

CRISES AND ENERGY MARKETS REFORMS[°]

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Abstract

The spikes in energy prices observed following recent major global shocks—e.g., COVID-19 and Russia-Ukraine war—as well as issues related to the diffusion of renewable energy power generation, have reopened the debate about the design of electricity markets and the role of the “state” vs. “market” in the electricity markets governance. In this article, we contribute to this debate by looking at the effect of economic crises on energy markets regulation. We find that, historically, economic crises have been associated with a persistent tightening in energy markets regulation (i.e., more restrictions to competition), with the effect being larger during periods of high economic and policy uncertainty and when governments were politically strong—that is, characterized by a larger majority, in majoritarian systems, and at the beginning of their mandate.

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1. Introduction

Energy prices have recently seen unprecedented spikes, due to the combined impacts of the supply disruptions caused by the COVID-19 pandemic and the Russia-Ukraine war. These spikes have had tremendous consequences for households and the economy (Bettarelli et al., 2023), with electricity bills shooting up four times since 2021, on average at the global level.⁴ Policy makers around the world rapidly implemented policy actions to combat increasing and volatile energy prices. However, these measures may be not sustainable in the medium run, and radical renovation in the design of electricity markets may be needed. In addition, climate change events have underlined the urgency of converting renewable energy sources into electricity generation. However, the penetration of renewable energy poses various technical challenges to power systems (IEA, 2011; Impram et al., 2020), which call for changes in the way electricity is produced and distributed, both for domestic and industrial use.

In early 2023, the European Commission put forward a proposal to reform the energy market, with the objectives of securing European energy sovereignty and facilitating the transition to green energy.⁵ In July 2022, the UK launched the REMA—Review of Electricity Market Arrangements—to reform the electricity market. Energy markets reforms are top priorities also for China (IMF, 2023), while reforms to modernize energy’s infrastructures, rules, policies and procedures, and facilitate the transformation to green energy are on the agenda of several Asian and Latin American nations, e.g., Brazil, India, Japan and Thailand (Han et al., forthcoming; Nepal, Sen and Jamasb, 2022).

While the drivers of energy market reforms are numerous, vary between developing and developed countries and may be related to factors internal or external to the energy sector, the recent events discussed earlier revive the idea that crises may also significantly drive major reforms (Alesina and Drazen, 1991; Drazen and Grilli, 1993).⁶ In fact, although reforms are expected to produce net

⁴ Source: Primary Commodity Price System (International Monetary Fund).

⁵ https://energy.ec.europa.eu/topics/markets-and-consumers/market-legislation/electricity-market-design_en

⁶ For example, Jamasb et al. (2017) identify several specific drivers of electricity market reforms, categorized in electricity sector drivers and external drivers. Among the former they include excess capacity, cost of the generation

economic benefits (see, Blagrove and Furceri, 2021, for the economic effects of electricity markets deregulation), their implementation is often problematic due to potential short-term costs and distributional effects (Jain and Mukand, 2003).⁷ As formalized theoretically by Alesina and Drazen (1991), if reforms lead to distributional issues, socio-economic groups may attempt to shift costs to other groups, according to the so-called “war of attrition”. In this context, crises may facilitate the implementation of reforms (Drazen and Easterly, 2001) as their associated welfare losses force governments to embark in reforms that would be otherwise delayed (Gokmen et al., 2019). Typical examples are inflation crises, where the economic costs of high inflation force an agreement among political groups to implement stabilization programs.

However, crises may also operate as an obstacle to reforms. First, crises may lead to fragmentation of the legislative body and increased political gridlock (Mian et al., 2014). Second, they can increase economic and political polarization, and thereby lead to a decline in the strength of the governing coalition to implement reforms (Binder, 2003). Finally, economic crises may lead to social discontent and the supply of a populist agenda (Dornbusch and Edwards, 1990; Kaufman and Stallings, 1991; Moffitt, 2015) characterized by nationalism and protectionism policies, including tightening in market regulation (i.e., more restrictions to competition) (Dalio et al., 2017).

Similar to the theoretical findings, the empirical literature has also produced mixed results (Mahmalat and Curran, 2017, for a recent survey of results). Bruno and Easterly (1996) find empirical support for the positive effect of crises on reforms, by analyzing a group of developing countries and high inflation conditions. Alesina et al. (2006), using a sample of both developed and developing countries, confirm that stabilization programs are more likely to occur when crises occur. Similar results are found in Pitlik and Wirth (2003), Lora (2004), and Hoi et al. (2006), mainly focusing on

technologies, growing consumer demand (especially for developed countries) and institutional inefficiency, low service quality, high energy losses (especially for developing countries). Among the latter they include political and economic ideology, technological innovation, and macroeconomic events.

⁷ Evaluating how successful are reforms is out of the scope of the paper; however, we note that the existing literature has provided mixed results. For details on the debate about the effects of liberalization and privatization of network utilities, see among others Newbery (1997) and Megginson et al. (2001).

inflation crises and financial reforms. Tornell (1998) finds that reforms occur more frequently when economic crises are accompanied by political crises. Drazen and Easterly (2001) show that the effect of high inflation on reforms only materializes for extreme values of inflation, thus making the effect irrelevant in most of real situations. In contrast, they find that low GDP growth and high government deficits do not have any effect on reforms. Similarly, Brooks and Kutz (2007) find no effect of crises on reforms. Other studies have found that crises are associated with an increase in market regulation. According to Abiad and Mody (2005), banking crises may lead to a tightening of financial regulation, while Forbes and Klein (2015) and Broz et al. (2016) show that balance of payment crises push governments to impose restrictions to capital flows and trade. Similarly, Hoj et al. (2006), Roberts and Saeed (2012) and Galasso (2014), find that crises hinder privatizations on average, but the results are mixed and depend on several political characteristics (such as ideological orientation, government tenure and fractionalization). Gokmen et al. (2021) find that crises have no significant impact on liberalization measures in democratic countries; differently, autocracies tend to reduce economic liberalization after economic crises.

In this article, we empirically investigate the crises-reforms nexus, with a specific focus on the energy (electricity and gas) markets. In detail, we estimate the short- and medium-term response of energy market regulation to economic crises, by means of local projections (Jordà, 2005), for a large sample of developed and developing economies. As for the measurement of energy markets regulation, we use two complementary databases. The first is provided by the IMF (Alesina et al. 2023); it has the advantage to cover a large set of developed and developing economies over about 40 years (90 countries, for the period 1973-2014), and considers four sub-categories of electricity markets regulation related to bundling or unbundling of generation transmission and distribution; the presence or absence of an independent regulatory agency; public ownership; and the degree of liberalization in the wholesale market. The second is taken from the OECD; although it covers a restricted group of (46) countries for the period 1975-2013, it has the main advantage to provide more granular data regarding regulation for both electricity and natural gas markets related to

generation/import, transmission, distribution, and supply (for a total of eight sub-indicators). As for economic crises, we consider economic recessions identified (in the baseline) using Harding and Pagan's (2002) approximation of Bry and Boschan's (1971) method. In particular, we define recessions as the period between the year after an economic peak (i.e., the local maximum) and the year of the trough (i.e., the local minimum).

The results of our analysis suggest that crises are followed by a tightening in energy markets regulation (i.e., more restrictions to competition), with the effect being statistically significant and persistent in the medium term. The results are robust to several sensitivity tests—using different recession variables, and econometric specifications.

Next, we recognize that other aspects/events may affect market regulation. Thus, we include several control variables to the baseline specification, e.g., oil price, financial stress, change in regulation associated with climate change policy, reforms in other areas (trade liberalization, labor market regulation), expectations of future growth. Moreover, shocks other than economic recession may directly contribute to reforms themselves. To check for this, we substitute our economic recession indicator with variables broadly linked to economic turmoil—such as oil price shocks,⁸ financial crises, or pandemics—or we consider the implementation of strict climate change policy, or changes in democracy.

We also consider that the probability of undertaking reforms after crises, as well as the direction of reforms, may vary across countries. For instance, while emerging market economies may embark in reforms to deregulate low-performing state-owned utilities, advanced economies may implement reforms to facilitate the green transition or stabilizing energy prices. To check for this possibility, we compare the effect of crises on energy market reforms in different groups of countries

⁸ The period under analysis covers several energy shocks—e.g., the oil price shocks—which have forced countries and international agencies to adopt measures to ensure the availability of energy sources, such as the emergency reserve mechanism. Moreover, they have stimulated the debate about the development of nuclear fission-based energy. Energy security has also been at the core of the Consumer-Producer dialogue, involving oil producers and consumers, with the aim to disclose long-term strategies for the stability of the energy market.

according to the level of income. Our results suggest that while the effect of crises on reform is similar and not statistically different across countries, it is more precisely estimated for advanced economies.

Finally, we examine whether the effects of economic crises on energy markets reforms vary with the domestic economic, political and institutional context. Indeed, as discussed in the literature, several domestic factors can affect the role of crises on reforms (Galasso, 2014; Duval et al., 2021). One stream of the literature has emphasized the role of economic uncertainty (Bonfiglioli and Gancia, 2013; Bonfiglioli et al., 2022). Uncertainty is likely to induce governments to invest in long-term policy, such as structural reforms, as their probability of being re-elected becomes less sensitive to policy actions, because voters are not able to correctly evaluate politicians' ability. In this view, uncertainty operates as a *smoke screen* giving politicians more freedom (Alesina and Cukierman, 1990). The characteristics of the political environment, as well as the electoral cycle, may also affect the way crises affect reforms. Alesina et al. (2006) show that the likelihood of governments implementing reforms after crises increases in the case of strong governments and when institutional constraints are less binding. The likelihood of implementation of reforms is also expected to be higher at the beginning of the government mandate (during the political "honeymoon"), while being lower close to elections (Alesina and Drazen, 1991; Drazen and Grilli, 1993; Alesina et al. 2006), as politicians have an incentive to shift the costs of reforms to next governments. Indeed, Alesina et al. (2023) find that reforms may provoke significant political costs if implemented close to elections; contrarily, when they are undertaken earlier at the beginning of the electoral term, reforms do not affect the probability to win elections. Finally, the political orientation of the government may influence the direction (tightening vs. liberalization) of reforms (Alesina and Roubini, 1992; Cukierman and Tommasi, 1998; Ciminelli et al., 2019).

Taking these considerations into account, we augment our baseline model with interaction terms that account for the degree of uncertainty surrounding the country, the distance to elections, the strength of the government and its political orientation. The results show that the tightening effect of crises on energy markets regulation is larger during periods of high economic and policy uncertainty

and when governments are politically strong—that is, characterized by a larger majority, in majoritarian systems, and at the beginning of their mandate. Conversely, we do not find any significant difference between left- and right-wing governments in pursuing reforms in the energy markets after crises.

In the rest of the paper, Section 2 introduces the data and the empirical methodology, Section 3 presents the results, and Section 4 concludes.

2. Data and methodology

This section presents data and empirical approach used to assess the effect of crises on energy markets regulation. To this end, we assemble two novel datasets that cover a large sample of countries, sectors, and years.

2.1. Data

Energy markets regulation

We use two alternative datasets to measure regulation in energy markets.⁹ The first database, henceforth referred to as *Reform-IMF*, is based on the Product Market Structural Reform indicator of Alesina et al. (2023) that is compiled using several sources (such as the annual issues of *Electricity Regulation* from the International Energy Agency (IEA); country profiles from the Clean Energy Info Portal; reports from the EBRD, the OECD, the World Bank and the Council of European Energy Regulators (CEER), as well as annual reports from countries' regulatory authority). In particular, we focus on the Electricity Reform Indicator that evaluates the following dimensions of electricity markets: unbundling (i.e., the degree of vertical integration in generation, transmission, and distribution of energy); degree of public ownership; the presence of an independent regulatory agency; the degree of liberalization in the wholesale market. Each sub-indicator takes a score between

⁹ Table A1 in the Appendix reports the country coverage of the two datasets in our sample, while Table A2 reports detailed descriptive statistics.

zero and two, with zero corresponding to a fully restricted electricity market and two to a fully liberalized one.¹⁰ The *Reform-IMF* dataset is composed of 15,120 observations, including 90 countries, four sub-indicators, for the period 1973-2014.

The second dataset, henceforth referred to as *Reform-OECD*, is provided by the OECD (Koske et al. 2015) and includes several product market regulation (PMR) indicators estimated using published sources and replies to the OECD Regulatory Indicators Questionnaire. It contains measures related to the restrictions to competition in specific industries. We focus on the energy industry reform indicator, which is composed of electricity and natural gas sub-indicators. The indicators cover transmission, distribution and supply regulations in the electricity and gas industries, with particular emphasis devoted to the measurement of barriers to entry, public ownership, vertical integration, and market structure (that are captured using the so-called *low-level indicators*). The indicators for each industry vary between 0 and 6, with higher values indicating a more stringent regulation.¹¹ For consistency with the IMF index of electricity market reform, where higher values indicate more liberalization, we multiply each OECD indicator by -1. The dataset covers 10,257 observations, for 46 countries (35 OECD and 11 non-OECD), and 8 sub-indicators, during the period of 1975-2013. Both databases, and all the indicators, capture ‘*de jure*’ policy settings that do not necessarily reflect the actual enforcement of the laws and regulations.¹²

¹⁰ Table A3 in the Appendix provides additional information on the construction of the IMF indicators. For further details see the IMF’s website on Structural Reform Database and the technical paper “Data Documentation of the Structural Reform Database” downloadable at <https://data.imf.org/?sk=8a361b05-ac3f-4cb2-be4a-f9a2b0cba124> (accessed in April 2024).

¹¹ In detail, the OECD dataset provides a score for entry, vertical integration, market structure and public ownership, for both electricity and natural gas, for a total of eight scores. The dataset relies on answers of a questionnaire sent to national authorities. Answers are then transformed into quantitative scores by assigning a numerical value, normalized over a zero to six scale, to each answer. Lower values reflect more competition friendly regulatory stance. Tables A4 and A5 in the Appendix provides additional information on the construction of the OECD indicator (i.e., questionnaire and scoring system). For more technical details, see Koske et al. (2015) and <https://stats.oecd.org/viewhtml.aspx?datasetcode=ETCR&lang=en> (accessed on April 2024).

¹² Although IMF’s and OECD’s indicators reflect the degree of regulatory stance, we must note that competition-friendly regulations and reforms do not always translate in “*de facto*” more competition (or efficiency), since a key role is played by the enforcement of the laws that is not captured by such indicators. Examples of this issue are related to the degree of genuine (or effective) independence that can depend on countries’ institutional quality (Foster and Rana. 2020), the skills and experience of the staff running and managing energy sectors regulators (AFDB, 2020) or the extent and way deregulation processes (related either to unbundling or degree of public ownership) are managed (see for example Besant-Jones, 2006).

Figure A1 (Panel A for the IMF, Panel B for the OECD) in the Appendix plots the evolution of the aggregate indicators of energy markets regulation—computed as the average of the respective sub-indicators across countries—over time. Three facts stand out. First, advanced and developing economies have broadly pursued liberalization since the late 1980s, with an acceleration in the reform progress since early-1990s (with waves of liberalization in developed countries, followed with some lag in emerging economies). Second, energy markets in advanced economies are more liberalized than in developing economies, on average. Third, since the Global Financial Crisis, pro-market reforms have stalled or reversed—suggesting that crises may indeed represent a turning point in de-regulation. We formally test this in the rest of the paper.

Recessions

Economic recessions are defined as negative peaks in the (log of) business cycle. Specifically, we use Harding and Pagan's (2002) approximation to Bry and Boschan's (1971) algorithm, identifying turning points (i.e., peaks and troughs) in a time series. As we use yearly data, we follow Abiad et al. (2012) and impose the condition that the minimum length of the cycle is 5 years. We define recessions as the period between the year after an economic peak (i.e., the local maximum) and the year of the trough (i.e., the local minimum). In the robustness check, we also use an alternative measure of economic recession: a dummy for the year in which a country experiences negative real GDP growth.

Other variables

To further validate our empirical analysis, we consider several additional variables, either as controls, or as alternative shocks, or as mediating variables.

In detail, we consider the occurrence of oil price shocks, by looking at the evolution of oil prices at global level, during the period under analysis (source: BP Statistical Review of World Energy). We also consider changes in the production of renewable energy, and in regulation associated with climate change policies—with data drawn from the OECD. Reforms in energy market

regulation may depend on reforms in other areas, such as trade, product market, capital account and labor market. We retrieve data on such reforms from the OECD's SPIDER dataset. How energy markets are regulated could also be affected by changes in democracy, with liberalizing reforms more likely to be implemented by democratic institutions (Giuliano et al., 2013); thus, we consider the level of democracy at country/year level by means of the *Polity2* index. In addition, we consider several variables potentially linked to economic recession, i.e., an index of financial stress by Romer and Romer (2017), budget deficit (OCSE), pandemics and major epidemic events (see Furceri et al., 2022, for details), and inflation (World Bank's Global Dataset of Inflation). As the effect of recession on reforms may weaken if economic agents expect future growth, we consider the IMF's October forecast of economic growth.

Then, we account for the degree of uncertainty at country/year level (Bonfiglioli and Gancia, 2013) using the World Uncertainty Index (Ahir et al. 2022)—which captures the degree of economic and policy uncertainty, for 143 countries since 1952.

Next, as discussed earlier, the effect of crises on reforms may change according to the domestic political and institutional context. Thus, we collect various political variables that are expected to affect the crises-reforms nexus, from the World Bank's Database of Political Institutions (DPI) (Scartascini et al., 2021)—which provides a wide set of information on various aspects of political institutions, for 180 countries, for the period 1975-2020. In particular, we consider the strength of the governments in terms of votes and seats share of governing parties. We consider the possibility that reforms are more likely to be implemented in majoritarian systems, and we create a binary variable that is equal to one when a country is characterized by a majoritarian electoral system, and zero otherwise. Next, we consider the political cycle of reforms and construct a measure of distance from current elections. The variable takes zero for the year of election, $n-1$ for the year after an election—where n is the length of the electoral term of each country—, and $n-t$ for years in between two elections, where t is the current year. Finally, we consider the ideological orientation of the

government, by constructing a dummy, which is equal to one if the government is center/right-oriented, and zero if it is left-oriented.

Table A2 in the Appendix reports some descriptive statistics of these variables.

2.2. Methodology

We investigate the impact of economic crises on energy markets regulation using local projections (Jordà, 2005). This dynamic approach is better suited compared to alternative methods to generate impulse response functions—such as VAR and ARDL models—in accommodating nonlinearity in the way the recession variable is modeled (including interaction terms) and in including a large set of fixed effects. In detail, the estimated equation reads as follows:

$$y_{i,s,t+k} - y_{i,s,t-1} = \alpha_{is}^k + \gamma_{itrend}^k + \beta^k Recession_{i,t} + \delta^k X_{i,s,t-l} + \varepsilon_{i,s,t+k} \quad (1)$$

where subscripts i , s , and t indicate country, sector and time, respectively. The term $y_{i,s,t+k} - y_{i,s,t-1}$ denotes the cumulative change of energy markets reform, in country i and sector s , between $t+k$ and $t-1$, with $k=0, \dots, 5$ (years). $Recession_{i,t}$ is the dummy variable that identifies economic recessions in country i at t . In an alternative specification, we substitute economic recession with other shocks potentially driving reforms in the energy market, such as oil price shocks and policies addressing climate change issues. Therefore, we control for country-sector fixed effects (α_{is}^k) to absorb time-invariant drivers of reforms, in each country-sector—as a result, we use time variation in reforms, within each country-sector pair, for identification. Additionally, we control for country-specific-time-trends (γ_{itrend}^k) to account for country-specific evolution in energy market regulation. Besides these fixed effects, we consider a vector of controls ($X_{i,s,t-l}$) comprising of two lags (with $l=1, 2$) of the dependent variable and of recessions dummies. In the robustness checks, we extend the vector $X_{i,s,t-l}$ to additional control variables. Standard errors are clustered at the country level.

Next, we extend equation (1) to examine how the response of energy markets reforms to economic recessions vary with the country's economic and political characteristics. For continuous variables, we follow the approach proposed by Auerbach and Gorodnichenko (2013):

$$y_{i,s,t+k} - y_{i,s,t-1} = \alpha_{is}^k + \gamma_{itrend}^k + F(z_{it})[\beta_L^k \text{Recession}_{i,t} + \theta_L^k X_{i,s,t-l}] + (1 - F(z_{it}))[\beta_H^k \text{Recession}_{i,t} + \theta_H^k X_{i,s,t-l}] + F(z_{it}) + \varepsilon_{si,t+k} \quad (2)$$

$$\text{with } F(z_{it}) = \frac{\exp^{-\gamma z_{it}}}{1 + \exp^{-\gamma z_{it}}}, \quad \gamma = 1$$

where z is an indicator of the country-characteristic, normalized to have zero mean and unit variance. In our analysis, we consider the yearly change of the degree of uncertainty at country level, the strength of government in terms of vote and seats share, and the distance from elections. $F(z_{it})$ is the corresponding smooth transition function that, in our framework, represents the likelihood of being in a specific (country-level) condition, at the horizon k . We exploit both cross- and within-country variation in the normalization, i.e., we use $z_{it} = \frac{s_{it} - \bar{s}}{sd(s_{it})}$. In detail, β_L^k is the coefficient associated with the low regime, while β_H^k is the one associated with the high regime. This econometric strategy directly tests if the effect of economic recessions changes according to different country-level economic and political conditions (Granger and Teravistra, 1993). Moreover, differently from a standard linear interaction model, the smooth transition function approach makes the effect of recessions to vary non-linearly as a function of different country-level aspects. Finally, instead of estimating a structural vector autoregression model for each characteristic, our approach allows the effect of reforms to vary smoothly, making the response more stable and precise.

When we use binary country-level variables as mediating factors—i.e., the electoral system and the political orientation of governments—we estimate this equation:

$$y_{i,s,t+k} - y_{i,s,t-1} = \alpha_{is}^k + \gamma_{itrend}^k + \beta^{k,D} D \cdot Recession_{i,t} + \beta^{k,1-D} (1 - D) \cdot Recession_{i,t} + \theta^k X_{i,s,t-l} + \varepsilon_{si,t+k} \quad (3)$$

where D is the dummy variable indicating the above political characteristics.

3. Results

3.1. Baseline

We start by reporting the baseline results obtained by estimating equation (1). Figure 1 shows the effect of economic recessions on the two alternative indicators of energy market reforms (IMF and OECD). We report year (time) on the x-axis, the solid line displays the average estimated coefficients, and shaded areas denote 90 percent confidence bands. Table 1 reports the associated regressions.

The results suggest that economic recessions lead to a persistent, and statistically significant, increase in energy markets reforms, in the form of more tightening. The peak effect, observed in the medium term—that is, five years after the crisis—is of about -0.06 point for the IMF index and -0.2 point for the OECD index, which represent approximately $\frac{1}{2}$ standard deviation of the average change in the indicators in our sample—that is, 0.15 and 0.42, respectively. The fact that the effects materialize (and the results are significant) after few years it is likely to reflect delays associated with decision making and implementation of the reforms (note that the database captures only the date (year) when the change in regulation has been implemented). Countries experiences reflecting these findings are numerous. For example, after the global financial crisis in 2008, the Hungarian authorities decided to increase the share of public ownership of the country's largest oil and gas company, MOL.¹³ According to the Centre for Eastern Studies (OSW, 2011), such buyback shares was in line with the government's vision of a state regaining its influence and playing an increasing

¹³ Specifically, the government approved the purchase of a 21 percent stake from Surgutneftegas (Russia) for €1.88bn (US \$2.6 billion) corresponding to a change of about 0.6 point in the OECD index. See for example the UNCTAD's Investment Policy Monitor: <https://investmentpolicy.unctad.org/investment-policy-monitor/measures/189/hungary-buys-stakes-in-oil-and-gas-company-> (accessed in April 2024).

role in the economy during difficult times. Similarly, in Luxembourg, the market structure of the electricity industry undergone major changes. The Enovos International group was indeed created in 2009, as a result of Soteg's restructuring through acquisition of Cegedel and Saar Ferngas shares (two other competitors in the electricity market in Luxembourg). Such a merging process led also to an increase in the shares owned by the Luxembourg State that become the largest shareholder of Enovos with 28.27% (Enovos, 2009). The Great Recession triggered and speeded up (tightening) reforms also in other countries. In Norway, the biggest and most powerful businesses in the oil and gas sectors, Statoil and Hydro, joined their forces to become StatoilHydro (in 2018 rebranded as Equinor), with the total percentage share owned by the government increasing from 62.5% to 67% in 2009. In Spain, the effective wholesale market concentration in the gas industry increased during 2009, following the acquisition by Gas Natural of 50% stake in Unión Fenosa Gas. The overall Gas Natural's share in the wholesale gas market thus jumped from 53% to 63% (Federico, 2010). Furthermore, the Fukushima disaster in Japan, which paved the way to a deep recession, pushed the Japanese government to support the Tokyo Electric Power Co. (TEPCO) with 1 trillion yen (\$12.8 billion), thus bringing the company under public control.¹⁴

All these findings are in line with the literature suggesting that crises act as a catalyst to changes in regulation (Drazen and Grilli, 1993; Drazen and Easterly, 2001; Gokmen et al., 2019), particularly in the form of more tightening (i.e., Abiad and Mody, 2005 for financial sector regulations; Forbes and Klein, 2015 and Broz et al., 2016 for the capital flows and trade).

To confirm the validity of our baseline analysis, we try alternative specifications. First, we examine whether our results are driven by the choice of the lag structure. Second, we check if the precision of the estimates significantly changes with the way we cluster the standard errors. Reassuringly, Figures 2 and 3 show that regardless of the number of lags for crisis dummy and for the dependent variable, as well as the alternative standard errors clusterization (i.e., country-sector

¹⁴ See also Bloomberg press release at: <https://www.bloomberg.com/news/articles/2012-07-31/tepcos-under-state-control-as-government-gets-shares-for-cash?embedded-checkout=true> (accessed on April 2024)

instead of only country), the results are qualitatively similar to the baseline ones. Next, Figure 4 shows that results are similar when we use alternative set of fixed-effects: (i) sector, country, time fixed effect; (ii) sector-time and country fixed effect; (iii) sector specific and country specific time trends; (iv) sector-country-time trends. Finally, we define recessions as years of negative real GDP growth, and we find similar results (see Figure 5).

3.2. Recessions vs. other shocks

In this Section, we recognize that other shocks/events may affect energy market reforms. Examples include the oil price shocks of 1970s and early 1990s; the Asian 1997 financial crisis, impacting several energy producers; waves of privatization and nationalization due to governments' changes, e.g., in countries such as Argentina, Bolivia, Brazil and Peru; recent penetration of renewable energy. Moreover, our baseline results may be influenced by reforms in other areas—such as trade tariffs, product market regulation, capital account and labor markets—or changes in government deficit, as reforms could be part of either fiscal consolidation plans or expansionary fiscal policies. Finally, expectation of future growth may alleviate the effects of current economic recession. To investigate the impact of these factors, we augment our baseline regression with variables controlling for: (i) oil prices; (ii) change in the production of renewable energy; (iii) financial crises; (iv) changes in regulation associated with climate change policies; (v) changes in democracy; (vi) trade, product market, capital account and labor market reforms; (vii) budget deficit; (viii) inflation; and (ix) expectation of future growth.¹⁵ In addition, to check whether our results are mostly driven by change in public ownership, we replicate our baseline analysis by taking out the “public ownership” sub-components in both IMF and OECD reform indicators. Results, reported in Figures 6, are similar to, and not statistically different from, baseline ones. It is worth noting that the impact of recession on

¹⁵ See Table A2, in the Appendix, for descriptive statistics and sources of these variables.

energy market reforms is somewhat smaller when we control for oil price shocks, as these coincide with some economic recessions.

In a second step, we substitute the economic recession variable in Equation (1), with other shocks potentially driving reforms in energy market regulation. These include variables broadly linked to economic turmoil, such as the occurrence of oil price shocks and financial stress, or pandemics and major epidemic events (Furceri et al., 2022). Alternatively, we consider the implementation of strict climate change policies, or changes in democracy. Results in Figure 7 confirm that these shocks are also significantly correlated with energy market reforms. In particular, oil price shocks lead to tightening reforms in energy market regulation. The same applies to pandemics, changes in regulation associated with climate change and, to a lesser extent, to financial stress. Contrarily, and in line with the previous literature (Giuliano et al., 2013), an increase in democracy fosters liberalizing reforms.

3.3 Heterogeneity across different countries income groups

The impact of crises on reforms, as well as the direction of the effect, may vary across countries depending on their level of income. In fact, if crises may potentially make energy market reforms more likely, as our baseline results show, the capacity of governments to actually implement reforms, as well as the drivers of such reforms may change depending on country's income. By way of example, in 1990s most emerging market economies embarked on reforming low-performing energy markets through privatization; however, such impetus for major power sector reforms very often translated into incomplete interventions. Differently, advanced economies may embark on reforming energy markets for different motivations—e.g., facilitating the introduction of green technologies, spurring innovation (Foster and Rana, 2020)—which may lead to extensive public

policy interventions.¹⁶ As a result, the effect captured in the baseline analysis may mask significant heterogeneity across countries.

To address this issue, we group countries according to the World Bank income classification—low-, middle-low-, upper-middle-, and high-income countries—and create a vector of dummy variables, one for each group. Then, we interact each dummy with the recession shock in equation (1).¹⁷ In detail, we estimate the following model:

$$y_{i,s,t+k} - y_{i,s,t-1} = \alpha_{is}^k + \gamma_{itrend}^k + \beta^k \text{Recession}_{it} * \text{LOW}_i + \phi^k \text{Recession}_{it} * \text{MID LOW}_i + \rho^k \text{Recession}_{it} * \text{UPPER MID}_i + \sigma^k \text{Recession}_{it} * \text{HIGH}_i + \delta^k X_{i,s,t-l} + \varepsilon_{i,s,t+k}. \quad (4)$$

The results are reported in Figure 8. They suggest that while the shape of the IRFs as well as the point estimates are similar across income groups and not significantly different, the effects are more precisely estimated for high-income countries.

3.4 Heterogeneity across country characteristics

Other sources of countries heterogeneity may be related to the political and economic context under which they are carried out may be relevant.

To explore this heterogeneity, we extend the baseline analysis and estimate Equations (2) and (3)—depending on the characteristics of the mediating variables, as discussed earlier—to allow the response of the energy sector reforms to economic recessions to be nonlinear, depending on some key factors. As mentioned, we consider economic and policy uncertainty (using the World Uncertainty Index by Ahir et al., 2022) and some institutional and political variables from DPI (Scartascini et al., 2021), such as the form of government (majoritarian vs proportional), the distance from the elections, the strength of government (proxied, alternatively, by the number of

¹⁷ Note that we only consider the *Reform-IMF* outcome variable, as the one from OECD only includes advanced/high-income economies.

votes or the seats share of the government parties), and the ideologic orientation of governments (left vs center-right).

Figures 9-13 report the results of these exercises. For each figure, we show the estimated response for low and high levels of each key factor (solid blue line and dotted red line, respectively), for both the indices of energy markets reforms (IMF and OECD). We start by considering the average change in economic and policy uncertainty. Figure 9 shows that the implementation of tightening reforms (that lead to more restrictions to competition) after economic crises is more likely in countries characterized by higher uncertainty. In fact, the medium-term effect of crises on reforms increases to about -0.15 and -0.4 for IMF and OECD indices, respectively. One remarkable example of this finding is what happened in Japan in the aftermath of the Fukushima disaster, where the economic and policy uncertainty peaked, and the government was forced to strongly intervene in the economy. This result is also in line with the *smoke screen* hypothesis by Alesina and Cukierman (1990), suggesting that uncertainty gives politicians more freedom to act as it decreases electoral costs of investing in policies with future returns due to the limited ability of voters to correctly evaluate politicians' actions.

Next, we consider the form of government and the distance from elections. Consistently with previous theoretical and empirical studies, results shown in Figure 10 suggest that using the OECD index, majoritarian systems stimulate more reforms than proportional ones, even in cases of economic crises when reforms are pursued in the form of more tightening.¹⁸ The peak effect observed in the medium term is about of -0.4, which is twice than the baseline. Indeed, according to the partisan theory, proportional electoral systems are typically characterized by parliaments where political opponents have enough power to veto major policy actions (Ciminelli et al. 2019). Figure 11 reports the results of the impact of crises on energy markets reforms, depending on the distance from the elections. The results suggest that in period of crises more tightening reforms are carried out when the distance from the elections is larger. The peak effect is observed in the medium term and is about

¹⁸ Such findings are weaker when using the IMF index.

-0.08 and -0.28 for IMF and OECD indices, respectively. For example, the 2008 slowdown is associated with an increase in vertical integration in Estonia, just one year after the beginning of the government mandate (started in 2007). Specifically, Eesti Energia, the leading energy company owned by the Estonian state, was involved in significant transformations in the range of its operations to become an energy solutions partner with an integral value chain, operating both in Estonia and in international markets. This result confirms that politicians are less willing to undertake major reforms when elections approach, as political costs dramatically increase close to elections (Bonfiglioli and Gancia, 2013).

In Figure 12, we look at the strength of government. Using both the number of votes or the seats share of the government parties we find that the tightening effect of crises on energy markets reforms is larger in case of stronger and less fractionalized governments. The effect is statistically significant at almost all horizons, and it is about twice than the average effect shown in the baseline (-0.16 and -0.5 at the peak, for IMF and OECD indices, respectively). Conversely, the effect is not statistically significant in case of weak governments. A noteworthy example is what happened in Hungary in 2011 where the government led by Prime Minister Viktor Orban, controlling about 70% of seats, decided a marked increase in the share of public ownership of the country's largest oil and gas company, MOL. These findings are also in line with the war of attrition model (Alesina and Drazen, 1991), suggesting that reforms are delayed when the government is weak or fractionalized, since opponents have more power to maintain the status quo.

Finally, we consider the extent to which the ideologic orientation of governments (center-left vs. right) matter. The results reported in Figure 13 do not point to statistically different response between center-right-leaning governments and left-leaning. The results are very similar and broadly unchanged when we consider alternative combinations (i.e., center-right vs. left governments, and when we exclude the center – i.e., right vs. left), highlighting the fact that the ideologic orientation is not relevant in shaping regulation in the energy sector in the aftermath of economic crises.

4. Conclusions

In a period when energy prices are dramatically increasing, due to shocks in the distribution of energy, the way in which energy markets are designed and regulated is a priority in the political agenda of many governments worldwide. In addition, climate change is calling for a global effort to support the transition to a green economy, and policy actions and regulation of energy markets may play a key role in fostering the green transition.

However, changes in regulation are often not easy to implement, as reforms are expected to bring long-term benefits but at short-term costs (Alesina and Drazen, 1991). If costs are concentrated and specific social groups would suffer more than others from the implementation of reforms, policymakers may lack the political capital needed to do reforms (Alesina et al., 2023; Ciminelli et al., 2019). The literature has long investigated the conditions that may make the implementation of reforms easier. Among them, a relevant debate has concentrated around the role of crises, according to the crises-reforms nexus (Alesina and Drazen, 1991; Drazen and Gilli, 1993). Theoretical and empirical studies have provided mixed explanations and findings in support of the role of crises as a catalyst to reforms. Indeed, on the one hand, crises may facilitate reforms by worsening *status-quo* conditions; on the other hand, they may factionalize the ruling coalition and weaken the capacity of governments to implement strong policy actions.

By using a dynamic approach that also accounts for nonlinearities, we show that crises—measured in terms of economic recessions or other shocks—facilitate the implementation of tightening reforms in the energy markets. We show that the capacity of governments to implement reforms is amplified during periods of higher economic and policy uncertainty, when governments are strong, and at the beginning of the electoral cycle. Conversely, the political orientation of government seems to not affect the way in which governments make reforms in the energy market in the aftermath of crises.

Overall, our results support the hypothesis of Drazen and Grilli (1993) suggesting that crises are potential push-factors for major changes in regulation. In the specific context of energy markets,

our findings suggest that crises lead to tightening regulations. Nonetheless, our findings leave open for future research the investigation of the extent and way changes in the regulatory stance driven by crises are enforced. This would require the construction of databases, with internationally comparable measures on the actual enforcement of the laws related to the energy markets.

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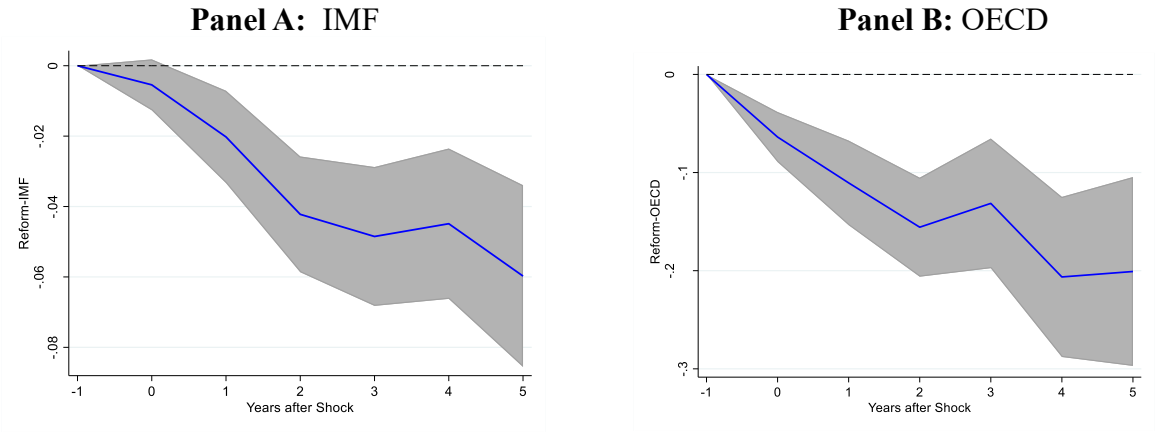
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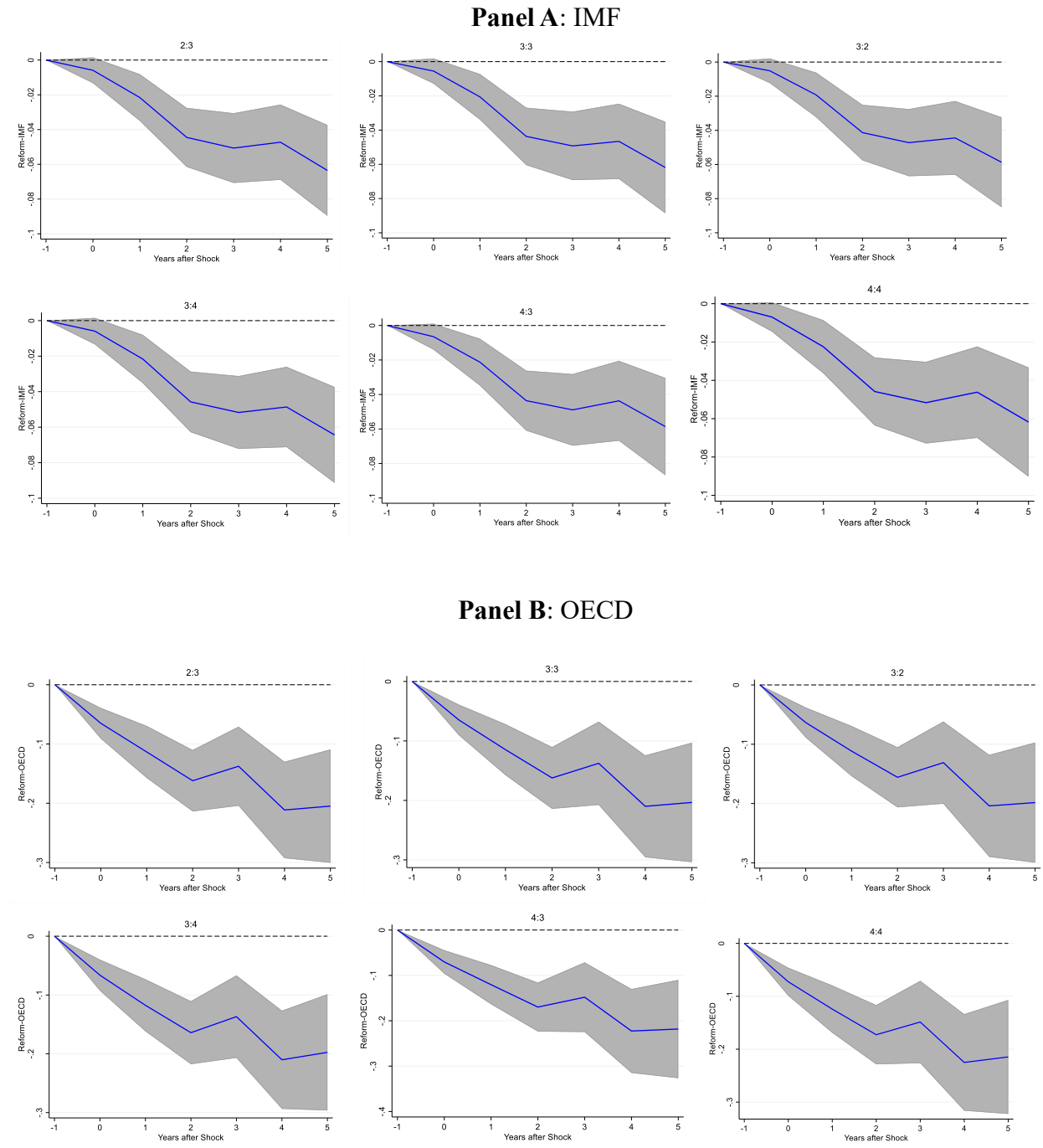
FIGURES

Figure 1. The effect of crises on energy market reforms – Baseline



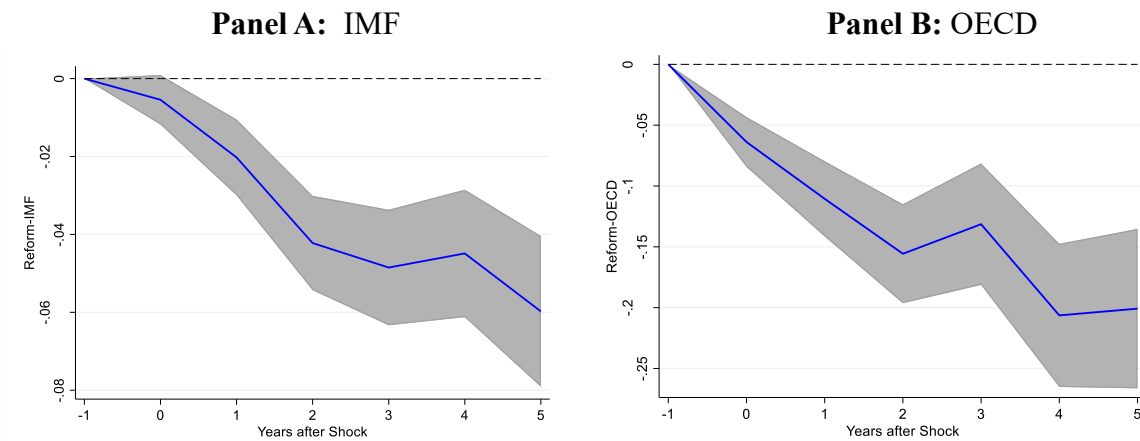
Note: The charts show the impulse response function of energy market reform to economic recession, based on equation (1). Left panel refers to the *Reform-IMF* dataset; right-panel refers to the *Reform-OECD* dataset. The shaded area represents the 90 percent confidence interval; $t=0$ is the year of the shock.

Figure 2. Robustness checks – alternative lag structure



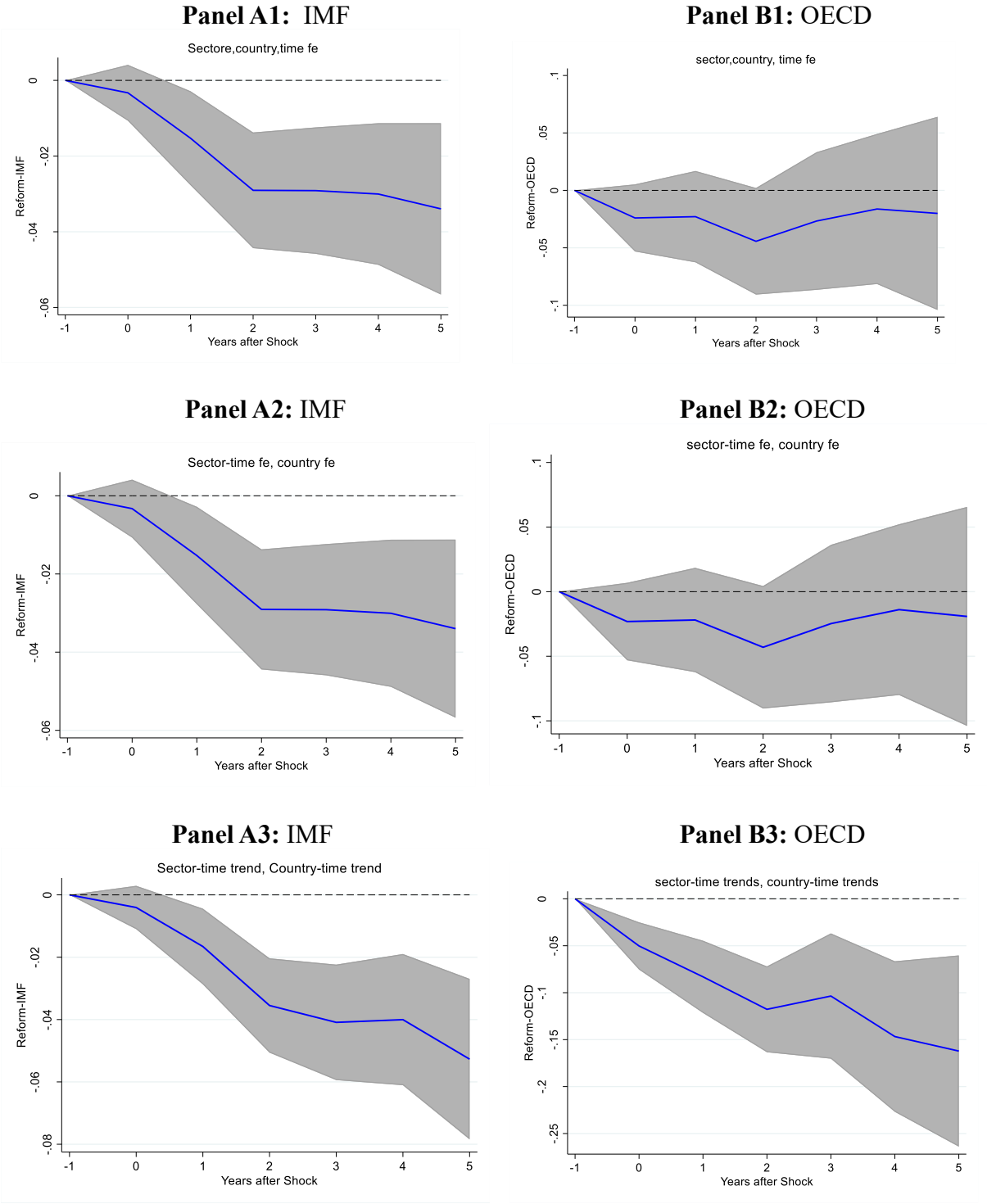
Note: The charts show the impulse response function of energy market reform to economic recession, based on equation (1). Left panel refers to the *Reform-IMF* dataset; right-panel refers to the *Reform-OECD* dataset. The shaded area represents the 90 percent confidence interval; $t=0$ is the year of the shock. Each panel shows the results for different lag structures: first number in the caption of each figure indicates the number of lags of the recession variable, and the second number indicates the number of lags of the dependent variable.

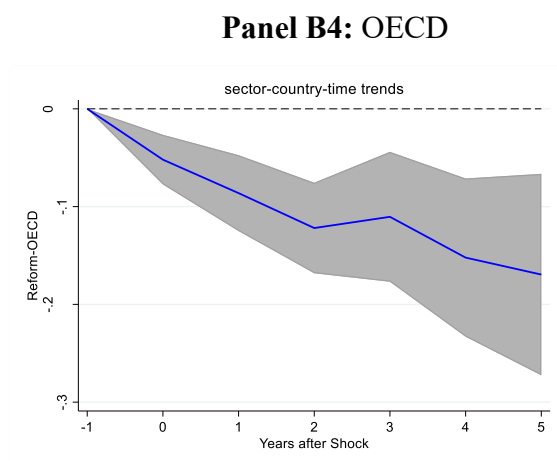
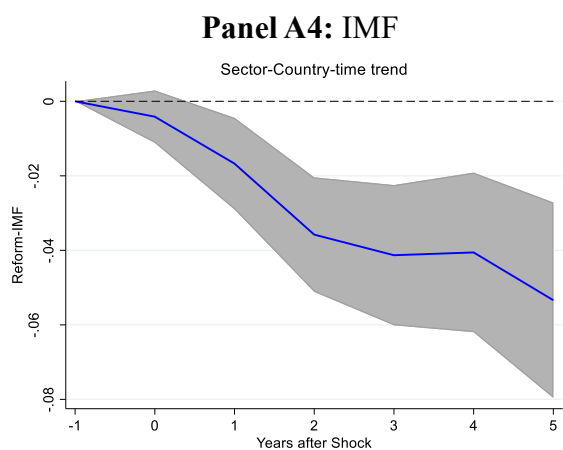
Figure 3. Robustness checks – alternative standard errors clusterization



Note: The charts show the impulse response function of energy market reform to economic recession, based on equation (1). Left panel refers to the *Reform-IMF* dataset; right-panel refers to the *Reform-OECD* dataset. The shaded area represents the 90 percent confidence interval; $t=0$ is the year of the shock. The standard errors are clustered at country-sector level.

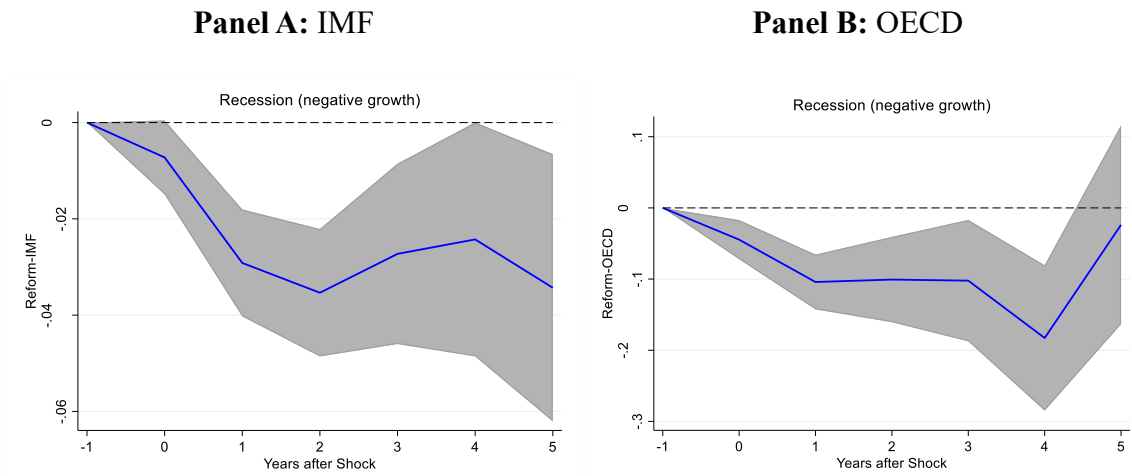
Figure 4. Robustness check – alternative specifications





Note: The charts show the impulse response function of energy market reform to economic recession, based on equation (1). Left panel refers to the *Reform-IMF* dataset; right-panel refers to the *Reform-OECD dataset*. The shaded area represents the 90 percent confidence interval; $t=0$ is the year of the shock. Captions of each figure indicates the set of fixed effects used.

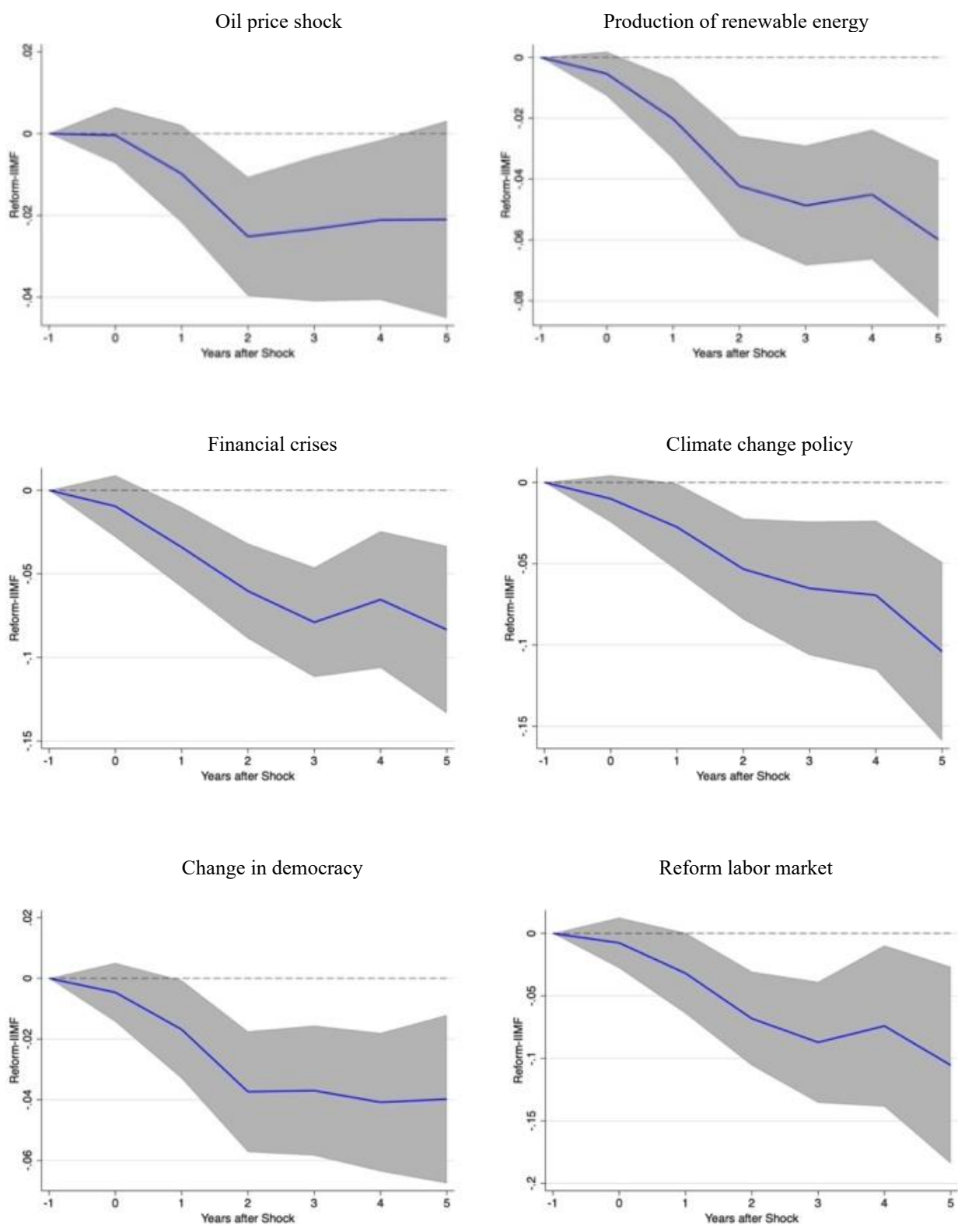
Figure 5. Robustness checks – alternative recession variable



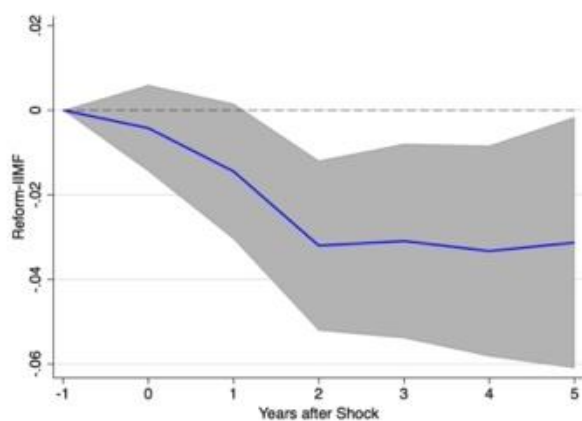
Note: The charts show the impulse response function of energy market reform to economic recession (computed as years of negative GDP growth), based on equation (1). Left panel refers to the *Reform-IMF* dataset; right-panel refers to the *Reform-OECD* dataset. The shaded area represents the 90 percent confidence interval; $t=0$ is the year of the shock.

Figure 6. Additional recessions/shocks as controls

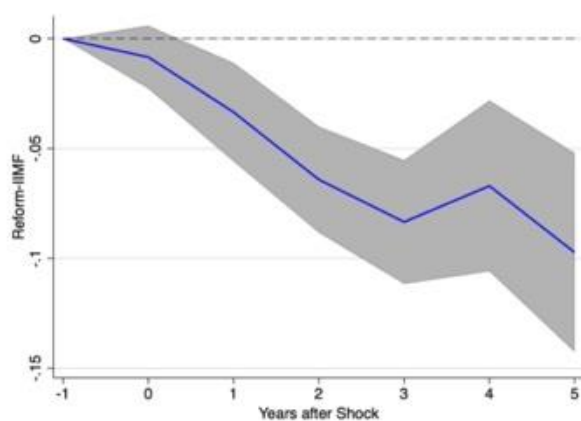
Panel A: IMF



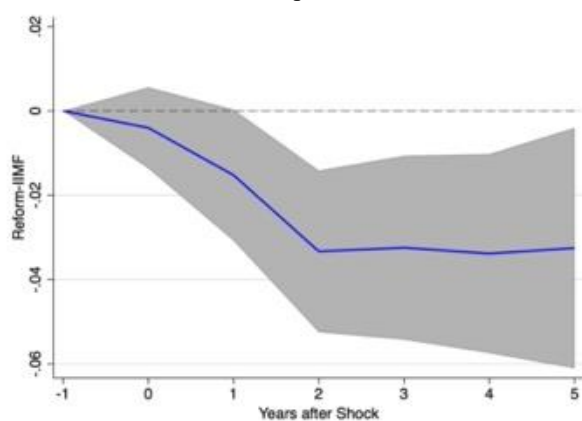
Reform trade



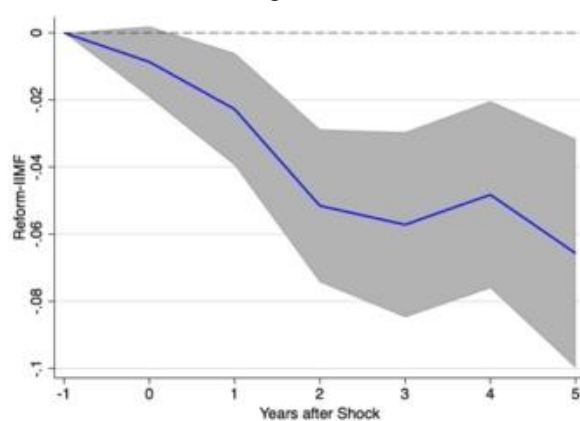
Reform PMR



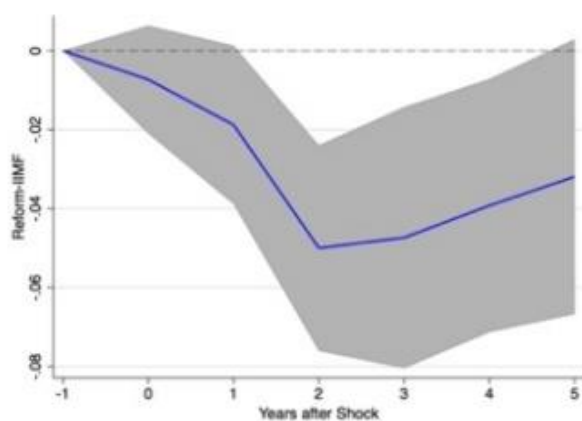
Reform capital account



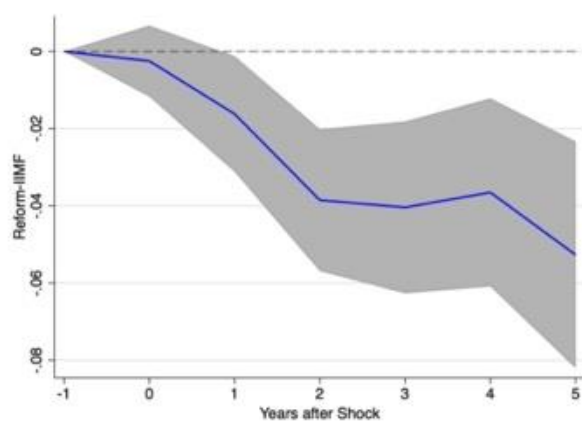
Budget deficit



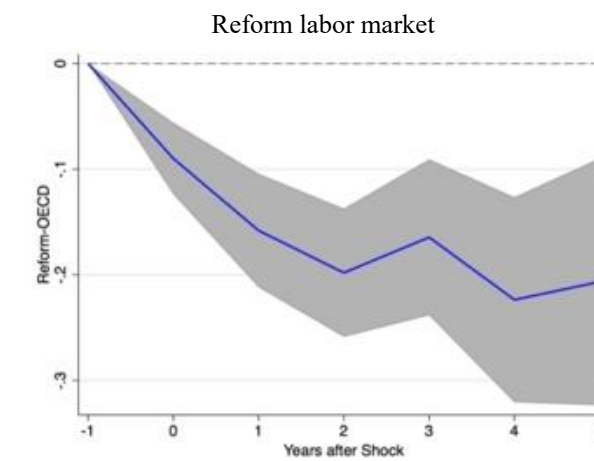
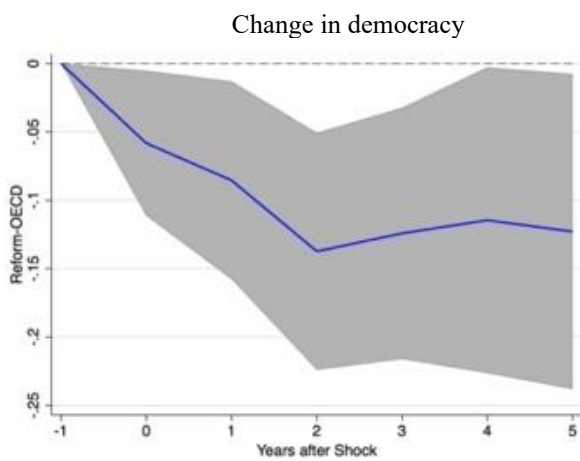
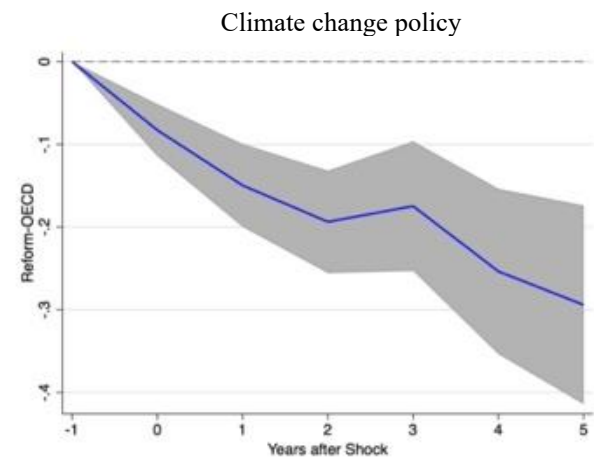
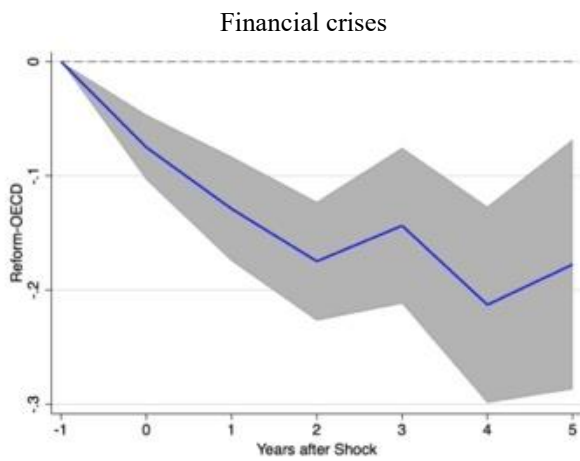
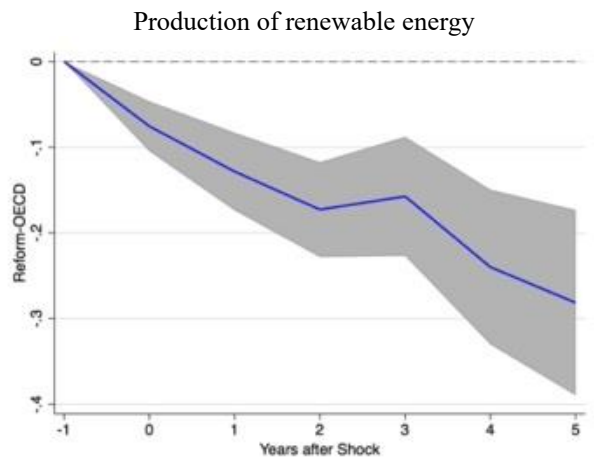
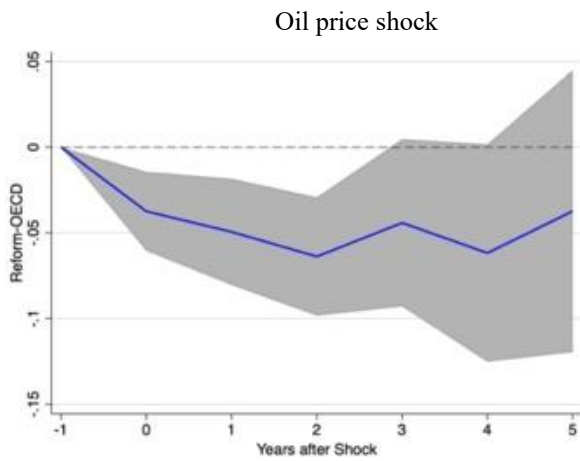
Growth forecast (oct)

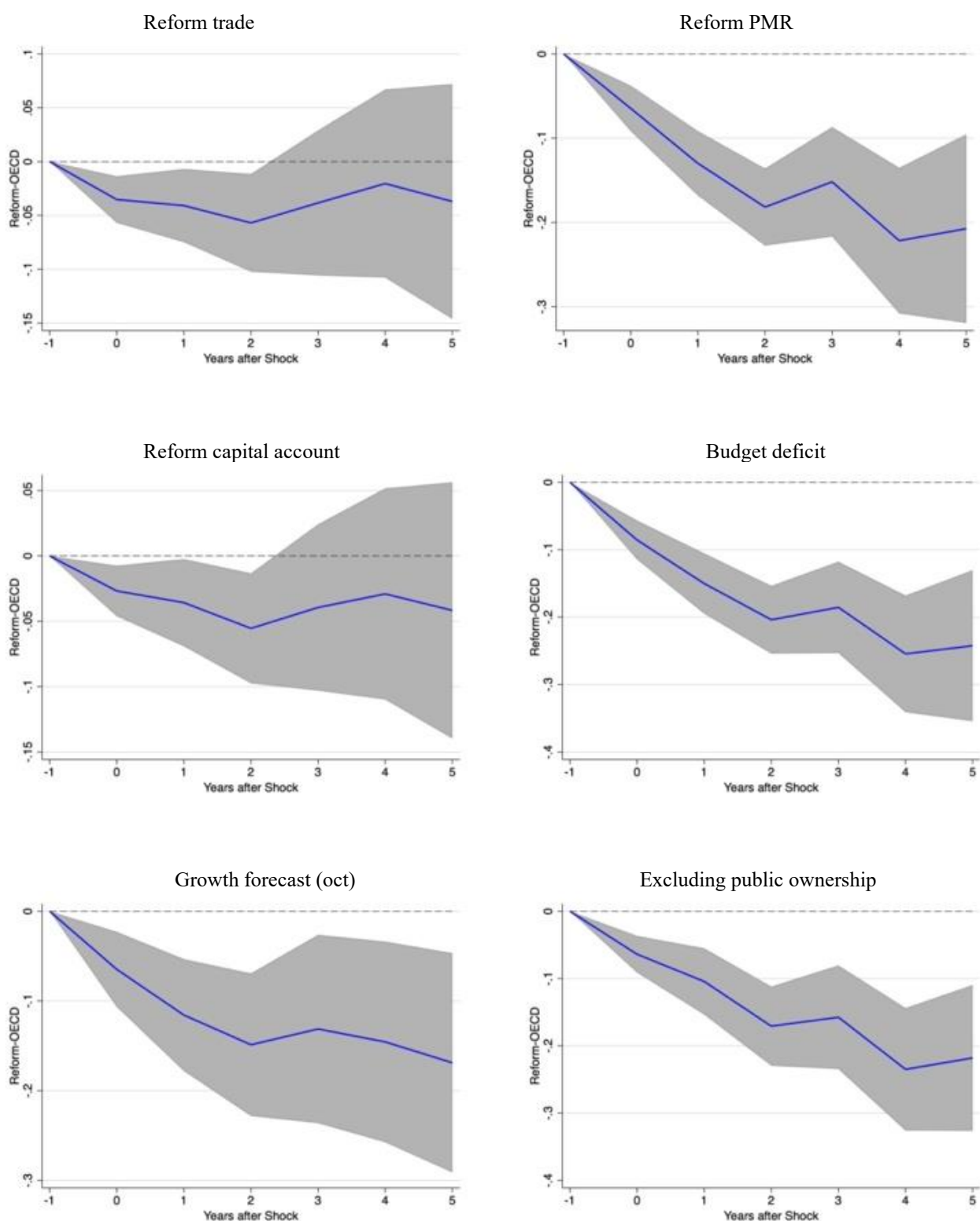


Excluding public ownership



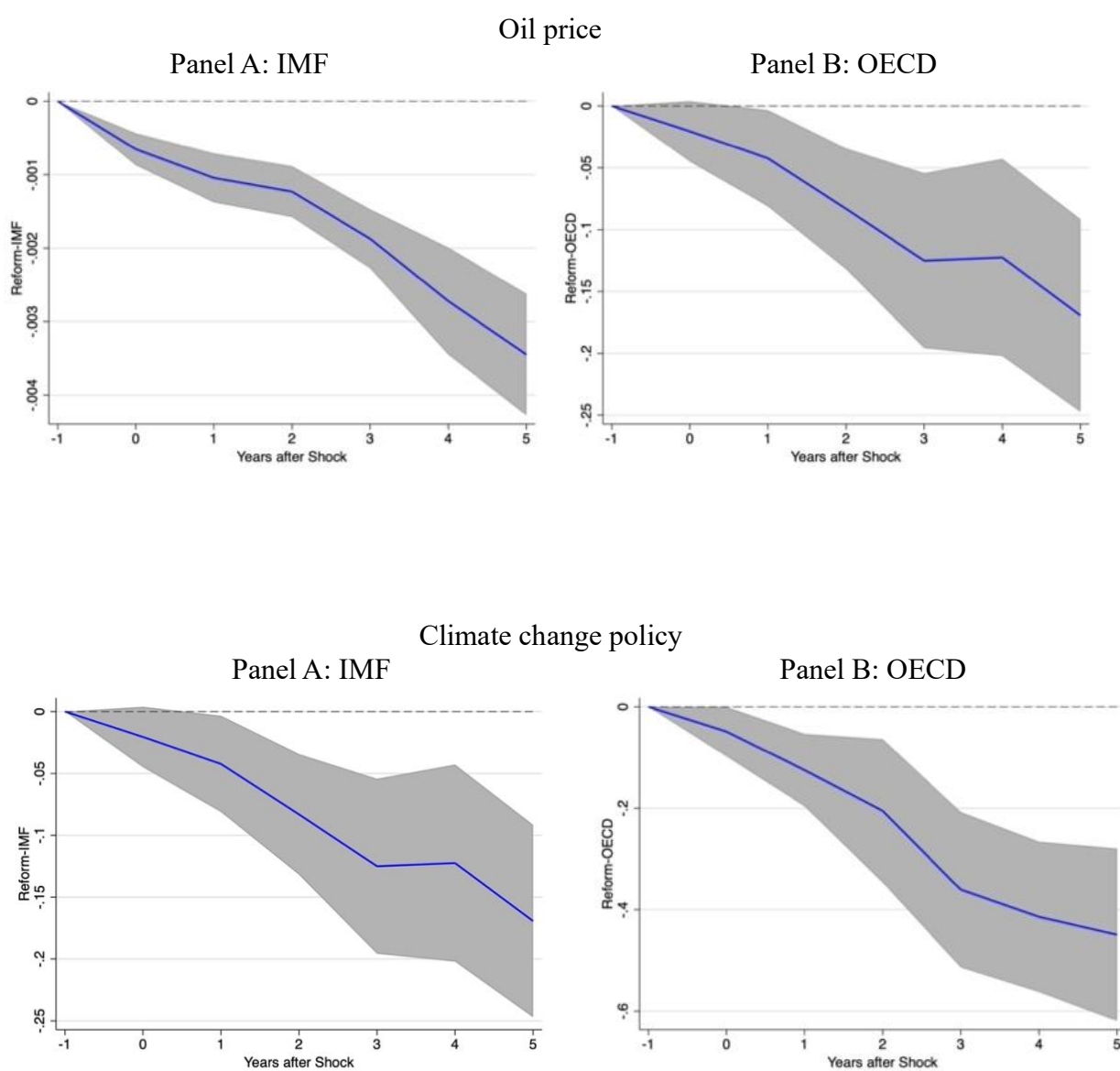
Panel B: OECD





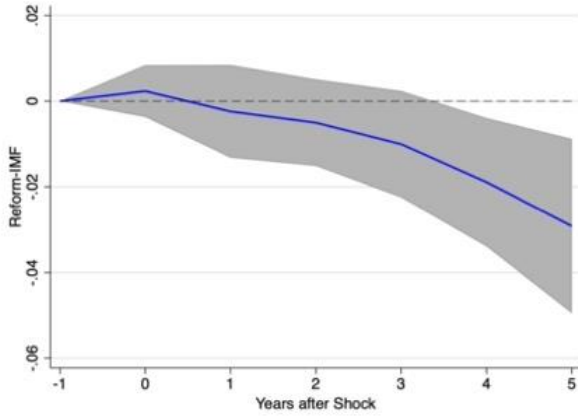
Note: The charts show the impulse response functions of energy market reform to economic recession, based on equation (1). Estimations include additional controls as in the caption of each chart. Top panels refer to the *Reform-IMF* dataset; bottom panels refer to the *Reform-OECD* dataset. The shaded area represents the 90 percent confidence interval; $t=0$ is the year of the shock.

Figure 7. Effects of other crises/shocks on energy market reforms

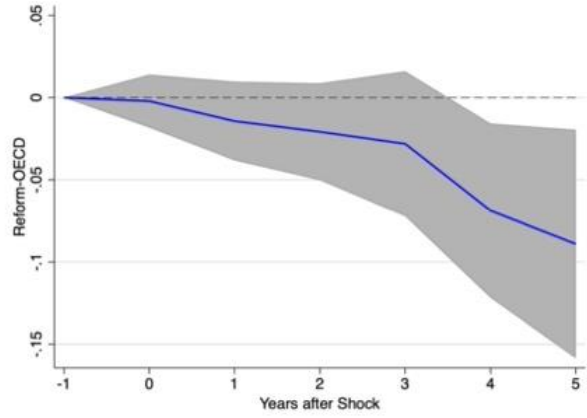


Financial stress

Panel A: IMF

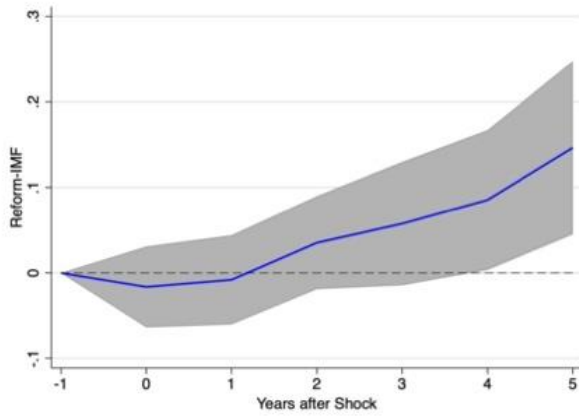


Panel B: OECD

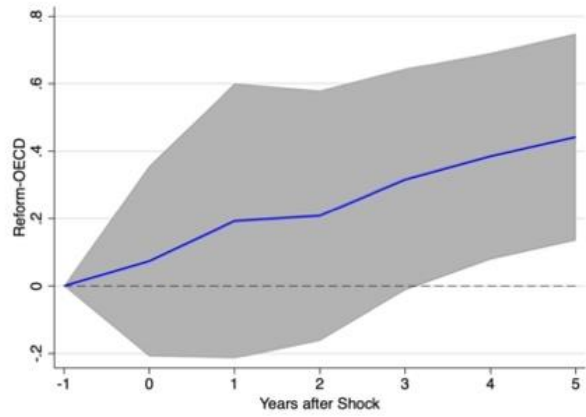


Change in democracy

Panel A: IMF

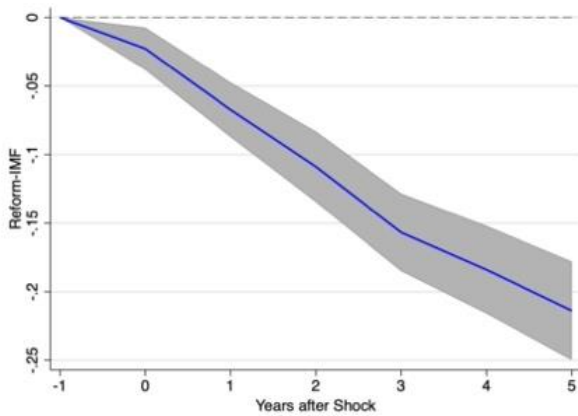


Panel B: OECD

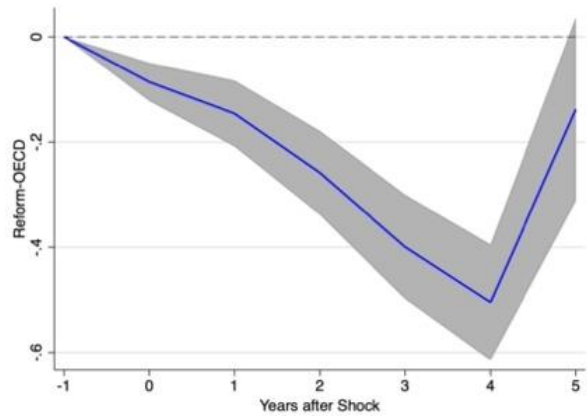


Pandemics and major epidemics

Panel A: IMF

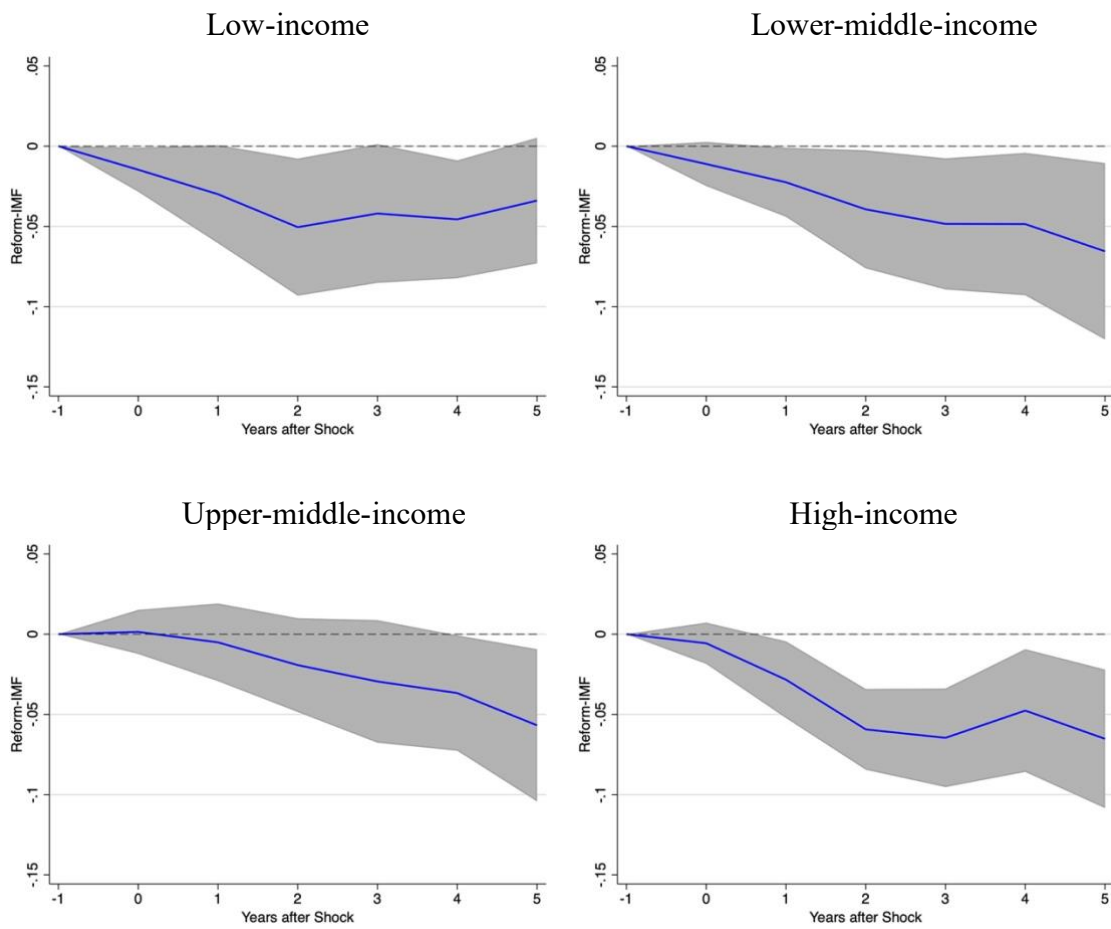


Panel B: OECD



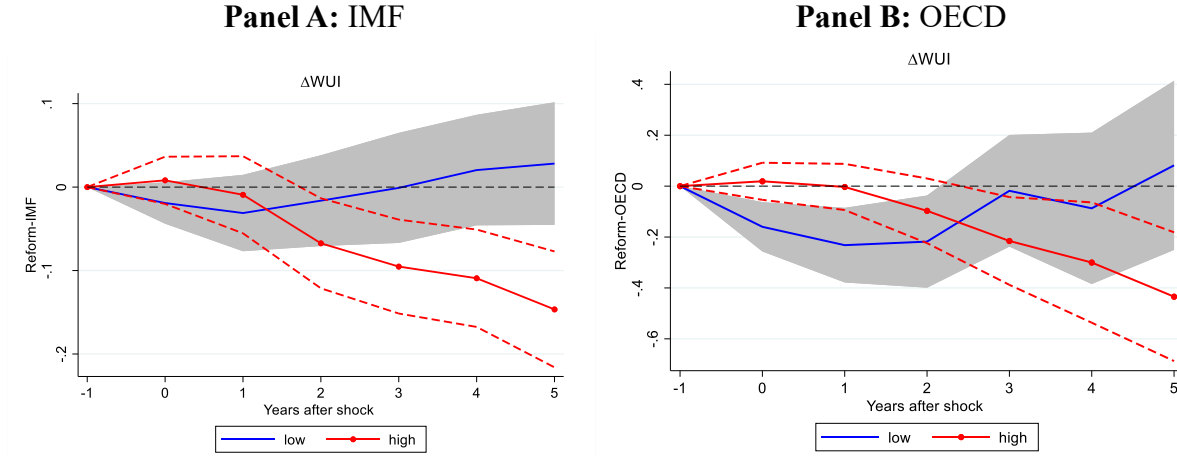
Note: The charts show the impulse response function of energy market reform to different crises/shocks, as in the caption of charts. Estimations are based on equation (1). Left panels refer to the *Reform-IMF* dataset; right-panels refer to the *Reform-OECD* dataset. The shaded area represents the 90 percent confidence interval; $t=0$ is the year of the shock.

Figure 8. Heterogeneity across income groups of countries



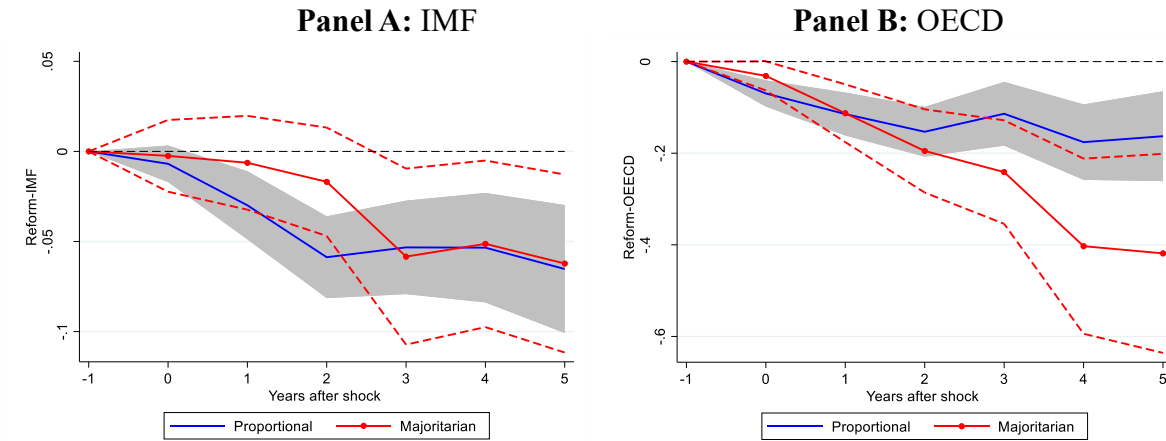
Note: The charts show the impulse response function of energy market reform (based on the IMF index) to economic recession, for different income groups of countries, as in the caption of the charts. Estimations are based on equation (4). The shaded area represents the 90 percent confidence interval; $t=0$ is the year of the shock.

Figure 9. The role of economic and policy uncertainty



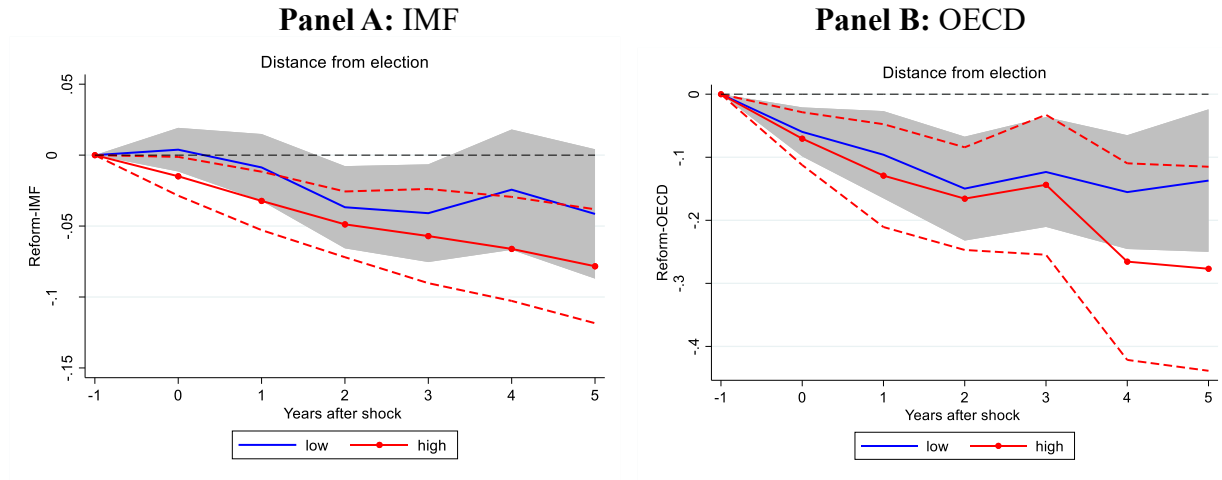
Note: The charts show the impulse response function of energy market reform to economic recession, based on equation (2), with “ ΔWUI ” as mediating variable. Blue line indicates to low-uncertainty scenario, and shaded area represents the 90 percent confidence interval; red line indicates the high-uncertainty scenario, and red-dot lines represent the 90 percent confidence interval. Left panel refers to the *Reform-IMF* dataset; right-panel refers to the *Reform-OECD* dataset. $t=0$ is the year of the shock.

Figure 10. The role of the share of electoral systems (Majoritarian vs Proportional)



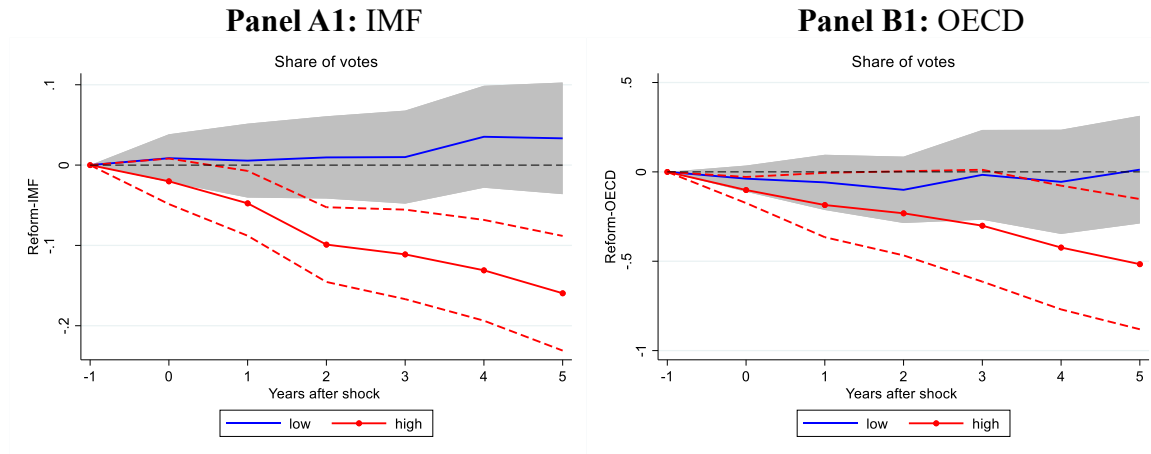
Note: The charts show the impulse response function of energy market reform to economic recession, based on equation (3), with “Majoritarian vs Proportional” as mediating variable. Blue line indicates to “Proportional” scenario, and shaded area represents the 90 percent confidence interval; red line indicates the “Majoritarian” scenario, and red-dot lines represent the 90 percent confidence interval. Left panel refers to the *Reform-IMF* dataset; right-panel refers to the *Reform-OECD* dataset. $t=0$ is the year of the shock.

Figure 11. The role of the distance to elections

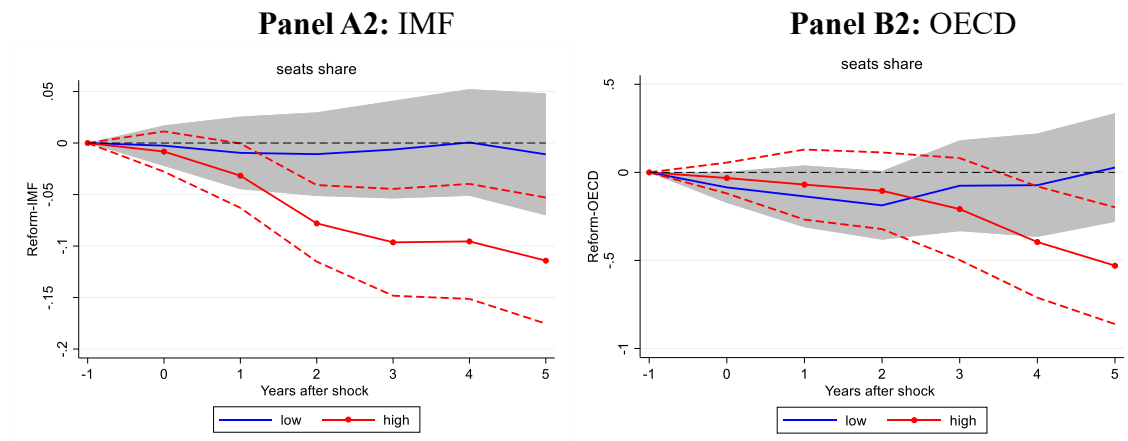


Note: The charts show the impulse response function of energy market reform to economic recession, based on equation (2), with “Distance to election” as mediating variable. Blue line indicates to low-distance to election scenario, and shaded area represents the 90 percent confidence interval; red line indicates the high-distance to election scenario, and red-dot lines represent the 90 percent confidence interval. Left panel refers to the *Reform-IMF* dataset; right-panel refers to the *Reform-OECD* dataset. $t=0$ is the year of the shock.

Figure 12. The role of government strength (votes and seat shares)

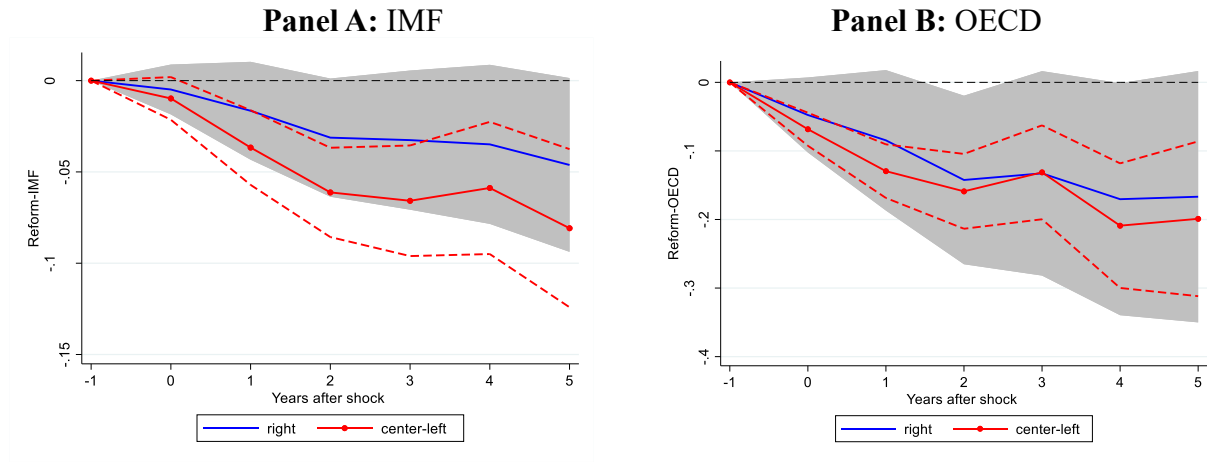


Note: Note: The charts show the impulse response function of energy market reform to economic recession, based on equation (2), with "Number of Vote" as mediating variable. Blue line indicates to low-share of votes scenario, and shaded area represents the 90 percent confidence interval; red line indicates the high-share of votes scenario, and red-dot lines represent the 90 percent confidence interval. Left panel refers to the *Reform-IMF* dataset; right-panel refers to the *Reform-OECD* dataset. $t=0$ is the year of the shock.



Note: Note: The charts show the impulse response function of energy market reform to economic recession, based on equation (2), with "Seats Share" as mediating variable. Blue line indicates to low-share of seats scenario, and shaded area represents the 90 percent confidence interval; red line indicates the high-share of seats scenario, and red-dot lines represent the 90 percent confidence interval. Left panel refers to the *Reform-IMF* dataset; right-panel refers to the *Reform-OECD* dataset. $t=0$ is the year of the shock.

Figure 13. The role of the share ideological orientation of governing parties



Note: The charts show the impulse response function of energy market reform to economic recession, based on equation (3), with “Ideological orientation of governing parties” as mediating variable. Blue line indicates to right-wing government scenario, and shaded area represents the 90 percent confidence interval; red line indicates the center-left-wing government scenario, and red-dot lines represent the 90 percent confidence interval. Left panel refers to the *Reform-IMF* dataset; right-panel refers to the *Reform-OECD* dataset. $t=0$ is the year of the shock.

TABLES

Table 1. The effect of crises on energy market reforms – Baseline

Panel A: IMF						
	K=0	K=1	K=2	K=3	K=4	K=5
$rec_{si,t}$	-0.0598*** (0.0157)	-0.0202** (0.0080)	-0.0422*** (0.0100)	-0.0485*** (0.0120)	-0.0449*** (0.0130)	-0.0598*** (0.0157)
$rec_{si,t-1}$	-0.0130* (0.0077)	-0.0205*** (0.0060)	-0.0115** (0.0053)	-0.0097* (0.0057)	-0.0269*** (0.0069)	-0.0130* (0.0077)
$rec_{si,t-2}$	0.0070 (0.0171)	-0.0084 (0.0078)	-0.0161 (0.0101)	-0.0243* (0.0128)	-0.0079 (0.0152)	0.0070 (0.0171)
$reform_IMF_{si,t-1}$	-0.2673*** (0.0178)	-0.0652*** (0.0084)	-0.1187*** (0.0135)	-0.1691*** (0.0160)	-0.2244*** (0.0171)	-0.2673*** (0.0178)
$reform_IMF_{si,t-2}$	-0.2707*** (0.0124)	-0.0867*** (0.0114)	-0.1331*** (0.0135)	-0.1862*** (0.0142)	-0.2293*** (0.0161)	-0.2707*** (0.0124)
Observations	10,948	12,372	12,016	11,660	11,304	10,948
R-squared	0.1898	0.0542	0.0861	0.1192	0.1555	0.1898

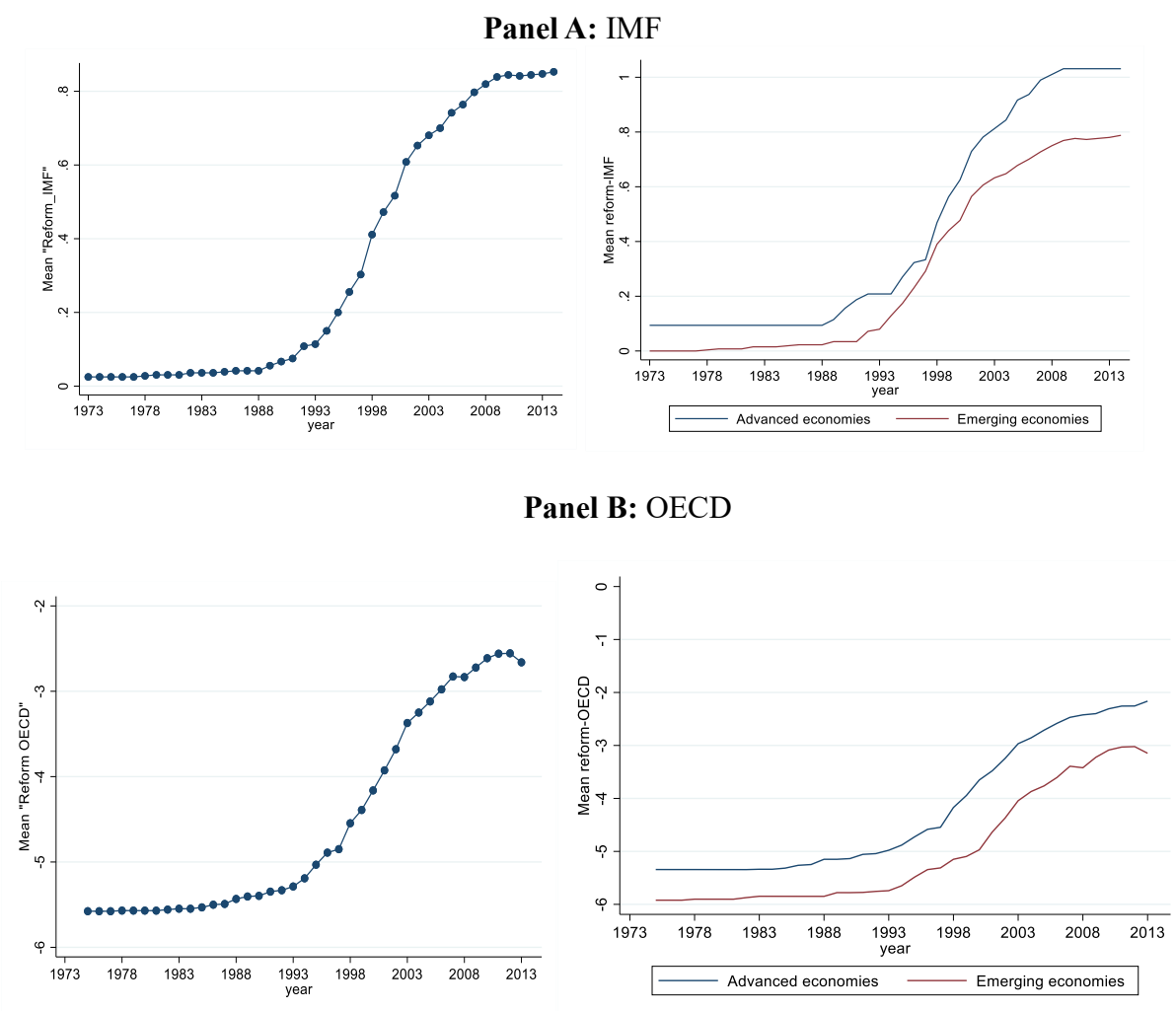
Note: Results are obtained by estimating equation (1). Standard errors in parentheses. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

Panel B: OECD						
	K=0	K=1	K=2	K=3	K=4	K=5
$rec_{si,t}$	-0.2008*** (0.0585)	-0.1105*** (0.0262)	-0.1557*** (0.0307)	-0.1314*** (0.0401)	-0.2064*** (0.0496)	-0.2008*** (0.0585)
$rec_{si,t-1}$	0.0321 (0.0280)	-0.0043 (0.0172)	0.0276 (0.0168)	-0.0503** (0.0209)	-0.0113 (0.0201)	0.0321 (0.0280)
$rec_{si,t-2}$	0.0030 (0.0647)	-0.0425 (0.0262)	-0.0994*** (0.0358)	-0.0564 (0.0478)	-0.0233 (0.0553)	0.0030 (0.0647)
$reform_OECD_{si,t-1}$	-0.2398*** (0.0344)	-0.0299* (0.0169)	-0.0841*** (0.0218)	-0.1015*** (0.0285)	-0.1605*** (0.0319)	-0.2398*** (0.0344)
$reform_OECD_{si,t-2}$	-0.2621*** (0.0267)	-0.0733*** (0.0173)	-0.0911*** (0.0255)	-0.1440*** (0.0268)	-0.2207*** (0.0294)	-0.2621*** (0.0267)
Observations	7,214	8,314	8,036	7,762	7,488	7,214
R-squared	0.2537	0.0798	0.1207	0.1628	0.2091	0.2537

Note: Results are obtained by estimating equation (1). Standard errors in parentheses.. *, **, *** denote statistical significance at 10, 5, and 1 percent, respectively.

APPENDIX

Figure A1: Evolution of Reforms – IMF & OECD indices



Note: The charts show the overtime evolution of the average structural market reforms index across countries.

Table A1: Country coverage of energy market reforms

Country name – IMF index		Country name - OECD index
United States	Vietnam	United States
United Kingdom	Algeria	United Kingdom
Austria	Cameroon	Austria
Belgium	Ethiopia	Belgium
Denmark	Ghana	Denmark
France	Cote d'Ivoire	France
Germany	Kenya	Germany
Italy	Madagascar	Italy
Netherlands	Morocco	Luxembourg
Norway	Mozambique	Netherlands
Sweden	Mozambique	Norway
Switzerland	Zimbabwe	Sweden
Canada	Senegal	Switzerland
Japan	Tanzania	Canada
Finland	Tunisia	Japan
Greece	Uganda	Finland
Ireland	Burkina Faso	Greece
Portugal	Azerbaijan	Iceland
Spain	Belarus	Ireland
Turkey	Albania	Malta
Australia	Georgia	Portugal
New Zealand	Kazakhstan	Spain
South Africa	Kyrgyz Republic	Turkey
Argentina	Bulgaria	Australia
Bolivia	Russia	New Zealand
Brazil	China	South Africa
Chile	Ukraine	Brazil
Colombia	Uzbekistan	Chile
Costa Rica	Czech Republic	Mexico
Dominican Republic	Estonia	Cyprus
Ecuador	Latvia	Israel
El Salvador	Hungary	India
Guatemala	Lithuania	Indonesia
Mexico	Poland	Korea
Nicaragua	Romania	Bulgaria
Paraguay		China
Peru		Czech Republic
Uruguay		Slovak Republic
Venezuela		Estonia
Jamaica		Latvia
Israel		Hungary
Jordan		Lithuania
Egypt		Croatia
Bangladesh		Slovenia
Sri Lanka		Poland
Hong Kong SAR, China		Romania
India		
Indonesia		
Korea		
Malaysia		
Nepal		
Pakistan		
Philippines		
Singapore		
Thailand		

Table A2: Descriptive Statistics**Panel A: IMF data**

Variable	Obs	Mean	Std. Dev.	Min	Max	Source
Reform IMF	15120	.335	.604	0	2	Alesina et al. (2023)
Recession (HP)	13712	.349	.476	0	1	OECD
Recession (negative growth)	13708	.142	.349	0	1	
ΔWUI	14112	.002	.129	-.959	.914	Ahir et al. (2022)
Share of votes	11060	60.309	19.199	1	100	DPI2020
Seat share	12468	.643	.215	0	1.125	DPI2020
Distance to elections	12000	1.967	1.454	0	7	DPI2020
Majoritarian (vs Proportional) (Maj=1)	10956	.29	.454	0	1	DPI2020
Center-Left vs Right (Right =1)	9308	.384	.486	0	1	DPI2020
Oil price	15120	36.804	30.276	3.29	111.67	BP Statistical Review of World Energy
Budget deficit	8876	-2.309	4.184	-32.066	30.453	OECD
Production of renewable energy	8352	-.068	2.261	-20.26	15.95	OECD
Financial stress	3520	.591	1.691	0	12	Romer and Romer (2017)
Change in climate policy	3456	.084	.228	-.84	1.34	OECD
Change in democracy	10880	2.086	7.369	-10	10	Polity2
Reform trade	9980	.707	.24	0	1	OECD
Reform PMR	3964	.224	.424	-1	1	OECD
Reform capital account	10552	.557	.378	0	1	OECD
Reform labor market	2884	1.811	1.271	.01	7.07	OECD
Pandemics	15210	.035	.185	0	1	Furceri et al. (2022)
Inflation	12768	30.37	291.093	-10.63	11749.64	World Bank
Expectation of future growth (OCT)	10196	.033	.034	-.205	.257	IMF

Panel B: OECD data

Variable	Obs	Mean	Std. Dev.	Min	Max	Source
Reform OECD	10257	-4.461	2.127	-6	0	Alesina et al. (2023)
Recession (HP)	9481	.309	.462	0	1	OECD
Recession (negative growth)	9481	.142	.349	0	1	
ΔWUI	9079	.001	.113	-.486	.455	Ahir et al. (2022)
Share of votes	9176	51.852	12.855	11.1	100	DPI2020
Seat share	9488	.58	.131	.112	1	DPI2020

Distance to elections	9536	1.797	1.352	0	7	DPI2020
Majoritarian (vs	9278	.131	.338	0	1	DPI2020
Proportional) (Maj=1)						
Center-Left vs Right	8843	.458	.498	0	1	DPI2020
(Right =1)						
Oil price	10257	38.271	30.228	11.53	111.67	BP
						Statistical
						Review of
						World
						Energy
Budget deficit	6930	-2.448	4.421	-32.066	18.633	OECD
Production of renewable	6257	.204	1.416	-11.24	7.63	OECD
energy						
Financial stress	6384	.642	1.767	0	12	Romer and
						Romer
						(2017)
Change in climate policy	6209	.095	.238	-.67	1.5	OECD
Change in democracy	6977	6.876	5.666	-8	10	Polity2
Reform trade	7084	.829	.159	0	1	OECD
Reform PMR	7203	.252	.438	-1	1	OECD
Reform capital account	6683	.731	.352	0	1	OECD
Reform labor market	5464	1.807	1.255	.01	7.07	OECD
Pandemics	10257	.045	.207	0	1	Furceri et al.
						(2022)
Inflation	9768	21.726	136.703	-4.478	2947.733	World Bank
Expectation of future	9239	.023	.026	-.151	.093	IMF
growth (OCT)						

Table A3: Electricity Market Indicators according to IMF’s Structural Reform Database

Index Score	0	1	2
Unbundling	A vertical integrated operator handles generation, transmission, and distribution	Otherwise (partial unbundling—e.g., Generation is unbundled from transmission but still transmission and distribution are integrated)	Generation, transmission, and distribution are completely unbundled
Regulation	Otherwise	A separate regulatory body, other than government has established; and the authority sets service tariffs and issues relevant licenses	N/A (i.e., no country is assigned score 2)
Wholesale	Otherwise	A liberalized wholesale market exists where generators compete to sell power to distributors or to large customers	N/A (i.e., no country is assigned score 2)
Ownership	State owned (private ownership less than 20%, no golden shares)	Partially owned by state	Privately owned (state ownership less than 20%, no golden shares)

Source: IMF’s Structural Reform Database: “Data Documentation of the Structural Reform Database” downloadable at <https://data.imf.org/?sk=8a361b05-ac3f-4cb2-be4a-f9a2b0cba124> (accessed in April 2024)

Table A4: Electricity Market Indicators according to OECD's PMR Database

	Topic weight a_i	Question weight b_j	Coding of data					
Entry regulation	1/4							
How are the terms and conditions of third-party access (TPA) to the electricity transmission grid determined?		1/3	regulated TPA 0		negotiated TPA 3		no TPA 6	
Is there a liberalised wholesale market for electricity (a wholesale pool)?		1/3		yes 0		no 6		
What is the minimum consumption threshold that consumers must exceed in order to be able to choose their electricity supplier?		1/3	no minimum consumption threshold 0	<=250 1	between 251 and 500 2	between 501 and 1000 3	>1000 4	no consumer choice 6
Public ownership	1/4							
What is the percentage of shares owned, either directly or indirectly, by the government in the largest firm in the sector? ¹		1	% of shares owned by government /100*6					
Vertical Integration	1/4							
What is the degree of vertical separation between a certain segment of the electricity sector and other segments of the industry? ¹		1	ownership separation 0	legal separation 3			accounting separation 4.5	no separation 6
Market structure	1/4							
What is the market share of the largest company in the electricity industry? ²		1	smaller than 50% 0		between 50 and 90% 3		greater than 90% 6	
Country scores (0-6)			$\sum_i a_i \sum_j b_j \text{answer}_{ij}$					

1.Simple average over 4 segments: generation/import, transmission, distribution and supply.

2.Simple average over 2 segments: generation/import and supply

Note: The original scoring system goes from 0 to 6 (from least to most restrictive policy). Source: Koske et al. (2015)

Table A5: Gas Market Indicators according to OECD's PMR Database

	Topic weight a_i	Question weight b_j	Coding of data
Entry regulation How are the terms and conditions of third party access (TPA) to the gas transmission grid determined? Do national, state or provincial laws or other regulations restrict the number of competitors allowed to operate a business in at least some markets in the sector? ¹ What percentage of the retail market is open to consumer choice?	1/4	1/3	regulated TPA 0 negotiated TPA 3 no TPA 6
Public ownership What percentage of shares in the largest firm in the gas sector are owned by government? ²	1/4	1/3	yes 0 no 6
Vertical Integration What is the degree of vertical separation between a certain segment of the gas sector and other segments of the industry? ²	1/4	1/3	(1-% of shares owned by government /100)*6
Market structure What is the market share of the largest company in the gas industry? ¹	1/4	1	% of shares owned by government /100*6
		1	ownership separation 0 legal separation 3 accounting separation 4.5 no separation 6
		1	smaller than 50% 0 between 50 and 90% 3 greater than 90% 6
Country scores (0-6)			$\sum_i a_i \sum_j b_j \text{answer}_{ij}$

1.Simple average over 4 segments: generation/import, transmission, distribution and supply.

2.Simple average over 2 segments: generation/import and supply.

Note: The original scoring system goes from 0 to 6 (from least to most restrictive policy). Source: Koske et al. (2015)