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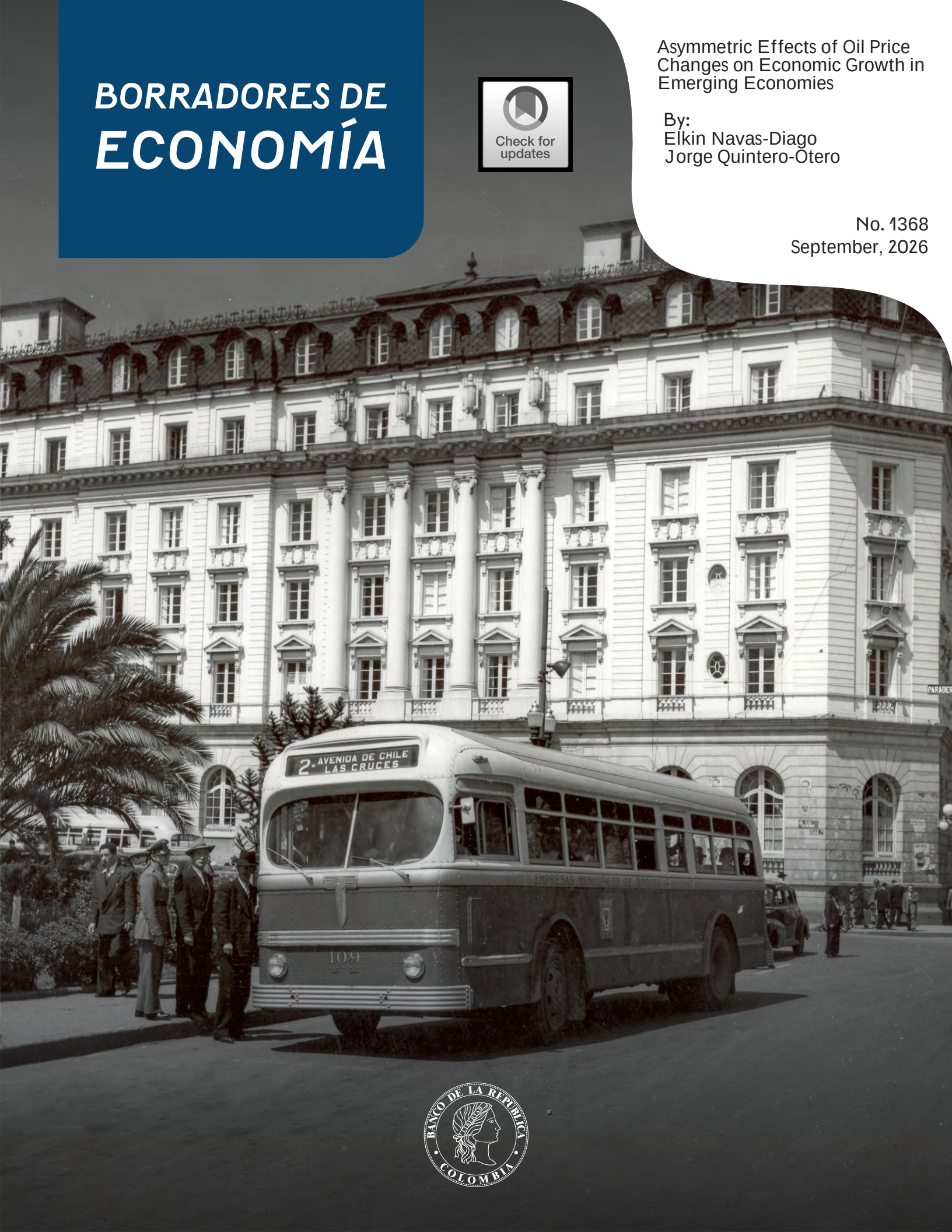

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Asymmetric Effects of Oil Price Changes on Economic Growth in Emerging Economies

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Abstract

This study examines the short- and long-run effects of oil price increases and decreases on economic growth in 31 emerging economies, distinguishing between oil-exporting and oil-importing countries, through a Nonlinear Autoregressive Distributed Lag model. The results show that an increase (decrease) in oil prices has a positive (negative) effect on exporting economies and a negative (positive) effect on importing economies. In the long run, oil price changes generate asymmetric effects on economic growth in emerging oil-importing countries, with price increases exerting a stronger impact than price declines. In contrast, among oil-exporting economies, the growth response is symmetric to both increases and decreases in crude oil prices. In the short run, however, there is no evidence of asymmetry, since oil price increases and decreases affect economic growth with similar magnitudes in both importing and exporting countries. Finally, the findings indicate that structural factors, such as the monetary policy framework and the degree of oil dependence, significantly shape the magnitude of these effects, constituting an additional source of asymmetry in the relationship between oil prices and economic growth across the countries analyzed.

JEL Classification: C32, O47, F41, E52, Q43.

Keywords: Asymmetric effects on time series; Economic growth; Open emerging economies; Monetary policy; Oil price.

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Efectos Asimétricos de Variaciones en el Precio del Petróleo sobre el Crecimiento Económico de Economías Emergentes

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Resumen

Este estudio examina los efectos de corto y largo plazo de aumentos y disminuciones en el precio del petróleo sobre el crecimiento económico de 31 economías emergentes, distinguiendo entre países exportadores e importadores de petróleo, mediante un modelo Autorregresivo No Lineal de Rezagos Distribuidos. Los resultados muestran que un aumento (disminución) en el precio del petróleo tiene un efecto positivo (negativo) sobre las economías exportadoras y un efecto negativo (positivo) sobre las economías importadoras. En el largo plazo, las variaciones en el precio del petróleo generan efectos asimétricos sobre el crecimiento económico en los países emergentes importadores de petróleo, siendo mayor el impacto de aumentos en el precio del petróleo que el de las disminuciones. En contraste, en las economías exportadoras de petróleo, la respuesta del crecimiento es simétrica frente a aumentos y disminuciones en el precio del crudo. En el corto plazo, sin embargo, no se encuentra evidencia de asimetrías, ya que los aumentos y disminuciones en el precio del petróleo afectan el crecimiento económico con magnitudes similares tanto en países importadores como exportadores. Finalmente, los resultados indican que factores estructurales, como el régimen de política monetaria y el grado de dependencia del petróleo, influyen significativamente en la magnitud de estos efectos, constituyéndose en una fuente adicional de asimetría en la relación entre el precio del petróleo y el crecimiento de los países analizados.

Clasificación JEL: C32, O47, F41, E52, Q43.

Palabras clave: Efectos asimétricos en series de tiempo; Crecimiento económico; Economías emergentes abiertas; Política monetaria; Precio del petróleo.

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1 Introduction

Oil prices are one of the main determinants of global economic activity, given their role in industrial production, transportation, international trade, and the financial conditions of economies. This relevance is documented by Fernandez et al. (2017), who show that global exogenous shocks transmitted through international commodity prices account for approximately 33% of countries' business cycles, with their importance increasing notably since 2000.

The economics literature has extensively documented how oil price shocks significantly affect global economic activity. Seminal studies such as Hamilton (1983), Mork (1989), Bernanke et al. (1997), and Kilian (2009) conclude that unexpected changes in oil prices generate considerable fluctuations in countries' Gross Domestic Product (GDP), although the magnitude and direction of these effects depend on the structural characteristics of each economy.

In particular, the transmission channels through which an oil price shock affects macroeconomic variables differ according to the role that countries play in the energy market. In oil-importing countries, an increase (decrease) in the price of this commodity raises (reduces) production costs in oil-intensive sectors, thereby reducing (increasing) the supply of goods and, consequently, output. By contrast, in oil-exporting countries, the effect of an increase (decrease) in oil prices on economic growth moves in the same direction and is explained by the improvement (deterioration) in the terms of trade and aggregate demand. However, these effects on economic growth in oil-exporting and oil-importing countries are nonlinear and asymmetric, as shown by several studies, including Darby (1982), Mory (1993), Hamilton (1996), Jimenez-Rodriguez and Sanchez (2005), Mendoza and Vera (2010), Bodenstein et al. (2011), Moshiri and Banihashem (2012), Moshiri (2015), Borozan and Cipcic (2022) and Belloumi et al. (2023).

The objective of this paper is to identify the predominant patterns of asymmetric macroeconomic responses to increases and decreases in oil prices across emerging economies. This article contributes to the literature by identifying structural factors that shape the asymmetric effects of oil price changes on economic growth in a broad sample of 31 emerging economies over a common period.

The findings provide new evidence on sources of heterogeneity underlying the asymmetric effects of oil price changes on economic growth across emerging economies.

Specifically, four possible types of asymmetries are evaluated as sources of heterogeneity in the effects of oil price changes on economic growth in emerging countries.

The first type of asymmetry describes the differential effect of a given change in oil prices depending on the role of countries in the oil market, either as net oil exporters or net oil importers. The second type of asymmetry refers to the differential and nonlinear impact on countries' economic growth resulting from increases and decreases in oil prices. The third type of asymmetry concerns possible differences between the short-run and long-run effects of oil price changes on countries' productive activity. Finally, the fourth type of asymmetry evaluates the role of structural factors, such as the monetary policy framework and the degree of oil dependence of the countries analyzed, in shaping the magnitude of the effects of oil price changes on the economic growth of emerging economies.

To this end, a quarterly economic growth index is constructed for the period 2005–2024, weighted by the size of each economy, separately for a group of oil-exporting countries and for a group of oil-importing countries. Then, using a Nonlinear Autoregressive Distributed Lag model (NARDL), the asymmetric short- and long-run effects of positive and negative oil price changes on the economic growth of these groups of countries are estimated.

Clearly, the impact of oil prices on economic growth is influenced by certain country-specific characteristics, one of which is undoubtedly the level of economic development. This is shown by Cushman and Zha (1997), De Paoli (2009), and Azad and Serletis (2022), who find that macroeconomic variables in emerging economies are more strongly affected by oil price changes than those in developed economies, due to their fragile economic structure, limited bargaining capacity, and integration into international markets. For this reason, this study restricts the analysis to a sample of emerging economies whose economic performance does not influence the international price of oil.

However, it is acknowledged that other country characteristics may also significantly influence the results obtained. This study explicitly evaluates the incidence of two of them. First, considering that studies such as Bernanke et al. (1997) and Leduc and Sill (2004) suggest that changes in crude oil prices may have different effects on a country's macroeconomic aggregates depending on the rigidity and manner in which monetary authorities conduct monetary and exchange-rate policy, the effects of oil price variations on productive activity are compared between countries that use an inflation-targeting

regime to conduct monetary policy and economies that follow other monetary policy frameworks.

Second, the share of oil revenues or oil expenditures in countries' economies may also be a determining factor in the effect of oil price changes on economic growth. This is shown by Bacon and Kojima (2008), who find that countries with a larger oil share in their economies, whether as oil exporters or importers, face greater vulnerability and larger impacts from changes in oil prices. Therefore, in a subsequent estimation, the weights used to calculate the aggregate production indices for groups of countries are modified so that they are based on the share of external oil revenues or expenditures as a percentage of GDP. The results obtained are then compared with those based on weighting by economic size.

The results of this study show that an increase in oil prices produces a positive cumulative effect on economic growth in emerging oil-exporting countries, while price decreases generate the opposite effect. For emerging oil-importing countries, an increase in the price of this commodity leads to a cumulative decline in economic growth, whereas a decrease in oil prices increases GDP growth in these countries.

In the long run, there is evidence of asymmetry in the effects of oil price variations on economic growth in emerging oil-importing countries. The results reveal that increases in oil prices have a larger impact on economic growth than decreases in oil prices. By contrast, in oil-exporting countries, the output response is symmetric in the long run with respect to increases and decreases in oil prices. Regarding short-run dynamics, the impact of oil price variations on growth is symmetric in both oil-importing and oil-exporting countries.

Finally, the results of this study indicate that the monetary policy framework and oil dependence, in both oil-exporting and oil-importing countries, are determining factors in the magnitude of the effects of oil price variations on economic growth in emerging economies. First, countries that adopt an inflation-targeting regime to conduct monetary policy experience smaller impacts on their productive activity in response to oil price changes. Second, greater oil dependence increases the impact of oil price variations on economic growth in emerging countries.

The remainder of the paper is organized as follows. Section 2 provides a brief review of the related literature on this topic. Section 3 presents in detail the methodology used to estimate the asymmetric effects of oil price variations on economic growth in emerging

economies, as well as the results and the corresponding robustness tests. Sections 4 and 5 evaluate the incidence of the monetary policy framework and oil dependence, respectively, on the effects of oil price changes on economic growth. Section 6 presents the main conclusions.

2 Empirical literature

There has been growing interest in the economics literature in studying the impact of oil price changes on economic growth in both net oil-exporting and net oil-importing countries. Until the 1980s, a significant part of the macroeconomic literature tended to assume that oil price changes had approximately linear and symmetric effects on economic activity: an increase in oil prices would generate a contraction in real output, while a decrease would have an expansionary effect of similar magnitude. However, subsequent research has shown that the relationship between oil shocks and macroeconomic performance is more complex, characterized by nonlinear dynamics and asymmetric effects that depend on factors such as the nature of the shock, the productive structure of the economy, the country's position as a net oil exporter or importer, and the response of economic authorities.

Darby (1982) is the seminal study on the asymmetric effects of oil price changes. Using simulated time-series experiments for the United States, the United Kingdom, Canada, France, Germany, Italy, Japan, and the Netherlands, this study finds that high (low) dependence on oil, lower (greater) capacity to substitute energy sources, and weak (strong) diversification of productive activity across economic sectors cause oil price variations to affect countries' economies with greater (lesser) intensity. For an oil-importing country with these vulnerabilities, an increase in oil prices leads to higher inflation and a recession, while no considerable effects are observed for the other countries.

Subsequently, Mork (1989), Lee et al. (1995), and Hamilton (1996) introduced a methodological advance by decomposing oil prices into cumulative sums of positive and negative changes to explicitly identify the asymmetric effect of oil shocks. These studies agree in concluding that an increase in oil prices has a negative and larger impact on industrial production in oil-importing countries such as the United States, compared with the effect of oil price decreases.

Nevertheless, Kilian and Vigfusson (2011) argue that much of the previous literature on these asymmetric effects presents important methodological limitations. The authors state that identifying asymmetries requires methodologies capable of estimating the structural response of GDP to positive and negative oil price variations, distinguishing between causal effects and those that arise from correlations in the data. In addition, they argue that explanations based on resource reallocation across economic sectors or on investors' uncertainty about future oil prices are not sufficient to explain asymmetric responses in economic activity. Other elements, such as the monetary policy response to inflationary pressures derived from oil shocks, may help explain the asymmetry in the macroeconomic effects of oil shocks in oil-importing countries.

Empirical evidence also indicates the existence of asymmetry in the effects of these variations on the macroeconomic variables of oil-exporting countries. Moshiri and Banihashem (2012), Moshiri (2015), and Bunce and Carrillo-Maldonado (2023) point out that a decrease in oil prices has a negative and larger effect on the economic growth of crude oil exporters, compared with the positive impact caused by increases in this indicator.

More recently, the literature has also focused on identifying possible sources of asymmetry in the differential responses across countries to the same oil price shock, beyond their condition as oil exporters or importers. One of these sources of asymmetry is oil dependence.

Recent evidence suggests that the macroeconomic effects of oil price variations in crude oil-importing and oil-exporting countries depend on countries' vulnerability to changes in oil prices (Salem et al., 2024; Pilatowska and Geise, 2025). In oil-importing countries, Bacon and Kojima (2008) find that greater dependence on crude oil causes economic activity to decline more sharply in response to an increase in oil prices and conditions the macroeconomic policy response aimed at controlling oil shocks.

In the case of oil-exporting countries with high oil dependence, variations in oil prices also generate stronger macroeconomic effects (Sadeghi, 2017). This is because oil price changens significantly affect these countries' terms of trade and fiscal revenues, which are fundamental to the state of their public finances. In addition, oil activity attracts both domestic and foreign investment, generating a multiplier effect on these economies.

Another factor that may be decisive in the impact of oil price changes on economic growth, and which has not been extensively discussed in the literature, is the framework

under which monetary policy is conducted. Tjosvold and Trehan (2006)is one of the few comparative studies that evaluates how different monetary policy frameworks responded to oil shocks during the 2000s. Their results show that inflation expectations in countries with inflation-targeting regimes, such as Canada and the United Kingdom, are less affected by oil price variations than in the United States, which follows a different monetary policy framework. This suggests that inflation-targeting monetary policy may help mitigate the transmission of these shocks to the economy.

From a theoretical perspective, Natal (2012) uses a dynamic stochastic general equilibrium (DSGE) model with nominal rigidities in an oil-importing country to show that an increase in oil prices raises inflation and reduces economic activity. The results show that optimal monetary policy must consider the trade-off between controlling inflation and stabilizing output. Therefore, less rigid monetary policy rules in response to oil price increases generate better welfare outcomes in these economies.

For oil-exporting countries, Omotosho (2022) uses a DSGE model calibrated for Nigeria and finds that declines in oil prices generate a contraction in aggregate output, exchange-rate depreciation, and a restrictive monetary policy stance due to inflationary pressures arising from the foreign exchange market. In addition, the study finds that the macroeconomic effects of oil price shocks are determined by oil dependence, the fiscal structure, and the way in which the oil shock is transmitted to domestic prices. The study indicates that a Taylor rule based on core inflation is more effective in controlling the recessionary effects of a negative oil price shock.

For Colombia, Bejarano et al. (2016), using a DSGE model in which the oil sector is modeled as an optimal resource extraction process, find that a decrease in oil prices generates currency depreciation, which in turn produces inflationary pressures, an increase in country risk, and a contraction in economic activity. The study concludes that, in this context, central banks face a monetary policy dilemma because an increase in the policy instrument may lead to a stronger reduction in output.

Clearly, the literature has identified other factors that also determine different responses across countries that may otherwise share similar degrees of oil dependence and monetary policy frameworks. In oil-exporting countries, for example, some of these determinants of asymmetric responses include the role of the state in the economy (Tazhibayeva et al., 2008), the quality of institutions in countries dependent on oil revenues (Sala-i-Martin and Subramanian, 2013; van der Ploeg and Arezki, 2007), and

the incidence of Dutch disease effects (Corden and Neary, 1982; Wijnbergen, 1984).

Taken together, the economic literature on this topic suggests that the effects of oil price variations on economic growth are asymmetric. However, the studies conducted to date present important methodological limitations, rely on relatively small country samples, and involve key heterogeneous factors across countries that generate asymmetries in the macroeconomic impact of oil price variations. In this context, this study proposes a novel analysis within this literature by comparing the characteristics of emerging oil-exporting and oil-importing economies while simultaneously examining the role of oil dependence and the monetary policy framework as determinants of asymmetries in the macroeconomic impact of oil price variations.

3 Impacts of oil price changes on economic growth in emerging economies

This section analyzes the asymmetric short- and long-run impact of positive and negative changes in oil prices on economic growth in emerging countries that are either crude oil exporters or importers. For each of these two groups of countries, a weighted production index is constructed, and its response to increases and decreases in oil prices is evaluated.

3.1 Sample of countries

The first criterion considered for selecting the countries was that they belonged to the group of economies classified as emerging by the International Monetary Fund (2024). From this initial selection, countries that play a fundamental role in the oil market as major producers or consumers were excluded, so that the sample would be limited to countries for which the oil price behaves as an exogenous variable.

This sample is divided into net oil-exporting and net oil-importing countries (Table 1), based on annual net oil exports in U.S. dollars from 2005 to 2024. The sample includes countries that, over the study period, were classified at different points in time as net crude oil exporters and, at others, as net importers. In these cases, the criterion used for classification is the condition—exporter or net importer—that the country

experienced during the greatest number of periods.

Cuadro 1: Sample of countries analyzed classified as net oil exporters or net oil importers

Net oil exporters		**Net oil importers**	
Albania	Ecuador	Bosnia	Macedonia del Norte
Argentina	Guatemala	Bulgaria	Paraguay
Belice	Kazajistán	Chile	Perú
Bolivia	México	Costa Rica	Filipinas
Colombia	Nigeria	El Salvador	Polonia
		Honduras	Rumania
		Hungría	Serbia
		Indonesia	Sudáfrica
		Jamaica	Tailandia
		Jordania	Turquía
		Nicaragua	

Source: Le Centre d'études prospectives et d'informations internationales, The Observatory of Economic Complexity and cálculo de los autores.

For each country i in the sample during each quarter t, a production index ($I^y_{i,t}$) is constructed using real GDP growth in domestic currency, $\Delta \ln(y_{i,t})$, as follows:

$$I^y_{i,t} = 100 \times (1 + \Delta \ln(y_{i,t})), \qquad i = 1, 2, 3, \ldots, 31 \tag{1}$$

The weighted index ($IP^y_{j,t}$) is then constructed by grouping emerging oil-exporting and oil-importing countries, using each country's production index and the share of each economy in the total GDP of the respective country group, as follows:

$$IP^y_{j,t} = \sum_{i=1}^{n} I^y_{i,t} \times w_{i,j,t} \tag{2}$$

where $w_{i,j,t} = \frac{y_{i,t}}{\sum_{i=1}^{n} y_{i,t}}$ corresponds to the weight of each country i in group j for period t.

The main reason for using weighted production indices for groups of emerging

economies is to account for the relative size of the countries considered in the econometric estimations of the effects of oil price changes on the economic growth of groups of nations with common characteristics. In this way, larger economies receive greater weight in the estimations, providing a more appropriate measure of the impact on the category of countries analyzed, whether oil exporters or oil importers.

3.2 Data and indicators

The study uses quarterly data for the period 2005:1 to 2024:1 (77 quarters), taking into account the availability of GDP time series for the selected sample of emerging countries.

As an indicator of the real oil price, the quarterly end-of-period Brent price was used. Oil prices were obtained from the World Bank commodity price statistics. These nominal prices were deflated using the U.S. Consumer Price Index, available from the FRED database of the Federal Reserve Bank of St. Louis.

To ensure better comparability of the results, the production data used for each country correspond to seasonally adjusted quarterly real GDP series in domestic currency, obtained from the IMF and the Economic Commission for Latin America and the Caribbean (ECLAC).

For the quarterly production weights used to calculate the production indices by country group, annual real GDP data in U.S. dollars from the International Monetary Fund (IMF) were used. Since real GDP data in U.S. dollars are available only on an annual basis, the same weight is used for each quarter within the corresponding year. [1]

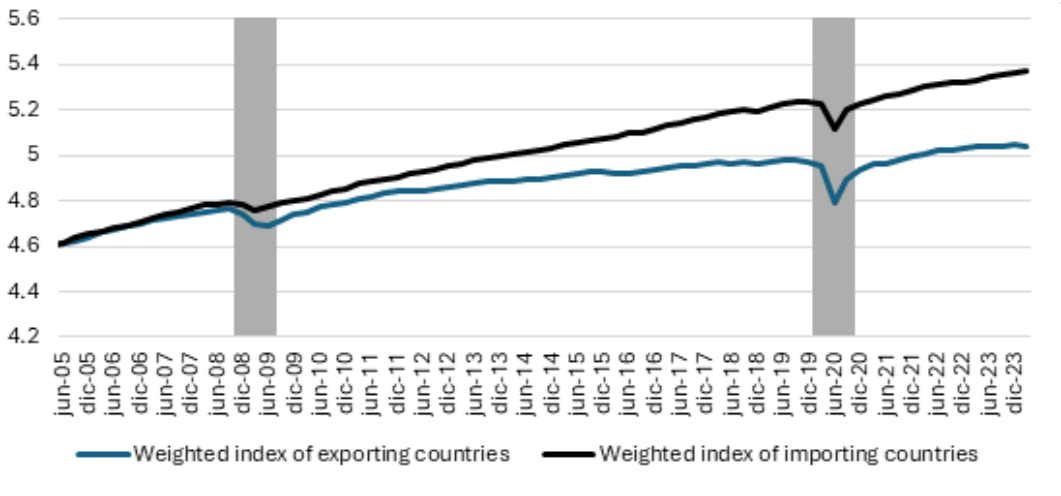
Figure 1 shows the behavior of the weighted production index for net oil-exporting countries (black line) and net oil-importing countries (blue line) during the period from 2005:1 to 2024:1. In both cases, an upward trend is observed throughout the time series. However, from 2008 onward, the index for oil-exporting countries is shown to be above the index for oil-importing countries, indicating a better relative performance of economic activity in these countries.

The figure also highlights two gray-shaded periods in which the production index contracts significantly, interrupting its upward trend. The first, between 2008 and 2009,

[1] Given data availability at the time of sample selection, the weight used for 2024Q1 was calculated using the 2023 weighting data.

corresponds to the international financial crisis, a period in which a larger decline is recorded among importing countries. The second period corresponds to the COVID-19 pandemic in 2020, when a more pronounced contraction in production is observed in both groups compared with the financial crisis. In this case, the decline is particularly marked among importing countries (blue line), which experienced a sharper fall in their productive activity.

Figura 1: Weighted production index for oil-exporting and oil-importing countries (2005-2024)



Source: IMF, ECLAC and authors' calculations.

3.3 Econometric analysis

Estimating the impact of oil price changes on economic growth in the emerging countries analyzed through an autoregressive distributed lag (ARDL) model would involve running the following regression:

$$IP_{j,t}^{y} = a + \sum_{p=1}^{m} \beta_p IP_{j,t-p}^{y} + \sum_{q=1}^{d} \varphi_q OIL_{t-q} + \mu_{j,t} \tag{3}$$

where a is the intercept, β_p and φ_q are the estimators associated with the lags of the explanatory variables, $IP_{j,t}^{y}$ is the natural logarithm of the weighted production index of countries in group j, OIL_t is the natural logarithm of the real oil price, and $\mu_{j,t}$ represents the model disturbances, with $\mu_{j,t} \sim N(0, \vartheta)$.

However, this study estimates a nonlinear variant of the ARDL model known as the NARDL model, proposed by Shin et al. (2014), which allows the asymmetric effects of increases and decreases in oil prices on economic growth indicators to be estimated in both the short and long run.

3.3.1 The NARDL model

Consider a regression with asymmetric long-run effects of the following form:

$$IP_{j,t}^{y} = \alpha + \beta^{+} OIL_{t}^{+} + \beta^{-} OIL_{t}^{-} + \mu_{j,t} \tag{4}$$

where α is the intercept, β^{+} and β^{-} are the parameters representing the asymmetric long-run effect, and $\mu_{j,t}$ is a model disturbance, with $\mu_{j,t} \sim N(0, \vartheta)$. The exogenous variable in the model, OIL_t, is decomposed as $OIL_t = OIL_0 + OIL_t^{+} + OIL_t^{-}$ where OIL_t^{+} and OIL_t^{-} are processes obtained from the partial sums of positive and negative changes in OIL_t, such that:

$$OIL_{t}^{+} = \sum_{h=1}^{t} \Delta OIL_{h}^{+} = \sum_{h=1}^{t} (\Delta OIL_{h}^{+}, 0) \tag{5}$$

$$OIL_{t}^{-} = \sum_{h=1}^{t} \Delta OIL_{h}^{-} = \sum_{h=1}^{t} (\Delta OIL_{h}^{-}, 0) \tag{6}$$

By linking equation 4 to the ARDL model in equation 3, a NARDL(p, q) model can be represented as follows:

$$IP_{j,t}^{y} = \alpha + \sum_{h=1}^{p} \gamma_h IP_{j,t-h}^{y} + \sum_{h=0}^{q} \left(\varphi_h^{+} OIL_{t-h}^{+} + \varphi_h^{-} OIL_{t-h}^{-} \right) + \varepsilon_{j,t} \tag{7}$$

where γ_h is the autoregressive parameter, φ_h^{+} and φ_h^{-} are the parameters of the asymmetric distributed lags, and $\varepsilon_{j,t}$ is a model residual, with $\varepsilon_{j,t} \sim N(0, \vartheta)$.

Following Pesaran et al. (2001), the asymmetric error-correction equation for the NARDL model can be specified as:

$$\Delta IP^{y}_{j,t} = \rho IP^{y}_{j,t-1} + \phi^{+} OIL^{+}_{t-1} + \phi^{-} OIL^{-}_{t-1} + \sum_{h=1}^{p-1} \lambda_h \Delta IP^{y}_{j,t-h} + \sum_{h=0}^{q-1} \left(\varphi^{+}_{h} \Delta OIL^{+}_{t-h} + \varphi^{-}_{h} \Delta OIL^{-}_{t-h} \right) + \mu_{j,t}$$

where $\rho = \sum_{h=1}^{p} \gamma_h - 1$ and $\lambda_h = -\sum_{i=h+1}^{p} \gamma_t$, for all $h = 1, \ldots, p-1$. while φ^{+}_{h} and φ^{-}_{h} represent the coefficients that capture the asymmetric short-run relationship between economic growth in country group j and the oil price.

The inclusion of lags of the dependent variable helps reduce estimation problems caused by omitted-variable bias by controlling for the typical dynamics of the production variable.

Prior to estimating the NARDL model, unit root tests must be conducted to ensure that the variables used in the empirical model are not integrated of order two, that is, $I(2)$. In addition, an exogeneity test for the oil price must be performed to ensure that the regressors are weakly exogenous with respect to the long-run parameters.

The estimation of the NARDL model itself involves several steps (Shin et al., 2014; Liang et al., 2020). First, the error-correction equation (8) of the NARDL model is estimated by Ordinary Least Squares (OLS). The model is estimated with a lag length of $\max p = 2$ and $\max q = 2$ because the dependent variable corresponds to the growth of the production index, and this lag length makes it possible to capture the short-run effects of oil price variations, while also controlling for omitted-variable bias. Including additional lags in the NARDL estimation does not substantially affect the results and could considerably reduce the efficiency of the estimators.

Subsequently, the existence of asymmetric long-run cointegration relationships between the oil price series and the total production indices of the country groups is verified. To this end, the F_{PSS} and T_{BDM} statistics proposed by Pesaran et al. (2001) and Banerjee et al. (1998), respectively, are used. The F_{PSS} statistic is used to test the null hypothesis $H_0^{PSS} : \rho = \theta^{+} = \theta^{-} = 0$ against the alternative hypothesis $H_1^{PSS} : \rho \neq \theta^{+} \neq \theta^{-} \neq 0$. The T_{BDM} statistic tests the null hypothesis $H_0^{BDM} : \rho = 0$ against the alternative hypothesis $H_1^{BDM} : \rho < 0$.

If the previous tests provide statistical evidence of a stable long-run relationship between production and the positive and negative components of oil prices, the next

step is to use the Wald test to examine symmetry in the long-run and short-run relationship between economic growth and oil prices. In the long run, the null hypothesis of symmetry is given by $H_0^{LP} : \theta^+ = \theta^-$ against the alternative hypothesis of asymmetry $H_1^{LP} : \theta^+ \neq \theta^-$. In the short run, the null hypothesis of symmetry is evaluated as $H_0^{CP} : \sum_{h=0}^{q-1} \varphi_h^+ = \sum_{h=0}^{q-1} \varphi_h^-$ against the alternative hypothesis of asymmetry $H_1^{CP} : \sum_{h=0}^{q-1} \varphi_h^+ \neq \sum_{h=0}^{q-1} \varphi_h^-$.

Finally, the cumulative dynamic impact of a unit change in OIL_t^+ and OIL_t^- on $IP_{j,t}^y$ is calculated as follows:

$$m_h^+ = \sum_{i=0}^{h} \frac{\partial IP_{j,t+i}^y}{\partial OIL_t^+}, \qquad m_h^- = \sum_{i=0}^{h} \frac{\partial IP_{j,t+i}^y}{\partial OIL_t^-}, \qquad h = 0, 1, 2, \ldots \tag{8}$$

According to Shin et al. (2014), as $h \to \infty$, then $m_h^+ \to \theta^+$ and $m_h^- \to \theta^-$, where $\theta^+ = -\frac{\phi^+}{\rho}$ and $\theta^- = -\frac{\phi^-}{\rho}$ represent the asymmetric long-run coefficients.

For each calculated $P_{(j,t)}^y$, an auxiliary time-series regression is performed to remove the overall linear growth trend. Consequently, the results should be interpreted as deviations from this underlying linear trend.

The entire process described in this section is carried out separately for the groups of oil-exporting and oil-importing countries.

3.3.2 Unit root tests

The estimation of the NARDL model requires the time series of the adjusted production indices and oil prices to be either $I(1)$ or $I(0)$. Therefore, this study uses the augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to determine the order of integration of the variables (Table 2).

Cuadro 2: Unit Root Test Results

Index	**ADF test**		**PP test**	
	Levels	**First Diff.**	**Levels**	**First Diff.**
Weighted index for oil-importing	-2.781^{*}	-4.620^{***}	-3.712^{***}	-11.072^{***}
Weighted index for oil-exporting	-2.527	-4.417^{***}	-3.221^{**}	-9.883^{***}
Oil price BRENT reference	-2.035	-4.238^{***}	-2.598^{*}	-8.591^{***}

Note: *** statistical significance at 1%, ** statistical significance at 5%, and * statistical significance at 10%.
Source: Authors' calculations.

The results show that the series exhibit a combination of $I(0)$ and $I(1)$ behavior. In particular, the production index for importing countries shows stationarity in levels, while the production index for exporting countries and the Brent oil price become stationary after first difference. Since none of the variables shows evidence of being integrated of order two, $I(2)$, the necessary conditions for applying the NARDL methodology are satisfied.

3.3.3 Test of long-run weak exogeneity

The NARDL specification does not require assuming strict exogeneity of the explanatory variable; however, it does require the regressors to be weakly exogenous with respect to the long-run parameters. In this study, the international real Brent oil price is considered a weakly exogenous variable, since it is determined in international markets and the economies analyzed do not have the capacity to influence its formation. However, it could be argued that the production indicator constructed for the group of oil-exporting or oil-importing countries may have some long-run incidence on oil prices. To rule out this possibility, the Johansen cointegration test and two vector error correction models (VECM) with one lag are estimated, evaluating the direction of the long-run relationship between the variables analyzed.

Cuadro 3: Exogeneity Test Results

Statistic	**Oil-importing countries**	**Oil-exporting countries**
Johansen test	17.47***	16.98***
ECT coefficient (oil price equation)	0.19	0.01

Note: *** statistical significance at 1%, ** statistical significance at 5%, and * statistical significance at 10%.
Source: Authors' calculations.

The results of the Johansen statistic allow the null hypothesis of no cointegration to be rejected at the 1% significance level, indicating that there is at least one cointegrating vector in the long-run relationship between the economic growth indices of oil-exporting and oil-importing countries and the real oil price. On the other hand, the two VECM models for oil-exporting and oil-importing countries indicate that the estimator of the error correction term in the oil price equation is not statistically significant. Consequently, the international oil price does not respond to long-run disequilibria with the aggregate production indices and, therefore, can be considered weakly exogenous with respect to the long-run parameters of the model. This result supports the use of oil prices as an explanatory variable in the NARDL specification.

3.4 Results of the NARDL Model: Oil-exporting countries vs. Oil-importing countries

Table 4 presents the results of the cointegration tests proposed by Banerjee et al. (1998) and Pesaran et al. (2001), which are used to evaluate the existence of a long-run relationship between the oil price series and the economic growth index, both for emerging oil-exporting and oil-importing countries.

The results of both tests indicate that the null hypothesis of no cointegration between the variables is rejected at the 1% significance level for both groups of emerging countries. Therefore, it is possible to test for both short-run and long-run asymmetry in the relationship between the variables.

Cuadro 4: Results of asymmetric cointegration tests between production indices and oil prices

Weighted index	t_{BDM}	F_{PSS}
Oil-importing countries	-6.224^{***}	22.684^{***}
Oil-exporting countries	-9.605^{***}	34.120^{***}

Note: *** statistical significance at 1%, ** statistical significance at 5%, and * statistical significance at 10%.
Source: Authors' calculations.

To isolate the asymmetric effect of oil price variations, specific control variables were included for each group of countries. In the case of importing countries, the real end-of-quarter copper price was included because this indicator is correlated with oil prices and is one of the main export products of some economies, such as Chile and Peru. In the case of exporting economies, the end-of-quarter spot gasoline price on the U.S. Gulf Coast was used as the main reference for the international real gasoline price, since the U.S. Gulf Coast is the main source of imports for some countries, such as Mexico, which has the largest weight in the construction of the production index. This indicator captures the domestic channel through which energy shocks negatively affect the industrial sector in countries, such as Mexico, that do not produce enough gasoline to meet their entire domestic demand and therefore continue to import a significant share of the fuel they consume. [2] In both groups of countries, time dummies were included to control for the macroeconomic effects of the 2008 financial crisis and the COVID-19 pandemic.

Table 5 presents the estimation results of the NARDL model, while Figure 2 illustrates the behavior of the cumulative dynamic multipliers, which reflect the asymmetric short- and long-run dynamic interactions between the real oil price and the economic growth index of emerging crude oil-exporting and oil-importing countries. The confidence intervals for the asymmetry indicator were constructed using the bootstrap method with 1,000 resampling iterations.

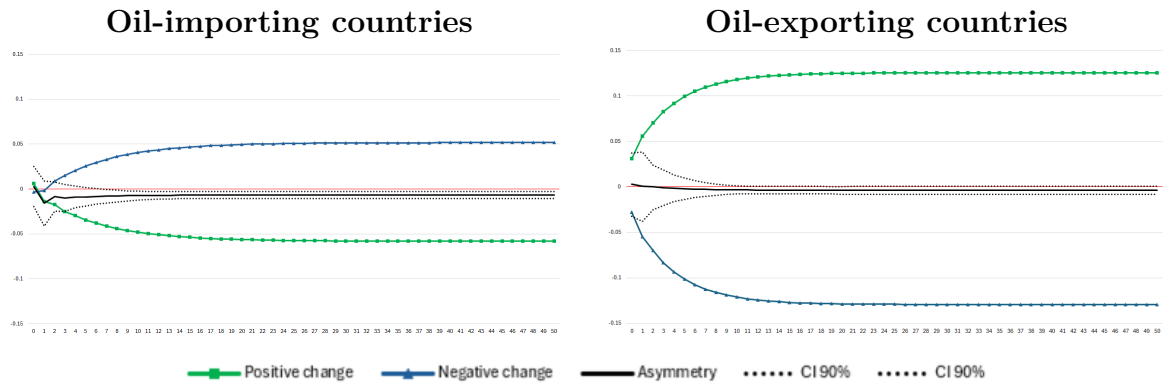
[2]The nominal prices of copper and gasoline were obtained from the World Bank's commodity price statistics and converted into real terms using the U.S. Consumer Price Index.

Cuadro 5: Estimation of the asymmetric effects of oil prices on economic growth in emerging oil-importing and oil-exporting countries

$\Delta IP^{y}_{j,t}$	**Oil-importing countries**	**Oil-exporting countries**
$IP^{y}_{j,t-1}$	-0.209^{***}	-0.267^{***}
OIL^{+}_{t-1}	-0.012^{***}	0.033^{***}
OIL^{-}_{t-1}	-0.011^{***}	0.034^{***}
$\Delta IP^{y}_{j,t-1}$	-0.290^{***}	-0.165^{***}
ΔOIL^{+}_{t}	0.006	0.031^{*}
ΔOIL^{+}_{t-1}	-0.005	0.004
ΔOIL^{-}_{t}	0.003	0.028
ΔOIL^{-}_{t-1}	0.011	0.004
Copper	0.009^{*}	—
ΔCopper	-0.015^{*}	—
Gasoline	—	-0.040^{***}
ΔGasoline	—	0.014
2008q1	0.009^{*}	-0.003
2008q2	-0.005	-0.002
2008q3	-0.005	0.004
2008q4	-0.018^{*}	-0.030^{**}
2009q1	-0.033^{***}	-0.059^{***}
2009q2	-0.019^{***}	-0.049^{***}
2020q1	-0.015^{**}	-0.031^{***}
2020q2	-0.127^{***}	-0.190^{***}
Cons	0.899^{***}	1.288^{***}
Long-run positive effect [+]	-0.058^{***}	0.125^{***}
Long-run negative effect [−]	0.052^{***}	-0.129^{***}
Long-run asymmetry (F-stat)	6.431^{**}	1.943
Short-run asymmetry (F-stat)	0.476	0.013

Note: *** statistical significance at 1%, ** statistical significance at 5%, and * statistical significance at 10%.
Source: Authors' calculations.

Figura 2: IRF of the asymmetric effects of oil prices on economic growth in emerging oil-importing and oil-exporting countries



Source: Authors' calculations.

In general terms, the results indicate that the role of countries in the energy market conditions the direction of the impact of oil price changes on economic growth. For emerging oil-exporting economies, an increase in oil prices raises economic growth, whereas a decrease in oil prices leads to a decline in economic activity. In contrast, for emerging oil-importing economies, an increase in oil prices produces an economic slowdown, while a reduction in oil prices supports economic growth in these countries. The findings also reveal that the response of aggregate output to oil price changes, whether positive or negative, is stronger in emerging oil-exporting countries than in oil-importing countries.

For importing countries, as shown in Table 5, the Wald statistic (6.431) allows the null hypothesis of a symmetric long-run relationship between real oil prices and economic growth to be rejected. This suggests that there are differences in the long-run impact on aggregate output in response to positive and negative oil price changes. A 1% increase in oil prices reduces long-run economic growth by up to 0.058%, while a decrease of the same magnitude increases growth by approximately 0.052%.

This result has been documented in the literature by studies such as Mork (1989), Hamilton (1996), and Jimenez-Rodriguez and Sanchez (2005). It can be explained, first, by the fact that increases in oil prices generate high adjustment costs associated with the reallocation of resources from energy-intensive sectors toward sectors that are less dependent on energy. This process raises marginal costs and leads to a contraction in economic activity. In addition, an increase in this indicator reduces the profitability of

investment in the medium term due to macroeconomic uncertainty. Another relevant factor explaining the asymmetry in the macroeconomic effect of oil price variations is the response of macroeconomic policy. In particular, inflationary pressures caused by these changes force monetary authorities to adopt more restrictive policies. The contractionary stance of monetary policy deepens the decline in economic activity. Thus, higher production costs, lower investment, and a more contractionary monetary policy stance amplify the negative effects of oil price increases on output.

For emerging oil-exporting countries, the results indicate that a 1% increase in oil prices raises their long-run economic growth by around 0.125%, while a decrease of the same magnitude reduces it by approximately 0.129%. In this case, unlike for importing countries, the Wald statistic (1.943) does not support the hypothesis of asymmetry in the long-run impact of real oil price variations on economic growth. This indicates that positive and negative variations have the same effect on economic growth in this group of countries, but with opposite signs.

Regarding short-run dynamics, the Wald statistics reported in Table 5 do not provide evidence of asymmetric short-run effects on economic activity in response to increases and decreases in real oil prices, either for emerging oil-importing countries or for emerging oil-exporting countries (0.476 and 0.013, respectively).

3.5 Robustness analysis

The robustness of the baseline results is assessed through two complementary exercises. First, the NARDL models are re-estimated for both groups of countries using the WTI oil price as an alternative benchmark to Brent. Second, the models are re-estimated using shorter samples that exclude the most recent observations. Specifically, one specification is estimated using data up to 2023Q1 ($T-4$) and another using data up to 2022Q1 ($T-8$). These exercises allow us to evaluate whether the main conclusions are sensitive to the oil price measure employed and to the inclusion of the most recent observations in the sample.

3.5.1 Estimation using the real WTI oil price

The first robustness test consists of re-estimating the NARDL models for the groups of oil-importing and oil-exporting countries by replacing the real Brent oil price with the

WTI benchmark. Table 6 and Figures 3 and 4 compare the estimates obtained using both oil price benchmarks. The estimates suggest that the signs of the coefficients and the main conclusions obtained with the Brent oil price are maintained when the WTI price is used.

In particular, the results show that an increase in oil prices raises economic growth in exporting countries and reduces it in importing countries. A decrease in oil prices produces the opposite effects in both groups of countries. The estimation using the WTI oil price preserves the long-run asymmetric effect for importing economies in response to variations in this indicator, as well as the absence of asymmetry in the impact on exporting economies.

Cuadro 6: Estimation of the asymmetric effects of oil prices on economic growth in emerging oil-importing and oil-exporting countries, by oil price benchmark

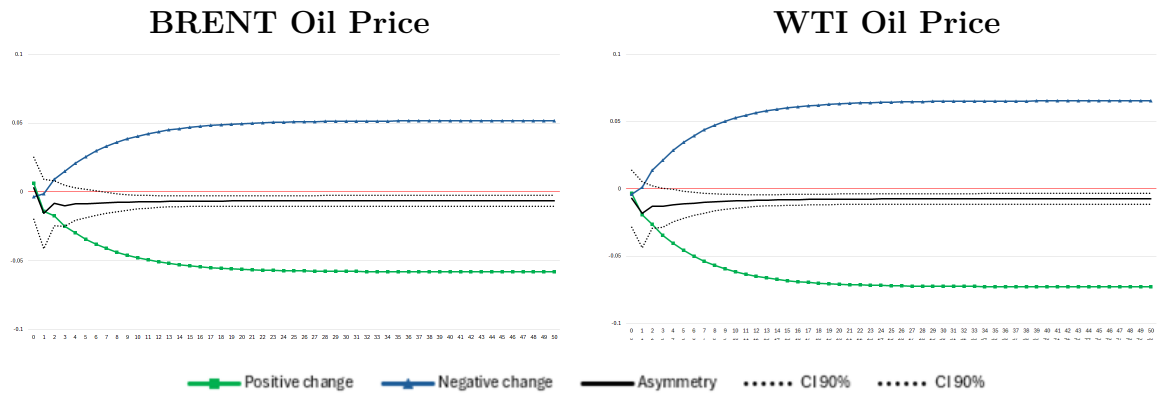
$\Delta IP^{y}_{j,t}$	**Oil-importing countries**		**Oil-exporting countries**	
	BRENT Oil Price	**WTI Oil Price**	**BRENT Oil Price**	**WTI Oil Price**
$IP^{y}_{j,t-1}$	-0.209^{***}	-0.216^{***}	-0.267^{***}	-0.255^{***}
OIL^{+}_{t-1}	-0.012^{***}	-0.016^{***}	0.033^{***}	0.015
OIL^{-}_{t-1}	-0.011^{***}	-0.014^{***}	0.034^{***}	0.016
$\Delta IP^{y}_{j,t-1}$	-0.290^{***}	-0.277^{***}	-0.165^{***}	-0.171^{***}
ΔOIL^{+}_{t}	0.006	-0.003	0.031^{*}	0.023
ΔOIL^{+}_{t-1}	-0.005	-0.002	0.004	0.007
ΔOIL^{-}_{t}	0.003	0.004	0.028	0.013
ΔOIL^{-}_{t-1}	0.011	0.011	0.004	-0.002
Copper	0.009^{*}	0.011^{**}	—	—
ΔCopper	-0.015^{*}	-0.015^{**}	—	—
Gasoline	—	—	-0.040^{***}	-0.018
ΔGasoline	—	—	0.014	0.004
2008q1	0.009^{*}	0.010^{*}	-0.003	-0.004
2008q2	-0.005	-0.002	-0.002	-0.003
2008q3	-0.005	-0.003	0.004	-0.001
2008q4	-0.018^{*}	-0.014	-0.030^{**}	-0.034^{**}
2009q1	-0.033^{***}	-0.031^{***}	-0.059^{***}	-0.062^{***}
2009q2	-0.019^{***}	-0.016^{**}	-0.049^{***}	-0.049^{***}
2020q1	-0.015^{**}	-0.015^{**}	-0.031^{***}	-0.028^{**}
2020q2	-0.127^{***}	-0.128^{***}	-0.190^{***}	-0.191^{***}
Cons	0.899^{***}	0.912^{***}	1.288^{***}	1.214^{***}
Long-run positive effect [+]	-0.058^{***}	-0.073^{***}	0.125^{***}	0.060
Long-run negative effect [−]	0.052^{***}	0.065^{***}	-0.129^{***}	-0.063
Long-run asymmetry (F-stat)	6.431^{**}	9.423^{***}	1.943	1.241
Short-run asymmetry (F-stat)	0.476	1.217	0.013	0.369

Note: *** statistical significance at 1%, ** statistical significance at 5%, and * statistical significance at 10%.
Source: Authors' calculations.

However, the long-run effects for exporting countries cease to be statistically significant. The macroeconomic impact of positive and negative variations in the Brent oil price is greater than that generated by the WTI price. This result can be explained by the fact that Brent better reflects conditions in the global oil market, whereas WTI incorporates to a greater extent factors specific to the U.S. market. Since most of the exporting countries included in the sample trade their production using benchmarks linked to Brent or differentials relative to this marker, the Brent price more accurately captures the relevant external shock for these economies. Consequently, the use of WTI

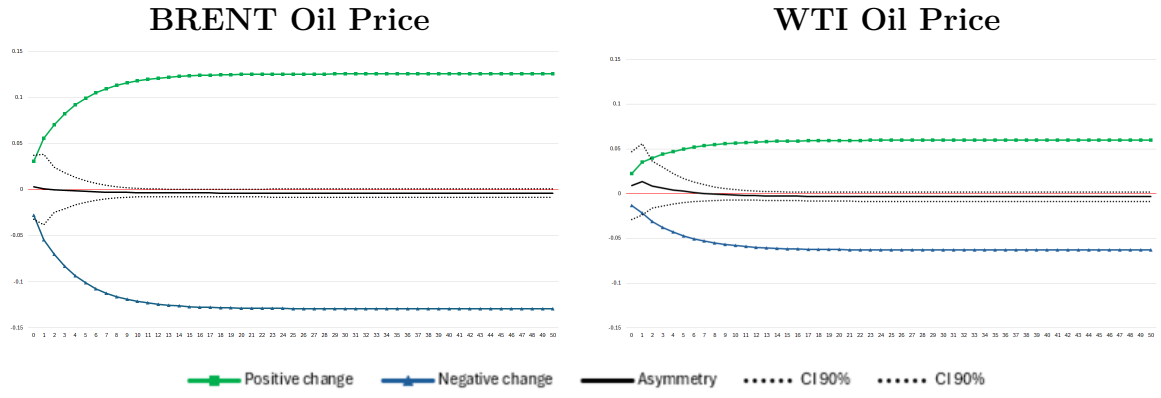
reduces the precision of the long-run estimates, although it does not alter the signs of the coefficients or the qualitative conclusions of the analysis, thereby confirming the robustness of the main results

Figura 3: IRF of the asymmetric effects of oil prices on economic growth in emerging oil-importing countries, by oil price benchmark



Source: Authors' calculations.

Figura 4: IRF of the asymmetric effects of oil prices on economic growth in emerging oil-exporting countries, by oil price benchmark



Source: Authors' calculations.

3.5.2 Estimation restricting the sample period

The second robustness test consists of estimating two models. In the first, the sample period is restricted up to 2023Q1 ($T-4$), while in the second, the sample is limited up

to 2022Q1 ($T-8$). These exercises are conducted in order to verify that the results are robust to minor changes in the sample period.

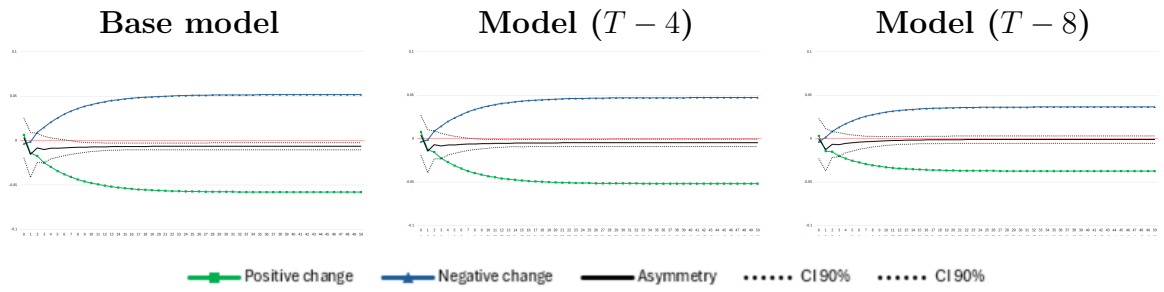
Cuadro 7: Estimation of the asymmetric effects of oil prices on economic growth in emerging oil-importing and oil-exporting countries, by sample size

$\Delta IP^y_{j,t}$	**Oil-importing countries**			**Oil-exporting countries**		
	Base model	**Model** ($T-4$)	**Model** ($T-8$)	**Base model**	**Model** ($T-4$)	**Model** ($T-8$)
$IP^y_{j,t-1}$	-0.209^{***}	-0.217^{***}	-0.236^{***}	-0.267^{***}	-0.274^{***}	-0.282^{***}
OIL^+_{t-1}	-0.012^{***}	-0.011^{***}	-0.009^{**}	0.033^{***}	0.030^{**}	0.031^{**}
OIL^-_{t-1}	-0.011^{***}	-0.010^{***}	-0.009^{**}	0.034^{***}	0.031^{**}	0.032^{**}
$\Delta IP^y_{j,t-1}$	-0.290^{***}	-0.286^{***}	-0.275^{***}	-0.165^{***}	-0.164^{***}	-0.166^{***}
ΔOIL^+_t	0.006	0.007	0.003	0.031^{*}	0.030^{*}	0.035^{*}
ΔOIL^+_{t-1}	-0.005	-0.005	-0.007	0.004	0.003	-0.004
ΔOIL^-_t	0.003	0.004	0.004	0.028	0.028	0.035^{*}
ΔOIL^-_{t-1}	0.011	0.010	0.005	0.004	0.001	-0.005
Copper	0.009^{*}	0.008	0.007	—	—	—
ΔCopper	-0.015^{*}	-0.014^{*}	-0.012	—	—	—
Gasoline	—	—	—	-0.040^{***}	-0.035^{**}	-0.036^{*}
ΔGasoline	—	—	—	0.014	0.010	0.004
2008q1	0.009^{*}	0.010^{*}	0.011^{*}	-0.003	-0.002	-0.001
2008q2	-0.005	-0.004	-0.002	-0.002	-0.001	0.000
2008q3	-0.005	-0.004	-0.003	0.004	0.005	0.008
2008q4	-0.018^{*}	-0.018^{*}	-0.018^{*}	-0.030^{**}	-0.030^{**}	-0.033^{**}
2009q1	-0.033^{***}	-0.033^{***}	-0.036^{***}	-0.059^{***}	-0.060^{***}	-0.063^{***}
2009q2	-0.019^{***}	-0.019^{***}	-0.017^{***}	-0.049^{***}	-0.048^{***}	-0.047^{***}
2020q1	-0.015^{**}	-0.015^{**}	-0.015^{**}	-0.031^{***}	-0.030^{***}	-0.030^{**}
2020q2	-0.127^{***}	-0.128^{***}	-0.131^{***}	-0.190^{***}	-0.192^{***}	-0.196^{***}
Cons	0.899^{***}	0.940^{***}	1.034^{***}	1.288^{***}	1.314^{***}	1.354^{***}
Long-run positive effect [+]	-0.058^{***}	-0.052^{**}	-0.037^{**}	0.125^{***}	0.111^{**}	0.111^{**}
Long-run negative effect [−]	0.052^{***}	0.047^{**}	0.036^{**}	-0.129^{***}	-0.112^{**}	-0.112^{*}
Long-run asymmetry (F-stat)	6.431^{**}	3.316^{*}	0.171	1.943	0.0128	0.013
Short-run asymmetry (F-stat)	0.476	0.3517	0.421	0.013	0.015	0.000

Note: *** statistical significance at 1%, ** statistical significance at 5%, and * statistical significance at 10%.
Source: Authors' calculations.

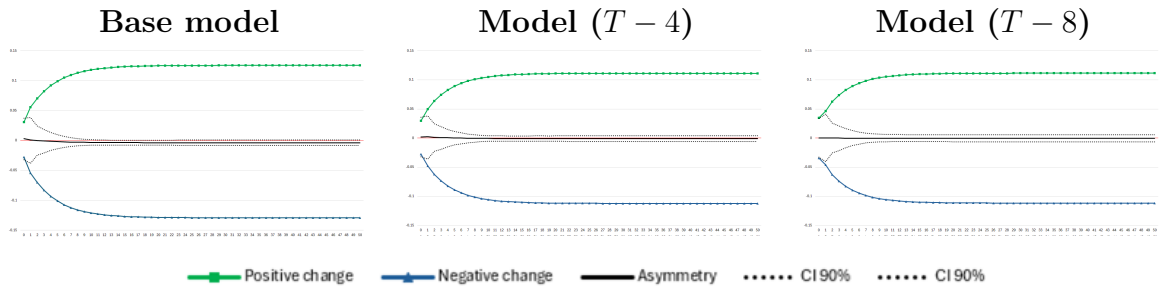
The results obtained from these estimations (Table 7 and Figures 5 and 6) are consistent with those of the baseline model. The macroeconomic effects of oil price variations maintain the same sign for both exporting and importing countries. Although the magnitudes of the coefficients show marginal variations, the main conclusions of the baseline model remain unchanged. This suggests that the results found in the study are robust to different sample sizes and reflect a solid relationship between oil prices and economic growth in emerging countries.

Figura 5: IRF of the asymmetric effects of oil prices on economic growth in emerging oil-importing countries, by sample size



Source: Authors' calculations.

Figura 6: IRF of the asymmetric effects of oil prices on economic growth in emerging oil-exporting countries, by sample size



Source: Authors' calculations.

4 The monetary policy framework as a source of asymmetry in the effects of oil price changes on economic growth in emerging countries

The literature suggests that the monetary policy framework plays a determining role in the asymmetric relationship between real oil prices and economic growth in emerging countries. For this reason, the group of emerging oil-exporting and oil-importing countries is divided into two additional subgroups: those with an inflation-targeting regime (ITR) and those operating under other monetary policy frameworks (OMPF). The classification is constructed using the information reported in the IMF's *Annual*

Report on Exchange Arrangements and Exchange Restrictions. The countries included in each subgroup are presented in Table 8.

Cuadro 8: Emerging oil-importing and oil-exporting countries by monetary policy framework

Oil-importing countries		**Oil-exporting countries**	
Inflation-targeting regime	**Other monetary policy frameworks**	**Inflation-targeting regime**	**Other monetary policy frameworks**
Chile	Bosnia	Albania	Argentina
Costa Rica	Bulgaria	Colombia	Belice
Hungría	El Salvador	Guatemala	Bolivia
Indonesia	Honduras	Kazajistán	Ecuador
Jamaica	Jordania	México	
Paraguay	Nicaragua		
Perú	Macedonia del Norte		
Filipinas			
Polonia			
Rumania			
Serbia			
Sudáfrica			
Tailandia			
Turquía			

Source: IMF and Authors' calculations.

For each subgroup of emerging countries, a new NARDL model is estimated in order to assess the differential effect of increases and decreases in oil prices on economic growth. The results obtained (Table 9 and Figures 7 and 8) indicate that emerging crude oil-importing and oil-exporting countries that adopt an inflation-targeting regime experience a smaller impact on economic growth in response to oil price changes than those that follow other monetary policy frameworks.

For emerging oil-importing countries, a 1% increase in the real oil price is associated with a 0.058% decrease in economic growth in countries with an inflation-targeting regime, while in countries with other monetary policy frameworks the reduction is 0.068%. Similarly, a 1% decrease in the real oil price generates an increase in economic growth of 0.051% in countries with an inflation-targeting regime and 0.064% in those with other monetary policy frameworks.

In emerging oil-exporting countries, the results show effects with the opposite sign, although they are also shaped by the monetary policy framework. A 1% increase in the real oil price translates into an increase in economic growth of 0.065% in emerging exporting countries with an inflation-targeting regime and 0.246% in countries with other monetary policy frameworks. Conversely, a reduction of the same magnitude in crude oil prices produces an economic contraction of 0.068% in countries with an inflation-targeting regime and 0.262% in countries with other monetary policy frameworks.

In the short run, the results show the same pattern as the long-run findings. Oil-importing and oil-exporting countries that adopt an inflation-targeting regime experience smaller fluctuations in economic growth in response to oil price changes compared with countries under other monetary policy regimes. However, the Wald statistic does not support the hypothesis of short-run asymmetry for either emerging oil-importing or oil-exporting countries.

Cuadro 9: Estimation of the asymmetric effects of oil prices on economic growth in emerging oil-importing and oil-exporting countries, by monetary policy framework

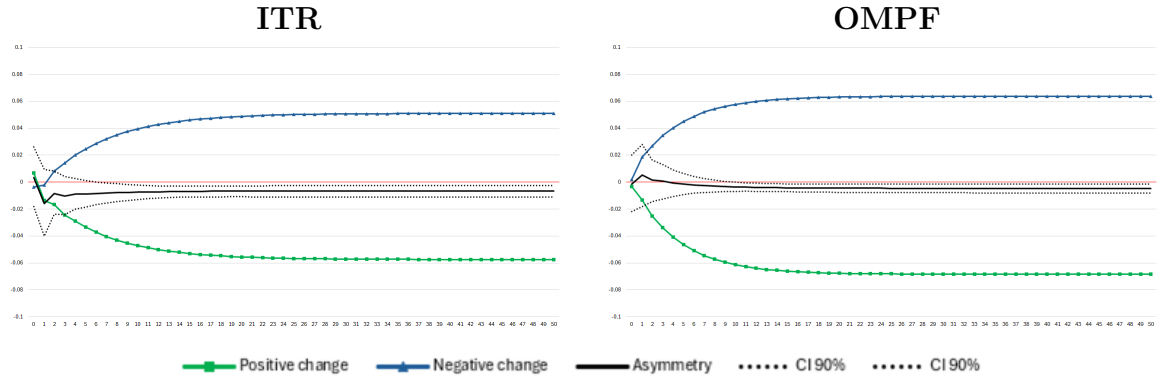
$\Delta IP^{y}_{j,t}$	**Oil-importing countries**		**Oil-exporting countries**	
	ITR	**OMPF**	**ITR**	**OMPF**
$IP^{y}_{j,t-1}$	-0.206^{***}	-0.254^{***}	-0.308^{***}	-0.163^{***}
OIL^{+}_{t-1}	-0.012^{***}	-0.017^{***}	0.020^{*}	0.040
OIL^{-}_{t-1}	-0.011^{***}	-0.016^{***}	0.021^{**}	0.043^{*}
$\Delta IP^{y}_{j,t-1}$	-0.292^{***}	-0.198^{***}	-0.158^{***}	-0.106
ΔOIL^{+}_{t}	0.007	-0.003	0.014	0.055
ΔOIL^{+}_{t-1}	-0.005	0.006	-0.005	0.034
ΔOIL^{-}_{t}	0.003	-0.002	0.006	0.062^{*}
ΔOIL^{-}_{t-1}	0.011	-0.001	0.009	-0.005
Copper	0.008	0.022^{***}	—	—
ΔCopper	-0.014^{*}	-0.026^{***}	—	—
Gasoline	—	—	-0.030^{**}	-0.048
ΔGasoline	—	—	0.012	0.016
2008q1	0.008	0.027^{***}	-0.003	-0.006
2008q2	-0.006^{*}	0.016^{***}	0.003	-0.013
2008q3	-0.005	0.007	0.001	0.009
2008q4	-0.018^{*}	0.000	-0.033^{***}	-0.023
2009q1	-0.034^{***}	-0.012^{*}	-0.058^{***}	-0.061^{**}
2009q2	-0.019^{***}	0.002	-0.046^{***}	-0.057^{***}
2020q1	-0.015^{**}	-0.018^{***}	-0.031^{***}	-0.030
2020q2	-0.128^{***}	-0.109^{***}	-0.186^{***}	-0.194^{***}
Cons	0.890^{***}	0.995^{***}	1.459^{***}	0.826^{***}
Long-run positive effect [+]	-0.058^{**}	-0.068^{***}	0.065^{*}	0.246
Long-run negative effect [−]	0.051^{**}	0.064^{***}	-0.068^{*}	-0.262^{*}
Long-run asymmetry (F-stat)	6.144^{**}	6.199^{**}	1.575	2.518
Short-run asymmetry (F-stat)	0.466	0.130	0.058	0.310

Note: *** statistical significance at 1%, ** statistical significance at 5%, and * statistical significance at 10%.
Source: Authors' calculations.

The results indicate that inflation-targeting regimes help reduce the volatility of economic growth generated by oil price variations, moderating both the negative (positive) effects in importing economies and the expansions (contractions) in exporting economies following increases (decreases) in crude oil prices.

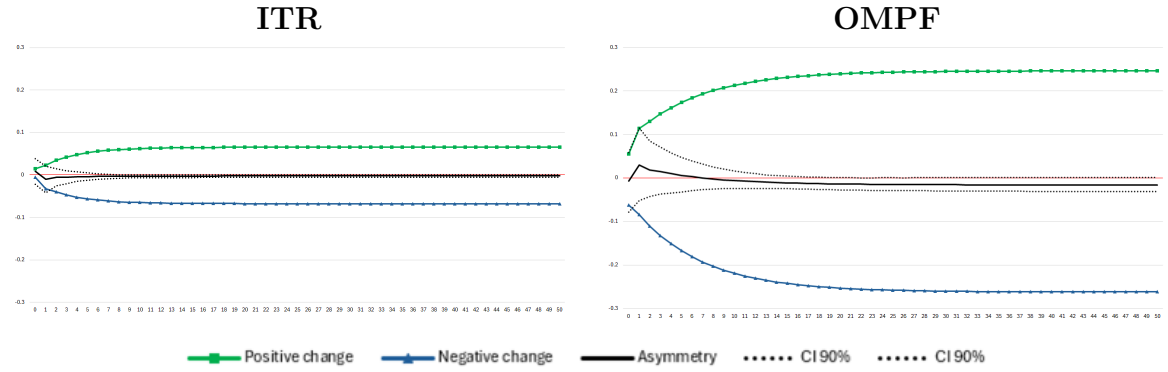
This suggests that an emerging country, whether an oil importer or exporter, may

Figura 7: IRF of the asymmetric effects of oil prices on economic growth in emerging oil-importing countries, by monetary policy framework



Source: Authors' calculations.

Figura 8: IRF of the asymmetric effects of oil prices on economic growth in emerging oil-exporting countries, by monetary policy framework



Source: Authors' calculations.

reduce the amplitude of the effects of oil price changes on its macroeconomic variables if it operates under an inflation-targeting regime, compared with emerging countries that follow other monetary policy frameworks. This finding highlights the fundamental role of monetary policy frameworks in mitigating, or taking advantage of, the adverse or beneficial effects of oil shocks on economic growth in emerging economies.

5 Oil dependence as a source of asymmetry in the effects of oil price changes on economic growth in emerging countries

In this section, alternative aggregate production indices are constructed for emerging oil-exporting and oil-importing countries, using as the weighting criterion the share of external oil revenues and external oil expenditures as a percentage of GDP per year, respectively. [3] These shares are normalized so that the weights reflect the relative importance of oil in the economy of each oil-importing or oil-exporting country (Tables 10 and 11). Subsequently, both NARDL models are estimated again in order to identify whether the impact of oil price variations on economic growth in emerging crude oil-importing and oil-exporting countries is greater when oil dependence is taken into account instead of countries' economic size.

[3] Given data availability at the time of sample selection, the weight used for 2024Q1 was calculated using the 2023 weighting data.

Cuadro 10: Emerging oil-importing countries by level of dependence (Average oil imports as a percentage of GDP from 2005 to 2023 (dependence) and assigned weight in the alternative production index)

Country	Dependence	Weighting	Country	Dependence	Weighting
Thailand	6.46%	12.64%	Chile	2.16%	4.22%
Bulgaria	6.46%	12.62%	Rumania	2.13%	4.17%
Jordan	4.99%	9.76%	Philippines	1.91%	3.73%
Jamaica	3.60%	7.03%	Bosnia	1.82%	3.56%
Nicaragua	3.45%	6.73%	Perú	1.51%	2.95%
South Africa	3.11%	6.09%	Indonesia	1.20%	2.34%
North Macedonia	2.91%	5.68%	El Salvador	0.98%	1.92%
Serbia	2.65%	5.18%	Turkey	0.40%	0.79%
Poland	2.62%	5.13%	Costa Rica	0.27%	0.53%
Hungary	2.52%	4.93%	Paraguay	0.00%	0.01%
			Honduras	0.00%	0.00%

Source: Le Centre d'études prospectives et d'informations internationales, The Observatory of Economic Complexity, World Bank and Authors' calculations.

Cuadro 11: Emerging oil-exporting countries by level of dependence (Average oil exports as a percentage of GDP from 2005 to 2023 (dependence) and assigned weight in the alternative production index)

Country	Dependence	Weighting	Country	Dependence	Weighting
Kazakhstan	16.96%	40.09%	Albania	2.07%	4.90%
Ecuador	11.04%	26.09%	Bolivia	0.84%	1.98%
Colombia	5.07%	11.98%	Guatemala	0.37%	0.87%
México	2.92%	6.90%	Argentina	0.35%	0.83%
Belize	2.69%	6.36%			

Source: Le Centre d'études prospectives et d'informations internationales, The Observatory of Economic Complexity, World Bank and Authors' calculations.

Table 12 presents the estimation results using the production indices weighted by oil dependence, while Figures 9 and 10 show the cumulative dynamic multipliers obtained from the estimation of these alternative NARDL models, comparing them with those obtained in the baseline estimation, where weights are assigned according to the size of the economies. As can be seen, a 1% increase in oil prices reduces the long-run economic growth index of emerging oil-importing countries to a greater extent when the index is

constructed using oil-dependence weights, compared with the index constructed using economic-size weights (-0.082% vs. -0.058%). Likewise, a decline in crude oil prices of the same magnitude is associated with a larger positive impact on long-run GDP growth in the index weighted by oil dependence than in the index constructed according to economic size (0.076% vs. 0.052%).

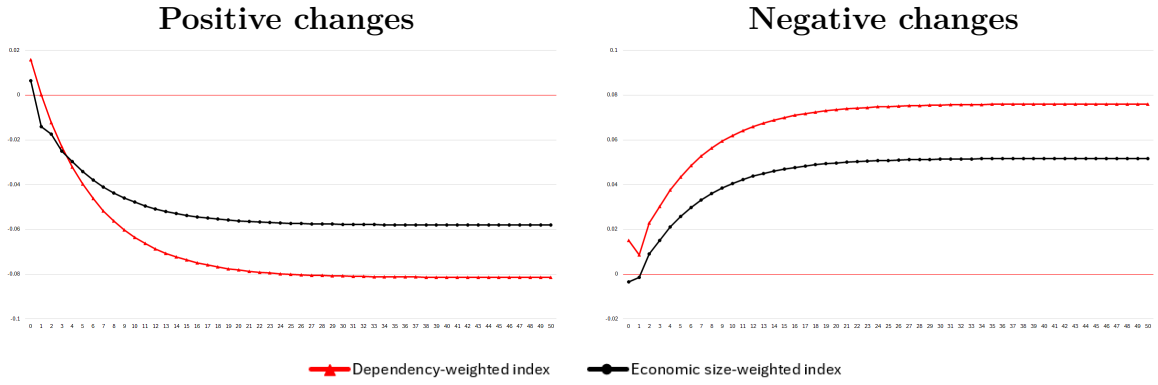
On the other hand, in emerging oil-exporting countries, the production index weighted by oil dependence responds more strongly in the long run to 1% increases and decreases in oil prices (0.239% and -0.244%, respectively), compared with the results obtained for the index weighted by economic size (0.125% and -0.129%, respectively).

Cuadro 12: Estimation of the asymmetric effects of oil prices on economic growth in emerging oil-importing and oil-exporting countries

$\Delta IP^{y}_{j,t}$	**Oil-importing countries**	**Oil-exporting countries**
$IP^{y}_{j,t-1}$	-0.192^{***}	-0.137^{***}
OIL^{+}_{t-1}	-0.016^{***}	0.033^{**}
OIL^{-}_{t-1}	-0.015^{***}	0.033^{**}
$\Delta IP^{y}_{j,t-1}$	-0.202^{***}	-0.144^{**}
ΔOIL^{+}_{t}	0.016	0.018
ΔOIL^{+}_{t-1}	0.006	0.001
ΔOIL^{-}_{t}	-0.015	0.011
ΔOIL^{-}_{t-1}	0.015	0.021^{*}
Copper	0.015^{*}	—
ΔCopper	-0.016	—
Gasoline	—	-0.033^{**}
ΔGasoline	—	0.012
2008q1	0.008	-0.002
2008q2	0.005	-0.001
2008q3	0.001	-0.008
2008q4	-0.008	-0.039^{***}
2009q1	-0.025^{**}	-0.004
2009q2	-0.017^{*}	-0.011
2020q1	-0.081^{***}	-0.029^{**}
2020q2	-0.137^{***}	-0.115^{***}
Cons	0.772^{***}	0.672^{***}
Long-run positive effect [+]	-0.082^{**}	0.239^{**}
Long-run negative effect [−]	0.076^{**}	-0.244^{**}
Long-run asymmetry (F-stat)	1.923	0.955
Short-run asymmetry (F-stat)	0.622	0.215

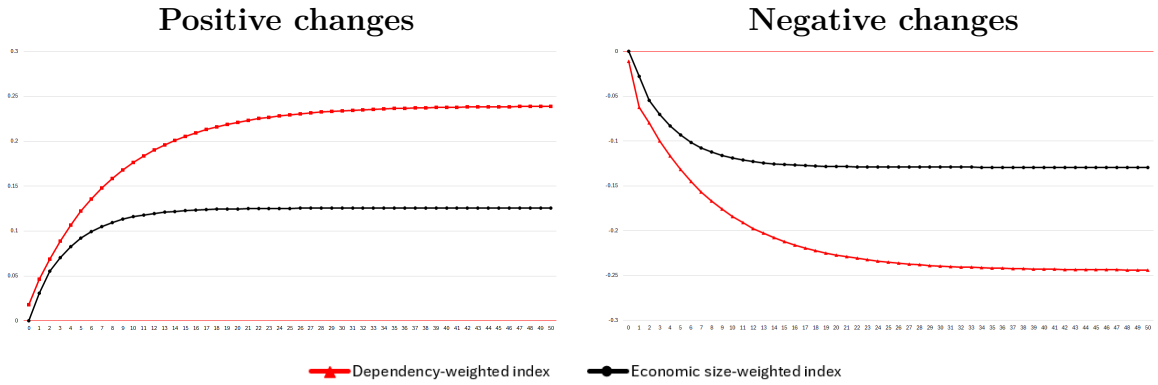
Note: *** statistical significance at 1%, ** statistical significance at 5%, and * statistical significance at 10%.
Source: Authors' calculations.

Figura 9: IRF of the asymmetric effects of oil prices on economic growth in emerging oil-importing countries, by level of dependence



Source: Authors' calculations.

Figura 10: IRF of the asymmetric effects of oil prices on economic growth in emerging oil-exporting countries, by level of dependence



Source: Authors' calculations.

6 Conclusions

This study applies a NARDL model to evaluate the asymmetric impact of oil price variations on economic growth in 31 emerging economies over the period 2005–2024, distinguishing between oil-exporting and oil-importing countries. In addition, it shows the differential effect of these impacts in the short and long run, and presents results differentiated by monetary policy framework, as well as an alternative specification that

takes into account the level of oil dependence in the countries analyzed.

The results show that an increase in oil prices reduces economic growth in importing countries, while a decrease generates an expansionary effect. For exporting countries, a positive effect on economic activity is observed following an increase in oil prices, while declines in oil prices lead to a contraction.

For importing countries, the response of productive activity to increases and decreases in oil prices is asymmetric in the long run, since increases in oil prices generate a larger impact on economic growth than price decreases. This finding suggests that adjustment costs, resource reallocation, and economic policy responses amplify the contractionary effects of positive oil fluctuations in importing countries. For exporting countries, this asymmetry is not present either in the short run or in the long run, since increases and decreases generate effects of similar magnitude on GDP growth, but with opposite signs.

An important contribution of this paper is that it conducts a comparative analysis of the role played by the monetary policy framework in the asymmetric effect of oil price variations on economic growth across countries. The results suggest that emerging oil-importing and oil-exporting countries that adopt an inflation-targeting regime experience a smaller impact on their business cycles in response to oil price changes. The empirical evidence found in this study indicates that this monetary policy framework is more effective in mitigating the transmission of oil shocks to economic activity.

Another important contribution of this study is that it finds that oil dependence generates greater vulnerability to oil price variations. The results reveal that an emerging country with high oil dependence, whether an oil exporter or importer, is more vulnerable to oil price changes than economies that are less dependent on crude oil.

The results of this study have important implications for the design of macroeconomic policy in emerging economies. First, the evidence that countries with inflation-targeting regimes exhibit lower sensitivity of economic growth to oil price changes suggests that a credible, transparent monetary policy framework aimed at anchoring expectations can help reduce the transmission of external shocks to economic activity. In this regard, strengthening central bank independence, improving monetary policy communication, and consolidating the credibility of the monetary regime are elements that may increase the capacity of economies to absorb disturbances originating in international commodity markets. Nevertheless, these results should be interpreted as evidence of greater resilience associated with this institutional framework, and not necessarily as a direct causal

relationship.

Second, the results show that high oil dependence increases the vulnerability of emerging economies to fluctuations in oil prices, regardless of whether they are net exporters or net importers. This highlights the importance of implementing policies aimed at diversifying the productive and export structure, reducing fossil-fuel-based energy intensity, and strengthening macroeconomic stabilization mechanisms, such as countercyclical fiscal rules and stabilization funds for economies that export natural resources. In the case of importing countries, diversifying the energy matrix, increasing energy efficiency, and reducing dependence on imported fuels may help reduce the exposure of economic growth to international oil shocks. These measures would make it possible to reduce business cycle volatility and strengthen resilience to external disturbances.

Overall, the findings suggest that the vulnerability of emerging economies to oil shocks does not depend exclusively on whether they are crude oil exporters or importers, but also on the strength of their macroeconomic institutions and their degree of oil dependence. Consequently, policies aimed at strengthening monetary and fiscal policy frameworks, together with productive and energy diversification strategies, may play a complementary role in mitigating the effects of oil price changes on economic growth and in increasing economies' capacity to face episodes of high volatility in international energy markets.

As a recommendation for future research, it would be valuable to further analyze other factors that may influence the dynamics of the effects of oil price variations, such as fiscal and trade policies. In addition, comparing the impacts across emerging economies with different characteristics and levels of development could provide a more comprehensive understanding of the challenges and opportunities that countries face in the context of oil price volatility.

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