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Abstract

We analyze the impact of natural resource discoveries on fiscal policy, focussing on the effects of expectations due to the discovery of large oil and gas deposits. The response of fiscal policy to resource discoveries is analyzed through changes in its cyclicality. To do this, we use a Local Projection method on two country-groups: high- and upper-middle-income countries (HMICs) and low- and lower-middle-income countries (LMICs) over the period 1984-2012. Our results show that natural resource discoveries do drive a fiscal policy response in HMICs and LMICs. Indeed, following the announcement of a natural resource discovery, we observe, around the first year after the discovery, the beginning of an increasing contracyclicality in total public spending in the HMICs. This contracyclicality is stronger in the presence of fiscal rules, and the response of fiscal policy is faster in the presence of good institutions. Overall HMICs have a disciplined response to a shock of natural resource discoveries. However, for LMICs, discovery shocks have different effects depending on the type of public spending: for public consumption expenditure, there is an increasing procyclicality starting from the first year after discovery, whereas for public investment expenditure, this procyclicality begins in the second year after discovery, after a slight contracyclicality before. These results are robust to different sample sizes, different specifications and various measures of the cyclicality coefficient.

Keywords: Natural resources discoveries, Fiscal policy, Institutions, Fiscal rules, Local projections

JEL Codes: E02, E62, H87, O13, P4, Q3

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1 Introduction

Natural resources are often seen either as a blessing or as a curse for countries. The literature provides arguments in both directions. For example, natural resources are found to slow economic growth in resource-rich developing countries (Van der Ploeg, 2011; Venables, 2016), to limit export diversification (Ross, 2017), to favor exchange rate appreciation (Stokke, 2007) or to diminish foreign investment in non-resource sectors (Poelhekke and van der Ploeg, 2013). They can also be associated with positive effects on the economy of resource-rich countries generating small government debt and low inflation (Fasano, 2002), high public expenditure on education (Sarraf and Jiwanji, 2001) or economic growth (Larsen, 2006).

Hence, most of the literature is built on the direct impact of natural resources exploitation and production on a country's economic development and growth, or on its economic policies. Very little work has been done on the impact of natural resource discoveries themselves on the economy (Arezki et al., 2017). These resource discoveries can have short-run (and sometimes longer-run) economic and financial effects before windfalls start, herding the business cycle.

In this study we focus on the impact of the discovery itself on the economy. Natural resource discoveries can indeed be considered as news shocks, i.e., the announcement of news about a resource discovery can generate expectations at the level of the economy that can impact the economic cycle through the anticipations of economic agents, and this can happen even before the start of resources exploitation. Therefore, by studying resource discoveries, the mechanism at play in this paper works through expectations of future revenues associated to discoveries, rather than revenues themselves (i.e. there is a delay of several years between the announcement of a resource discovery and the moment the resource production starts and rents are obtained). Hence the anticipation effect plays a crucial role in the analysis.

A historical example (Arezki et al., 2017) of the impact of natural resource discoveries on the economy is Norway, where, following the first oil discoveries in the North Sea in the 1960s and 1970s, the anticipation of greater future production led to an increase in investment and a fall in the savings rate, leading to a current account deficit, approaching 15 per cent of GDP at its lowest level in 1977. Following these discoveries, the country also saw its debt increasing significantly to finance its oil installations (Arezki, Ramey, and Sheng, Arezki et al.).

Overall, only very few studies exploit the effect of the resource discoveries themselves on the economy (Arezki et al., 2017; Bhattacharyya et al., 2017). If they do, they focus on the response of macroeconomic aggregates (such as savings rate, investment, GDP, etc.) to natural resource discoveries.

In this paper, we put a focus on different types of exhaustible resource discoveries (oil, gas) while considering a specific macroeconomic policy that can be impacted: the fiscal policy. If the latter has been discussed and analyzed in relation to resource windfalls or rents, or to the creation of sovereign wealth funds, a work on the definition and dynamics of fiscal policy in the presence of resource discoveries only is missing.

Hence the major contribution of our study is to analyze the impact of resource discoveries on a specific economic policy, namely the fiscal policy. We choose to investigate this policy in particular as the announcement of an arrival of large amounts of financial resources in the economy, in relation to natural resources discoveries, directly concerns the government's budget and may impact the government current expenditure and revenue policy. In fact, the question of fiscal policy's reaction to a natural resource discovery is crucial as it can be connected to the emergence of permanent budget deficits, and to the sustainability of sovereign debt. Thus, the analysis of the effects on fiscal policy of a future abundance perception due to the resources discoveries, is essential for decision-makers and remains rather unexploited in the literature.

We aim to fill in the gap and analyze the impact of natural resource discoveries on the definition and evolution of fiscal policies, exploring the effect of expectations due to the discovery of large oil and gas deposits. The response of fiscal policy to natural resource discoveries is analyzed through changes in the cyclicality of fiscal policy. The effect of natural resource discoveries is also assessed in interaction with countries' institutional quality and the presence of fiscal rules. To do this, we use the Local Projections (LP) method on two countr-groups: high-income and upper-middle-income countries (HMICs) and low- and lower-middle-income countries (LMICs) over the period 1984-2012. Our results show that natural resource discoveries do drive a fiscal policy response in the analyzed countries. Indeed, following the announcement of a natural resource discovery, we observe, around the first year after the discovery, an increasing contracyclicality in total public spending in the HMICs. This contracyclicality is stronger in the presence of fiscal rules, and the fiscal policy response is faster in the presence of good institutions. Thus, the HMICs seem to have a disciplined response to a natural resource discovery shock. However, for LMICs, discovery shocks have different effects depending on the type of public spending. For the public consumption expenditure, there is an increasing procyclicality since the first year after discovery, whereas for public investment expenditure this tendency begins in the second year after discovery, after a slight contracyclicality between the date of discovery and the second year.

These results are robust to different sample sizes, different specifications and various measures of the cyclicality coefficient.

The rest of the work will structured as follows: section 2 presents the literature review motivating our intuitions, section 3 describes and justifies the methodology used, section 4 presents the results, section 5 details the robustness tests and section 6 concludes.

2 Literature Review

Several strands of the literature can be considered. The idea of expectations due to the discovery of natural resources is in line with the existing literature on the determinants of economic cycles. The latter is dominated by the reincarnation of the "Pigouvian" hypothesis (Pigou 1927) according to which economic cycles are determined by agents' expectations. Undoubtedly, this hypothesis, due to the seminal work of Beaudry and Portier (2006), has become one of the most important topics of debate in macroeconomics. Using data from the United States, Beaudry and Portier (2006) provide a broader understanding of the role of expectations in business cycle fluctuations. To do so, they exploit the movement in stock prices in conjunction with movements in total factor productivity.

According to their results, a large share of business cycle fluctuations can be triggered by changes in expectations, but these changes may well be based on fundamentals as they anticipate future changes in productivity. In sum, their study has inspired the literature on the role of expectations in explaining economic cycles[1].

A vast literature on the role of expectations in macroeconomic fluctuations in general is also available. Whatever the causes of economic agents' expectations, they generally relate to changes in future productivity. But given the difficulty of identifying structural shocks that may be at the root of fluctuations in business cycles, the literature has gradually moved towards the analysis of news shocks: agents' expectations are considered the result of news that reach them. This justifies the recurrence of the term "news shock" in this literature. More precisely, the question is whether business cycles are driven by news shocks. A large number of theoretical works focus on the expansion of neoclassical models by introducing news shocks. However, empirical studies generally use VAR models to analyze the role of news shocks in explaining business cycles. On the basis of the existing literature, it appears that very few studies exist on the impact of news about natural resource discoveries on macroeconomic fluctuations, via macroeconomic aggregates. This is the case, for example, of Arezki et al. (2017), who analyze the dynamic impact of the discovery of large oil deposits on the current account and macroeconomic aggregates such as employment; GDP; investment and savings. Using a sample covering the period 1970-2012 for about 130 countries and using a dynamic panel model with distributed lag, the authors conclude that following the announcement of the discovery of large oil reserves, the current account balance and savings deteriorate immediately while investment increases. Then after the start of production, these variables improve with the GDP. However employment begins to fall as soon as the news is announced, but at a decreasing rate in the years following the announcement. Similar results are found by Toscani (2017) who focuses on a smaller sample, namely countries of Latin America.

Our study aims to contribute to the literature by analyzing the expectations' role in relation to

[1]An example that can be likened to this idea is the 1999-2001 expansion-recession cycle in the United States. Many economic observers argue that during this period, the high growth rates of 1999 and 2000 were, to a large extent, the consequences of agents' optimistic expectations about the future, while a revision of these expectations led to the economic slowdown of 2001.

natural resource discoveries, within the framework of fiscal discipline.

We assess the impact of natural resource discoveries on fiscal policy through changes in the cyclicality of fiscal policy in reaction to a discovery shock. In the literature on fiscal policy, there are studies that underline the counter-cyclical character of this policy (Larsen, 2006; Sarraf and Jiwanji, 2001), i.e. countries are recommended to reduce spending and debt during periods of high economic cycle growth and then increase spending in order to stimulate the economy in times of economic difficulty or downturn. However, the literature also shows that fiscal policy is not always counter-cyclical in many countries. Many studies link the procyclicality of fiscal policy to the socio-political interests of policymakers. In fact, according to the political-fiscal cycle models, three main behaviours are identified: first, a government may initiate an expansionary fiscal policy with a view to re-election, in the run-up to elections, without taking into account the economic cycle (Persson and Svensson, 1989). Second, a government may consciously pursue a policy of massive indebtedness in order to undermine the governance of its opponent successor (Alesina and Tabellini, 1990; Persson and Svensson, 1989). Finally, the work of Tornell and Lane (1999) highlights the "voracity effects" to explain the procyclicality of fiscal policy. In reality, public spending can be motivated and directed by the interests of several interest groups close to the government, and this phenomenon can be more accentuated in periods of export boom.

Thus, it seems that positive shocks to the government budget can lead to greater procyclicality in fiscal policy in some countries. This is true in the sense that a procyclicality in fiscal policy is very present in some resource-rich countries such as the Gulf monarchies. Thus, the discovery of natural resources, such as a positive exogenous shock, could lead to a similar behavior among policymakers even before the exploitation begins. However, this will depend in particular on the existence of fiscal rules and/or good institutions. In fact, one solution proposed by the literature to fight against the procyclicality of fiscal policy is the introduction of fiscal rules. Schaechter et al. (2012) describe fiscal rules as "agreements to mitigate deficit bias and promote fiscal discipline by limiting fiscal aggregates through numerical limits". In the context of the 2008 financial crisis and the debt crisis, there has been growing interest in fiscal rules, with more than 90 countries adopting fiscal rules today (IMF, 2015) compared with 10 in the 1990s. The role of fiscal rules is to promote fiscal discipline: in this framework we can expect the presence of fiscal rules to enhance fiscal discipline in the context of resource discovery shocks.

Nevertheless, the literature on fiscal rules has criticized their effectiveness by underlying their rigidity and/or lack of enforcement. In this sense, many studies focus on the way fiscal rules can actually be used to become more effective. Based on country experiences, Eyraud et al. (2018) describe second-generation fiscal rules, characterized by three main properties: simplicity, flexibility, and enforceability. Indeed, the authors argue that fiscal rules should be adapted to country specific situations, have broad institutional coverage, be closely linked to fiscal sustainability objectives, be easy to understand and control, and support counter-cyclical fiscal policy. Other studies link the effectiveness of fiscal rules to structural factors such as institutions and exchange rate regimes. Keita and Turcu (2019) demonstrate that fiscal rules alone are not sufficient to promote fiscal discipline; they must be combined with strong institutions to be efficient. The authors also find that fiscal rules better limit procyclicality in flexible exchange rate regimes compared with fixed exchange rate regimes and that the discipline effect of rules differs across different types of rules (expenditure rules, fiscal balance rules, debt rules, or revenue rules).

With regard to the institutional quality, a large body of the literature underlines its key role in the setting and proper functioning of economic, social and environmental policies (MacLeod, 2013; Gholipour and Farzanegan, 2018; Roy and Tisdell, 1998). Thus, one might expect a country's fiscal policy response to a natural resource discovery shock to be more disciplined in the presence of fiscal rules and/or good institutions.

Accordingly, we try to answer the following questions: (*Q1*) What is the effect of expectations due to the discovery of natural resources on the cyclicality of fiscal policy? Can the perception of future abundance due to the discovery of natural resources lead countries to deviate from fiscal discipline? (*Q2*) Does the presence of fiscal rules and/or good institutions promote good fiscal governance in the presence of a natural resource discovery shock?

3 Methodology

Identifying and assessing the relevance of news shocks has long been a challenge in the literature due to the difficulty of measuring the expectations of economic agents. This literature is largely built on the structural estimation of dynamic stochastic general equilibrium (DSGE) models and structural vector autoregressive (SVAR) models, characterized by numerous hypotheses that are the subject to debate (Beaudry and Portier, 2014). The use of resource discoveries to assess news shocks is recent (Arezki et al., 2017; Bhattacharyya et al., 2017) and plausible since resource discoveries have characteristics that allow to avoid many of the assumptions used in VAR approaches. First of all, a natural resource discovery corresponds to a significant future increase in production; in fact, the identification of agents' expectations requires a shock of great magnitude. To our knowledge, it is unlikely to find other events that could have similar effects on a country's economy. Moreover, discoveries of large deposits of natural resources are relatively rare and specific to countries, which gives them the characteristic of surprise, and allows them to be treated as country-specific shocks. Secondly, the delay between the date of discovery and the start of exploitation (due to the time taken to set the installations, to run the environmental prospecting and to obtain other exploitation authorizations) allows us to identify the effect of discoveries itself, before the start of exploitation (indeed, according to the literature, it takes between 4 and 6 years of gestation between drilling and the exploitation of large oil deposits)[2]. Finally, although technology can identify with varying degrees of accuracy the regions where discoveries are likely to be made, it is obviously impossible to know when the discoveries will occur. Thus, our identification strategy is based on the exogenous nature of discovery dates and resource quantities.

To assess the impact of natural resource discoveries on fiscal policy through changes in the cyclicality of fiscal policy, we proceed in two steps. First, we calculate the cyclicality coefficient and, second, we analyze the relationship between resource discoveries and the cyclicality coefficient by adopting a dynamic panel approach, i.e., an approach that allows us to analyze several countries at once, taking into account the characteristics of these countries and their evolution over time. This makes

[2]See for example the UK report, Department of Energy and Climate Change, 2013: https://www.gov.uk/.../130718$_{d}ecc-fossil-fuel-price-projections.pdf$

it possible to capture the heterogeneity of countries and to identify possible non-linearities in the response of fiscal policy (through the cyclicality coefficient) to these natural resource discovery shocks.

3.1 Computing the cyclicality coefficient

Following Guerguil et al. (2017) and Keita and Turcu (2019) we calculate the cyclicality coefficient with a non-parametric regression method, Local Gaussian-Weighted Ordinary Least Squares (LGWOLS), illustrated by the following equation :

$$\Delta Log(EXP_{it}) = \alpha_{it} + \beta_{it}\Delta Log(GDP_{it}) + \varepsilon_{it} \tag{1}$$

$$\text{With} \quad \varepsilon_{it} \rightarrow N(0, \frac{\sigma^2}{\omega_t(\tau)}) \quad \text{and} \quad \omega_t(\tau) = \frac{1}{\sigma\sqrt{2\pi}} \exp{(-\frac{(\tau - t)^2}{2\sigma^2})}$$

We follow Aghion et al. (2007) and Guerguil et al. (2017) for the choice of σ so $\sigma = 5$. $\Delta Log(EXP_{it})$ is, for country i at time t, the growth rate of real public expenditure and $\Delta Log(GDP_{it})$ is the growth rate of real GDP. $\hat{\beta}_{it}$ is the cyclicality coefficient, which takes into account temporal variations and individual country specificities. It captures the behavior of fiscal policy according to the different phases of the economic cycle over time. Implicitly, this method consists in calculating the cyclicality coefficient by giving a weight to all observations by a Gaussian centered at t, for country i, and then performing a regression for each date t, giving more weight to the observation close to the year in question.

Thus, the cyclicality coefficient $\hat{\beta}_{it}$ measures the cyclicality of public spending in country i in period t. Fiscal policy is considered pro-cyclical when $\hat{\beta}_{it}$ is positive and significant and counter-cyclical when it is not. When $\hat{\beta}_{it}$ is close to zero then fiscal policy is acyclical.

3.2 Addressing the link between natural resources discoveries and the cyclicality of fiscal policy: a Local Projections approach

To estimate the dynamic responses of fiscal policy cyclicality to natural resource discovery shocks, we use the LP method developed by Jorda (2006). This method is widely used in the literature to assess the dynamic effect of shocks (Auerbach and Gorodnichenko, 2011, 2012; Jordà and Taylor, 2013, 2016; Asonuma et al., 2016). The LP method is a flexible and semi-parametric method that easily takes into account a non-linear response of the cyclicality of fiscal policy that could be expected in this study. It can then be estimated using standard regression models.

Let t = 1,2,3...T be the time dimension of the data and h = 0,1,2,3,4 the projection horizon. Let CC_{it} be the cyclicality coefficient which is our dependent variable and DSC_{it} the resource discovery dummy variable, our main explanatory variable. IQ_{it} and FR_{it} represent institutional quality and fiscal rules variables, respectively. X_{it} covers our control variables. Based on the set of available data in t, the LP method generates estimates for each forecast horizon h by regressing the dependent variable at t+h. Thus, by estimating h different ordinary least squares regressions, the local projection of the cyclicality coefficient CC_{it} is obtained with the following LP model :

$$\Delta CC_{i,t+h} = \alpha_{i,h} + \beta_h DSC_{i,t} + \sum_{k=1}^{q} \mu_h CC_{i,t-k} + \sum_{j=0}^{1} \lambda_h X_{i,t-j} + \gamma_h U_{t+h} \tag{2}$$

such that $U_{t+h} \sim N(0,1)$, $\gamma_h > 0$, $\Delta CC_{i,t+h} = CC_{t+h}$ - CC_{t-1} for h

Thus an estimate of the local projection of the impulse response $RI_{h,t}$ of the cyclicality coefficient at horizon h, faced with a natural resource discovery shock at period t is a graphical representation of the evolution of β_h with h=0,1,2,3,4. Actually, an impulse response can be defined as the difference between two forecasts :

$RI_{h,t} = E[(\mathrm{CC}_{t+h}$ - CC_{t-1})—$\mathrm{DSC}_t = 1] - E[(\mathrm{CC}_{t+h}$ - CC_{t-1})—$\mathrm{DSC}_t = 0] = \beta_h$

We limit the h horizon to 4 because on average, production starts 4 years after the discovery. Thus, after this date, fiscal policy will depend more on the level of production than on expectations. The X vector of the control variables also contains our variables of interest IQ_t and FR_t and we introduce q lags of the cyclicality coefficient to account for possible serial dependence, with q = 1.2. We use the control variables at t and t-1 because the effect of a discovery shock at date t will most likely depend on the economic situation at period t-1 and t.

Based on the literature, we introduce as control variables, the presence or absence of a target inflation rate (Combes et al. 2017), the electoral calendar, the level of development and the degree of trade openness (in line for example with Jalles (2020)). We also introduce the level of public debt (debt ratio), which is a determining factor in the decisions regarding the government budget. Finally, in line with the Dutch disease hypothesis suggesting that the abundance of natural resources associated with bad public management can have negative consequences on the economy, we introduce the natural resource rents ratio. We also control for the exploration effort (more details on this variable are available in the next section).

Equation (2) is our basic model: it underlines the dynamic reaction of the cyclicality coefficient to a natural resource discovery shock (β_h). Equation (3) reflects the impact of the interaction between discovery shocks and institutional quality δ_h. Equation (4) captures the effect of the interaction between discovery shocks and the fiscal rules ϕ_h on the cyclicality coefficient:

$$\Delta CC_{i,t+h} = \alpha_{i,h} + \delta_h DSC_{i,t} \times IQ_{i,t} + \sum_{k=1}^{q} \mu_h CC_{i,t-k} + \sum_{j=0}^{1} \lambda_h X_{i,t-j} + \gamma_h U_{t+h} \quad (3)$$

$$\Delta CC_{i,t+h} = \alpha_{i,h} + \phi_h DSC_{i,t} \times FR_{i,t} + \sum_{k=1}^{q} \mu_h CC_{i,t-k} + \sum_{j=0}^{1} \lambda_h X_{i,t-j} + \gamma_h U_{t+h} \quad (4)$$

3.3 Data

We use data on three categories of variables: resource discovery data; macroeconomic data; and control variables. We have data for 31 HMICs and 41 LMICs. The data on large oil and gas discoveries are from Arezki et al. (2017). According to these authors, a large deposit is considered to be a deposit capable of producing at least 500 million barrels of oil or gas equivalent recoverable over time[3]. In fact, in order to get the shock effect and capture the effect of expectations, deposits must be large. As Bhattacharyya et al. (2017) we also control for the exploration effort by introducing a variable that captures whether countries have discovered resources during the three years preceding

[3]This value is based on the estimate at the time of discovery, which is important because expectations are based on the estimate at the time of discovery.

the discovery of the large deposit. For reasons of associated macroeconomic data availability, we limit this database to 1984, so our sample for all variables covers the 1984 - 2012 interval. Table 1 shows the spatial and temporal distribution of large resource discoveries in the world, over the analyzed period.

Region	**DISC1980s**	**DISC1990s**	**DISC2000s**	**DISC2010s**	**Total**
Africa	2	9	9	9	29
Asia	6	20	23	0	49
Central and Eastern Europe	0	1	0	0	1
Commonwealth of Independent States and Mongolia	1	2	5	3	11
Europe	2	6	3	5	16
Middle East and North Africa	2	15	11	2	30
Western Hemisphere	9	11	12	2	34

Table 1: Spatial and Temporal Distribution of Large Oil and Gas Deposits
Note: DISC indicates the number of discoveries per 10-year interval (e.g. DISC1980s indicates the number of discoveries that took place in the 1980s).

Then, to compute the cyclicality coefficient, we use the World Bank macroeconomic data (public expenditures and real GDP). We choose to assess the cyclicality of fiscal policy by estimating the impact of real GDP growth on real public spending. We focus on this indicator as, in order to influence the economic cycle, government usually stimulate or slows down demand by increasing or decreasing public spending. Moreover, according to Bergman and Hutchison (2015), the joint evolution of GDP and public spending allows us to clearly observe the nature of a fiscal policy (pro-cyclical or counter-cyclical). Hence, we focus on public spending as a measure of the cyclicality of fiscal policy. This is also in line with Kaminsky et al. (2004). We also compute the cyclicality coefficient in a disaggregated way by calculating the cyclicality of investment spending and consumption spending (see their distributions in the Appendix). Figure 1 shows the distribution of the computed cyclicality coefficient for HMIs and LMIs.

The distribution shows that HMICs and LMICs have different regression curves, with HMICs tending toward contracyclicality while LMICs being characterized by procyclical fiscal policy. This implies a separate analysis of the two groups of countries in the panel.

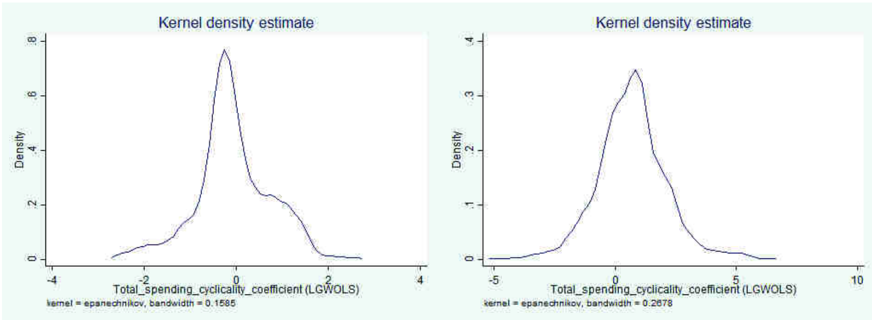

Figure 1: Distribution of cyclicality coefficients for HMICs (left) and LMICs (right)

The data on fiscal rules used as key control variables are from the IMF (IMF Fiscal Rules Dataset 2016). We exploit in this database, details on the presence or absence of fiscal rules of any type (expenditure rules, debt rules, budget balance rules, revenue rules) since 1985. Data on institutional quality are provided by the "International Country Risk Guide" (ICRG 2016). For observations beginning in 1984, we alternately use different indicators of institutional quality from the ICRG 2016 : Bureaucracy Quality (BQ); Democratic Accountability (DAC); Law and Order (LO). However, we mainly use Bureaucracy Quality (BQ) as a measure of institutional quality. In fact, Bureaucracy Quality represents "the institutional strength and quality of bureaucracy; a buffer that tends to minimize policy revisions when governments change" (ICRG 2015). It ranges from 0 to 4, "with high points indicating countries where the bureaucracy has the strength and expertise to govern without drastic policy changes or disruptions to government services. In these low-risk countries, the bureaucracy tends to be somewhat independent of political pressures and has an established mechanism for recruitment and training" (ICRG). Tables 2 and 3 present descriptive statistics on these variables for our sample and by country group:

Variable	Obs	Mean	Std. Dev.	Min	Max
Bureaucracy quality (in HMICs)	678	**3.155912**	.9391761	.5833333	4
Bureaucracy quality (in LMICs)	1,186	**1.608122**	.9104285	0	3.5

Table 2: Descriptive statistics related to institutional quality

On average, the 31 HMICs have much higher institutional quality scores and adopt fiscal rules more often than the 41 LMICs, which supports our choice to study these two types of countries separately. Indeed, in terms of institutional quality, the HMICs in our sample have an average

Fiscal Rules Dummy variable (in HMICs)	**Freq.**	**Percent**	**Cum.**
0	466	61.80	61.80
1	288	**38.20**	100.00
Total	754	100	
Fiscal Rules Dummy variable (in LMICs)	**Freq.**	**Percent**	**Cum.**
0	1,146	85.91	85.91
1	188	**14.09**	100.00
Total	1,334	100	

Table 3: Descriptive statistics related to fiscal rules

score of 3.15 out of 4 compared to 1.60 out of 4 for LMICs, and 38.20% of the HMICs have adopted fiscal rules while only 14.09% of the LMICs have adopted them.

4 Results and interpretations

As shown by the distribution of cyclicality coefficients and descriptive statistics, unlike developing countries, developed countries generally have counter-cyclical fiscal policies because of their better institutional quality and greater frequency of application of fiscal rules. Thus, to account for this structural difference in the panel, we analyze the dynamic response of fiscal policy to natural resource discoveries by country group. The list of countries can be found in the appendix: the first group is composed of high-income and upper-middle-income countries (HMICs) and the second of low-income and lower-middle-income countries (LMICs) according to the World Bank classification.

4.1 High-income countries and upper-middle income countries (HMICs)

We begin the presentation of results by first focusing on the case of high-income and upper-middle-income countries. These results are represented in the figures below. In order to facilitate the reading of these results we underline the following: the x-axis represents the years after the discovery (that arrives at period zero), the y-axis represents the percentage changes in the cyclicality coefficient. Thus the blue line indicates the evolution of the coefficients β_h; δ_h ; ϕ_h over time and as the case may be. The bands "dark grey" and "light grey" represent respectively the confidence intervals at the upper and lower threshold (for example at the threshold of 10% (dark grey) and 5% (light grey). The effect is significant when zero is outside the band (otherwise the effect is not significant).

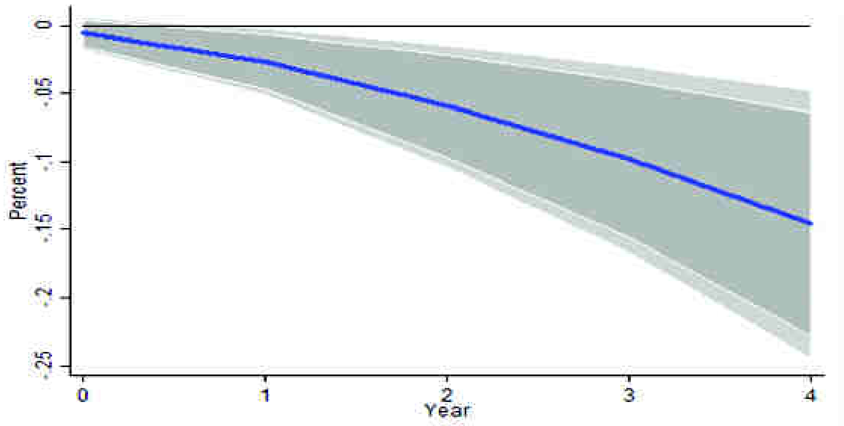

Figure 2: Direct effect of natural resource discoveries (equation (2)), at the 5% and 10% threshold.

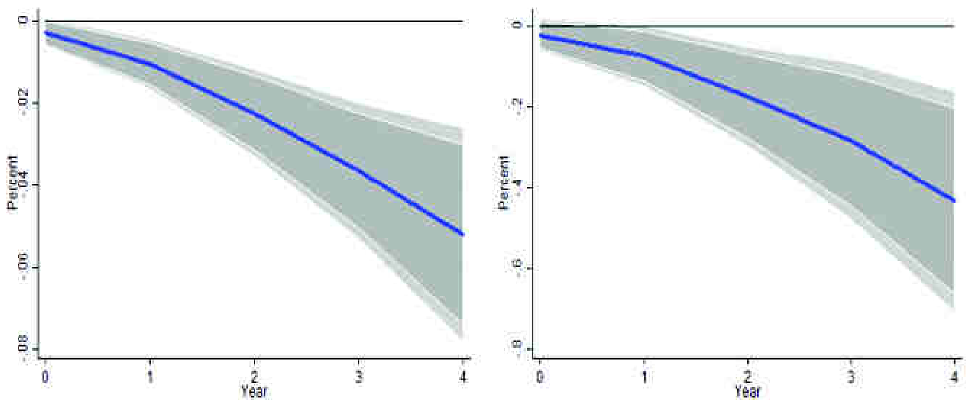

Figure 3: Effect of natural resource discoveries in interaction with institutional quality (equation (3)) and fiscal rules (equation (4)), at the 5% and 10% threshold.

The results show that for the HMICs, the fiscal policy response to natural resource discoveries is counter-cyclical. Indeed, the reaction of these countries is immediate. As soon as the discovery of resources is announced, around the first year after the discovery, the effect begins to be significant, leading to an increasing contracyclicality of about 0.15% in the fourth year (Figure 2).

Then when institutional quality is taken into account (Figure 3, left-side graph), the fiscal policy response is faster and also leads to a certain contracyclicality. Even before the first year after the discovery, a tendency towards contracyclicality of fiscal policy is observed, but to a lesser extent (about 0.048% at the end of the fourth year). Institutional quality therefore seems to favor a more rapid fiscal policy response to natural resource discoveries. Figure 3 (right-side graph) shows that the presence of fiscal rules does not change the time of response to fiscal policy; it remains essentially the same, i.e., contracyclicality begins one year after the discovery. However, fiscal rules lead to a much higher contracyclicality, from about 0.1% after the first year to 0.45% in the fourth year after the discovery. In short, the more developed countries are, the better the reaction of their fiscal policy (contracyclicality) to a natural resource discovery shock is. Thus, the perception of future abundance due to the discovery of natural resources does not seem to affect the fiscal discipline of developed countries. The disciplinary response is faster and/or stronger in the presence of institutional quality and/ or fiscal rules.

4.2 Low- and lower-middle income countries (LMICs)

The results show that natural resource discoveries do not have a significant effect on the fiscal policy of LMICs before the start of resource exploitation. This may be due to the bad quality of institutions to deal with shocks in the economy, characterized by a slow response of economic policies. However, it can be put forward that there is a certain trend toward procyclicality in fiscal policy in these countries and that institutional quality may favor less procyclicality while fiscal rules may lead to counter-cyclicality. To go further in studying the reactions of these countries, we disaggregate public spending into public investment spending and public consumption spending, in order to examine more precisely which type of spending reacts more to natural resource discoveries.

Figure 6 shows that, for public investment spending (left-side graph), a relative tendency towards contracyclicality is observed from the time of the announcement of the natural resources discovery until the second year when the a certiain procyclicality begins. The procyclicality can be due to investment spending on petroleum and gas facilities after the discovery. However, this result is significant at the 15% only. Consumer spending, on the other hand, tends to be pro-cyclical, implying that consumption (and therefore economic activity) increases following the discovery.

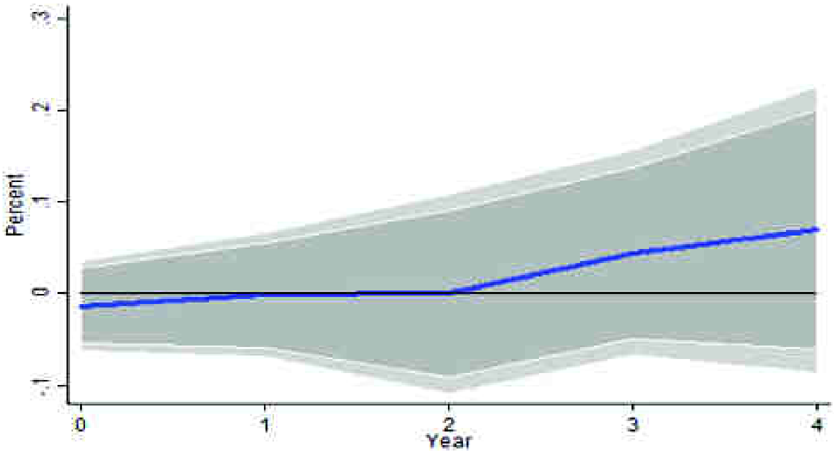

Figure 4: Direct effect of natural resource discoveries (equation (2)), at the 5% and 10% threshold.

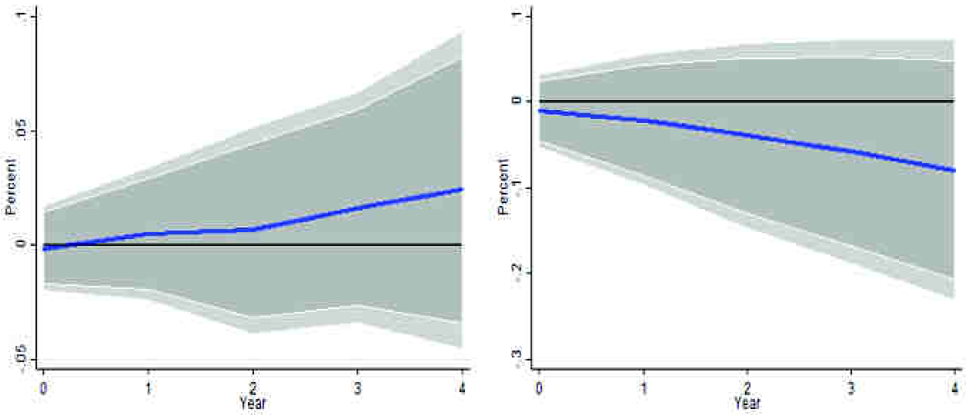

Figure 5: Effect of natural resource discoveries in interaction with institutional quality (equation (3)) and fiscal rules (equation (4)), at the 5% and 10% threshold.

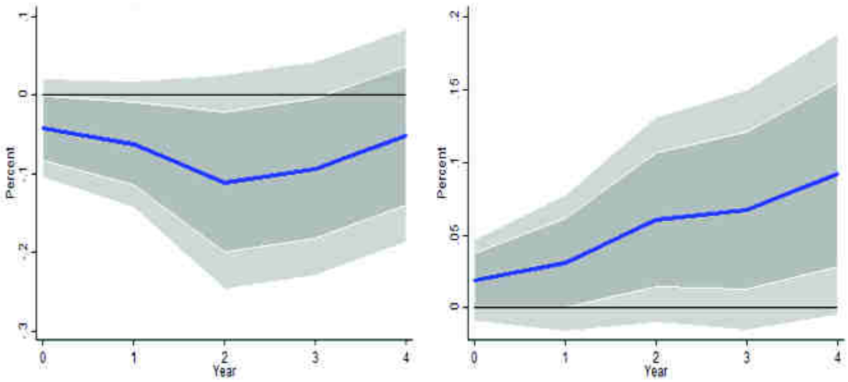

Figure 6: Public investment and consumption expenditure, direct effect of natural resource discoveries (equation (2)), at the 5% and 15% threshold.

5 Robustness Tests

5.1 Different sample sizes

To test the robustness of our results we remove from our two samples, specific groups of countries. Thus we run the analysis by removing the major traditional oil and gas producers and the countries where there has not been a major oil and gas discovery since 1960. These countries may indeed bias the results. Thus the samples go from 31 to 21 HMICs and from 41 to 33 LMICs. The list of countries can be found in the appendix. The robustness of the results obtained in the baseline scenario and plotted in Figures 2, 3 and 6 respectively is now presented below in Figures 7, 8 and 9 respectively. These figures show that our results are robust to a relevant change of our samples: the general trend of the results does not change if we reduce the number of countries included in each group (HMICs and LMICs respectively).

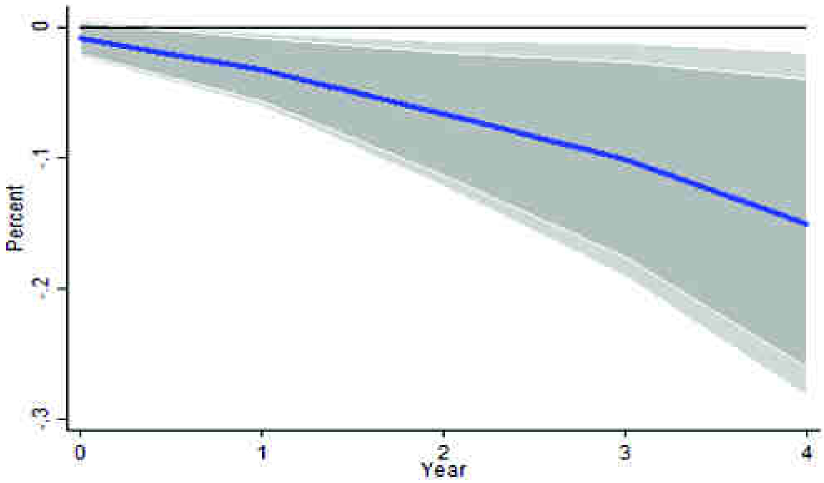

Figure 7: Direct effect of natural resource discoveries (equation (2)), at the 5% and 10% threshold.

Our results are also robust to various measures of institutional quality. Figure 10 shows the effect of natural resource discovery interacting with institutional quality (equation (3)) for HMICs with Democratic Accountability (at the left) and Law and Order (at the right) as alternative measures of institutional quality, respectively, at the 5% and 10% threshold.

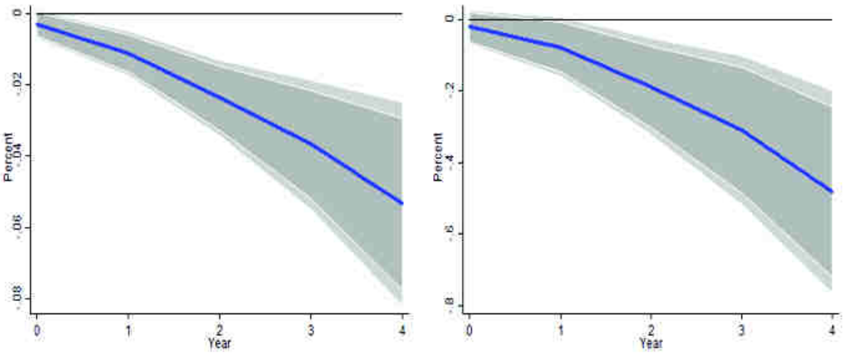

Figure 8: Effect of natural resource discoveries in interaction with institutional quality (equation (3)) and fiscal rules (equation (4)), at the 5% and 10% threshold.

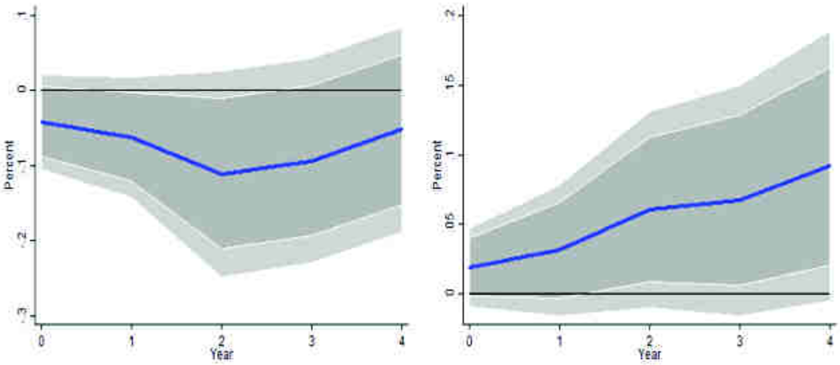

Figure 9: Public investment and consumption expenditure, direct effect of natural resource discoveries (equation (2)), at the 5% and 15% threshold.

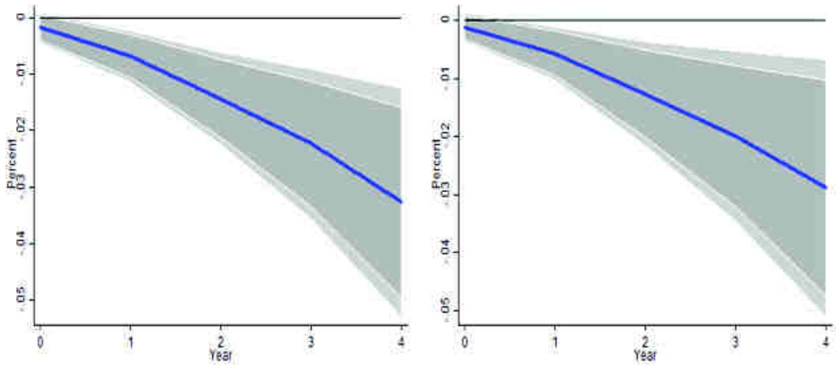

Figure 10: Effect of natural resource discoveries interacting with alternative measures of institutional quality (equation (3)), at the 5% and 10% threshold.

5.2 Different specifications

We correct our sample from outlayers and large oil and gas producers, and we further evaluate the sensitivity of our results to the addition of control variables and to the variation in the number of lags in our specification (i.e., q = 1,2,3,4). We add to the control variables, the sizes of the deposits in million barrels of oil or gas equivalent recoverable in the future, based on the estimate at the time of discovery, as well as a variable that captures whether or not the discoveries are made sequentially. Discoveries may have less effect on expectations when they occur sequentially. The respective robustness results of Figures 2, 3 and 6 obtained after a change in specification are presented below in Figures 11, 12 and 13 respectively, these figures show that our results remain valid with changes in specification, which is further evidence that our results are robust.

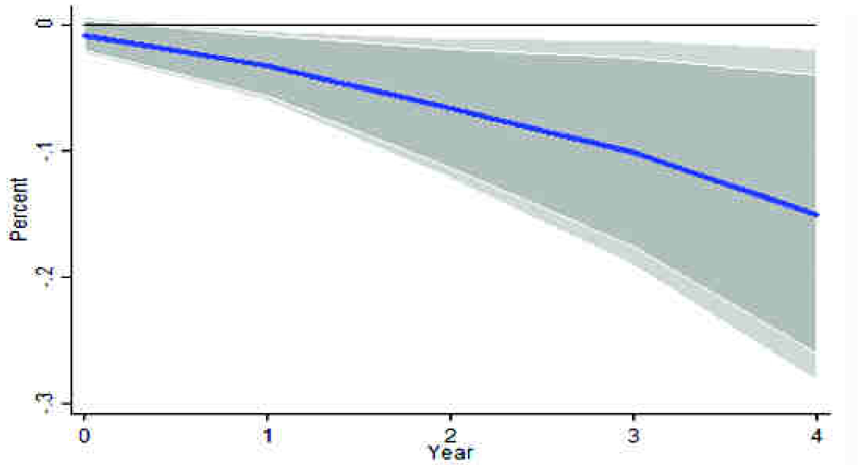

Figure 11: Direct effect of natural resource discoveries (equation (2)), at the 5% and 10% threshold.

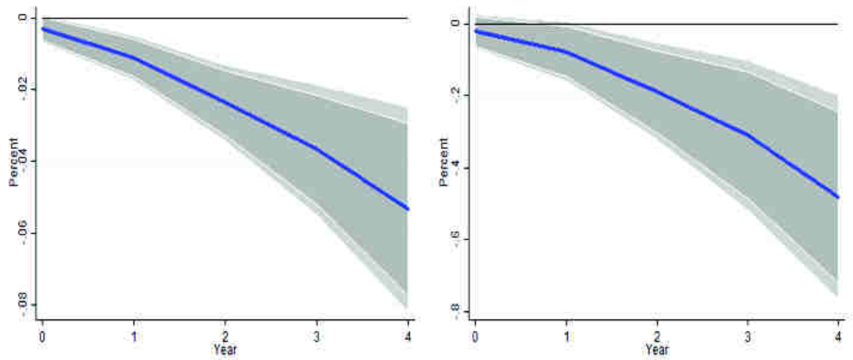

Figure 12: Effect of natural resource discoveries in interaction with institutional quality (equation (3)) and fiscal rules (equation (4)), at the 5% and 10% threshold.

5.3 Another measure of the cyclicality coefficient

To assess the robustness of our results, we compute another measure of the cyclicality coefficient. To do this, we proceed in two steps: first we calculate an augmented version of the cyclicality coefficient and then we use this new measure of the cyclicality coefficient to run again the analysis

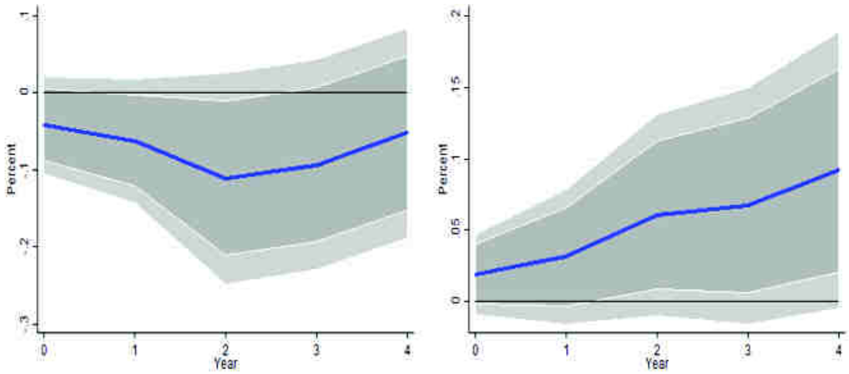

Figure 13: Public investment and consumption expenditure, direct effect of natural resource discoveries (equation (2)), at the 5% and 15% threshold.

with the samples corrected of the outliers. Indeed, under an expansionary fiscal policy, government spending causes GDP growth, and in this framework we propose a method that takes this into account. In order to capture the inertia of public spending and to take account of possible inverse causalities between changes in public spending and changes in real GDP, we introduce lagged values of the two variables and estimate the following specification :

$$\Delta Log(EXP_{it}) = \alpha_{it} + \rho_{it}\Delta Log(GDP_{it}) + \theta_{it}\Delta Log(GDP_{it-1}) + \pi_{it}\Delta Log(EXP_{it-1}) + \varepsilon_{it} \quad (5)$$

Where ρ_{it} is the resulting cyclicality coefficient, corrected for potential bias and varying over time and across individuals with ε_{it} the error term. Figure 14 shows respectively the distributions of the cyclicality coefficients of HMICs and LMICs.

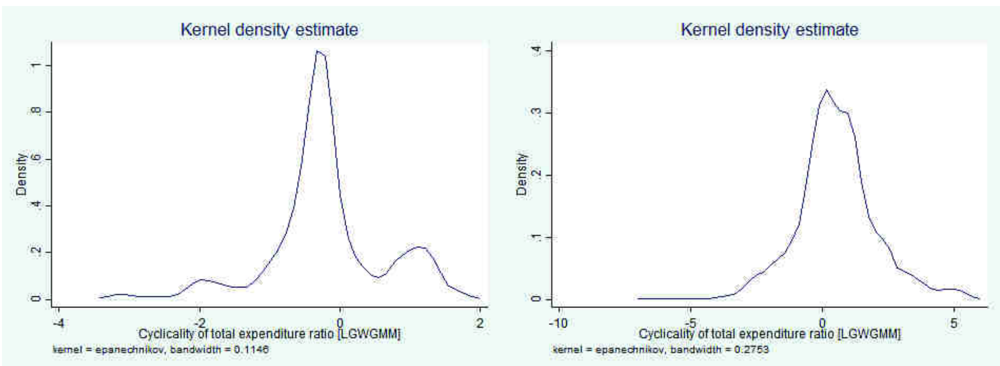

Figure 14: Distribution of revised cyclicality coefficients of HMICs (in the left) and LMICs (in the right)

As it can be seen in Figure 14, the trend for each group of countries remains essentially the same, with HMICs tending towards contracyclicality while LMICs being dominated by a certain procyclicality . The respective robustness results of Figures 2, 3 and 6 obtained with these coefficients are presented below in Figures 15, 16 and 17 respectively.

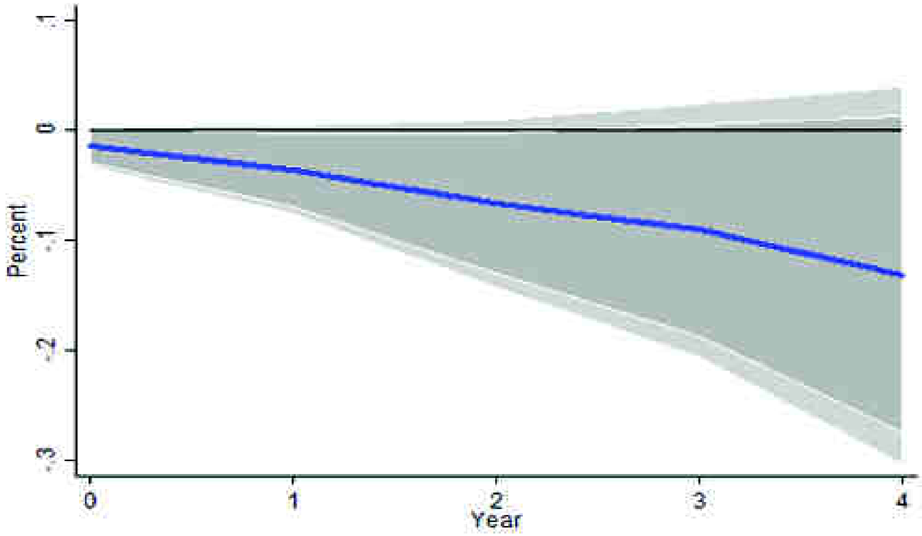

Figure 15: Direct effect of natural resource discoveries (equation (2)), at the 5% and 10% threshold.

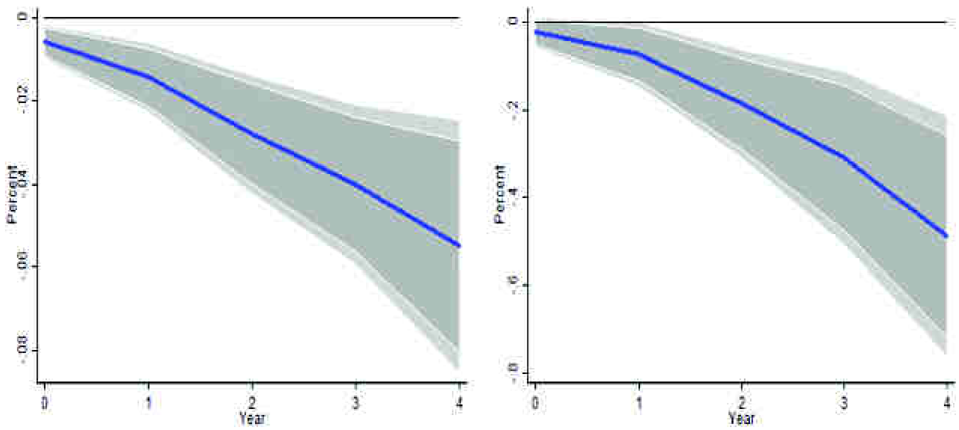

Figure 16: Effect of natural resource discoveries in interaction with institutional quality (equation (3)) and fiscal rules (equation (4)), at the 5% and 10% threshold.

All these additional investigations show that our results are significant overall. The different robustness tests underline that our findings are not subject to potential biases due to a certain group of countries, nor to the specifications that are used. Moreover, overall, the results do not seem very

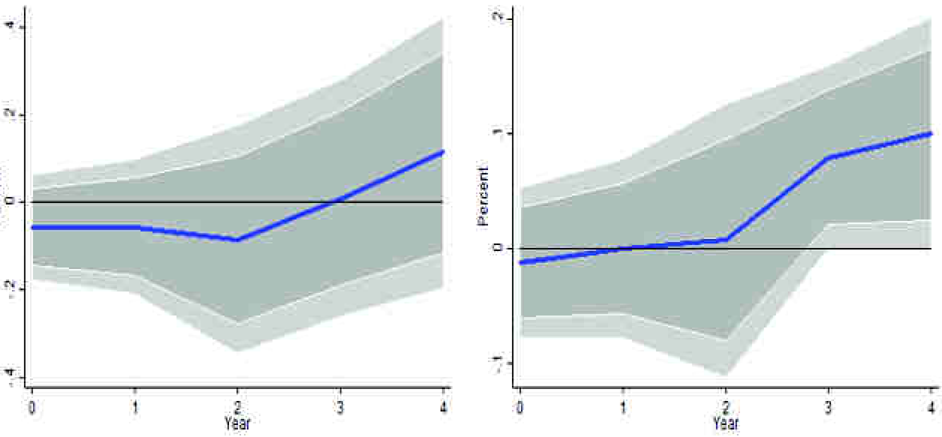

Figure 17: Public investment and consumption expenditure, direct effect of natural resource discoveries (equation (2)), at the 5% and 15% threshold.

sensitive to the different measures of cyclicality or of institutional quality. In sum, we can underline that our results are robust overall.

6 Conclusion

To the best of our knowledge, we provide the first study assessing the effect of the perception of future abundance due to the discovery of natural resources on countries' fiscal discipline. Our analysis shows that the expectations due to the discovery of natural resources impact the definition and evolution of fiscal policy. Natural resource discoveries, such as positive shocks to the government budget, lead to a disciplined response (contracyclicality) of fiscal policy in countries characterized by good institutions and a high frequency of application of fiscal rules. However, deviations in fiscal discipline in reaction to such shocks are observed in countries with weak institutions and less frequent applications of fiscal rules. Thus, we can conclude that the presence of fiscal rules and/or good institutions can promote a good fiscal governance in the context of resource discovery shocks.

Further research in this respect can be developed. Since a potential effect of expectations due to natural resource discoveries on fiscal discipline has been highlighted, a relevant research question that might arise is related to the effect that natural resource discoveries might have on countries' access to international capital markets. In fact, good fiscal governance is one of the key factors considered in the assessment strategies of rating agencies and international lenders such as the IMF and the World Bank (Bodea and Hicks, 2018). For this reason, we can ask: can the discovery of large oil or gas deposits in a country provide better access to the international capital market, regardless of the quality of fiscal governance in that country? If so, what impact this could have on the financial markets? Future research on the role of expectations due to the discovery of natural resources could be addressed in order to bring in new elements to this rather unexploited part of the literature.

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