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The Distributional Implications of the Impact of Fuel Price Increases on Inflation

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Abstract

This paper investigates the response of consumer price inflation to changes in domestic fuel prices, looking at the different categories of the overall consumer price index (CPI). We then combine household survey data with the CPI components to construct a CPI index for the poorest and richest income quintiles with the view to assess the distributional impact of the pass-through. To undertake this analysis, the paper provides an update to the Global Monthly Retail Fuel Price Database, expanding the product coverage to premium and regular fuels, the time dimension to December 2020, and the sample to 190 countries. Three key findings stand out. First, the response of inflation to gasoline price shocks is smaller, but more persistent and broad-based in developing economies than in advanced economies. Second, we show that past studies using crude oil prices instead of retail fuel prices to estimate the pass-through to inflation significantly underestimate it. Third, while the purchasing power of all households declines as fuel prices increase, the distributional impact is progressive. But the progressivity phases out within 6 months after the shock in advanced economies, whereas it persists beyond a year in developing countries.

JEL Classification Numbers: E30, E31, H23

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I. INTRODUCTION

Understanding how and by how much changes in fuel prices affect consumer price inflation, and the differentiated impact on households, is critical for policy making, given their widespread economic and social consequences. The strong, though divergent, recovery amid the COVID-19 pandemic has been accompanied with inflationary pressures. While analysts perceived these inflationary pressures as largely transitory in advanced economies, reflecting pandemic-related supply-demand mismatches and a base-effect from a recovery in commodity prices; in emerging and developing countries, they are likely to persist owing to higher oil and food prices and exchange rate depreciation (see IMF, 2021). Crude oil prices which collapsed to less than $10 dollars a barrel in March 2020, rose above $80 dollars a barrel in October 2021, well above the pre-pandemic level. A further increase is likely against the backdrop of the global reopening and active supply management by oil producing countries. Should rising oil prices lead to intensified inflationary pressures, this could trigger an early tightening in global financial conditions with significant downside risks to the global post-COVID 19 recovery.

The climate change debate has also brought to the forefront the need to leverage carbon taxation to reduce greenhouse gas emissions, while providing much-needed revenue to boost green investment and technology and strengthen social safety nets. IMF (2021) estimates that a global carbon tax of around $75 per ton is needed to cut emissions to a level consistent with the objective of the Paris Agreement to limit the global temperature increase to below 2°C above preindustrial levels. However, current global average emissions price (estimated at only $3 per ton) significantly falls short of the target. Closing this gap requires a delicate balancing act. In this setting, the response of inflation to higher fuel prices and the distributional consequences have been a central concern for policy makers, particularly where concerns about the adverse effect of higher fuel prices on the most vulnerable have led to social unrests. Recent episodes suggested that even advanced economies are not immune of a such social protest.

The economic literature has consequently devoted a considerable attention to the pass-through of fuel prices to inflation, but gaps remain. First, while most of the existing studies focus on the effect of fuel prices on the overall consumer price index (CPI), more need to be done to investigate the goods and services that are the most sensitive to fuel price shocks. Food and transport prices are the usual suspects but estimates of the magnitude of the price response are scant and a systematic analysis of all components of the CPI is lacking.

Second, the differentiated price response across goods and services has important distributional consequences due to the varying shares of the goods and services whose prices are most sensitive to fuel price changes among households. While the distributional impact of fuel price shocks has been investigated using partial or general equilibrium models, the empirical estimations carried out in this paper represents a new approach.[2]

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[2] The partial and general equilibrium models estimate the distributional impact of fuel price changes subject to a set of theoretical assumptions, and allow to simulate reform policies, notably to balance fiscal considerations and social objectives. On the other hand, the empirical estimations take a backward-looking approach to gauge what the actual distributional impact was in retrospective.

Third, as underlined in Kpodar and Abdallah (2017, 2020), a shortcoming of many studies in the literature looking at the impact of fuel price shocks is to rely on crude oil prices, as data on domestic fuel prices are scarce, particularly at a high frequency. Since domestic fuel prices in many developing countries are regulated, changes in contemporaneous crude oil prices may be a poor proxy of domestic fuel price dynamic. For advanced economies, the rationale is that with fuel prices fully liberalized, using either crude oil prices or retail fuel prices should lead to similar results. But ignoring the other components of the retail fuel prices can lead to a significant bias. Indeed, refinery margins fluctuate; changes in taxes take place; weather-related events affect domestic fuel prices; and the structure and regulation of the petroleum market matter. As a result, variations in crude oil prices can fail to mimic that of the domestic fuel prices.

Against this backdrop, this paper assesses the response of consumer prices to changes in gasoline prices, looking at not only the overall consumer price index (CPI), but also the consumer price index for 12 categories of goods and services according to the Classification of Individual Consumption According to Purpose (COICOP). These categories include food, transport, housing and energy, beverages, clothing, communication, education, health, equipment, recreation, hotels and other goods and services.[3] The paper also differentiates between advanced and developing economies to tease out any heterogeneity across these income groups.

Households do not consume goods and services in the same proportion, consequently they are impacted differently depending on the response of the prices of their basket of consumption to fuel prices. It is well known that the poor devote a higher share of their spending to foods, making them highly vulnerable to fuel price shocks as food prices are quite sensitive to changes in fuel prices, mainly due to transport cost. Unfortunately, there is no systematic database on the CPI index for different household income groups. To tackle this shortcoming, we rely on multi-year household surveys for several countries to extract the shares of the 12 different categories of goods and services in household spending for the poorest quintile (the 20 percent poorest households) and for the richest quintile (the 20 percent richest households). We then reconstruct a CPI index for these two groups of households as the weighted average of the different components of the CPI, with the weights being the expenditure shares of the relevant category of goods and services. This allows us to estimate how the fuel price increases affect the cost of living of the rich and the poor, and how this varies across advanced and developing countries.

Data availability on domestic fuel prices is critical. This paper builds on the Global Monthly Retail Fuel Price Database by Kpodar and Abdallah (2017) and expands it along several dimensions. First, the paper extends the end period of the dataset from December 2014 to December 2020. Second, it expands the country coverage to 190 countries, up from 162 countries. Finally, it adds more product differentiation by compiling data on premium and regular gasoline and diesel prices, thus providing more granularity as opposed to the average prices of these products.

The findings confirm that, as expected, fuel price increases are associated with higher inflation, with the magnitude of the pass-through being smaller, but more persistent in developing

[3] For more information on the detailed composition of these different categories, see UN (2018).

countries than in advanced economies. This persistence ultimately results in a stronger impact of fuel price changes on consumer price levels in developing economies. Looking at the CPI components, predictably transport CPI stand out as the most sensitive to fuel prices in both advanced and developing economies. Nonetheless, we see a more broad-based pass-through in developing countries with 10 out of the 12 CPI components showing a positive and significant response to an increase in gasoline prices, against 7 out of the 12 CPI components in advanced economies. Comparing the estimates of the pass-through using crude oil prices to that of retail fuel prices for European Union countries reveals that using crude oil prices underestimates the pass-through by a large margin due to the pass-through of fuel taxes not being accounted for. Finally, gasoline price increases lead to a decline in the purchasing power of households regardless of their income group, but the impact is larger for the richest households than for the poorest households. However, this differential impact is short-lived in advanced economies (up to 6 months) in contrast to developing countries where it persists beyond a year.

The rest of the paper is organized as follows. Section II takes stock of the literature on the pass-through of fuel prices to inflation, followed by section III which summarizes the salient features of the updated Global Monthly Retail Fuel Price Database. Subsequently. Section IV discusses the CPI and household survey data, as well as the model and methodology of estimations. Section IV delves into the results, while section V concludes with a summary of the findings and the policy implications.

II. CHANNELS AND REVIEW OF THE LITERATURE

Higher fuel prices, all else equal, affect directly and indirectly inflation and hence the cost of living of households. Since households consume fuels for transport, lighting and cooking, the prices of which being included in the CPI index, any increase in fuel prices would mechanically translate to an increase in the overall CPI index. Where fuel prices are subject to market forces, the magnitude of this pass-through to inflation depends on the extent to which consumers can adjust to the new fuel price level, either by reducing their consumption or switching to alternative energy sources, although the likelihood of a significant dampening effect on the initial fuel price increases is small (see Shang (2021) for a comprehensive discussion on the channels).

The indirect effect of a fuel price increase feeds through the supply chain by affecting the price of goods and services for which fuel enters in the production. The extent to which the rise in production cost translates into higher consumer prices depends on producers' behaviors and product market structure. Some producers may choose to fully or partially absorb the higher production cost by reducing their margins, improving energy efficiency or opting for alternative energy sources. Others may fully pass the cost on to the consumer prices, in which case the impact of inflation would be larger than if they were to absorb part of the cost.

Market structure also plays a role. In a competitive market, some firms may be unable to pass on the cost to consumers if they stand to lose market shares. In contrast, monopolistic firms would have incentives to charge higher prices to consumers to maintain their profits. Another factor is the prevalence of government price regulation which weakens the transmission of fuel price increases to the prices of other goods and services. Further, one should expect consumers to adjust their consumption basket, which should dampen the overall inflation impact depending on the price elasticity of demand of different goods and services

Labor market effects and the monetary policy response should not be overlooked. An upward pressure on wages following an increase in fuel prices can amplify inflationary pressures, particularly where monetary policy is not credible enough to anchor inflation expectations. On the other hand, tighter monetary policy in response to the overall price increase would reduce aggregate demand and help contain inflation.

Much of the empirical literature finds that the pass-through from oil prices to headline inflation is present, but the effect is mild, transitory, and declining over time. Blanchard and Gali (2007) provide evidence that the effects of oil price shocks on inflation and activity was much stronger before the mid-1980s than thereafter, and attribute this to declining wage rigidities, higher credibility of monetary policy and the decrease in the share of oil in consumption and production.[4] De Gregorio, Landerretche, and Nielson (2007) reach similar conclusions with the estimated pass-through being 5 times stronger before 1980 than after (where a 10 percentage increase in oil prices leads to a 0.3 percentage point increase in inflation). The estimate from Choi et al. (2018) is also comparable, with the effect dying out within two years after the shocks.[5]

Unlike previous studies using crude oil price as the variable of interest, Kpodar and Abdallah (2020) exploit variations in domestic fuel prices for a large sample of developing and advanced economies, and test successfully the hypothesis that cross-country differences in the pass-through of fuel price changes are driven by country-specific factors such as energy intensity, labor market flexibility, and central bank credibility. This, in effect, extends the Blanchard and Gali's (2007) hypotheses to explain cross-country heterogeneity in the response of inflation to fuel price shocks. Gelos and Ustyugova (2017) also find that commodity price shocks (world food and fuel prices) have stronger effects on domestic inflation in developing countries than in advanced economies, with countries exhibiting certain structural characteristics being subject to larger spillovers.[6] Further, studies provide evidence of an asymmetry in the responses of inflation to fuel prices shocks as positive oil price shocks lead to larger effect on inflation than negative price shocks (Choi et al., 2018, and Kpodar and Abdallah, 2020).

A related, but parallel, literature investigates the distributional impact of fuel price increases using partial and general equilibrium models. Many of these studies provide evidence that fuel subsidies in developing countries are poorly targeted, and that fuel price increases are in general either neutral or progressive, although the impact on the poor is not negligible (Clements, Hong-Sang and Gupta (2003); Coady et al. (2006); Arze del Granado and Coady (2010); Kpodar and Djiofack (2010) and Soile and Mu, 2015). Dorband et al. (2019) reach similar conclusions when

[4] Another set of studies traces back the time-varying effect to the underlying sources of oil price changes (see Kilian (2009), Peersman and Van Robays (2012), and Baumeister and Peersman, 2013)

[5] There also several regional studies that show that inflation reacts to changes in fuel prices (see for instance for the Euro area: Álvarez et al. (2011) and Castro and Jiménez-Rodríguez (2017); and Caceres, Poplawski-Ribeiro and Tartari (2013) for Central African countries).

[6] These structural characteristics include among others the share of food and fuel in the CPI, past inflation history, central bank independence and the quality of governance.

assessing the incidence of a carbon tax on CO2 emissions from using fossil fuels, but noted that, in contrast to poorer countries, carbon pricing tends to be regressive in countries with higher income per capita (above USD 15,000 per year in 2011 PPP-adjusted terms), mainly reflecting energy consumption patterns. Studies underscore the importance of mitigating measures to soften the impact of a fuel subsidy removal on the poor, a key ingredient for reform acceptability and sustainability. Siddiq et al. (2014) find that in Nigeria a partial subsidy removal, accompanied by a targeted transfer to poor households can more than offset the initial decrease in income associated with the subsidy removal. Denis (2016) report similar findings for selected net oil importing economies.

Our study ties together two strands of the literature: the pass-through of fuel prices to inflation and the distributional impact of fuel prices. In comparison to the former, our paper takes a more granular approach by looking systematically at how fuel price changes affect the different components of the CPI index. This analysis is a critical step to understand the distributional impact of a rise in fuel prices. We take advantage of a consistent set of household survey data to extract household expenditure shares for each category of goods and service, which allows us to derive a CPI index for the poorest (the bottom 20 percent of households) and the richest quintile (the 20 percent richest households) for each country and over time. By estimating empirically, the pass-through of fuel price changes to the quintile specific inflation rates, our paper adds to the literature on distributional impact of fuel prices which so far has relied on partial and general equilibrium models.

III. The Global Monthly Retail Fuel Price Database: an update

The lack of availability of a consistent dataset on high frequency retail fuel prices, has often hindered empirical research on the macroeconomic impact of fuel price shocks. Studies tend to use crude oil prices, implicitly assuming that all countries are subject to the same price shocks with the same magnitude simultaneously. This approach neglects recurrent government interventions in many developing countries to delay the transmission of crude oil price shocks to their domestic economy or fully absorb these price shocks through their budget. It also ignores movements in fuel taxes, notably in advanced economies, which because of their high share in the price of the final fuel products, affect retail fuel price dynamics in a significant way. In this setting, what ultimately matters are not the movements in crude oil prices, but that of the retail fuel prices, which drive the economic decisions of firms and households.

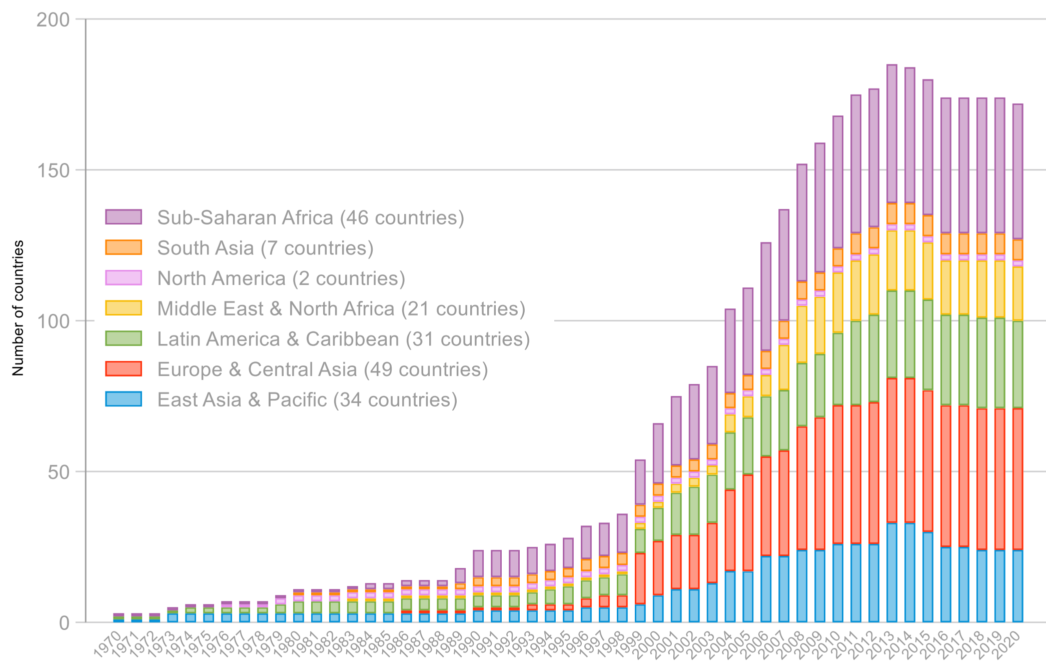
To address this shortcoming, Kpodar and Abdallah (2017) compile a novel monthly dataset of retail fuel prices (gasoline, diesel, kerosene, motor liquefied petroleum gas (LPG) and cooking LPG) in 162 countries over the period January 2000-December 2014.[7] Kpodar and Abdallah (2020) provide an update of the database by extending the time dimension through December 2016. In this paper, the dataset undergoes a major upgrade. The period of data availability now ranges from January 2000 to December 2020 for most countries (a few of them have historical data back to the 70s, see Figure 1). Twenty-eight additional countries have been added to the dataset, bringing the total sample from 190 countries (see Annex 1 for sample composition).

[7] For a discussion on the data sources and the methodology of compilation to construct the time series on retail prices and ensure comparability across countries, see Kpodar and Abdallah (2017).

Finally, the dataset now provides price data for premium and regular grades for gasoline and diesel. This differentiation can be important in cases where different fuel grades are subject to different pricing policies. Premium fuels supposedly consumed by richer households are typically taxed more heavily than regular fuels, and in some cases to cross-subsidize other fuel products.[8]

Overall, the dataset consists of more than 425,000 country-month-product observations. Data are in local currencies, but also converted in US dollars using the prevailing official exchange rates. Figure 2 shows the trends in retail gasoline prices (average of premium and regular gasoline prices) in different regions of the world. Not surprisingly, the highest gasoline prices are observed in Europe, while South Asia, Middle East and North Africa, and North America exhibit the lower prices. It is also interesting to see that there are regional differences in the response of retail gasoline prices to the sharp drop in crude oil prices amid the COVID-19 pandemic, with consumers in Europe, North and South America, and South Asia having benefited from the sharpest drop in gasoline prices in Q1 2020.

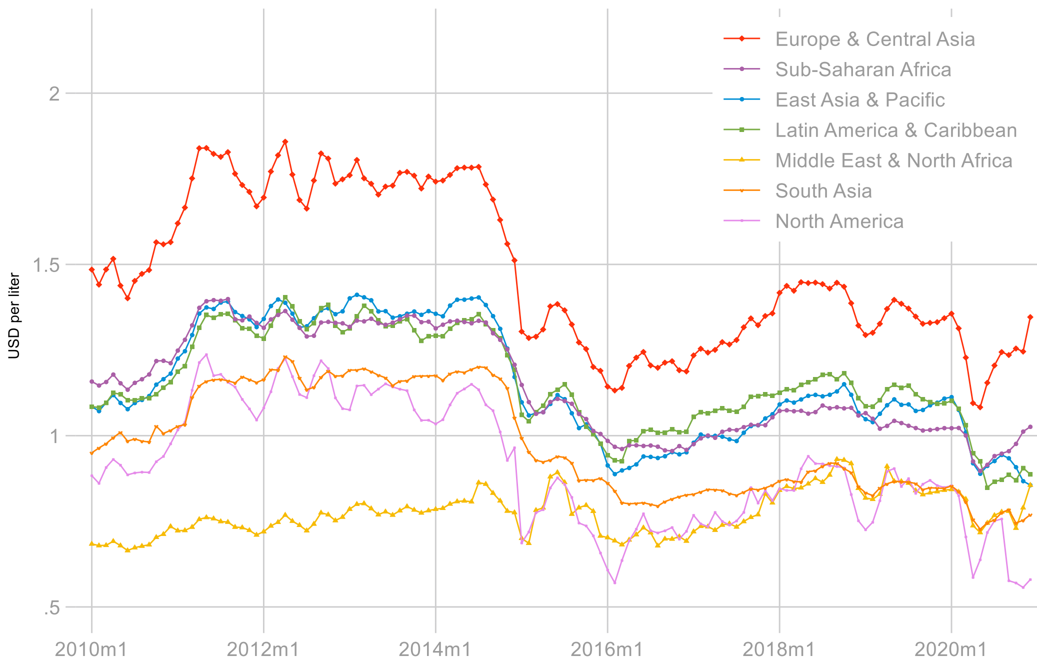
Figure 1. Fuel Price Data Availability by Region over Time, 1970-2020
(Number of Countries)



Source: The Global Monthly Retail Fuel Price Database, 2021

[8] As the focus on this paper is not on fuel pricing, this granularity will not be relevant here. But researchers may find it useful to assess how the difference in prices across grades of the same fuel product distorts fuel consumption patterns.

Figure 2. Average Gasoline Price by Region over Time, Jan 2010–Dec 2020
(USD per liter)



Source: The Global Monthly Retail Fuel Price Database, 2021

IV. THE EMPIRICAL APPROACH

A. The data

The data on monthly retail fuel prices are taken from the dataset described above, while the data on monthly CPI and its 12 components are provided by the International Monetary Fund Macroeconomic and Financial Database, supplemented by data from national authorities. The CPI components are based on the COICOP classification, which categorizes goods and services consumed by households in the following sub-groups: food, transport, housing and energy, beverages, clothing, communication, education, health, equipment, recreation, hotels and other goods and services. The overall CPI is the weighted average of its components, with the weights being the average share of each component in total household expenditure. By combining the fuel price and inflation data, we obtained for the regressions a sample of 122 countries (of which 48 advanced/high-income economies and 74 developing economies) with data during the period January 2000 to June 2019 (see Annex 2 for the sample composition).

While the weights are representative of consumption basket of the average household, they do vary substantially across income groups. For instance, poor households devote a larger share of their expenditures to food products than richer households. To assess whether the pass-through of changes in fuel prices to inflation has distributional implications, we need to calculate the CPI index for the different income groups, as the weighted of the CPI components. But this time, the weights are the average share of the relevant components in the total expenditure of households in the given income groups.

The challenge lies in the lack of a centralized database on the share of the CPI components in household expenditure for different income groups for a large sample of countries.[9] To overcome this, we take advantage of the harmonized household survey databases made available by the World Bank. For each country, we group households by income quintiles, and calculate the average share of each category of goods and services in total expenditure, adjusted by the household survey weights to ensure that the figures are representative at the national level (see Annex 3 for the list of household surveys).[10] As over the medium term, changes in household consumption patterns are likely to be minor, the expenditure shares from each household survey are applied to the CPI components over a 15-year window (4 years before the survey year and 10 year afterwards),[11] unless data are available from another household survey during that period. The monthly CPI index is then calculated for each quintile in 84 countries in the sample during January 2000—June 2019 and based on the availability of the household survey data.[12]

Annex Figure 1 shows the average household expenditure share across quintiles and CPI components. It depicts significant heterogeneities across quintiles, CPI components and country income groups. Predictably, food products dominate the household's consumption basket in developing economies, with the share reaching 55 percent for the poorest quintile compared to 33 percent for the richest quintile. In advancing economies, housings account for the highest share in total household expenditure, followed by food products and transport services. As expected, the food consumption share declines with household income in all country income groups, whereas spending shares for transport, hospitality and recreation services increase with household income.

To come up with a simple metric to assess the distributional impact of fuel price changes, we use the ratio of the CPI index of the richest quintile to the CPI index of the poorest quintile. If this ratio is positively associated with fuel price changes, one can conclude that fuel price increases are progressive; otherwise they are regressive or neutral.

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[9] With the exception of European countries for which data are available on a 5 year-period basis during 2005-2015 (see the dataset on final consumption expenditure of households by consumption purpose compiled by Eurostat)

[10] We also thank Olivier Dupriez for providing the quintile expenditure shares for several countries.

[11] Using a 10-year window centered at the year of the survey does not materially affect the findings, but reduces the data sample.

[12] Note that overall, we had household survey data available for 110 countries. But, ensuring cross-country comparability of the quintile CPI requires to have available data on the expenditure shares for the 12 CPI components, and the CPI indexes for the 12 components. A minimum threshold of 80 percent was set, meaning that the quintile CPIs are only computed if data are available for a least 80 percent of goods and services of the household consumption basket. This requirement brought down the sample to 84 countries.

B. The model and methodology

A standard approach to estimate the response of inflation to changes in retail fuel prices is to rely on a conventional Vector Autoregressive models (VARs), which allows to impose sufficient identifying restrictions to derive the impulse responses functions (IRFs). Nevertheless, if the VAR specification turns out to be non-representative of the data generating process, this can lead a bias in the estimation of and inference from the IRFs. A more flexible approach that has gained popularity in the recent years is the local projection method developed by Jorda (2005).[13] The local projection approach basically consists in generating multi-step predictions using direct forecasting models that are re-estimated for each forecast horizon. Jordà (2005) argues that the local projections are robust to misspecification of the lag structure as the impulse responses can be defined without any reference to the unknown data generating process. To reduce potential bias in the estimations of the IRFs, Teulings and Zubanov (2014) proposes to augment the local projections with innovations in the regressors between periods t and t+h when estimating the impulse response at horizon h.

The following model is estimated, taking gasoline as a representative fuel product:

$$\Delta Ln(CPI)_{it+h} = \sum_{q=1}^{p} \gamma_{1q} \Delta Ln(CPI)_{it-q} + \sum_{q=1}^{p} \gamma_{2q} \Delta Ln(RFP)_{it-q} + \partial_h \Delta Ln(RFP)_{it} + \sum_{l=1}^{h} \gamma_{3l} \Delta Ln(RFP_{it+h-l}) + \gamma_4 \tau + u_i + \varepsilon_{it+h} \quad \text{for h=0,…, H} \qquad (1)$$

where CPI is the monthly consumer price index, RFP is the average retail gasoline price denominated in local currency, τ is a time dummy, u_i denotes country specific effects, and ε_{it+h} is the error term clustered at the country-level. The fourth term in Eq (1) accounts for the correction factor proposed by Teulings and Zubanov (2014).

The coefficient ∂_h represents the pass-through of gasoline prices to the consumer price at the horizon *h*, following a gasoline price shock at period *t*. Equation (1) is estimated sequentially by OLS for each horizon *h* up to a maximum horizon *H*=11 (12 months). The same model will be used to estimate the response of inflation to gasoline prices and the distributional impact with a slight modification on the dependent variable.

V. Empirical results

A. Pass-through of gasoline prices to consumer price inflation

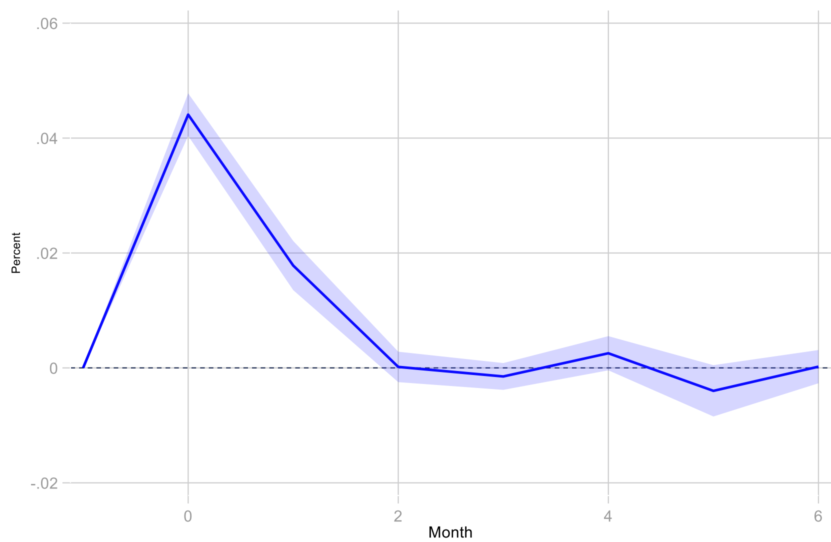
Before investigating the distributional implications of the impact of fuel price increases on inflation, a critical step is to carry out an in-depth analysis of magnitude of the response of inflation to fuel price increases, and which categories of goods and services are the most affected.

Figure 3 shows the response of CPI inflation to the changes in gasoline prices in advanced economies. The finding suggests that a one percentage point increase in the retail gasoline price leads to a 0.04 percentage point increase in consumer price inflation at peak level. The pass-

[13] Studies that have adopted this method include Auerbach and Gorodnichenko (2013); Jordà et al. (2013); Caselli and Roitman (2016); Kpodar and Abdallah (2017, 2020); Ramey and Zubairy (2018); and Alesina et al. (2019).

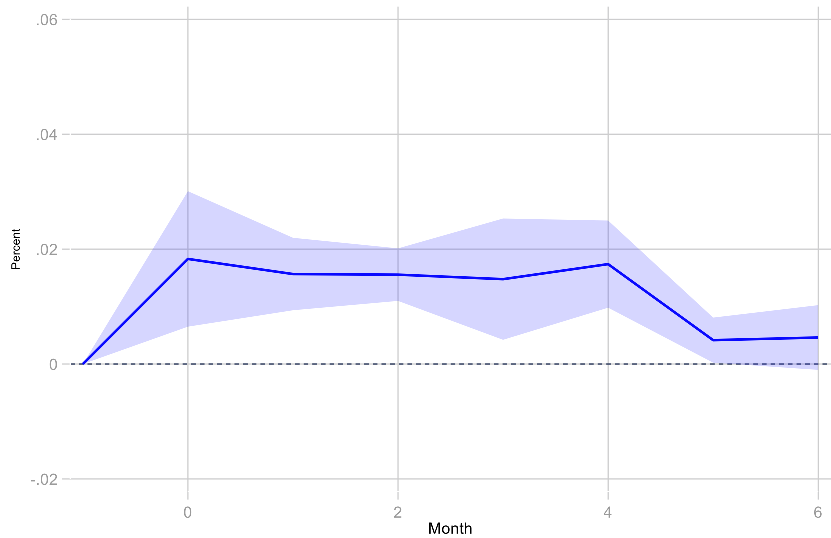
through dies out within 2 months after the gasoline price shock, significantly less persistent than the five to six months found for developing economies (Figure 4). Further, the peak pass-through in advanced economies is double that of developing economies, where a one percentage point increase in gasoline prices is estimated to push consumer prices up by a 0.02 percentage point (Annex Table 1 and 2 show the underlying regressions for Figure 3 and 4, respectively). But, in fact the cumulative impact on the CPI level is larger in developing countries as the persistence of the pass-through more than offsets the lower peak pass-through. The results are quantitively comparable even after controlling for: (i) the policy rate of the central bank to account for a change in the monetary policy stance in response to higher inflation, and (ii) exchange rate movements and international food prices to control for imported inflation (see Annex Figure 2 and 3). Higher energy intensity and lower substitution effects may explain the larger impact of gasoline price increases on inflation in developing countries, while the persistence of this impact could be driven by price and labor market rigidities as well as weak monetary policy credibility.

Figure 3. Impulse Response Function of Consumer Price Inflation to Gasoline Price Changes in Advanced Economies



Source: Authors' calculations.
Notes: Shaded area represents the 90 percent confidence interval.

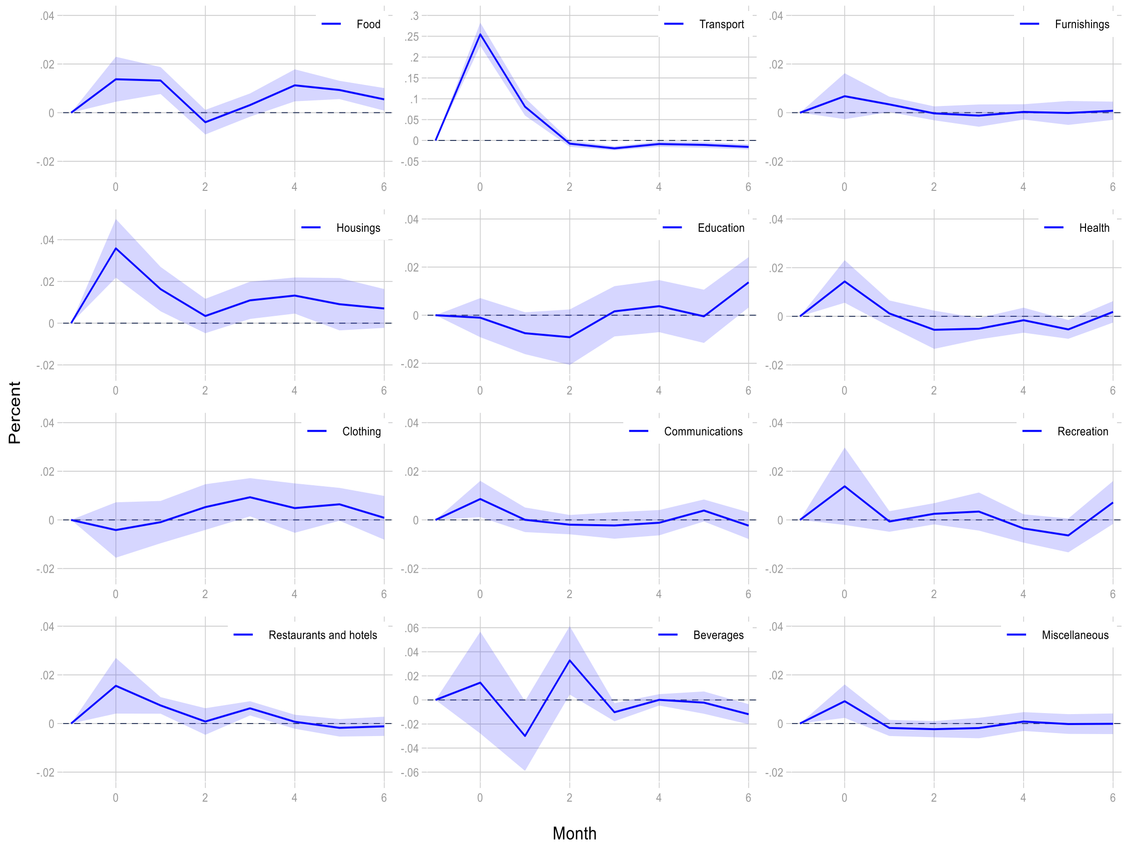
Figure 4. Impulse Response Function of Consumer Price Inflation to Gasoline Price Changes in Developing Economies



Source: Authors' calculations.
Notes: Shaded area represents the 90 percent confidence interval.

Looking at the disaggregated CPI, the response is heterogenous across goods and services (Figure 4 and 5). The transport CPI has the strongest response in both advanced and developing countries, although the magnitude is larger in the former group possibly due to the transport costs being more likely to be regulated in developing economies. The second largest response comes from housing and utilities CPI, with a similar magnitude in advanced and developing countries. Part of this response is attributed to the direct effect of the gasoline price shock as this component captures fuel price changes in the CPI. Food prices also react in a similar manner to gasoline price shock in advanced and developing economies, although the pass-through is more persistent in the latter group. Much of the overall impact on inflation results from transport, housing and utilities, and food prices as these three categories account for a combined 60 percent of household expenditure in advanced economies, and 70 percent in developing economies. It is also worth noting that 10 out of the 12 CPI components show a positive and significant response to an increase in gasoline prices in developing countries, against 7 out of the 12 CPI components in advanced economies. This suggests that the inflationary impact of fuel price shocks is much broad-based in developing economies than in advanced economies.

Figure 5. Advanced Economies: Impulse Response Functions of Consumer Price Inflation to Gasoline Price Changes, by CPI Components



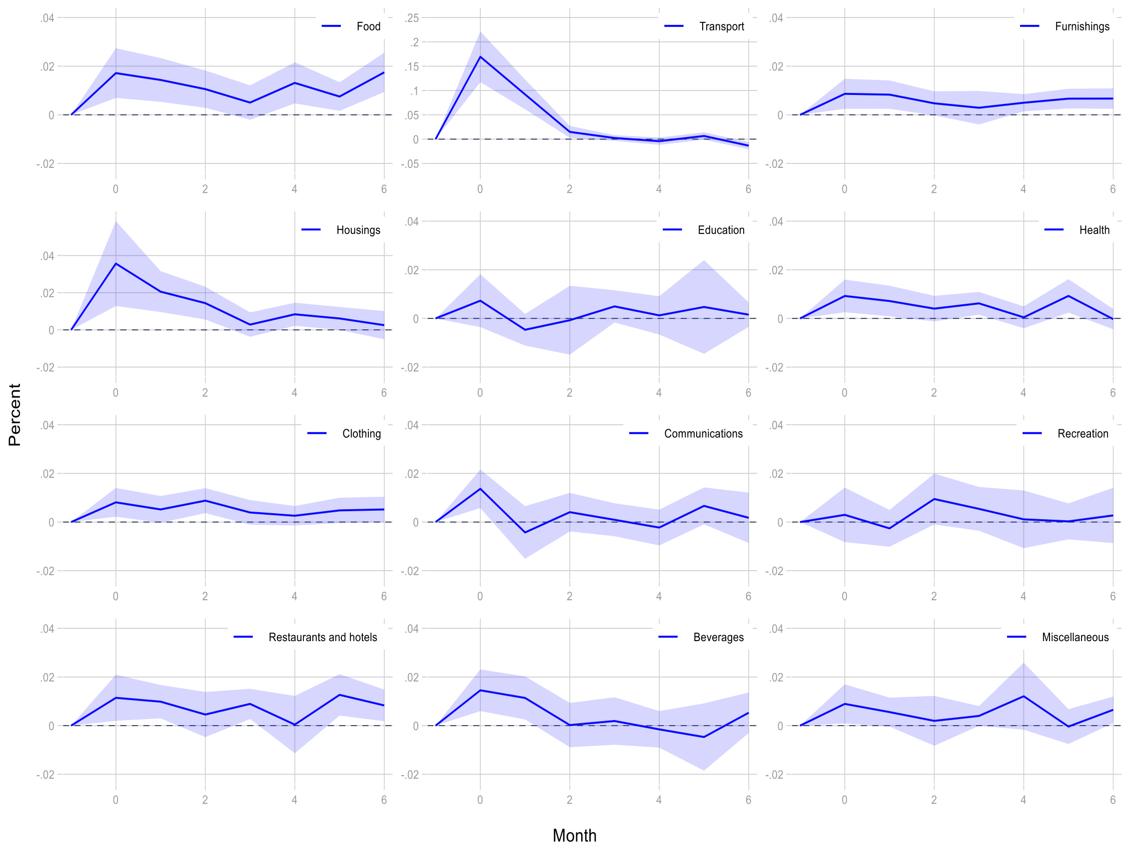
Source: Authors' calculations.
Notes: Shaded area represents the 90 percent confidence interval.

B. Crude oil prices vs retail gasoline prices: how does the pass-through compare?

In this section, the paper makes the case for why it focuses the analysis on retail gasoline prices, as opposed to crude oil prices, and demonstrates the usefulness of the Global Monthly Retail Fuel Price Database for economic research.

It is common in the literature that studies looking at the pass-through of oil prices to inflation focus on crude oil prices instead of retail fuel prices (see for instance Cuñado and Pérez de Gracia, 2003; Gregorio, Landerretche, and Nielson, 2007; Blanchard and Galí, 2007; Cologni and Manera, 2008; Chen, 2009; Choi et al., 2018; Hammoudeh, Shawkat and Reboredo, 2018). But consumers do not consume crude oil, but instead consume refined fuel products, whose prices are multiple time that of crude oil. Likewise, refined fuel products enter in the production of goods and services, and not crude oil, except for the oil refinery sector.

Figure 6. Developing Economies: Impulse Response Functions of Consumer Price Inflation to Gasoline Price Changes, by CPI Components



Source: Authors' calculations.
Notes: Shaded area represents the 90 percent confidence interval.

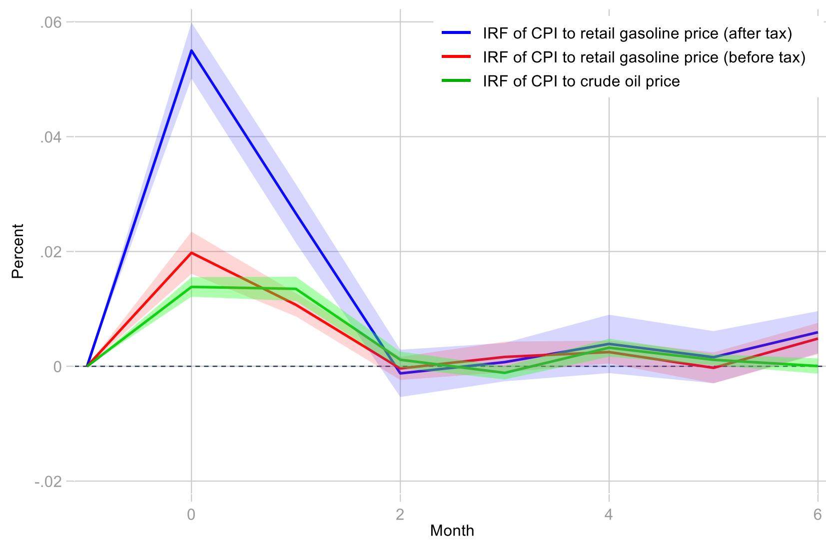
While it might be sensible to assume a co-movement between crude oil prices and retail fuel prices where fuel prices are liberalized, the relationship is not one to one considering that factors such as margins (refinery, storage, distribution) and government taxes add to crude oil prices. Overlooking the idiosyncratic changes in these factors can lead to a significant bias in the pass-through, particularly as government taxes make up a large component of retail fuel prices in advanced economies. For instance, in the European Union (EU), fuel taxes account on average for about 60 percent of retail gasoline prices in June 2021, compared to less than 20 percent in the US. Moreover, the level of these taxes vary with crude oil prices as fuel prices are subject to ad valorem taxes.

To illustrate the magnitude of the bias, we estimate the Impulse Response Functions (IRFs) of inflation with respect of changes in crude oil prices, retail fuel gasoline price after taxes and retail gasoline price before taxes for EU countries.[14] Figure 7 shows that using crude oil prices

[14] The analysis was done on EU countries because the data on pre- and post-tax gasoline prices are readily available.

significantly understates the pass-through of fuel prices to inflation. A 1 percentage point increase in crude oil prices is associated with a 0.015 percentage point increase in the consumer price inflation at the peak level, compared to 0.055 percentage point increase for a similar increase in the after-tax retail gasoline prices. Using the before-tax retail gasoline price, the pass-through at peak level stands at 0.02 percentage point, close to that of crude oil prices.[15] This suggests that the underestimation of the pass-through from using crude oil prices is almost entirely explained by not accounting for fuel tax dynamics. To address a concern that a one percentage point change in the after-tax gasoline price may not be comparable to a one percentage point change in the before-tax gasoline price, the impulse response function is rerun with the standardized variables (rescaled to have a mean of zero and a standard deviation of one). The finding remains unchanged, even though the magnitude of the underestimation is smaller (see Annex Figure 4).

Figure 7. Impulse Response Function of Consumer Price Inflation to Crude Oil Prices, and Changes in Gasoline Prices Before and After Tax



Source: Authors' calculations.
Notes: Shaded area represents the 90 percent confidence interval. The sample consists of European Union countries.

C. The distributional impact

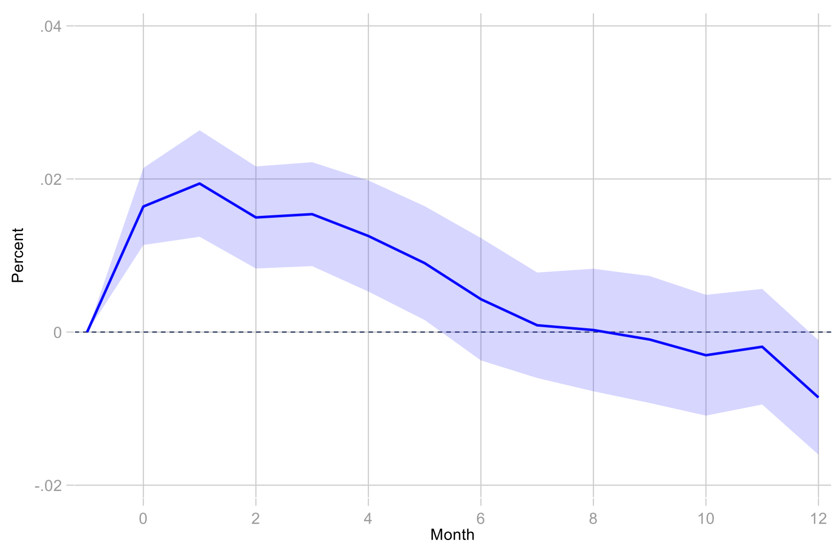
To come up with a simple metric to assess the distributional impact of gasoline price shocks, we use the ratio of the CPI of the richest quintile to that of the poorest quintile. A positive and significant response of this ratio to gasoline price shocks denotes a progressive impact, as the CPI for the poorest households would increase less than that of the richest households. This, nevertheless, does not rule out a significant adverse impact on the poor. Conversely, a negative and significant coefficient would signal a regressive impact of gasoline price shocks.

[15] The regression using the before-tax retail gasoline price includes gasoline taxes as a control variable.

We estimate the model presented in section IV.B by replacing the change in CPI with the ratio of the ratio of the CPI of the richest quintile to that of the poorest quintile as the dependent variable. Figure 8 show the IRFs for advanced economies. A 1 percent increase in gasoline prices raises the CPI of the richest households by about 0.02 percentage point more than the CPI of the poorest households in the first two months, then the marginal impact declines over time to zero from the 6th month, at which point there is no differential impact on the CPI of the two income groups. The larger impact on the richest households could be attributable to a higher expenditure shares on transport, combined with the strong response of transport price to changes in gasoline prices.[16]

For developing countries, we also find a similar larger impact on the CPI of the richest households (Figure 9), but the differential impact only declines slightly, and persists in the positive territory for more than 12 months. In addition to higher transport cost and transport expenditure share, housings and food products are also a contributing factor. For instance, the richest households in developing countries devote on average a third of their expenditure to food products (this compares to 55 percent for the poorest quintile in developing economies and 20 percent for the poorest quintile in advanced economies). The persistence of the impact likely reflects labor market rigidities and weaker monetary policy credibility, which are more prevalent in developing economies than in advanced economies.

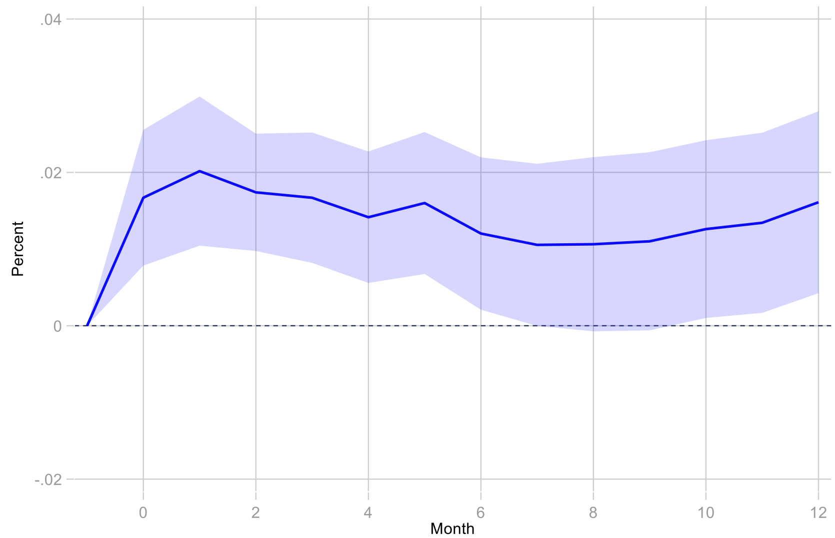
Figure 8. Advanced Economies: Impulse Response Functions of the Ratio of the Richest Quintile CPI to the Poorest Quintile CPI with respect to Gasoline Price Changes



Source: Authors' calculations.
Notes: Shaded area represents the 90 percent confidence interval.

[16] The poorest households in advanced economies spend more on foods and housings, but the price response for those expenditure items is relatively modest compared to the response of transport cost.

Figure 9. Developing Economies: Impulse Response Functions of the Ratio of the Richest Quintile CPI to the Poorest Quintile CPI with respect to Gasoline Price Changes

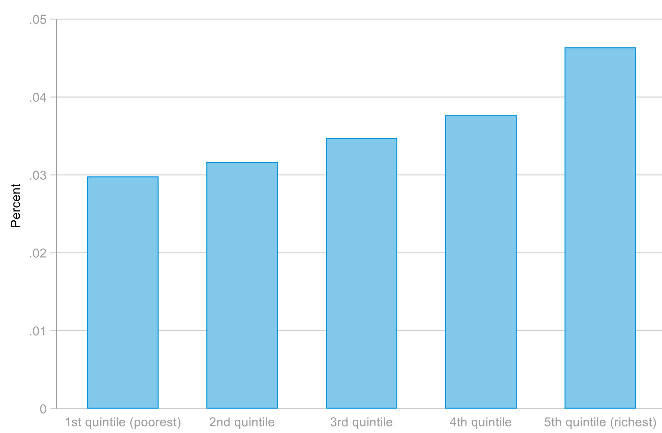


Source: Authors' calculations.
Notes: Shaded area represents the 90 percent confidence interval.

These findings suggest that a fuel subsidy reform or raising carbon taxation to an appropriate level is a progressive policy in both advanced and developing countries. To ensure that the results are robust across the sample, we re-estimate the IRFs for selected regions. The results broadly confirm previous findings, although the progressivity is stronger in Asia and Latin America than in Sub-Saharan Africa (see Annex Figure 5)

It is also interesting to look at the entire distribution of the pass-through across household quintiles. To do so, we run the IRFs separately for the consumer price inflation of each quintile using the sample of developing countries. As shown in Figure 10, the peak pass-through of gasoline price shocks to inflation increases with household income.

Figure 10. Developing Economies: Response of the Quintile-Specific CPI to Gasoline Price Changes at Peak Pass-Through



Source: Authors' calculations.

VI. CONCLUSION

In this paper, we study the propagation of gasoline price shocks to inflation and uncover different dynamics in developing and advanced economies. First, the paper tackles data shortcoming on retail fuel prices by compiling an update of the Global Monthly Retail Fuel Price Database.

It then estimates the impulse response of the consumer price inflation to a change in gasoline price using local projections. The findings suggest that the peak pass-through in advanced economies is double that in developing economies, but the transmission of the gasoline price shocks is more protracted in the latter group. This ultimately leads to a higher consumer price level for the average developing economy, likely reflecting higher energy intensity and lower substitution effects, while the persistence of the inflation shock could be driven by price and labor market rigidities as well as weak monetary policy credibility. The paper also provides evidence that using crude oil prices, as opposed to retail fuel prices, underestimates the true magnitude of the pass-through, as shown for EU countries. Fuel taxes are the main contributing factor, and therefore should not be ignored as in some previous studies.

By zooming in on the different components of the CPI, we find that the pass-through is more broad based in developing countries with 10 out the 12 CPI components reacting positively to gasoline price shocks compared to 7 out of the 12 CPI components for advanced economies. Much of the overall impact on inflation stem from transport, housing and utilities, and food prices as not only do these categories account for a large share of household expenditure in both advanced and developing economies, their prices are also the most sensitive to a gasoline price shock, particularly the transport sector. To conduct the distributional analysis, the paper combines household survey data with CPI data to construct quintile specific CPI for a large sample of countries. While the distributional impact of a gasoline price shock is typically progressive in both developing and advanced economies, the progressivity phases out within 6 months after the shock in advanced economies, whereas it persists beyond a year in developing countries.

The policy implications are straightforward. Policy decisions aiming to increase fuel prices, notably in response to pollution and environmental concerns, should also factor in the knock-on effect on inflation which has important distributional implications. Concurrent policy actions to improve energy efficiency (e.g. through technological innovations), and boosting availability of affordable and cleaner energy sources, could help mitigate the inflationary impact of higher fuel prices. Further, improving labor market flexibility, strengthening monetary policy credibility as well as limiting price controls could reduce the risk of a protracted pass-through of fuel prices to inflation, and inflation expectations becoming de-anchored to the upside. The progressivity of the distributional impact reinforces calls for streamlining fuel subsides as they benefit the richest households more than the poorest ones. Nevertheless, as the purchasing power of the poorest households also dips with fuel price increases, targeted mitigating measures could alleviate this impact. While targeting takes time and efforts to implement, it is achievable. The COVID-19 pandemic has demonstrated that many countries, including in the developing world, were able to put in place effective social safety net mechanisms to protect the most vulnerable from the health and economic fallout of the pandemic.

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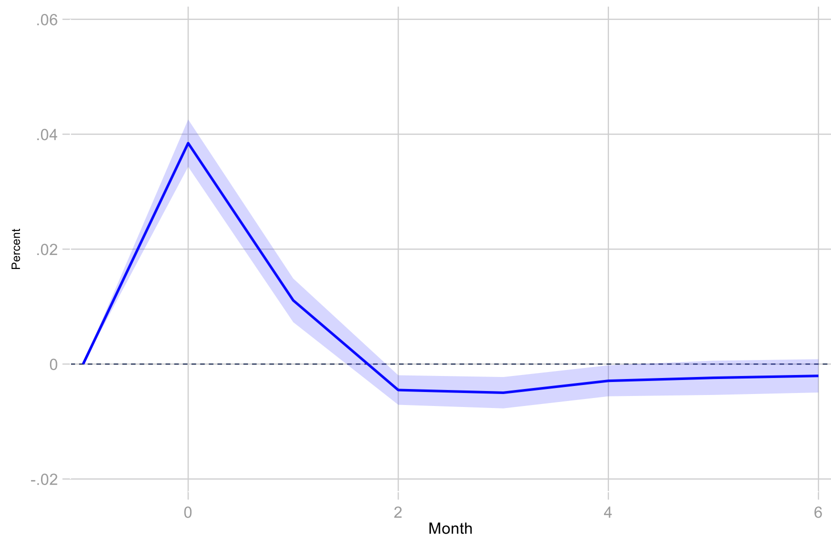
Annex Figure 1. Average Household Expenditure Share by Quintiles and CPI Components
(percent)

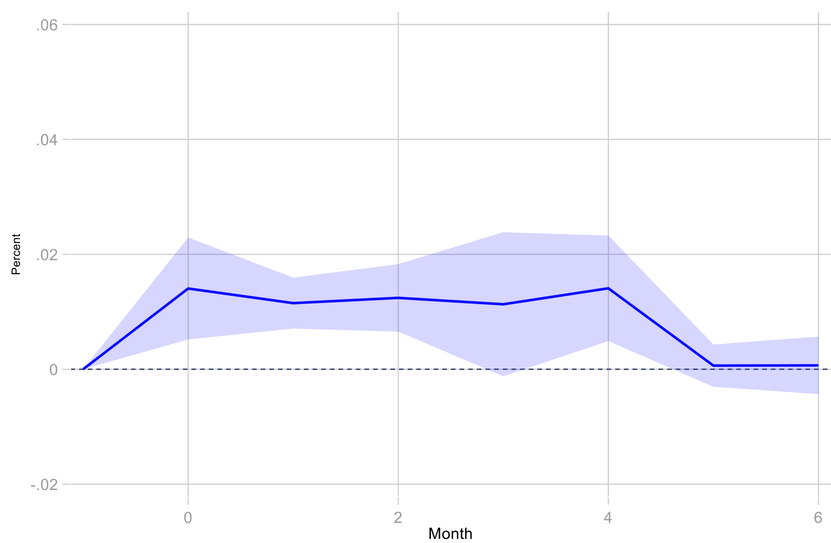
Sources: OECD, World Bank and Authors' calculations
Notes: Data from the latest household survey available (see Annex 3).

Annex Figure 2. Impulse Response Function of Consumer Price Inflation to Gasoline Price Changes in Advanced Economies – Additional Controls



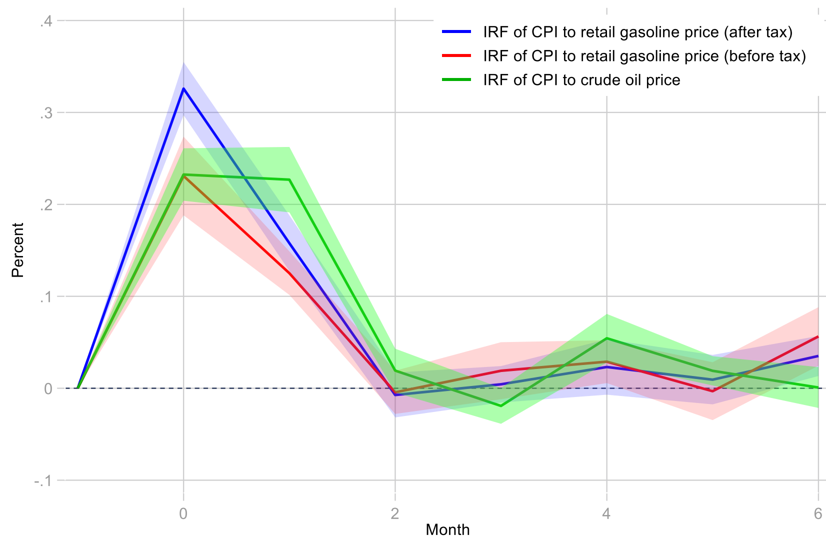
Source: Authors' calculations.
Notes: Additional controls include exchange rate, monetary policy rate and international food prices. Shaded area represents the 90 percent confidence interval.

Annex Figure 3. Impulse Response Function of Consumer Price Inflation to Gasoline Price Changes in Developing Economies – Additional Controls



Source: Authors' calculations.
Notes: Additional controls include exchange rate, monetary policy rate and international food prices. Shaded area represents the 90 percent confidence interval.

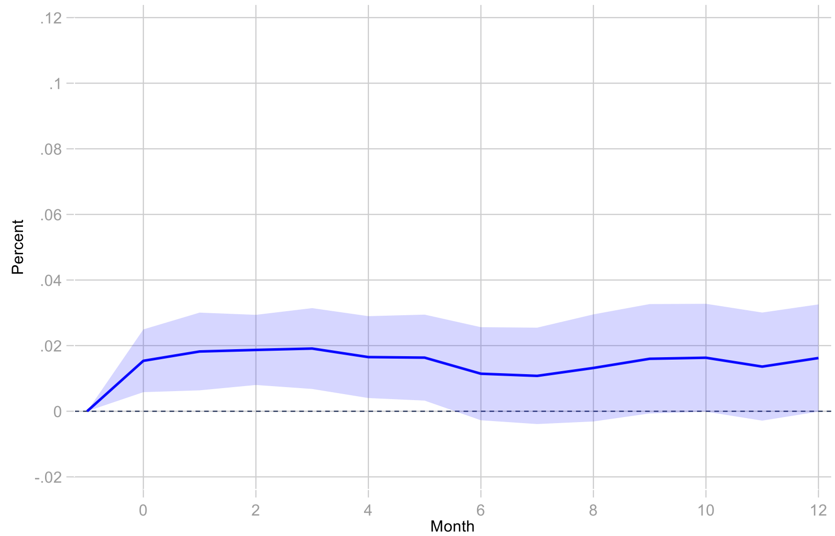
Annex Figure 4. Impulse Response Function of Consumer Price Inflation to Changes in Crude Oil Prices, Gasoline Prices Before and After Tax – Standardized variables



Source: Authors' calculations.
Notes: To estimate the impulse response function, the change in CPI, crude oil prices, and gasoline prices before and after tax have been rescaled to have a mean of zero and a standard deviation of one. Shaded area represents the 90 percent confidence interval. The sample consists of European Union countries.

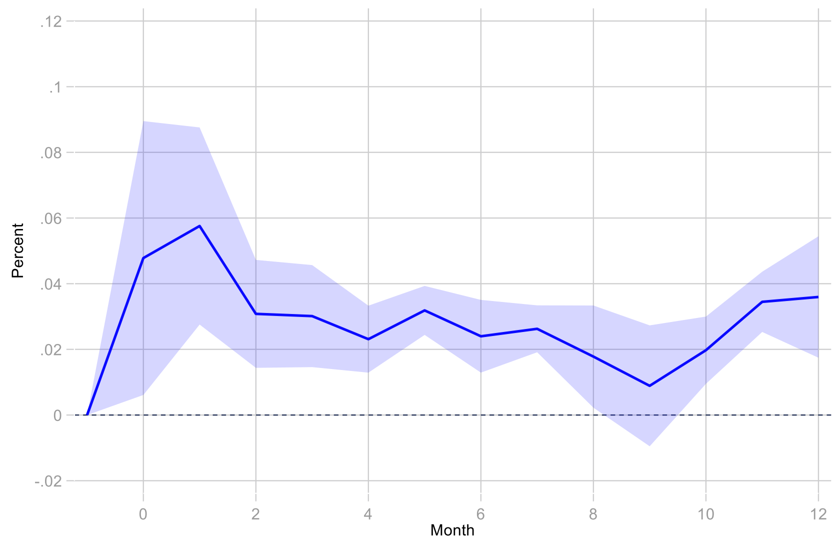
Annex Figure 5. Selected Developing Regions: Impulse Response Functions of the ratio of the Richest Quintile CPI to the Poorest Quintile CPI with respect to Gasoline Price Changes

Sub-Saharan Africa (32 countries)



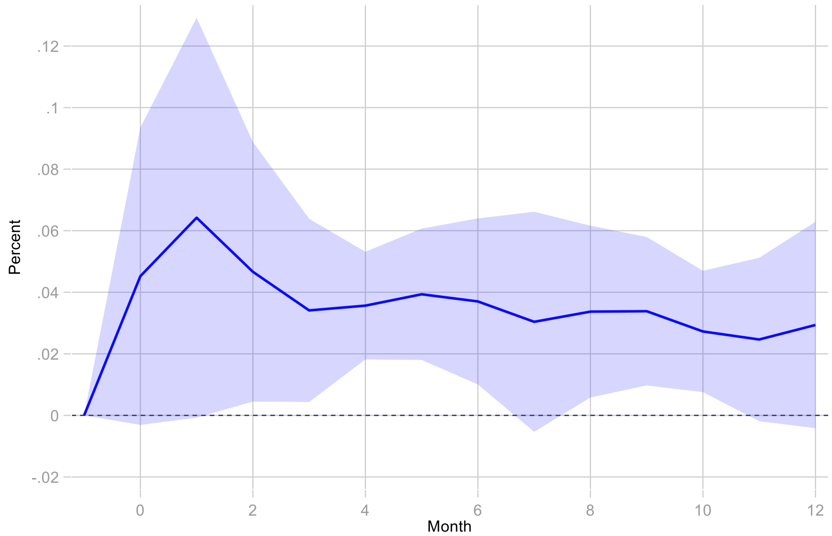
Source: Authors' calculations.
Notes: Shaded area represents the 90 percent confidence interval.

South and East Asia, and Pacific (6 countries)



Source: Authors' calculations.
Notes: Shaded area represents the 90 percent confidence interval.

Latin America (4 countries)



Source: Authors' calculations.
Notes: Shaded area represents the 90 percent confidence interval.

Annex 1. The Global Monthly Retail Fuel Price Database (2021): Country Sample[18]

Europe & Central Asia	East Asia & Pacific	Latin America & Caribbean	Sub-Saharan Africa
Andorra	American Samoa	Argentina	Angola
Armenia	Australia	Aruba	Benin
Austria	Brunei	Barbados	Botswana
Azerbaijan	Cambodia	Belize	Burkina Faso
Belarus	China	Bolivia	Burundi
Belgium	Fiji	Brazil	Cabo Verde
Bosnia and Herzegovina	French Polynesia	British Virgin Islands	Cameroon
Bulgaria	Hong Kong SAR, China	Chile	Central African Republic
Croatia	Indonesia	Colombia	Chad
Cyprus	Japan	Costa Rica	Comoros
Czech Republic	Kiribati	Cuba	Congo, Dem. Rep.
Denmark	Korea, Rep.	Curacao	Congo, Rep.
Estonia	Lao PDR	Dominican Republic	Cote d'Ivoire
Finland	Macao SAR, China	Ecuador	Equatorial Guinea
France	Malaysia	El Salvador	Eswatini
Georgia	Marshall Islands	Grenada	Ethiopia
Germany	Mongolia	Guatemala	Gabon
Greece	Myanmar	Haiti	Gambia, The
Hungary	Nauru	Honduras	Ghana
Iceland	New Caledonia	Jamaica	Guinea
Ireland	New Zealand	Mexico	Guinea-Bissau
Isle of Man	Palau	Nicaragua	Kenya
Italy	Papua New Guinea	Panama	Lesotho
Kazakhstan	Philippines	Paraguay	Liberia
Kyrgyz Republic	Samoa	Peru	Madagascar
Latvia	Singapore	Puerto Rico	Malawi
Lithuania	Solomon Islands	Sint Maarten (Dutch part)	Mali
Luxembourg	Taiwan, China	St. Lucia	Mauritania
Moldova	Thailand	Trinidad and Tobago	Mauritius
Netherlands	Timor-Leste	Uruguay	Mozambique
North Macedonia	Tonga	Venezuela, RB	Namibia
Norway	Tuvalu		Niger
Poland	Vanuatu	**Middle East & North Africa**	Nigeria
Portugal	Vietnam	Algeria	Rwanda
Romania		Bahrain	Sao Tome and Principe
Russian Federation	**South Asia**	Djibouti	Senegal
San Marino	Afghanistan	Egypt, Arab Rep.	Seychelles
Serbia	Bangladesh	Iran, Islamic Rep.	Sierra Leone
Slovak Republic	India	Iraq	Somalia
Slovenia	Maldives	Israel	SouthAfrica
Spain	Nepal	Jordan	Sudan
Sweden	Pakistan	Kuwait	Tanzania
Switzerland	Sri Lanka	Lebanon	Togo
Tajikistan		Libya	Uganda
Turkey	**North America**	Malta	Zambia
Turkmenistan	Canada	Morocco	Zimbabwe
Ukraine	United States	Oman	
United Kingdom		Qatar	
Uzbekistan		Saudi Arabia	
		Syria	
		Tunisia	
		United Arab Emirates	
		West Bank and Gaza	
		Yemen, Rep.	

[18] Includes countries and territories.

Annex 2. Country Sample for the IRFs of Consumer Price Inflation to Gasoline Price Changes[19]

Advanced/High-income economies	Developing economies	
Aruba	Azerbaijan	Lao PDR
Austria	Bangladesh	Liberia
Barbados	Belarus	Malawi
Belgium	Benin	Malaysia
Brunei	Bolivia	Maldives
Canada	Bosnia and Herzegovina	Mauritania
Chile	Botswana	Mauritius
Curacao	Brazil	Mexico
Cyprus	Burkina Faso	Moldova
Czech Republic	Burundi	Mongolia
Denmark	Cabo Verde	Mozambique
Estonia	Cameroon	Myanmar
Finland	Chad	Nicaragua
France	China	Niger
Germany	Colombia	Nigeria
Greece	Comoros	Paraguay
Hong Kong SAR, China	Congo, Dem. Rep.	Philippines
Hungary	Costa Rica	Romania
Iceland	Cote d'Ivoire	Russian Federation
Ireland	Djibouti	Rwanda
Israel	Dominican Republic	Samoa
Italy	Egypt, Arab Rep.	Sao Tome and Principe
Japan	El Salvador	Senegal
Korea, Rep.	Equatorial Guinea	South Africa
Kuwait	Ethiopia	Sri Lanka
Latvia	Gambia, The	St. Lucia
Lithuania	Georgia	Tanzania
Luxembourg	Ghana	Thailand
Macao SAR, China	Grenada	Timor-Leste
Netherlands	Guatemala	Togo
New Caledonia	Guinea	Tonga
Norway	Haiti	Tunisia
Oman	India	Turkey
Poland	Jamaica	Uganda
Portugal	Kazakhstan	Venezuela, RB
Qatar	Kenya	Vietnam
San Marino	Kiribati	Yemen, Rep.
Saudi Arabia		
Singapore		
Slovak Republic		
Slovenia		
Spain		
Sweden		
Switzerland		
Trinidad and Tobago		
United Arab Emirates		
United Kingdom		
United States		

[19] Includes countries and territories.

Annex 3. Household Expenditure Share Data by Quintiles: Survey Years

Countries	Source	Survey years	Countries	Source	Survey years
Afghanistan	World Bank	2007	Latvia	Eurostat	1999, 2005, 2010, 2015
Angola	World Bank	2009	Lesotho	World Bank	2002
Armenia	World Bank	2013	Liberia	World Bank	2007, 2014
Austria	Eurostat	1999, 2005, 2010, 2015,	Lithuania	Eurostat	1999, 2005, 2010, 2015
Azerbaijan	World Bank	2008	Luxembourg	Eurostat	1999, 2005, 2010, 2015
Bangladesh	World Bank	2016, 2019	Madagascar	World Bank	2010
Belarus	World Bank	2010	Malawi	World Bank	2010, 2016, 2019
Belgium	Eurostat	1999, 2005, 2010, 2015	Maldives	World Bank	2009
Benin	World Bank	2011	Mali	World Bank	2006
Bolivia	World Bank	2007	Malta	Eurostat	1999, 2005, 2010, 2015
Bosnia and Herzego	World Bank	2007	Mauritania	World Bank	2004, 2008
Botswana	World Bank	2009	Mauritius	World Bank	2006
Bulgaria	Eurostat	1999, 2005, 2010, 2015	Mexico	World Bank	2012
Burkina Faso	World Bank	2010, 2014	Moldova	World Bank	2009
Burundi	World Bank	2013	Mongolia	World Bank	2012
Cabo Verde	World Bank	2007	Morocco	World Bank	2006
Cambodia	World Bank	2012	Mozambique	World Bank	2008
Cameroon	World Bank	2007, 2014	Namibia	World Bank	2009
Colombia	World Bank	2010	Nepal	World Bank	2010
Comoros	World Bank	2004	Netherlands	Eurostat	1999, 2005, 2010, 2015
Congo, Dem. Rep.	World Bank	2012	Nicaragua	World Bank	2005
Congo, Rep.	World Bank	2005	Niger	World Bank	2007, 2011
Cote d'Ivoire	World Bank	2008, 2015	Nigeria	World Bank	2012
Croatia	Eurostat	1999, 2005, 2010, 2015	North Macedonia	World Bank	2008
Cyprus	Eurostat	1999, 2005, 2010, 2015	Norway	Eurostat	1999, 2005, 2010, 2015
Czech Republic	Eurostat	1999, 2005, 2010, 2015	Pakistan	World Bank	2013
Denmark	Eurostat	1999, 2005, 2010, 2015	Panama	World Bank	2008
El Salvador	World Bank	2010	Paraguay	World Bank	2000
Estonia	Eurostat	1999, 2005, 2010, 2015	Peru	World Bank	2010
Eswatini	World Bank	2009	Philippines	World Bank	2012
Ethiopia	World Bank	2004, 2010	Poland	Eurostat/World Bank	1999, 2005, 2010, 2012, 2015
Fiji	World Bank	2008	Portugal	Eurostat	1999, 2005, 2010, 2015
Finland	Eurostat	1999, 2005, 2010, 2015	Romania	Eurostat/World Bank	1999, 2005, 2010, 2013, 2015
France	Eurostat	1999, 2005, 2010, 2015	Rwanda	World Bank	2010, 2013
Gabon	World Bank	2005	Sao Tome and Principe	World Bank	2010
Gambia, The	World Bank	2010	Senegal	World Bank	2005, 2011
Georgia	World Bank	2013	Serbia	Eurostat	1999, 2005, 2010, 2015,
Germany	Eurostat	1999, 2005, 2010, 2015	Sierra Leone	World Bank	2003
Ghana	World Bank	2005, 2012	Slovak Republic	Eurostat	1999, 2005, 2010, 2015,
Greece	Eurostat	1999, 2005, 2010, 2015	Slovenia	Eurostat	1999, 2005, 2010, 2015,
Guatemala	World Bank	2006	South Africa	World Bank	2011, 2014
Guinea	World Bank	2012	Spain	Eurostat	1999, 2005, 2010, 2015
Haiti	World Bank	2012	Sri Lanka	World Bank	2012
Honduras	World Bank	2004	Sweden	Eurostat	1999, 2005, 2010, 2015
Hungary	Eurostat	1999, 2005, 2010, 2015	Tajikistan	World Bank	2009
India	World Bank	2011	Tanzania	World Bank	2011
Indonesia	World Bank	2012	Thailand	World Bank	2010
Iraq	World Bank	2012	Timor-Leste	World Bank	2010
Ireland	Eurostat	1999, 2005, 2010, 2015	Togo	World Bank	2011
Italy	Eurostat	1999, 2005, 2010, 2015	Turkey	Eurostat/World Bank	1999, 2005, 2010, 2012, 2015
Jamaica	World Bank	2007	Uganda	World Bank	2010, 2012
Kazakhstan	World Bank	2011	Ukraine	World Bank	2013
Kenya	World Bank	2005	United Kingdom	Eurostat	1999, 2005, 2010, 2015
Kyrgyz Republic	World Bank	2010	Vietnam	World Bank	2012
Lao PDR	World Bank	2007	Zambia	World Bank	2010, 2015

Annex Table 1. Impact of Gasoline Price Changes on Inflation in Advanced Economies

Variables \ Horizons		h=0	h=1	h=2	h=3	h=4	h=5	h=6
CPI change	Lag 1	0.054	0.010	-0.010	-0.017	-0.007	0.151	-0.035
		[0.028]*	[0.021]	[0.019]	[0.017]	[0.016]	[0.035]***	[0.019]*
	Lag 2	0.002	-0.011	-0.017	-0.011	0.151	-0.043	-0.062
		[0.018]	[0.018]	[0.016]	[0.016]	[0.036]***	[0.018]**	[0.018]***
	Lag 3	-0.004	-0.010	-0.005	0.156	-0.042	-0.068	-0.030
		[0.017]	[0.016]	[0.015]	[0.035]***	[0.017]**	[0.017]***	[0.011]***
	Lag 4	-0.008	-0.002	0.159	-0.041	-0.065	-0.032	-0.065
		[0.016]	[0.015]	[0.035]***	[0.017]**	[0.018]***	[0.011]***	[0.016]***
	Lag 5	0.006	0.163	-0.034	-0.063	-0.030	-0.067	-0.024
		[0.016]	[0.036]***	[0.017]*	[0.017]***	[0.011]***	[0.016]***	[0.017]
	Lag 6	0.170	-0.030	-0.060	-0.032	-0.064	-0.028	0.484
		[0.037]***	[0.016]*	[0.017]***	[0.011]***	[0.016]***	[0.018]	[0.054]***
	Lag 7	-0.052	-0.082	-0.052	-0.078	-0.035	0.474	-0.047
		[0.017]***	[0.017]***	[0.012]***	[0.014]***	[0.016]**	[0.049]***	[0.014]***
	Lag 8	-0.058	-0.050	-0.078	-0.030	0.473	-0.039	-0.058
		[0.016]***	[0.012]***	[0.013]***	[0.018]	[0.049]***	[0.013]***	[0.015]***
	Lag 9	-0.031	-0.076	-0.029	0.473	-0.038	-0.050	-0.065
		[0.013]**	[0.013]***	[0.018]	[0.049]***	[0.013]***	[0.014]***	[0.011]***
	Lag 10	-0.064	-0.028	0.474	-0.038	-0.050	-0.061	-0.056
		[0.014]***	[0.018]	[0.049]***	[0.014]***	[0.015]***	[0.012]***	[0.011]***
	Lag 11	-0.020	0.477	-0.037	-0.051	-0.060	-0.049	-0.031
		[0.017]	[0.049]***	[0.014]**	[0.014]***	[0.012]***	[0.013]***	[0.016]*
	Lag 12	0.481	-0.043	-0.056	-0.066	-0.053	-0.029	0.118
		[0.050]***	[0.013]***	[0.014]***	[0.012]***	[0.013]***	[0.016]*	[0.034]***
Gasoline price change		0.044	0.018	0.000	-0.001	0.003	-0.004	0.000
		[0.002]***	[0.003]***	[0.002]	[0.001]	[0.002]	[0.003]	[0.002]
	Lag 1	0.005	0.000	-0.001	0.003	-0.004	-0.006	0.002
		[0.002]**	[0.002]	[0.002]	[0.002]	[0.003]	[0.002]***	[0.002]
	Lag 2	0.003	-0.001	0.003	-0.004	-0.006	0.001	0.007
		[0.002]	[0.002]	[0.002]	[0.003]	[0.002]***	[0.001]	[0.002]***
	Lag 3	0.002	0.003	-0.004	-0.007	0.001	0.006	0.003
		[0.002]	[0.002]	[0.003]	[0.002]***	[0.001]	[0.002]***	[0.001]**
	Lag 4	0.005	-0.004	-0.007	0.002	0.006	0.003	0.008
		[0.002]**	[0.003]	[0.002]***	[0.001]	[0.002]***	[0.001]**	[0.002]***
	Lag 5	-0.001	-0.006	0.002	0.007	0.003	0.007	0.003
		[0.003]	[0.002]***	[0.001]	[0.002]***	[0.001]**	[0.002]***	[0.003]
	Lag 6	-0.002	0.002	0.007	0.003	0.007	0.003	-0.016
		[0.002]	[0.001]	[0.002]***	[0.001]**	[0.002]***	[0.002]	[0.003]***
	Lag 7	0.005	0.008	0.004	0.009	0.004	-0.016	0.002
		[0.001]***	[0.002]***	[0.001]***	[0.002]***	[0.002]	[0.003]***	[0.002]
	Lag 8	0.011	0.004	0.009	0.005	-0.016	0.001	0.003
		[0.002]***	[0.001]***	[0.002]***	[0.002]*	[0.003]***	[0.002]	[0.001]*
	Lag 9	0.004	0.009	0.005	-0.016	0.001	0.001	0.004
		[0.001]***	[0.002]***	[0.002]**	[0.003]***	[0.002]	[0.001]	[0.001]***
	Lag 10	0.007	0.005	-0.016	0.001	0.001	0.004	-0.003
		[0.002]***	[0.002]**	[0.003]***	[0.002]	[0.001]	[0.001]**	[0.001]*
	Lag 11	0.000	-0.016	0.002	0.002	0.004	-0.004	-0.001
		[0.002]	[0.003]***	[0.002]	[0.001]	[0.001]***	[0.001]**	[0.002]
	Lag 12	-0.016	0.001	0.002	0.002	-0.004	-0.001	-0.006
		[0.002]***	[0.002]	[0.001]	[0.001]*	[0.001]***	[0.002]	[0.002]***
	Lead 1			0.018	0.000	-0.002	0.002	-0.002
				[0.003]***	[0.002]	[0.001]	[0.002]	[0.002]
	Lead 2				0.018	0.000	-0.002	0.002
					[0.003]***	[0.002]	[0.001]	[0.002]
	Lead 3					0.018	0.000	-0.002
						[0.003]***	[0.002]	[0.001]
	Lead 4						0.018	0.001
							[0.003]***	[0.002]
	Lead 5							0.018
								[0.003]***
Trend		0.000	0.000	0.000	0.000	0.000	0.000	0.000
		[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Constant		0.001	0.002	0.002	0.002	0.002	0.002	0.002
		[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Observations		8,368	8,320	8,272	8,224	8,176	8,128	8,080
Number of countries		48	48	48	48	48	48	48
Adjusted R2		0.43	0.34	0.34	0.35	0.35	0.35	0.35

Notes. Fixed effect estimations. Robust standard errors in brackets. *,**,*** denote significance at 10 percent, 5 percent and 1 percent, respectively. The shaded line represents the coefficients of the impulse response function shown in Figure 3.

Annex Table 2. Impact of Gasoline Price Changes on Inflation in Developing Economies

Variables \ Horizons		h=0	h=1	h=2	h=3	h=4	h=5	h=6
CPI change	Lag 1	0.317	0.147	0.091	0.006	-0.014	0.055	-0.013
		[0.054]***	[0.039]***	[0.039]**	[0.038]	[0.038]	[0.048]	[0.042]
	Lag 2	0.043	0.039	-0.033	-0.027	0.053	-0.032	-0.005
		[0.023]*	[0.028]	[0.026]	[0.035]	[0.043]	[0.032]	[0.025]
	Lag 3	0.022	-0.037	-0.026	0.057	-0.030	-0.009	-0.026
		[0.026]	[0.026]	[0.035]	[0.047]	[0.032]	[0.025]	[0.022]
	Lag 4	-0.047	-0.029	0.055	-0.030	-0.007	-0.025	-0.010
		[0.022]**	[0.034]	[0.046]	[0.033]	[0.025]	[0.020]	[0.018]
	Lag 5	-0.015	0.059	-0.028	-0.014	-0.026	-0.008	0.090
		[0.030]	[0.046]	[0.036]	[0.025]	[0.020]	[0.018]	[0.019]***
	Lag 6	0.060	-0.021	-0.010	-0.023	-0.006	0.094	0.235
		[0.039]	[0.032]	[0.024]	[0.020]	[0.019]	[0.020]***	[0.062]***
	Lag 7	-0.040	-0.018	-0.026	-0.003	0.095	0.233	0.068
		[0.023]*	[0.025]	[0.020]	[0.022]	[0.020]***	[0.063]***	[0.023]***
	Lag 8	-0.009	-0.007	0.029	0.128	0.239	0.068	-0.018
		[0.027]	[0.024]	[0.035]	[0.037]***	[0.065]***	[0.023]***	[0.025]
	Lag 9	-0.011	0.002	0.059	0.154	0.052	-0.007	-0.014
		[0.014]	[0.018]	[0.029]**	[0.072]**	[0.022]**	[0.017]	[0.019]
	Lag 10	0.004	0.053	0.138	0.031	-0.013	-0.014	-0.020
		[0.016]	[0.031]*	[0.076]*	[0.027]	[0.017]	[0.018]	[0.018]
	Lag 11	0.050	0.144	0.047	0.007	-0.008	-0.022	-0.031
		[0.027]*	[0.072]**	[0.022]**	[0.018]	[0.020]	[0.019]	[0.020]
	Lag 12	0.125	0.029	-0.009	-0.022	-0.037	-0.047	-0.030
		[0.061]**	[0.015]*	[0.021]	[0.023]	[0.021]*	[0.024]*	[0.023]
Gasoline price change		0.018	0.016	0.016	0.015	0.017	0.004	0.005
		[0.007]**	[0.004]***	[0.003]***	[0.006]**	[0.005]***	[0.002]*	[0.003]
	Lag 1	0.010	0.013	0.013	0.018	0.005	0.004	0.006
		[0.002]***	[0.003]***	[0.006]**	[0.004]***	[0.003]*	[0.004]	[0.002]***
	Lag 2	0.010	0.012	0.017	0.005	0.004	0.005	0.005
		[0.003]***	[0.006]*	[0.004]***	[0.003]*	[0.004]	[0.002]**	[0.003]*
	Lag 3	0.009	0.015	0.004	0.004	0.006	0.005	0.008
		[0.006]	[0.004]***	[0.003]	[0.004]	[0.002]**	[0.003]	[0.001]***
	Lag 4	0.014	0.003	0.004	0.006	0.005	0.008	0.011
		[0.003]***	[0.003]	[0.005]	[0.002]**	[0.004]	[0.002]***	[0.004]**
	Lag 5	0.000	0.003	0.006	0.006	0.008	0.010	-0.003
		[0.004]	[0.005]	[0.003]*	[0.004]	[0.002]***	[0.004]***	[0.003]
	Lag 6	0.004	0.006	0.007	0.009	0.010	-0.004	-0.004
		[0.004]	[0.002]**	[0.004]*	[0.002]***	[0.004]***	[0.003]	[0.003]
	Lag 7	0.006	0.006	0.009	0.010	-0.004	-0.005	-0.007
		[0.002]***	[0.003]*	[0.002]***	[0.004]***	[0.003]	[0.003]	[0.003]**
	Lag 8	0.006	0.008	0.010	-0.004	-0.005	-0.007	-0.003
		[0.003]*	[0.002]***	[0.004]***	[0.003]	[0.003]	[0.003]**	[0.003]
	Lag 9	0.006	0.009	-0.002	-0.002	-0.006	-0.003	0.001
		[0.002]***	[0.004]**	[0.003]	[0.003]	[0.003]**	[0.003]	[0.003]
	Lag 10	0.007	-0.002	-0.002	-0.006	-0.003	0.000	0.001
		[0.003]**	[0.003]	[0.003]	[0.003]**	[0.003]	[0.003]	[0.003]
	Lag 11	-0.002	-0.001	-0.005	-0.002	0.000	0.000	0.003
		[0.002]	[0.003]	[0.003]*	[0.003]	[0.003]	[0.003]	[0.003]
	Lag 12	-0.002	-0.005	-0.002	0.000	0.001	0.003	0.001
		[0.003]	[0.003]*	[0.003]	[0.003]	[0.003]	[0.003]	[0.002]
	Lead 1			0.017	0.016	0.014	0.017	0.005
				[0.004]***	[0.003]***	[0.007]**	[0.005]***	[0.002]**
	Lead 2				0.017	0.016	0.014	0.018
					[0.004]***	[0.003]***	[0.007]**	[0.005]***
	Lead 3					0.017	0.016	0.015
						[0.004]***	[0.003]***	[0.007]**
	Lead 4						0.017	0.016
							[0.004]***	[0.003]***
	Lead 5							0.017
								[0.003]***
Trend		0.000	0.000	0.000	0.000	0.000	0.000	0.000
		[0.000]*	[0.000]*	[0.000]*	[0.000]*	[0.000]*	[0.000]*	[0.000]**
Constant		0.003	0.004	0.005	0.005	0.005	0.005	0.005
		[0.001]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***	[0.002]***
Observations		9,147	9,085	9,007	8,929	8,851	8,773	8,695
Number of countries		74	74	74	74	74	74	74
Adjusted R2		0.23	0.13	0.12	0.12	0.15	0.15	0.15

Notes. Fixed effect estimations. Robust standard errors in brackets. *,**,*** denote significance at 10 percent, 5 percent and 1 percent, respectively. The shaded line represents the coefficients of the impulse response function shown in Figure 4.