assess the impact of government size on [GDP](#) per capita according to its different stages, where it is apparent that government size starts by providing positive marginal effects, nonetheless, after a certain stage, it's clear that it starts to have nefarious impacts. Only on System-GMM for 5-year periods can we observe too much excess variation, which ultimately leads to the quadratic effect being non-existent in this case.

Figure 10 applies the same concept of marginal effects for [HDI](#), with obviously less estimation precision visible compared to [GDP](#). It is clear from the marginal effects that in 3-year periods for System-GMM, the standard deviation is too high to address results, except around 50% of GDP, where increments of government size imply positive effects on [HDI](#) growth. For 5-year periods System-GMM, it is clear that the quadratic effect would have been present if not for the noise in the upper bound of above 50% of [GDP](#). However, it is visible that the size of the government here provides a positive impact on [HDI](#) prospects

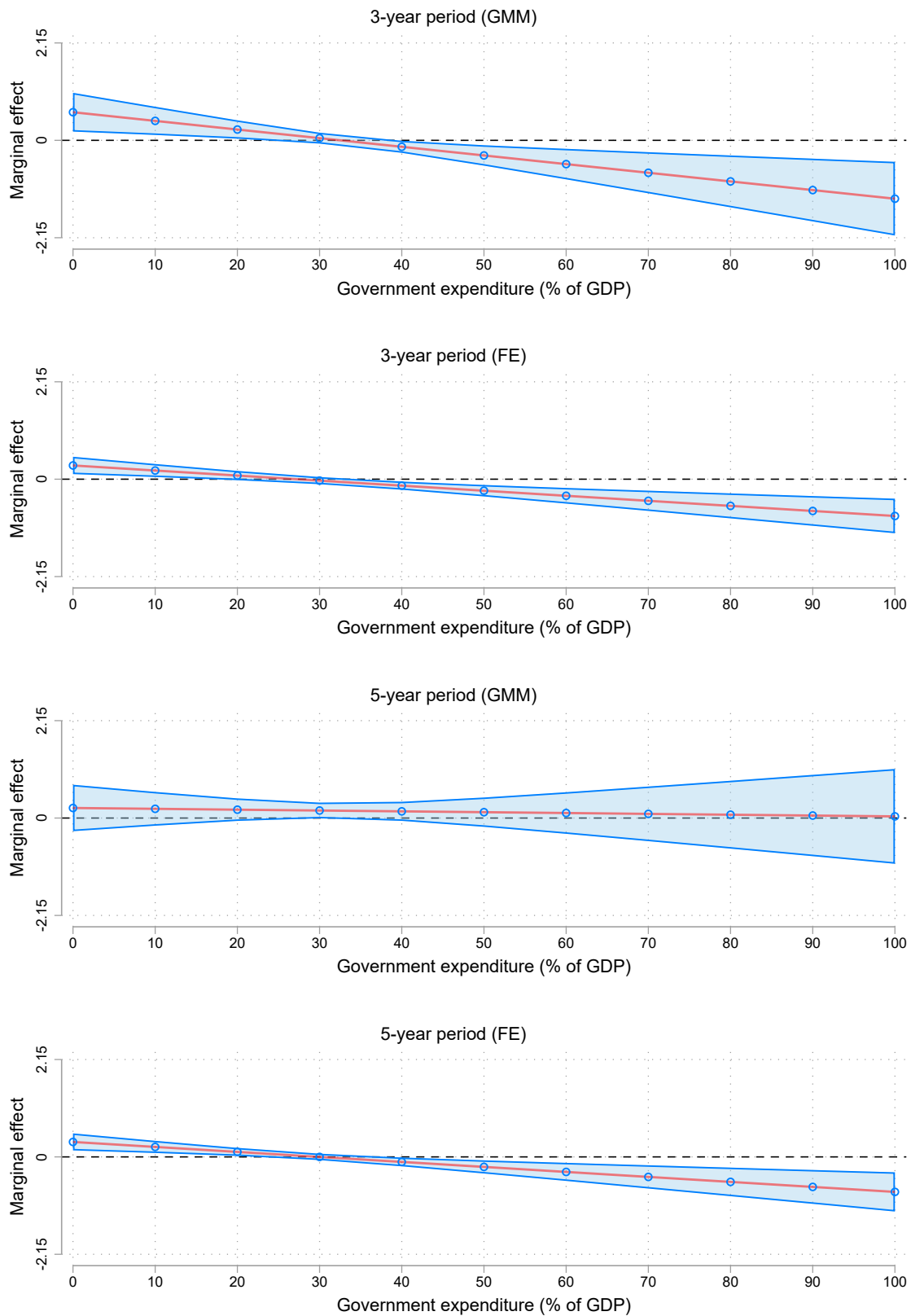


Figure 9: Marginal effects of government size on GDP per capita.

Source: Own computations.

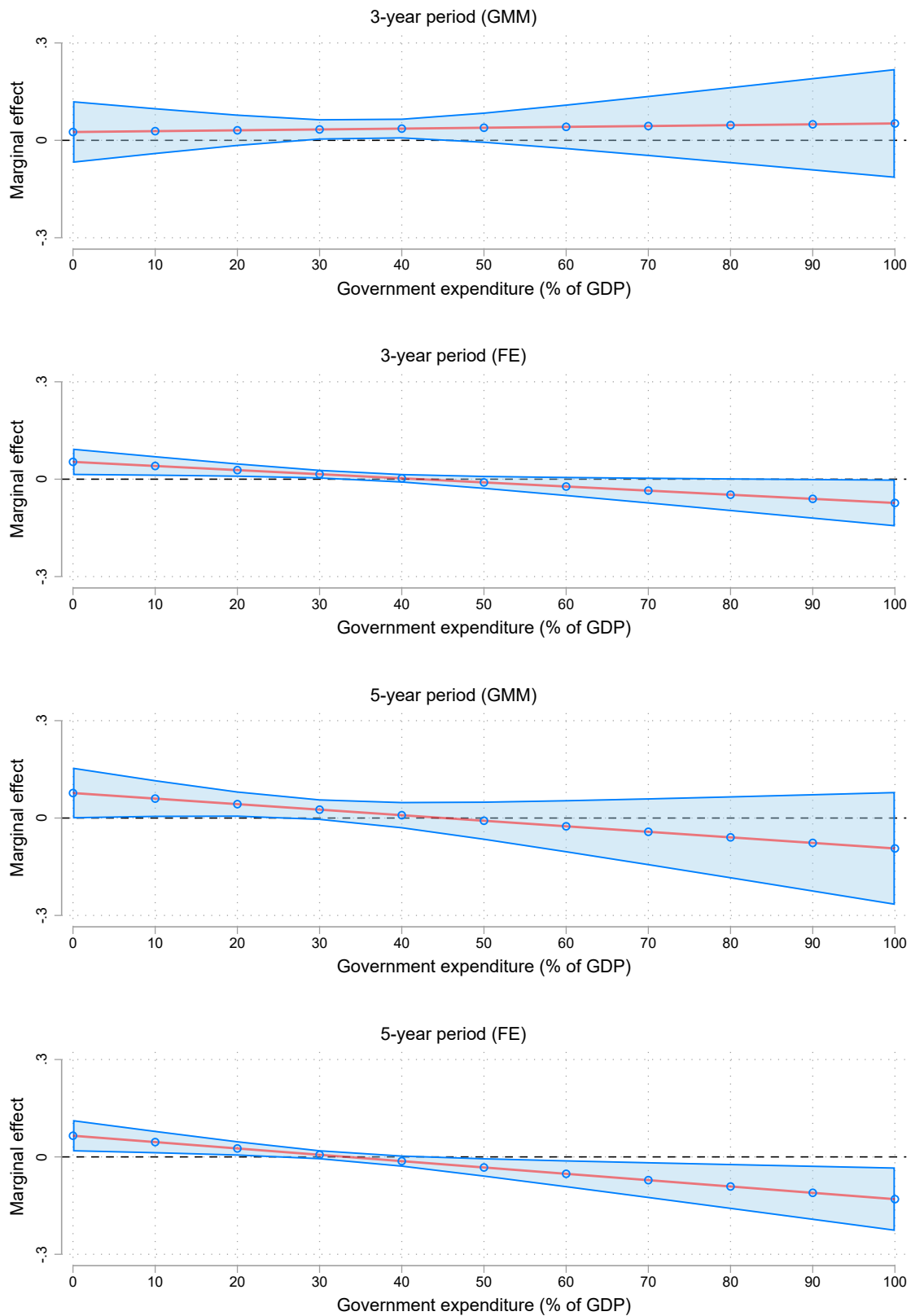


Figure 10: Marginal effects of government size on [HDI](#).

Source: Own computations.

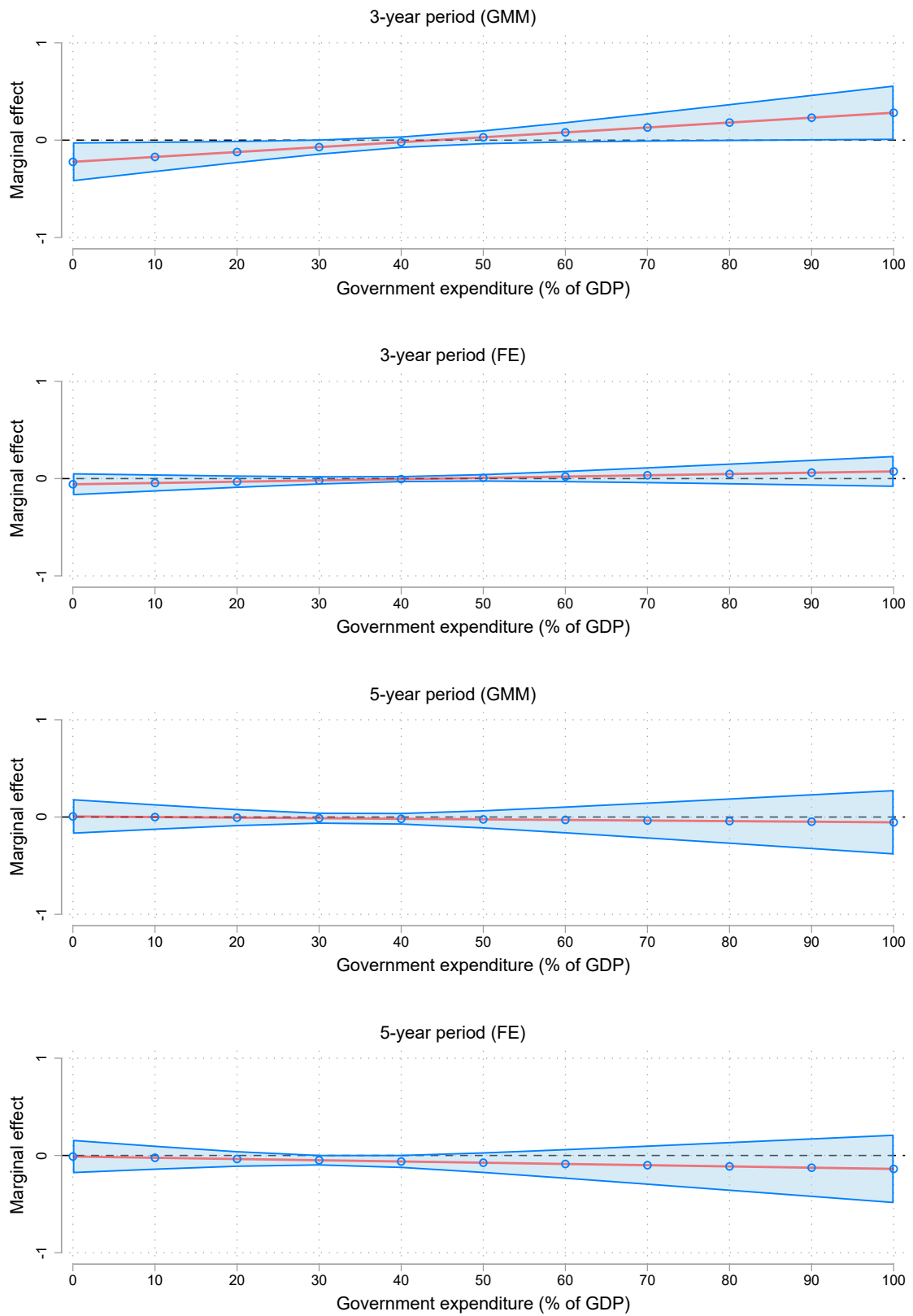


Figure 11: Marginal effects of government size on [IHDI](#).

Source: Own computations.

until roughly 40% of GDP, and beyond that, although the direction becomes negative, there is no statistical significance.

In Figure 11, it is visible that the impact of the size of the government on IHDI growth is puzzling, with the marginal impacts providing no clear insight into why such an indicator behaves as it did in the econometric model. It is evident, however, that the effect of government size on IHDI growth probably does not behave like in a U-shaped form, given the opposite and random directions of the marginal models. As such, it is plausible that small sample bias may be damaging the direction of the results, with the consequence being somewhat random effects of government size on IHDI.

Considering those ongoing concerns, alternative econometric approaches are implemented to judge the detrimental effects of small sample biases on results related to IHDI. Table 5 reflects the equivalent results, where some econometric controls are relaxed to increment sample dimensions and consequently depict possibly more accurate results by trading off econometric rigour for more sample robustness.

Column (1) loosens the 3-year System-GMM regression by dropping the gross capital formation, governance, and tertiary enrolment, and as a result, increasing observations by roughly 30%. In this case, the quadratic effect takes form, with an optimal government size of 39.04% of GDP. Column (2), which uses FE, only depicts similar associations if it further excludes infant mortality. In this case, the optimal value is roughly 40.69%.

It is clear that the small sample partially conceals the evidence of the Arme y Curve, nonetheless, the dismissal of such a large number of controls might imply too much delicacy to the results, while at the same time, expressing an academic fallacy of selection bias by only removing the variables that are fitting for my narrative.

Consequently, to depict the empirical veracity and not author tampering, columns (3) and (4) exert the same practice for 5-year periods, with the first only removing the education enrolment, the variable that allows us to extract the largest number of observations, while the latter also removes gross capital formation. The results of both columns (3) and (4) also exhibit evidence for the Arme y Curve, with optimal sizes of 37.72% and 31.23% of GDP, respectively.

Considering the evidence here conveyed, there is satisfactory reason to assume that the results depicted express the first empirical evidence of an Arme y Curve relationship for IHDI, nonetheless, at least for now, with substantially less statistical robustness. Given that the results for IHDI were not computed using procedures equivalent to HDI, it is not accurate to represent if the optimal government size for IHDI is greater than HDI, nevertheless, it is clear that the general tendency is for IHDI to report at least sizes similar to those of HDI. Specifically, we could infer that the optimal government size for IHDI ranges from

Table 5: Alternative estimations for inclusive development

Variables	3-year periods		5-year periods	
	(1) Sys-GMM	(2) FE	(3) Sys-GMM	(4) FE
Log IHDI _{t-1}	1.311 (2.362)	-14.910*** (1.160)	4.761 (3.142)	-16.544*** (1.816)
Size	0.214*** (0.059)	0.110** (0.051)	0.150* (0.078)	0.115* (0.069)
Size ²	-0.003*** (0.001)	-0.001* (0.001)	-0.002** (0.001)	-0.002* (0.001)
GCF			0.049* (0.028)	
Governance			-0.212 (0.299)	0.430* (0.231)
Infant	0.064 (0.046)		0.107** (0.043)	-0.039 (0.036)
Observations	461	462	327	335
Countries	128	126	121	125
AR(1)	0.000147		0.0340	
AR(2)	0.193			
Hansen test	0.126		0.324	
Instruments	65		35	
Adj. R ²		0.515		0.404

Notes: Two-step System-GMM and Fixed effects regressions, including 3-year or 5-year period dummies. GMM estimations use robust standard errors. FE estimations use standard errors clustered by country and robust to heteroskedasticity. All variables are treated as endogenous in System-GMM estimations with the exception of period dummies. The dependent variable is the average annual growth rate of IHDI for all regressions. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

31.23% to 40.69% of GDP.

In order not to implement too much noise in the analysis and avoid overcomplication of results by alternating between variables, future results reported for IHDI will be computed using the original controls used in HDI, nonetheless, the concern of small sample is not ignored, and confusing or lacking evidence may be expressed as a direct consequence of small sample, and not of causality.

4.1.2 Components of governance

As depicted in the literature, this dissertation also tries to elucidate some of the inferences and mechanisms by which governance affects welfare, which in the previous results has already been empirically highly beneficial and favourable to many economic indicators.

Tables 6 and 20 depict results to address which particular components of governance seem to affect most economic growth. One conclusion, which is parallel to both tables, is easily noticeable. That relates to the fact that two indicators of governance appear to be particularly relevant for GDP growth, particularly government effectiveness and political stability and absence of violence/terrorism.

As for the rest of the variables, they do not seem as relevant to explain growth, at least when addressed individually. The results for HDI and IHDI are not depicted due to the statistical insignificance of all individual governance indicators, which might lead us to question if we can extrapolate that governance is only broadly relevant to both measures of development and that the particular emphasis on specific components appears as irrelevant, contrary to GDP, where a focus on the specified world governance indicators is more pertinent.

This might prompt us to inquire whether effectiveness and political stability are primordial to promote private sector activity and economic prosperity, nonetheless, only focusing on those indicators may not benefit every individual equally, and as such, particular governance components appear irrelevant to development metrics. Consequently, to promote distributed welfare, the equal and widespread focus on all governance appears as more appropriate.

Table 6: Governance components and economic growth for 3-year periods

Variables	(1) FE	(2) FE	(3) FE	(4) FE	(5) FE	(6) FE
Log GDP _{t-1}	-4.809*** (0.692)	-4.795*** (0.788)	-4.961*** (0.756)	-5.327*** (0.768)	-5.525*** (0.777)	-5.100*** (0.765)
Education _{t-1}	0.011 (0.011)	0.010 (0.010)	0.011 (0.011)	0.011 (0.011)	0.009 (0.011)	0.012 (0.011)
Size	0.327*** (0.103)	0.331*** (0.101)	0.327*** (0.099)	0.308*** (0.102)	0.293*** (0.094)	0.321*** (0.102)
Size ²	-0.006*** (0.001)	-0.006*** (0.001)	-0.006*** (0.001)	-0.006*** (0.001)	-0.005*** (0.001)	-0.006*** (0.001)
GCF	0.148*** (0.027)	0.147*** (0.027)	0.146*** (0.027)	0.138*** (0.028)	0.146*** (0.027)	0.146*** (0.027)
Population	-0.438*** (0.152)	-0.426*** (0.153)	-0.432*** (0.157)	-0.446*** (0.153)	-0.419** (0.161)	-0.435*** (0.153)
Trade	0.016* (0.009)	0.016* (0.009)	0.016* (0.009)	0.019** (0.009)	0.018* (0.009)	0.016* (0.009)
Voice	0.495 (0.540)					
Law		0.064 (0.600)				
Regulatory			0.544 (0.479)			
Stability				1.203*** (0.346)		
Effectiveness					1.418*** (0.484)	
Corruption						0.771 (0.499)
Observations	834	834	834	834	834	834
Countries	126	126	126	126	126	126
Adj. R ²	0.491	0.490	0.491	0.505	0.498	0.492

Notes: Fixed effects regressions, including 3-year period dummies. FE estimations use standard errors clustered by country and robust to heteroskedasticity. The dependent variable is the average annual growth rate of GDP per capita for all regressions. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

4.1.3 The interplay of government quality and quantity

Although government size is the primary focus of this study, its implications and interconnection with institutional quality, as highlighted by [Cooray \(2009\)](#), are also highly relevant. Accordingly, this section examines this dynamic.

In particular, following a methodology similar to [Cooray \(2009\)](#), Table 7 presents the results for the interaction between government size and a categorical variable for quantiles of governance, namely, low, middle, and high governance countries. The empirical evidence for [IHDI](#), in particular, is notably lacking. However, for [GDP](#) and [HDI](#), statistical significance is abundant, particularly in low governance countries, which, surprisingly, show stronger evidence of the Armeý Curve relationship for both indicators.

This finding is not only peculiar but also directly contrasts with the evidence of [Cooray \(2009\)](#) and [Afonso and Jalles \(2016\)](#), which suggest that countries with weaker institutions should be less efficient in managing public expenditure.

Furthermore, the evidence for the Armeý Curve weakens as governance improves. As a result, the effect is less pronounced for middle governance countries and even completely disappears for high governance countries.

Specifically, for low governance countries, the estimated optimal government size ranges from 27.38% to 28.38% for [GDP](#) and from 28.15% to 30.97% for [HDI](#). For middle governance countries, the optimal size is 26.74% for [GDP](#) and ranges from 29.60% to 37.97% for [HDI](#).

Although these results may appear paradoxical, their statistical consistency supports their potential validity. If verified, these findings could suggest the need to reconsider current development strategies employed by nations worldwide. The causal relationship depicted here highlights that while governance is crucial for prosperity, adjusting government size as a policy to stimulate prosperity might be even more important than what previously thought in overcoming poverty traps, even in countries with weak institutional foundations.

Table 7: Interactions of government size and government quality

Variables	3-year periods			5-year periods		
	(1) FE	(2) FE	(3) FE	(4) FE	(5) FE	(6) FE
Log GDP _{t-1}	-4.759*** (0.715)			-5.019*** (0.698)		
Log HDI _{t-1}		-10.070*** (0.971)			-11.134*** (1.132)	
Log IHDI _{t-1}			-18.412*** (2.650)			-17.646*** (3.125)
Education _{t-1}	0.012 (0.009)	0.003 (0.003)	-0.000 (0.005)	0.034*** (0.010)	0.006*** (0.002)	0.007 (0.006)
Size·Govern ₌₀	0.677*** (0.134)	0.131*** (0.031)	-0.028 (0.121)	0.696*** (0.153)	0.147*** (0.035)	0.153 (0.116)
Size ² ·Govern ₌₀	-0.012*** (0.002)	-0.002*** (0.001)	0.000 (0.002)	-0.012*** (0.003)	-0.003*** (0.001)	-0.004*** (0.001)
Size·Govern ₌₁	0.207 (0.137)	0.049** (0.022)	-0.074 (0.057)	0.242** (0.100)	0.063** (0.025)	-0.000 (0.105)
Size ² ·Govern ₌₁	-0.004 (0.003)	-0.001** (0.000)	0.001 (0.001)	-0.005** (0.002)	-0.001*** (0.000)	-0.001 (0.002)
Size·Govern ₌₂	-0.170 (0.147)	-0.016 (0.032)	-0.100 (0.061)	-0.142 (0.144)	-0.013 (0.032)	-0.100 (0.084)
Size ² ·Govern ₌₂	-0.000 (0.002)	0.000 (0.000)	0.001* (0.001)	0.000 (0.002)	0.000 (0.000)	0.001 (0.001)
GCF	0.146*** (0.026)	0.017*** (0.004)	0.025** (0.011)	0.144*** (0.034)	0.012** (0.005)	0.014 (0.017)
Govern	7.301*** (1.903)	1.067** (0.420)	1.525 (1.196)	6.929*** (1.898)	1.086*** (0.402)	2.179 (1.544)
Population	-0.437*** (0.159)			-0.249 (0.200)		
Trade	0.015* (0.009)			0.013 (0.009)		
Infant		-0.023*** (0.005)	-0.074** (0.035)		-0.029*** (0.007)	-0.051 (0.041)
Observations	834	814	343	565	553	247
Countries	126	124	100	121	119	93
Adj. R ²	0.509	0.705	0.597	0.554	0.729	0.485

Notes: Fixed effects regressions, including 3-year or 5-year period dummies. FE estimations use standard errors clustered by country and robust to heteroskedasticity. The dependent variable is the average annual growth rate of GDP per capita for (1) and (4), of HDI for (2) and (5), and of IHDI for (3) and (6). Govern corresponds to quantiles according to the variable of governance (=0 if low governance, =1 if middle, =2 if high). Significance level at which the null hypothesis is rejected:

***, 1%, **, 5%, and *, 10%.

4.1.4 Levels of development and income

The literature also stresses that the effects of development, particularly when clustered by developed or developing countries, are relevant to addressing the different impacts of government size. [Asimakopoulou and Karavias \(2016\)](#) and [Martins and Veiga \(2014\)](#) depict that the quadratic effect of developed countries is higher than that of the developing ones, particularly because developed countries possess institutions of higher quality, and thus the central resources are better employed. As stressed in the literature, however, that somewhat hints at an possible error in the reasoning, given that they are capturing the effect of institutional quality, here proxied by governance, and not the mechanisms of development status.

From this perspective, controlling for governance should lead to distinct results, something which [Goh and Mohd Aznan \(2023\)](#) had already advocated. Consequently, Tables 8 and 21 depict a similar approach to [Martins and Veiga \(2014\)](#), but now controlling for institutional quality. Table 8 uses 3-year periods and exhibits different inferences than what most literature depicted. Particularly, the results depict inverted U-shaped effects of government size on economic growth and development for developing countries, with respective optimal government sizes ranging from 28.45% to 31.99% for GDP and 33.94% for HDI. Developed countries appear to behave quadratically, nonetheless uniquely for economic growth, reporting an optimal size of government of 39.26%.

Table 21 depicts the results for 5-year periods, where the quadratic significance for developing countries still holds, nevertheless, now not only for GDP and HDI but also for IHDI. The respective results depict an optimal size of government of 29.55% for GDP, 29.26% for HDI, and 19.30% for IHDI.

For developed ones, the effect is also quadratic for all metrics, nonetheless, the direction is quite distinct. Peculiarly, the results depict U-shaped effects of government size for GDP and IHDI, while only the HDI depicts the expected inverted U-shaped effect with an optimal government size of 29.26%.

Overall, there is strong corroboration that after controlling for governance, there is evidence that developing countries benefit more from increments in government size, nonetheless, they are later also more penalised for too much government, which depicts a stronger Armey Curve for developing countries. As for developed countries, it is clear that the effect is a lot weaker, with the quadratic effect being substantially random and often paradoxical according to the metric and period established.

The rationale for such structure may rely on the fact that developing countries lack the basic structure to promote growth, and consequently, any marginal improvement in government size is more significantly felt, nonetheless, only when governance is controlled.

This may also reflect that since the private sector is extremely inefficient in that cluster, there is room to grow the public sector without too much of a cost to private sector efficiency.

Table 8: Development dynamics for 3-year periods

Variables	(1) Sys-GMM	(2) FE	(3) Sys-GMM	(4) FE	(5) Sys-GMM	(6) FE
Log GDP _{<i>t</i>-1}	-3.587** (1.699)	-5.604*** (0.774)				
Log HDI _{<i>t</i>-1}			12.340** (4.987)	-10.239*** (1.016)		
Log HDI _{<i>t</i>-2}			-12.422*** (3.441)			
Log IHDI _{<i>t</i>-1}					7.770** (3.151)	-18.156*** (2.408)
Education _{<i>t</i>-1}	0.074* (0.040)	0.017* (0.010)	0.005 (0.007)	0.002 (0.003)	-0.013 (0.014)	0.001 (0.005)
Developing·Size	0.837* (0.431)	0.473*** (0.161)	0.054 (0.091)	0.093*** (0.027)	-0.054 (0.189)	0.020 (0.078)
Developing·Size ²	-0.013* (0.007)	-0.008*** (0.003)	-0.000 (0.001)	-0.001*** (0.000)	-0.001 (0.003)	-0.001 (0.001)
Developed·Size	0.690* (0.393)	-0.431** (0.215)	0.094 (0.077)	-0.017 (0.036)	-0.103 (0.166)	-0.079 (0.055)
Developed·Size ²	-0.009* (0.005)	0.003 (0.002)	-0.001 (0.001)	0.000 (0.000)	0.002 (0.002)	0.001* (0.001)
GCF	0.186** (0.076)	0.137*** (0.028)	-0.001 (0.016)	0.016*** (0.005)	0.069** (0.032)	0.020 (0.014)
Governance	0.238 (0.841)	0.752*** (0.285)	-0.239 (0.189)	0.061 (0.068)	-0.757* (0.423)	0.318 (0.216)
Population	-0.673* (0.374)	-0.456*** (0.160)				
Trade	0.036*** (0.014)	0.016* (0.009)				
Infant			0.031* (0.016)	-0.024*** (0.006)	0.094* (0.050)	-0.059 (0.037)
Observations	838	834	807	814	355	343
Countries	130	126	130	124	112	100
AR(1)	0.000502		0.000357		0.00482	
AR(2)	0.778		0.230			
Hansen test	0.126		0.271		0.551	
Instruments	49		53		31	
Adj. R ²		0.508		0.703		0.588

Notes: See Table 3

As for developed countries, the lack of consistency may express that they are developed for a reason, given that they possess structures and infrastructure enough to sustain growth, and as such, even if incremental government expenditure is applied, contrary to developing countries, it comes at too high of a cost due to the detrimental effects on their highly efficient private sectors. Broadly, it partially reflects the behaviour of not altering a winning formula.

This broadly suggests that although the Armey Curve may still exist in developed countries, nonetheless, purely government expenditure dynamics are more indirect and thus harder to assess.

Accordingly, this depiction slightly contradicts the impact for developed countries exhibited by [Asimakopoulou and Karavias \(2016\)](#) and [Martins and Veiga \(2014\)](#). Furthermore, this finding might stem from these studies addressing the effect of government expenditure without accounting for the possible bias that may arise from the omission of institutional quality. In contrast, here the impact of governance is accounted for, and as such, consequential results provide innovative inferences, whose policymaking relevance will be outlined later.

Similar to [Martins and Veiga \(2014\)](#), the income categorisation is also addressed, nonetheless, given the lack of statistical significance, four categories of income were used rather than two. Tables 9 and 22 depict such dynamics for 3-year and 5-year periods, respectively.

Assuming the intrinsic correlation between development and income levels, one could anticipate that low income countries could also be more affected by changes in government expenditure, nonetheless, this does not appear to be the case. For [GDP](#) in particular, the quadratic effect of government expenditure appears at least in one specification present in every cluster of income, thus obstructing the inference of causality according to level of income.

The relation for [HDI](#) is similar, nonetheless, in this case, the cluster in which government expenditure has no statistical significance is in lower-income countries. For [IHDI](#), that cluster is middle-lower income countries, although in this case, it is common for the relationships to be odd, particularly since it is not uncommon for the quadratic relationship to be in a U-shape.

In a broad sense, it is hard to uncover if the upper bound or the lower bound of the percentile of income provides different impacts on government expenditure, however, in a more elastic approach, we could state that it appears to be a very slight statistical superiority for upper middle and high-income countries than for the rest. If greatly accommodating and choosing the latter inference, we could depict that the results are on par with [Martins and Veiga \(2014\)](#), nonetheless, precaution is suggested, given the lack of statistical robustness for such a statement.

Table 9: Income dynamics for 3-year periods

Variables	(1) Sys-GMM	(2) FE	(3) Sys-GMM	(4) FE	(5) Sys-GMM	(6) FE
Log GDP _{<i>t</i>-1}	-3.912*** (1.318)	-5.851*** (0.753)				
Log HDI _{<i>t</i>-1}			1.002 (4.193)	-10.468*** (1.156)		
Log GDP _{<i>t</i>-2}			-7.899** (3.455)			
Log IHDI _{<i>t</i>-1}					-4.900 (3.417)	-18.757*** (2.286)
Education _{<i>t</i>-1}	0.007 (0.027)	0.020* (0.011)	0.009 (0.006)	0.003 (0.003)	-0.004 (0.013)	0.001 (0.005)
Low.I-Size	0.393 (0.384)	0.216 (0.222)	-0.089 (0.118)	0.084 (0.089)	-0.461** (0.229)	-0.424** (0.166)
Low.I-Size ²	-0.009 (0.009)	-0.004 (0.005)	0.002 (0.002)	-0.001 (0.002)	0.007 (0.006)	0.008** (0.003)
L.M.I-Size	0.540* (0.306)	0.667** (0.292)	0.060 (0.100)	0.125** (0.060)	-0.316* (0.170)	0.147 (0.117)
L.M.I-Size ²	-0.008 (0.007)	-0.011** (0.005)	0.000 (0.003)	-0.002* (0.001)	0.004 (0.003)	-0.002 (0.002)
U.M.I-Size	0.725*** (0.248)	0.715*** (0.138)	0.152*** (0.057)	0.083** (0.041)	-0.070 (0.122)	-0.023 (0.112)
U.M.I-Size ²	-0.009** (0.004)	-0.012*** (0.002)	-0.002** (0.001)	-0.002** (0.001)	-0.000 (0.002)	-0.001 (0.001)
High.I-Size	0.908*** (0.289)	-0.387** (0.174)	0.167** (0.068)	0.004 (0.029)	-0.093 (0.111)	-0.144** (0.055)
High.I-Size ²	-0.013*** (0.004)	0.002 (0.002)	-0.002* (0.001)	0.000 (0.000)	0.001 (0.001)	0.002*** (0.001)
GCF	0.171*** (0.052)	0.136*** (0.026)	0.015 (0.016)	0.016*** (0.005)	0.044 (0.029)	0.018 (0.014)
Governance	0.134 (0.530)	0.734*** (0.278)	0.000 (0.127)	0.071 (0.070)	0.043 (0.346)	0.293 (0.211)
Population	-0.412 (0.302)	-0.440*** (0.148)				
Trade	0.043*** (0.012)	0.015* (0.008)				
Infant			0.006 (0.016)	-0.024*** (0.006)	-0.006 (0.045)	-0.065** (0.031)
Observations	838	834	806	814	355	343
Countries	130	126	129	124	112	100
AR(1)	0.000150		0.00121		0.00868	
AR(2)	0.698		0.240			
Hansen test	0.405		0.253		0.399	
Instruments	121		73		104	
Adj. R ²		0.515		0.706		0.608

Notes: See Table 3

4.1.5 Consumption and investment expenditure

Until this point, the broad effect of government expenditure was exhibited, nonetheless, its allocation was ignored. Tables 10 and 23 depict a different approach for the computation of the government size by distinguishing between consumption and investment, with the resulting summation of both optimums, when they are present, representing the optimal size of government.

Table 10 in particular depicts that for 3-year periods there is strong evidence of the Armey Curve relationship for GDP and HDI when using FE. The consequential optimal government consumptions are 19.96% and 38.78% of GDP, respectively. Contrary to the anticipated, a quadratic statistical significance of public investment was only found in this case for GDP, and in the contrary direction to that of the Armey Curve. This would imply that investment has negative effects on growth until 8.30%, and after that, any investment increment would benefit economic growth.

In Table 23, for 5-year periods, the quadratic effect of the Armey Curve is widespread for consumption, with GDP, HDI, and IHDI, depicting that relationship in at least some econometric setting. The resulting optimal consumptions are 26.15%, 35.60%, and 33.02% of GDP, respectively. As for investment, the dynamic is similar to Table 10, where investment is commonly quadratic in a U-shape, at least for System-GMM for GDP and HDI, with respective minimising values of 7.03% and 4.10%, respectively. Nonetheless, in this case, there is some evidence of the Armey Curve for HDI when computed for FE, where the optimal government investment is 8.97%.

These results depict that there is a substantial amount of government expenditure that should be allocated to consumption, contradicting the findings of Barro (1991) but reinforcing the evidence of Lin (1994). Given the number of optimal values referenced earlier, it is clear that most government expenditure should be allocated to consumption and only a small proportion to investment.

Given the adversity in computing the optimal investment, a very simple computation was made assuming that the optimal investment could be proxied by subtracting in the optimal government size the optimal government consumption, which depicts that for all metrics the allocation is ambiguous without clear distinction, but overall, the investment should, very broadly, range from about one-sixth to one-third of total government expenditure.

Consequently, the present results make it hard to purge the doubt that investment contributes more to growth, as suggested by Lin (1994), than government consumption, given the vague direction of investment.

Table 10: Consumption and investment for 3-year periods

Variables	(1) Sys-GMM	(2) FE	(3) Sys-GMM	(4) FE	(5) Sys-GMM	(6) FE
Log GDP _{<i>t-1</i>}	-2.179* (1.323)	-6.094*** (1.056)				
Log HDI _{<i>t-1</i>}			10.933** (5.130)	-10.916*** (1.342)		
Log HDI _{<i>t-2</i>}			-12.598*** (3.697)			
Log IHDI _{<i>t-1</i>}					-0.255 (2.011)	-21.625*** (3.276)
Education _{<i>t-1</i>}	0.002 (0.025)	-0.005 (0.012)	0.005 (0.005)	-0.000 (0.003)	-0.002 (0.011)	-0.003 (0.007)
Consumption	0.352 (0.215)	0.238** (0.098)	0.060 (0.056)	0.031** (0.015)	-0.034 (0.086)	0.009 (0.079)
Consumption ²	-0.007** (0.003)	-0.006*** (0.001)	-0.001 (0.001)	-0.000* (0.000)	0.000 (0.001)	0.000 (0.001)
Investment	-0.904** (0.457)	0.139 (0.208)	-0.040 (0.075)	0.053* (0.032)	0.131 (0.218)	-0.040 (0.186)
Investment ²	0.054** (0.026)	-0.016 (0.010)	0.004 (0.004)	-0.003 (0.002)	-0.011 (0.013)	0.003 (0.009)
GCF	0.194*** (0.052)	0.135*** (0.034)	-0.014 (0.011)	0.012** (0.005)	0.013 (0.021)	0.026** (0.010)
Governance	0.506 (0.663)	1.018*** (0.330)	0.019 (0.089)	0.054 (0.086)	-0.207 (0.135)	0.148 (0.247)
Population	-1.640*** (0.339)	-0.703*** (0.193)				
Trade	0.022** (0.009)	0.014 (0.010)				
Infant			0.006 (0.015)	-0.034*** (0.008)	-0.014 (0.042)	-0.122* (0.065)
Observations	701	697	677	684	253	237
Countries	122	118	123	117	105	89
AR(1)	0.000554		0.000989		0.00763	
AR(2)	0.882		0.142			
Hansen test	0.326		0.373		0.769	
Instruments	87		93		76	
Adj. R ²		0.528		0.685		0.571

Notes: See Table 3

4.1.6 Quantile regressions

To further analyze the dynamics of government size, a quantile regression is conducted for [HDI](#), [GDP](#), and [IHDI](#), with the corresponding results being portrayed in Tables [11](#), [24](#), and [25](#), respectively. The objective is to assess the mechanisms through which manipulating government expenditure can affect countries of different structures.

For the 3-year period results, specifically for [HDI](#), it is evident that the quadratic effect of government size is statistically more robust in countries positioned within lower development clusters. Specifically, the 10%, 25%, and 50% of least developed countries in terms of [HDI](#) can leverage government expenditure strategies to enhance their development outcomes, whereas the rest cannot. For these three quantiles, the optimal government size is 37.16%, 38.61%, and 42.09% of [GDP](#), respectively.

For [HDI](#), this pattern is also observed in the results for the 5-year periods, where the same quantiles exhibit quadratic effects of government size. However, in this case, an additional quantile, the 75% least developed, is also affected. The respective optimal government sizes for these quantiles are 29.90%, 31.29%, 33.72%, and 38.44%, as follows.

The evidence for [GDP](#) and [IHDI](#), however, is less straightforward. For [GDP](#), quadratic effects of government size are only observed in the 5-year period results, and interestingly, only for the 50% and 75% less prosperous countries in terms of [GDP](#). Conversely, for [IHDI](#), there is no evidence of quadratic effects across different quantiles of inclusive development, regardless of whether we are analysing periods of 3 or 5 years.

These results partially corroborate the hypothesis that countries that have already reached a certain level of development, at least in terms of [HDI](#), should place less emphasis on manipulating government expenditure as a strategy to further economic prosperity. Instead, government intervention seems to be particularly relevant for countries disadvantaged in terms of development.

Table 11: Economic development quantile regression

3-year periods	(1) $\tau = 0.1$	(2) $\tau = 0.25$	(3) $\tau = 0.5$	(4) $\tau = 0.75$	(5) $\tau = 0.9$
Log HDI _{<i>t</i>-1}	0.705*** (0.060)	0.701*** (0.042)	0.695*** (0.050)	0.689*** (0.089)	0.684*** (0.122)
Education _{<i>t</i>-1}	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Size	0.002** (0.001)	0.002*** (0.001)	0.002* (0.001)	0.001 (0.002)	0.001 (0.002)
Size ²	-0.000** (0.000)	-0.000** (0.000)	-0.000* (0.000)	-0.000 (0.000)	-0.000 (0.000)
GCF	0.001** (0.000)	0.001*** (0.000)	0.000** (0.000)	0.000 (0.000)	0.000 (0.000)
Governance	0.002 (0.003)	0.002 (0.002)	0.002 (0.002)	0.002 (0.004)	0.001 (0.006)
Infant	-0.001** (0.000)	-0.001*** (0.000)	-0.001** (0.000)	-0.001 (0.001)	-0.001 (0.001)
Observations	820	820	820	820	820
5-year periods	(1) $\tau = 0.1$	(2) $\tau = 0.25$	(3) $\tau = 0.5$	(4) $\tau = 0.75$	(5) $\tau = 0.9$
Log HDI _{<i>t</i>-1}	0.490*** (0.097)	0.478*** (0.070)	0.463*** (0.049)	0.445*** (0.062)	0.433*** (0.086)
Education _{<i>t</i>-1}	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Size	0.003* (0.002)	0.002** (0.001)	0.002*** (0.001)	0.002* (0.001)	0.002 (0.001)
Size ²	-0.000** (0.000)	-0.000** (0.000)	-0.000*** (0.000)	-0.000* (0.000)	-0.000 (0.000)
GCF	0.000 (0.000)	0.000 (0.000)	0.000** (0.000)	0.000* (0.000)	0.000 (0.000)
Governance	-0.001 (0.005)	-0.001 (0.003)	0.000 (0.002)	0.001 (0.003)	0.002 (0.004)
Infant	-0.001** (0.001)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)	-0.001*** (0.001)
Observations	563	563	563	563	563

Notes: Quartile regressions using the quantiles of 0.1, 0.25, 0.5, 0.75 and 0.9. The dependent variable is the logarithm of HDI for all regressions. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

4.1.7 Functions of government

Lastly, to analyse even further the relevance of niches of expenditure, an analysis by decomposing expenditure according to COFOG is made, with Tables 12 and 26 depicting the results for GDP, Tables 13 and 27 for HDI, and Tables 14, 15, and 28 for IHDI.

It is imperative to highlight that the relevance of particular components of expenditure in this analysis is made with very few observations, thus, only recurrent results are considered supportable and legitimate empirical conclusions, and not a result of randomness and small sample size.

The results of Tables 12 and 26 jointly exhibit two expenditure components as persistent, particularly defence and safety, with both depicting a quadratic effect. For defence, the optimal expenditure ranges from 3.77% to 3.81%, while for safety, that value is situated between 1.94% and 2.17% of GDP. Although all components are relevant in one way or another, defence and safety are crucial to promoting GDP growth.

Nevertheless, the results for HDI in Tables 13 and 27 depict dynamics, at least for defence, where it is always detrimental to development growth, contradicting the findings of Martins and Veiga (2014). As for safety, it is surprising to observe that its quadratic effect transposes to HDI with such intensity, independently of the periods and similarly to the GDP, in some cases significant in both settings of System-GMM and FE. For HDI, the respective optimal expenditure on safety ranges from 2.17% to 2.45% of GDP.

In Tables 14, 15, and 28, it is clear that small number of observations continue to punish statistical significance and relevance, nonetheless, even with an even further lack of statistical robustness, the component of safety continues to provide quadratic significance, now for IHDI growth, in both period settings and commonly for both System-GMM and FE. Now the respective optimal component expenditure ranges from 2.02% to 2.50% of GDP.

Even though it is not clear or easy to infer the direction and the optimal allocation of very specific expenditure components, it is innovative to observe that public order and safety emerge as the primordial foundation in guaranteeing not only an economically prosperous nation but also one that guarantees good welfare for the common citizen. Such a component reflects the conceptual need for police services, law courts, prisons, public order, and safety, and partially reflects some ideals related to the role of government.

The idea of maintaining a “referee” government as suggested by Friedman (2016) or a neo-liberal setting does not appear necessarily corroborated by the overall findings of government size depicted here, nonetheless, its description of the government's three primary functions appears somewhat reliable. Its extrapolation that defence should be provided by the central government is partially corroborated by the quadratic effect of defence on GDP, nonetheless, the direction does not seem to empirically transpose for development metrics.

As for the other two major roles stated by [Friedman \(2016\)](#), particularly of enforcing contracts between individuals and protecting citizens from crimes against themselves or their property, they appear as remarkably accurate, given that roughly 2% of [GDP](#) should always be allocated to public order and safety, which includes those tasks, independent of whether the objective is to maximise economic growth, development, or even inclusive development.

Table 12: Economic growth and COFOG components for 3-year periods

Variables	(1) Sys-GMM	(2) FE	(3) FE
Defense	2.855*** (1.049)		
Defense ²	-0.375*** (0.122)		
Safety		5.250** (2.516)	
Safety ²		-1.354** (0.566)	
Social			-0.631* (0.369)
Observations	424	420	427
Countries	68	63	65
AR(1)	0.0481		
AR(2)	0.374		
Hansen test	0.833		
Instruments	25		
Adj. R ²		0.560	0.487

Notes: Statistically relevant Two-step System-GMM and Fixed effects regressions, including 3-year period dummies. Controls equal to Table 1, but omitted due to size constraints. GMM estimations use robust standard errors. FE estimations use standard errors clustered by country and robust to heteroskedasticity. All variables are treated as endogenous in System-GMM estimations with the exception of period dummies. The dependent variable is the average annual growth rate of GDP per capita for all regressions. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%; and *, 10%.

Table 13: Economic development and COFOG components for 3-year periods

Variables	(1) FE	(2) Sys-GMM	(3) FE	(4) Sys-GMM	(5) Sys-GMM	(6) FE	(7) FE
Defense	-0.140** (0.054)						
Public		-0.051* (0.027)	-0.041*** (0.012)				
Public ²		0.001* (0.001)	0.001*** (0.000)				
Health				-0.288* (0.164)			
Health ²				0.036*** (0.013)			
Safety				1.079** (0.470)	0.602*** (0.166)		
Safety ²				-0.220** (0.087)	-0.132*** (0.034)		
Social						-0.040** (0.018)	
Social ²						0.002** (0.001)	
Observations	404	419	413	418	413	406	413
Countries	60	69	63	68	68	61	63
AR(1)		0.00216		0.00520	0.00446		
AR(2)		0.932		0.929	0.853		
Hansen test		0.153		0.294	0.124		
Instruments		65		51	65		
Adj. R ²	0.695		0.673			0.696	0.671

Notes: Statistically relevant Two-step System-GMM and Fixed effects regressions, including 3-year period dummies. Controls equal to Table 1, but omitted due to size constraints. GMM estimations use robust standard errors. FE estimations use standard errors clustered by country and robust to heteroskedasticity. All variables are treated as endogenous in System-GMM estimations with the exception of period dummies. The dependent variable is the average annual growth rate of HDI for all regressions. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%; and *, 10%.

Table 14: Inclusive economic development and COFOG components for 3-year periods

Variables	(1) Sys-GMM	(2) FE	(3) Sys-GMM	(4) FE	(5) Sys-GMM	(6) Sys-GMM
Defense	-0.362*** (0.135)	-0.196*** (0.058)				
Economic			0.244** (0.114)			
Economic ²			-0.006*** (0.002)			
Gov.Education				-0.148* (0.074)		
Environment				-4.100** (1.986)		
Environment ²				2.778** (1.246)		
Health						-0.478** (0.241)
Health ²						0.046*** (0.015)
Observations	205	200	207	203	207	207
Countries	62	57	62	58	62	62
AR(1)	0.0592		0.00974		0.00695	0.0173
AR(2)	0.872		0.730		0.203	0.450
Hansen test	0.421		0.323		0.193	0.233
Instruments	52		38		32	44
Adj. R ²		0.652		0.621		

Notes: Notes: Statistically relevant Two-step System-GMM and Fixed effects regressions, including 3-year period dummies. Controls equal to Table 1, but omitted due to size constraints. GMM estimations use robust standard errors. FE estimations use standard errors clustered by country and robust to heteroskedasticity. All variables are treated as endogenous in System-GMM estimations with the exception of period dummies. The dependent variable is the average annual growth rate of IHDI for all regressions. Significance level at which the null hypothesis is rejected: *** , 1%, ** , 5%, and * , 10%.

Table 15: Inclusive economic development and COFOG components for 3-year periods (extension)

Variables	(1) FE	(2) Sys-GMM	(3) FE	(4) Sys-GMM	(5) FE
Housing	-0.284*** (0.102)				
Safety		1.092* (0.657)	0.612* (0.364)		
Safety ²		-0.260*** (0.100)	-0.151*** (0.047)		
Culture				1.715** (0.759)	
Culture ²				-0.352* (0.182)	
Social					-0.129*** (0.038)
Social ²					0.006** (0.002)
Observations	203	205	200	207	203
Countries	58	62	57	62	58
AR(1)		0.0295		0.0157	
AR(2)		0.748		0.859	
Hansen test		0.238		0.238	
Instruments		56		56	
Adj. R ²	0.621		0.657		0.631

Notes: Notes: Statistically relevant Two-step System-GMM and Fixed effects regressions, including 3-year period dummies. Controls equal to Table 1, but omitted due to size constraints. GMM estimations use robust standard errors. FE estimations use standard errors clustered by country and robust to heteroskedasticity. All variables are treated as endogenous in System-GMM estimations with the exception of period dummies. The dependent variable is the average annual growth rate of HDI for all regressions. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%; and *, 10%.

4.2 Robustness analysis

As suggested in Part 2, Labonte (2010) and Vedder and Gallaway (1998) depict that government expenditure is a more appropriate metric to measure government size than government revenue, nonetheless, using the latter is still reasonable. Therefore, this section depicts the basic results using government revenue as a percentage of GDP as a proxy for government size to ensure that the basic results in Tables 3 and 4 hold.

Table 16 displays the results using 3-year periods, with the fundamental results corroborating the hypothesis of conditional convergence, implying that after controlling for country-specific characteristics, they tend to their steady states, independently of the metric adopted as dependent. Although at times less significant, the rest of the explanatory variables still hold their effects on economic indicators. Particularly, education and trade still present beneficial impacts on prosperity.

Governance and gross capital formation remain beneficial to GDP and HDI. Additionally, the population growth rate and infant mortality remain nefarious, the first to GDP growth and the latter to HDI and IHDI. As for government size, the quadratic effect of the Arme y Curve is still present, at least for HDI, with the respective optimum of 43.73% for System-GMM and 36.71% for FE.

In Table 29, explanatory variables behave as anticipated. Regarding government size, the quadratic effect is significant for both GDP and HDI, with optimums of 42.46% and 35.96% of GDP for the latter.

Similarly to subsection 4.1.1, the lack of statistical relevance may not necessarily indicate the inexistence of the Arme y Curve but rather a direct repercussion of the small sample size. As such, the same exercise is practised here, where controls are discarded to augment sample size, nonetheless, now using revenues.

In Table 17, the main inferences are clear, particularly that, in most regressions, the quadratic effect of government size appears, similar to the Arme y Curve. Respective optimums are 39.78% and 32.24% for 3-year System-GMM and FE estimations. For 5-year periods, only System-GMM provides results, with an optimal size of 43.69%.

Summarising, it is clear that government revenue presents a partial loss of statistical capability than when government size is represented by expenditure, nonetheless, the robust empirical evidence, for at least economic growth and development, and less robustly, for inclusive economic development, strongly supports the existence of the Arme y Curve.

Table 16: Robustness check using government revenue for 3-year periods

Variables	(1) Sys-GMM	(2) FE	(3) Sys-GMM	(4) FE	(5) Sys-GMM	(6) FE
Log GDP _{<i>t-1</i>}	-3.006*** (0.854)	-5.487*** (0.852)				
Log HDI _{<i>t-1</i>}			-8.590*** (3.124)	-9.843*** (1.025)		
Log IHDI _{<i>t-1</i>}					5.844* (3.141)	-18.326*** (2.465)
Education _{<i>t-1</i>}	0.025 (0.019)	0.007 (0.012)	0.014** (0.007)	0.002 (0.002)	0.013 (0.018)	0.002 (0.005)
Size (revenue)	0.458** (0.193)	0.213** (0.106)	0.248*** (0.075)	0.058*** (0.020)	-0.112 (0.095)	0.024 (0.069)
Size (revenue) ²	-0.005 (0.003)	-0.002 (0.002)	-0.003** (0.001)	-0.001*** (0.000)	0.002 (0.001)	-0.000 (0.001)
GCF	0.230*** (0.051)	0.138*** (0.031)	0.005 (0.014)	0.015*** (0.005)	0.049 (0.045)	0.019 (0.014)
Governance	0.177 (0.536)	0.890*** (0.309)	0.358* (0.195)	0.063 (0.065)	-0.279 (0.354)	0.292 (0.215)
Population	-0.755* (0.403)	-0.432** (0.170)				
Trade	0.025** (0.012)	0.018* (0.010)				
Infant			-0.006 (0.025)	-0.023*** (0.006)	0.127** (0.064)	-0.062* (0.033)
Observations	838	834	820	814	355	343
Countries	130	126	130	124	112	100
AR(1)	0.000291		0.0216		0.00530	
AR(2)	0.610		0.254		0.751	
Hansen test	0.366		0.258		0.291	
Instruments	129		102		38	
Adj. R ²		0.480		0.700		0.585

Notes: Two-step System-GMM and Fixed effects regressions, including 3-year period dummies. GMM estimations use robust standard errors. FE estimations use standard errors clustered by country and robust to heteroskedasticity. All variables are treated as endogenous in System-GMM estimations with the exception of period dummies. The dependent variable is the average annual growth rate of GDP per capita for (1) and (2), of HDI for (3) and (4), and of IHDI for (5) and (6). Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Table 17: Alternative estimations for inclusive development using government revenue

Variables	3-year periods		5-year periods	
	(1) Sys-GMM	(2) FE	(3) Sys-GMM	(4) FE
Log IHDI _{t-1}	0.332 (2.471)	-14.913*** (1.543)	4.616 (5.186)	-13.660*** (1.823)
Size (revenue)	0.156*** (0.051)	0.131* (0.074)	0.141** (0.056)	0.069* (0.041)
Size (revenue) ²	-0.002* (0.001)	-0.002* (0.001)	-0.002* (0.001)	-0.001 (0.001)
GCF		0.021* (0.011)	0.048* (0.025)	
Governance		0.247 (0.206)	-0.448 (0.448)	
Infant	0.050 (0.051)		0.094 (0.068)	
Observations	461	441	327	338
Countries	128	119	121	122
AR(1)	0.000115		0.0334	
AR(2)	0.139			
Hansen test	0.102		0.276	
Instruments	59		35	
Adj. R ²		0.523		0.385

Notes: Two-step System-GMM and Fixed effects regressions, including 3-year or 5-year period dummies. GMM estimations use robust standard errors. FE estimations use standard errors clustered by country and robust to heteroskedasticity. All variables are treated as endogenous in System-GMM estimations with the exception of period dummies. The dependent variable is the average annual growth rate of IHDI for all regressions. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

4.3 Policy and research recommendations

The innovative relations this dissertation depicts allow us to ponder the current situation related to government expenditure worldwide. The worldwide average government size, around 32%, is not much further from the roughly 30% provided by the [GDP](#), while it is still somewhat lower than the 35% to 40% provided by the [HDI](#) or [IHDI](#). Considering this, there are no worldwide applicable policy recommendations in this aspect.

Rather, the worldwide heterogeneity makes it clear that certain clusters should follow certain policies. For instance, it is clear that the Western World, mainly European countries, report much larger government sizes than the optimum, commonly even larger than 50%.

Table 18: Optimal government size by indicator

Optimal Government Size		
GDP	HDI	IHDI
27.22% - 32.54%	33.34% - 42.20%	31.23% - 40.69%

Table 19: Actual government size as of 2022 across different regions

Actual Government Size as of 2022		
Developed	Developing	European Union
43.20%	28.33%	45.36%
Sub-Saharan Africa	Europe	Western World
24.48%	43.29%	44.67%

Even though each country should consider their specific cases, the evidence of overgrown governments is real for the Western World, and as such, it is highly recommended for such governments to start to consider trimming governmental presence in the economy, given that, independently of the metric used, whether it is more economic or social, there does not seem to be much to gain from incremental governmental presence.

Such policymaking could be a tool to oppose the recent history of deficient growth that has been taking place in Europe, particularly in the [European Union \(EU\)](#) member states, and broad efforts to lower government size to roughly 30-40% would be optimal, however, taking into account the private sector and social responses, given that it is important to guarantee that government cuts do not impose unequal

social damage on the most vulnerable layers of society.

Instituting European margins controlling the size of government in state members could be a method in which some inefficient central interference is replaced by private sector activity in an attempt to stimulate corporate strength and competitiveness. The results, however, also stress that governance still takes a major role, and consequently, the European institutions, such as the [EU](#) and its branches, should continue to focus on further guaranteeing institutional robustness and efficiency, although that recommendation applies to the rest of the world.

The situation is the opposite for developing countries, where the government size is largely lower than any of the optimums computed, where it is common, particularly for regions such as sub-Saharan Africa, to report values of only 15% of government size.

Contrary to the expectations, the evidence does not indicate that manipulations in government size are only valuable when accompanied by institutional quality, although the latter remains highly relevant for prosperity. In other words, while puzzling, it appears that countries severely hindered by weak institutional settings may, in some cases, be better positioned to extract greater utility from adjustments in government presence.

Consequently, at least theoretically, countries that lack sufficient governance resilience to effectively and significantly promote prosperity could utilize development policies involving adjustments to the size of government to enhance their overall economic prosperity. This, in turn, could enable countries that could not initially afford good governance to overcome stagnation and gain momentum.

Regarding overall governance, the most significant takeaway for policymakers, particularly international aid institutions, is the need to shift their focus away from merely funding precarious nations. Instead, they should prioritize implementing and sharing knowledge to help strengthen their lacking institutions, resorting to financial assistance only when absolutely necessary. Structuring development policies in this way would enable developing countries to enhance institutional efficiency in a manner that fosters growth and development. At the same time, international oversight would help ensure that the newly established institutions are stimulative rather than extractive.

Such a distinct approach could be a method by which developing countries overcome the poverty trap that has been sabotaging the convergence of some regions, particularly sub-Saharan Africa. In general, this practice would focus on investing in teaching rather than just providing and thus enabling independence rather than dependence.

Additionally, to guarantee prosperity, both developed and developing countries should take into account the distinct dynamics of certain expenditures and guarantee that the financial needs for public order and

safety are the first to be satisfied, given their pivotal role in the promotion of economic and social welfare.

It is, however, important to stress that no metric of welfare is perfect, consequently, it is essential to continue to elaborate more perfected measures to represent quality of life. Particularly, although HDI and IHDI represent, at least in theory, enhancements from GDP, it is clear that they also have their shortcomings. The reason that most economists still use GDP to capture welfare may indicate that the new development indicators cannot still do what they were supposed to do, particularly to replace GDP in most studies of development. For HDI and IHDI, specifically, their bounding from zero to one may present a disadvantage rather than an advantage, given that it furthers itself too much from the numeric and benefic nature of GDP, which allows it to provide more accurate results.

Such ranges do not allow so much heterogeneity and, consequently, commonly do not have as much statistical relevance as one hopes for. While GDP disregards inequality, the HDI and IHDI may be focused too much on the social aspect by disconnecting themselves too much from the intrinsic economic validity of normative indicators.

Additionally, controlling for inequality may even be more appropriate than including health and education in the construction of HDI and IHDI. The rationale focuses on the fact that the inclusion of health prospects and education prospects does not allow economic variability, while at the same time, it is extremely rare for countries to have good incomes and satisfactory income distributions while lacking in levels of education and health.

Consequently, including health and education could cause more harm than benefits, and thus, for future analysis, it could be more interesting to assess dynamics for a new variable that connects GDP and income inequality. The IHDI has a similar construction to its income component, but unfortunately, it computes it to be in the range from zero to one.

$$\text{Inequality-adjusted GDP per capita} = \frac{\text{Real GDP per capita}}{1 + \left(\frac{\text{Gini Index}}{100}\right)}$$

For new dynamics, I recommend the construction of a new variable of GDP per capita adjusted for inequality, which allows us to guarantee that we focus on the numerical nature of GDP while at the same time guaranteeing that we are capturing citizens welfare, penalising an unequal distribution of economic power. A simple computation of GDP per capita discounted according to the Gini index could be a good starting point for the construction of that variable.

The study of government size is highly relevant to assess the relevance of a central government and its presence in society and consequently addressing how the mechanisms change when attempting to

compute an optimal government size according to a new metric of inequality-adjusted GDP is not only highly relevant due to its probable new dynamics but also because of its foreseeable higher statistical prowess.

5 Conclusion

This dissertation attempted to shed light on the relationships and mechanisms by which government size affects economic welfare and how addressing the distinct but intrinsically similar indicators of economic prosperity can help clarify the dynamics of government size, particularly in the context of the possible anomalies and fallacies that may have been committed in the literature. Additionally, this work attempted to be the first to infer the empirical existence of the Armey Curve for [IHDI](#), which until presently, was still being ignored in the study of government size.

Moreover, the findings provide evidence that the study of optimal government size depends a lot on whether we are testing normative metrics of economic growth such as [GDP](#) or if we are considering alternative development metrics, such as [HDI](#) and [IHDI](#). The evidence for the Armey Curve is straightforward for [GDP](#) and [HDI](#) and, with less robustness, partially clear for [IHDI](#), while at the same time, it is safe to state that the optimal government size is larger for [HDI](#) than for [GDP](#), partially supporting the hypothesis that some literature reports considerably meagre optimums due to their complete disregard for the social role of government, which is completely put aside by normative economic indicators such as the [GDP](#).

Theoretically, the [IHDI](#), given that it addresses distribution inequality, is suggested in the hypothesis to potentially infer even higher optimal sizes of government than for [HDI](#), nonetheless, data and econometric limitations make it harder to compare both, so it is safe to assert that the optimal government size for [IHDI](#) is at least as high as [HDI](#). Particularly, the optimal government size was found to range from 27.22% to 32.54% for [GDP](#), to range from 33.34% to 42.20% for [HDI](#), and lastly, from 31.23% to 40.69% for [IHDI](#).

The study also depicted robust evidence for the Armey Curve, independently of the metric, by estimating joint regressions for both 3- and 5-year periods for both System-[GMM](#) and [FE](#), in an attempt to provide robust results deprived of manipulative strategies, which are common by nature, intentionally or unintentionally, in the study of growth and government size.

Furthermore, the findings also reveal worldwide heterogeneity in their respective positions on optimal government sizes, with developing and sub-Saharan African countries reporting much smaller government sizes than any of the optimums, while the developed, Europe, the [EU](#), or the Western World as a whole

depict overgrown government sizes. That evidence should concern the EU countries in particular, with respective member states considering that this evidence of overgrown governments in their case might imply the need for government trimming in an attempt to reinstate growth-promoting structures hoping to overcome the long-lasting economic stagnation of the region.

The concerns related to the omission of governance and institutional quality are also empirically supported, particularly given the unique and distinct findings that the quadratic effect of government size is stronger in developing countries, findings commonly opposite to most literature. As for developed countries, the relationship was found to be less clear.

It is also plausible to extrapolate that evidence supports the idea that development strategies focused on changes in government size do not necessarily need to be employed only by countries with sufficient institutional standards. Countries with low institutional quality can also, if not more effectively, utilize these mechanisms to promote prosperity. In this sense, they could serve as a means of overcoming the hindrance posed by the lack of institutional quality.

Additionally, the crucial role of governance suggests that new strategies for addressing poverty are needed. Specifically, foreign lending of knowledge and providing supervision to help strengthen institutions could be a more effective development strategy than relying on the simpler and often inefficient methods of direct lending or debt forgiveness.

Broadly, the main implications are that to promote GDP, HDI, or IHDI, development policies should focus on adjusting government size, while governance, being a key pillar for prosperity, should be promoted through oversight by third parties with institutional trustworthiness.

There is also evidence suggesting that government expenditure manipulations may have a more significant impact on countries at less advantaged levels of development. This further highlights the importance of establishing a strong and efficient central government in countries that are less economically developed, with potentially greater effects the lower their current level of prosperity.

Although it was found that broad government expenditure has optimal levels that should be respected if a nation attempts to place itself as more efficient and self-sufficient, this work also clarifies the transmission mechanism by which that expenditure affects growth prospects. Particularly, it is clear that consumption is highly relevant to promote and, in certain circumstances, to damage growth, while the relationship is less clear for investment. Broadly, it is exhibited that the government should allocate most of its expenditure on consumption.

A more particular estimate for components of expenditure was also carried out, and to avoid omission of dynamics of disaggregated components, the results were inferred for each of the COFOG components in

their natural state, where results depicted only one robust, widespread, and relevant result. The findings reveal that while it is true that government components report heterogeneous relations according to metrics and econometric approaches, it is clear that the component of public order and safety has the most foundational and impactful effect on economic growth, development, and even inclusive development.

Additionally, the elaboration of new and the use of old development metrics, although relevant, has been substantially overlooked by many authors, which could be related to their lack of numerical relevance and statistical appropriateness, and as such, the construction of a new measure of inequality-adjusted GDP per capita, in which the result is not constrained between zero and one is endorsed here. The construction of such an indicator and its use in the study of government size might help clarify even further any dynamics that are still to be uncovered while at the same time proposing a new indicator that establishes a middle ground between economic growth and development indicators in an attempt to integrate their strengths while also minimising the drawbacks that each of them suffers.

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A Annex

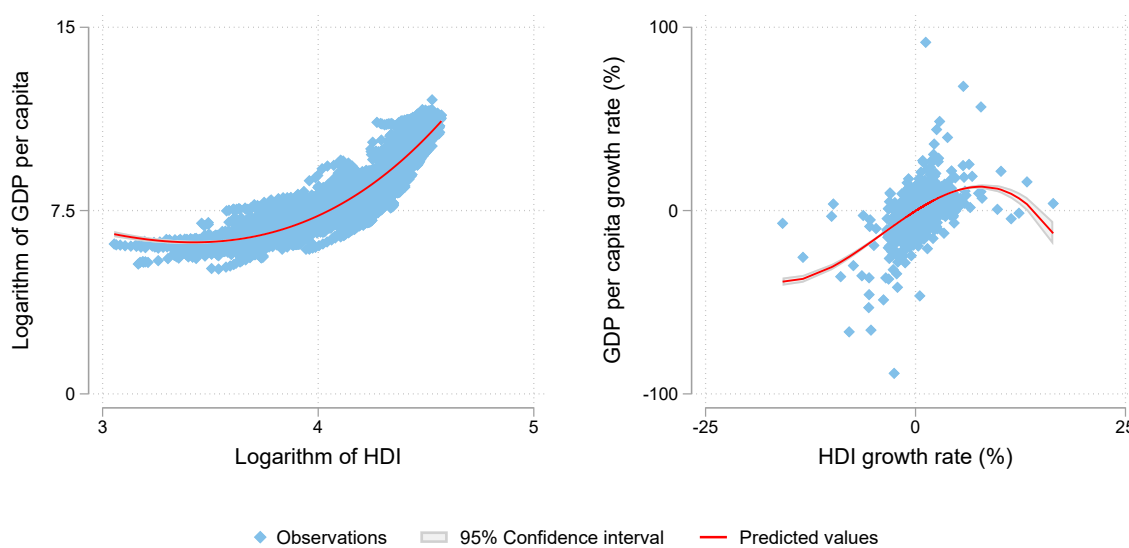


Figure 12: Trend lines of [GDP](#) per capita and [HDI](#).
Source: [UNDP/WB](#).

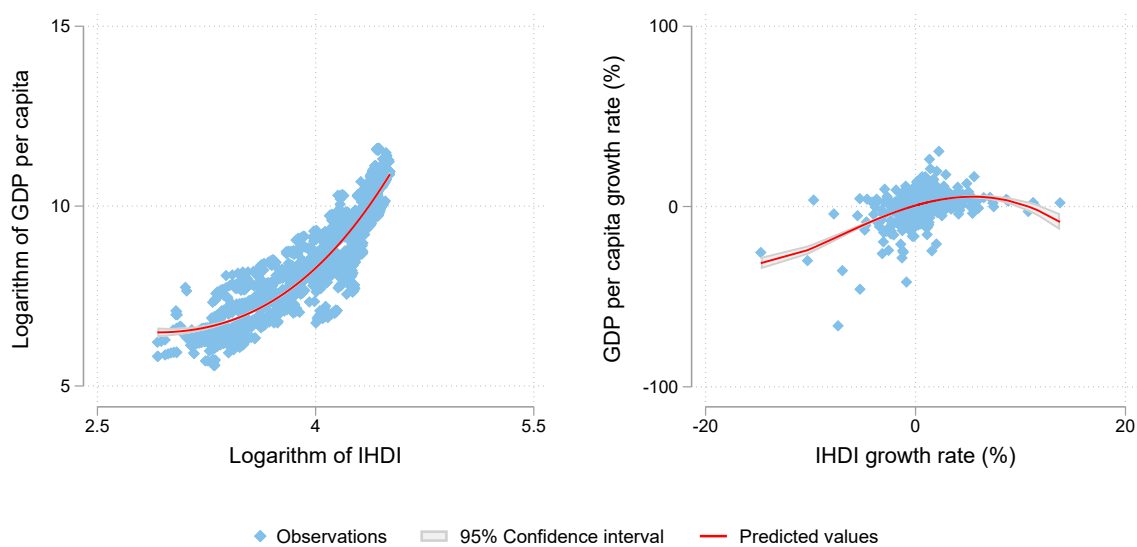


Figure 13: Trend lines of [GDP](#) per capita and [IHDI](#).
Source: [UNDP/WB](#).

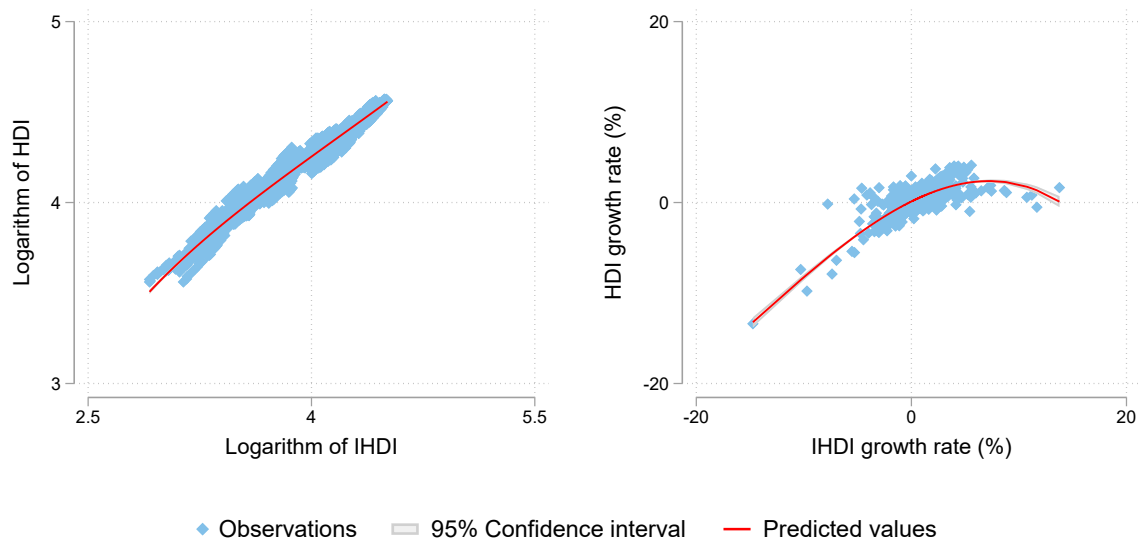


Figure 14: Trend lines of [HDI](#) and [IHDi](#).
Source: [UNDP](#).

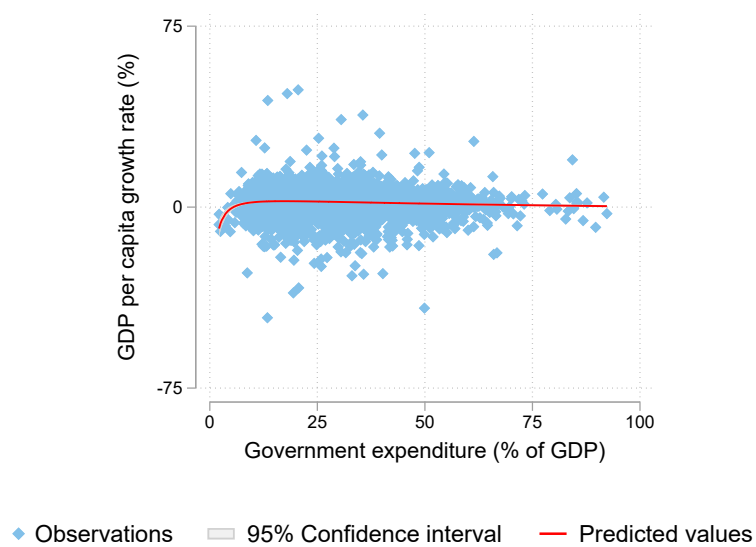


Figure 15: Trend line of government size and the [GDP](#) per capita growth rate.
Source: [WB/IMF](#).

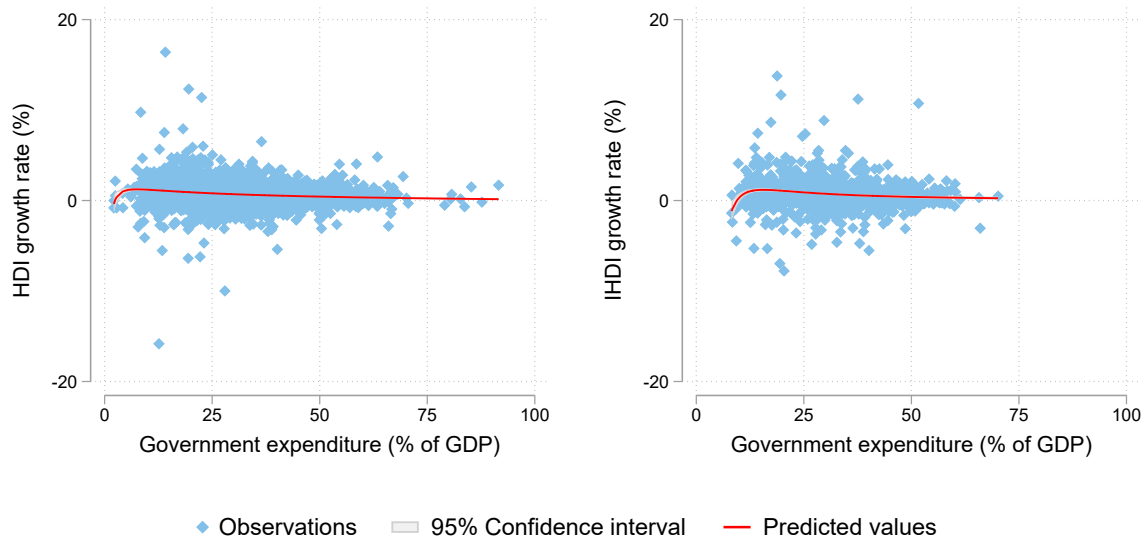


Figure 16: Trend lines of government size and the [HDI/IHDI](#) growth rates.
Source: [WB/IMF](#).

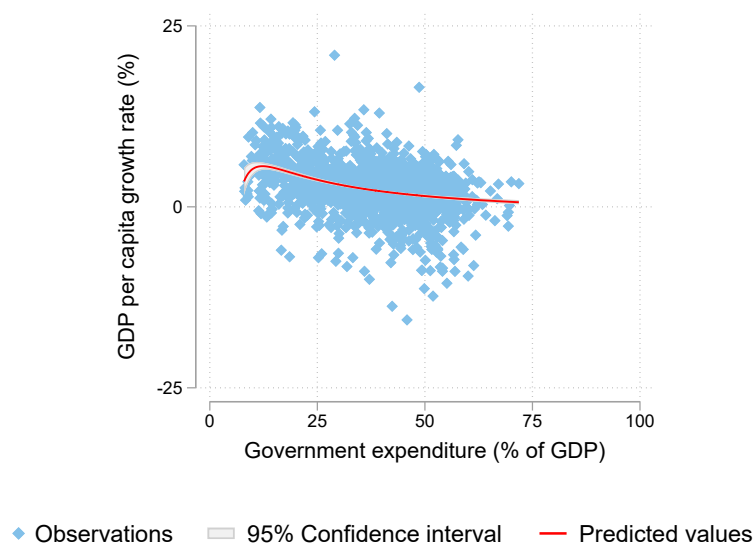


Figure 17: Trend line of government size and the [GDP](#) per capita growth rate for developed countries.
Source: [WB/IMF](#).

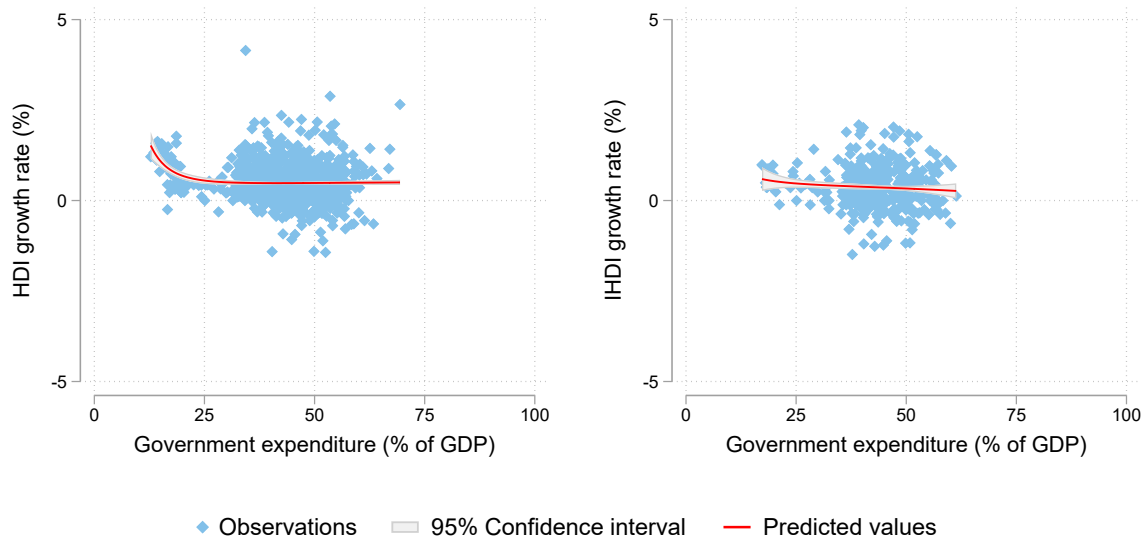


Figure 18: Trend lines of government size and the [HDI/IHDI](#) growth rates for developed countries.
Source: [UNDP/IMF](#).

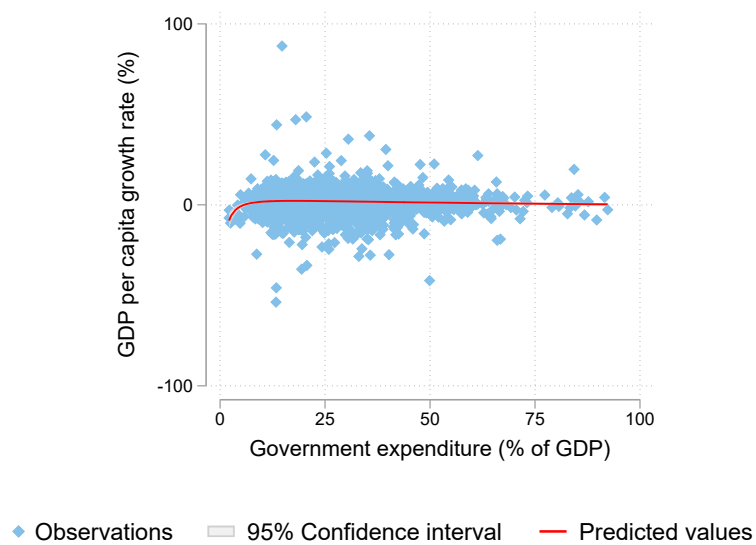


Figure 19: Trend line of government size and the [GDP](#) per capita growth rate for developing countries.
Source: [WB/IMF](#).

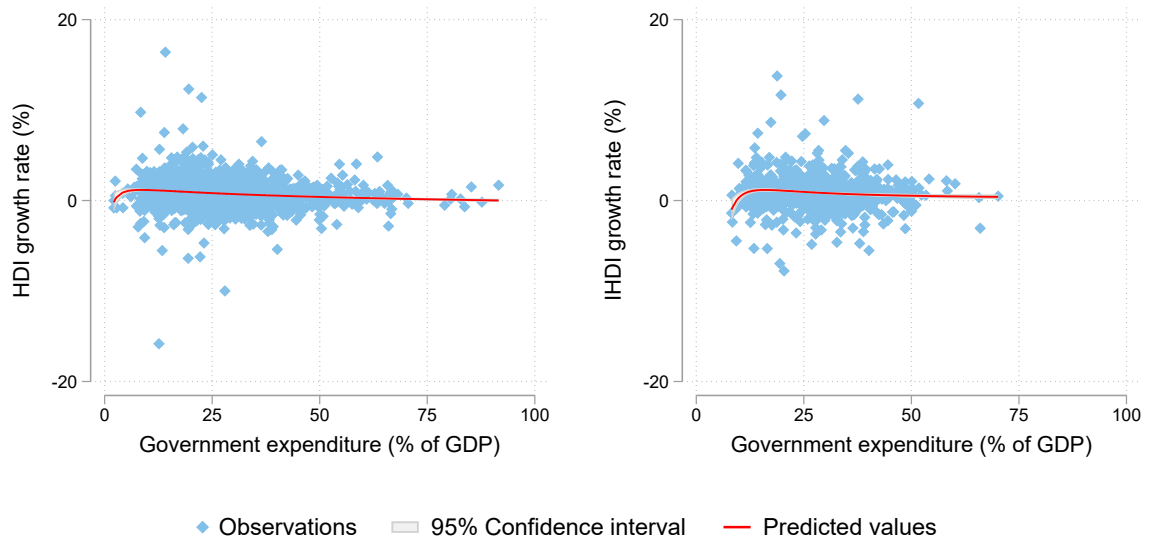


Figure 20: Trend lines of government size and the [HDI/IHDI](#) growth rates for developing countries.
Source: [UNDP/IMF](#).

Table 20: Governance components and economic growth for 5-year periods

Variables	(1) FE	(2) FE	(3) FE	(4) FE	(5) FE	(6) FE
Log GDP _{<i>t</i>-1}	-5.119*** (0.727)	-5.179*** (0.804)	-5.283*** (0.723)	-5.631*** (0.746)	-5.774*** (0.752)	-5.406*** (0.729)
Education _{<i>t</i>-1}	0.031*** (0.011)	0.030*** (0.011)	0.030*** (0.011)	0.032*** (0.011)	0.028*** (0.011)	0.032*** (0.011)
Size	0.356*** (0.099)	0.358*** (0.097)	0.353*** (0.097)	0.335*** (0.095)	0.324*** (0.096)	0.353*** (0.099)
Size ²	-0.006*** (0.002)	-0.006*** (0.002)	-0.006*** (0.002)	-0.006*** (0.001)	-0.005*** (0.002)	-0.006*** (0.002)
GCF	0.156*** (0.033)	0.156*** (0.033)	0.153*** (0.032)	0.141*** (0.032)	0.151*** (0.032)	0.154*** (0.033)
Population	-0.229 (0.218)	-0.217 (0.214)	-0.217 (0.220)	-0.234 (0.205)	-0.199 (0.221)	-0.225 (0.217)
Trade	0.014 (0.009)	0.014 (0.009)	0.014 (0.009)	0.017* (0.009)	0.016* (0.009)	0.014 (0.009)
Voice	0.690 (0.546)					
Law		0.232 (0.627)				
Regulatory			0.682 (0.533)			
Stability				1.449*** (0.341)		
Effectiveness					1.369*** (0.477)	
Corruption						0.759 (0.511)
Observations	565	565	565	565	565	565
Countries	121	121	121	121	121	121
Adj. R ²	0.540	0.538	0.540	0.559	0.546	0.540

Notes: Fixed effects regressions, including 5-year period dummies. FE estimations use standard errors clustered by country and robust to heteroskedasticity. The dependent variable is the average annual growth rate of GDP per capita for all regressions. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Table 21: Development dynamics for 5-year periods

Variables	(1) Sys-GMM	(2) FE	(3) Sys-GMM	(4) FE	(5) Sys-GMM	(6) FE
Log GDP _{<i>t</i>-1}	-5.377** (2.659)	-5.998*** (0.721)				
Log GDP _{<i>t</i>-2}	0.737 (2.658)					
Log GDP _{<i>t</i>-3}	1.969* (1.073)					
Log HDI _{<i>t</i>-1}			-4.706*** (1.504)	-11.314*** (1.109)		
Log IHDI _{<i>t</i>-1}					3.606 (5.390)	-17.821*** (2.776)
Education _{<i>t</i>-1}	0.060** (0.025)	0.039*** (0.010)	0.014*** (0.004)	0.006** (0.002)	0.016 (0.024)	0.010* (0.005)
Developing·Size	0.158 (0.433)	0.605*** (0.140)	0.073 (0.065)	0.126*** (0.031)	0.164 (0.137)	0.157* (0.083)
Developing·Size ²	0.000 (0.008)	-0.010*** (0.003)	-0.001 (0.001)	-0.002*** (0.001)	-0.003 (0.003)	-0.004*** (0.001)
Developed·Size	0.127 (0.325)	-0.571*** (0.161)	0.083* (0.049)	-0.026 (0.030)	0.099 (0.092)	-0.085* (0.043)
Developed·Size ²	-0.003 (0.005)	0.005*** (0.002)	-0.001* (0.001)	0.000 (0.000)	-0.001 (0.001)	0.001* (0.001)
GCF	0.242*** (0.063)	0.138*** (0.033)	0.016 (0.011)	0.012** (0.005)	0.006 (0.027)	0.003 (0.021)
Governance	1.291** (0.604)	0.865*** (0.256)	0.093 (0.118)	0.026 (0.050)	-0.017 (0.626)	0.450 (0.300)
Population	-0.205 (0.357)	-0.260 (0.211)				
Trade	0.019** (0.008)	0.012 (0.008)				
Infant			-0.005 (0.014)	-0.030*** (0.007)	0.123* (0.065)	-0.049 (0.036)
Observations	560	565	563	553	263	247
Countries	128	121	129	119	109	93
AR(1)	0.00548		0.000761		0.0438	
AR(2)	0.156		0.676			
Hansen test	0.195		0.184		0.363	
Instruments	81		95		30	
Adj. R ²		0.569		0.730		0.509

Notes: See Table 4

Table 22: Income dynamics for 5-year periods

Variables	(1) Sys-GMM	(2) FE	(3) Sys-GMM	(4) FE	(5) Sys-GMM	(6) FE
Log GDP _{t-1}	-3.767** (1.722)	-6.024*** (0.698)				
Log HDI _{t-1}			-11.804*** (2.160)	-11.686*** (1.203)		
Log IHDI _{t-1}					-6.681 (5.679)	-17.355*** (2.892)
Education _{t-1}	0.068* (0.036)	0.037*** (0.010)	0.014*** (0.004)	0.006** (0.002)	0.010 (0.021)	0.008 (0.005)
Low.I-Size	0.185 (0.648)	0.331** (0.141)	-0.136 (0.157)	0.020 (0.065)	0.036 (0.287)	-0.153 (0.260)
Low.I-Size ²	-0.005 (0.013)	-0.007** (0.003)	0.003 (0.003)	0.000 (0.002)	-0.001 (0.007)	0.001 (0.007)
L.M.I-Size	0.212 (0.492)	0.110 (0.209)	0.002 (0.114)	0.086 (0.062)	0.113 (0.174)	0.009 (0.144)
L.M.I-Size ²	-0.003 (0.010)	0.001 (0.005)	0.001 (0.002)	-0.001 (0.001)	-0.001 (0.003)	0.001 (0.003)
U.M.I-Size	-0.336 (0.454)	1.084*** (0.168)	0.192** (0.077)	0.177*** (0.036)	0.319** (0.144)	0.089 (0.165)
U.M.I-Size ²	0.017 (0.011)	-0.019*** (0.003)	-0.003** (0.001)	-0.003*** (0.000)	-0.006** (0.002)	-0.003 (0.002)
High.I-Size	0.519 (0.579)	-0.332* (0.171)	0.150** (0.069)	-0.001 (0.030)	0.172 (0.130)	-0.152 (0.095)
High.I-Size ²	-0.008 (0.008)	0.002 (0.002)	-0.002* (0.001)	-0.000 (0.000)	-0.002 (0.002)	0.002 (0.001)
GCF	0.193*** (0.073)	0.144*** (0.032)	0.019 (0.012)	0.011** (0.005)	0.087** (0.037)	-0.001 (0.020)
Governance	-0.539 (1.134)	0.844*** (0.242)	0.073 (0.120)	0.041 (0.052)	0.514 (0.369)	0.476 (0.289)
Population	-0.674 (0.538)	-0.291 (0.202)				
Trade	0.022* (0.013)	0.011 (0.008)				
Infant			-0.039*** (0.014)	-0.034*** (0.007)	0.006 (0.074)	-0.041 (0.041)
Observations	573	565	562	553	263	247
Countries	129	121	128	119	109	93
AR(1)	0.0341		0.00934		0.0649	
AR(2)	0.128		0.411			
Hansen test	0.365		0.280		0.459	
Instruments	62		95		54	
Adj. R ²		0.582		0.736		0.494

Notes: See Table 4

Table 23: Consumption and investment for 5-year periods

Variables	(1) Sys-GMM	(2) FE	(3) Sys-GMM	(4) FE	(5) Sys-GMM	(6) FE
Log GDP _{t-1}	0.194 (1.773)	-5.871*** (1.029)				
Log GDP _{t-2}	-1.768 (1.658)					
Log HDI _{t-1}			6.116 (5.128)	-11.042*** (1.392)		
Log HDI _{t-2}			-6.492*** (2.104)			
Log IHDI _{t-1}					-3.655 (5.805)	-18.388*** (4.374)
Education _{t-1}	-0.013 (0.019)	0.002 (0.013)	-0.006 (0.013)	-0.001 (0.002)	0.003 (0.028)	-0.008 (0.008)
Consumption	0.440 (0.317)	0.271*** (0.092)	0.281** (0.123)	0.024 (0.018)	0.384** (0.183)	0.037 (0.076)
Consumption ²	-0.007 (0.005)	-0.005*** (0.001)	-0.004*** (0.002)	-0.000 (0.000)	-0.006** (0.003)	-0.000 (0.001)
Investment	-1.466** (0.678)	0.082 (0.175)	-0.303* (0.167)	0.072** (0.030)	0.162 (0.336)	-0.245 (0.293)
Investment ²	0.104** (0.053)	-0.012 (0.010)	0.037** (0.017)	-0.004* (0.002)	-0.022 (0.023)	0.027 (0.031)
GCF	0.147** (0.069)	0.144*** (0.035)	0.014 (0.024)	0.007 (0.006)	0.060 (0.048)	0.049*** (0.011)
Governance	-0.014 (0.533)	1.230*** (0.335)	0.424** (0.201)	0.003 (0.071)	0.187 (0.538)	0.401 (0.260)
Population	-1.747** (0.737)	-0.621*** (0.207)				
Trade	0.016* (0.009)	0.015* (0.009)				
Infant			0.059 (0.049)	-0.034*** (0.008)	-0.020 (0.064)	-0.095 (0.063)
Observations	451	443	432	435	165	128
Countries	122	114	121	112	101	64
AR(1)	0.0428		0.00621			
AR(2)	0.215		0.815			
Hansen test	0.331		0.116		0.952	
Instruments	34		31		20	
Adj. R ²		0.614		0.796		0.708

Notes: See Table 4

Table 24: Economic growth quantile regression

	(1)	(2)	(3)	(4)	(5)
3-year periods	$\tau = 0.1$	$\tau = 0.25$	$\tau = 0.5$	$\tau = 0.75$	$\tau = 0.9$
Log GDP _{<i>t</i>-1}	0.823* (0.445)	0.829*** (0.304)	0.836*** (0.142)	0.842*** (0.038)	0.846*** (0.100)
Education _{<i>t</i>-1}	0.000 (0.006)	0.000 (0.004)	0.000 (0.002)	0.000 (0.001)	0.000 (0.001)
Size	0.016 (0.056)	0.013 (0.039)	0.009 (0.018)	0.006 (0.005)	0.003 (0.013)
Size ²	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
GCF	0.003 (0.015)	0.004 (0.010)	0.004 (0.005)	0.005*** (0.001)	0.005 (0.003)
Governance	0.030 (0.160)	0.026 (0.109)	0.022 (0.051)	0.018 (0.014)	0.016 (0.036)
Population	-0.004 (0.108)	-0.008 (0.074)	-0.014 (0.035)	-0.018* (0.009)	-0.021 (0.024)
Trade	0.000 (0.004)	0.000 (0.003)	0.001 (0.001)	0.001* (0.000)	0.001 (0.001)
Observations	838	838	838	838	838
	(1)	(2)	(3)	(4)	(5)
5-year periods	$\tau = 0.1$	$\tau = 0.25$	$\tau = 0.5$	$\tau = 0.75$	$\tau = 0.9$
Log GDP _{<i>t</i>-1}	0.687*** (0.128)	0.693*** (0.094)	0.703*** (0.052)	0.713*** (0.047)	0.718*** (0.066)
Education _{<i>t</i>-1}	0.001 (0.002)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
Size	0.015 (0.016)	0.014 (0.012)	0.014** (0.007)	0.014** (0.006)	0.014 (0.008)
Size ²	-0.000 (0.000)	-0.000 (0.000)	-0.000** (0.000)	-0.000** (0.000)	-0.000 (0.000)
GCF	0.006 (0.005)	0.006* (0.003)	0.006*** (0.002)	0.007*** (0.002)	0.007*** (0.002)
Governance	0.042 (0.047)	0.040 (0.034)	0.037* (0.019)	0.033* (0.017)	0.031 (0.024)
Population	-0.012 (0.030)	-0.012 (0.022)	-0.012 (0.012)	-0.012 (0.011)	-0.012 (0.016)
Trade	0.000 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001* (0.000)	0.001 (0.001)
Observations	573	573	573	573	573

Notes: Quantile regressions using the quantiles of 0.1, 0.25, 0.5, 0.75 and 0.9. The dependent variable is the logarithm of GDP per capita for all regressions. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Table 25: Inclusive economic development quantile regression

3-year periods	(1) $\tau = 0.1$	(2) $\tau = 0.25$	(3) $\tau = 0.5$	(4) $\tau = 0.75$	(5) $\tau = 0.9$
Log IHDI _{<i>t</i>-1}	0.523*** (0.162)	0.499*** (0.125)	0.460*** (0.083)	0.417*** (0.099)	0.391*** (0.134)
Education _{<i>t</i>-1}	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Size	-0.002 (0.003)	-0.002 (0.003)	-0.002 (0.002)	-0.002 (0.002)	-0.002 (0.003)
Size ²	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
GCF	0.001 (0.001)	0.001 (0.001)	0.001 (0.000)	0.000 (0.000)	0.000 (0.001)
Governance	0.009 (0.012)	0.009 (0.009)	0.009 (0.006)	0.010 (0.007)	0.010 (0.010)
Infant	-0.002 (0.002)	-0.002 (0.002)	-0.002* (0.001)	-0.002 (0.001)	-0.002 (0.002)
Observations	355	355	355	355	355
5-year periods	(1) $\tau = 0.1$	(2) $\tau = 0.25$	(3) $\tau = 0.5$	(4) $\tau = 0.75$	(5) $\tau = 0.9$
Log IHDI _{<i>t</i>-1}	0.098 (0.210)	0.106 (0.164)	0.121 (0.102)	0.136 (0.127)	0.142 (0.157)
Education _{<i>t</i>-1}	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Size	0.002 (0.005)	0.002 (0.004)	0.001 (0.002)	-0.001 (0.003)	-0.001 (0.004)
Size ²	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
GCF	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
Governance	0.026 (0.016)	0.022* (0.012)	0.015* (0.008)	0.009 (0.010)	0.006 (0.012)
Infant	-0.003 (0.003)	-0.003 (0.002)	-0.002 (0.001)	-0.002 (0.002)	-0.002 (0.002)
Observations	263	263	263	263	263

Notes: Quartile regressions using the quantiles of 0.1, 0.25, 0.5, 0.75 and 0.9. The dependent variable is the logarithm of IHDI for all regressions. Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Table 26: Economic growth and COFOG components for 5-year periods

Variables	(1) Sys-GMM	(2) FE	(3) FE	(4) Sys-GMM	(5) FE
Defense	1.912*** (0.619)				
Defense ²	-0.254*** (0.073)				
Public		-1.507*** (0.416)			
Public ²		0.074*** (0.024)			
Housing			-3.138** (1.403)		
Housing ²			0.881** (0.334)		
Safety				3.101** (1.578)	3.621*** (1.226)
Safety ²				-0.715*** (0.242)	-0.900*** (0.152)
Observations	297	294	294	297	290
Countries	69	63	63	69	62
AR(1)	0.0110			0.00179	
AR(2)	0.818			0.449	
Hansen test	0.428			0.458	
Instruments	60			70	
Adj. R ²		0.503	0.479		0.578

Notes: Equal approach as Table 12 but using 5-year period dummies.

Table 27: Economic development and COFOG components for 5-year periods

Variables	(1) FE	(2) FE	(3) FE	(4) FE	(5) Sys-GMM	(6) Sys-GMM	(7) FE
Defense	-0.160*** (0.047)						
Economic		0.174*** (0.059)					
Economic ²		-0.015*** (0.004)					
Gov.Education			0.419** (0.166)				
Gov.Education ²			-0.041*** (0.014)				
Public				-0.031* (0.017)			
Health					-0.444** (0.211)		
Health ²					0.037** (0.016)		
Housing						-0.841* (0.432)	
Housing ²						0.274** (0.112)	
Safety							0.572*** (0.150)
Safety ²							-0.132*** (0.022)
Observations	282	286	286	286	291	291	282
Countries	61	62	62	62	67	67	61
AR(1)					0.0218	0.0282	
AR(2)					0.530	0.402	
Hansen test					0.208	0.130	
Instruments					56	56	
Adj. R ²	0.637	0.592	0.582	0.583			0.651

Notes: Equal approach as Table 13 but using 5-year period dummies.

Table 28: Inclusive economic development and COFOG components for 5-year periods

Variables	(1) FE	(2) Sys-GMM	(3) FE	(4) Sys-GMM	(5) FE
Defense	0.332* (0.188)				
Defense ²	-0.038*** (0.012)				
Gov.Education		2.243* (1.249)			
Gov.Education ²		-0.256** (0.128)			
Health			0.106* (0.063)		
Housing				-3.135** (1.487)	
Housing ²				0.991* (0.567)	
Safety					0.867** (0.428)
Safety ²					-0.173*** (0.044)
Observations	146	154	147	154	146
Countries	54	61	54	61	54
AR(1)		0.0884		0.0673	
AR(2)					
Hansen test		0.611		0.518	
Instruments		30		17	
Adj. R ²	0.543		0.421		0.536

Notes: Equal approach as Table 15 but using 5-year period dummies.

Table 29: Robustness check using government revenue for 5-year periods

Variables	(1) Sys-GMM	(2) FE	(3) Sys-GMM	(4) FE	(5) Sys-GMM	(6) FE
Log GDP _{<i>t</i>-1}	-2.317*** (0.896)	-5.686*** (0.749)				
Log HDI _{<i>t</i>-1}			-5.405*** (1.790)	-10.807*** (1.098)		
Log IHDI _{<i>t</i>-1}					0.956 (4.287)	-18.701*** (3.018)
Education _{<i>t</i>-1}	0.044 (0.029)	0.027*** (0.010)	0.013*** (0.005)	0.004* (0.002)	-0.004 (0.013)	0.013** (0.005)
Size (revenue)	0.292* (0.168)	0.242** (0.101)	0.108*** (0.040)	0.057*** (0.019)	0.081 (0.073)	0.057 (0.053)
Size (revenue) ²	-0.004 (0.003)	-0.003* (0.002)	-0.001 (0.001)	-0.001*** (0.000)	-0.000 (0.001)	-0.001 (0.001)
GCF	0.177*** (0.045)	0.148*** (0.034)	0.031** (0.012)	0.012** (0.005)	0.113** (0.046)	0.004 (0.023)
Governance	0.288 (0.499)	0.869*** (0.266)	0.157 (0.106)	0.031 (0.050)	-0.179 (0.304)	0.357 (0.305)
Population	-0.468 (0.324)	-0.207 (0.246)				
Trade	0.008 (0.008)	0.015 (0.009)				
Infant			0.001 (0.013)	-0.029*** (0.007)	0.039 (0.065)	-0.058 (0.036)
Observations	573	565	563	553	263	247
Countries	129	121	129	119	109	93
AR(1)	0.000844		0.000367		0.0573	
AR(2)	0.106		0.837			
Hansen test	0.294		0.379		0.759	
Instruments	67		81		41	
Adj. R ²		0.539		0.717		0.429

Notes: Two-step System-GMM and Fixed effects regressions, including 5-year period dummies. GMM estimations use robust standard errors. FE estimations use standard errors clustered by country and robust to heteroskedasticity. All variables are treated as endogenous in System-GMM estimations with the exception of period dummies. The dependent variable is the average annual growth rate of GDP per capita for (1) and (2), of HDI for (3) and (4), and of IHDI for (5) and (6). Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Table 30: Government size, growth, development, and inclusive development for annual periods

Variables	(1) FE	(2) FE	(3) FE
Log GDP _{<i>t</i>-1}	-5.332*** (1.006)		
Log HDI _{<i>t</i>-1}		-9.907*** (1.336)	
Log IHDI _{<i>t</i>-1}			-22.120*** (2.964)
Education _{<i>t</i>-1}	0.005 (0.011)	0.002 (0.003)	0.005 (0.007)
Size	0.226** (0.105)	0.040* (0.021)	0.001 (0.058)
Size ²	-0.005*** (0.001)	-0.001* (0.000)	-0.000 (0.001)
GCF	0.155*** (0.024)	0.017*** (0.005)	0.034*** (0.012)
Governance	0.979*** (0.307)	0.037 (0.091)	0.329 (0.233)
Population	-0.345** (0.133)		
Trade	0.027*** (0.008)		
Infant		-0.017** (0.008)	-0.059* (0.032)
Observations	2,286	2,245	1,076
Countries	129	128	110
Adj. R ²	0.471	0.485	0.309

Fixed effects regressions, including year dummies. FE estimations use standard errors clustered by country and robust to heteroskedasticity. The dependent variable is the annual growth rate of GDP per capita for (1), of HDI for (2), and of IHDI for (3). Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Table 31: Development dynamics for annual periods

Variables	(1) FE	(2) FE	(3) FE
Log GDP _{<i>t</i>-1}	-5.546*** (0.948)		
Log HDI _{<i>t</i>-1}		-9.975*** (1.346)	
Log IHDI _{<i>t</i>-1}			-22.136*** (2.899)
Education _{<i>t</i>-1}	0.011 (0.010)	0.003 (0.003)	0.004 (0.007)
Developing·Size	0.452*** (0.146)	0.077*** (0.026)	0.090 (0.062)
Developing·Size ²	-0.009*** (0.002)	-0.001*** (0.000)	-0.002** (0.001)
Developed·Size	-0.501*** (0.188)	-0.022 (0.032)	-0.069 (0.054)
Developed·Size ²	0.003* (0.002)	0.000 (0.000)	0.001 (0.001)
GCF	0.153*** (0.025)	0.018*** (0.005)	0.034*** (0.013)
Governance	0.984*** (0.307)	0.038 (0.091)	0.323 (0.228)
Population	-0.379*** (0.117)		
Trade	0.024*** (0.007)		
Infant		-0.017** (0.008)	-0.059* (0.032)
Observations	2,286	2,245	1,076
Countries	129	128	110
Adj. R ²	0.478	0.488	0.316

Fixed effects regressions, including year dummies. FE estimations use standard errors clustered by country and robust to heteroskedasticity. The dependent variable is the annual growth rate of GDP per capita for (1), of HDI for (2), and of IHDI for (3). Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Table 32: Income dynamics for annual periods

Variables	(1) FE	(2) FE	(3) FE
Log GDP _{t-1}	-5.598*** (0.908)		
Log HDI _{t-1}		-10.101*** (1.389)	
Log IHDI _{t-1}			-22.406*** (2.911)
Education _{t-1}	0.011 (0.010)	0.003 (0.003)	0.004 (0.006)
Low.I-Size	0.319 (0.340)	0.043 (0.058)	-0.262** (0.116)
Low.I-Size ²	-0.006 (0.006)	-0.000 (0.001)	0.004** (0.002)
L.M.I-Size	0.250 (0.164)	0.072 (0.050)	0.279 (0.174)
L.M.I-Size ²	-0.004* (0.002)	-0.001 (0.001)	-0.004 (0.003)
U.M.I-Size	0.652*** (0.211)	0.066* (0.039)	0.002 (0.076)
U.M.I-Size ²	-0.012*** (0.003)	-0.001** (0.001)	-0.001* (0.001)
High.I-Size	-0.386*** (0.140)	-0.000 (0.033)	-0.113** (0.049)
High.I-Size ²	0.002 (0.001)	0.000 (0.000)	0.001** (0.001)
GCF	0.151*** (0.025)	0.016*** (0.005)	0.032** (0.013)
Governance	0.975*** (0.308)	0.057 (0.093)	0.356 (0.228)
Population	-0.411*** (0.105)		
Trade	0.024*** (0.007)		
Infant		-0.017** (0.008)	-0.057* (0.032)
Observations	2,286	2,240	1,076
Countries	129	127	110
Adj. R ²	0.480	0.492	0.325

Fixed effects regressions, including year dummies. FE estimations use standard errors clustered by country and robust to heteroskedasticity. The dependent variable is the annual growth rate of GDP per capita for (1), of HDI for (2), and of IHDI for (3). Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

Table 33: Consumption and investment for annual periods

Variables	(1) FE	(2) FE	(3) FE
Log GDP _{<i>t</i>-1}	-5.506*** (1.215)		
Log HDI _{<i>t</i>-1}		-10.502*** (1.817)	
Log IHDI _{<i>t</i>-1}			-26.793*** (4.304)
Education _{<i>t</i>-1}	-0.016 (0.012)	-0.001 (0.003)	-0.005 (0.009)
Consumption	0.125* (0.075)	0.023 (0.017)	0.017 (0.072)
Consumption ²	-0.004*** (0.001)	-0.000 (0.000)	-0.000 (0.001)
Investment	0.153 (0.223)	0.035 (0.031)	0.132 (0.112)
Investment ²	-0.011 (0.012)	-0.000 (0.001)	-0.006 (0.006)
GCF	0.135*** (0.028)	0.014** (0.006)	0.024 (0.018)
Governance	1.283*** (0.359)	0.017 (0.120)	0.149 (0.278)
Population	-0.771*** (0.135)		
Trade	0.021*** (0.007)		
Infant		-0.024** (0.011)	-0.108** (0.046)
Observations	1,908	1,881	783
Countries	122	122	105
Adj. R ²	0.407	0.459	0.278

Fixed effects regressions, including year dummies. FE estimations use standard errors clustered by country and robust to heteroskedasticity. The dependent variable is the annual growth rate of GDP per capita for (1), of HDI for (2), and of IHDI for (3). Significance level at which the null hypothesis is rejected: ***, 1%; **, 5%, and *, 10%.

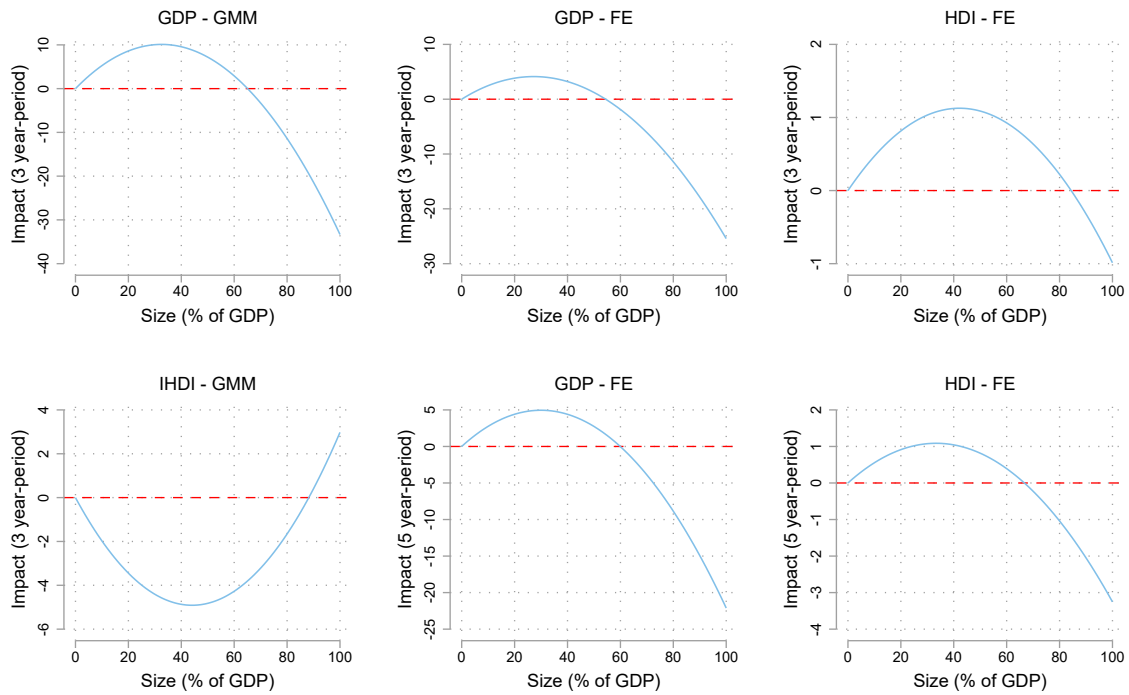


Figure 21: Armey Curve and overall government size

Source: Own computations.

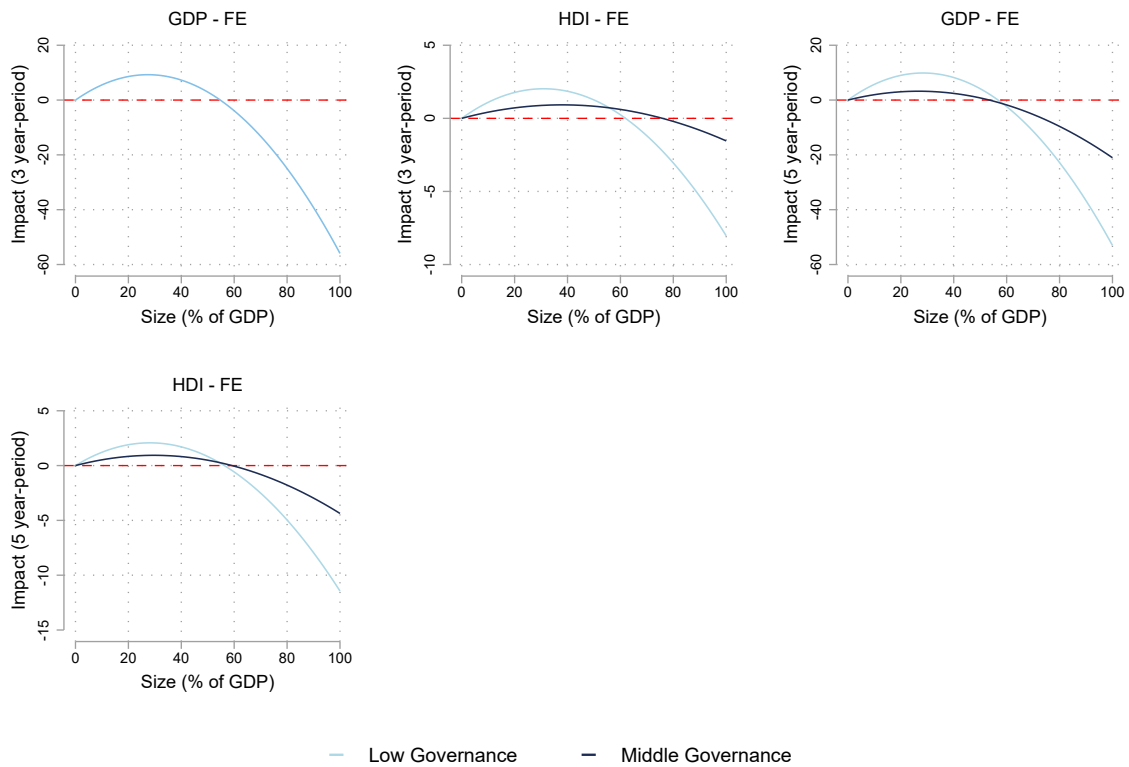


Figure 22: Armey Curve and governance

Source: Own computations.

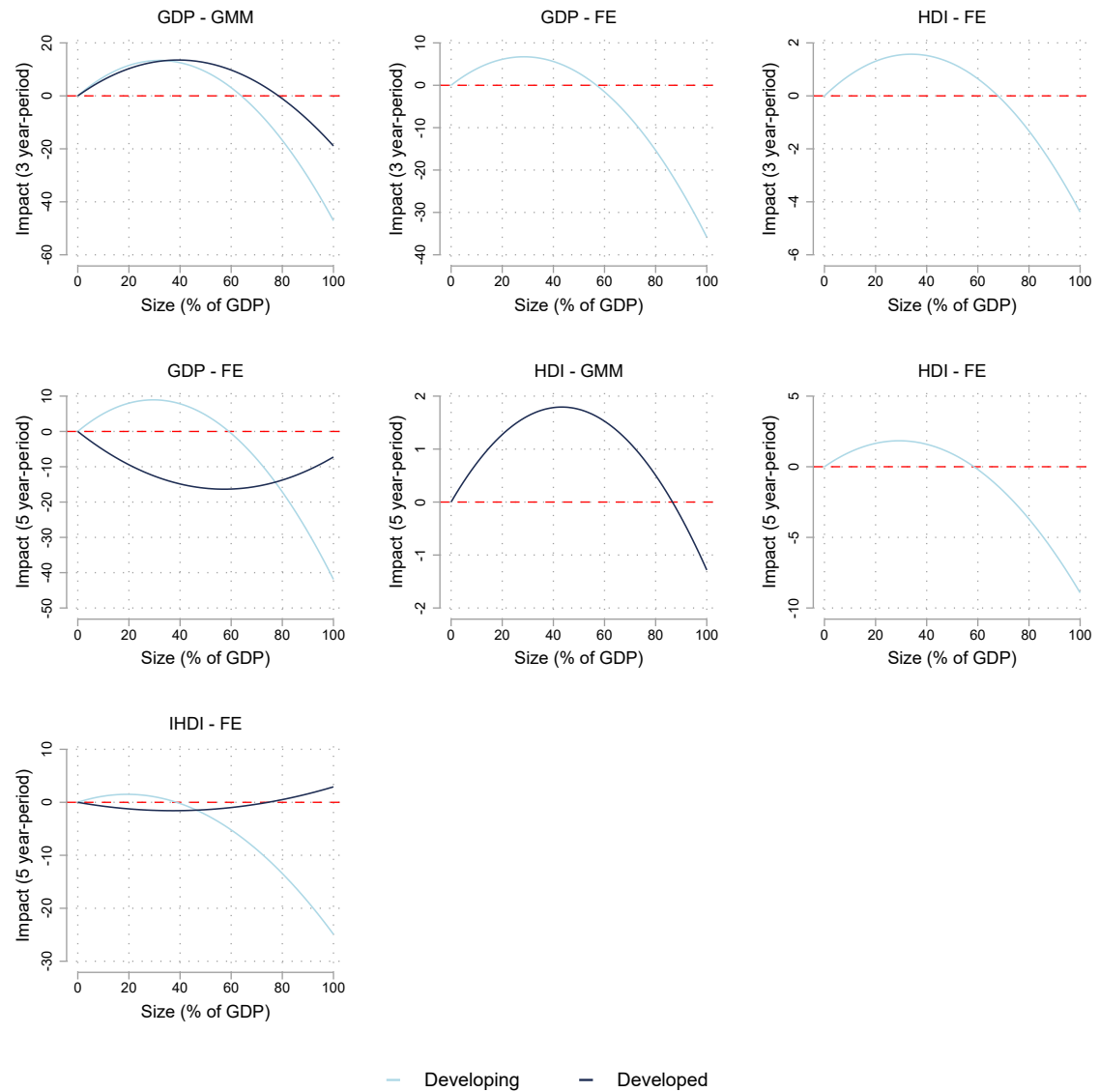


Figure 23: Armey Curve and development dynamics
Source: Own computations.

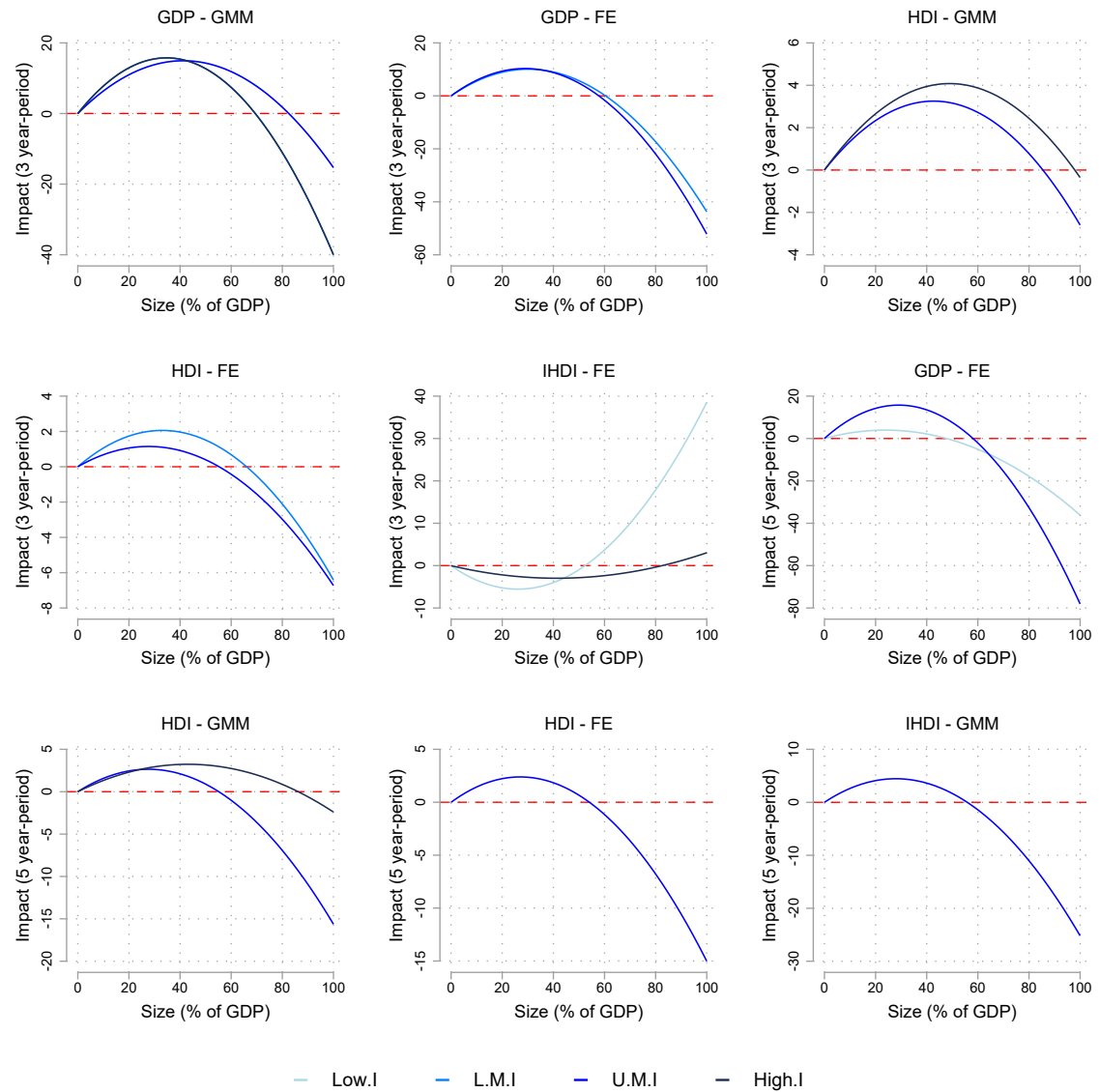


Figure 24: Armey Curve and income dynamics
Source: Own computations.

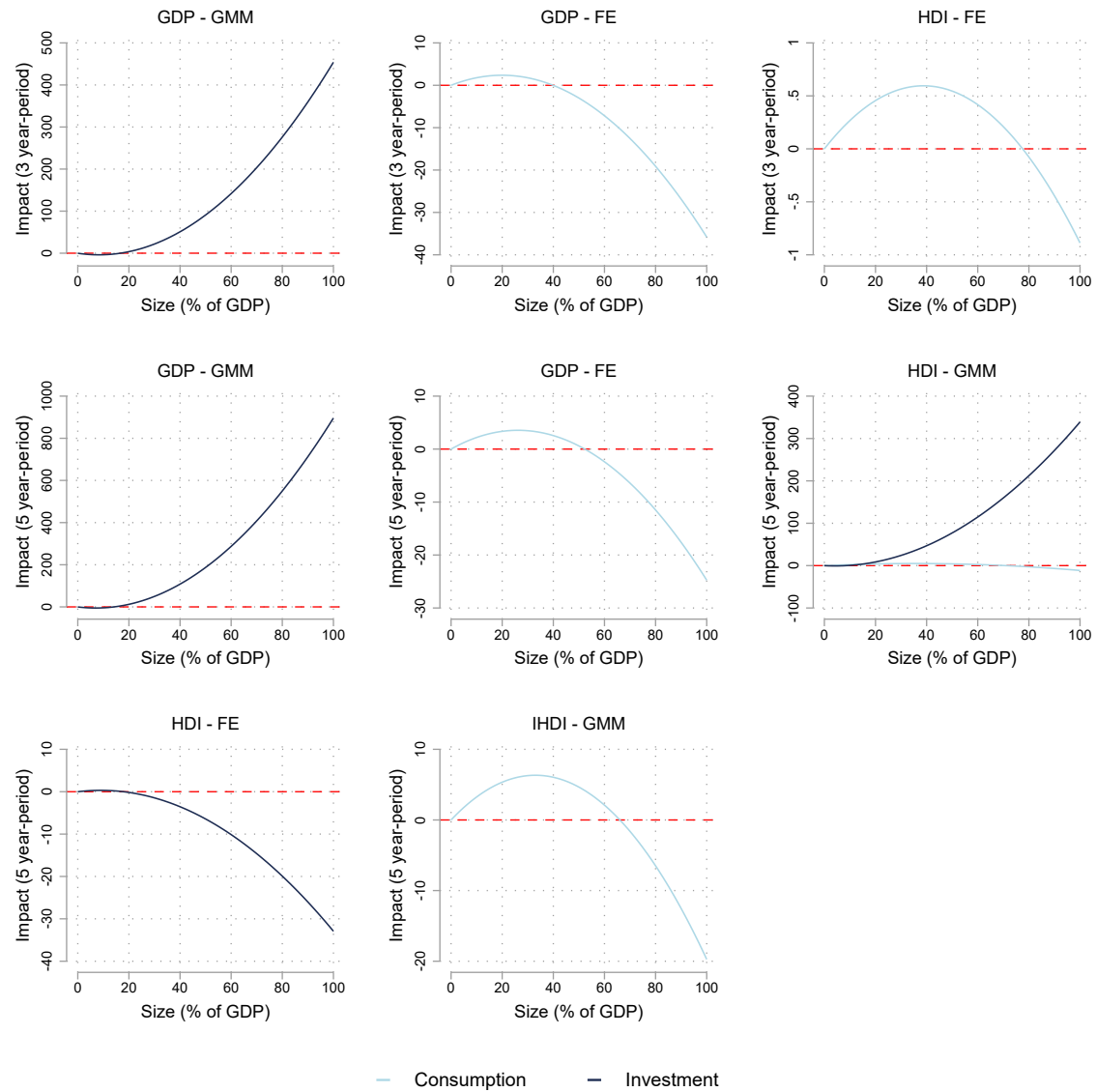


Figure 25: Armev Curve for consumption and investment
Source: Own computations.

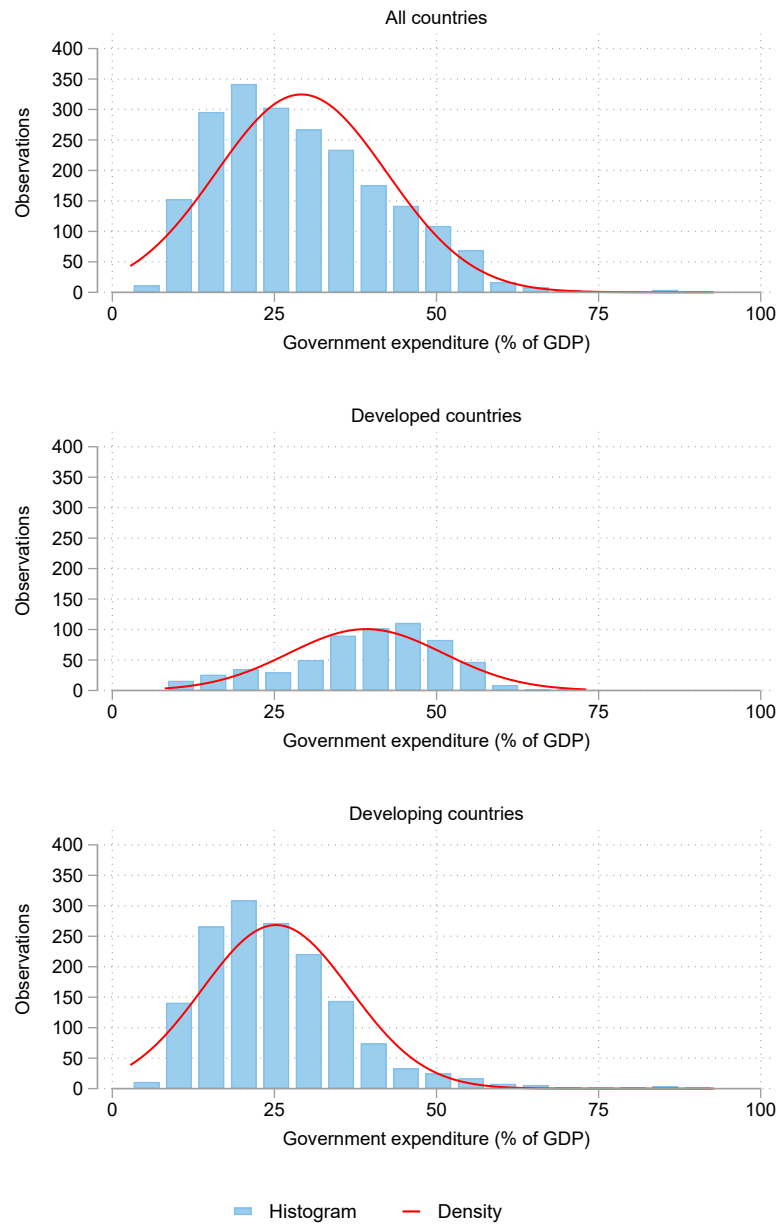


Figure 26: Distribution of observations by development cluster for 3-year periods.
Source: Own computations.

