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Fiscal Rules and Green Investments in Developing Countries

HISGUIMA DASSIDI Crépin^{1 2}

2022-2023

Abstract

This study highlights the effect of Fiscal Rules(FR) on Green Investments(GI) in developing countries. We analyze the causal effect of adopting rules on green financing using the entropy balancing method in 78 countries. Two hypotheses are tested in this study. The first one states that adopting Fiscal Rules increases green financing, and the second one is related to the ability of different types of rules to attract more investments to fight climate change. First, the results are robust and show that adopting Fiscal Rules increases climate finance. Unlike expenditure rules, deficit, debt, and revenue rules positively affect green financing. The effect of Fiscal Rules on green finance is amplified in countries with strong economic performance, high levels of democracy, good-quality institutions, and a well-functioning state apparatus. On the other hand, the effect of the rules is mitigated in the presence of high natural resource rents.

Key words : Fiscal rules, green investment, fiscal policy

JEL Classification : E60 ; E62 ; Q5

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1 Introduction

As a result of macroeconomic imbalances resulting from internal and external factors, several countries started by setting a numerical limit to a budgetary and accounting aggregate, such as inflation, deficit, debt, or public expenditure. Over the years (the 1990s), fiscal rules have emerged as one of the main tools for fiscal policy discipline, making them a credible alternative for achieving economic stability (Fatás et Mihov, 2006 ; Badinger, 2009 ; Andrés et Doménech, 2006 ; Schaechter et al., 2012). Thus, international institutions such as the International Monetary Fund (IMF) have overwhelmingly recommended the adoption of fiscal rules (fiscal institutions) for countries that suffer from a credibility deficit in managing their macroeconomic framework. In developing countries, adopting fiscal rules is even more justified because of the high exposure of these countries to exogenous shocks that affect the macroeconomic balance. The adoption of fiscal institutions in these countries could also be explained by the desire to make fiscal policy management more credible and to attract more investment. The rules help to restrain the deficit trend that could lead to excessive debt levels. They also prevent pro-cyclical policies that exacerbate economic cycles, thus helping to promote a more prudent fiscal path (Wyplosz, 2012 ; Alesina et Tabellini, 1990 ; Persson et al., 2000). Fiscal institutions can be national or supranational : National rules often aim to constrain macroeconomic aggregates to avoid fiscal drift and increase fiscal policy credibility. Supranational rules, beyond the credibility they offer, allow coordination of fiscal policies (of an economic area or monetary union), thus internalizing externalities and obtaining an optimal path in managing the macroeconomic framework. The various debt crises and other exogenous shocks have demonstrated the capacity of fiscal institutions to impose fiscal discipline. Rules bring discipline to the management of fiscal policy (Drazen, 2004 ; Kopits, 2001 ; Schaechter et al., 2012) through their binding nature.

Green investments refer to all financial operations carried out by an economic agent to promote the energy transition, combat climate change and promote environmental protection and management. These are socially responsible investments (SRI or RI). They include investments in sustainable projects, green funds, green bonds. According to the BloombergNEF report³, Green investments totaled \$26 billion in the first half of 2022. Green investments are a way to boost the economy and meet environmental goals. For example, green investments are essential to economic recovery in the US and South Korea. They have created more than 26,000 jobs in the US and 276,000 new jobs in South Korea⁴. There is a timid evolution of green investments in developing countries compared to the rest of the world. In 2022, at COP27 in Egypt, the African Development Bank presented a green banking initiative (1.5 billion dollars) to increase green investments. It is an initiative that aims to reduce financing costs and mobilize private sector investment in climate action in Africa. With the implementation of this initiative, access to green investments is expected

3. report published in August 2022

4. Ministry of Ecological Transition, France : Green investments for economic recovery for economic recovery

ted to increase from 3% in 2022 to 10% in 2030. According to the AfDB⁵, 80% of climate finance comes from public entities : the Green Climate Change Fund, the Global Environment Facility, and contributions from donor countries. Developing countries are the least likely to benefit from green financing, even though they are the least responsible for greenhouse gas emissions and the most exposed to climate disruption⁶. Hence the need to find credible alternatives that can promote green investments. These alternatives include mobilizing internal resources and easy access to external green resources. The ease of access to external resources depends on factors such as economic stability, repayment capacity, the credibility of the country's macroeconomic framework, etc. The consideration and implementation of these factors depend on adopting fiscal rules. Fiscal rules play an essential role in attracting and accessing foreign investment(Sawadogo, 2020 ; Regling, 2022 ; Sutherland *et al.*, 2005).

The impact of fiscal rules depends on its ability to consolidate key macroeconomic aggregates such as debt, inflation, and the budget deficit. The link between fiscal rules and green investment is through the credibility of fiscal policy and the ability to attract investment. The adoption of fiscal rules could send a strong signal to financial markets about the credibility of the macroeconomic framework and lower borrowing costs (Sawadogo (2020)). These resources can be used to finance environmental protection and management. The adoption of the rules could also encourage or influence the decision of investors to come and invest (Göndör *et Nistor*, 2012 ; Rădulescu *et Druica*, 2014) in environmental protection and management. Environmental investors have the incentive to invest in fiscally stable and credible countries.

This article is linked to two strands of literature : The first strand highlights the importance of fiscal rules (Debrun *et Kumar*, 2007 ; Debrun, 2007 ; Debrun *et al.*, 2008 ; Debrun *et al.*, 2009 ; Rose, 2006 ; Kumar *et Ter-Minassian*, 2007 ; Beetsma *et al.*, 2018 ; Combes *et al.*, 2021) in the management of fiscal policy and the second stream questions the link between fiscal rules and green investments(Eyraud *et al.*, 2011 ; Eyraud *et al.*, 2013 ; Cottarelli, 2020 ; Regling, 2022 ; Barabanov *et al.*, 2021 ; Jaraite *et al.*, 2014 ; Darvas *et Anderson*, 2020 ; Darvas *et Wolff*, 2021 ; Mathieu *et al.*, 2022). In the first strand of the literature, understanding the importance of fiscal institutions is necessary to understand the contribution of fiscal policy, and more specifically, the contribution of macroeconomic stability and the credibility of fiscal policy to economic activity. The second stream presents green investments and their link with fiscal rules. Indeed, the link between fiscal rules and green investments goes through the channel of credibility and resource allocation, which creates a favorable environment to attract more green investments. Also, fiscal rules have a close link with green investments because, by granting more credibility and stability to fiscal policy, fiscal institutions also influence the decision of foreign investors(Ranjan *et Agrawal*, 2011 ; Shah,

5. African Development Bank

6. Déclaration de la COP 21 de Paris en 2015

2014; Aizenman, 2003).

Several studies have examined the link between fiscal rules and public finance or economic performance, but very little work has focused on the effect of fiscal rules on green investments; hence the interest of this study, which differs from existing work (Bergman *et al.*, 2016; Marneffe *et al.*, 2010; Annicchiarico et Giammarioli, 2004; Bergman *et al.*, 2013; Schuknecht, 2004) by analyzing the causal effect of fiscal rules on green investments. This study focuses on developing countries because they are both the ones that struggle to mobilize green investments and the ones that are most exposed to environmental degradation but pollute the least (compared to the rest of the world). This study analyses the link between fiscal rules and green investments. Hence the need to answer the following questions : What is the effect of fiscal rules on green investments in developing countries ?

In this study, we make the following contributions : First, we contribute to the existing literature by studying the effects of fiscal rules on green investments in developing countries using the entropy balancing method (Hainmueller, 2012; Hainmueller et Xu, 2013), which is an innovative method. Secondly, we examine the type of rules that are more conducive to green investment in developing countries. An in-depth analysis will identify the transmission channels through which fiscal rules affect green investments. Since developing countries do not have the same characteristics, a heterogeneity analysis will finally be carried out to identify the specificities between these countries.

The rest of the study is structured as follows : The second section looks at a review of the theoretical and empirical literature. The third section presents the stylized facts of fiscal rules and green investments in developing countries. The fourth section focuses on the theoretical identification of transmission channels. In the fifth section, we present the data. The sixth and seventh sections present the identification strategy and the study's main results. The eighth section analyses the sensitivity of the results. The ninth and tenth sections deal with the heterogeneity and validation of the transmission channels. Finally, the last section concludes the study.

2 Review of the literature

Fiscal rules are adopted to reduce the budget deficit and inflation, making the debt more sustainable through binding the rules and preventing or limiting political interference in fiscal policy management. Therefore, these budgetary institutions make it possible to discipline fiscal policy management (Kumar et Ter-Minassian, 2007). Several solutions have been proposed in the economic literature (Debrun *et al.*, 2008) to reduce deficit bias. Debrun *et al.* (2008) propose four solutions to the deficit bias problem : Firstly, they suggest that with the rules, fiscal policymakers will be more accountable for their actions, thus bound by an obligation of result. This is consistent

with the work of [Kumar et Ter-Minassian \(2007\)](#), which suggests the same thing. Secondly, they also suggest as [Von Hagen et Harden \(1995\)](#) that adopting the rules contributes to improving the budgetary procedures governing the preparation, approval, and implementation of the annual budget. Thirdly, adopting and implementing the rules would lead to less political interference or pressure in fiscal policy management. This argument is also developed by [Wyplosz \(2005\)](#). Finally, adopting ex-ante rules contributes to more efficient fiscal policy management. They can therefore reduce the discretionary power of the budgetary authorities and allow the achievement of the objectives set through the ceilings of the budgetary aggregates. This argument is also developed in the work of [Krogstrup et Wyplosz \(2010\)](#). Fiscal rules are budgetary institutions that function as binding devices for fiscal policymakers and reduce the information asymmetry between the electorate and policymakers ([Debrun et Kumar, 2007](#)). Their binding nature prevents decision-makers from drifting in the execution of the budget [Rose \(2006\)](#) and enhances the credibility of fiscal policy ([Combes et al., 2021](#)). Fiscal institutions also contribute to reducing financial risks [Begg \(2017\)](#). However, the economic literature suggests that proper implementation of fiscal rules requires institutions that are sufficiently independent and insulated from political interference ([Debrun et al., 2009](#); [Beetsma et al., 2018](#)). Similarly, [Bergman et al. \(2016\)](#) show that the effectiveness of rules depends on better quality institutions. They explain that the quality of institutions is a necessary precondition for the formulation, implementation, and monitoring of fiscal rules. Other economic work [Debrun \(2007\)](#) shows that the effectiveness of rules depends on the cost of circumventing them. A fiscal rule is effective when the cost of circumventing it by policymakers is high. The higher the cost of circumventing the rules, the more discipline they bring to fiscal policy management. The adoption of rules also helps to send a strong signal to investors and financial markets about the credibility of fiscal policy. This helps to lower the cost of borrowing on financial markets ([Sawadogo, 2020](#)).

The link between fiscal rules and public finances has been extensively discussed in the economic literature ([Bergman et al., 2016](#); [Marneffe et al., 2010](#); [Annicchiarico et Giammarioli, 2004](#); [Bergman et al., 2013](#); [Schuknecht, 2004](#); [Corbacho et Ter-Minassian, 2013](#)). The adoption of fiscal rules contributes to increasing the efficiency of public finances. It also allows for a better allocation of public resources. The rules, through their binding character, favor the good use and distribution of resources, thus allowing the achievement of public policy objectives.

Another strand of the literature analyses the link between fiscal rules and green finance. For example, recent work by [Cottarelli \(2020\)](#) proposes a series of reforms to green the fiscal rules. They suggest excluding green public investments from the deficit and other ceilings, but this should be done on an accrual basis. The aim is to increase green investments. Also, the benefits of green public investment are such that it would be helpful to accept higher costs that can potentially result in higher deficits and debt. However, it warns that the additional public debt created by deficit-financed green public investment will likely increase fiscal sustainability risks. In contrast, the work of [Regling \(2022\)](#) Instead propose a budget deficit limit of 3 percent, but this must be

combined with a higher limit (above 60 percent) on the debt/GDP target and a combination of an expenditure rule and a primary balance rule targeting debt reduction in good economic times. The studies of [Cottarelli \(2020\)](#) identify green economic activities as those that contribute to the achievement of at least one of the following six objectives (climate change, mitigation, adaptation to climate change, sustainable use of water and marine resources, circular economy, pollution prevention, and ecosystem health). However, considering one objective should not prejudice the achievement of another objective.

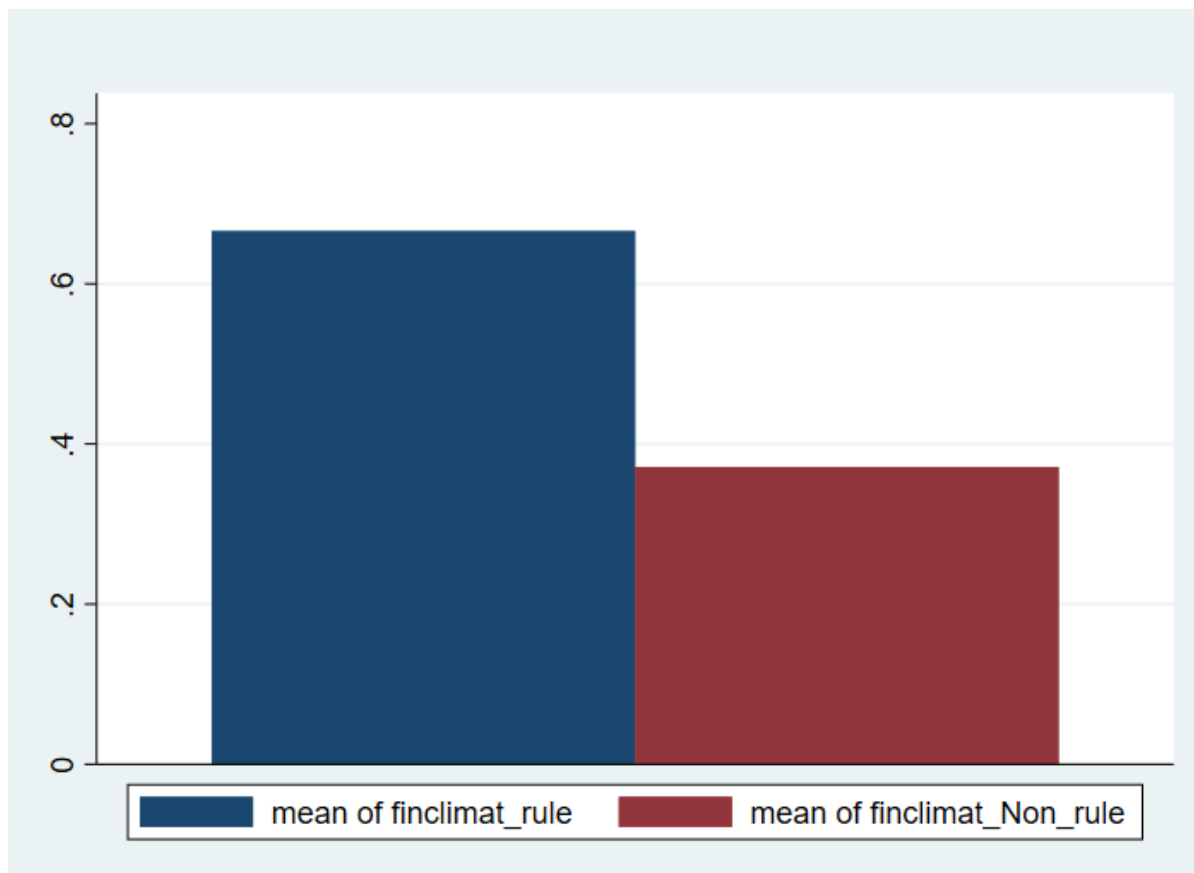
[Eyraud *et al.* \(2013\)](#) define green investments as investments needed to reduce greenhouse gas emissions and air pollutants without significantly reducing the production and consumption of non-energy goods. They analyze the effects of macroeconomic factors on green investment and show that strong economic performance and higher income levels lead to increased green investment. As a reminder, green investments cover both public and private investments. The work of [Eyraud *et al.* \(2011\)](#) identifies economic growth, population, technical progress and innovation, interest rates, the cost of fossil fuels, the cost of producing green capital goods, and public policies to support green investments as the main determinants of green investments. Recent studies by [Barabanov *et al.* \(2021\)](#) identify GDP per capita, population, creditor rights, and the quality of the judiciary as determinants of green investment. They find that large firms are more likely to invest in the environment, while highly valued or more profitable firms invest less in the environment sector. These arguments are consistent with the work of [Jaraite *et al.* \(2014\)](#) and [Haller *et al.* \(2012\)](#), which also found the same result. The work of [Stern \(2004\)](#) finds that companies in high-income countries have higher environmental spending and are more involved in environmental innovation. He says that investment in renewable energy sources and green technologies is helping to offset the fossil fuel deficit.

Recent work by [Darvas *et al.* \(2021\)](#) analyses the link between fiscal rules and green investments. They propose reforming the European Union's fiscal rules to increase green investment while consolidating the budget deficit. The reform aims to create a golden rule that excludes net green investment from the fiscal indicators used to measure compliance with fiscal rules. They suggest that better regulatory policy and higher emissions prices should encourage private green investment. The limitation of the work of [Darvas *et al.* \(2021\)](#) is that they need to analyze the link between fiscal rules and green investments empirically. The main contribution of our study is that it considers this limitation by analyzing the causal effect of rules on green investments and identifies the channels through which fiscal rules affect green investments. [Beetsma \(2022\)](#) warns that excluding green investments from the caps could increase the risk of "greenwashing ." [Mathieu *et al.* \(2022\)](#) also analyze the possibilities of reforming the current fiscal rules to favor green investments. They suggest replacing the current rules with a single rule, the public expenditure rule. The public expenditure rules have advantages and disadvantages, but for them to succeed, their implementation must be monitored by an independent budget committee. The recent work of [Mathieu *et al.* \(2022\)](#) opposes those of [Mitsi *et al.* \(2022\)](#), who find that expenditure rules

negatively affect foreign investment because these rules refer to fiscal indiscipline. In our study, as a contribution to the literature, we will make the same estimates to see whether or not these results are confirmed in our analysis. In the same vein of fiscal rules reforms, the recent work of [Goncalves *et al.* \(2022\)](#) propose instead a risk-based medium-term fiscal framework that combines strengthened norms, rules, and institutions would strike a better balance between flexibility and credibility. In the case of the latter, a multi-year spending rule anchored in an appropriate public debt target is proposed, augmented by an asymmetric golden rule that provides additional fiscal space only in times of recession([Darvas et Anderson, 2020](#)). However, the contribution of our study to the existing literature lies in the analysis of the causal effect between fiscal rules and green investments. This study differs from the existing literature by performing the analysis for developing countries. This still needs to be addressed in the literature. Also, this study contributes to the literature through the policy implications and the consideration of cross-country specificities in the analysis.

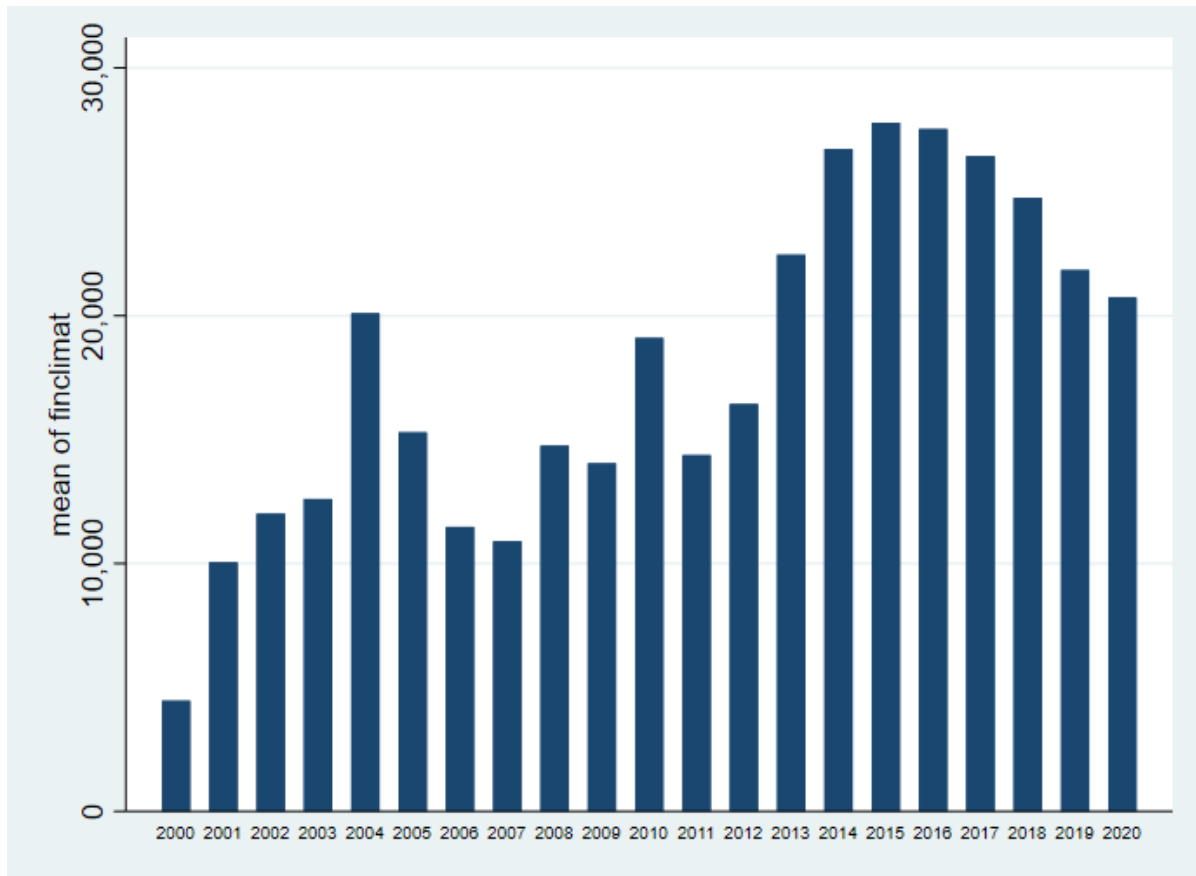
3 Stylized facts

Figure 1 : Average evolution of the Green Investment(GI) of the countries having adopted the fiscal rules and the countries having not adopted (% of the GDP)



Source : Author's calculation.

Figure 2 : Evolution of Green Investment(GI) from 2000 to 2020



Source : Author's calculation.

In this section, we present the stylized facts that characterize green investments as a function of adopting fiscal rules (FR) in developing countries. Several economic studies highlight the important contribution of fiscal rules to the dynamics of green investments(Darvas et Anderson, 2020 ; Darvas et Wolff, 2021). The works of(Darvas et Wolff, 2021 ; Eyraud et al., 2011 ; Barabanov et al., 2021) find a positive and significant effect of fiscal rules on green investments. Figure 1 shows the increase in the green investment ratio as a function of whether or not fiscal rules were adopted between 2000-2020. On average, the ratio of investment to GDP increased by more than 60% over the study period. However, this increase was more significant in countries that adopted at least one fiscal rule (around 0.7% of GDP) than in countries that did not adopt a fiscal rule (with 0.3% of GDP on average) (see Figure 1). A link can therefore be established between adopting fiscal rules (FR) and increasing green investments. This link was highlighted in the works of(Darvas et Anderson, 2020 ;Darvas et Wolff, 2021), which show that fiscal rules promote macroeconomic stability and create a favorable environment for attracting more climate-friendly investments. The stability of macroeconomic aggregates provided by the rules also influences investors' decision-

making [Simões *et al.* \(2014\)](#). Countries with at least one Fiscal rule attract more green investment than countries without fiscal rules (See Figure 1).

Following economic crises and other fiscal abuses, international financial institutions (The IMF) have advised adopting fiscal institutions by developing countries to withstand exogenous shocks to the economy, allowing for a better allocation of resources and stability of the macroeconomic framework. Thus, several developing countries have adopted one or more fiscal rules to discipline their fiscal policy and make it more credible. In sum, we find that climate-friendly investments and the number of countries adopting fiscal rules have increased from 2000 to 2020.

4 Identification of transmission channels

This section identifies the channels through which fiscal rules affect green investments. First, there is the credibility channel. Indeed, adopting fiscal rules increases the credibility of fiscal policy [Kopits \(2001\)](#), and the credibility that fiscal rules give attracts more green investment because the credibility of fiscal policy influences the decision to invest [Sawadogo \(2020\)](#). Secondly, fiscal rules help to reduce the debt ratio through fiscal policy discipline. This fiscal policy discipline helps to raise the country’s sovereign debt rating [Sawadogo \(2020\)](#). An increase in the sovereign rating of countries attracts more investments because investors invest in stable countries. Thirdly, the adoption of the rules also contributes to strengthening inflation stabilization (inflation targeting) ([Svensson \(1996\)](#); [Combes *et al.* \(2018\)](#)). Stable inflation is a signal of economic stability and attracts more investment to the country ([Tapsoba, 2012](#); [Mason et Vracheva, 2017](#)). Finally, the adoption of the rules promotes growth [Afonso et Jalles \(2013\)](#), and the resulting economic performance attracts more green finance ([Zenghelis, 2012](#); [Zhang *et al.*, 2022](#)). In sum, credibility, sovereign debt rating, inflation targeting, and economic performance are the channels through which fiscal rules affect climate investments.

5 Data

5.1 Data source

Much of the data for this study comes from the World Development Indicators(WDI) database⁷. Data on fiscal rules are taken from the International Monetary Fund (IMF) Fiscal rules dataset⁸. The institutional data comes from the International Country Risk Guide (ICRG) database⁹. The data on green investment comes from the Organisation for Economic Co-operation and Development (OECD) database.

7. <https://databank.worldbank.org/source/world-development-indicators>

8. <https://www.imf.org/external/datamapper/fiscalrules/map/map.htm>

9. <https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/4YHTPU>

5.2 Database description

This study uses the ratio of green investment to GDP as the dependent variable. Our treatment variable is a binary variable that indicates 1 if the country has adopted a fiscal rule and 0 otherwise. Then, we control for a series of control variables : Growth, exchange rate regime, debt ratio, trade index, and bureaucracy index. The period (2000-2020) is chosen according to the availability of green investments data.

Measuring fiscal rules

As a reminder, fiscal rules or fiscal institutions appeared in the middle of the 19th century in the constituent states of the United States. They are tools for the management of fiscal policy. They aim to combat deficit bias, generate credibility in order to be able to borrow more cheaply on international markets, and also represent a means of combating the budgetary externalities resulting from excessive deficits. Several fiscal rules are identified in the economic literature, namely procedural and numerical rules : Procedural rules are rules of the budgetary procedure. Whatever the institutional structure of the country, two main procedures can be distinguished in the sense of decision-making :

1- Collegial procedure : a procedure that allows the representation of several groups in the decision-making process; several structures participate in the budgetary decision-making process. This procedure allows for better representation of social groups but can lead to the tragedy of the commons.

2- Hierarchical procedure : In this procedure, one agent has a predominant role in budget making. The most effective way to reduce the tragedy of the commons is to adopt top-down or hierarchical budget procedures.

Numerical rules, conversely, are numerical targets (ceilings or floors on macroeconomic aggregates) that constrain fiscal aggregates. They are permanent constraints on the execution of budgetary policy and are expressed as a synthetic indicator of budgetary performance.

However, fiscal rules also have limitations that should be noted : First, they encourage the pro-cyclicality of fiscal policy : in times of expansion, it is easier to respect the rule than in times of economic slowdown. The target is the structural balance, which is independent of the economic situation. Fiscal rules can sometimes penalize investment : when fiscal constraints are imposed on the government, it will sacrifice investment because it is easier to sacrifice investment than to reduce current expenditure. Fiscal rules could have positive endogenous effects because the countries that adopt them are generally virtuous regarding fiscal policy management. The second criticism is that these rules sometimes weaken investment spending. This often leads to limiting or even prohibiting debt or deficit when the debt is generated by investment spending. Apart from adopting fiscal rules, there is a need for independent Fiscal committees, which are structures that can monitor the budget and will be responsible for making an independent forecast. Several

economic studies also suggest that the control of major budgetary aggregates should be entrusted to these independent budgetary committees (Debrun *et al.*, 2009; Beetsma *et al.*, 2017; Beetsma *et al.*, 2018). In this study, fiscal rules are measured by a binary variable that takes the value 1 if the country has adopted a fiscal rule and 0 otherwise. The database comes from the fiscal Rules Dataset of the International Monetary Fund (IMF)¹⁰.

Measuring green investment

The data on green investment is taken from the OECD database. The green investment data in this study is the ratio of the sum of all incoming (climate) finance to GDP. According to the IMF¹¹, Green investment is the investment needed to reduce emissions of greenhouse gases and air pollutants significantly. These are investments that promote climate change mitigation and adaptation. This study is a new multi-country historical dataset that tracks green investments received by developing countries. The works of Eyraud *et al.* (2011) propose a definition of green investment and identify the determinants of green investment. Their study finds that green investment is stimulated by economic growth and a sound financial system conducive to low-interest rates and high fuel prices. Other work NUMÉRO (2012) propose solutions (sustained growth, lowering the cost of capital, and carbon pricing) to boost climate-friendly investments.

The control variables are composed of the following :

The growth represents the positive change in the production of goods and services in an economy over a period of time, usually a long period. It also represents the economic performance of countries. The more a country grows, the more likely it is to attract more investment (Afonso *et Jalles*, 2013; Gründler *et Potrafke*, 2020) as investors look for countries in which they can make better returns on their investments.

The debt ratio is an indicator of the sustainability of a country's debt. Indeed, the higher it is, the less sustainable the country is, and therefore the less attractive it is to foreign investors. Investors often choose to invest in places with stable macroeconomic aggregates making macroeconomic stability a determinant of FDI (Ranjan *et Agrawal*, 2011; Vijayakumar *et al.*, 2010). We expect the debt ratio to affect green investments negatively.

Bureaucracy : Therefore, high points are given to countries where the bureaucracy has the strength and expertise to govern without drastic changes in policy or interruptions in government services. We expect that bureaucracy will positively affect green investments.

Trade index : captures the percentage ratio of the export unit value indexes to the import unit value indexes, measured relative to the base year 2000. The terms of trade index measures the relative prices of a country's exports and imports. When a country's net barter terms of trade

10. <https://www.imf.org/external/datamapper/fiscalrules/map/map.htm>

11. <https://www.imf.org/external/pubs/ft/fandd/fre/2012/06/pdf/eyraud.pdf>

index increases, its exports become more expensive or its imports become cheaper. We expect that the terms of trade index will positively affect green investments. An increase in exports proves the dynamism of the country's economic performance (Dollar et Kraay, 2003), which is essential for attracting foreign investment.

The exchange rate regime : The exchange rate regime is essential in attracting foreign investment. It reassures investors and influences their decision to invest. The work of (Aizenman, 1992) shows that a fixed exchange rate regime attracts more foreign investment than a flexible exchange rate regime. The study of (Aizenman, 1992) also shows the importance of the exchange rate regime in the attractiveness of foreign investment. We expect the exchange rate regime to affect green investments positively.

6 Identification strategy

In this study, the causal effect is analyzed through the entropy balancing method (Hainmueller, 2012; Hainmueller et Xu, 2013). The model developed in this study is based on the work of Badinger et Reuter (2017). First, referring to the work of (Chakraborty et Mukherjee, 2013), we add the trade index among the control variables. Second, we rely on the work on fiscal rules (Sawadogo, 2020; Ardagna, 2004), which use the debt-to-GDP ratio as control. We also use these two variables as controls in our model. Several economic studies (Ardagna, 2004; Badinger et Reuter, 2017; Badinger, 2009) provide information on the link between the adoption of fiscal rules and economic performance. Thus, we introduce the variable that captures economic performance (Growth) among the controls. Based on the work of (Taylor, 2000; Snudden, 2016), We also introduce the exchange rate regime variable among our control variables. Finally, drawing on the work of (Teles, 2009; Evans et Rauch, 1999), we add the institutional variable that captures the bureaucracy of the government among the controls. We use the fixed effect model, the GMM estimator, the Mahalanobis distance balancing method, and other alternatives to test our results' robustness.

6.1 Entropy balancing

Based on the work of Hainmueller (2012), which was subsequently implemented in the economic work of Neuenkirch et Neumeier (2016) In our policy impact assessment work, we use the entropy balancing method to analyze the causal effect of the adoption of fiscal rules on green investments. This is a two-step method : In the first step, we calculate weights assigned to the control units (countries that have not adopted fiscal rules). In the second step, we use the weights obtained in the first step in a regression analysis with the treatment variable (countries having adopted the fiscal rules) as the explanatory variable. Then, we match countries that have adopted the fiscal rules with countries that have not adopted fiscal rules on the basis of observable characteristics. The objective of this study is to analyze the causal effect between the adoption of fiscal rules and climate investments. In other words, to see whether adopting fiscal rules improves or attracts more

green investments in developing countries. The green investments used in this study are the ratio of total incoming climate investments to GDP. The treatment variable indicates 1 if the country has adopted at least one fiscal rule and 0 otherwise. The countries that have adopted the fiscal rules constitute the treatment group. Our empirical analysis's main challenge is finding a causal relationship between fiscal rules and green investments. There are several reasons why countries adopt fiscal rules : economic stability, limiting fiscal drift, fiscal profligacy, political risk, lack of liquidity, attracting more investment, etc. These reasons could be associated with macroeconomic factors and the political situation of countries. This could trigger an endogeneity problem. In order to remedy this situation, we propose the use of the matching method. It is more reliable and sufficiently robust than the usual linear regression methods. The relation gives the average effect of the treatment on the treated (ATT) :

$$ATT = E[(Y_{i1}Y_{i0})|FR = 1] = E[(Y_{i1}|FR = 1)] - E[(Y_{i0}|FR = 1)] \quad (1)$$

In equation (1), FR is a binary variable that represents the adoption of fiscal rules (FR) in country i , Y_{i1} is a variable that captures green investments when country i has not adopted FR (Non-FR). $Y_{i0}|FR=1$ denotes the value of green investments that would have been observed if a country that did not adopt FR (Non-FR) had adopted FR. $Y_{i1} |FR=1$ denotes the green investments observed for the same Non-FR country. The above equation compares the green investments observed in the Non-FR countries and the green investments observed in the same countries if they had adopted fiscal rules (FR). This would give us an unbiased estimate of the ATT. However, the main difficulty with this equation is that the second term on the right-hand side of this equation is unobservable. To circumvent this difficulty, we make a random selection of countries that have not adopted FR(Non-FR). Using this random selection, we can compare the sample average of the Non-AR countries with that of the AR countries.

In equation(1), we replace $E[Y_{i0} FR=1, X_i]$ with the term $E[Y_{i0} FR=0, X_i]$, and we obtain this equation.

$$ATT = E[(Y_{i1}Y_{i0})|FR = 1] = E[Y_{i1}FR = 1, X_i] - E[Y_{i0}FR = 0, X_i] \quad (2)$$

The entropy balancing method has several advantages : First, it is more efficient and reliable than classical matching methods (Propensity Score Matching) because of its non-parametric character. With this method, there is little chance of having a problem of misspecification of the model's functional form, which could bias our results. Secondly, since the treatment variable is orthogonal to the covariate due to the reweighting mechanism, it avoids the problems of multicollinearity that could eventually arise. Finally, the entropy balancing method also allows us to combine a reweighting mechanism with a regression analysis [Neuenkirch et Neumeier \(2016\)](#). This method allows controlling for country and time-fixed effects in the regression analysis. Including country-fixed effects allows for potential unobserved heterogeneity between countries with and without fiscal rules. To account for country-specific temporal and structural specificities, we also use fixed effects to capture invariant factors that explain differences in green investment attractiveness.

7 Interprétation des résultats

Dans cette partie, nous procédons à l'interprétation des résultats principaux de notre étude.

7.1 Entropy balancing : Results

TABLE 1 – Descriptive statistics

	(1)	(2)	3=(2-1)		
Variables	FR	Non-FR	Difference	t value	p-value
finclimat	0.665	0.371	-0.294	-4.3810	0.0000
lagfineclassi	6.377	7.086	0.709	3.0460	0.0024
laggrowth	4.0737	4.691	0.617	2.9113	0.0037
lagggdy	45.547	53.818	8.270	3.7344	0.0002
lagtradeindex	118.291	120.609	2.317	1.2007	0.2300
lagbureaucracy	1.8325	1.7200	-0.112	-2.6090	0.0092
Number of observations	416	603			

TABLE 2 – Covariate balancing

	(1)	(2)	3=(2-1)		
Variables	FR	Non-FR	Difference	t value	p-value
finclimat	0.455	0.454	-0.001	-0.002	0.999
lagfinclassi	6.404	6.483	0.079	-0.323	0.747
laggrowth	4.451	4.495	0.044	-0.178	0.859
lagggdy	41.21	42.82	1.61	-0.992	0.322
lagtradeindex	120.7	120.4	-0.3	0.100	0.920
lagbureaucracy	1.775	1.763	-0.012	0.266	0.790
Number of observations	416	603			

The results of the table (1) show us that there is a difference in average between the group of countries that have adopted at least one fiscal rule and those that have not adopted a fiscal rule. Column (1) represents the averages of the group of countries that have adopted the fiscal rules, and column (2) presents the average of those that have not adopted any fiscal rules. Column (3) shows the difference between columns (2) and (1). The fourth and fifth columns present the results of the t-test and p-value statistics, respectively. The results show us that developing countries

TABLE 3 – Entropy balancing : Baseline model

	1	2	3	4	5	6	7	8
	Baseline	Adding Year	Adding Country	Adding Year /Country	Adding controls	Adding controls/Year	Adding controls/Country	Adding controls/Year /Country
VARIABLES	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp
rule	0.078* (0.047)	0.059 (0.046)	0.045*** (0.014)	0.031** (0.014)	0.064 (0.045)	0.045 (0.046)	0.049*** (0.014)	0.038** (0.015)
l <i>fine_lassi</i>					-0.023*** (0.007)	-0.024*** (0.007)	0.006* (0.003)	0.010*** (0.003)
lggdy					0.002 (0.001)	0.002 (0.002)	0.001 (0.001)	-0.0001 (0.001)
lbureaucracy _{erg}					-0.353*** (0.060)	-0.349*** (0.060)	0.082** (0.041)	0.066** (0.032)
lgrowth					-0.010 (0.006)	-0.007 (0.006)	-0.001 (0.002)	0.003 (0.002)
lterm _{di}					-0.001 (0.000)	-0.001** (0.000)	-0.0001 (0.0002)	0.0002 (0.0002)
Constant	0.377*** (0.027)	0.239*** (0.044)	0.134*** (0.017)	0.122*** (0.021)	1.186*** (0.130)	1.114*** (0.147)	-0.031 (0.118)	-0.093 (0.099)
Observations	1,019	1,019	1,019	1,019	1,019	1,019	1,019	1,019
R-squared	0.003	0.025	0.946	0.960	0.188	0.207	0.947	0.960
Country FE	No	No	Yes	No	No	No	Yes	Yes
Year	No	Yes	No	No	No	Yes	No	Yes

Notes : In this table, we use the entropy balancing method. The treatment variable indicates 1 if the country has adopted at least one fiscal rule and 0 otherwise. The dependent variable is the ratio of inward green investment to GDP. ***p<0.001, **p<0.01, *p<0.05. Standard errors in parentheses.

that have adopted the fiscal rules receive more green finance than those that have not adopted the fiscal rules. The average of the exchange rate regime, Growth, trade index, and debt ratio is lower in countries with fiscal rules than the average in countries without fiscal rules. However, it can be seen from the table (1) that the bureaucracy index is higher in countries with fiscal rules than in countries without fiscal rules. With these descriptive statistics, choosing a reliable control group before estimating the treatment effect (matching approach) is still helpful. If this is not the case, the treatment effect estimated through the fiscal rules on green investments may be biased. Thus, in the table (2), we construct a control group and compare the means of all corresponding covariates in the treatment and control groups created earlier. The results in the table (2) show us that the differences in means between these two groups are statistically insignificant.

Using the control group of the covariate table, we estimate the effect of adopting fiscal rules on green investment. For this, we use weighted least squares regressions. The results are presented in table (16). In column (1), we run a simple regression without adding controls, country, and time-fixed effects. We add the time and country effects in columns (2) and (3). In column (4), we add both the time and country effects to our basic equation (1). In column (5), we add only the control variables. In columns (6) and (7), in addition to the control variables, we add the time and country fixed effects, respectively. Finally, in column (8), in addition to the controls, we add the country and time-fixed effects simultaneously. The results in columns (1) to (8) show that adopting fiscal rules increases climate investment. This effect is positive and significant. Adopting fiscal rules gives fiscal policy management more credibility, and this credibility of the fiscal framework attracts more

climate-friendly investments. This is consistent with the ideas developed in the work of (Cottarelli, 2020; Eyraud *et al.*, 2013; Darvas et Wolff, 2021; Darvas et Anderson, 2020). Also, these results could be justified by the fact that the adoption of fiscal rules sends a positive signal to investors on the economic stability of the country because the rules, through their binding character, confer macroeconomic stability by making the economic environment more attractive to climate-friendly investments. It should also be added that the adoption of the rules allows for a better allocation of resources in the economic sectors, and this contributes to making the different sectors more attractive and favorable to green investments (Darvas et Anderson, 2020; Darvas et Wolff, 2021). Finally, adopting the rules makes it possible to reduce the cost of borrowing on the financial markets because the markets, being reassured of the credibility of the fiscal framework, reduce the cost of borrowing Sawadogo (2020). This means that with the adoption of fiscal rules, the resulting economic stability reduces the cost of borrowing and thus allows developing countries to attract sufficient investors Sawadogo (2020) and mobilize resources to make the economic environment more attractive to green external investment. A major problem for developing countries remains the difficulty of borrowing cheaply on financial markets¹². The adoption of the rules helps reassure financial markets of economic stability and makes it easier for countries to borrow to combat the effects of climate change. The positive and significant effect of fiscal rules on green investments could also be explained by the fact that developing countries, being constantly exposed to the vagaries of climate change, need macroeconomic stability in order to attract more green finance to strengthen their resilience to the effects of climate change. However, to receive massive financing from these donors, they need to reassure international partners of economic stability and credibility in fiscal policy management, without which these donors will be reluctant to invest. Fiscal rules are important because they allow developing countries to have more credibility and stability in macroeconomic aggregates to encourage investors to invest and attract more investment for the climate. These funds can be used to invest in green growth and make the economic environment more conducive to attracting sufficient green and other types of investment.

7.2 Entropy balancing : The effect of different types of fiscal rules

In this section, we present the results of the effect of different types of fiscal rules on green investments in the table (4). This result identifies the fiscal rules likely to attract more green investments in developing countries. In column 1, we present the results of the effect of adopting the rules on green investments. In columns (2) and (3), we present results on the effect of deficit and debt rules on climate-friendly investments. In the last two columns, we present the results of the expenditure rules and the income rules. The results (see table 4) show through column (1) that the adoption of fiscal rules positively and significantly influences green investments. In column (2), the table 4 shows that fiscal rules on the budget deficit increase climate-friendly investments. The effect

12. The studies of Sawadogo (2020) show that developing countries borrow at high costs

TABLE 4 – Robutness checks : Entropy balancing : Types of fiscal rules

	1	2	3	4	5
Variables	Reg1	Reg2	Reg3	Reg4	Reg5
rule	0.038** (0.0151)				
bbr		0.030** (0.0137)			
dr			0.027* (0.0153)		
er				0.003 (0.0219)	
rr					1.805*** (0.0993)
<i>N</i>	1019	1019	1019	1019	1019
r2	.9603	.9603	.9603	.9602	.9602

Notes : In this table, we use the entropy balancing method. The treatment variable(column 1) indicates 1 if the country has adopted at least one fiscal rule and 0 otherwise. The dependent variable is the ratio of inward green investment to GDP. In column 2, we measure the effect of adopting a deficit rule on green investments. In column 3, we measure the effect of adopting a debt rule on green investments. In column 4, we measure the effect of adopting an expenditure rule on green investments. Finally, in column 5, we measure the effect of adopting an income rule on green investments. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Standard errors in parentheses.

is positive and significant. Column (3) of table 4 analyses the link between debt rules and green investments and shows that debt ratio rules increase climate-friendly investments. Their effects are also positive and significant. In column (4), the results of the table 4 show that spending rules do not affect green investments. The procyclicality of the fiscal rules could explain this. Some works(Combes *et al.*, 2017; Bova *et al.*, 2014) show the procyclical character of the rules in developing countries. Also, recent work by Mitsi *et Kottaridi* (2022) analyses the link between expenditure rules and FDI and shows that expenditure rules negatively affect foreign investment. They explain this by the fact that expenditure rules refer to fiscal indiscipline. In column (5) of the table (4), the results show that income rules positively and significantly affect green investment. Apart from expenditure rules, the other rules positively and significantly affect climate investments in developing countries.

8 Sensitivity analysis of results

In this section, we test the robustness of our results. Thus, a model is robust if it is valid under different circumstances. The analysis of the robustness will be done in several steps.

8.1 Robustness : fixed effects and GMM estimator

In order to test the robustness of our results, we proceed by using the fixed effects model and the GMM estimator.

For the fixed effects model, the equation is as follows :

$$GI_{it} = \alpha_0 + \beta FR_{i,t} + \sum_{k=1}^k \Delta X_{i,t} + \eta_i + \gamma t + \epsilon_{it} \quad (3)$$

η_i is the fixed country effect. γt is the fixed effect that capture temporal characteristics and ϵ_{it} is the error term.

GI is the ratio of incoming green investment to GDP. It represents the dependent variable of the model. FR is the treatment variable (Fiscal rules). X is a vector that represents the set of level explanatory variables used in the model. Eta and gamma represent country-fixed effects and time-fixed effects, respectively. Epsilon is the error term. The results in column 1 of the table (5). By incrementally adding the variables corruption, stability, credit, internal conflict, external conflict, democracy index, fiscal balance, foreign direct investment and owid(democracy) index, we find that the adoption of fiscal rules increases green investment.

For the Generalized Moment Method (GMM), the equation is as follows :

$$GI_{it} = \alpha_0 + \beta GI_{i,t-1} + \gamma FR_{i,t} + \sum_{k=1}^k \Delta X_{i,t} + \epsilon_{it} \quad (4)$$

GI represents the dependent variable of the model. It represents the ratio of incoming green investments to GDP. FR represents the treatment variable (Fiscal rules). X is a vector representing the set of explanatory variables used in the model. Epsilon is the error term. The results in column 1 of the table 6 show that fiscal rules positively and significantly affect green investments. Gradually adding the variables : foreign direct investment, Official development assistance, corruption, quality of government, stability, socioeconomic index, oil rents, internal and external conflicts, remittances, inflation targeting, GDP per capita, capital openness, GDP per capita purchasing power parity and inflation we find that the effect of the rules on green investment remains unchanged.

8.2 Robustness : Additional control variables (Entropy)

In order to test the robustness of our results, we add new control variables to see if the model is still robust despite these additions. Column 1 of the table 7 shows us that rules positively and significantly affect green investments. By progressively adding variables such as internal and external conflict, corruption, quality of institutions, investment profile, socio-economic welfare index, and democracy, we find that the effect of rules on green investments is always positive and significant at the 1% level.

13.

(With $i= 1, \dots, N$; $t= 1, \dots, T$).

14.

(With $i= 1, \dots, N$; $t= 1, \dots, T$).

TABLE 5 – Robutness : Fixed effect

	1	2	3	4	5	6	7	8	9	10	11
VARIABLES	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp
rule	0.066** (0.031)	0.066** (0.031)	0.066** (0.031)	0.066** (0.031)	0.084** (0.032)	0.066** (0.031)	0.071** (0.031)	0.067** (0.031)	0.064** (0.031)	0.069** (0.030)	0.065** (0.031)
fine _{lassi}	0.011** (0.005)	0.012** (0.005)	0.012** (0.005)	0.011** (0.005)	0.017** (0.007)	0.011** (0.005)	0.011** (0.005)	0.011** (0.005)	0.011** (0.005)	0.011** (0.005)	0.010** (0.005)
ggdy	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.002* (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)
bureaucracy _{crg}	0.032 (0.062)	0.032 (0.061)	0.033 (0.062)	0.032 (0.062)	-0.028 (0.081)	0.033 (0.061)	0.037 (0.061)	0.035 (0.061)	0.029 (0.062)	0.033 (0.060)	0.066 (0.052)
growth	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.002)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.002 (0.001)	-0.002 (0.001)	-0.002 (0.002)
term _{wdi}	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	0.0001 (0.0002)	-0.0001 (0.0002)
socio _{crg}		0.004 (0.008)									
corruption _{crg}			0.003 (0.013)								
stability _{crg}				-0.002 (0.007)							
credit					0.001 (0.001)						
iconflicts _{crg}						-0.002 (0.007)					
econflicts _{crg}							-0.018* (0.009)				
democracy _{crg}								-0.014 (0.009)			
fly									-0.002 (0.002)		
fdi										0.002 (0.001)	
polity _{wid}											-0.001 (0.002)
Constant	0.184 (0.157)	0.170 (0.156)	0.173 (0.173)	0.209 (0.204)	0.241 (0.194)	0.196 (0.184)	0.358** (0.174)	0.232 (0.156)	0.190 (0.157)	0.173 (0.156)	0.148 (0.147)
Observations	1,006	1,006	1,006	1,006	841	1,006	1,006	1,006	1,003	1,005	998
R-squared	0.318	0.318	0.318	0.318	0.332	0.318	0.321	0.320	0.316	0.321	0.320
Number of idcoun	68	68	68	68	68	68	68	68	68	68	68
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes : In this table, we use the fixed effect model. The treatment variable indicates 1 if the country has adopted at least one fiscal rule and 0 otherwise. The dependent variable is the ratio of inward green investment to GDP.

***p<0.001, **p<0.01, *p<0.05. Standard errors in parentheses.

8.3 Robustness : Change of variable of interest

In this section, we test the robustness of our results by changing the variable of interest by proxy variables of the fiscal rule. For the first case (see table 8, the treatment variable is replaced by a proxy variable which indicates 1 if the fiscal rules are effectively implemented and 0 otherwise. The results (see table 8) show that the new treatment variable positively and significantly affects (columns 1 to 8) climate investments. In the second case, the treatment variable is replaced by a

TABLE 6 – Robustness : GMM

VARIABLES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
L.finclimatgdp	0.222*** (0.030)	0.221*** (0.031)	0.226*** (0.029)	0.222*** (0.030)	0.222*** (0.031)	0.219*** (0.031)	0.222*** (0.030)	0.223*** (0.030)	0.221*** (0.030)	0.223*** (0.030)	0.210*** (0.031)	0.222*** (0.030)	0.223*** (0.030)	0.222*** (0.031)	0.223*** (0.030)	0.224*** (0.031)
rule	0.082** (0.035)	0.081** (0.035)	0.091*** (0.034)	0.080** (0.035)	0.085** (0.037)	0.076** (0.035)	0.081** (0.035)	0.081** (0.035)	0.080** (0.035)	0.082** (0.035)	0.081** (0.035)	0.081** (0.035)	0.081** (0.035)	0.089** (0.036)	0.075** (0.036)	0.077** (0.035)
fine_fassi	0.012*** (0.004)	0.013*** (0.004)	0.011*** (0.004)	0.013*** (0.004)	0.014*** (0.005)	0.012*** (0.004)	0.012*** (0.004)	0.012*** (0.004)	0.012*** (0.004)	0.012*** (0.004)	0.013*** (0.004)	0.012*** (0.004)	0.013*** (0.004)	0.012*** (0.004)	0.012*** (0.004)	0.016*** (0.005)
ggdy	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)	0.003*** (0.001)
bureaucracy_crg	0.130 (0.079)	0.130 (0.079)	0.168** (0.077)	0.125 (0.079)	0.113 (0.087)	0.124 (0.080)	0.128 (0.079)	0.128 (0.080)	0.129 (0.079)	0.130 (0.079)	0.127 (0.079)	0.125 (0.080)	0.128 (0.079)	0.135* (0.081)	0.117 (0.080)	0.137 (0.088)
growth	-0.002 (0.001)	-0.002 (0.002)	-0.002 (0.001)	-0.002 (0.001)	-0.003 (0.002)	-0.002 (0.001)	-0.002 (0.001)	-0.002 (0.001)	-0.002 (0.001)	-0.002 (0.001)	-0.002 (0.001)	-0.002 (0.001)	-0.002 (0.001)	-0.000 (0.007)	-0.002 (0.002)	-0.002 (0.001)
term_e di	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)
fdi	-0.0003 (0.001)															
oda			0.007*** (0.002)													
corruption_crg				0.024 (0.019)												
icrg_gog					0.178 (0.289)											
stability_crg						-0.005 (0.006)										
socio_crg							0.005 (0.014)									
oil								-0.0004 (0.003)								
iconflicts_crg									-0.005 (0.010)							
econflicts_crg										0.001 (0.014)						
remit											0.004 (0.004)					
hard_t												0.023 (0.054)				
gdppcg													-0.002 (0.007)			
kaopen														0.035* (0.021)		
gdppc																0.0003 (0.0002)
inflation																-0.0001 (0.001)
Constant	-0.118 (0.145)	-0.115 (0.146)	-0.232 (0.144)	-0.159 (0.149)	-0.159 (0.176)	-0.063 (0.162)	-0.136 (0.154)	-0.118 (0.146)	-0.063 (0.175)	-0.130 (0.213)	-0.150 (0.148)	-0.112 (0.146)	-0.119 (0.146)	-0.113 (0.147)	-0.133 (0.147)	-0.138 (0.158)
Observations	844	843	844	844	790	844	844	844	844	844	839	844	844	824	844	828
Number of idcoun	67	67	67	67	63	67	67	67	67	67	67	67	67	65	67	67

Notes : In this table, we use the GMM estimator. The treatment variable indicates 1 if the country has adopted at least one fiscal rule and 0 otherwise. The dependent variable is the ratio of inward green investment to GDP.

***p<0.001, **p<0.01, *p<0.05. Standard errors in parentheses.

proxy variable that indicates 1 if the fiscal rule is flexible and 0 otherwise. The results (see table 9) show that this new treatment variable positively and significantly influences green investments. Finally, in the third case, the treatment variable is replaced by a treatment variable that indicates 1 if the rule has been adopted by a legal framework (Parliament) and 0 otherwise. The results (see Table 10) show that this new variable positively and significantly affect (from columns 1 to 8) green investments.

TABLE 7 – Robutness : Additive controls

	1	2	3	4	5	6	7	8
	Reg0	Reg1	Reg2	Reg3	Reg4	Reg5	Reg6	Reg7
VARIABLES	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp
rule	0.038** (0.015)	0.038** (0.015)	0.037** (0.015)	0.039** (0.016)	0.034** (0.017)	0.037** (0.015)	0.039** (0.015)	0.038** (0.015)
lfine _{classi}	0.010*** (0.003)	0.010*** (0.003)	0.010*** (0.003)	0.010*** (0.003)	0.011*** (0.004)	0.010*** (0.004)	0.010*** (0.003)	0.010*** (0.003)
lggdy	-0.0001 (0.001)	-0.0001 (0.001)	-0.0001 (0.001)	-0.0001 (0.001)	-0.0001 (0.001)	-0.0001 (0.001)	-0.0001 (0.001)	-0.0001 (0.001)
lbureaucracy _{icrg}	0.066** (0.032)	0.069** (0.031)	0.068** (0.032)	0.066** (0.031)	0.073** (0.035)	0.065** (0.032)	0.067** (0.031)	0.066** (0.031)
lgrowth	0.003 (0.002)	-0.003 (0.006)	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)
lterm _{wdi}	0.0001 (0.0002)	0.0001 (0.0002)	0.0001 (0.0002)	0.0001 (0.0002)	0.0001 (0.0002)	0.0001 (0.0002)	0.0001 (0.0002)	0.0001 (0.0002)
lexelec	-0.016 (0.013)							
lgdppcg		0.005 (0.006)						
lcorruption _{icrg}			0.013 (0.009)					
lconflicts _{icrg}				-0.003 (0.007)				
lpvr					0.001 (0.001)			
lremit						-0.001 (0.006)		
lsocio _{icrg}							0.005 (0.005)	
ldemocracy _{icrg}								0.002 (0.006)
Constant	-0.091 (0.099)	-0.074 (0.107)	-0.129 (0.108)	-0.063 (0.119)	-0.151 (0.113)	-0.098 (0.102)	-0.103 (0.097)	-0.098 (0.097)
Observations	1,019	1,019	1,019	1,019	977	1,006	1,019	1,019
R-squared	0.960	0.960	0.960	0.960	0.961	0.961	0.960	0.960
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes : In this table, we use the entropy balancing method. The treatment variable indicates 1 if the country has adopted at least one fiscal rule and 0 otherwise. The dependent variable is the ratio of inward green investment to GDP. ***p<0.001, **p<0.01, *p<0.05. Standard errors in parentheses.

8.4 Robustness : The strength of the fiscal rules

In this section, we conduct a robustness test of our model using the strength of the fiscal rules. This variable is computed using the procedure of rule adoption, the character of the rules, the flexibility, the implementation, and the nature of the rules. The results show that the strength of the rules positively and significantly affects green investment. In column 1, we keep only the treatment variable and green investments. In column 2, we add the country-fixed effects. In column 3, we add time-fixed effects. In column 4, we add country and time-fixed effects simultaneously. In column 5, we add controls only. In column 6, we add controls and country-fixed effects. In column 7, we add controls and time-fixed effects. Finally, in column 8, we add controls, country-fixed effects, and time-fixed effects. From columns 1 to 8, we find (see table 11) that the strength of the rules has a positive and significant impact on climate investments.

8.5 Robustness : Alternative

In the alternative robustness section, we test the robustness of our results across different factors : In column (1) of the table(12), we only consider countries with an inflation rate below 40% . The results show that the effect of the rules on green investment is always positive and significant. In column (2), we exclude the financial crisis years of 2008 and 2009 from the sample. The results remain unchanged. In column (3) of the table (12), We only consider years after 1993 because the rules came into being in the 1990s, and their effects are visible in the medium and long term. By considering only the years after 1993, we want to know the effect of the rules after their adoption. The results show that the rules still have a positive and significant effect on climate investments. In column (4), we consider only the least developed countries in the sample. The results show that there is a positive and significant effect between the adoption of rules and green investments. In column (5), we exclude the years 2019 and 2020 ; in column (6), we only consider the years below 2020 to consider the Covid19 effect. The results show that in these two columns, the effect of the rules on green investment is still positive and significant. Finally, in column (7), we only consider countries that have adopted inflation targeting. The results show that the rules positively and significantly affect green investments.

8.6 Change in estimation method and treatment variable

In this section, we test the robustness of our results by changing the estimation method. It is an alternative matching method, "Mahalanobis distance matching.". It is a method that compares each treated unit with the closest control unit in terms of distance. The treatment variable is replaced by another proxy variable that captures the strength of the fiscal rules. Indeed, some work [King et Nielsen \(2019\)](#) show, for example, the limitations of using propensity scores for matching. The study [King et Nielsen \(2019\)](#) suggests instead the use of a potentially more robust method, which is the Mahalanobis Distance Matching method. Following this proposal, we use the

TABLE 8 – Robutness : Enforcement rule

	1	2	3	4	5	6	7	8
	Baseline	Adding Year	Adding Country	Adding Year/Country	Adding controls	Adding controls/Year	Adding controls/Country	Adding controls/Year/Country
VARIABLES	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp
enforcement	0.761*** (0.157)	0.741*** (0.156)	0.323*** (0.101)	0.296*** (0.075)	-0.158 (0.208)	-0.173 (0.202)	0.290*** (0.104)	0.324*** (0.085)
l <i>fine_lassi</i>					-0.024*** (0.006)	-0.025*** (0.006)	0.006* (0.003)	0.010*** (0.003)
lggdy					0.002 (0.001)	0.002 (0.001)	0.001 (0.001)	-0.000 (0.001)
lbureaucracy, <i>cr</i> g					-0.360*** (0.065)	-0.355*** (0.064)	0.075* (0.041)	0.059* (0.031)
lgrowth					-0.011* (0.006)	-0.007 (0.007)	-0.001 (0.002)	0.002 (0.002)
l <i>term_wdi</i>					-0.0001 (0.0002)	-0.001** (0.0002)	-0.0001 (0.0002)	0.0001 (0.0002)
Constant	0.372*** (0.028)	0.227*** (0.041)	0.134*** (0.017)	0.121*** (0.021)	1.250*** (0.144)	1.164*** (0.157)	-0.031 (0.117)	-0.091 (0.098)
Observations	1,019	1,019	1,019	1,019	1,019	1,019	1,019	1,019
R-squared	0.018	0.040	0.946	0.960	0.186	0.207	0.947	0.961
Country FE	No	No	Yes	Yes	No	No	Yes	Yes
Years	No	Yes	No	Yes	No	Yes	No	Yes

Notes : In this table, we use the entropy balancing method. The treatment variable indicates 1 if the country has adopted the enforcement rule and 0 otherwise. The dependent variable is the ratio of inward green investment to GDP. ***p<0.001, **p<0.01, *p<0.05. Standard errors are in parentheses.

TABLE 9 – Robutness : Flexibility rule

	1	2	3	4	5	6	7	8
	Baseline	Adding Year	Adding Country	Adding Year/Country	Adding controls	Adding controls/Year	Adding controls/Country	Adding controls/Year/Country
VARIABLES	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp
flexibility	0.170*** (0.060)	0.154*** (0.059)	0.039*** (0.015)	0.027 (0.017)	0.113* (0.062)	0.095 (0.062)	0.040*** (0.015)	0.035** (0.017)
l <i>fine_lassi</i>					-0.020** (0.008)	-0.021*** (0.008)	0.006* (0.003)	0.010*** (0.003)
lggdy					0.002 (0.001)	0.002 (0.001)	0.001 (0.001)	-0.0001 (0.001)
lbureaucracy, <i>cr</i> g					-0.356*** (0.060)	-0.351*** (0.060)	0.081* (0.041)	0.065** (0.032)
lgrowth					-0.010 (0.006)	-0.006 (0.007)	-0.001 (0.002)	0.002 (0.002)
l <i>term_wdi</i>					-0.001 (0.0002)	-0.001** (0.0002)	-0.0001 (0.0002)	0.0001 (0.0002)
Constant	0.361*** (0.021)	0.228*** (0.044)	0.134*** (0.017)	0.121*** (0.021)	1.178*** (0.125)	1.103*** (0.143)	-0.031 (0.118)	-0.095 (0.099)
Observations	1,019	1,019	1,019	1,019	1,019	1,019	1,019	1,019
R-squared	0.013	0.034	0.946	0.960	0.191	0.210	0.947	0.960
Country FE	No	No	Yes	Yes	No	No	Yes	Yes
Years	No	Yes	No	Yes	No	Yes	No	Yes

Notes : In this table, we use the entropy balancing method. The treatment variable indicates 1 if the country has adopted the flexibility rule and 0 otherwise. The dependent variable is the ratio of inward green investment to GDP. ***p<0.001, **p<0.01, *p<0.05. Standard errors are in parentheses.

Mahalanobis Distance Matching method to test the robustness of our basic results. We progressively add the control variables electoral weight, growth, primary balance, capital openness, the binary variable on emerging countries, and the corruption variable to the basic model to see if our model

TABLE 10 – Robutness : Legal basis rule

	1	2	3	4	5	6	7	8
	Baseline	Adding Year	Adding Country	Adding Year/Country	Adding controls	Adding controls/Year	Adding controls/Country	Adding controls/Year/Country
VARIABLES	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp
<i>legal_basis2</i>	0.091* (0.050)	0.068 (0.048)	0.028** (0.013)	0.025* (0.013)	0.038 (0.042)	0.015 (0.042)	0.032** (0.013)	0.031** (0.015)
<i>lfiue_lassi</i>					-0.023*** (0.007)	-0.024*** (0.007)	0.006* (0.003)	0.010*** (0.003)
<i>lggdy</i>					0.002 (0.001)	0.002 (0.001)	0.001 (0.001)	-0.0001 (0.001)
<i>lbureaucracy_crg</i>					-0.352*** (0.059)	-0.348*** (0.059)	0.081* (0.041)	0.065** (0.031)
<i>lgrowth</i>					-0.010 (0.006)	-0.006 (0.007)	-0.001 (0.002)	0.003 (0.002)
<i>lterm_wdi</i>					-0.001 (0.000)	-0.001** (0.0001)	-0.0001 (0.0002)	0.0001 (0.0002)
Constant	0.377*** (0.025)	0.243*** (0.043)	0.134*** (0.017)	0.122*** (0.021)	1.207*** (0.128)	1.132*** (0.145)	-0.027 (0.118)	-0.089 (0.099)
Observations	1,019	1,019	1,019	1,019	1,019	1,019	1,019	1,019
R-squared	0.004	0.025	0.946	0.960	0.186	0.206	0.947	0.960
Country FE	No	No	Yes	Yes	No	No	Yes	Yes
Years	No	Yes	No	Yes	No	Yes	No	Yes

Notes : In this table, we use the entropy balancing method. The treatment variable indicates 1 if the country has adopted the legal basis rule and 0 otherwise. The dependent variable is the ratio of inward green investment to GDP. ***p<0.001, **p<0.01, *p<0.05. Standard errors are in parentheses.

TABLE 11 – Robutness : Strength of fiscal rules

	1	2	3	4	5	6	7	8
	Baseline	Adding Year	Adding Country	Adding Year/Country	Adding controls	Adding controls/Year	Adding controls/Country	Adding controls/Year/Country
	rule2	rule2	rule2	rule2	rule2	rule2	rule2	rule2
	0.212*** (0.0556)	0.090*** (0.0272)	0.188*** (0.0503)	0.061** (0.0241)	0.097** (0.0471)	0.089*** (0.0236)	0.068* (0.0405)	0.067*** (0.0228)
N	1019	1019	1019	1019	1019	1019	1019	1019
r2	.0207	.9528	.0409	.9637	.216	.9537	.2421	.9651
Country FE	No	No	Yes	Yes	No	No	Yes	Yes
Years	No	Yes	No	Yes	No	Yes	No	Yes

Notes : In this table, we use the entropy balancing method. The treatment variable indicates the strength of fiscal rules. The dependent variable is the ratio of inward green investment to GDP. ***p<0.001, **p<0.01, *p<0.05.

Standard errors are in parentheses.

is still robust under different circumstances. The results (see table 13) show us that there is still a positive and significant link between the strength of fiscal rules and green investments.

9 Heterogeneity

We perform the heterogeneity analysis on institutional (political counterweight, quality of institutions, democracy, quality of government) and macroeconomic (growth and natural resource rents) variables.

TABLE 12 – Robutness : Alternative

	1	2	3	4	5	6	7
VARIABLES	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp	finclimatgdp
rule	0.040*** (0.015)	0.035** (0.016)	0.038** (0.015)	0.038** (0.015)	0.038** (0.015)	0.038** (0.015)	0.036*** (0.010)
lfine _{classi}	0.010** (0.004)	0.008** (0.003)	0.010*** (0.003)	0.010*** (0.003)	0.010*** (0.003)	0.010*** (0.003)	0.000 (0.001)
lggdy	-0.000 (0.001)	0.001 (0.001)	-0.0004 (0.001)	-0.0003 (0.001)	-0.0006 (0.001)	-0.0008 (0.001)	0.001*** (0.000)
lbureaucracy _{icrg}	0.075** (0.033)	0.077** (0.033)	0.066** (0.032)	0.066** (0.032)	0.066** (0.032)	0.066** (0.032)	0.063*** (0.015)
lgrowth	0.003* (0.002)	0.004* (0.002)	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)	0.003 (0.002)	-0.0004 (0.001)
lterm _w di	0.0001 (0.0002)	0.0001 (0.0002)	0.0001 (0.0004)	0.0001 (0.0005)	0.0001 (0.0003)	0.0001 (0.0002)	0.0003 (0.0001)
Constant	-0.112 (0.105)	-0.149 (0.091)	-0.093 (0.099)	-0.093 (0.099)	-0.093 (0.099)	-0.093 (0.099)	-0.210*** (0.036)
Observations	987	889	1,019	1,019	1,019	1,019	223
R-squared	0.962	0.960	0.960	0.960	0.960	0.960	0.975
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes : In this table, we use the entropy balancing method. The treatment variable indicates 1 if the country has adopted the fiscal rule and 0 otherwise. The dependent variable is the ratio of inward green investment to GDP.

***p<0.001, **p<0.01, *p<0.05. Standard errors are in parentheses.

TABLE 13 – Robutness : Mahalanobis distance matching

ATT : FR and GI	1	2	3	4	5	6	7
Mahalanobis1 Mahalanobis2 Mahalanobis3 Mahalanobis4 Mahalanobis5 Mahalanobis6 Mahalanobis7							
rule2	0.3127*** (0.0484)	0.2810*** (0.0705)	0.3203*** (0.0528)	0.3404*** (0.0541)	0.3618*** (0.0450)	0.3028*** (0.0490)	0.2943*** (0.0554)
N	1019	866	1019	1015	996	1019	1019

Notes : In this table, we use the Mahalanobis distance matching method. The treatment variable indicates the strength of fiscal rules. The dependent variable is the ratio of inward green investment to GDP. ***p<0.001,

**p<0.01, *p<0.05. Standard errors are in parentheses.

TABLE 14 – Heterogeneity

	1	2	3
VARIABLES	finclimatgdp	finclimatgdp	finclimatgdp
rule	0.027* (0.016)	0.083*** (0.022)	0.028* (0.016)
FR _{growth}	0.108** (0.050)		
growth	-0.004** (0.002)		
lfine _{lassi}	0.009*** (0.003)	0.010*** (0.003)	0.012*** (0.004)
lggdy	0.0002 (0.001)	-0.0002 (0.001)	-0.0002 (0.001)
lbureaucracy _{icrg}	0.058* (0.032)	0.072** (0.032)	0.061** (0.029)
lgrowth	0.003* (0.002)	0.002 (0.002)	0.003 (0.002)
lterm _{wdi}	0.0004 (0.0002)	0.0004 (0.0002)	0.0004 (0.0002)
FR _{rents}		-0.060*** (0.020)	
rents		0.002 (0.003)	
FR _{icrg_{qog}}			0.052* (0.030)
icrg _{qog}			0.332*** (0.121)
Constant	-0.069 (0.099)	-0.147 (0.138)	-0.236* (0.123)
Observations	1,019	1,019	956
R-squared	0.961	0.961	0.961
Country FE	Yes	Yes	Yes
Year	Yes	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

1- Heterogeneity according to the quality of the institutions

The quality of institutions is a factor that investors highly scrutinize in a country's business environment. Beyond the fact that it influences the decision of investors to settle in a country, it reinforces the reliability of the entrepreneurial ecosystem and reassures economic partners. Numerous studies ([Gwartney et al. \(2006\)](#); [Yang et al. \(2023\)](#)) show the positive effects of institutional quality on growth and green investment. For this analysis, we use an index calculated by the ICRG that captures institutional quality to analyze heterogeneity. In column 3 of the table 14, we find that fiscal rules positively affect green investments and in the presence of high institutional quality, this effect is amplified. These results corroborate with those obtained by ([Issoufou et Ouattara \(2011\)](#); [Ren et al. \(2022\)](#)), which highlight the important contribution of institutional quality to the attractiveness of green investments.

2- Heterogeneity according to natural resource endowment

We analyze the effect of fiscal rules on green investment as a function of natural resource endowment. The results in column 2 of the table 14 show that rules affect green investments, but with high resource rents, the effect of rules on green investments is mitigated. This could be because developing countries endowed with many natural resources often mismanage these resources. Also, there is a shift from other sectors of the economy to the natural resource sector which could also explain this attenuation of the effect of fiscal rules. Good management of natural resources could better contribute to mobilizing sufficient resources to combat the effects of climate change.

3- Heterogeneity according to economic performance

The analysis in this section is based on the economic performance of countries. Indeed, economic performance is an essential factor in the attractiveness of investments in general. This is even more true for green investments. Investors invest more in countries with solid economic performance, which will likely yield a better return on investment. The results in column 1 of the table (14) show that fiscal rules positively affect green investments, and this effect is amplified in the presence of strong economic performance. This could be explained by the fact that, beyond the credibility conferred by the rules, a solid economic performance reassures investors and contributes to attracting massive investments in favor of the climate. The work of [Wan et Sheng \(2022\)](#) shows the link between green investments and economic performance and underlines the importance of green investments in economic growth.

10 Transmission channel validation

Inspired by the work of [Neuenkirch et Neumeier \(2016\)](#), we use the same method to test our transmission channels. Indeed, we find through the descriptive statistic that there is a slight dif-

ference in the mean between the control and treated groups. In this study, we identify growth, inflation targeting, primary balance, fiscal balance, debt rating, GDP per capita, and fixed regime as factors through which fiscal rules affect green financing. This study aims to analyze the effect of fiscal rules on green financing. The results below show that average growth in the presence of the fiscal rules is lower than before the adoption; the difference is statistically highly significant ($t = 3.3222$; $p\text{-value} = 0.0009$). For inflation targeting, the average when the rules are adopted is higher than the average before adopting the fiscal rules, the difference being statistically very significant ($t = -9.2804$; $p\text{-value} = 0.0000$). The average fiscal balance in the presence of the adoption of the fiscal rules is lower than in the period before the adoption of the rules, the difference being statistically highly significant ($t = 3.4937$; $p\text{-value} = 0.0005$). For the primary balance, the results show that the average before the adoption of the rules is higher than in the period with the fiscal rules, the difference still being statistically highly significant ($t = 3.1352$; $p\text{-value} = 0.0017$). The average debt rating before adopting the fiscal rules is lower than that observed in the presence of the fiscal rules, with the difference between the two still statistically significant ($t = -2.3449$; $p\text{-value} = 0.0192$). On the other hand, for GDP/H, the results show that the average before the adoption of the rules is higher than that observed in the period of the fiscal rules with a statistically significant difference ($t = 2.0186$; $p\text{-value} = 0.0437$). Finally, the mean of the fixed exchange rate regime variable is higher in the presence of the rules than that observed before adopting the fiscal rules, with the difference being statistically highly significant ($t = -7.1435$; $p\text{-value} = 0.0000$). Growth, inflation targeting, primary balance, fiscal balance, debt rating, GDP/H, and fixed exchange rate regime are transmission channels through which fiscal rules affect climate-friendly investment.

Variables	Growth	Hard-it	Fiscal balance	Primary balance	Sovereign debt	GDP per capital	Regime
Before FR adoption	4.349698	.133	-1.770138	.0187243	10.12991	2.471264	.1736909
During FR	3.525141	.3181818	-2.788337	-.7821559	10.59572	1.98096	.349345
Control group	4.609513	.1662859	-1.262876	0.3303537	10.52494	2.581666	.2195666

11 Conclusion

This analysis aims to study the causal effect of fiscal rules on green investments from 2000 to 2020. Two hypotheses are at the heart of this study: The first hypothesis states that the adoption of fiscal rules increases green investments, and the second hypothesis relates to the ability of different types of fiscal rules to attract climate-friendly investments. The results are robust and show that adopting fiscal rules increases green investments. This effect is positive and significant. Apart from expenditure rules, fiscal rules on deficit, debt, and income increase green investment. The results confirm the two hypotheses stated. The study of transmission channels showed that economic performance, primary balance, fiscal balance, inflation targeting, sovereign debt rating, and fixed exchange rate regime as the main factors through which fiscal rules affect climate-friendly investments. Further analysis of the study shows that in the presence of good economic performance, a high level of political checks and balances, better quality institutions, an excellent democratic

culture, and a stable government, fiscal rules' positive and significant effect on green investments is amplified. On the other hand, this effect is attenuated in the presence of a high level of natural resource rents.

This study makes four main contributions : First, it contributes to the literature on analyzing the effect of fiscal rules on green investments in developing countries. Second, this study is distinctive in identifying the transmission channels through which fiscal rules affect green investments. Third, this analysis contributes to the literature through innovative methods like entropy balancing. Finally, this study makes a significant contribution through the policy implications.

In terms of economic policy implications, it is desirable that countries consider the challenges of climate change in developing economic policies. Implementing social programs is paramount as these programs provide immediate responses and help build resilience to the effects of climate change rapidly. It is also essential for developing countries to put in place a green initiative (green investment fund). This initiative is a kind of debt contracted by each economic zone or monetary union to finance climate change adaptation and mitigation strategy. This debt could be repaid according to each country's economic weight within the economic zone or monetary union. This enshrines the principle of solidarity between member countries and allows the development of a common strategy to combat the effects of climate change. It is also recommended that countries that have not yet adopted fiscal rules put in place on inflation and budget deficit to reassure investors on the management of fiscal policy and thus quickly mobilize resources to fight against the effects of climate change. In order to stimulate green investments, it helps developing countries lower the cost of borrowing through a program to strengthen the credibility of economic agents. This will allow individual economic agents to borrow easily from the financial market and banking institutions to finance their green transition. However, the implementation of such schemes must be highly restrictive and must be supervised in order to avoid free-riding situations. Building countries' capacities require significant investments and an obligation to achieve results to be more effective. A carbon pricing policy will also help to stimulate green investments in developing countries. In order to boost green investment, countries need to ensure that they have a dynamic and sustained economic performance, sound quality institutions, a stable and accountable government aware of climate issues, and good political and macroeconomic stability.

Developing countries could also favor the "green act certificate." This initiative allows economic actors to prove through actions their involvement in the management and protection of the environment in exchange for a certificate that can be used to raise green capital in the financial markets. The initiative falls within the framework of corporate social responsibility. Through the green act certificate, companies can also finance environmental protection and management projects in return for the certificate. This initiative allows governments to control better and limit environmental degradation.

The other innovative instrument is the polluter country guarantee. This is a sovereign guarantee (from major polluting countries to developing countries that are most affected by the effects of climate change) on the financing of public and private investments in environmental protection and management. This will also help to mobilize sufficient resources to combat the effects of climate change. This solution will boost green investments in developing countries.

Finally, taxation should be introduced in local value chains (cotton, wood, cocoa, cashew nuts, in short, all cash resources) to enable developing countries producing these resources to benefit from the profits generated by these value chains in order to finance the resilience of countries to the effects of climate change.

To further explore the effects of fiscal rules on green investments, it is desirable to explore the possibilities of a study focusing on the neighborhood effects of fiscal rules. Also, it is helpful to extend the reflection on the effects of the effectiveness of green investments in developing countries.

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TABLE 15 – Statistique descriptive

Variables	Observations	Moyenne	SD	Min	Max
finclimat	1,244	.4919163	1.028903	.0019776	10.6904
rule	1,638	.3894994	.4877857	0	1
fineclassi	1,241	6.811442	3.905525	1	15
Growth	1,636	4.028141	4.911483	-36.65815	53.38179
hardit	1,638	.2051282	.4039186	0	1
Bureaucracy	1,398	1.763919	0.7519254	0	4
Trade index	1,638	119.8824	39.26822	21.39672	290.9305
ggdy	1,595	51.31518	46.75327	1.562	600.13

TABLE 16 – Description

Variables	Description	Source
Green investments	The green investment data in this study is the ratio of the sum of all incoming (climate) finance to GDP	OECD
Finclassique	is an index that captures the exchange rate regime. The higher it is, the more flexible the exchange rate regime	Reinhart et al. (2017)
Growth	This variable captures the positive change in the production of goods and services in an economy over a given period, usually a long period	WDI
Debt/GDP	Debt measures the total outstanding direct fixed-term contractual obligations of the government to others outstanding at a given date. It includes domestic and external liabilities such as cash and deposits, securities other than shares and loans	WDI
Fiscal rules	is a binary variable that indicates 1 if the country has adopted at least one fiscal rule and 0 otherwise	FMI
Harditi	is an index that captures 1 if the country has adopted inflation targeting and 0 otherwise	Roger (2009) ; Rose (2007) ; Tapsoba (2012) ; Jahan (2012)
Bureaucracy	is an index that captures the quality of institutions	ICRG
Trade index	is the ratio of an index of a country's export prices to an index of its import prices.	WDI