The transition to renewables: dampening the impact of fossil fuel price shocks on local inflation

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Overview

Fossil fuel prices are inherently volatile and prone to large shocks. Fossil fuel shocks tend to directly affect headline inflation by increasing its energy cost component, which incorporates the prices of energy-related items such as gasoline, natural gas, and electricity. The task of managing inflation, driven by escalating energy costs in economies heavily dependent on fossil fuels, is becoming increasingly challenging. This difficulty has been highlighted by the recent increase in market volatility for energy commodities. The coronavirus pandemic triggered a demand shock for fossil fuels, while the conflict between Russia and Ukraine caused a significant supply shock in natural gas. Ari et al. (2022) show that the recent surge in international fossil fuel prices raised the European average cost of living by close to 7% in 2022. However, Kilian and Zhou (2022) show that recent energy price shocks affect overall inflation in the United States mainly through the energy component of the consumer basket and have only modest effects on core inflation.

Given the economies' vulnerability to shocks from fossil fuel prices, transitioning to renewable, energy-efficient, and low-carbon technologies is emerging as a crucial strategy. This shift is not solely motivated by concerns over energy security and climate change but also by the need to enhance resilience against the recurrent shocks in international fossil fuel markets. Furthermore, reducing reliance on fossil fuels paves the way for diminishing fossil fuel subsidies, thereby expanding fiscal space in the long term.

This study contributes to the empirical literature by assessing the relevance of renewable electricity adoption in Latin America and the Caribbean (LAC) countries in reducing the impacts of fossil fuel price shocks on local headline inflation and energy inflation. By analyzing the positive effects of the energy transition on price stability from a historical perspective, this work emphasizes the positive externality of renewable energy investment and contributes to the literature investigating the broader economic impacts of transitioning to a low-carbon economy, particularly the impact of the energy transition on the transmission channels of hydrocarbon price volatility.

The LAC region has the highest share of renewables in its electricity matrix. Nevertheless, there are significant heterogeneities across countries and over time. This study seeks to exploit these heterogeneities to identify differences in the transmission effects of international energy prices to domestic prices.

Methods

Our identification strategy consists of a two-stage approach. In the first stage, we identify global fuel price shocks through a structural model of the global oil and natural gas markets. To identify global fossil fuel price shocks, we estimate a Structural Vector Autoregressive (SVAR) model based on monthly data for $Y_t = (\Delta prod_t, \Delta rea_t, \Delta price_t)'$, where $\Delta prod_t$ is the monthly log-difference in global fossil-fuel production, Δrea_t denotes the monthly log-difference index of real economic activity, and $\Delta price_t$ is the monthly log-difference of real price of fossil fuels. The sample period is 2003:1-2021:12 for both fossil fuels. For each fossil fuel price, we identify three types of shocks: fossil fuel supply, fossil fuel-specific demand, and aggregate demand shocks:

$$\boldsymbol{A_0 Y_t} = \boldsymbol{\alpha} + \sum_{i=1}^{24} \boldsymbol{A_i Y_{t-i}} + \boldsymbol{\varepsilon_t} \qquad \textbf{(1)}$$

where $\boldsymbol{\varepsilon_t}$ denotes the vector of serially and mutually uncorrelated structural innovations. We assume that $\boldsymbol{A_0^{-1}}$ has a recursive structure such that the reduced-form errors $\boldsymbol{e_t}$ can be decomposed according to $\boldsymbol{e_t} \equiv \boldsymbol{A_0^{-1}\varepsilon_t}$:

$$\boldsymbol{e_t} \equiv \begin{pmatrix} e_t^{\Delta prod} \\ e_t^{\Delta rea} \\ e_t^{\Delta price} \end{pmatrix} = \begin{bmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & 0 \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{pmatrix} \varepsilon_t^{fuel\ supply\ shock} \\ \varepsilon_t^{aggregate\ demand\ shock} \\ \varepsilon_t^{fossil\ fuel\ specific-demand\ shock} \end{pmatrix} \qquad \textbf{(2)}$$

In the second stage, we estimate the transmission of those shocks to local inflation conditioned by an electricity matrix with low or high penetration of renewable electricity using local projection methods for a panel data. We consider a panel of 18 LAC countries spanning from 2005:1-2021:12. This study aims to disentangle the effect of the two fossil fuel price shocks: oil and natural gas. We follow a nonlinear approach and use the local projection method to estimate the IRFs in a state-dependent model. Specifically, we estimate a smooth transition model using a logistic function as the transition between two different states: a low and a high renewable electricity matrix.

Results

Figure 1 shows the cumulative response of monthly headline inflation and energy inflation to a one standard deviation fossil fuel shock.

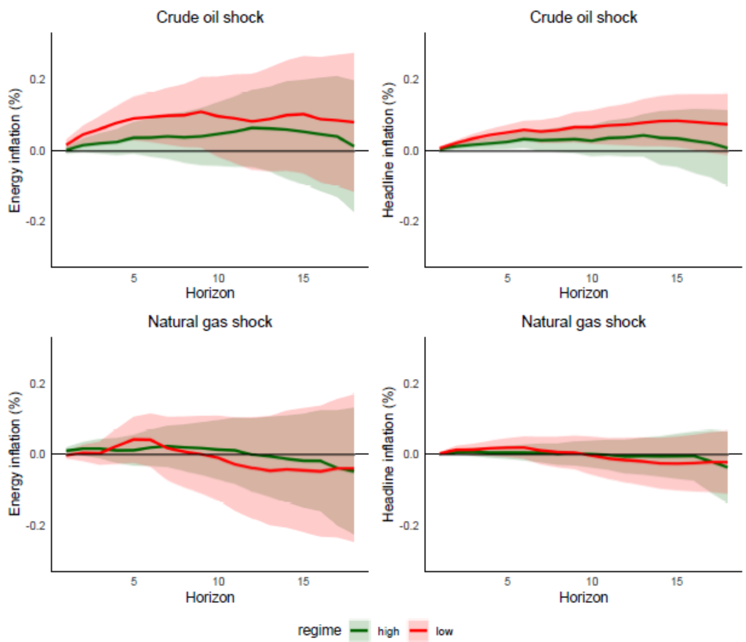

Figure 1: Cumulative response of inflation to structural crude oil and natural gas price shocks conditional on the degree of renewable electricity generation.

Notes: The first and second columns show the cumulative response of energy inflation and headline inflation, respectively. The colors distinguish the periods of renewable electricity generation: red for low and green for high generation. The figures show the cumulative effect on inflation of a one standard deviation shock. Shaded areas denote 90% confidence intervals.

Monthly inflation rates are sensitive to shocks in crude oil prices, whereas the impact of natural gas shocks is negligible. The persistence of oil shocks exceeds that of natural gas shocks, attributable to the substantial proportion of petroleum derivatives in the region's overall energy consumption. Oil and natural gas-specific demand shocks exert a less significant cumulative effect on headline inflation compared to energy inflation. Overall, results show that the electricity transition based on a higher share of renewable energies in each country's electricity generation had a clear dampening effect on the pass-through of international fossil fuel price shocks. For countries with a high share of renewable electricity generation, the impact is statistically negligible, underscoring the effectiveness of renewable energy adoption in enhancing economic resilience against global energy price fluctuations. Results are robust to different speeds of regime switching and a different definition of the transition.

Conclusions

The recent sustained increase and volatility in international oil and gas prices have raised fears of persistently high local inflation, along with concerns about the emergence of an energy price spiral. This study's principal finding underscores the positive externality of an energy transition, emphasizing the increased incorporation of renewable sources within national electricity portfolios in mitigating the repercussions of global fossil fuel price shocks. Such a transition towards renewables emerges as a pivotal mechanism for strengthening economies against energy price shocks in the forthcoming decades.

References

Ari, M. A., Arregui, M. N., Black, M. S., Celasun, O., Iakova, M. D. M., Mineshima, M. A., Mylonas, M. V., Parry, I. W., Teodoru, I., and Zhunussova, K. (2022). Surging energy prices in europe in the aftermath of the war: How to support the vulnerable and speed up the transition away from fossil fuels. Technical report, International Monetary Fund.

Kilian, L. and Zhou, X. (2022). The impact of rising oil prices on us inflation and inflation expectations in 2020–23. Energy Economics, 113:106228.