European Industrial Production in the Face of Energy Dynamics and Geopolitical Shocks

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Abstract

We assess the resilience and vulnerability of European industrial production to cyclical hydrocarbon-price shocks, geopolitical risks, and real effective exchange rates. Employing advanced analytical tools such as Panel VAR-GMM and Dynamic Common Correlation Effect (DCCE), we analyse monthly data from January 2000 to June 2023, encompassing 23 selected EU countries. Our findings reveal that European industrial production exhibits a degree of vulnerability to oil price shocks, particularly in the case of manufacturing production. Conversely, the industrial sector demonstrates resilience when faced with shocks in gas prices. Notably, industrial production responds adversely to geopolitical risks and escalations, with the impact being more pronounced in the presence of geopolitically induced hydrocarbon price shocks. Our country-specific analysis underscores significant variations in vulnerability and resilience across the examined nations. The implications of our study extend to the formulation of pertinent policy measures tailored to address the specific challenges identified in each context.

Keywords: Industrial Production; Oil Price Shocks; Geopolitical Risks; PVAR; EU.

1. Introduction

The stability of industrial production is critically important for achieving sustainable development goals at the national level. A variety of factors influence industrial output, including the stability of financial markets, the reliability of supply chains, and the strength of trade relations and diplomatic engagements. Energy availability and affordability also play a decisive role, alongside traditional inputs such as labor and capital. Given that industrial production often depends on energy-intensive processes, fluctuations in the prices of key resources—such as oil, gas, metals, and minerals—have profound implications. Previous research has consistently shown a strong link between geopolitical tensions and shifts in energy prices. This connection carries significant economic consequences, particularly for industrial sectors in EU member countries that rely heavily on imported energy. Against this backdrop, our primary objective is to assess how resilient—or vulnerable—industrial production in selected EU nations is to energy price volatility driven by geopolitical factors. By examining these dynamics, we aim to inform strategic decision-making and policy development, ultimately contributing to more sustainable and stable industrial production within the region.

Geopolitical risks exert influence on industrial production through both direct and indirect channels. One prominent direct channel is the disruption or difficulty faced by international supply chains. A notable example is the impact of sanctions on the Russian economy during the conflict with Ukraine in 2022, leading to a sluggish industrial production in several European countries. Moreover, geopolitical acts in hydrocarbon-exporting countries can directly impact industrial production. Instances of military conflict or revolution in these countries complicate production processes, leading to a reduction in energy exports to international partners. Such direct effects may have a lasting nature, requiring substantial time and resources for infrastructure restoration. Existing studies in the field, exploring international flows of hydrocarbon resources, affirm the impact of geopolitical risks on industrial production through these direct supply chain channels (Plakandaras et al., 2019; Reboredo et al., 2017; Desogus et al., 2023; Liu et al., 2023; Yang et al., 2023). The literature suggests that the increase of geopolitical risks positively affects the assets of green energy companies. This is attributed to countries viewing green energy sources as more stable and resistant to international events, leading to a shift away from traditional and volatile oil and gas. While in the short term, the growth of such technologies may impose a negative effect on industrial production due to substantial investments and time requirements, in the long run, it holds the potential for positive impacts (Gong et al., 2020; Rasoulinezhad et al., 2020). Anticipating and

navigating these dynamics is crucial for informed decision-making in the realm of industrial production.

Turning to the indirect channel, the pricing dynamics of hydrocarbon resources assume a pivotal role. Existing literature and anecdotal evidence consistently indicate that geopolitical risks wield a significant influence over hydrocarbon prices (Monge et al., 2023; Wang et al., 2022; Demirer et al., 2018; Cavalcanti et al., 2013). Consequently, an upswing in oil prices amplifies the costs associated with energy inputs, transportation, and procurement, thereby escalating the overall expenses of industrial production. Historical instances underscore the profound impact of geopolitical escalations on oil prices and, subsequently, on industrial production costs. An illustrative example is the oil embargo of 1973 during the Arab-Israeli war, which triggered a sharp spike in oil prices. The ensuing consequences included rapid global inflation and a substantial downturn in industrial production, emphasizing the critical role of energy as the lifeblood of industrial processes. Additionally, the Iranian Revolution of 1978-1979 and the subsequent Iran-Iraq War in 1980 were marked by increased oil costs. Furthermore, the United States' invasion of Iraq contributed to a sustained surge in oil prices, reaching a peak during another significant international geopolitical event—the Global Economic Crisis of 2008. Against this historical backdrop, we incorporate the indirect repercussions of geopolitically induced oil price hikes and their respective impact on industrial production. Understanding and accounting for these indirect influences are essential for a comprehensive assessment of the intricate interplay between geopolitical events, hydrocarbon prices, and industrial production dynamics.

Secondly, geopolitical risks extend their impact to the financial sector, a critical component of the economy. Empirical studies found that elevated geopolitical risks are correlated with a decline in asset profitability, subsequently diminishing the appeal of investments in production (Caldara et al., 2022; Balcilar et al., 2018). This reduction in investment attractiveness, in turn, has the potential to decelerate the growth of the country's industrial sector. Frequent geopolitical shocks, ranging from the outbreak of wars to terrorist acts and military buildups, are identified as triggers for economic downturns and a reduction in the overall standard of living (Glick et al., 2010). Moreover, the escalation of global geopolitical tensions can prompt individuals to curtail consumption in the present period, thereby contributing to a downturn in corporate profits. This interconnected relationship underscores the far-reaching consequences of geopolitical risks on both the financial realm and the broader economic landscape, necessitating a comprehensive understanding for effective risk management and policy formulation.

Despite the evident potential linkages between geopolitical risks and industrial production, the current body of literature has surprisingly neglected to explore this intersection in empirical settings. While a handful of studies have delved into analyzing the dynamic relationships between geopolitical risks and hydrocarbon prices, such as those conducted by Wang et al., 2022; Song et al., 2022; Bouoiyour et al., 2019; Zhang et al., 2023; Zhao et al., 2023; and Zheng et al., 2023, focusing on quantile connectedness and oil price volatilities, there remains a notable gap in addressing the direct implications for industrial production. Furthermore, investigations by Bossman et al., 2023; Sohag et al., 2022; and Das et al., 2019 have highlighted a robust connection between geopolitical events and capital market volatilities. A limited number of studies have explored how an increase in geopolitical risks negatively impacts foreign investment in less developed countries (Wang et al., 2019, and Bussy et al., 2023). This reduced foreign investment seeking safer havens with promising business potential and political stability may also influence industrial production. In our comprehensive review of the existing literature, we affirm that the empirical exploration of the dynamic effects of geopolitical risks on industrial production is conspicuously absent. This underscores the need for a more focused and inclusive examination of the intricate relationships between geopolitical risks and industrial production dynamics to better inform policymaking and risk management strategies.

In light of these premises, our study zeroes in on selected European Union member countries. The European Union stands as a formidable global alliance, boasting a collective GDP of $17.2 trillion in 2022, positioning it as the third-largest economy worldwide. Moreover, EU nations play pivotal roles as major exporters of industrial products and significant importers of natural resources. Consequently, ensuring a stable energy supply to EU countries becomes paramount for sustaining industrial production and fostering robust macroeconomic performance.

To the best of our knowledge, the extant literature does not examine the direct response of industrial production to rising geopolitical tensions and in the face of energy price shocks. Consequently, our study seeks to address this gap in the literature by examining the response of industrial production in the European Union to these external shocks. Our analysis delves into the dynamic response of industrial production, including the manufacturing production index, to shocks in these respective variables. Leveraging the Panel Vector Autoregression (VAR) method with the system Generalized Method of Moments (GMM), we adeptly account for both fixed effects and cross-sectional dependence (Love & Zicchino, 2006). For enhanced robustness and a nuanced country-specific examination, we employ the Dynamic Common Correlated Effects (DCCE) framework. This facilitates capturing the heterogeneous responses of industrial

production indices to various exogenous shocks. Our empirical inquiry yields novel insights. Across 23 EU countries, we observe that geopolitical risks, geopolitical actions, and oil price shocks collectively impede industrial production. Gas price shocks, on the other hand, appear insignificant, possibly attributable to the stable gas supply to the EU via pipelines from Russia until October 2022. To illustrate, Finland, Spain, Ireland and Slovenia demonstrate a favourable response to rising geopolitical risks, whereas France, Portugal, Austria and Latvia exhibit a reduction in industrial production in the context of rising geopolitical tensions. With regard to oil price shocks, a positive industrial response is evident in France, Germany, Poland and Slovakia, while industrial production in Spain, Ireland and Finland declines. These findings underscore the importance of considering individual countries' internal dynamics when assessing the impact of geopolitical and energy-related shocks on industrial production.

Rest of the paper is organized as following structure. Section 2 highlights the existing studies focusing on the interplay between geopolitical risks and economic performance. Section 3 describes data, DCCE and Panel VAR frameworks. Section 4 focuses Results and Discussion. Section 5 concludes the study along with policy implications.

2. Review of Literature

The first strand of literature focuses on examining the influence of geopolitical risks on the prices and volatility of traditional hydrocarbon resources. Within this body of research, scholars contend that geopolitical risks exert a noteworthy impact on escalating the volatility of oil prices, alongside other natural mineral resource prices (Wang et al., 2022; Song et al., 2022; Bouoiyour et al., 2019; Henriques et al., 2008; Dutta et al., 2020; Lee et al., 2021). Notably, investigations explore the correlation between geopolitical risks and diverse resources such as coal, copper, crude oil, gold, and iron ore. The surge in geopolitical risk markedly heightens the futures prices' volatility for coal, crude oil, and iron ore. Furthermore, heightened geopolitical risk correlates with decreased volatility in gold prices and exhibits no significant impact on copper prices. Additional analyses underscore that the price reactions become more pronounced in instances of exceptionally high geopolitical risk (Zheng et al., 2023; Zhao et al., 2023; Ahmed et al., 2012).

In the context of analyzing industrial production levels, as previously discussed, this influence can manifest indirectly through both price and input channels. Elevated price levels and increased price volatility contribute to heightened uncertainty in the business environment, complicating planning processes. Moreover, the rise in the cost of goods itself can potentially impede industrial production by exerting pressure on the overall production process.

The second strand of literature delves into the intricate relationship between geopolitical risks and the financial sector of the economy. This avenue of research explores the impact on investments in production, research and development, green investments, as well as the valuation and volatility of shares and assets of companies. Firstly, this line of inquiry unveils a substantial connection between the stock prices of firms and geopolitical risk. Importantly, this relationship is non-linear and exhibits variations contingent on the sector of activity. Secondly, it is observed that the shares of companies situated in more developed countries can function as a hedge, safeguarding investments against geopolitical risks, whereas companies in developing nations prove to be more susceptible to external influences (Bossman et al., 2023; Pringpong et al., 2023; Das et al., 2019; Li et al., 2017; Fernandez, 2008; Blomberg et al., 2004;).

Thirdly, research in this domain highlights a significant impact on dividend payout policies. The escalation of geopolitical risk introduces heightened uncertainty into firms' cash flows, instigating concerns about potential financial crises. Additionally, an upswing in geopolitical risk contributes to increased borrowing costs for firms and introduces impediments to investment (Adra et al., 2023; Wang et al., 2019; Nguyen et al., 2023).

Fourthly, geopolitical risk manifests discernible effects on investments in research and development (R&D). Consequently, there exists a negative correlation between geopolitical risk and R&D investments, with this influence persisting over multiple quarters. Notably, high-tech firms, small enterprises, and burgeoning companies are more susceptible to this effect (Wang et al., 2023; Plakandaras et al., 2019). The existing literature indicates that innovation matters in the promotion of industrial production (Liu et al., 2022). In the era of globalization, industrialization significantly relies on foreign direct investment (FDI), while FDI is considerably exposed to geopolitical risks. The influence of geopolitical factors poses a notable constraint on the investment decisions of multinational corporations, as these decisions are intricately tied to global tensions and uncertainties. Unlike other forms of political risk, prior experiences and mitigation strategies may not seamlessly apply to the distinct challenges posed by geopolitical risk. Governments, recognizing the role of stable political environments in fostering investor confidence, can leverage investments in good governance as a signaling mechanism. This signals to investors that the political landscape is resilient and less likely to undergo unpredictable shifts in response to geopolitical tensions. To effectively draw in foreign direct investment, governments must establish conditions that guarantee stability and reliability in the business environment (Bussy et al., 2023).

A strand of recent studies focus on green investment in the industrial sector, such as cleaner energies. Many studies document that green investment and green industries are resilient to external shocks including geopolitical risks. Thus, this encourages industry to switch from fossil-fuel to clean energy sources. However, geopolitical acts negatively impact green bonds and green capital in extreme quantiles. Investors prefer "green" investments over "dirty" investments or other geopolitically vulnerable investments during geopolitical events. The onset and escalation of wars and terrorist acts negatively impact asset prices and yields. An increase in geopolitical risks can accelerate the transition to clean energy sources, but it also increases the likelihood of an energy crisis (Dutta et al., 2022; Kuzemko et al., 2022; Sohag et al., 2022; Song et al., 2022; Wang et al., 2022; Yang et al., 2021; Bouoiyour et al., 2019; Henriques et al., 2008;). In addition, the studies find that the cost of transportation also depends significantly on the level of geopolitical risks. There is a positive correlation between the level of international tensions and the price of transportation, which increases the price for both the final consumers of products and production costs (Monge et al., 2023). An additional interesting finding in the literature is it has been observed that more developed countries may be more likely to be sources of geopolitical risk, while less developed countries may be more likely to be recipients (Zhang et al., 2023). Increasing geopolitical risk is also an important factor in investment and financial planning.

3. Data and Methodology

3.1 Data, definition and sources

Our dependent variables include total industrial production index (IPI) and manufacturing production index (MPI), obtained from OECD statistics. Table 1 reports the short name, definition and sources of our all variables. All variables follow the monthly time frequency ranging from January 2000 to July 2023 for 23 selected European Union (EU) member countries[1]. We exclude a number of European Union countries (Bulgaria, Cyprus, Malta, Romania) from our sample due to the unavailability. Table 1 provides a description and sources of our data.

Table 1. Data description

Variable	Description	Sources
	Dependent variables	
Total Industrial Production Index (IPI)	Industrial production encompasses the output of industrial enterprises. The indicator encompasses a range of	Organization for Economic Cooperation and Development https://data.oecd.org/

[1] Austria, Belgium, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden.

	economic sectors, including construction, manufacturing, electricity generation, mining and others. The indicator is calculated as the ratio of output in a particular year to 2015 (2015 production = 100).	
Manufacture Production Index (MPI)	A narrower index of industrial production that includes only the transformation of raw materials into final products. The indicator is calculated as the ratio of output in a particular year to the 2015 baseline (2015 production = 100).	Organization for Economic Cooperation and Development https://data.oecd.org/
Energy prices and shocks		
The price of Brent crude oil (Oil Price)	The price of Brent crude oil in US dollars per barrel.	The World Bank https://www.worldbank.org/
The price of natural gas in Europe (Gas Price)	The price of natural gas in Europe in US dollars per cubic meter. From April 2015, the price is based on the Netherlands Title Transfer, and prior to April 2015, the price is an average import border price with a spot price component.	The World Bank https://www.worldbank.org/
The gas price shock (Gas Shock)	We apply Hodrick-Prescott filter to generate oil price shocks.	Compiled by the authors on the basis of World Bank data
The oil price shock (Oil Shock)	We apply Hodrick-Prescott filter to generate oil price shocks.	Compiled by the authors on the basis of World Bank data
Geopolitical risks and REER		
Real Effective Exchange Rate (REER)	An indicator that characterises the dynamics of exchange rates is calculated as the weighted sum of the indices of the real exchange rate of a given year in relation to the base. Each such index is multiplied by the share of trading partner countries in foreign trade turnover.	Brussels European and Global Economic Laboratory https://www.bruegel.org/
Geopolitical Risk Index (GPR)	The index is based on a text search among 10 news outlets, namely the Chicago Tribune, the Daily Telegraph, the Financial Times, the Globe and Mail, the Guardian, the Los Angeles Times, the New York Times, USA Today, the Wall Street Journal and the Washington Post. The index is calculated by counting the number of articles that contain information about unfavourable events in 8 categories (Beginning of War, Escalation of War, Terror Acts, War Threats, Peace	Dario Caldara & Matteo Iacoviello https://www.matteoiacoviello.com/

	Threats, Military Build-ups, Nuclear Threats, Terror Threats).	
Geopolitical Acts Index (GPRA)	A narrower indicator relative to GPR. Search is carried out only by categories: Beginning of War, Escalation of War, Terror Acts.	Dario Caldara & Matteo Iacoviello https://www.matteoiacoviello.com/
Geopolitical Threats Index (GPRT)	A narrower indicator relative to GPR. Search is carried out only by categories: War Threats, Peace Threats, Military Build-ups, Nuclear Threats, Terror Threats.	Dario Caldara & Matteo Iacoviello https://www.matteoiacoviello.com/

3.2. Panel Vector-Autoregressive under System Generalized Method of Moments

To analyse the dynamic relationships between industrial production, energy prices, the real effective exchange rate, and geopolitical risks, we use a panel vector autoregression (PVAR) framework. PVAR is an extension of the standard time-series VAR model to a panel data setting, allowing us to account for both the time-series and cross-sectional dimensions of the data.

The equation describing Panel VAR has the following formulation

$$Y_{i,t} = A_0 + A_1 Y_{i,t-1} + A_2 Y_{i,t-2} + \cdots + A_p Y_{i,t-p} + BX_{i,t} + \mu_i + \varepsilon_{i,t} \quad (1)$$

Where Y_{it} – is the vector of endogenous variables, including industrial production index (IPI), manufacturing production index (MPI); X_{it} – is the vector of exogenous variables; A_0 is the intercept term; $A_1, A_2, \ldots, A_p$ and B are the coefficient matrices to be estimated; μ_i represents the country-specific fixed effects; $\varepsilon_{i,t}$ is the error term.

The PVAR model allows us to capture the dynamic interactions among the variables and account for the heterogeneity across countries through the inclusion of fixed effects. To address the potential endogeneity issues, we employ the system Generalized Method of Moments (GMM) estimator proposed by Love and Zicchino (2006). The system GMM estimator uses internal instruments, derived from the lagged values of the endogenous variables, to obtain consistent and efficient parameter estimates.

3.3. Dynamic Common Correlated Effects

To account for potential heterogeneity in the responses of industrial production to the exogenous variables, we further apply the Dynamic Common Correlated Effects (DCCE) approach proposed by Chudik and Pesaran (2015). The DCCE model allows for slope heterogeneity and addresses cross-sectional dependence that may arise from observed and unobserved common factors.

$$Y_{it} = \alpha_i Y_{it-1} + \delta_i X_{it} + \sum_{p=0}^{pT} \gamma_{xip} \bar{X}_{t-p} + \sum_{p=0}^{pT} \gamma_{yip} \bar{Y}_{t-p} + \mu_{it} \quad (2)$$

In equation (2), the Y_{it} and Y_{it-1} represent the dependent variable and the lag of the dependent variable. X_{it} indicates the vector of regressors. The index t and i show the time and cross-section, respectively. The $\bar{X}_{t-p}$ *and* $\bar{Y}_{t-p}$ indicate cross-sectional variables. The γ_{xip} and γ_{yip} parameters are common unobservable parameters. The μ_{it} indicates error term. In this model, we incorporate the interaction between geopolitical risks and hydrocarbon price to demonstrate geopolitically induced oil price effect on EU industrial and manufacturing productions.

The DCCE approach allows us to capture the heterogeneous responses of industrial production to the exogenous variables, while also addressing the cross-sectional dependence in the data. The country-specific coefficients obtained from the DCCE model provide insights into the varying impacts of energy prices, real effective exchange rate, and geopolitical risks on industrial production across the selected European Union countries.

4. Results and Discussion

4.1 Descriptive statistics

Figure 1 depicts the dynamics of industrial production in our sample countries. Across all panels in the graph, two bearish conditions stand out—namely, the periods corresponding to the global financial crisis and the Covid-19 pandemic. Notably, Denmark, France, Germany, Greece, Luxembourg, and the Netherlands exhibit a consistent trend in industrial production. In contrast, Poland and Ireland demonstrate robust growth in industrial production, with Ireland, however, facing considerable volatility in this regard. Additionally, it is evident that Italy and Spain have struggled to recover their industrial production levels to those observed in the pre-crisis period.

Figure 1. Dynamics of industrial production in the EU countries

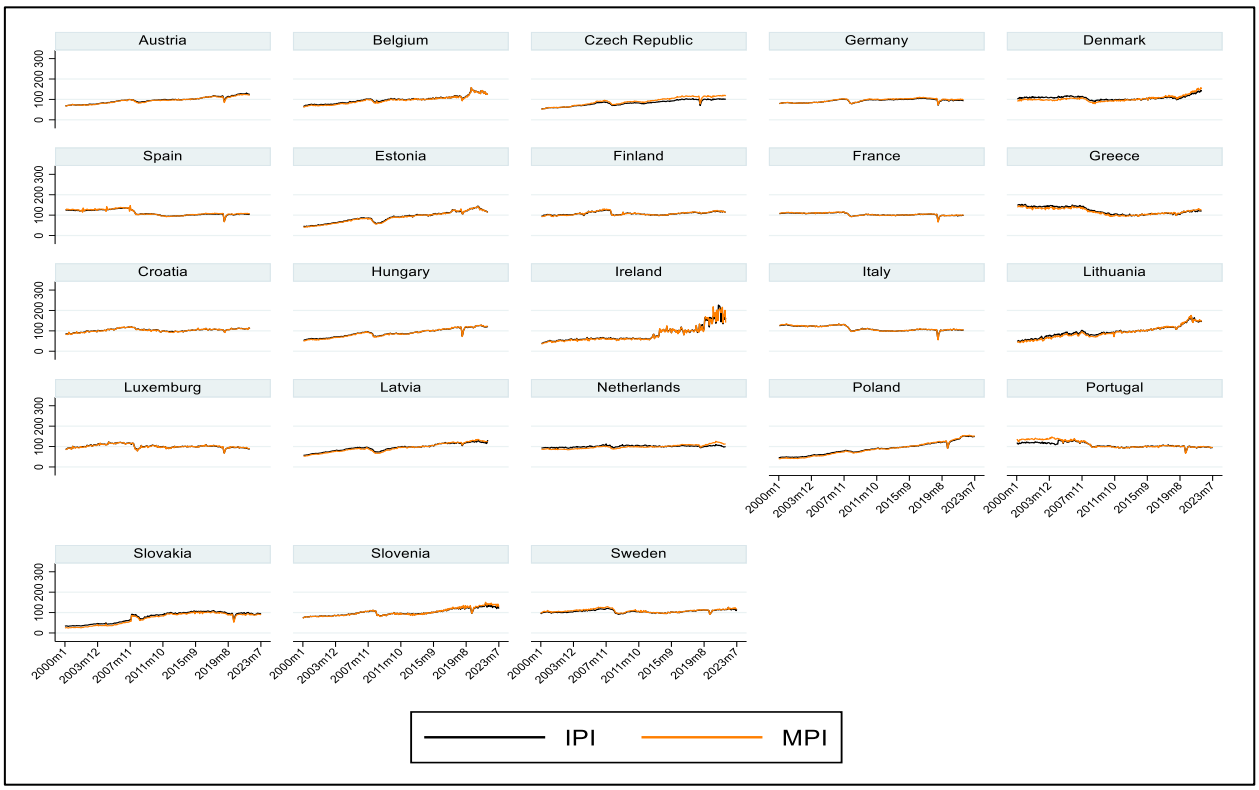


Table 2. Descriptive statistics

Variable	Mean	Median	Max.	Min.	Std. Dev.	Obs.
IPI	98.987	100.661	226.962	32.087	20.538	6 509
MPI	98.478	100.080	218.182	23.890	22.383	6 509
Oil Price	65.820	63.300	133.873	18.605	29.224	6 509
Oil Shock	0.000	-0.196	48.468	-35.063	9.802	6 509
Gas Price	9.068	7.487	70.044	1.575	8.264	6 509
Gas Shock	0.000	-0.035	37.061	-11.506	3.800	6 509
GPR	104.852	92.016	512.530	45.061	52.024	6 509
GPRA	107.205	88.031	854.075	28.455	84.759	6 509
GPRT	104.380	93.808	403.714	44.358	44.358	6 509
REER	95.590	96.214	132.343	60.209	8.299	6 509

Table 2 presents the descriptive statistics, revealing noteworthy insights. Firstly, it is evident that MPI exhibits a larger standard deviation compared to IPI. Moreover, the data indicates that the price of oil demonstrates higher volatility than the price of natural gas. The maximum oil shock registers at $48.468 higher than the expected price, while a notable dip of -$35.063 below the expected price is observed. Regarding the cost of gas, the maximum difference from the expected price upward was $37.061, while downward was -$11.506. Additionally, geopolitical risks and acts also exhibit high volatility in this analysis.

4.2. Main Results under PVAR approach

Figures 2-7 illustrates the panel vector autoregression (PVAR) results for different model specifications. To visualize the results, we construct impulse response functions (IRFs) that show how a change in one indicator (impulse) affects a change in another variable (response) over time.

Our results show that there are common trends in the response of manufacturing and industrial production to shocks in gas and oil prices, changes in the geopolitical environment, and their interrelationship.

Thus, an oil price shock results in a short-term increase in industrial production and manufacturing, with a time horizon of up to four months. However, from the fifth month post-shock, the effect turns negative and remains for up to ten months (Figures 2-7). With respect to gas prices, for industrial production, gas price shocks have only a lagged negative effect that appears five months post-shock (Figures 2-4). Conversely, in manufacturing, there existis a short-lived weak positive effect at the 3-month interval, which turns negative (Figures 5-7).

Regarding the variable of the joint impact of geopolitical risks and the volatility of oil prices, industrial production and manufacturing respond identically. Thus, the joint effect of the GPR total geopolitical risk index and oil prices causes both industry types to defer growth from fourth month. The joint movement of the GPRA geopolitical risk index and the oil prices stimulates growth in both industry types, manifesting more rapidly from the third month and exhibiting greater smoothness compared to the GPR. The GPRT index of geopolitical risks and oil prices exhibit a short-term decline in both industries during the third month, followed by a subsequent positive effect (Figures 2-7).

The simultaneous fluctuations in gas prices and the GPR and GPRA indices exert minimal influence on both industrial types. However, we observe that the joint movement of the gas prices and the GPRT index has a significant positive impact on both manufacturing and industrial production, and this impact persists for an extended period (Figures 2-7).

Regarding the net impact of geopolitical risks, we observe that only GPRT geopolitical threats have a short-term positive effect on both industrial production and manufacturing. Simultaneously, it is important to acknowledge that this effect manifests itself after three months and is short-lived.

Figure 2. Responses of IPI to oil and gas price shocks, REER and GPR obtained by the Panel VAR

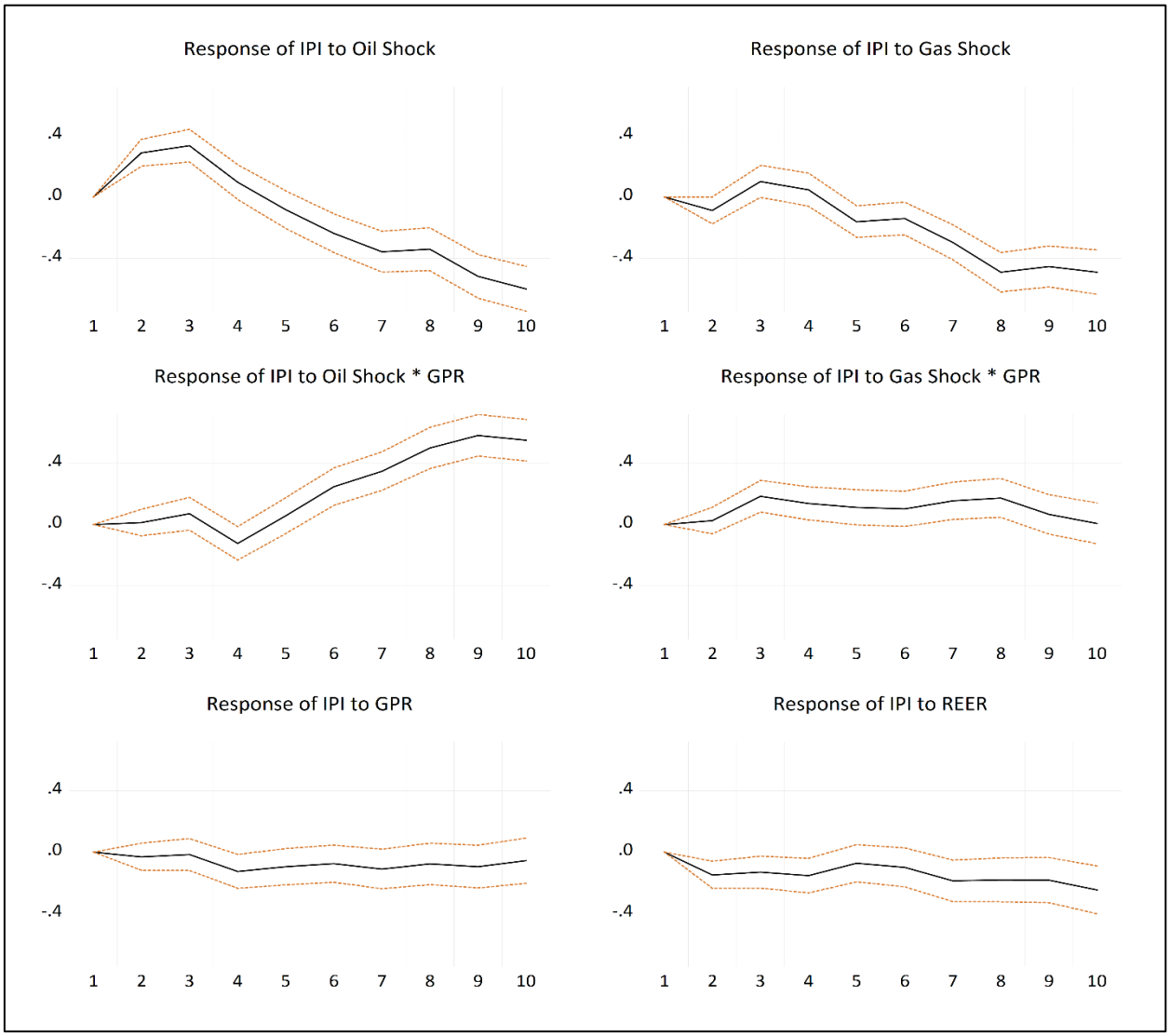


Figure 3. Responses of IPI to oil and gas price shocks, REER and GPRA obtained by the Panel VAR

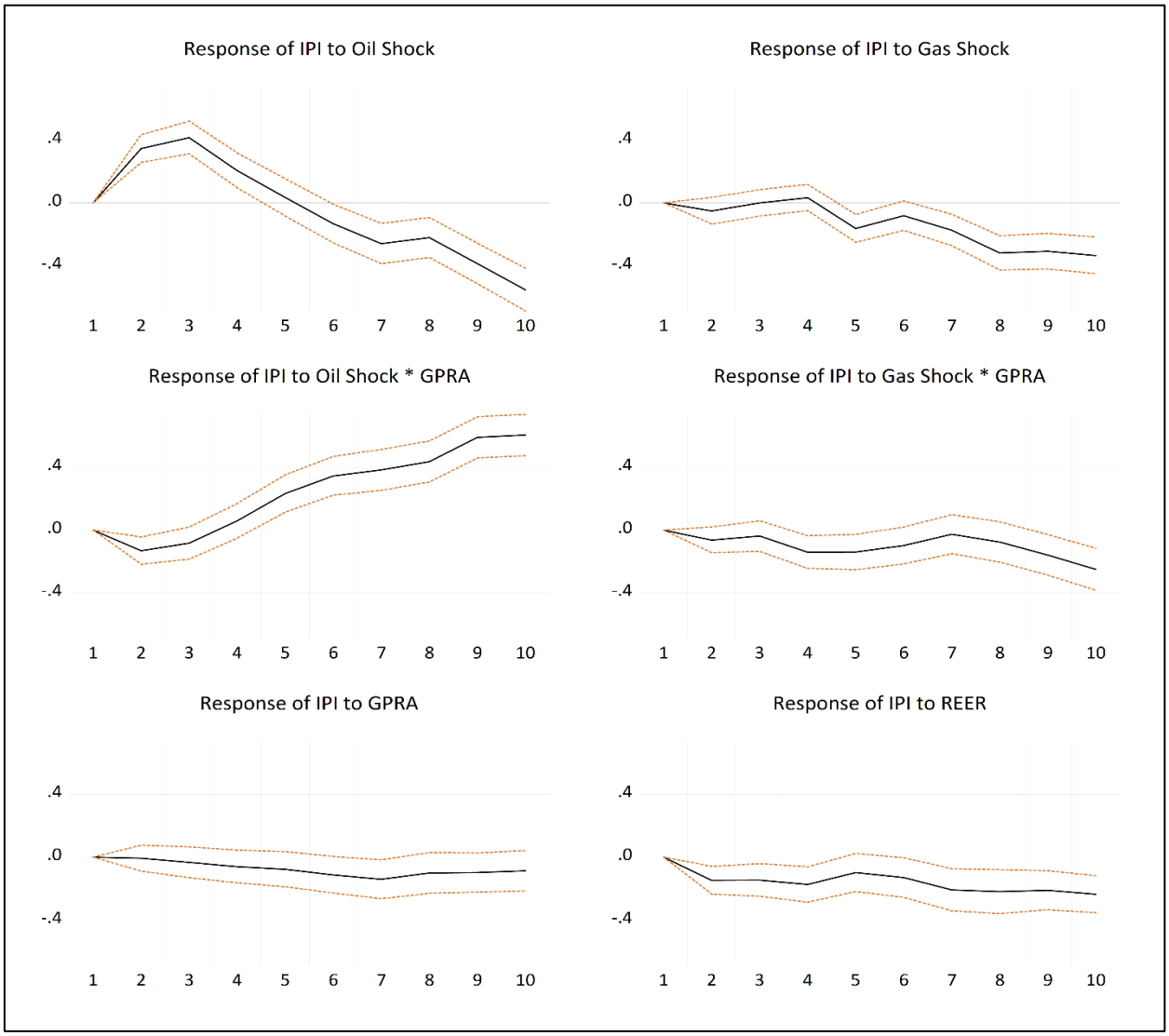


Figure 4. Responses of IPI to oil and gas price shocks, REER and GPRT obtained by the Panel VAR

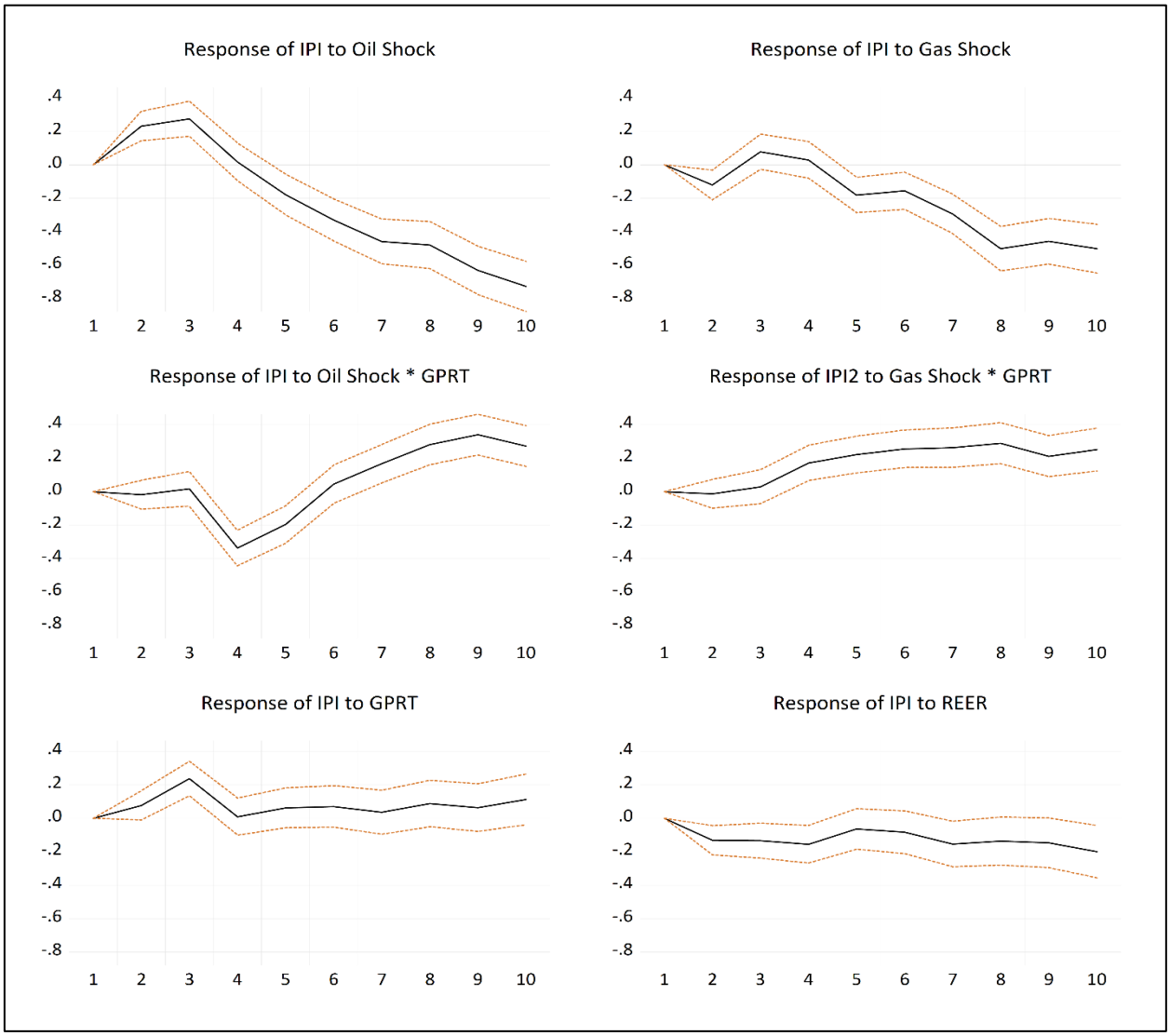


Figure 5. Responses of MPI to oil and gas price shocks, REER and GPR obtained by the Panel VAR

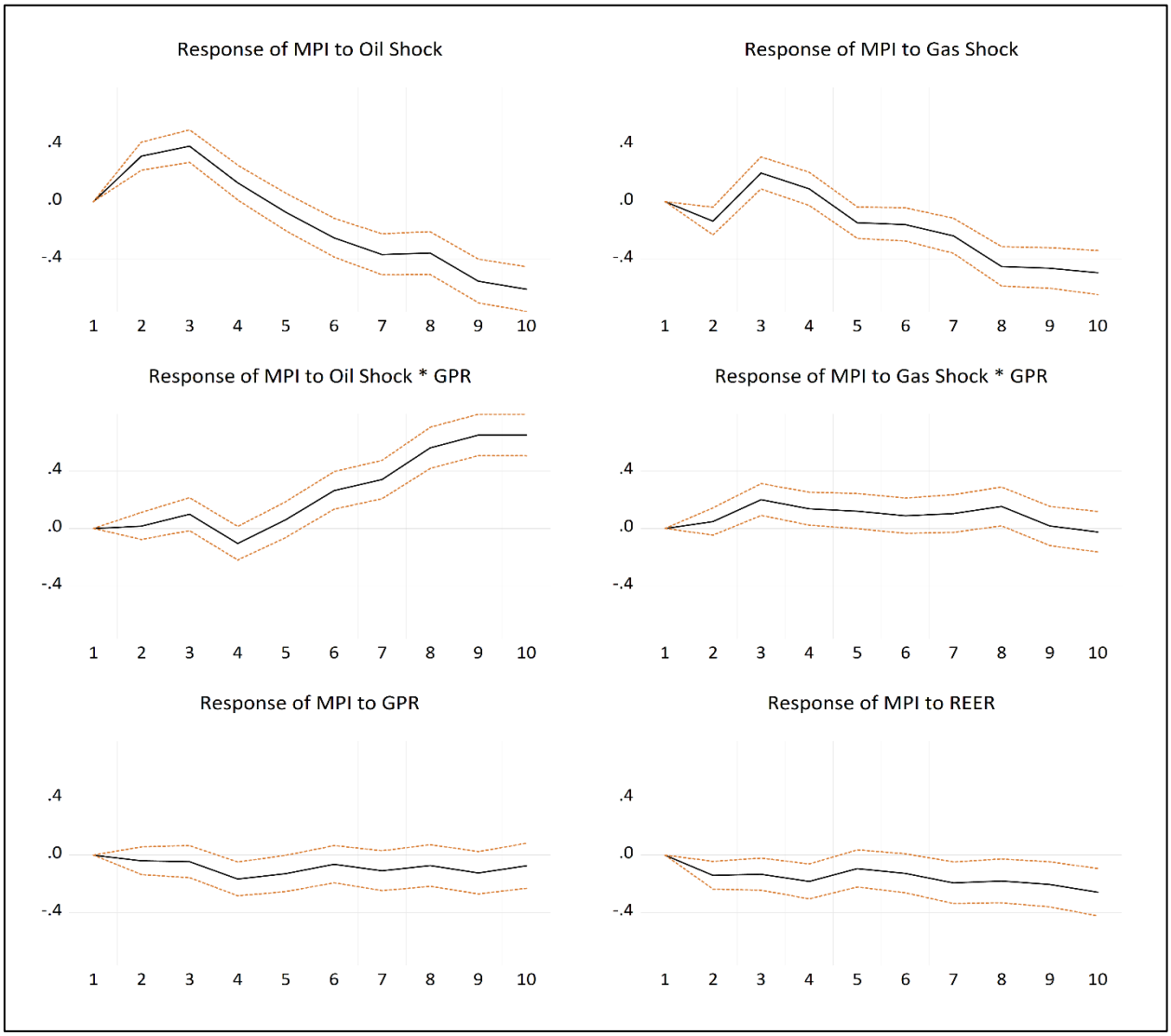


Figure 6. Responses of MPI to oil and gas price shocks, REER and GPRA obtained by the Panel VAR

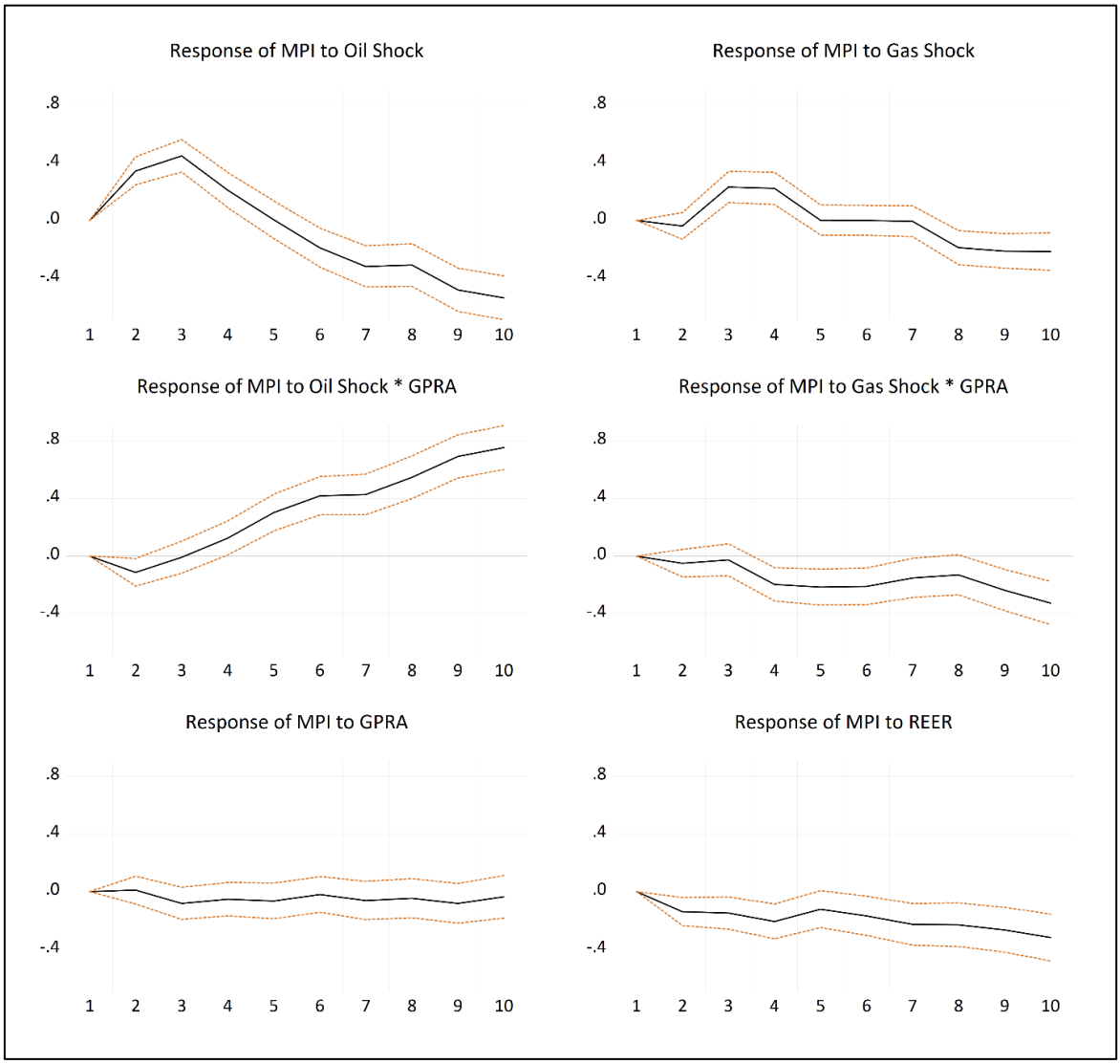
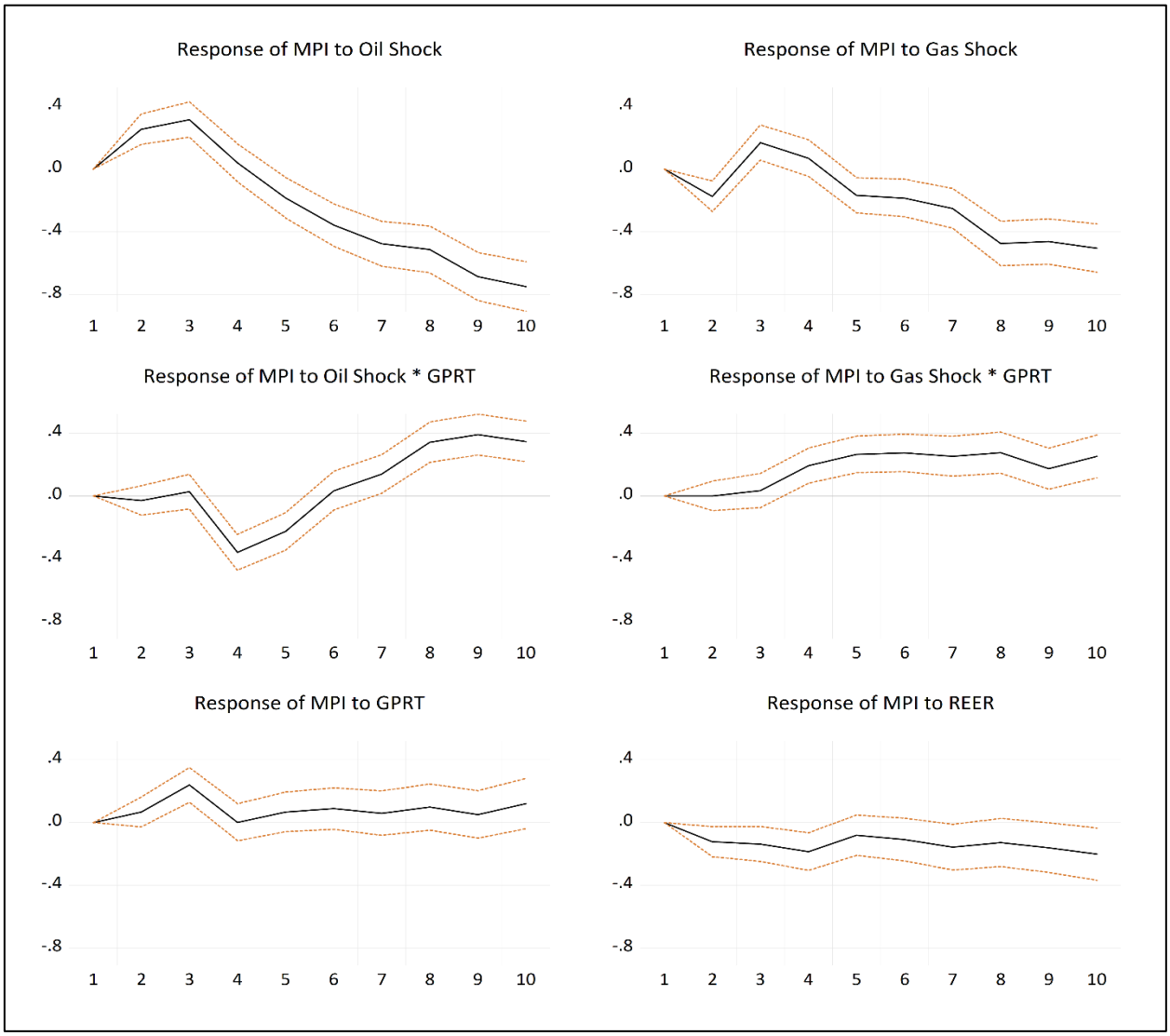


Figure 7. Responses of MPI to oil and gas price shocks, REER and GPRT obtained by the Panel VAR



Our results show the existence of a dependence of both types of industries on commodity prices and the joint effect of commodity prices and geopolitical risks. However, we find that pure geopolitical risks do not have a strong significant impact in the sample as a whole. It is important to note that although the European Union is a close union, it includes countries at different levels of economic development and with different industries. In this context, a country-by-country analysis may provide more accurate results, taking into account the asymmetry in the response of different countries.

4.3 Granger Non-Causality Test for Robustness Check

To further examine the causal relationships between the variables, we conduct Granger non-causality tests in a panel data setting. The Granger non-causality test is based on the following panel data model:

$$Y_{i,t} = a_i + \beta_i Y_{i,t-1} + \gamma_i X_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

Where $Y_{i,t}$ is the vector of endogenous variables, including industrial production index (IPI), manufacturing production index (MPI); Xi, t is the vector of exogenous variables, including oil price shock (Oil Shock), gas price shock (Gas Shock), geopolitical risk index (GPR), geopolitical acts index (GPRA), and geopolitical threats index (GPRT) and joint effects (Oil Shock * GPR, Oil Shock * GPRA, Oil Shock * GPRT, Gas Shock * GPR, Gas Shock * GPRA, Gas Shock * GPRT); a_i represents the country-specific fixed effects; β_i and γ_i are the coefficient vectors to be estimated; $\varepsilon_{i,t}$ is the error term.

The null hypothesis of the Granger non-causality test is that the coefficients γi are jointly equal to zero, indicating that the variable $X_{i,t-1}$ does not Granger-cause $Y_{i,t}$. We employ the panel Granger non-causality test developed by Dumitrescu and Hurlin (2012), which allows for heterogeneous slope coefficients and cross-sectional dependence.

Table 3. Testing for Granger Non-Causality

			Model 1			
IPI	GPR	Oil Shock	Gas Shock	Oil S.*GPR	Gas S.*GPR	REER
t-1	-0.013***	0.047*	0.235***	0.0003	0.001***	-0.255***
	(0.002)	(0.025)	(0.039)	(0.0002)	(0.0002)	(0.049)
t-2	0.014***	0.035	0.003	-0.001***	-0.002***	0.285***
	(0.002)	(0.032)	(0.052)	(0.0003)	(0.0003)	(0.076)
t-3	-0.001	-0.082**	-0.079	0.0003	0.0005*	-0.078
	(0.002)	(0.032)	(0.052)	(0.0003)	(0.0003)	(0.076)
t-4	-0.002	-0.024	-0.238***	0.0005	-0.0002	0.062
	(0.002)	(0.032)	(0.055)	(0.0003)	(0.0003)	(0.076)
t-5	-0.003	0.003	0.219***	-0.00005	-0.0002	-0.051
	(0.002)	(0.031)	(0.055)	(0.0002)	(0.0003)	(0.075)
t-6	0.006***	-0.102***	-0.014	0.001***	0.0007***	0.0146
	(0.002)	(0.023)	(0.044)	(0.0002)	(0.0002)	(0.049)
			Model 2			
IPI	GPRA	Oil Shock	Gas Shock	Oil S.*GPRA	Gas S.*GPRA	REER
t-1	-0.004***	0.097***	0.134***	-0.0001	0.001***	-0.256***
	(0.001)	(0.019)	(0.032)	(0.0002)	(0.0002)	(0.0494)
t-2	-0.002	-0.061**	-0.033	0.0001	-0.0007***	0.242***
	(0.002)	(0.025)	(0.043)	(0.0002)	(0.0002)	(0.075)
t-3	0.007***	-0.171***	-0.059	0.001***	-0.0004*	-0.010
	(0.002)	(0.025)	(0.045)	(0.0002)	(0.0002)	(0.076)
t-4	0.003	-0.022	-0.115**	0.0003	-0.0002	0.040

	(0.002)	(0.026)	(0.053)	(0.0002)	(0.0002)	(0.076)
t-5	-0.003	0.055**	0.166***	-0.0004**	-0.0001	-0.048
	(0.002)	(0.025)	(0.054)	(0.0002)	(0.0002)	(0.075)
t-6	0.006***	-0.088***	0.007	0.0007***	0.0001	0.0082
	(0.001)	(0.018)	(0.038)	(0.0001)	(0.0002)	(0.049)
			Model 3			
IPI	GPRT	Oil Shock	Gas Shock	Oil S.*GPRT	Gas S.*GPRT	REER
t-1	-0.005**	0.039*	0.387***	0.0002	0.0003*	-0.239***
	(0.002)	(0.020)	(0.043)	(0.0002)	(0.0002)	(0.049)
t-2	0.019***	0.028	0.028	-0.0006**	-0.002***	0.248***
	(0.002)	(0.027)	(0.057)	(0.0002)	(0.0003)	(0.075)
t-3	-0.017***	0.060**	-0.295***	-0.001***	0.002***	-0.063
	(0.002)	(0.026)	(0.059)	(0.0003)	(0.0003)	(0.076)
t-4	0.010***	-0.048*	-0.127**	0.0009***	-0.001***	0.019
	(0.002)	(0.026)	(0.058)	(0.0002)	(0.0003)	(0.076)
t-5	-0.008***	0.010	-0.022	-0.0004*	0.001***	0.0024
	(0.002)	(0.026)	(0.057)	(0.0002)	(0.0003)	(0.075)
t-6	0.001	-0.158***	0.169***	0.002***	0.0002	0.016
	(0.002)	(0.021)	(0.048)	(0.0002)	(0.0002)	(0.049)
			Model 4			
MPI	GPR	Oil Shock	Gas Shock	Oil S.*GPR	Gas S.*GPR	REER
t-1	-0.015***	0.067**	0.207***	0.0002	0.001***	-0.246***
	(0.002)	(0.027)	(0.043)	(0.0003)	(0.0002)	(0.054)
t-2	0.016***	0.027	0.154***	-0.0009***	-0.003***	0.261***
	(0.003)	(0.035)	(0.057)	(0.0003)	(0.0003)	(0.083)
t-3	0.001	-0.076**	-0.164***	0.0003	0.0007**	-0.050
	(0.003)	(0.035)	(0.057)	(0.0003)	(0.0003)	(0.084)
t-4	-0.002	-0.010	-0.092	0.0003	-0.0002	0.051
	(0.003)	(0.035)	(0.060)	(0.0003)	(0.0003)	(0.083)
t-5	-0.001	-0.001	0.155***	0.0001	-0.0007**	-0.044
	(0.003)	(0.034)	(0.060)	(0.0003)	(0.0003)	(0.082)
t-6	0.006***	-0.127***	-0.036	0.001***	0.001***	0.0022
	(0.002)	(0.025)	(0.048)	(0.0002)	(0.0002)	(0.054)
			Model 5			
MPI	GPRA	Oil Shock	Gas Shock	Oil S.*GPRA	Gas S.*GPRA	REER
t-1	-0.006***	0.110***	0.091***	0.00006	0.001***	-0.247***
	(0.001)	(0.021)	(0.035)	(0.0002)	(0.0002)	(0.0540
t-2	-0.002	-0.075***	0.080*	0.0002	-0.001***	0.201**
	(0.002)	(0.027)	(0.047)	(0.0002)	(0.0002)	(0.083)
t-3	0.007***	-0.188***	-0.184***	0.001***	-0.00002	0.025
	(0.002)	(0.028)	(0.049)	(0.0002)	(0.0002)	(0.083)
t-4	0.006***	-0.030	0.098*	0.0003	-0.0006***	0.046
	(0.002)	(0.028)	(0.058)	(0.0002)	(0.0002)	(0.083)
t-5	-0.002	0.070***	0.118**	-0.0006***	-0.0004	-0.045
	(0.002)	(0.027)	(0.059)	(0.0002)	(0.0003)	(0.082)
t-6	0.005***	-0.100***	-0.039	0.0008***	0.0005**	-0.009
	(0.002)	(0.019)	(0.042)	(0.0002)	(0.0002)	(0.053)
			Model 6			
MPI	GPRT	Oil Shock	Gas Shock	Oil S.*GPRT	Gas S.*GPRT	REER
t-1	-0.006***	0.073***	0.395***	-0.0001	0.0006***	-0.234***
	(0.002)	(0.022)	(0.047)	(0.0002)	(0.0002)	(0.054)
t-2	0.024***	0.023	0.188***	-0.0006**	-0.002***	0.217***
	(0.003)	(0.029)	(0.062)	(0.0003)	(0.0003)	(0.082)
t-3	-0.018***	0.083***	-0.386***	-0.002***	0.002***	-0.032
	(0.003)	(0.029)	(0.065)	(0.0003)	(0.0003)	(0.083)
t-4	0.009***	-0.027	-0.042	0.0006**	-0.0009***	0.008
	(0.003)	(0.029)	(0.064)	(0.0003)	(0.0003)	(0.083)
t-5	-0.006**	-0.017	-0.088	-0.0001	0.0006**	0.008
	(0.003)	(0.029)	(0.062)	(0.0003)	(0.0003)	(0.082)
t-6	-0.001	-0.179***	0.191***	0.002***	0.0007***	0.013
	(0.002)	(0.0224)	(0.052)	(0.0002)	(0.0002)	(0.053)

Table 3 presents the Granger causality test with the maximum number of lags at 6 months. As can be seen from the results, the indicators obtained are consistent with the PVAR results presented earlier. This allows us to conclude on the stability of the model as a whole, as well as the existence of a real causal relationship between changes in exogenous variables and the influence on the dependent variables.

4.4 Country-Specific Analysis by Dynamic Common Correlated Effects

Before moving to country-specific analysis, we conduct slope homogeneity test offered Pesaran & Yamagata (2008). The test results presented in Table 3 show that the null hypothesis of slope homogeneity is rejected. Such results allow us to speak of heterogeneity in the response of countries to shocks in exogenous variables, which allows us to conduct a country-by-country analysis.

Table 4. Testing for slope heterogeneity

Model specification	Delta	p-value
Model 1:	125.211	0.000
Model 2:	124.966	0.000
Model 3:	121.545	0.000
Model 4:	120.174	0.000
Model 5:	120.538	0.000
Model 6:	115.827	0.000

Notes: H0: slope coefficients are homogenous. Model 1: IPI REER Oil Shock * GPR Gas Shock * GPR Oil Shock Gas Shock GPR; Model 2: IPI REER Oil Shock * GPRA Gas Shock * GPRA Oil Shock Gas Shock GPRA; Model 3: IPI REER Oil Shock * GPRT Gas Shock * GPRT Oil Shock Gas Shock GPRT; Model 4: MPI REER Oil Shock * GPR Gas Shock * GPR Oil Shock Gas Shock GPR; Model 5: MPI REER Oil Shock * GPRA Gas Shock * GPRA Oil Shock Gas Shock GPRA; Model 6: MPI REER Oil Shock * GPRT Gas Shock * GPRT Oil Shock Gas Shock GPRT.

In the second step, we use Pesaran's test for cross-sectional dependence. The test is conducted for balanced panel data with N-number of cross-sections and T-number of time periods. The cross-sectional dependence test allows us to detect whether there are spill overs from one country to another in the dataset. Besides, our sample countries belong to European Union where they maintain close ties in terms of economy, political, financial, and other factor mobility. Pesaran, Ullah, & Yamagata (2008); De Hoyos et al. (2006) proposed CD test where:

$$\mathrm{CD} = \sqrt{\frac{2\mathrm{T}}{\mathrm{N}(\mathrm{N}-1)}}\left[\sum_{\mathrm{i}=1}^{\mathrm{N}-1}\sum_{\mathrm{j}=\mathrm{i}+1}^{\mathrm{N}}\hat{\rho}_{\mathrm{ij}}\right] (3)$$

In equation 3, T, N and $\hat{\rho}_{ij}$ indicates time, cross-section and pair wise correlation coefficients. Table 4 reports that our all variables are subject to cross-sectionally dependent and stationary.

Table 5. Cross-sectional dependence tests and second-generation unit root test statistics

Test		IPI	MPI	REER
		Statistics	Statistics	Statistics
Pesaran's CD		75.46***	82.33***	137.49***
Bias-corrected LM		21.69***	24.08***	21.73***
CADF	Level	-3.20***	-3.20***	-1.14
	1st Difference	-6.19***	-6.19***	-6.19***
	Trend	-4.81***	-4.88***	-2.00
	1st Difference + trend	-6.42***	-6.42***	-6.42***

Notes: H0: Pesaran's CD Null Hypothesis – Cross-Sectional Independence; CADF Null Hypothesis – all series are no stationary; Bias-corrected LM Null Hypothesis – No serial correlation up to order p (p = 2).

As for the country specific analysis, we apply Dynamic Common Correlated Effects (DCCE) to re-estimate our models due to fixed effect and slope heterogeneity. To facilitate comparison of effects and understanding of results, we present the DCCE coefficients in geographic map format. The models are presented in algebraic form in the Appendix.

Figure 8 – Response of IPI and MPI to GPR, GPRA and GPRT

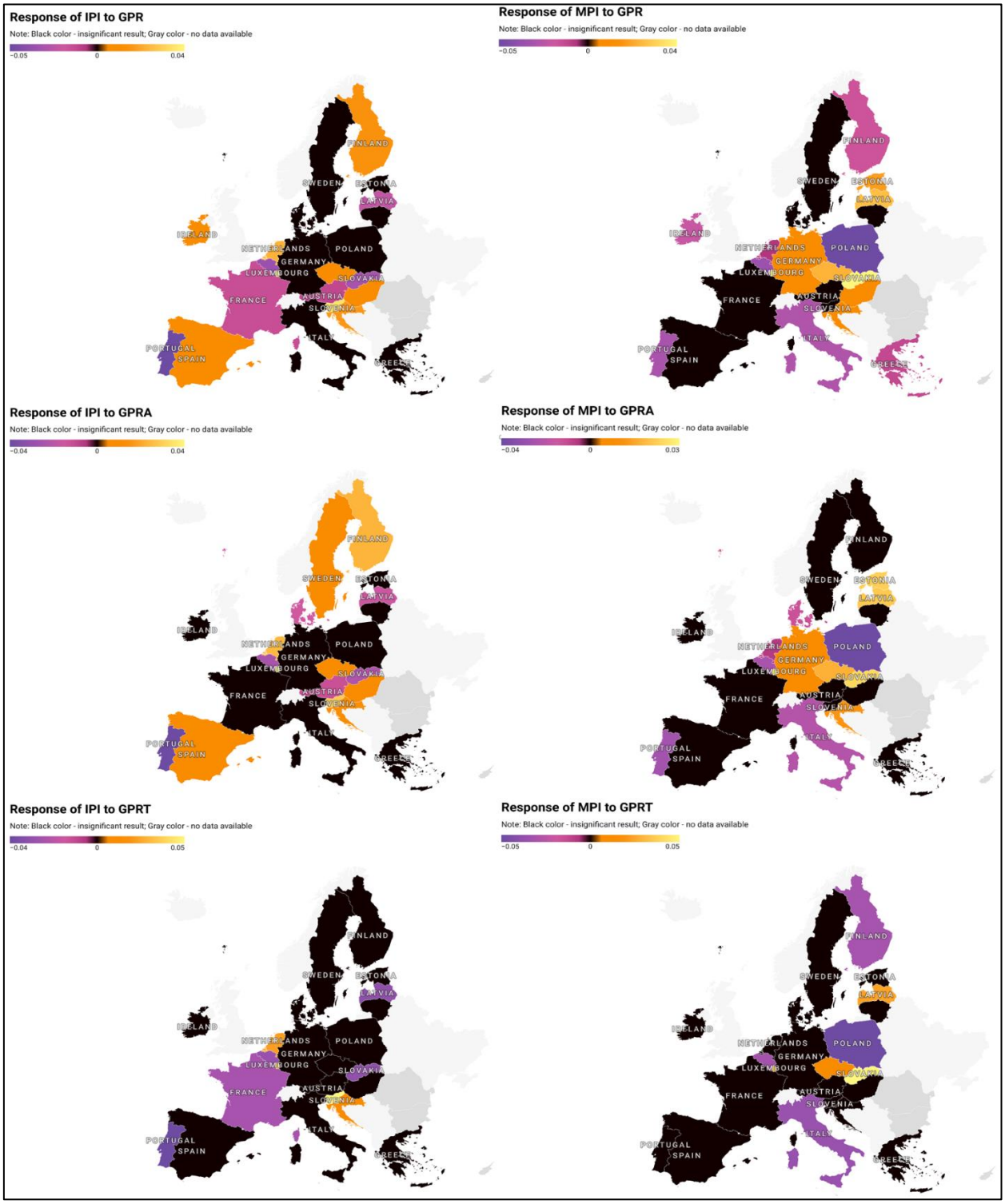


Figure 8 shows the responses of industrial production and manufacturing to different types of geopolitical risks. The results differ by industry type and geopolitical risk type. Thus, the industrial production of countries such as Spain, Ireland, Netherlands, Luxembourg, Czech Republic, Slovenia, Croatia, Hungary and Finland reacts positively to the GPR index. At the same time, a positive response of industrial production to the GPRA is observed in Spain, the Netherlands, Luxembourg, Czech Republic, Slovenia, Croatia, Hungary, Sweden and Finland. The Netherlands, Luxembourg, the Czech Republic, Slovenia, Croatia, Hungary, Sweden and France

show an increase in industrial production concurrent with the rise in the GPRT index. The industries of Portugal, France, Belgium, Austria, Slovakia and Latvia responded negatively to GPR. The IPI of Portugal, Belgium, Denmark, Latvia, Austria and Slovakia also reacts negatively to the growth of the GPRA index. Finally, the industrial production of Portugal, France, Belgium, Slovakia and Latvia reacts negatively to the GPRT index.

In the manufacturing sector, significant differences in the response of different countries can be observed. For example, the MPIs of countries such as Germany, the Czech Republic, Estonia, Latvia, Croatia, Hungary and Slovakia react positively to the GPR, while negative effects are observed for Portugal, Italy, Ireland, Belgium, Poland, Finland and Greece. The manufacturing industries of Estonia, Latvia, Germany, the Czech Republic, Slovakia, Croatia and Luxembourg responded positively to GPRA growth, whereas those of Portugal, Belgium, the Netherlands, Italy, Denmark and Poland. Luxembourg, the Czech Republic, Latvia and Slovakia demonstrated a positive response to GPRT growth, while Belgium, Finland, Poland and Italy respond negatively.

At this stage of the analysis, it is evident that Poland, Italy, Belgium and Portugal are the most exposed to the negative effect of net geopolitical risks. Concurrently, Luxembourg's industry is the most resilient to geopolitical risks.

Figure 9 – Response of IPI and MPI to Energy Prices Shocks

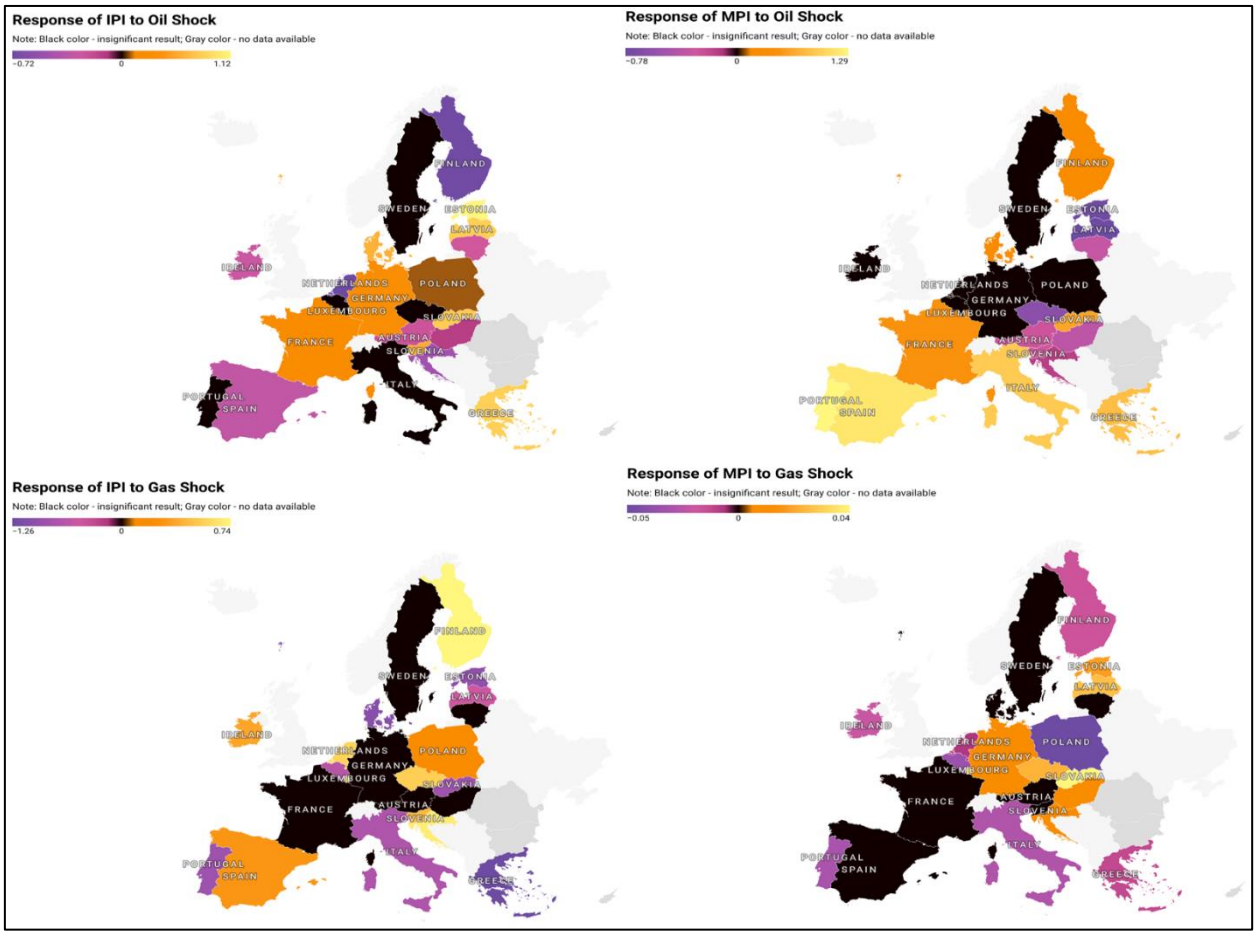


Figure 9 shows the industry's response to energy price shocks. The country-by-country analysis reveals significant differences in the responses of countries, differentiated by industry type and by the specific resources experiencing price increases. For example, industrial production in France, Germany, Slovakia, Slovenia, Estonia, Latvia and Greece responds positively to the oil price spike. The IPIs of Finland, the Netherlands, Spain, Ireland, Austria, Croatia, Hungary and Lithuania react negatively to oil price shocks.

The IPIs of Ireland, Spain, the Netherlands, Luxembourg, Slovenia, Croatia, the Czech Republic, Poland and Finland exhibits a positive response to gas price shocks, while Portugal, Italy, Greece, Slovakia, Latvia, Estonia and Denmark react negatively.

The manufacturing sector exhibits a broader positive response to oil price shocks. The MPI increases in countries such as Portugal, Spain, France, Italy, Greece, Slovakia, Denmark and Finland. The MPI falls in Estonia, Latvia, Lithuania, the Czech Republic, Austria, Slovenia, Croatia and Hungary. The analysis of gas price shocks reveals a decreasing positive effect on the manufacturing sector. Germany, the Czech Republic, Croatia, Hungary, Slovakia, Latvia, Luxembourg and Estonia react positively, while Finland, Ireland, the Netherlands, Belgium, Poland, Portugal, Italy and Greece display negative responses.

Figure 10 – Joint Effect of Gas Price Shocks and Geopolitical Risks

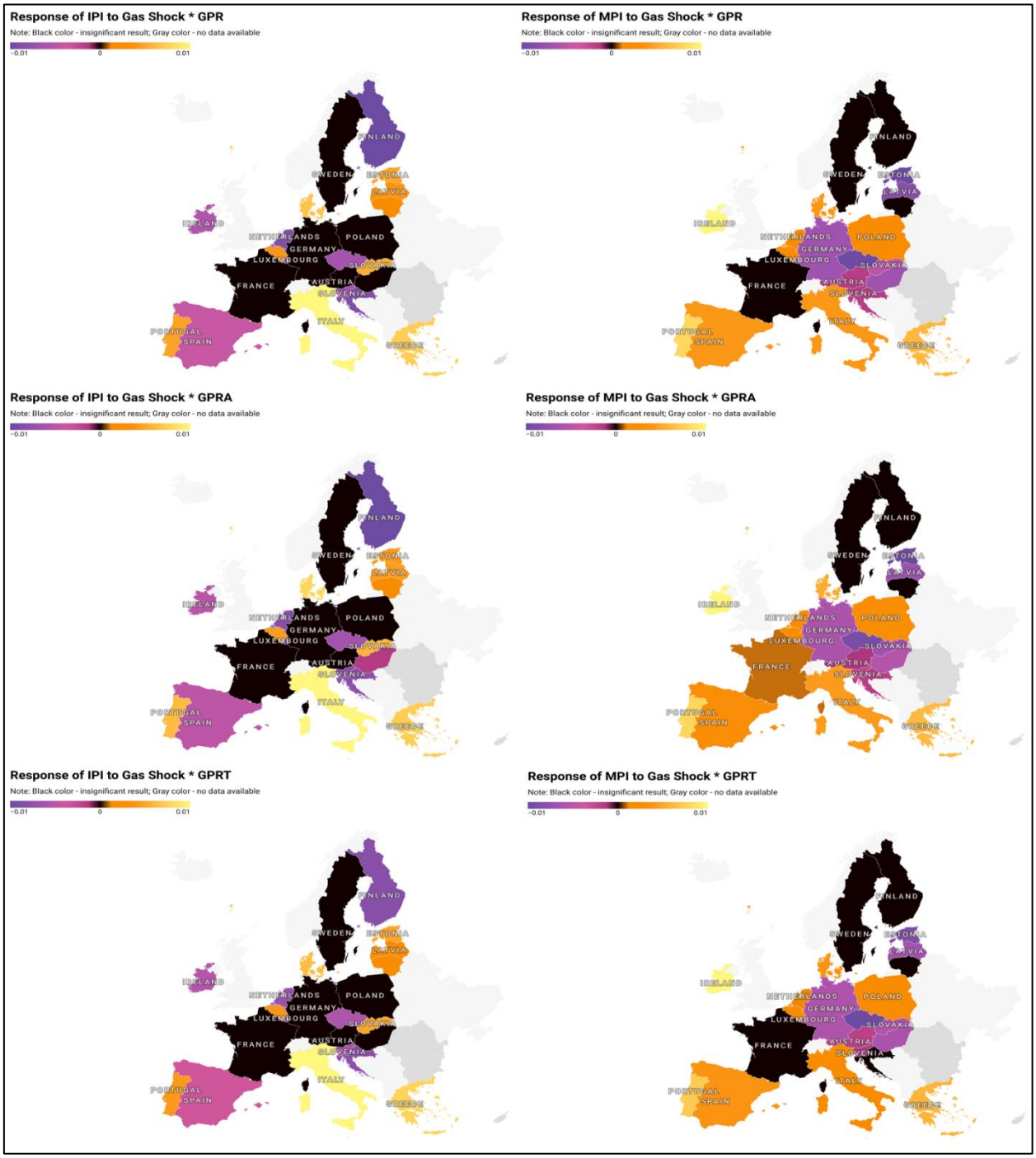


Figure 10 presents a country-by-country analysis of the joint effect of gas prices and geopolitical risks on industrial and manufacturing productions indices. The joint effects appear consistent across different types of geopolitical risk. An increase in the IPI is observed in countries, including Portugal, Italy, Belgium, Denmark, Estonia, Latvia, Lithuania and Greece. Simultaneously, industrial production declines in Finland, Ireland, the Netherlands, Luxembourg, the Czech Republic, Croatia, Slovenia and Spain.

The combined effect of gas prices and geopolitical risks on the manufacturing remains largely unchanged. The MPIs of Ireland, Portugal, Spain, Italy, the Netherlands, Belgium, Denmark, Poland and Greece exhibit positive responses. The manufacturing sector in France reacts positively, when analysing the joint impacts of gas price and the GPRA index. In contrast, the MPI exerts a negative effect in Estonia, Latvia, Germany, Austria, the Czech Republic, Slovakia, Hungary, Slovenia and Croatia.

Figure 11 shows the joint effect of oil prices and geopolitical risks. The effect remains consistent across various types of geopolitical risk, therefore, we will focus on establishing the baseline using the GPR index. Industrial production in Spain, Ireland, the Netherlands, the Czech Republic, Croatia, Finland, Lithuania and Spain exhibits a positive effect. The negative effect on the IPI is observed in Germany, Belgium, Italy, Slovakia, Estonia, Latvia and Greece.

The MPI reacts positively to the combined effect of rising oil prices and geopolitical risks in Germany, Estonia, Latvia, Lithuania, Austria, Slovenia, the Czech Republic, Hungary and Croatia. The negative effects are more widespread. For example, the MPI falls in Ireland, Portugal, Spain, France, Italy, Denmark, Greece and Spain.

Figure 11 – Joint Effect of Oil Price Shocks and Geopolitical Risks

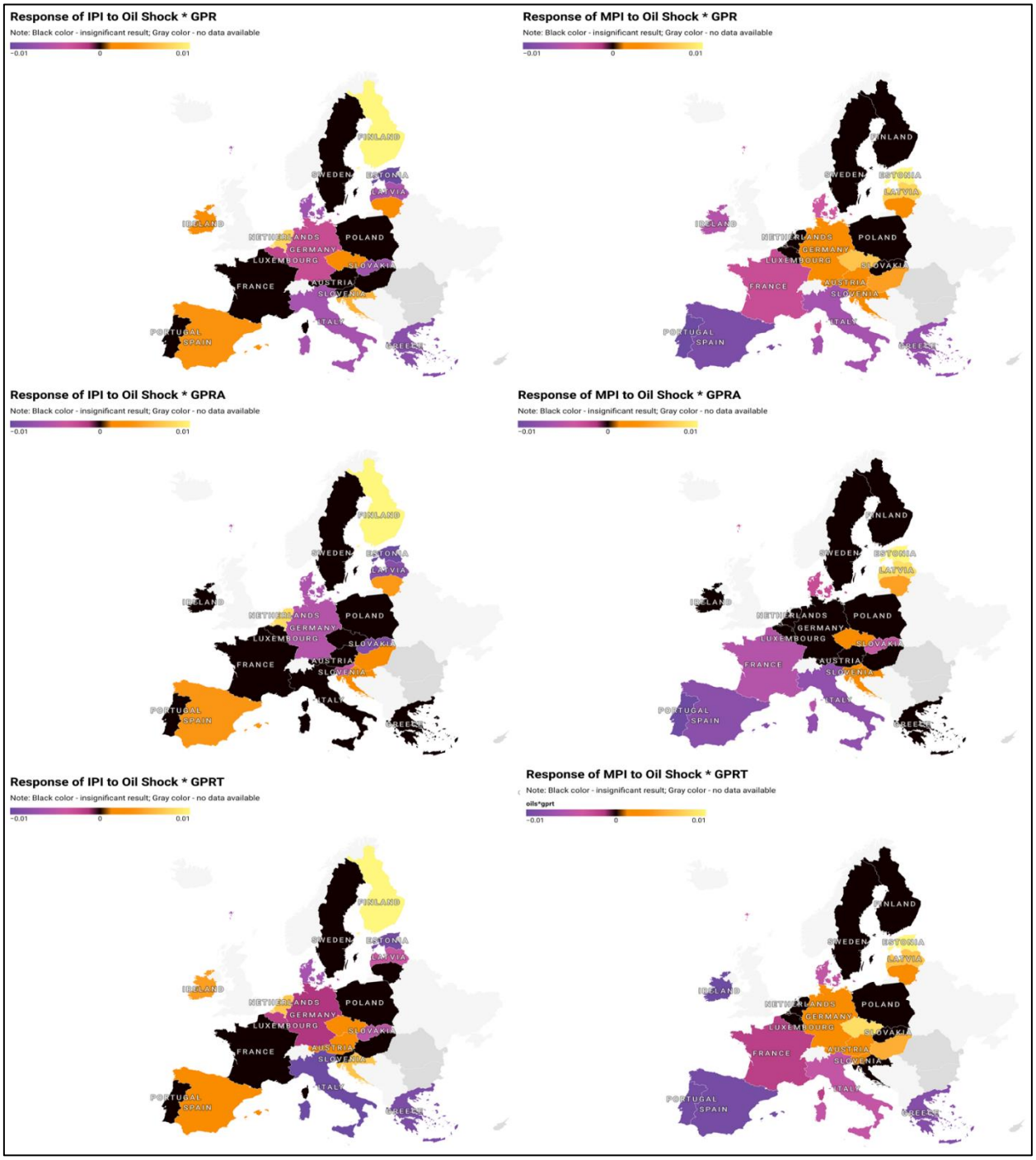


Figure 12 – Response of IPI and MPI to REER

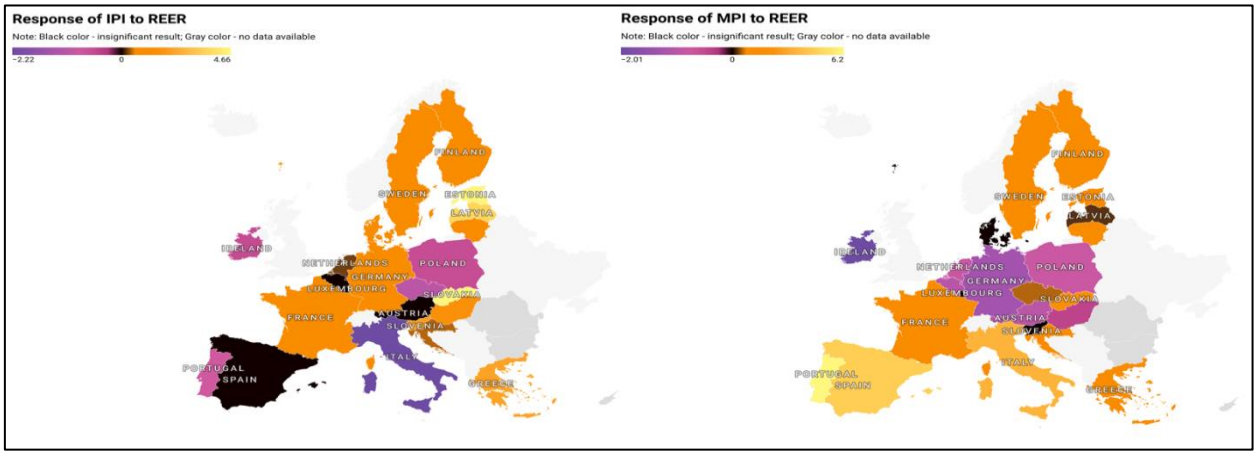


Figure 12 shows the impact of the real effective exchange rate on industrial production and manufacturing. The impact on industrial production is predominantly positive, with the exception of Portugal, Italy, the Czech Republic, Poland and Ireland. The REER adversely impacts a greater number of nations in the manufacturing sector.

4.5. Discussion

We found that GRP and GRP-acts negatively influence industrial and manufacture production in the general analysis by PVAR and Panel Causality approaches. The impact of GPR-acts are overwhelmingly more pronounced than general index of geopolitical risks. Our results are partially in line with several existing studies those who found inverse relations between geopolitical risks and commodity futures prices in China (Zheng et al., 2023). Besides, a several studies observed a downturn of stock returns during high geopolitical tension, for instance Bossman et al., (2023) for EU sectoral stocks; Pringpong at al., (2023) and Das et al., (2019) for emerging markets.

We found that oil and gas prices influence industrial and manufacturing production differently. For instance, both IPI and MPI respond to oil price shocks positively in first few months lead and turn into negative response from third month and onward months of lead. Gas price appears to be mostly insignificant in promoting IPI and MPI in our sample countries. Our results echo with the findings of Khan et al. (2020); Gokmenoglu et al. (2015), Yıldırım et al. (2014) those who found a rise of oil price impede industrial production for different OECD member countries.

Overwhelmingly, REER negatively affects both industrial and manufacturing production, corroborating international trade economic theory. Thus, European Union countries are exporters of industrial products, while an increase in the real effective exchange rate leads to a decrease in

the competitiveness of these goods in foreign markets, which may lead to a decrease in output. We provide an insight into the literature that the joint effect geopolitical risks and hydrocarbon prices may provide a different signal to industrial production.

Given the fact that, European countries also vary from each other in terms of size, economic endowments, and population. Therefore, some of the EU states might be more resilient to hydrocarbon prices shocks and geopolitical risks. Besides, our analysis nullified the slope homogeneity assumption. Thus, we extend our analysis the country-specific joint effects of geopolitical risks and hydrocarbon prices using the DCCE method under Mean Group estimator, which will allow us to consider the individual characteristics of the economies and trace the point effect.

Our country-specific analysis highlight that geopolitical risks somewhat provide some benefit to some countries, e.g., Greece, Portugal, and Slovakia. In contrast geopolitical risk impedes industrial production of some European countries for instance, Germany, Hungary, Ireland, Luxembourg, and Poland. The direct and joint effect of energy prices and geopolitical risks exert different implications to industrial production because both factors have their own peculiarities. For example, in some cases, an increase in the price of energy resources may be compensated for by a decrease in geopolitical risk, which may positively influence industrial production. In addition, our results show that tradable production turns out to be more susceptible to external shocks, including geopolitical risk, energy prices or their joint effect.

In general, the large economy like German industry is more vulnerable to the GPR. For example, in 2022, international trade amounted to 98.62% of the country's GDP, that clearly indicates the country's dependence on external conditions. Besides, Germany is a major importer of energy resources from Russia. Thus, the imposition of sanctions on Russian energy import in 2020 significantly aggravated the situation for German industry. Our proposition is further supported by our investigation that German industrial production negatively associated with the interaction of oil price and GPRA. Noted that there are major oil companies in Germany, such as Wintershell, BASF Group. Thus, an increase in the price of oil is uncorrelated with an increase in geopolitical tensions, specifically the GPRA index, can cause an increase in German industrial output, due to the higher revenue of oil companies.

Concerning a thriving GPR act, investors tend to reduce oil consumption and oil companies become volatile, which may negatively affect industrial output. The insignificant impact of gas price can be explained by the fact that most of our sample countries enjoyed a stable

supply of Russian gas through the pipeline. Thus, international gas was affected less due to exiting gas storage with older bidding price. For example, in 2022, German storage facilities were more than 85% full, which can provide protection against external resource prices over a one-year forecast horizon. Besides, in the first half of 2022, the German company Uniper recorded a loss of 12 billion dollars due to restrictions on gas supplies caused by the growing geopolitical risk in the world (conflict in Ukraine).

As for France which is the second largest economy in the European Union, where industrial (including manufacturing) production positively responds to geopolitical risks, but insignificantly responds to real effective exchange rate and gas price shocks. The fact that France's energy structure, more than 70% of electricity is currently generated by nuclear power plants. As of 2020, 56 industrial nuclear reactors were registered in the country. Thus, we can see that France is much less dependent on imported energy resources compared to Germany. In addition, France exports nuclear reactors to their international counterpart. Therefore, while geopolitical risks induced gas price affect other economies, France economy keeps thriving. Concerning the negative impact of oil price shocks, it is overwhelmingly used in the transportation of goods. Our finding further implies that France lacks large refining companies as Germany disadvantage their industry during the hike of oil price.

Italy, the third largest economy in the EU reacts negatively to oil price shocks, while insignificant response to natural gas prices shocks. The joint effect of oil price and GPR and gas price impedes industrial including manufacturing production. Anecdotal evidence shows that Italian economy energy depends on oil and gas imports close to 100%. At the same time, energy dependence on gas has been increasing since the end of the 20th century. In addition, Italy's share of imports from Russia is quite high (4.1% as of 2022), with a total deficit of trade balance by fuel category in 2022 of more than $120 billion. In addition, in the case of relations with Russia, we can note 2014-2015, when sanctions and restrictions began. Thus, in 2015, there was a reduction in Italy's GDP by 325 billion dollars in relation to 2014. In 2022, the reduction amounted to 103 billion compared to 2021.

Spanish industrial production insignificantly responds to oil and gas prices shocks, it responds positively to changes in geopolitical risks, with a stronger response to the GPRA. However, it reacts negatively to a REER as the exports become expensive. Besides, we also observe a negative reaction to the joint effect of the gas price and the GPRA. With higher uncertainty in the international market and high gas price jointly create hurdles importing natural

gas and negatively affects industrial production. The positive response of Spanish industrial production to oil price shocks can be explained by the fact that, this country possesses one of the sizeable oil companies, such as Repsol, which probably facilitate to absorb the shock.

The Netherlands is the fifth largest economy in the EU by GDP. Industry in this country reacts negatively to oil price shocks and geopolitical risks. Besides, its reaction to GPR act index turns out to be more profound than to the GPR. However, gas price shocks insignificantly influence Dutch industry. In general, Dutch economy enjoys a massive production of Machine building, petrochemicals and ferrous metallurgy. Besides, Netherlands produces gas which is about 15.1 billion cubic meters per year that enables the country with relative independence from gas imports.

According to our empirical results, Polish industrial production negatively responds to gas price shocks, GPR and GPRA. Besides, polish industry negatively reacts to the joint effect of oil price and geopolitical risks. Poland used to be a major importer from Russian hydrocarbon. Their imposition of sanction on Russian energy augment their cost of industrial production.

5. Conclusion and Policy Implications

Given the growing importance of stable industrial production development for achieving sustainable development goals and improving welfare, we investigate the dynamic response of industrial production to geopolitical risks, and oil and gas prices shocks. To this end, we use several advanced econometric methods. First, we apply Panel VAR approach to obtain the impulse response function by addressing country fixed effect, endogeneity and cross-sectional dependency. At second stage, we apply Granger test as robustness check. Finally, we use DCCE to identify country-specific effects and identify differences across countries. As indicators of geopolitical risks, we use two indicators: the GPR to determine the overall effect of the international state and the GPRA to detect the response to immediate dangerous events in the world.

Our investigation provides several new insights. First, European industrial production is somewhat vulnerable to oil price shocks. The vulnerability is profound in the case of manufacturing production. Besides, this vulnerability becomes higher at second- and sixth-month time horizon. Our country specific analysis shows that the negatives responses are profound in the case of Greece, Ireland, Portugal, and Slovakia. Secondly, our PVAR analysis suggests that European industrial production displays resilience in the face of gas price shocks. Following a one-month lag from the shock, industrial production exhibits a positive response; however, this trend reverses, showing a negative impact over a three-month lag period. Nevertheless, caution is advised in generalizing these results, as a country-specific analysis reveals a detrimental impact of gas price shocks on the German industry. In contrast, positive responses are observed in Denmark, Greece, and Ireland.

Third, GPR, GPRA and GPRT escalation adversely affect European industry. The granger causality test shows that the impact of GRP is immediate compared with other shocks. The country specific analysis reveals that Germany, Finland, Hungary, Ireland, Hungary, Ireland, Luxemburg, and Poland are more vulnerable to geopolitical risks. Fourth, our country specific analysis further confirms that geopolitically induced hydrocarbon prices shock in general adversely affect many EU countries industrial sector, including Germany, Hungary, Netherlands, Poland, Slovakia.

Based on the findings of the study on the dynamic response of industrial production to geopolitical risks, oil and gas price shocks, several policy implications can be considered. Given the vulnerability of European industrial production, particularly in Germany, to oil price shocks, policymakers may consider strategies to diversify energy sources and reduce dependence on oil. Promoting renewable energy sources and investing in energy efficiency measures could be crucial to mitigate the impact of oil price fluctuations. Countries identified as particularly vulnerable to shocks, such as Greece, Ireland, Portugal, and Slovakia, should develop specific risk mitigation strategies for their industrial sectors. This may involve creating contingency plans, establishing reserve funds, or implementing targeted policies to enhance resilience. Acknowledging the country-specific variations in responses to shocks, policymakers should design industrial policies that are tailored to the unique characteristics and vulnerabilities of each country. This may involve targeted support for industries in countries that are more susceptible to adverse effects. The positive response of European industrial production to gas price shocks followed by a reversal suggests the need for resilience-building measures. Policymakers could encourage industries to adopt flexible production processes, invest in technology that can withstand price volatility, and consider strategic reserves to buffer against sudden changes. Geopolitical risks, as indicated by the GPR and GPR escalation, pose a significant threat to European industry. Policymakers should prioritize risk preparedness and consider diplomatic efforts to mitigate geopolitical tensions. Strengthening international cooperation and diplomatic relations may contribute to a more stable geopolitical environment.

References

Adra, S., Gao, Y., Huang, J., & Yuan, J. (2023). Geopolitical risk and corporate payout policy. International Review of Financial Analysis, 87, 102613.

Ahmed, H. J. A., Bashar, O. H., & Wadud, I. M. (2012). The transitory and permanent volatility of oil prices: What implications are there for the US industrial production?. Applied Energy, 92, 447-455.

Balcilar, M., Bonato, M., Demirer, R., & Gupta, R. (2018). Geopolitical risks and stock market dynamics of the BRICS. Economic Systems, 42(2), 295-306.

Blomberg, S. B., Hess, G. D., & Orphanides, A. (2004). The macroeconomic consequences of terrorism. Journal of monetary economics, 51(5), 1007-1032.

Bossman, A., Gubareva, M., & Teplova, T. (2023). EU sectoral stocks amid geopolitical risk, market sentiment, and crude oil implied volatility: an asymmetric analysis of the Russia-Ukraine tensions. Resources Policy, 82, 103515.

Bouoiyour, J., Selmi, R., Hammoudeh, S., & Wohar, M. E. (2019). What are the categories of geopolitical risks that could drive oil prices higher? Acts or threats?. Energy Economics, 84, 104523.

Bussy, A., & Zheng, H. (2023). Responses of FDI to geopolitical risks: The role of governance, information, and technology. International Business Review, 32(4), 102136.

Caldara, D., & Iacoviello, M. (2022). Measuring geopolitical risk. American Economic Review, 112(4), 1194-1225.

Cavalcanti, T., & Jalles, J. T. (2013). Macroeconomic effects of oil price shocks in Brazil and in the United States. Applied Energy, 104, 475-486.

Chudik, A., & Pesaran, M. H. (2015). Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors. Journal of econometrics, 188(2), 393-420.

Das, D., Kannadhasan, M., & Bhattacharyya, M. (2019). Do the emerging stock markets react to international economic policy uncertainty, geopolitical risk and financial stress alike?. The North American Journal of Economics and Finance, 48, 1-19.

De Hoyos, R. E., & Sarafidis, V. (2006). Testing for cross-sectional dependence in panel-data models. The stata journal, 6(4), 482-496.

Demirer, R., Gupta, R., Suleman, T., & Wohar, M. E. (2018). Time-varying rare disaster risks, oil returns and volatility. Energy Economics, 75, 239-248.

Desogus, E., Grosso, D., Bompard, E., & Russo, S. L. (2023). Modelling the geopolitical impact on risk assessment of energy supply system: The case of Italian crude oil supply. Energy, 284, 128578.

Dutta, A., & Dutta, P. (2022). Geopolitical risk and renewable energy asset prices: Implications for sustainable development. Renewable Energy, 196, 518-525.

Dumitrescu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic modelling*, *29*(4), 1450-1460.

Dutta, A., Jana, R. K., & Das, D. (2020). Do green investments react to oil price shocks? Implications for sustainable development. Journal of Cleaner Production, 266, 121956.

Fernandez, V. (2008). The war on terror and its impact on the long-term volatility of financial markets. International Review of Financial Analysis, 17(1), 1-26.

Glick, R., & Taylor, A. M. (2010). Collateral damage: Trade disruption and the economic impact of war. The Review of Economics and Statistics, 92(1), 102-127.

Gokmenoglu, K., Azin, V., & Taspinar, N. (2015). The relationship between industrial production, GDP, inflation and oil price: the case of Turkey. Procedia Economics and Finance, 25, 497-503.

Gong, C., Gong, N., Qi, R., & Yu, S. (2020). Assessment of natural gas supply security in Asia Pacific: Composite indicators with compromise Benefit-of-the-Doubt weights. Resources Policy, 67, 101671.

Henriques, I., & Sadorsky, P. (2008). Oil prices and the stock prices of alternative energy companies. Energy Economics, 30(3), 998-1010.

Juodis, A., Karavias, Y., & Sarafidis, V. (2021). A homogeneous approach to testing for Granger non-causality in heterogeneous panels. Empirical Economics, 60(1), 93-112.

Khan, A., Khan, M. Y., & Khan, A. Q. (2020). How Do Oil and Natural Gas Prices affect US industrial production? Utilizing wavelet nonlinear denoised based quantile analysis. *Energy Strategy Reviews*, *32*, 100550.

Kuzemko, C., Blondeel, M., Dupont, C., & Brisbois, M. C. (2022). Russia's war on Ukraine, European energy policy responses & implications for sustainable transformations. Energy Research & Social Science, 93, 102842.

Lee, C. C., Lee, C. C., & Li, Y. Y. (2021). Oil price shocks, geopolitical risks, and green bond market dynamics. The North American Journal of Economics and Finance, 55, 101309.

Li, Q., Cheng, K., & Yang, X. (2017). Response pattern of stock returns to international oil price shocks: From the perspective of China’s oil industrial chain. Applied Energy, 185, 1821-1831.

Liu, C., Han, W., & Xue, X. (2022). Experimental investigation of a high-temperature heat pump for industrial steam production. Applied Energy, 312, 118719.

Liu, W., Li, X., Liu, C., Wang, M., & Liu, L. (2023). Resilience assessment of the cobalt supply chain in China under the impact of electric vehicles and geopolitical supply risks. Resources Policy, 80, 103183.

Love, I., & Zicchino, L. (2006). Financial development and dynamic investment behavior: Evidence from panel VAR. The Quarterly Review of Economics and Finance, 46(2), 190-210.

Monge, M., Rojo, M. F. R., & Gil-Alana, L. A. (2023). The impact of geopolitical risk on the behavior of oil prices and freight rates. Energy, 269, 126779.

Nguyen, T. C., & Thuy, T. H. (2023). Geopolitical risk and the cost of bank loans. Finance Research Letters, 54, 103812.

Pesaran, M. H., Ullah, A., & Yamagata, T. (2008). A bias-adjusted LM test of error cross-section independence. *The econometrics journal*, *11*(1), 105-127.

Pesaran, M. H., & Yamagata, T. (2008). Testing slope homogeneity in large panels. Journal of econometrics, 142(1), 50-93.

Plakandaras, V., Gupta, R., & Wong, W. K. (2019). Point and density forecasts of oil returns: The role of geopolitical risks. Resources Policy, 62, 580-587.

Pringpong, S., Maneenop, S., & Jaroenjitrkam, A. (2023). Geopolitical risk and firm value: Evidence from emerging markets. The North American Journal of Economics and Finance, 68, 101951.

Rasoulinezhad, E., Taghizadeh-Hesary, F., Sung, J., & Panthamit, N. (2020). Geopolitical risk and energy transition in russia: Evidence from ARDL bounds testing method. Sustainability, 12(7), 2689.

Reboredo, J. C., Rivera-Castro, M. A., & Ugolini, A. (2017). Wavelet-based test of co-movement and causality between oil and renewable energy stock prices. Energy Economics, 61, 241-252.

Sohag, K., Hammoudeh, S., Elsayed, A. H., Mariev, O., & Safonova, Y. (2022). Do geopolitical events transmit opportunity or threat to green markets? Decomposed measures of geopolitical risks. Energy Economics, 111, 106068.

Song, Y., Chen, B., Wang, X. Y., & Wang, P. P. (2022). Defending global oil price security: Based on the perspective of uncertainty risk. Energy Strategy Reviews, 41, 100858.

Wang, D., Wang, Z., & Zong, X. (2023). Impact of economic policy uncertainty on higher education expansion. Finance Research Letters, 52, 103564.

Wang, X., Wu, Y., & Xu, W. (2019). Geopolitical risk and investment. Journal of Money, Credit and Banking, Forthcoming.

Wang, Y., Wei, M., Bashir, U., & Zhou, C. (2022). Geopolitical risk, economic policy uncertainty and global oil price volatility—an empirical study based on quantile causality nonparametric test and wavelet coherence. Energy Strategy Reviews, 41, 100851.

Yang, K., Wei, Y., Li, S., & He, J. (2021). Geopolitical risk and renewable energy stock markets: An insight from multiscale dynamic risk spillover. Journal of Cleaner Production, 279, 123429.

Yang, T., Dong, Q., Du, M., & Du, Q. (2023). Geopolitical risks, oil price shocks and inflation: Evidence from a TVP–SV–VAR approach. Energy Economics, 107099.

Yıldırım, E., & Öztürk, Z. (2014). Oil price and industrial production in G7 countries: evidence from the asymmetric and non-asymmetric causality tests. *Procedia-Social and Behavioral Sciences*, *143*, 1020-1024.

Zhang, Z., Wang, Y., & Li, B. (2023). Asymmetric spillover of geopolitical risk and oil price volatility: A global perspective. Resources Policy, 83, 103701.

Zhao, J. (2023). Time-varying impact of geopolitical risk on natural resources prices: Evidence from the hybrid TVP-VAR model with large system. Resources Policy, 82, 103467.

Zheng, D., Zhao, C., & Hu, J. (2023). Impact of geopolitical risk on the volatility of natural resource commodity futures prices in China. Resources Policy, 83, 103568.

Appendix

Appendix A. DCCE for IPI index with GPR

ipi	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Mean	Group:					
reer	.8580204	.3620492	2.37	0.018	.148417	1.567624
Individual	Results					
reer_1	-.2015494	.2057381	-0.98	0.327	-.6047886	.2016898
reer_2	-.5048128	.337207	-1.50	0.134	-1.165726	.1561008
reer_3	.3458207	.0492546	7.02	0.000	.2492834	.442358
reer_4	-1.09808	.0888218	-12.36	0.000	-1.272167	-.923992
reer_5	1.239729	.2974464	4.17	0.000	.6567453	1.822714
reer_6	4.592438	.4890868	9.39	0.000	3.633845	5.55103
reer_7	1.407125	.0964143	14.59	0.000	1.218156	1.596094
reer_8	.6332735	.1638538	3.86	0.000	.312126	.9544211
reer_9	1.500418	.0886282	16.93	0.000	1.32671	1.674126
reer_10	2.163306	.3753176	5.76	0.000	1.427697	2.898915
reer_11	1.677899	.1820375	9.22	0.000	1.321112	2.034686
reer_12	-.5668949	.0724917	-7.82	0.000	-.7089761	-.4248137
reer_13	-2.220618	.1988936	-11.16	0.000	-2.610442	-1.830794
reer_14	3.669702	.2666485	13.76	0.000	3.147081	4.192324
reer_15	.9536794	.0698789	13.65	0.000	.8167194	1.090639
reer_16	.1494483	.5011819	0.30	0.766	-.8328503	1.131747
reer_17	.2163269	.0578859	3.74	0.000	.1028726	.3297812
reer_18	-.59274	.0692193	-8.56	0.000	-.7284073	-.4570728
reer_19	-.7994787	.1368805	-5.84	0.000	-1.06776	-.5311978
reer_20	4.657472	.2426162	19.20	0.000	4.181953	5.132991
reer_21	2.064608	.062733	32.91	0.000	1.941654	2.187563
reer_22	-.0408757	.368046	-0.11	0.912	-.7622326	.6804811
reer_23	.4882721	.0438111	11.14	0.000	.4024039	.5741404
gpr	-.0004341	.0047553	-0.09	0.927	-.0097542	.0088861
Individual	Results					
gpr_1	-.0120755	.0060918	-1.98	0.047	-.0240152	-.0001358
gpr_2	-.0357818	.0084987	-4.21	0.000	-.052439	-.0191246
gpr_3	.0179747	.0055313	3.25	0.001	.0071335	.028816
gpr_4	.0123004	.005066	2.43	0.015	.0023713	.0222296
gpr_5	-.0130766	.0090437	-1.45	0.148	-.030802	.0046488
gpr_6	-.0010774	.0141751	-0.08	0.939	-.0288602	.0267054
gpr_7	.0164768	.0099391	1.66	0.097	-.0030035	.035957
gpr_8	-.0138678	.0073087	-1.90	0.058	-.0281926	.000457
gpr_9	.0044054	.004875	0.90	0.366	-.0051494	.0139603
gpr_10	-.0075311	.0197573	-0.38	0.703	-.0462547	.0311924
gpr_11	.0120036	.0055156	2.18	0.030	.0011932	.022814
gpr_12	.010458	.0062048	1.69	0.092	-.0017032	.0226192
gpr_13	-.0143487	.0183218	-0.78	0.434	-.0502588	.0215613
gpr_14	-.0228253	.0106912	-2.13	0.033	-.0437797	-.0018709
gpr_15	-.0030304	.0079172	-0.38	0.702	-.0185478	.0124869
gpr_16	.0446476	.0111704	4.00	0.000	.0227539	.0665412
gpr_17	.0250711	.0079836	3.14	0.002	.0094234	.0407187
gpr_18	-.00255	.0033446	-0.76	0.446	-.0091053	.0040052
gpr_19	-.050664	.0147296	-3.44	0.001	-.0795336	-.0217945
gpr_20	-.031456	.0093297	-3.37	0.001	-.0497419	-.0131702
gpr_21	.039136	.0102252	3.83	0.000	.0190951	.059177
gpr_22	.0090418	.0053787	1.68	0.093	-.0015002	.0195838
gpr_23	.0067862	.0054831	1.24	0.216	-.0039606	.0175329
brent_shock	.125418	.1046357	1.20	0.231	-.0796642	.3305002
Individual	Results					
brent_shock_1	-.2198414	.0835697	-2.63	0.009	-.383635	-.0560478
brent_shock_2	.1073059	.117348	0.91	0.360	-.1226921	.3373038
brent_shock_3	-.4771412	.0744538	-6.41	0.000	-.6230679	-.3312144
brent_shock_4	.0021293	.0682432	0.03	0.975	-.1316249	.1358836
brent_shock_5	.6224718	.1191247	5.23	0.000	.3889917	.8559518
brent_shock_6	1.122358	.1970292	5.70	0.000	.7361883	1.508529
brent_shock_7	-.7099244	.1341044	-5.29	0.000	-.9727642	-.4470846

brent_shock_8	.1925709	.0951409	2.02	0.043	.0060982	.3790435
brent_shock_9	.3865397	.065282	5.92	0.000	.2585894	.5144901
brent_shock_10	.8458388	.2675791	3.16	0.002	.3213934	1.370284
brent_shock_11	-.1257529	.0746629	-1.68	0.092	-.2720896	.0205837
brent_shock_12	-.2860663	.0832212	-3.44	0.001	-.4491768	-.1229557
brent_shock_13	.1069278	.2459243	0.43	0.664	-.3750749	.5889305
brent_shock_14	.8307527	.1413242	5.88	0.000	.5537622	1.107743
brent_shock_15	-.2423886	.1063068	-2.28	0.023	-.4507461	-.0340312
brent_shock_16	.2315939	.1655376	1.40	0.162	-.0928538	.5560417
brent_shock_17	-.7244892	.1052607	-6.88	0.000	-.9307963	-.5181821
brent_shock_18	.0732263	.0443501	1.65	0.099	-.0136982	.1601508
brent_shock_19	.0376211	.2150675	0.17	0.861	-.3839035	.4591457
brent_shock_20	.8120922	.1203904	6.75	0.000	.5761313	1.048053
brent_shock_21	.5866523	.1404075	4.18	0.000	.3114586	.8618461
brent_shock_22	-.3347396	.0725756	-4.61	0.000	-.4769851	-.1924941
brent_shock_23	.0468756	.0759875	0.62	0.537	-.1020572	.1958084
gas_shock	-.1036739	.1307627	-0.79	0.428	-.359964	.1526162
Individual	Results					
gas_shock_1	-.1167446	.0985777	-1.18	0.236	-.3099533	.076464
gas_shock_2	-.6551052	.140032	-4.68	0.000	-.9295629	-.3806475
gas_shock_3	.6934125	.0934116	7.42	0.000	.510329	.8764959
gas_shock_4	.5476009	.0824499	6.64	0.000	.386002	.7091998
gas_shock_5	-1.060652	.1482187	-7.16	0.000	-1.351155	-.7701484
gas_shock_6	-.9791459	.2526049	-3.88	0.000	-1.474243	-.4840493
gas_shock_7	.7440887	.1640195	4.54	0.000	.4226163	1.065561
gas_shock_8	.0188813	.1149192	0.16	0.869	-.2063562	.2441188
gas_shock_9	.0732692	.0794037	0.92	0.356	-.0823593	.2288977
gas_shock_10	-1.260564	.3352904	-3.76	0.000	-1.917721	-.6034067
gas_shock_11	.0708543	.0915843	0.77	0.439	-.1086477	.2503563
gas_shock_12	.359599	.0998305	3.60	0.000	.1639348	.5552631
gas_shock_13	-.7276135	.302973	-2.40	0.016	-1.32143	-.1337974
gas_shock_14	-.4703496	.1728534	-2.72	0.007	-.8091361	-.1315631
gas_shock_15	-.0872556	.1327482	-0.66	0.511	-.3474373	.1729261
gas_shock_16	.6768193	.1976245	3.42	0.001	.2894823	1.064156
gas_shock_17	.5760186	.1299881	4.43	0.000	.3212467	.8307905
gas_shock_18	.1588705	.053556	2.97	0.003	.0539026	.2638384
gas_shock_19	-.8633167	.2430611	-3.55	0.000	-1.339708	-.3869257
gas_shock_20	-.8411046	.1549865	-5.43	0.000	-1.144873	-.5373366
gas_shock_21	.4458133	.1657426	2.69	0.007	.1209639	.7706628
gas_shock_22	.2896443	.0891235	3.25	0.001	.1149655	.4643232
gas_shock_23	.022479	.089545	0.25	0.802	-.1530259	.1979839
oils_gpr	-.0009748	.0009765	-1.00	0.318	-.0028887	.0009391
Individual	Results					
oils_gpr_1	.0011065	.0008206	1.35	0.178	-.0005018	.0027148
oils_gpr_2	-.002193	.0011606	-1.89	0.059	-.0044678	.0000818
oils_gpr_3	.0046583	.0007434	6.27	0.000	.0032013	.0061152
oils_gpr_4	.0014997	.0006748	2.22	0.026	.000177	.0028224
oils_gpr_5	-.0065618	.0011821	-5.55	0.000	-.0088786	-.0042449
oils_gpr_6	-.0098558	.0019847	-4.97	0.000	-.0137457	-.0059659
oils_gpr_7	.0083619	.0013251	6.31	0.000	.0057647	.0109592
oils_gpr_8	-.0011189	.0009461	-1.18	0.237	-.0029732	.0007355
oils_gpr_9	-.0026537	.0006495	-4.09	0.000	-.0039266	-.0013807
oils_gpr_10	-.0081343	.0026569	-3.06	0.002	-.0133418	-.0029269
oils_gpr_11	.0009937	.0007388	1.35	0.179	-.0004542	.0024417
oils_gpr_12	.0028762	.0008158	3.53	0.000	.0012772	.0044752
oils_gpr_13	-.0062344	.0024338	-2.56	0.010	-.0110045	-.0014643
oils_gpr_14	-.0059365	.0014015	-4.24	0.000	-.0086835	-.0031896
oils_gpr_15	.0017654	.0010525	1.68	0.093	-.0002975	.0038282
oils_gpr_16	.0001989	.0016678	0.12	0.905	-.0030699	.0034677
oils_gpr_17	.006581	.0010463	6.29	0.000	.0045303	.0086316
oils_gpr_18	-.0000863	.0004386	-0.20	0.844	-.0009459	.0007733
oils_gpr_19	-.0020815	.0020584	-1.01	0.312	-.006116	.0019529
oils_gpr_20	-.0065672	.001199	-5.48	0.000	-.0089172	-.0042172
oils_gpr_21	-.0016007	.0013671	-1.17	0.242	-.0042803	.0010788
oils_gpr_22	.0031026	.0007209	4.30	0.000	.0016896	.0045155
oils_gpr_23	-.0005398	.0007381	-0.73	0.465	-.0019865	.0009069
gass_gpr	.0004677	.0008306	0.56	0.573	-.0011602	.0020956

Individual	Results					
gass_gpr_1	.0002014	.0004349	0.46	0.643	-.0006509	.0010538
gass_gpr_2	.003468	.0006234	5.56	0.000	.0022461	.00469
gass_gpr_3	-.0048313	.0004195	-11.52	0.000	-.0056534	-.0040092
gass_gpr_4	-.0034931	.0003568	-9.79	0.000	-.0041924	-.0027937
gass_gpr_5	.0057263	.0006633	8.63	0.000	.0044262	.0070264
gass_gpr_6	.0041719	.0010828	3.85	0.000	.0020496	.0062941
gass_gpr_7	-.0054978	.0007209	-7.63	0.000	-.0069107	-.0040849
gass_gpr_8	.0005839	.0005141	1.14	0.256	-.0004237	.0015914
gass_gpr_9	.0000654	.0003509	0.19	0.852	-.0006223	.000753
gass_gpr_10	.006248	.0014187	4.40	0.000	.0034674	.0090286
gass_gpr_11	-.0006139	.0003947	-1.56	0.120	-.0013875	.0001597
gass_gpr_12	-.0031664	.0004435	-7.14	0.000	-.0040355	-.0022972
gass_gpr_13	.008563	.0013048	6.56	0.000	.0060056	.0111204
gass_gpr_14	.0032577	.0007604	4.28	0.000	.0017673	.0047481
gass_gpr_15	.001499	.0005836	2.57	0.010	.0003553	.0026428
gass_gpr_16	-.0035498	.0009602	-3.70	0.000	-.0054317	-.0016679
gass_gpr_17	-.0046992	.0005704	-8.24	0.000	-.0058172	-.0035812
gass_gpr_18	.0001264	.0002331	0.54	0.587	-.0003304	.0005833
gass_gpr_19	.0040234	.0010599	3.80	0.000	.0019459	.0061008
gass_gpr_20	.0046539	.0007015	6.63	0.000	.0032789	.0060288
gass_gpr_21	-.0034948	.0007183	-4.87	0.000	-.0049026	-.002087
gass_gpr_22	-.0023014	.0003979	-5.78	0.000	-.0030813	-.0015215
gass_gpr_23	-.0001828	.0003884	-0.47	0.638	-.000944	.0005784

Appendix B. DCCE for IPI index with GPRA

ipi2	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Mean	Group:					
reer	.8157748	.3517483	2.32	0.020	.1263607	1.505189
Individual	Results					
reer_1	-.1647289	.2054198	-0.80	0.423	-.5673442	.2378865
reer_2	-.6008925	.3471987	-1.73	0.084	-1.281389	.0796045
reer_3	.2907208	.0517839	5.61	0.000	.1892261	.3922154
reer_4	-1.110872	.0910717	-12.20	0.000	-1.289369	-.9323746
reer_5	1.143051	.299864	3.81	0.000	.5553287	1.730774
reer_6	4.23225	.4865129	8.70	0.000	3.278702	5.185797
reer_7	1.397119	.0990401	14.11	0.000	1.203004	1.591234
reer_8	.5788028	.1639279	3.53	0.000	.2575101	.9000955
reer_9	1.525684	.0877973	17.38	0.000	1.353605	1.697764
reer_10	2.044883	.3782278	5.41	0.000	1.303571	2.786196
reer_11	1.699944	.1799246	9.45	0.000	1.347298	2.05259
reer_12	-.5477914	.0739955	-7.40	0.000	-.6928198	-.402763
reer_13	-2.295018	.2034049	-11.28	0.000	-2.693684	-1.896351
reer_14	3.626211	.2674722	13.56	0.000	3.101975	4.150447
reer_15	.9862043	.0701344	14.06	0.000	.8487435	1.123665
reer_16	.2006613	.4875579	0.41	0.681	-.7549345	1.156257
reer_17	.2035251	.0596568	3.41	0.001	.0865998	.3204504
reer_18	-.601522	.0689548	-8.72	0.000	-.7366709	-.4663731
reer_19	-.7930039	.1357155	-5.84	0.000	-1.059001	-.5270064
reer_20	4.479504	.2412766	18.57	0.000	4.006611	4.952398
reer_21	2.055613	.0616911	33.32	0.000	1.934701	2.176526
reer_22	-.0789203	.3670798	-0.21	0.830	-.7983835	.6405429
reer_23	.4913941	.0433518	11.34	0.000	.4064262	.5763621
gpra	-5.10e-06	.0038592	-0.00	0.999	-.007569	.0075588
Individual	Results					
gpra_1	-.0122648	.0043913	-2.79	0.005	-.0208715	-.0036581
gpra_2	-.0263098	.0063208	-4.16	0.000	-.0386983	-.0139213
gpra_3	.0126248	.0042947	2.94	0.003	.0042073	.0210422
gpra_4	.010213	.0037564	2.72	0.007	.0028506	.0175753
gpra_5	-.0151704	.0066906	-2.27	0.023	-.0282839	-.002057
gpra_6	-.0014534	.0105541	-0.14	0.890	-.0221389	.0192322
gpra_7	.0209815	.0074485	2.82	0.005	.0063828	.0355802
gpra_8	-.004419	.0053083	-0.83	0.405	-.014823	.0059851
gpra_9	.0003109	.0035077	0.09	0.929	-.0065642	.0071859
gpra_10	-.0068726	.0144947	-0.47	0.635	-.0352817	.0215365

gpra_11	.0121801	.0039458	3.09	0.002	.0044464	.0199137
gpra_12	.006456	.0046392	1.39	0.164	-.0026366	.0155487
gpra_13	-.0107984	.0136097	-0.79	0.428	-.0374729	.0158761
gpra_14	-.0167128	.0077962	-2.14	0.032	-.031993	-.0014326
gpra_15	-.0003195	.0058568	-0.05	0.956	-.0117986	.0111596
gpra_16	.036364	.0082598	4.40	0.000	.0201751	.052553
gpra_17	.0220327	.0060002	3.67	0.000	.0102725	.0337928
gpra_18	-.0015363	.0024063	-0.64	0.523	-.0062525	.0031799
gpra_19	-.0432175	.0106366	-4.06	0.000	-.0640648	-.0223702
gpra_20	-.0245659	.0069464	-3.54	0.000	-.0381807	-.0109511
gpra_21	.0262252	.0073111	3.59	0.000	.0118958	.0405547
gpra_22	.009671	.0038621	2.50	0.012	.0021015	.0172406
gpra_23	.006464	.0039438	1.64	0.101	-.0012657	.0141936
brent_shock	.0773626	.0774639	1.00	0.318	-.0744639	.2291892
Individual	Results					
brent_shock_1	-.1081412	.0732984	-1.48	0.140	-.2518033	.035521
brent_shock_2	.0029883	.1050414	0.03	0.977	-.202889	.2088657
brent_shock_3	-.1486826	.0687529	-2.16	0.031	-.2834358	-.0139295
brent_shock_4	.1935183	.0611633	3.16	0.002	.0736404	.3133962
brent_shock_5	.2848798	.1053886	2.70	0.007	.078322	.4914377
brent_shock_6	.6797228	.1715187	3.96	0.000	.3435524	1.015893
brent_shock_7	-.4351435	.1204174	-3.61	0.000	-.6711572	-.1991298
brent_shock_8	.095714	.0836721	1.14	0.253	-.0682804	.2597084
brent_shock_9	.4005764	.0563622	7.11	0.000	.2901086	.5110443
brent_shock_10	.3639539	.236878	1.54	0.124	-.1003185	.8282263
brent_shock_11	-.1803442	.064888	-2.78	0.005	-.3075223	-.0531661
brent_shock_12	-.05233	.074406	-0.70	0.482	-.1981631	.0935032
brent_shock_13	-.5583219	.2199061	-2.54	0.011	-.9893299	-.1273139
brent_shock_14	.6717392	.1244995	5.40	0.000	.4277247	.9157536
brent_shock_15	-.2791654	.0941922	-2.96	0.003	-.4637788	-.0945521
brent_shock_16	.1945299	.1374526	1.42	0.157	-.0748722	.463932
brent_shock_17	-.5311843	.0949077	-5.60	0.000	-.7171999	-.3451686
brent_shock_18	.0761214	.0392644	1.94	0.053	-.0008353	.1530781
brent_shock_19	.0725047	.1867209	0.39	0.698	-.2934616	.438471
brent_shock_20	.613897	.1065985	5.76	0.000	.4049678	.8228261
brent_shock_21	.6532489	.1194606	5.47	0.000	.4191103	.8873874
brent_shock_22	-.2392407	.0626403	-3.82	0.000	-.3620135	-.1164679
brent_shock_23	.0084999	.0657467	0.13	0.897	-.1203613	.1373611
gas_shock	-.074285	.1073232	-0.69	0.489	-.2846346	.1360647
Individual	Results					
gas_shock_1	-.1577565	.0957357	-1.65	0.099	-.3453951	.029882
gas_shock_2	-.5266287	.1394026	-3.78	0.000	-.7998529	-.2534045
gas_shock_3	.5018254	.0960028	5.23	0.000	.3136635	.6899873
gas_shock_4	.4450289	.0822558	5.41	0.000	.2838105	.6062474
gas_shock_5	-.9417937	.1459897	-6.45	0.000	-1.227928	-.6556591
gas_shock_6	-.7596122	.2464553	-3.08	0.002	-1.242656	-.2765687
gas_shock_7	.6066026	.1640017	3.70	0.000	.2851651	.92804
gas_shock_8	.0437812	.112673	0.39	0.698	-.1770537	.2646162
gas_shock_9	.0350669	.0763601	0.46	0.646	-.114596	.1847299
gas_shock_10	-.9949411	.3289306	-3.02	0.002	-1.639633	-.350249
gas_shock_11	.0830832	.0878548	0.95	0.344	-.0891091	.2552755
gas_shock_12	.2347355	.0995995	2.36	0.018	.0395241	.4299469
gas_shock_13	-.3406693	.3010874	-1.13	0.258	-.9307897	.2494511
gas_shock_14	-.4058161	.169299	-2.40	0.017	-.7376361	-.0739961
gas_shock_15	.0051838	.1301421	0.04	0.968	-.24989	.2602575
gas_shock_16	.6307778	.1894939	3.33	0.001	.2593765	1.002179
gas_shock_17	.4405626	.1302711	3.38	0.001	.1852359	.6958894
gas_shock_18	.1484836	.0521609	2.85	0.004	.0462501	.2507171
gas_shock_19	-.8145449	.2362448	-3.45	0.001	-1.277576	-.3515136
gas_shock_20	-.6909238	.1511906	-4.57	0.000	-.987252	-.3945957
gas_shock_21	.4482658	.1594658	2.81	0.005	.1357185	.7608131
gas_shock_22	.281206	.0863001	3.26	0.001	.1120609	.450351
gas_shock_23	.0195284	.0871115	0.22	0.823	-.1512071	.1902639
oils_gpra	-.0004759	.0005844	-0.81	0.415	-.0016213	.0006694
Individual	Results					
oils_gpra_1	-.0000714	.0007184	-0.10	0.921	-.0014794	.0013367
oils_gpra_2	-.0011576	.00104	-1.11	0.266	-.003196	.0008807

oils_gpra_3	.0012298	.000683	1.80	0.072	-.0001089	.0025686
oils_gpra_4	-.0004983	.0006055	-0.82	0.411	-.0016851	.0006885
oils_gpra_5	-.0031289	.0010463	-2.99	0.003	-.0051797	-.0010781
oils_gpra_6	-.0052834	.0017203	-3.07	0.002	-.0086551	-.0019118
oils_gpra_7	.0055933	.0011879	4.71	0.000	.003265	.0079216
oils_gpra_8	-.0001458	.0008319	-0.18	0.861	-.0017763	.0014846
oils_gpra_9	-.0028788	.0005614	-5.13	0.000	-.003979	-.0017785
oils_gpra_10	-.0030922	.0023439	-1.32	0.187	-.0076862	.0015019
oils_gpra_11	.001608	.0006401	2.51	0.012	.0003535	.0028625
oils_gpra_12	.0004286	.0007289	0.59	0.557	-.0010001	.0018572
oils_gpra_13	.0008215	.0021727	0.38	0.705	-.0034369	.0050799
oils_gpra_14	-.0044157	.001234	-3.58	0.000	-.0068344	-.0019971
oils_gpra_15	.0022688	.0009286	2.44	0.015	.0004488	.0040888
oils_gpra_16	.0006517	.0013792	0.47	0.637	-.0020514	.0033549
oils_gpra_17	.0046626	.0009458	4.93	0.000	.002809	.0065163
oils_gpra_18	-.0001326	.0003871	-0.34	0.732	-.0008914	.0006261
oils_gpra_19	-.0025682	.0017828	-1.44	0.150	-.0060625	.0009261
oils_gpra_20	-.0046117	.0010601	-4.35	0.000	-.0066894	-.002534
oils_gpra_21	-.0022595	.0011708	-1.93	0.054	-.0045541	.0000352
oils_gpra_22	.0021835	.0006203	3.52	0.000	.0009677	.0033993
oils_gpra_23	-.0001501	.0006404	-0.23	0.815	-.0014053	.0011051
gass_gpra	.000312	.0007644	0.41	0.683	-.0011862	.0018102
Individual	Results					
gass_gpra_1	.0006447	.0004659	1.38	0.166	-.0002684	.0015578
gass_gpra_2	.0031164	.0006865	4.54	0.000	.0017709	.0044619
gass_gpra_3	-.0041272	.0004735	-8.72	0.000	-.0050552	-.0031991
gass_gpra_4	-.0033434	.0003929	-8.51	0.000	-.0041134	-.0025734
gass_gpra_5	.0056222	.0007204	7.80	0.000	.0042104	.0070341
gass_gpra_6	.0030445	.0011572	2.63	0.009	.0007763	.0053126
gass_gpra_7	-.005169	.0007982	-6.48	0.000	-.0067334	-.0036045
gass_gpra_8	.0003638	.0005557	0.65	0.513	-.0007252	.0014529
gass_gpra_9	.0002313	.0003732	0.62	0.535	-.0005001	.0009627
gass_gpra_10	.0052123	.0015346	3.40	0.001	.0022046	.0082201
gass_gpra_11	-.0008033	.0004171	-1.93	0.054	-.0016207	.0000141
gass_gpra_12	-.0026831	.0004907	-5.47	0.000	-.0036449	-.0017213
gass_gpra_13	.0071336	.0014299	4.99	0.000	.004331	.0099362
gass_gpra_14	.0030823	.0008211	3.75	0.000	.0014729	.0046917
gass_gpra_15	.0012581	.0006324	1.99	0.047	.0000187	.0024975
gass_gpra_16	-.0039274	.0010001	-3.93	0.000	-.0058875	-.0019673
gass_gpra_17	-.0043211	.0006318	-6.84	0.000	-.0055593	-.0030828
gass_gpra_18	.0002147	.0002493	0.86	0.389	-.0002739	.0007032
gass_gpra_19	.0043973	.0011297	3.89	0.000	.0021831	.0066114
gass_gpra_20	.0041734	.0007509	5.56	0.000	.0027016	.0056452
gass_gpra_21	-.0041882	.0007605	-5.51	0.000	-.0056788	-.0026976
gass_gpra_22	-.0025095	.0004247	-5.91	0.000	-.0033418	-.0016771
gass_gpra_23	-.0002464	.0004156	-0.59	0.553	-.0010609	.0005682

Appendix C. DCCE for IPI index with GPRT

ipi2	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Mean	Group:					
reer	.8620405	.3613095	2.39	0.017	.1538868	1.570194
Individual	Results					
reer_1	-.2151709	.2070147	-1.04	0.299	-.6209123	.1905704
reer_2	-.5744844	.3321902	-1.73	0.084	-1.225565	.0765963
reer_3	.3545248	.0480241	7.38	0.000	.2603992	.4486504
reer_4	-1.072351	.0877566	-12.22	0.000	-1.244351	-.9003515
reer_5	1.125566	.2977071	3.78	0.000	.5420708	1.709061
reer_6	4.620292	.4888378	9.45	0.000	3.662187	5.578396
reer_7	1.406298	.096926	14.51	0.000	1.216327	1.59627
reer_8	.6864586	.1617407	4.24	0.000	.3694528	1.003464
reer_9	1.483858	.0895176	16.58	0.000	1.308407	1.659309

reer_10	2.251363	.3757139	5.99	0.000	1.514977	2.987749
reer_11	1.695643	.184255	9.20	0.000	1.33451	2.056776
reer_12	-.5740438	.0711197	-8.07	0.000	-.7134358	-.4346518
reer_13	-2.163136	.1925899	-11.23	0.000	-2.540606	-1.785667
reer_14	3.677895	.2669439	13.78	0.000	3.154694	4.201095
reer_15	.9413246	.0699208	13.46	0.000	.8042824	1.078367
reer_16	.1521398	.4898989	0.31	0.756	-.8080444	1.112324
reer_17	.2068683	.0580401	3.56	0.000	.0931119	.3206247
reer_18	-.5785222	.0699104	-8.28	0.000	-.7155441	-.4415004
reer_19	-.7960314	.1374237	-5.79	0.000	-1.065377	-.5266859
reer_20	4.620363	.2419494	19.10	0.000	4.146151	5.094575
reer_21	2.06149	.0629287	32.76	0.000	1.938152	2.184828
reer_22	.0349708	.3766876	0.09	0.926	-.7033234	.773265
reer_23	.4816174	.044129	10.91	0.000	.3951262	.5681086
gprt	-.0005942	.004836	-0.12	0.902	-.0100726	.0088841
Individual	Results					
gprt_1	-.0064309	.0079487	-0.81	0.418	-.02201	.0091482
gprt_2	-.03165	.0109542	-2.89	0.004	-.0531199	-.0101801
gprt_3	.0146438	.0068718	2.13	0.033	.0011754	.0281122
gprt_4	.0089831	.0064316	1.40	0.162	-.0036226	.0215889
gprt_5	-.0051097	.0116311	-0.44	0.660	-.0279063	.017687
gprt_6	.002689	.0179922	0.15	0.881	-.0325751	.0379531
gprt_7	.0018978	.0127842	0.15	0.882	-.0231588	.0269543
gprt_8	-.0276395	.00927	-2.98	0.003	-.0458084	-.0094707
gprt_9	.0010976	.0063357	0.17	0.862	-.0113202	.0135154
gprt_10	-.0015563	.0252512	-0.06	0.951	-.0510477	.0479351
gprt_11	.007929	.0071263	1.11	0.266	-.0060383	.0218963
gprt_12	.0091351	.0077685	1.18	0.240	-.0060909	.0243611
gprt_13	.0105118	.0226995	0.46	0.643	-.0339783	.055002
gprt_14	-.0348084	.0137273	-2.54	0.011	-.0617135	-.0079033
gprt_15	-.0056044	.010051	-0.56	0.577	-.0253041	.0140952
gprt_16	.038896	.014282	2.72	0.006	.0109038	.0668881
gprt_17	.0236565	.0102482	2.31	0.021	.0035705	.0437426
gprt_18	-.0050695	.0043353	-1.17	0.242	-.0135665	.0034276
gprt_19	-.0442699	.0192392	-2.30	0.021	-.0819781	-.0065617
gprt_20	-.0340648	.0117112	-2.91	0.004	-.0570184	-.0111113
gprt_21	.053586	.0131951	4.06	0.000	.0277241	.079448
gprt_22	.0104115	.0071093	1.46	0.143	-.0035226	.0243456
gprt_23	-.0009013	.0070724	-0.13	0.899	-.0147629	.0129603
brent_shock	.1146315	.0916995	1.25	0.211	-.0650963	.2943593
Individual	Results					
brent_shock_1	-.2400069	.0715309	-3.36	0.001	-.380205	-.0998088
brent_shock_2	.0590209	.0993635	0.59	0.553	-.1357279	.2537698
brent_shock_3	-.4803709	.0630562	-7.62	0.000	-.6039588	-.356783
brent_shock_4	-.0496688	.0586819	-0.85	0.397	-.1646831	.0653455
brent_shock_5	.5537094	.1028769	5.38	0.000	.3520744	.7553443
brent_shock_6	1.00461	.1704031	5.90	0.000	.670626	1.338594
brent_shock_7	-.5739081	.1173976	-4.89	0.000	-.8040032	-.343813
brent_shock_8	.1478203	.0810372	1.82	0.068	-.0110098	.3066504
brent_shock_9	.2527748	.0575437	4.39	0.000	.1399913	.3655583
brent_shock_10	.8576334	.2313015	3.71	0.000	.4042907	1.310976
brent_shock_11	-.0519668	.0653246	-0.80	0.426	-.1800006	.0760671
brent_shock_12	-.306995	.0715613	-4.29	0.000	-.4472527	-.1667374
brent_shock_13	.3682542	.2074842	1.77	0.076	-.0384073	.7749157
brent_shock_14	.6194454	.122813	5.04	0.000	.3787363	.8601545
brent_shock_15	-.1616681	.0920619	-1.76	0.079	-.3421061	.0187699
brent_shock_16	.2742701	.1415229	1.94	0.053	-.0031096	.5516498
brent_shock_17	-.5577988	.09229	-6.04	0.000	-.7386839	-.3769137
brent_shock_18	.047322	.0385525	1.23	0.220	-.0282396	.1228836

brent_shock_19	-.1010652	.1833993	-0.55	0.582	-.4605212	.2583909
brent_shock_20	.6202308	.1044953	5.94	0.000	.4154238	.8250378
brent_shock_21	.5593834	.1246665	4.49	0.000	.3150415	.8037252
brent_shock_22	-.23745	.0637135	-3.73	0.000	-.3623261	-.1125739
brent_shock_23	.032948	.0662992	0.50	0.619	-.0969961	.1628922
gas_shock	-.1055234	.1289966	-0.82	0.413	-.3583521	.1473053
Individual	Results					
gas_shock_1	-.0882254	.0976846	-0.90	0.366	-.2796837	.1032328
gas_shock_2	-.6500464	.1365962	-4.76	0.000	-.9177699	-.3823228
gas_shock_3	.7035117	.0896241	7.85	0.000	.5278517	.8791717
gas_shock_4	.5657016	.0800915	7.06	0.000	.4087251	.722678
gas_shock_5	-.9902251	.1462196	-6.77	0.000	-1.27681	-.70364
gas_shock_6	-.9589476	.2479555	-3.87	0.000	-1.444931	-.4729639
gas_shock_7	.6854316	.1622803	4.22	0.000	.367368	1.003495
gas_shock_8	.0134634	.1114464	0.12	0.904	-.2049674	.2318943
gas_shock_9	.1309397	.0792789	1.65	0.099	-.0244441	.2863235
gas_shock_10	-1.307939	.3295053	-3.97	0.000	-1.953758	-.662121
gas_shock_11	.0338595	.0910656	0.37	0.710	-.1446259	.2123449
gas_shock_12	.3752433	.0970963	3.86	0.000	.1849381	.5655485
gas_shock_13	-.8758142	.2898488	-3.02	0.003	-1.443908	-.3077209
gas_shock_14	-.4095121	.1704252	-2.40	0.016	-.7435393	-.075485
gas_shock_15	-.128458	.1302971	-0.99	0.324	-.3838356	.1269196
gas_shock_16	.6525307	.192506	3.39	0.001	.2752258	1.029836
gas_shock_17	.5266801	.1288444	4.09	0.000	.2741498	.7792105
gas_shock_18	.1711269	.0526891	3.25	0.001	.0678582	.2743957
gas_shock_19	-.8029597	.2401037	-3.34	0.001	-1.273554	-.332365
gas_shock_20	-.7762604	.1530072	-5.07	0.000	-1.076149	-.4763718
gas_shock_21	.4515556	.1636974	2.76	0.006	.1307146	.7723966
gas_shock_22	.2357928	.0890456	2.65	0.008	.0612666	.4103191
gas_shock_23	.0155135	.0883292	0.18	0.861	-.1576086	.1886356
oils_gprt	-.0008429	.0008635	-0.98	0.329	-.0025354	.0008496
Individual	Results					
oils_gprt_1	.0012711	.0006826	1.86	0.063	-.0000667	.0026089
oils_gprt_2	-.0016332	.0009508	-1.72	0.086	-.0034967	.0002303
oils_gprt_3	.0045586	.0006105	7.47	0.000	.003362	.0057553
oils_gprt_4	.0019734	.0005613	3.52	0.000	.0008732	.0030736
oils_gprt_5	-.0056715	.0009869	-5.75	0.000	-.0076058	-.0037372
oils_gprt_6	-.0084051	.0016665	-5.04	0.000	-.0116713	-.0051389
oils_gprt_7	.0067841	.0011227	6.04	0.000	.0045836	.0089846
oils_gprt_8	-.000569	.0007781	-0.73	0.465	-.0020941	.0009561
oils_gprt_9	-.00119	.0005528	-2.15	0.031	-.0022734	-.0001066
oils_gprt_10	-.008091	.0022338	-3.62	0.000	-.012469	-.0037129
oils_gprt_11	.0002177	.0006281	0.35	0.729	-.0010134	.0014487
oils_gprt_12	.0030102	.0006785	4.44	0.000	.0016804	.00434
oils_gprt_13	-.0088791	.0019907	-4.46	0.000	-.0127807	-.0049774
oils_gprt_14	-.0035339	.0011784	-3.00	0.003	-.0058436	-.0012242
oils_gprt_15	.0008947	.0008851	1.01	0.312	-.0008401	.0026295
oils_gprt_16	-.0002642	.0013794	-0.19	0.848	-.0029678	.0024394
oils_gprt_17	.0046661	.0008853	5.27	0.000	.002931	.0064012
oils_gprt_18	.0001993	.0003716	0.54	0.592	-.0005289	.0009275
oils_gprt_19	-.00059	.0017009	-0.35	0.729	-.0039238	.0027438
oils_gprt_20	-.0043753	.001007	-4.35	0.000	-.006349	-.0024017
oils_gprt_21	-.0014094	.0011674	-1.21	0.227	-.0036975	.0008787
oils_gprt_22	.0019908	.0006124	3.25	0.001	.0007905	.003191
oils_gprt_23	-.0003408	.0006218	-0.55	0.584	-.0015596	.000878
gass_gprt	.0004051	.0006935	0.58	0.559	-.0009542	.0017644

Individual	Results					
gass_gprt_1	-.0000333	.0003488	-0.10	0.924	-.000717	.0006503
gass_gprt_2	.0028334	.0004926	5.75	0.000	.0018679	.003799
gass_gprt_3	-.0041199	.0003292	-12.52	0.000	-.0047651	-.0034748
gass_gprt_4	-.0030112	.0002833	-10.63	0.000	-.0035664	-.0024559
gass_gprt_5	.0044594	.0005322	8.38	0.000	.0034162	.0055025
gass_gprt_6	.0034549	.0008699	3.97	0.000	.00175	.0051598
gass_gprt_7	-.0042773	.000582	-7.35	0.000	-.005418	-.0031366
gass_gprt_8	.0005729	.0004057	1.41	0.158	-.0002223	.0013681
gass_gprt_9	-.0002531	.0002851	-0.89	0.375	-.000812	.0003057
gass_gprt_10	.0054802	.0011399	4.81	0.000	.0032461	.0077143
gass_gprt_11	-.0002869	.0003215	-0.89	0.372	-.0009169	.0003431
gass_gprt_12	-.0027618	.0003521	-7.84	0.000	-.0034518	-.0020717
gass_gprt_13	.007958	.0010207	7.80	0.000	.0059574	.0099586
gass_gprt_14	.0024156	.0006121	3.95	0.000	.0012159	.0036153
gass_gprt_15	.0014437	.0004681	3.08	0.002	.0005263	.0023611
gass_gprt_16	-.002761	.000759	-3.64	0.000	-.0042487	-.0012734
gass_gprt_17	-.0036502	.000461	-7.92	0.000	-.0045538	-.0027466
gass_gprt_18	.0000344	.0001886	0.18	0.855	-.0003352	.0004041
gass_gprt_19	.00295	.0008555	3.45	0.001	.0012732	.0046268
gass_gprt_20	.0035445	.0005652	6.27	0.000	.0024366	.0046523
gass_gprt_21	-.002945	.0005813	-5.07	0.000	-.0040844	-.0018056
gass_gprt_22	-.0016397	.0003259	-5.03	0.000	-.0022784	-.0010009
gass_gprt_23	-.0000904	.0003135	-0.29	0.773	-.0007049	.000524

Appendix D. DCCE for MPI index with GPR

mpi	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Mean	Group:					
reer	.8125566	.4043452	2.01	0.044	.0200546	1.605059
Individual	Results					
reer_1	-.9871216	.1685981	-5.85	0.000	-1.317568	-.6566753
reer_2	-1.022662	.3385509	-3.02	0.003	-1.68621	-.3591146
reer_3	.4554506	.0647473	7.03	0.000	.3285482	.5823529
reer_4	-1.302516	.0947777	-13.74	0.000	-1.488276	-1.116755
reer_5	-.3642982	.2740004	-1.33	0.184	-.9013291	.1727326
reer_6	4.541684	.5418449	8.38	0.000	3.479687	5.60368
reer_7	1.307768	.1083152	12.07	0.000	1.095474	1.520062
reer_8	.6547228	.1838613	3.56	0.000	.2943613	1.015084
reer_9	1.639556	.1025447	15.99	0.000	1.438572	1.840539
reer_10	1.198933	.37561	3.19	0.001	.4627513	1.935116
reer_11	1.867009	.2070755	9.02	0.000	1.461148	2.272869
reer_12	-.4190851	.076301	-5.49	0.000	-.5686323	-.2695379
reer_13	-2.004792	.2158705	-9.29	0.000	-2.42789	-1.581693
reer_14	3.534059	.2864007	12.34	0.000	2.972724	4.095394
reer_15	1.202196	.0833744	14.42	0.000	1.038785	1.365607
reer_16	.4149969	.4948293	0.84	0.402	-.5548506	1.384844
reer_17	.2221133	.0671186	3.31	0.001	.0905634	.3536633
reer_18	-.8150417	.0531395	-15.34	0.000	-.9191933	-.7108902
reer_19	-.7954458	.1412176	-5.63	0.000	-1.072227	-.5186645
reer_20	6.202035	.3146848	19.71	0.000	5.585264	6.818806
reer_21	2.188997	.0678433	32.27	0.000	2.056027	2.321967
reer_22	.2568101	.3865253	0.66	0.506	-.5007655	1.014386
reer_23	.7134353	.0670833	10.64	0.000	.5819544	.8449162
gpr	-.0001113	.0045673	-0.02	0.981	-.0090631	.0088405
Individual	Results					

gpr_1	-.0043228	.0048713	-0.89	0.375	-.0138703	.0052247
gpr_2	-.0320227	.0085153	-3.76	0.000	-.0487124	-.0153331
gpr_3	.0219888	.0070687	3.11	0.002	.0081344	.0358433
gpr_4	.0124379	.0053301	2.33	0.020	.001991	.0228847
gpr_5	-.0073363	.0081528	-0.90	0.368	-.0233155	.008643
gpr_6	.0020857	.0153882	0.14	0.892	-.0280747	.0322461
gpr_7	.017309	.0103164	1.68	0.093	-.0029108	.0375288
gpr_8	-.0141068	.0081598	-1.73	0.084	-.0300998	.0018861
gpr_9	.0023013	.0054613	0.42	0.673	-.0084025	.0130052
gpr_10	-.0107736	.0182271	-0.59	0.554	-.046498	.0249507
gpr_11	.0123121	.0062378	1.97	0.048	.0000862	.0245379
gpr_12	.0101823	.0063608	1.60	0.109	-.0022846	.0226492
gpr_13	-.0193895	.0188748	-1.03	0.304	-.0563835	.0176044
gpr_14	-.0257835	.0111924	-2.30	0.021	-.0477202	-.0038469
gpr_15	-.0061031	.0089521	-0.68	0.495	-.023649	.0114427
gpr_16	.0391192	.0110443	3.54	0.000	.0174727	.0607657
gpr_17	.0254462	.0090486	2.81	0.005	.0077113	.0431811
gpr_18	-.0058643	.0025578	-2.29	0.022	-.0108775	-.0008512
gpr_19	-.0464368	.0151184	-3.07	0.002	-.0760683	-.0168053
gpr_20	-.028378	.0117898	-2.41	0.016	-.0514855	-.0052705
gpr_21	.039131	.0107086	3.65	0.000	.0181424	.0601195
gpr_22	.0036701	.0056498	0.65	0.516	-.0074033	.0147436
gpr_23	.0119735	.0080716	1.48	0.138	-.0038466	.0277935
brent_shock	.1208949	.1188784	1.02	0.309	-.1121024	.3538922
Individual	Results					
brent_shock_1	-.2415105	.0667816	-3.62	0.000	-.3724	-.110621
brent_shock_2	.0452829	.1174232	0.39	0.700	-.1848624	.2754282
brent_shock_3	-.6424857	.0950846	-6.76	0.000	-.8288481	-.4561234
brent_shock_4	.0030091	.0718209	0.04	0.967	-.1377572	.1437754
brent_shock_5	.3462064	.1072932	3.23	0.001	.1359156	.5564973
brent_shock_6	1.157582	.2135719	5.42	0.000	.7389883	1.576175
brent_shock_7	-.7749106	.1394934	-5.56	0.000	-1.048313	-.5015086
brent_shock_8	.1925379	.1061573	1.81	0.070	-.0155266	.4006023
brent_shock_9	.4741516	.073123	6.48	0.000	.3308332	.61747
brent_shock_10	.8223625	.2467911	3.33	0.001	.3386608	1.306064
brent_shock_11	-.1444768	.0844065	-1.71	0.087	-.3099105	.0209569
brent_shock_12	-.3784192	.0855769	-4.42	0.000	-.5461469	-.2106916
brent_shock_13	.1130264	.2536474	0.45	0.656	-.3841135	.6101662
brent_shock_14	.9199573	.1478953	6.22	0.000	.6300879	1.209827
brent_shock_15	-.3330429	.1204349	-2.77	0.006	-.569091	-.0969949
brent_shock_16	.3447213	.163385	2.11	0.035	.0244925	.6649501
brent_shock_17	-.7826361	.1194288	-6.55	0.000	-1.016712	-.54856
brent_shock_18	.0127903	.0339078	0.38	0.706	-.0536678	.0792485
brent_shock_19	-.107913	.2210992	-0.49	0.625	-.5412596	.3254335
brent_shock_20	1.293034	.1520129	8.51	0.000	.9950938	1.590973
brent_shock_21	.6239443	.1476947	4.22	0.000	.334468	.9134206
brent_shock_22	-.259615	.0761979	-3.41	0.001	-.4089602	-.1102698
brent_shock_23	.0969875	.1120685	0.87	0.387	-.1226627	.3166377
gas_shock	-.1077731	.1505811	-0.72	0.474	-.4029066	.1873603
Individual	Results					
gas_shock_1	.1535685	.0792585	1.94	0.053	-.0017753	.3089122
gas_shock_2	-.4864868	.1419671	-3.43	0.001	-.7647371	-.2082365
gas_shock_3	.9542631	.119622	7.98	0.000	.7198083	1.188718
gas_shock_4	.5767751	.0877171	6.58	0.000	.4048527	.7486975
gas_shock_5	-.9011679	.1338834	-6.73	0.000	-1.163575	-.6387613
gas_shock_6	-1.037799	.2747242	-3.78	0.000	-1.576248	-.4993493
gas_shock_7	.8751233	.1708809	5.12	0.000	.5402028	1.210044
gas_shock_8	.1024968	.1292996	0.79	0.428	-.1509258	.3559195

gas_shock_9	.0305659	.0895558	0.34	0.733	-.1449603	.2060921
gas_shock_10	-1.226513	.3095296	-3.96	0.000	-1.83318	-.6198463
gas_shock_11	.1285088	.1042843	1.23	0.218	-.0758846	.3329022
gas_shock_12	.5305018	.1031855	5.14	0.000	.328262	.7327416
gas_shock_13	-1.402217	.3133996	-4.47	0.000	-2.016469	-.7879653
gas_shock_14	-.5496381	.181983	-3.02	0.003	-.9063183	-.1929579
gas_shock_15	.0141404	.1505111	0.09	0.925	-.280856	.3091367
gas_shock_16	.5381161	.1976122	2.72	0.006	.1508033	.925429
gas_shock_17	.6304001	.148224	4.25	0.000	.3398864	.9209138
gas_shock_18	-.0122899	.0413777	-0.30	0.766	-.0933887	.0688088
gas_shock_19	-.5249369	.252086	-2.08	0.037	-1.019016	-.0308575
gas_shock_20	-1.498667	.196289	-7.64	0.000	-1.883387	-1.113948
gas_shock_21	.5002743	.1759186	2.84	0.004	.1554801	.8450684
gas_shock_22	.1912573	.0939491	2.04	0.042	.0071204	.3753941
gas_shock_23	-.0650572	.1329103	-0.49	0.625	-.3255565	.1954421
oils_gpr	-.0009394	.0010849	-0.87	0.387	-.0030658	.0011871
Individual	Results					
oils_gpr_1	.0017727	.0006569	2.70	0.007	.0004852	.0030602
oils_gpr_2	-.001334	.001164	-1.15	0.252	-.0036154	.0009473
oils_gpr_3	.0062191	.0009501	6.55	0.000	.0043569	.0080812
oils_gpr_4	.0015625	.0007111	2.20	0.028	.0001687	.0029563
oils_gpr_5	-.0044169	.0010654	-4.15	0.000	-.006505	-.0023287
oils_gpr_6	-.010073	.0021531	-4.68	0.000	-.014293	-.005853
oils_gpr_7	.0088784	.001377	6.45	0.000	.0061795	.0115773
oils_gpr_8	-.0010305	.0010568	-0.98	0.330	-.0031018	.0010409
oils_gpr_9	-.0033982	.000728	-4.67	0.000	-.004825	-.0019713
oils_gpr_10	-.0080892	.0024515	-3.30	0.001	-.0128942	-.0032843
oils_gpr_11	.0012989	.0008363	1.55	0.120	-.0003403	.002938
oils_gpr_12	.003734	.0008391	4.45	0.000	.0020895	.0053785
oils_gpr_13	-.0064933	.0025116	-2.59	0.010	-.0114159	-.0015708
oils_gpr_14	-.0066866	.0014683	-4.55	0.000	-.0095644	-.0038089
oils_gpr_15	.002807	.0011917	2.36	0.018	.0004714	.0051426
oils_gpr_16	-.0006842	.0016497	-0.41	0.678	-.0039175	.0025491
oils_gpr_17	.0069936	.0011877	5.89	0.000	.0046657	.0093214
oils_gpr_18	-.0002652	.0003359	-0.79	0.430	-.0009235	.0003931
oils_gpr_19	-.0006965	.0021179	-0.33	0.742	-.0048475	.0034546
oils_gpr_20	-.0110291	.0015153	-7.28	0.000	-.0139991	-.0080591
oils_gpr_21	-.001864	.0014382	-1.30	0.195	-.0046829	.0009549
oils_gpr_22	.0023104	.0007574	3.05	0.002	.0008259	.0037949
oils_gpr_23	-.001121	.0010879	-1.03	0.303	-.0032532	.0010111
gass_gpr	.0004843	.0009109	0.53	0.595	-.001301	.0022696
Individual	Results					
gass_gpr_1	-.0011113	.0003501	-3.17	0.002	-.0017974	-.0004251
gass_gpr_2	.0028284	.0006277	4.51	0.000	.0015981	.0040586
gass_gpr_3	-.0063581	.0005355	-11.87	0.000	-.0074076	-.0053085
gass_gpr_4	-.0036568	.0003771	-9.70	0.000	-.0043959	-.0029177
gass_gpr_5	.0044636	.0005972	7.47	0.000	.0032931	.0056341
gass_gpr_6	.0042187	.00117	3.61	0.000	.0019255	.0065119
gass_gpr_7	-.0061274	.0007468	-8.20	0.000	-.0075911	-.0046636
gass_gpr_8	.0005238	.0005749	0.91	0.362	-.0006031	.0016507
gass_gpr_9	.0005059	.0003927	1.29	0.198	-.0002638	.0012757
gass_gpr_10	.0061445	.0013081	4.70	0.000	.0035806	.0087084
gass_gpr_11	-.0009164	.0004471	-2.05	0.040	-.0017927	-.00004
gass_gpr_12	-.0037314	.0004544	-8.21	0.000	-.0046219	-.0028408
gass_gpr_13	.010168	.0013439	7.57	0.000	.0075341	.012802
gass_gpr_14	.0037779	.000796	4.75	0.000	.0022178	.0053379
gass_gpr_15	.0003945	.0006577	0.60	0.549	-.0008946	.0016836
gass_gpr_16	-.0029372	.0009518	-3.09	0.002	-.0048028	-.0010717
gass_gpr_17	-.0045307	.0006455	-7.02	0.000	-.0057959	-.0032655

gass_gpr_18	.0010997	.0001792	6.14	0.000	.0007484	.001451
gass_gpr_19	.0024843	.0010943	2.27	0.023	.0003396	.0046291
gass_gpr_20	.0081701	.0008827	9.26	0.000	.00644	.0099002
gass_gpr_21	-.0033612	.0007581	-4.43	0.000	-.004847	-.0018755
gass_gpr_22	-.0011902	.0004185	-2.84	0.004	-.0020105	-.0003698
gass_gpr_23	.0002803	.000574	0.49	0.625	-.0008448	.0014053

Appendix E. DCCE for MPI index with GPRA

mpi	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Mean	Group:					
reer	.766391	.3895545	1.97	0.049	.0028781	1.529904
Individual	Results					
reer_1	-.9477545	.1700026	-5.57	0.000	-1.280953	-.6145555
reer_2	-1.112861	.3469435	-3.21	0.001	-1.792858	-.4328642
reer_3	.3872037	.0686267	5.64	0.000	.2526978	.5217095
reer_4	-1.323456	.0969806	-13.65	0.000	-1.513534	-1.133377
reer_5	-.4059785	.2738851	-1.48	0.138	-.9427835	.1308266
reer_6	4.176502	.5400368	7.73	0.000	3.118049	5.234955
reer_7	1.308307	.1114649	11.74	0.000	1.08984	1.526774
reer_8	.6033126	.18363	3.29	0.001	.2434043	.9632208
reer_9	1.667741	.1016345	16.41	0.000	1.468541	1.866941
reer_10	1.104969	.3795456	2.91	0.004	.3610737	1.848865
reer_11	1.899041	.206027	9.22	0.000	1.495236	2.302847
reer_12	-.4037672	.0789316	-5.12	0.000	-.5584703	-.2490641
reer_13	-2.069481	.2221556	-9.32	0.000	-2.504898	-1.634064
reer_14	3.493896	.2875744	12.15	0.000	2.93026	4.057531
reer_15	1.229296	.0833955	14.74	0.000	1.065844	1.392748
reer_16	.419879	.4818454	0.87	0.384	-.5245206	1.364279
reer_17	.2146682	.0687086	3.12	0.002	.0800018	.3493345
reer_18	-.7968136	.0535001	-14.89	0.000	-.9016719	-.6919554
reer_19	-.796611	.1396761	-5.70	0.000	-1.070371	-.5228509
reer_20	5.829176	.3245707	17.96	0.000	5.193029	6.465323
reer_21	2.179662	.066518	32.77	0.000	2.049289	2.310034
reer_22	.2518885	.3862758	0.65	0.514	-.5051982	1.008975
reer_23	.7181724	.0662412	10.84	0.000	.5883421	.8480027
gpra	.0001648	.0036558	0.05	0.964	-.0070004	.0073301
Individual	Results					
gpra_1	-.0043492	.0035578	-1.22	0.222	-.0113225	.002624
gpra_2	-.0226029	.0063208	-3.58	0.000	-.0349915	-.0102144
gpra_3	.0170514	.0055256	3.09	0.002	.0062214	.0278813
gpra_4	.0103186	.0039561	2.61	0.009	.0025648	.0180724
gpra_5	-.0109576	.0059785	-1.83	0.067	-.0226754	.0007601
gpra_6	-.0005554	.0114511	-0.05	0.961	-.022999	.0218883
gpra_7	.0231947	.0077342	3.00	0.003	.0080359	.0383535
gpra_8	-.0047153	.0059254	-0.80	0.426	-.0163289	.0068984
gpra_9	-.0021218	.0039312	-0.54	0.589	-.0098268	.0055832
gpra_10	-.0107511	.0134015	-0.80	0.422	-.0370176	.0155154
gpra_11	.0119277	.0044958	2.65	0.008	.0031161	.0207392
gpra_12	.0075118	.0048197	1.56	0.119	-.0019346	.0169583
gpra_13	-.0145877	.0141044	-1.03	0.301	-.0422318	.0130563
gpra_14	-.0202213	.0081733	-2.47	0.013	-.0362407	-.0042019
gpra_15	.0001401	.0065844	0.02	0.983	-.0127652	.0130453
gpra_16	.0310163	.0081927	3.79	0.000	.0149588	.0470737
gpra_17	.0218055	.0067514	3.23	0.001	.008573	.0350379
gpra_18	-.0058305	.0018661	-3.12	0.002	-.009488	-.002173

gpra_19	-.0375724	.0109271	-3.44	0.001	-.0589891	-.0161557
gpra_20	-.0244206	.009081	-2.69	0.007	-.0422191	-.0066221
gpra_21	.0249485	.0076726	3.25	0.001	.0099104	.0399866
gpra_22	.0053896	.0040689	1.32	0.185	-.0025853	.0133645
gpra_23	.009173	.0058113	1.58	0.114	-.0022169	.0205629
brent_shock	.0714028	.0871345	0.82	0.413	-.0993777	.2421832
Individual	Results					
brent_shock_1	-.1073942	.0591537	-1.82	0.069	-.2233333	.0085449
brent_shock_2	-.0292388	.1046306	-0.28	0.780	-.234311	.1758334
brent_shock_3	-.2311961	.088441	-2.61	0.009	-.4045373	-.0578549
brent_shock_4	.1998881	.0643401	3.11	0.002	.0737838	.3259925
brent_shock_5	.0804927	.0941854	0.85	0.393	-.1041073	.2650927
brent_shock_6	.6965345	.1861788	3.74	0.000	.3316307	1.061438
brent_shock_7	-.4771751	.1253978	-3.81	0.000	-.7229502	-.2314
brent_shock_8	.1126265	.093287	1.21	0.227	-.0702127	.2954658
brent_shock_9	.4691478	.0631898	7.42	0.000	.345298	.5929975
brent_shock_10	.3698284	.2190241	1.69	0.091	-.0594509	.7991077
brent_shock_11	-.1687974	.0738287	-2.29	0.022	-.3134989	-.0240959
brent_shock_12	-.1113533	.0775319	-1.44	0.151	-.2633131	.0406064
brent_shock_13	-.626782	.2282943	-2.75	0.006	-1.074231	-.1793334
brent_shock_14	.7425252	.1305224	5.69	0.000	.486706	.9983444
brent_shock_15	-.3108879	.1062595	-2.93	0.003	-.5191526	-.1026232
brent_shock_16	.2892474	.1358945	2.13	0.033	.0228991	.5555957
brent_shock_17	-.5825769	.1069947	-5.44	0.000	-.7922826	-.3728712
brent_shock_18	-.0181576	.0303906	-0.60	0.550	-.0777221	.0414068
brent_shock_19	.0004327	.1915518	0.00	0.998	-.375002	.3758674
brent_shock_20	.8433048	.1395806	6.04	0.000	.5697318	1.116878
brent_shock_21	.7060085	.1255543	5.62	0.000	.4599266	.9520904
brent_shock_22	-.2219909	.065882	-3.37	0.001	-.3511172	-.0928646
brent_shock_23	.017777	.0967371	0.18	0.854	-.1718242	.2073783
gas_shock	-.0749265	.1192983	-0.63	0.530	-.308747	.1588939
Individual	Results					
gas_shock_1	.0883965	.0775421	1.14	0.254	-.0635832	.2403762
gas_shock_2	-.3756162	.1403788	-2.68	0.007	-.6507536	-.1004788
gas_shock_3	.7038742	.1236589	5.69	0.000	.4615072	.9462412
gas_shock_4	.4650399	.0872526	5.33	0.000	.294028	.6360517
gas_shock_5	-.8174618	.1306417	-6.26	0.000	-1.073515	-.5614088
gas_shock_6	-.8029902	.2680616	-3.00	0.003	-1.328381	-.2775991
gas_shock_7	.7296544	.1707841	4.27	0.000	.3949237	1.064385
gas_shock_8	.1158612	.1264055	0.92	0.359	-.131889	.3636114
gas_shock_9	-.0026963	.0860242	-0.03	0.975	-.1713006	.1659079
gas_shock_10	-.9796337	.3039846	-3.22	0.001	-1.575433	-.3838348
gas_shock_11	.1244672	.10048	1.24	0.215	-.0724701	.3214045
gas_shock_12	.3775206	.1041872	3.62	0.000	.1733174	.5817238
gas_shock_13	-.9431963	.3131087	-3.01	0.003	-1.556878	-.3295145
gas_shock_14	-.4718957	.1782539	-2.65	0.008	-.8212669	-.1225246
gas_shock_15	.099601	.1467476	0.68	0.497	-.1880191	.3872211
gas_shock_16	.5091014	.1891644	2.69	0.007	.138346	.8798569
gas_shock_17	.4956123	.1474294	3.36	0.001	.2066559	.7845686
gas_shock_18	.0129551	.0407015	0.32	0.750	-.0668184	.0927286
gas_shock_19	-.5281048	.2439961	-2.16	0.030	-1.006328	-.0498812
gas_shock_20	-1.144384	.1983698	-5.77	0.000	-1.533182	-.7555867
gas_shock_21	.4869805	.1688499	2.88	0.004	.1560409	.8179202
gas_shock_22	.1925068	.0909478	2.12	0.034	.0142524	.3707613
gas_shock_23	-.0589021	.1287953	-0.46	0.647	-.3113361	.193532
oils_gpra	-.00042	.0006403	-0.66	0.512	-.001675	.000835

Individual	Results					
oils_gpra_1	.0003707	.0005809	0.64	0.523	-.0007678	.0015092
oils_gpra_2	-.0005933	.0010383	-0.57	0.568	-.0026282	.0014416
oils_gpra_3	.0019182	.0008792	2.18	0.029	.000195	.0036414
oils_gpra_4	-.0004975	.0006376	-0.78	0.435	-.0017471	.0007522
oils_gpra_5	-.0016879	.0009355	-1.80	0.071	-.0035214	.0001457
oils_gpra_6	-.0052834	.0018686	-2.83	0.005	-.0089458	-.0016209
oils_gpra_7	.0058837	.0012355	4.76	0.000	.0034621	.0083053
oils_gpra_8	-.0002416	.0009283	-0.26	0.795	-.0020611	.0015778
oils_gpra_9	-.0034407	.0006297	-5.46	0.000	-.0046749	-.0022065
oils_gpra_10	-.0033667	.0021675	-1.55	0.120	-.007615	.0008815
oils_gpra_11	.0015956	.0007292	2.19	0.029	.0001664	.0030248
oils_gpra_12	.0009357	.0007595	1.23	0.218	-.0005529	.0024244
oils_gpra_13	.0013736	.0022564	0.61	0.543	-.0030488	.005796
oils_gpra_14	-.0049813	.0012948	-3.85	0.000	-.007519	-.0024436
oils_gpra_15	.0026953	.0010466	2.58	0.010	.0006439	.0047466
oils_gpra_16	-.0000556	.001366	-0.04	0.968	-.002733	.0026218
oils_gpra_17	.0050158	.0010666	4.70	0.000	.0029252	.0071063
oils_gpra_18	.0000611	.0003	0.20	0.839	-.0005269	.0006492
oils_gpra_19	-.0019349	.0018302	-1.06	0.290	-.0055221	.0016523
oils_gpra_20	-.0063979	.0013891	-4.61	0.000	-.0091206	-.0036753
oils_gpra_21	-.0026988	.0012305	-2.19	0.028	-.0051104	-.0002871
oils_gpra_22	.0019715	.0006529	3.02	0.003	.0006918	.0032512
oils_gpra_23	-.0003019	.0009416	-0.32	0.749	-.0021473	.0015436
gass_gpra	.0003131	.000818	0.38	0.702	-.0012901	.0019163
Individual	Results					
gass_gpra_1	-.0007443	.0003783	-1.97	0.049	-.0014857	-2.86e-06
gass_gpra_2	.0025348	.0006874	3.69	0.000	.0011874	.0038821
gass_gpra_3	-.0054866	.0006088	-9.01	0.000	-.0066798	-.0042933
gass_gpra_4	-.0034988	.0004145	-8.44	0.000	-.0043113	-.0026864
gass_gpra_5	.004501	.0006434	7.00	0.000	.0032399	.0057622
gass_gpra_6	.0030216	.0012527	2.41	0.016	.0005663	.0054769
gass_gpra_7	-.0058759	.0008281	-7.10	0.000	-.007499	-.0042529
gass_gpra_8	.0003797	.0006206	0.61	0.541	-.0008366	.001596
gass_gpra_9	.0006855	.0004179	1.64	0.101	-.0001337	.0015046
gass_gpra_10	.0052413	.0014182	3.70	0.000	.0024617	.0080208
gass_gpra_11	-.001027	.0004753	-2.16	0.031	-.0019585	-.0000955
gass_gpra_12	-.0031539	.0005096	-6.19	0.000	-.0041527	-.002155
gass_gpra_13	.0085942	.0014822	5.80	0.000	.0056891	.0114993
gass_gpra_14	.0035899	.0008608	4.17	0.000	.0019027	.005277
gass_gpra_15	.0000442	.0007099	0.06	0.950	-.0013471	.0014355
gass_gpra_16	-.003363	.0009917	-3.39	0.001	-.0053068	-.0014193
gass_gpra_17	-.0041165	.0007105	-5.79	0.000	-.0055092	-.0027239
gass_gpra_18	.0011254	.0001938	5.81	0.000	.0007455	.0015053
gass_gpra_19	.0029771	.0011626	2.56	0.010	.0006985	.0052558
gass_gpra_20	.0067951	.0009805	6.93	0.000	.0048734	.0087168
gass_gpra_21	-.003926	.0008014	-4.90	0.000	-.0054967	-.0023554
gass_gpra_22	-.0013164	.0004472	-2.94	0.003	-.0021929	-.00044
gass_gpra_23	.0002201	.0006122	0.36	0.719	-.0009799	.0014201

Appendix F. DCCE for MPI index with GPRT

mpi	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Mean	Group:					
reer	.8177296	.4055767	2.02	0.044	.0228139	1.612645
Individual	Results					

reer_1	-.9623791	.1684646	-5.71	0.000	-1.292564	-.6321946
reer_2	-1.057869	.333193	-3.17	0.001	-1.710916	-.4048231
reer_3	.4625337	.0632319	7.31	0.000	.3386015	.586466
reer_4	-1.273004	.0940234	-13.54	0.000	-1.457286	-1.088721
reer_5	-.4788367	.2725616	-1.76	0.079	-1.013048	.0553743
reer_6	4.580307	.5399456	8.48	0.000	3.522033	5.63858
reer_7	1.301677	.1089793	11.94	0.000	1.088081	1.515273
reer_8	.7198214	.1819505	3.96	0.000	.3632051	1.076438
reer_9	1.618707	.1041405	15.54	0.000	1.414595	1.822818
reer_10	1.27784	.3751685	3.41	0.001	.542523	2.013157
reer_11	1.873211	.2089817	8.96	0.000	1.463615	2.282808
reer_12	-.4275826	.0745726	-5.73	0.000	-.5737423	-.2814229
reer_13	-1.959868	.2086812	-9.39	0.000	-2.368875	-1.55086
reer_14	3.537606	.2881671	12.28	0.000	2.972809	4.102403
reer_15	1.197242	.0835108	14.34	0.000	1.033564	1.36092
reer_16	.3984082	.4826311	0.83	0.409	-.5475313	1.344348
reer_17	.2126707	.0673776	3.16	0.002	.080613	.3447283
reer_18	-.8439086	.0536211	-15.74	0.000	-.9490039	-.7388132
reer_19	-.8038552	.1412911	-5.69	0.000	-1.080781	-.5269298
reer_20	6.215562	.3130238	19.86	0.000	5.602046	6.829077
reer_21	2.185874	.0683729	31.97	0.000	2.051866	2.319882
reer_22	.3291979	.3932108	0.84	0.402	-.4414811	1.099877
reer_23	.704426	.0676987	10.41	0.000	.5717391	.837113
gprt	.0002916	.0047362	0.06	0.951	-.0089912	.0095744
Individual	Results					
gprt_1	-.0027367	.0063171	-0.43	0.665	-.015118	.0096445
gprt_2	-.0305532	.0109647	-2.79	0.005	-.0520437	-.0090627
gprt_3	.0142007	.0088143	1.61	0.107	-.0030749	.0314763
gprt_4	.0094715	.0067881	1.40	0.163	-.0038329	.0227759
gprt_5	.0038997	.010434	0.37	0.709	-.0165506	.0243501
gprt_6	.0121541	.0195311	0.62	0.534	-.0261262	.0504343
gprt_7	.0002417	.0133112	0.02	0.986	-.0258477	.0263312
gprt_8	-.0302056	.0103777	-2.91	0.004	-.0505456	-.0098656
gprt_9	-.0000756	.0071425	-0.01	0.992	-.0140747	.0139236
gprt_10	-.0014063	.0232933	-0.06	0.952	-.0470603	.0442477
gprt_11	.0087998	.0080467	1.09	0.274	-.0069715	.0245711
gprt_12	.0051763	.007951	0.65	0.515	-.0104074	.0207601
gprt_13	.0070216	.0233989	0.30	0.764	-.0388394	.0528826
gprt_14	-.0344348	.014458	-2.38	0.017	-.0627721	-.0060976
gprt_15	-.0124543	.011415	-1.09	0.275	-.0348273	.0099186
gprt_16	.0368561	.0140828	2.62	0.009	.0092543	.0644579
gprt_17	.0255217	.0116478	2.19	0.028	.0026925	.0483509
gprt_18	-.0020511	.0033088	-0.62	0.535	-.0085363	.0044341
gprt_19	-.0475327	.0196844	-2.41	0.016	-.0861135	-.0089519
gprt_20	-.0177841	.0148102	-1.20	0.230	-.0468115	.0112432
gprt_21	.0540372	.0138666	3.90	0.000	.0268592	.0812153
gprt_22	.0032877	.0074249	0.44	0.658	-.0112649	.0178402
gprt_23	.0052729	.0104198	0.51	0.613	-.0151496	.0256954
brent_shock	.1154589	.1058929	1.09	0.276	-.0920874	.3230052
Individual	Results					
brent_shock_1	-.2486668	.0568896	-4.37	0.000	-.3601683	-.1371653
brent_shock_2	.0112882	.0994382	0.11	0.910	-.1836071	.2061835
brent_shock_3	-.6408006	.0806407	-7.95	0.000	-.7988535	-.4827478
brent_shock_4	-.047321	.0619128	-0.76	0.445	-.1686678	.0740258
brent_shock_5	.3448466	.091766	3.76	0.000	.1649886	.5247045
brent_shock_6	1.071853	.184075	5.82	0.000	.7110727	1.432633
brent_shock_7	-.6341228	.1224207	-5.18	0.000	-.874063	-.3941825
brent_shock_8	.1325282	.0904768	1.46	0.143	-.0448031	.3098594

brent_shock_9	.3216378	.0647401	4.97	0.000	.1947495	.4485261
brent_shock_10	.821531	.2130985	3.86	0.000	.4038656	1.239196
brent_shock_11	-.0721837	.0736676	-0.98	0.327	-.2165695	.0722021
brent_shock_12	-.3978184	.0733387	-5.42	0.000	-.5415597	-.2540771
brent_shock_13	.3931517	.2137027	1.84	0.066	-.0256979	.8120012
brent_shock_14	.6992371	.1288942	5.42	0.000	.446609	.9518652
brent_shock_15	-.248433	.1045721	-2.38	0.018	-.4533906	-.0434754
brent_shock_16	.3663362	.139389	2.63	0.009	.0931387	.6395337
brent_shock_17	-.5995656	.1047035	-5.73	0.000	-.8047808	-.3943504
brent_shock_18	.0187296	.0293861	0.64	0.524	-.0388661	.0763252
brent_shock_19	-.2485441	.1880956	-1.32	0.186	-.6172046	.1201165
brent_shock_20	1.116868	.1313321	8.50	0.000	.8594615	1.374274
brent_shock_21	.574317	.131591	4.36	0.000	.3164034	.8322307
brent_shock_22	-.1719684	.0664	-2.59	0.010	-.3021101	-.0418268
brent_shock_23	.0926547	.0981937	0.94	0.345	-.0998015	.2851108
gas_shock	-.111715	.1509	-0.74	0.459	-.4074736	.1840435
Individual	Results					
gas_shock_1	.1715819	.0781848	2.19	0.028	.0183425	.3248214
gas_shock_2	-.486132	.1383398	-3.51	0.000	-.757273	-.214991
gas_shock_3	.9600085	.1149665	8.35	0.000	.7346782	1.185339
gas_shock_4	.5975692	.0853675	7.00	0.000	.430252	.7648864
gas_shock_5	-.8565233	.1308516	-6.55	0.000	-1.112988	-.6000589
gas_shock_6	-1.028087	.2689737	-3.82	0.000	-1.555266	-.5009079
gas_shock_7	.8076495	.1693575	4.77	0.000	.4757148	1.139584
gas_shock_8	.1061758	.1254583	0.85	0.397	-.139718	.3520696
gas_shock_9	.0989887	.0897774	1.10	0.270	-.0769718	.2749493
gas_shock_10	-1.262234	.3039019	-4.15	0.000	-1.857871	-.6665969
gas_shock_11	.0946402	.1034645	0.91	0.360	-.1081465	.2974268
gas_shock_12	.5462979	.0999382	5.47	0.000	.3504227	.7421731
gas_shock_13	-1.555973	.2993068	-5.20	0.000	-2.142604	-.9693423
gas_shock_14	-.4777238	.1798486	-2.66	0.008	-.8302206	-.125227
gas_shock_15	-.0411495	.148103	-0.28	0.781	-.331426	.2491269
gas_shock_16	.5245307	.1920215	2.73	0.006	.1481755	.900886
gas_shock_17	.579188	.1467372	3.95	0.000	.2915883	.8667876
gas_shock_18	-.0101568	.0405667	-0.25	0.802	-.089666	.0693525
gas_shock_19	-.4674207	.2483461	-1.88	0.060	-.95417	.0193287
gas_shock_20	-1.458259	.1929061	-7.56	0.000	-1.836348	-1.08017
gas_shock_21	.5171855	.1738759	2.97	0.003	.176395	.857976
gas_shock_22	.1433318	.0931559	1.54	0.124	-.0392505	.3259141
gas_shock_23	-.0729348	.1314859	-0.55	0.579	-.3306425	.1847729
oils_gprt	-.0008649	.0009725	-0.89	0.374	-.002771	.0010413
Individual	Results					
oils_gprt_1	.0018006	.0005439	3.31	0.001	.0007345	.0028667
oils_gprt_2	-.0009309	.0009541	-0.98	0.329	-.0028008	.0009391
oils_gprt_3	.0060418	.0007817	7.73	0.000	.0045097	.0075739
oils_gprt_4	.0020193	.0005936	3.40	0.001	.0008559	.0031827
oils_gprt_5	-.0043033	.0008817	-4.88	0.000	-.0060314	-.0025752
oils_gprt_6	-.0089831	.001802	-4.99	0.000	-.0125149	-.0054513
oils_gprt_7	.0072388	.0011692	6.19	0.000	.0049473	.0095303
oils_gprt_8	-.0003126	.0008705	-0.36	0.720	-.0020189	.0013936
oils_gprt_9	-.0017197	.0006226	-2.76	0.006	-.00294	-.0004994
oils_gprt_10	-.0079301	.0020592	-3.85	0.000	-.0119661	-.0038941
oils_gprt_11	.0005262	.0007097	0.74	0.458	-.0008648	.0019171
oils_gprt_12	.0038505	.0006957	5.53	0.000	.002487	.0052141
oils_gprt_13	-.009322	.0020521	-4.54	0.000	-.0133441	-.0053
oils_gprt_14	-.0041746	.0012392	-3.37	0.001	-.0066034	-.0017458
oils_gprt_15	.0018888	.0010047	1.88	0.060	-.0000803	.003858
oils_gprt_16	-.0009209	.0013627	-0.68	0.499	-.0035916	.0017499
oils_gprt_17	.0048947	.0010052	4.87	0.000	.0029245	.0068649

oils_gprt_18	-.0003307	.000284	-1.16	0.244	-.0008874	.000226
oils_gprt_19	.0008313	.0017468	0.48	0.634	-.0025924	.004255
oils_gprt_20	-.0089484	.0012674	-7.06	0.000	-.0114324	-.0064643
oils_gprt_21	-.0014393	.0012331	-1.17	0.243	-.0038561	.0009775
oils_gprt_22	.0013376	.0006392	2.09	0.036	.0000848	.0025904
oils_gprt_23	-.0010064	.0009205	-1.09	0.274	-.0028105	.0007977
gass_gprt	.0004296	.0007647	0.56	0.574	-.0010692	.0019285
Individual	Results					
gass_gprt_1	-.0010342	.0002792	-3.70	0.000	-.0015814	-.0004869
gass_gprt_2	.0023338	.0004955	4.71	0.000	.0013626	.003305
gass_gprt_3	-.0053607	.0004209	-12.74	0.000	-.0061857	-.0045357
gass_gprt_4	-.0031502	.0002999	-10.50	0.000	-.003738	-.0025623
gass_gprt_5	.003521	.0004747	7.42	0.000	.0025905	.0044514
gass_gprt_6	.0035347	.0009374	3.77	0.000	.0016973	.005372
gass_gprt_7	-.0047419	.0006039	-7.85	0.000	-.0059254	-.0035583
gass_gprt_8	.0004885	.0004538	1.08	0.282	-.000401	.001378
gass_gprt_9	.0000615	.0003204	0.19	0.848	-.0005665	.0006895
gass_gprt_10	.0053168	.0010498	5.06	0.000	.0032593	.0073743
gass_gprt_11	-.000562	.0003632	-1.55	0.122	-.0012738	.0001498
gass_gprt_12	-.0032242	.0003592	-8.98	0.000	-.0039283	-.0025201
gass_gprt_13	.0092874	.0010494	8.85	0.000	.0072306	.0113442
gass_gprt_14	.0027992	.0006422	4.36	0.000	.0015405	.004058
gass_gprt_15	.0005993	.0005288	1.13	0.257	-.0004372	.0016358
gass_gprt_16	-.0023218	.0007505	-3.09	0.002	-.0037928	-.0008507
gass_gprt_17	-.0035089	.0005212	-6.73	0.000	-.0045304	-.0024873
gass_gprt_18	.0008933	.0001446	6.18	0.000	.0006099	.0011766
gass_gprt_19	.0017029	.0008806	1.93	0.053	-.000023	.0034288
gass_gprt_20	.0065901	.0007082	9.31	0.000	.0052021	.0079782
gass_gprt_21	-.0029097	.0006141	-4.74	0.000	-.0041133	-.0017062
gass_gprt_22	-.0007366	.0003402	-2.17	0.030	-.0014033	-.0000698
gass_gprt_23	.0003034	.0004647	0.65	0.514	-.0006075	.0012142