The transmission of supply shocks to inflation: the case of Argentina (2004-2022)

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Abstract

This article investigates how domestic and external supply shocks influence inflation in Argentina using the Local Projections methodology. We categorise supply shocks into two groups: domestic and external. Domestic supply shocks include the nominal exchange rate and regulated prices. In contrast, external supply shocks include international energy and food prices. The results reveal two main findings. First, both domestic and external supply shocks positively influence inflation. Second, there are significant variations in the magnitude and dynamic of how these supply shocks are transmitted to inflation. These findings provide new evidence on how supply shocks influence inflationary dynamics in developing countries and small open economies.

Keywords: Local Projections, Impulse responses, Supply shocks, Inflation, Exchange rate pass-through.

JEL classification codes: C32, E31, F41.

1. Introduction

Inflation has been back in the global news. Recent events – such as the COVID-19 pandemic, the Russia-Ukraine war, and the global shock of energy and food prices – have contributed to the resurgence of inflation in countries where it had been forgotten. These events have highlighted the role that supply shocks play in driving inflationary pressures (Ha et al., 2024; A. H. Shapiro, 2022). In addition, these events have drawn attention to the transmission mechanisms by which such shocks propagate and ultimately affect inflation (Blanchard & Bernanke, 2023; Jordà & Nechio, 2023; Tenreyro et al., 2023).

In this article, we study how domestic and external supply shocks influence inflation in Argentina using the Local Projections methodology. We provide new evidence to understand the impact of supply shocks on inflation in developing countries and small open economies.

Our study reveals two main findings. First, both domestic and external supply shocks positively influence inflation. Second, there are significant variations in the magnitude and dynamic of how these supply shocks are transmitted to inflation. These findings provide insights into how supply shocks influence inflationary dynamics over the one-year horizon.

Argentina is an interesting case to study due to its successive currency crises, chronic inflation, and persistent macroeconomic instability over the last two decades. In the last decade, Argentina has repeatedly broken the world record of being among the top ten countries with the highest inflation, sometimes even reaching the podium. The roots of this instability can be traced back to the resurgence of inflation in 2007. This period marked the onset of a moderate inflation regime that eventually turned into a high inflation regime (Dornbusch & Fischer, 1993; Frenkel, 1989; Heymann & Leijonhufvud, 1995). Fiscal dominance has been the main cause behind the shift in the inflationary regime (Kehoe & Nicolini, 2022; Sargent & Wallace, 1981). A key feature of Argentina's chronic inflation regime is that economic agents have adapted to living with high inflation (Pazos, 1972).

In October 2011, the Central Bank implemented restrictions and controls in the foreign exchange market in response to growing capital flight. These measures led to the emergence of a dual exchange rate system and currency instability that continues to this day. Argentina's inflation regime coexists with a significant distortion of relative prices in the economy, an issue that has been further exacerbated in recent years by the implementation of income policies (price controls, pricing of public services, and indexation of contracts). Another relevant point that completes this picture is the sudden stop of economic activity almost everywhere in the world due to the health measures of COVID-19. Since the third quarter of 2020, economic activity has gradually recovered after the global epidemic. However, macroeconomic imbalances have increased, and with them, the inflation rate.

To provide a theoretical foundation, we first derive the augmented Triangle Model to explain inflation in a small open economy. The augmented Triangle Model is motivated by the Hybrid New Keynesian Phillips curve for Argentina (D'Amato & Garegnani, 2009), the Triangle Model of inflation (Gordon, 2011) and the Neo-Structuralist Phillips curve (Rapetti, 2015). The augmented Triangle Model distinguishes three dimensions to analyse the factors that influence inflation dynamics: inflation inertia, demand factors, and supply factors. Unlike New Keynesian models, our approach explicitly incorporates the dimension of supply factors to illustrate its direct influence on inflation, as well as its indirect effects through interactions with the other two dimensions across multiple transmission channels. The augmented Triangle Model provides the theoretical foundation for the empirical baseline model which we have developed to examine the transmission of supply shocks to inflation.

We then present the empirical baseline model to study the transmission of supply shocks to inflation in Argentina from 2004 to 2022. In our analysis, we categorise supply shocks into two groups: domestic and external. Domestic supply shocks include the nominal exchange rate and regulated prices. In contrast, external supply shocks include international energy and food prices. Our article is related to the international evidence on the exchange rate pass-through to inflation provided by Caselli and Roitman (2019) and Carriere-Swallow et al. (2021). Moreover, our article is also related to Abdallah and Kpodar (2023) and Montes-Rojas and Toledo (2022), which provide empirical evidence of how international price shocks − energy and food − impact on domestic inflation. Finally, our article is related to that of Frenkel and Friedheim (2017) and de la Vega et al. (2024), which study the impact of regulated prices (or public service prices) on inflation.

We use the Local Projections methodology developed by Jordà (2005) to estimate the impulse responses of inflation. To examine the dynamics of these supply shocks over the one-year horizon, we present two types of impulse responses: the differential response and the cumulative response. This approach allows us to understand not only the immediate impact of the shocks, but also their persistence over time.

Our four main results show that both domestic and external supply shocks have a positive influence on inflation after one year: (i) the cumulative response of inflation to an exchange rate shock is 0.495 percentage points; (ii) the cumulative response of inflation to a regulated prices shock is 0.354 percentage points; (iii) the cumulative response of inflation to an energy prices shock is 0.055 percentage points; and (iv) the cumulative response of inflation to a food prices shock is 0.125 percentage points. These results demonstrate significant variations in the magnitude of the impact and in the dynamics of how these supply shocks are transmitted to inflation.

To ensure the robustness of our baseline model, we perform a battery of robustness checks. First, we identify non-linear effects of an exchange rate shock on inflation. Second, we compare the estimated pass-through effect in the baseline model with a subsample that excludes periods of exchange controls in Argentina. This approach enables a more accurate estimation of the exchange rate pass-through to inflation, as it eliminates the distortions associated with dual exchange rate systems or black market for foreign exchange. Third, we use the nominal effective exchange rate rather than the nominal bilateral exchange rate to estimate the exchange rate pass-through to inflation, aligning with the approach used in the recent literature.

Fourth, we demonstrate that the results for commodity shocks are robust across different indexes. For this exercise, we use the commodity price index of the Central Bank of Argentina. Fifth, we examine the non-linear effects of an energy shock on inflation within the context of Argentina's energy trade balance. Argentina experienced two phases of energy trade balance: from 2004 to 2010, the energy trade balance consistently recorded a surplus, while during the last decade it has been in deficit. Our results show that the impact of an energy price shock on inflation is higher when there is a deficit in the energy trade balance.

We test the wage transmission mechanism, given its importance in developing countries and small open economies. Specifically, we focus on the transmission of supply shocks to nominal and real wage growth in Argentina. To achieve this, we estimate the impulse responses of wage growth to both domestic and external supply shocks, providing insights into the dynamics of wage adjustments in response to these shocks.

Our main contribution is to provide new evidence on how supply shocks influence inflationary dynamics in Argentina. Argentina is an interesting case to study due to its successive currency crises, chronic inflation, and persistent macroeconomic instability during the last two decades. We use the Local Projections methodology developed by Jordà (2005) to estimate the impulse responses of inflation. Our findings expand the available evidence for understanding the transmission of supply shocks to inflation in developing countries and small open economies.

The structure of the article is as follows. After this introduction, in Section 2 we derive the augmented Triangle Model to explain inflation in a small open economy. Section 3 outlines the empirical methodology used in the baseline model. Section 4 presents the estimation results of the baseline model. Section 5 performs a battery of robustness checks to validate the consistency of the baseline model. Section 6 we test the wage transmission mechanism. Finally, Section 7 concludes.

2. Derivation of the augmented Triangle Model

In this section, we derive the augmented Triangle Model to explain inflation in a small open economy. The model distinguishes three dimensions to analyse the factors that influence inflation dynamics. We offer a conceptual framework to illustrate the multiple channels of transmission of supply shocks to inflation, which will be the focus of our study.

The consumer price index (P_t) is composed of four essential prices that represent all the goods and services marketed in our economy. First, P_X represents the price of exported goods. Second, P_M represents the price of imported goods. Third, P_R represents the price of regulated goods and services. Fourth, P_F represents the price of fix goods. The consumer price index is developed using a weighted geometric index, where α_i represents the respective weight of each category of goods and services withing the domestic consumption basket. Accordingly, the consumer price index is given by:

$$P_t = P_{X,t}^{\alpha_X} P_{M,t}^{\alpha_M} P_{R,t}^{\alpha_R} P_{F,t}^{\alpha_F} \tag{1}$$

Our model refers to a small open economy that is a price taker in international markets. Therefore, the prices of exportable (P_X) and importable (P_M) goods are expressed in domestic currency based on the nominal exchange rate (E) and the international prices (P^*). In our economy, the *"law of one price"* applies to exportable and importable goods.

$$P_{X,t} = E_t P_{X,t}^* \tag{2}$$

$$P_{M,t} = E_t P_{M,t}^* \tag{3}$$

The following goods and services are considered regulated: electricity, gas, water, transportation, and communication. Generally, the prices of these goods and services are fixed or conditioned by the government as part of economic policy decisions. For this reason, we assume them to be exogenous.

$$P_{R,t} = \bar{P_R} \tag{4}$$

Fix goods are differentiated goods, such as manufactured goods, where firms set prices under conditions of imperfect competition. Firms establish their price by applying a percentage profit margin κ over the costs. In a small open economy, the cost structure depends on three inputs: wages, regulated goods and services, and imported inputs. We use a weighted geometric cost index, with the respective weighted θ_i assigned to each input.

$$P_{F,t} = \kappa_t W_t^{\theta_W} P_{R,t}^{\theta_R} P_{M,t}^{\theta_M} \tag{5}$$

We obtain the change in the prices of our economy ($\Delta p_t = p_t - p_{t-1}$), applying the natural logarithm and then the difference operator (Δ) to equation (1). We denote the variables expressed in natural logarithms with lowercase letters.

$$\Delta p_t = p_t - p_{t-1} = \alpha_X \Delta p_{X,t} + \alpha_M \Delta p_{M,t} + \alpha_R \Delta p_{R,t} + \alpha_F \Delta p_{F,t} \tag{6}$$

Performing the same procedure on the remaining numbered equations, we obtain the changes in the four essential prices of our economy. Then, we substitute these equations into equation (6) and substitute all the endogenous relations of the expression. We assume that under normal conditions, the mark-up over the cost is constant, $\Delta\kappa_t$ is equal to zero.[1]

$$\Delta p_t = \alpha_X(\Delta e_t + \Delta p^*_{X,t}) + \alpha_M(\Delta e_t + \Delta p^*_{M,t}) + \alpha_R \Delta p_{R,t} + \alpha_F(\theta_W \Delta w_t + \theta_R \Delta p_{R,t} + \theta_M(\Delta e_t + \Delta p^*_{M,t})) \tag{7}$$

Standard New Keynesian models include wage adjustments as an amplifying mechanism of the effects of a given inflationary shock. The simplest way to represent wage setting is that workers can negotiate their wages at time t considering the previous period's inflation and labour market conditions. The basic logic of this approach is that workers seek to maintain their real purchasing power by adjusting their nominal wages in response to past inflation. Additionally, workers also consider the conditions of the labour market, which reflect the equilibrium between labour supply and demand. In our model, the output gap serves as a proxy for labour market conditions, the real wage rises with the level of activity (Blanchflower & Oswald, 1995) and can be justified by bargaining models and efficiency wages (Akerlof & Yellen, 1990; C. Shapiro & Stiglitz, 1984).

$$\Delta w_t = \gamma_1 \Delta p_{t-1} + \gamma_2(y_t - y_e) \tag{8}$$

In this equation, Δw_t represents the change in wages at time t, Δp_{t-1} denotes the inflation rate in the previous period, and $(y_t - y_e)$ captures the deviation between the actual level of output in an economy and its potential level. The coefficient γ_1 quantifies the sensitivity of wage adjustments to past inflation and γ_2 quantifies the sensitivity of the output gap deviation.

We define the variable p_{int} to represent international prices which include the international prices of exportable and importable goods that are part of the consumer price index (P_t). We obtain this variable by combining the international prices of exportable and importable goods from equation (7) into a single expression along with their respective coefficients. For simplicity, we assume that the coefficients accompanying the variables are the weights of the exportable and importable goods that are part of the consumer price index. Finally, we obtain the following equation:

$$\delta_{int} \Delta p_{int,t} = \alpha_X \Delta p^*_{X,t} + (\alpha_F \theta_M + \alpha_M) \Delta p^*_{M,t} \tag{9}$$

Substituting equation (8) and equation (9) into equation (7), and rearranging terms yields:

[1]Normal conditions are discussed in more detail in Frenkel (1989). As the author indicates, normal conditions imply a more or less known situation, in which the variables (exchange rate, monetary, public services prices, etc.) that provide additional information on acceleration or deceleration trends and the magnitude of their rates are signals commonly interpreted by most agents.

$$\Delta p_t = \alpha_F\theta_W\gamma_1\Delta p_{t-1} + \alpha_F\theta_W\gamma_2(y_t - y_e) + (\alpha_F\theta_R + \alpha_R)\Delta p_{R,t} + (\alpha_F\theta_M + \alpha_X + \alpha_M)\Delta e_t + \delta_{int}\Delta p_{int,t}$$

Which can be simplified to the following expression:

$$\Delta p_t = \phi_1\Delta p_{t-1} + \phi_2(y_t - y_e) + \phi_3\Delta e_t + \phi_4\Delta p_{R,t} + \phi_5\Delta p_{int,t} \tag{10}$$

Finally, we derive the augmented Triangle Model for a small open economy. This model offers us a conceptual framework to illustrate the multiple channels of transmission of supply shocks to inflation. The augmented Triangle Model is closely related to the Hybrid New Keynesian Phillips Curve for Argentina (D'Amato & Garegnani, 2009), the Triangle Model of inflation (Gordon, 2011) and the Neo-Structuralist Phillips curve (Rapetti, 2015), but presents some differences that we will highlight below.

The augmented Triangle Model distinguishes three dimensions to explain inflation. The first dimension is the inflationary inertia (Δp_{t-1}). When inflation exceeds a certain threshold, economic agents' behaviour changes in response to inflation expectations, leading to qualitative changes in contract negotiation mechanisms (Frenkel, 1989; Heymann & Leijonhufvud, 1995). As a result, contracts often include an indexation clause to minimise contracting costs and reduce the frequency of renegotiations of nominal contracts. (Frenkel, 1988). García-Cicco et al. (2023) provide evidence that inflationary inertia plays a significant role in Argentina's inflationary dynamics.

The second dimension is the influence of demand factors on prices, which is represented by the output gap ($y_t - y_e$). The output gap is a proxy for the influence of the labour market on inflation. The influence of this mechanism stems from the disagreement between workers and firms on the relative prices of goods and labour, represented by the real wage (W/P). Meanwhile, during wage negotiations, workers seek a higher ratio of W/P. The real wage resistance to decline leads to persistent nominal inflation in both prices and wages, which is known in the literature as "*wage price spiral*" (Blanchard, 1986). This interpretation of the "*wage price spiral*" is consistent with the recent literature of Lorenzoni and Werning (2023a, 2023b) who emphasize that distributional conflict is a potential channel for the transmission of inflationary shocks.

The third dimension is the influence of supply factors on inflation. We focus on this dimension to illustrate the multiple channels of transmission of supply shocks to inflation in a small open economy. We include three key variables to explain the transmission of supply shocks to inflation.

The first variable is the nominal exchange rate (e_t). Three mechanisms explain the exchange rate pass-through to prices. First, there is an increase in the price of imported inputs. In response to increasing costs, firms seek to preserve their profit margins by transferring these increased costs to prices. The second mechanism is the real wage resistance to decline. As prices rise, real wages decline, leading workers to demand higher nominal wages to restore their purchasing power. The real wages resistance to decline leads to persistent nominal inflation in both prices and wages, which is known in the literature as "*wage price spiral*" (Blanchard, 1986; Lorenzoni & Werning, 2023b). Third, imported consumer goods become more expensive. However, the pass-through of this channel is incomplete because households substitute imported goods with lower-quality goods in the aftermath of large contractionary devaluations (Burstein et al., 2005).

The second variable is the regulated prices ($p_{R,t}$). Regulated prices include prices of electricity, gas, water, transportation, and communication. These goods and services are part of the household consumption basket and serve as production inputs for firms. When regulated prices rise (or are deregulated), decreasing the purchasing power of households and increasing the costs of firms.

The third variable is the international prices ($p_{int,t}$). We consider the international price of energy (such as oil) and the international prices of food (such as cereals, fruits and vegetables, etc.). We selected this set of products because of their important role as inputs for firms' production and household consumption basket. An increase in international prices raises production costs for firms, which then pass these higher costs on to consumer prices. Consequently, households experience a reduction in purchasing power for two reasons. First, the increase in international prices directly affects the household consumption basket. Second, the increase in consumer prices due to the transfer of higher costs from firms.

3. Empirical methodology

We use the Local Projections methodology to estimate the impulse responses of inflation to supply shocks. We first argue the benefits of using Local Projections in our estimation. Next, we show our empirical baseline model adapted to the augmented Triangle Model to study the transmission of supply shocks to inflation. Finally, we make a description of the data for the period 2004 – 2022.

3.1 Local Projections

Local Projections is a methodology developed by Jordà (2005) that estimates the impulse responses of a dependent variable to shocks in independent variables. In recent decades, Local Projections have been used as an alternative to VARs models for estimate impulse responses.

The main advantage of the Local Projections methodology is its flexibility to obtain impulse responses of the dependent variable to a shock. The effect of a shock on the dependent variable, at a specified forecast horizon (h), is represented by the path of the estimated coefficients of the independent variable across sequential regressions for each value of h. The sequential forward of the dependent variable may induce a serial correlation of error terms. To solve this problem, we use Newey and West (1987) standard errors with lag-length set to the horizon of the Local Projections.

Compared to VARs models, Local Projections highlight four advantages. First, Local Projections are more flexible for model specification, as they do not require the imposition of restriction on the structure of the model (Jordà, 2005). Second, Local Projections do not impose restrictions on the shape of impulse responses, making them more robust to misspecification (Olea et al., 2024; Plagborg-Møller & Wolf, 2021). Third, Local Projections estimators have lower bias than VAR estimators (Li et al., 2024). Fourth, they can be estimated using simple regression techniques, as each time horizon is estimated separately using least squares regressions.

Using Local Projections also has its disadvantages. There is a trade-off between bias and variance: Local Projections estimators have lower bias than VAR estimators but substantially higher variance at intermediate and long horizons (Li et al., 2024). This increased variance arises because each time horizon is estimated separately, which can lead to greater instability in the estimates. As a result, Local Projections may be less accurate at longer horizons due to the accumulation of forecast errors, resulting in wider confidence intervals.

To address some of these disadvantages, we include the residual of the $h-1$ horizon estimation as an additional regressor in the estimation for horizon h to improve the inference. There are three reasons for including the residual from the $h-1$ horizon estimate. First, it improves the efficiency of the estimator, the standard errors of the estimates are smaller (Jordà, 2005). Second, it addresses a potential bias identified by Teulings and Zubanov (2014). Third, we obtain narrower confidence intervals (Carriere-Swallow et al., 2021).

3.2 Empirical baseline model

We present the empirical baseline model to study the transmission of supply shocks to inflation in Argentina from 2004 to 2022. We want to estimate the impulse responses of inflation to four supply shocks.

The typical Local projections equation that we estimate takes the following form:

$$p_{t+h-1} - p_{t-1} = \alpha_h + \beta_h \Delta shock_t + \sum_{i=0}^{k} X'_{t-i}\gamma_h + u_{t,h} \tag{11}$$

Local Projections generate estimates for each forecast horizon h by regressing the dependent variable at $t+h-1$ on the available information set at time t. Here, $t = 1, 2, \ldots, T$ represents the time dimension of the data, while $h = 1, 2, \ldots, 12$ denotes each forecast horizon.

Where p_t denotes the natural logarithm of the price level at time t, such that the dependent variable $p_{t+h-1} - p_{t-1}$ denotes the cumulative change from time $t-1$ to $t+h-1$. α_h is the constant of linear regression. $\Delta shock$ is the log difference of the variable to be shocked, alternating between the nominal exchange rate, regulated prices, food prices, and energy prices. X is a vector of control variables with dimension $n \times 1$, $u_{t,h}$ is the error term in each regression of each forecast horizon h and finally the operator Δ denotes a first difference.

The vector of control variables X includes six elements. First, the log difference of the rest of the variables that alternate the *shock* variable. Second, k lags of the log difference of the price level. Third, k lags of log difference of the shocked variable and k lags of the log difference of the variables that alternate the *shock* variable. In the three cases, the lags are chosen following the Bayesian Information Criterion (BIC), resulting in one lag for all variables. Fourth, we include the output gap as the variable that summarises the full impact of demand factors on inflation. Fifth, we include a dummy variable *stbreak* that takes the value of one from August 2018 to December 2022 to control for the effect of the structural break on inflation.[2] Sixth, the residual from the estimation of the horizon $h-1$.[3]

The coefficient β_h traces the cumulative impulse response of inflation from time $t-1$ to $t+h-1$ due to a shock occurring in time t. In this way, we obtain the path of impulse responses as the sequence of the estimated coefficients β_h of the sequential regressions for each horizon h.

We present an alternative empirical model to estimate the differential response of the prices (month-by-month). By varying $h = 1, 2, \ldots, 12$, we can see how the effect of the change in the shock variable at time t manifests itself at different future times. This approach enables us to understand not only the immediate impact of the shock, but also its persistence over time.

$$p_{t+h-1} - p_{t+h-2} = \alpha_h + \beta_h \Delta shock_t + \sum_{i=0}^{k} X'_{t-i}\gamma_h + u_{t,h} \tag{12}$$

The only difference with the previous model is the interpretation of the coefficient β_h. The coefficient β_h traces the differential response of the logarithm of prices from time $t+h-2$ to $t+h-1$ to a shock at time t, for each horizon $h = 1, 2, \ldots, 12$. For $h = 1$, β_1 traces the differential response of the logarithm of prices from time $t-1$ to t to a shock at time t. For $h = 2$, β_2 traces the differential response of the logarithm of prices from time t to $t+1$ to a shock at time t. And so on, we obtain the path of impulse responses as the sequence of the estimated coefficients β_h of the sequential regressions for each horizon h.

[2]We use the algorithm of Ditzen et al. (2021) to find the break dates. This algorithm implements the structural break tests discussed in Bai and Perron (1998, 2003).

[3]Local Projections with appropriate control variables allow obtaining approximately the same impulse response as VARs models (Plagborg-Møller & Wolf, 2021).

3.3 Data description

This section describes the dataset of our empirical analysis for the period 2004 to 2022. Next, we perform multiple stationarity tests in the time series.

The baseline model uses monthly data for the period January 2004 to December 2022. The data set includes six variables:

- For consumer prices (CPI), we use the consumer price index (CPI) of the National Institute of Statistics and Census (INDEC) and the Provincial Institutes of Statistics of Argentina. We use alternative estimates in the period of INDEC's intervention. Between 2007 and 2015, inflation data published by INDEC were distorted by reporting inflation rates lower than those estimated by subnational governments and private economists. For the period 2004 to 2007, we use the data published by INDEC GBA. From 2008 to April 2016, we use a weighted provincial CPI developed from data published by the Provincial Institutes of Statistics.[4] From there, we use the data by INDEC GBA until December 2016, after which we use the national coverage data published by INDEC.

- For nominal exchange rate (NER), we use the official bilateral exchange rate against the US dollar, published by the Central Bank of Argentina (BCRA), "Comunicación A 3500". The exchange rate is defined in units of domestic currency per unit of foreign currency, therefore a rise in the nominal exchange rate implies a nominal depreciation and a fall means an nominal appreciation.

- For regulated prices or public service prices (regulated), we use the regulated prices category of the INDEC consumer price index and the series provided by de la Vega et al. (2024). First, we use the de la Vega et al. (2024) series for the period January 2004 to January 2017 and then we use the INDEC series. Includes fuels for housing, electricity, water and sanitation services, public transport and other public services.

- For energy prices (energy), we use international energy prices corresponding to composite indexes in U.S. dollars reported in the World Bank's Commodity Markets (The Pink Sheet). Includes crude oil (petroleum), natural gas, and coal price indexes.[5]

- For food prices (food), we use food prices corresponding to composite indexes in U.S. dollars reported in the World Bank's Commodity Markets (The Pink Sheet). Includes cereals, meals, oils, grains, sugar, fruits, and vegetables.

[4]The provincial CPI is a Consumer Price Index (CPI) developed from a weighted average of the CPIs of Chubut (Rawson Trelew), Jujuy, La Pampa (Santa Rosa), Misiones (Posadas), Neuquén, Salta, San Luis, Santa Fe (Santa Fe and Rosario), Tierra del Fuego (Ushuaia) and the City of Buenos Aires, published by the respective Provincial Institute of Statistics. The share of each of these indices in the total is determined according to the share of household consumption expenditure in each province, based on information from the National Household Expenditure Survey (Encuesta Nacional de Gastos de los Hogares-INDEC).

[5]The weighting of commodities in the index is as follows: crude oil is 84.6, natural gas is 10.8, and coal is 4.6.

- We construct the output gap using the seasonally adjusted index of INDEC's monthly economic activity estimator (EMAE) using the Hodrick-Prescott filter.

We use the Dickey-Fuller and Perron tests to analyse the level of integration of the variables. We prefer augmented versions of these tests because they include multiple lags in the model, improving the ability to identify the presence of a unit root. We can see that the results in Table 2 of the appendix suggest that all the variables are integrated of order one. That is, the null hypothesis of a unit root in levels is not rejected, but it is rejected in the first difference.

4. Estimation results

Our results reveal two main findings: First, both domestic and external supply shocks positively influence inflation. Second, there are significant variations in the magnitude and dynamic of how these supply shocks are transmitted to inflation. To examine these dynamics over the one-year horizon, we present two types of impulse responses: the differential response and the cumulative response.

4.1 Impact of a nominal exchange rate shock to inflation

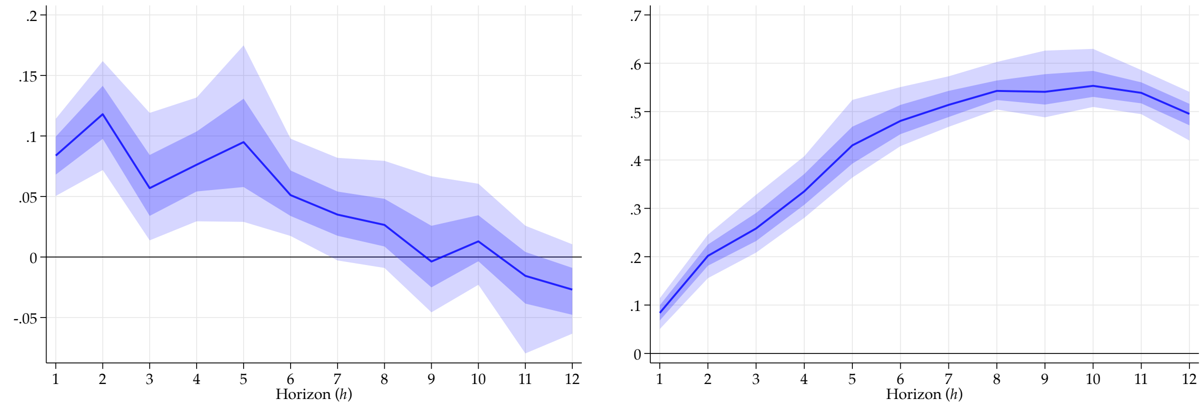
Figure 1 shows the impulse responses of inflation to a 1 pp increase in the nominal exchange rate (in percentage points).

Panel (a) reports the differential response of inflation (month-to-month). We can see an exchange rate pass-through of 0.084 pp at the time of shock. The largest pass-through to prices is observed in the horizon after the impact, reaching 0.118 pp. In the following horizons, the pass-through remains positive, but gradually decreases.

Panel (b) reports the cumulative response of inflation. We can see that the pass-through is positive and significant at all horizons. The exchange rate pass-through to inflation is 0.495 pp after twelve horizons from the initial shock.

Our main result is that the pass-through from the exchange rate to inflation is 0.495 pp after one year. This result is consistent with other studies that use the Local Projections methodology to analyse the exchange rate pass-through to consumer prices. Barberis (2021) estimates a pass-through of the bilateral exchange rate to inflation of 0.82 in one year for Argentina during the period 2004-2019. Carriere-Swallow et al. (2021) find that the pass-through of the nominal effective exchange rate to inflation is 0.60 for thirty emerging market economies (EMs) and 0.50 for the subsample of Latin American countries after one year during the period 1995-2019.

Figure 1. Impulse responses of inflation to a nominal exchange rate shock



(a) Differential response (b) Cumulative response

Notes: The panels show impulse responses of inflation to a 1 pp increase in the nominal exchange rate (in percentage points). The solid blue lines show the point estimates β_h for each horizon h. Panel (a) reports the differential response of inflation (month-by-month). Panel (b) reports the cumulative response of inflation. Shaded bands correspond to 95% and 68% confidence intervals obtained from 1000 Wild Bootstrap runs.

The exchange rate pass-through to inflation is higher in emerging countries than in developed countries for three reasons well documented in the literature. First, Calvo and Reinhart (2000) postulate that the volatility of the exchange rate and the lack of credibility contribute to a higher pass-through from exchange rate fluctuations to inflation in EMs.[6] Countries with greater nominal volatility have a greater exchange rate pass-through (Campa & Goldberg, 2005). Second, volatility in EMs influences the choice of invoice currencies in trade (Gopinath et al., 2020). Third, the lack of monetary policy credibility, with unanchored inflation expectations, increases the exchange rate pass-through to inflation. Caselli and Roitman (2019) and Carriere-Swallow et al. (2021) test Taylor's hypothesis and demonstrate that exchange rate pass-through is consistently lower in countries that implement inflation targeting compared to those that do not.

The main result of our study is higher than those presented in the recent literature that employs different methodologies to estimate the annual pass-through of the exchange rate to consumer prices in Argentina. For example, Montes-Rojas (2019) estimates that the exchange rate pass-through is 0.15 to 0.45 using the VAR and quantile VAR methodology for the period 2004-2018. On the other hand, Ito and Sato (2007) find an exchange rate pass-through of 0.28 for the period 1995-2006 using structural VAR.

However, Aron et al. (2014) highlight that single-equation methodology − such as Local Projections − offers advantages when estimating the exchange rate pass-through to inflation. These models, whether specified in levels or differences, are particularly effective at managing structural breaks and asymmetries, an essential factor in the Argentine

[6] In EMs devaluations, or large depreciations for that matter, are contractionary, the adjustments in the current account are far more acute and abrupt. Currency crises become credit crises as sovereign credit ratings often collapse following the currency collapse and access to international credit is lost. Lack of credibility also gives rise to chronic and marked volatility in domestic interest rates (Calvo & Reinhart, 2000).

context. When specified in first differences, single-equation models exhibit resilience to changes in the mean resulting from structural breaks.

4.2 Impact of a regulated prices shock to inflation

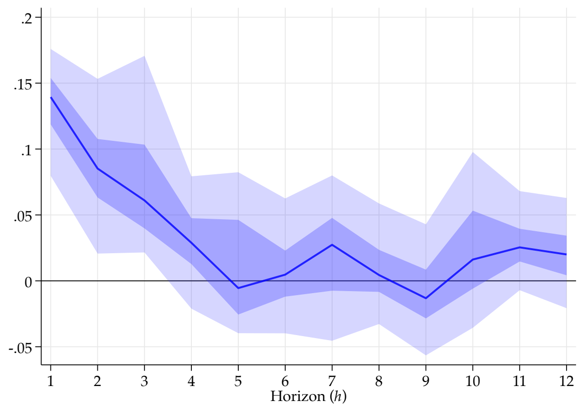
Figure 2 shows the impulse responses of inflation to a 1 pp increase in regulated prices (in percentage points).

Panel (a) reports the differential response of inflation (month-to-month). We can see the greatest impact of 0.139 pp at the time of the shock. The impact gradually decreases, with a decrease of 0.085 pp in the second horizon and 0.061 pp in the third horizon, although still positive and significant. The results gradually decrease in the following horizons.

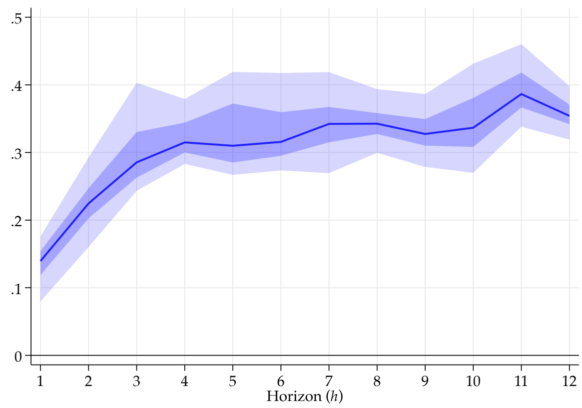
Panel (b) reports the cumulative response of inflation. We can observe that the impact is positive and significant at all horizons, with an increasing trend, reaching a maximum of 0.386 pp. The cumulative response of inflation to a regulated prices shock is 0.354 pp after twelve horizons.

In line with de la Vega et al. (2024) increases in regulated prices are inflationary in the short term, but this effect diminishes over time. Regulated prices have a positive impact in the first quarter, but become non-significant from the second quarter onwards. Frenkel and Friedheim (2017) estimate an elasticity of regulated prices to inflation of 0.13 for the period 2003-2014 using least squares.

Figure 2. Impulse responses of inflation to a regulated prices shock



(a) Differential response



(b) Cumulative response

Notes: The panels show impulse responses of inflation to a 1 pp increase in regulated prices (in percentage points). The solid blue lines show the point estimates β_h for each horizon h. Panel (a) reports the differential response of inflation (month-by-month). Panel (b) reports the cumulative response of inflation. Shaded bands correspond to 95% and 68% confidence intervals obtained from 1000 Wild Bootstrap runs.

4.3 Impact of an energy prices shock to inflation

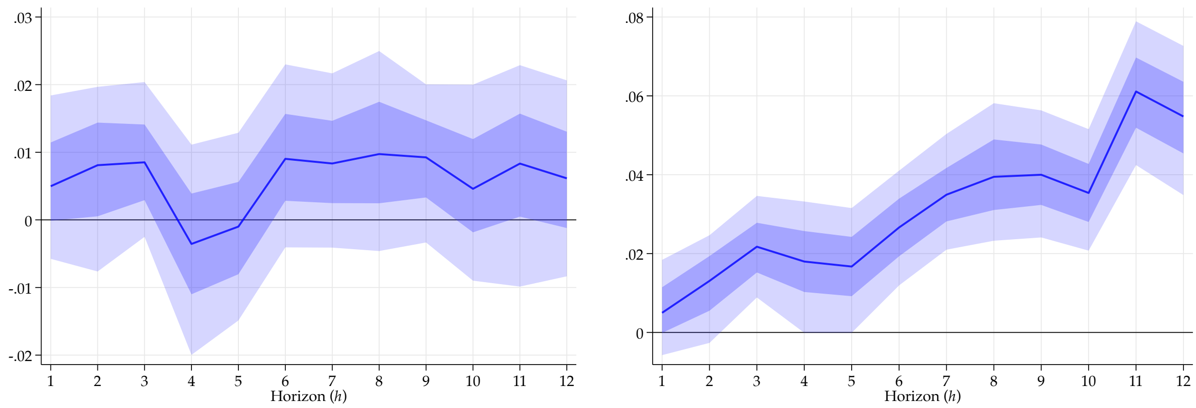
Figure 3 shows the impulse responses of inflation to a 1 pp increase in energy prices (in percentage points).

Panel (a) reports the differential response of inflation (month-to-month). We can see a slight positive impact on the horizon after the shock. This impact gradually diminishes over the next two horizons, after which we observe a resurgence in positive and increasing trends starting from the fifth horizon. Then the impact gradually decreases.

Panel (b) reports the cumulative response of inflation. We can see that the impact is positive and significant after the shock, with a rising trend. Over time, this impact continues to increase steadily. After twelve horizons from the initial shock, the cumulative response of inflation to an energy prices shock is 0.055 pp.

We find that the cumulative response of inflation to an energy prices shock is 0.055 pp. This result is consistent with recent studies for countries with characteristics similar to Argentina. Abdallah and Kpodar (2023) find that the inflation response to an energy shock is 0.05 after sixteen months in emerging and developing countries. Cherkasky (2022) finds that the impact of an energy prices shock to inflation is around 0.04 - 0.08 after one year in six Latin American countries.

Figure 3. Impulse responses of inflation to an energy prices shock



(a) Differential response (b) Cumulative response

Notes: The panels show impulse responses of inflation to a 1 pp increase in energy prices (in percentage points). The solid blue lines show the point estimates β_h for each horizon h. Panel (a) reports the differential response of inflation (month-by-month). Panel (b) reports the cumulative response of inflation. Shaded bands correspond to 95% and 68% confidence intervals obtained from 1000 Wild Bootstrap runs.

Three transmission channels explain the higher inflationary impact in Argentina. The first channel is the increase in production costs; the direct effect arises from the fact that some energy products are often used by industries as inputs in the production process of other (non-energy) goods and services, thereby increasing their production costs (Abdallah & Kpodar, 2023). The second channel is inflation expectations; the persistence of commodity shocks on domestic inflation is influenced by the degree of anchoring of inflation expectations, which is closely related to the credibility of monetary policy (Reis, 2022). The credibility of monetary policy in Argentina progressively deteriorated over the last two decades as monetary financing of the fiscal deficit increased. The third channel is the real wage resistance to decline. An increase in international prices raises production costs for firms, which then pass these higher costs on to consumer prices. Consequently, households experience a reduction in purchasing power.

4.4 Impact of a food prices shock to inflation

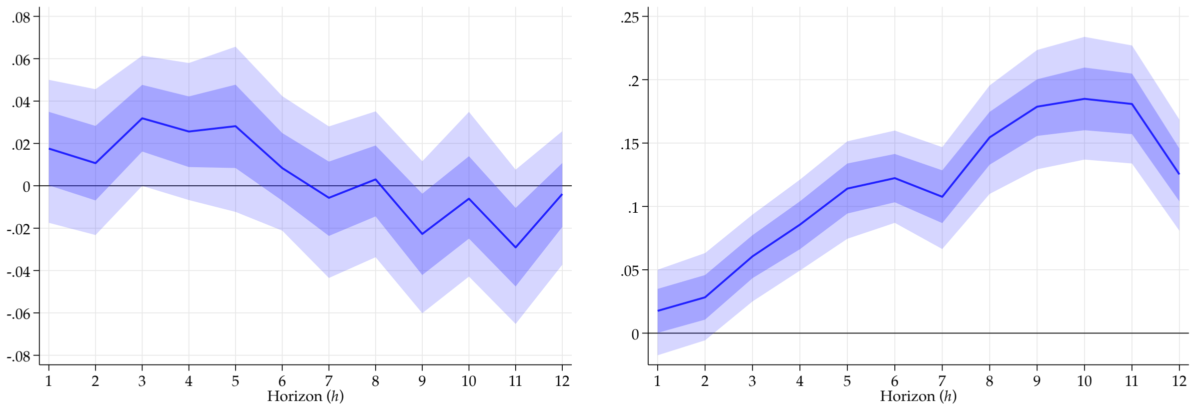
Figure 4 shows the impulse responses of inflation to a 1 pp increase in food prices (in percentage points).

Panel (a) reports the differential response of inflation (month-to-month). We can see a positive impact during the first six horizons. Over time, this impact gradually decreases, eventually leading to negative values.

Panel (b) reports the cumulative response of inflation. The cumulative impact is significant and positive, increasing positively until the tenth horizon. It then gradually decreases, reaching a value of 0.125 pp after one year.

We find that the cumulative response of inflation to a food prices shock is 0.125 pp. This result is consistent with recent studies for countries with characteristics similar to Argentina. Cherkasky (2022) finds that the impact of a food prices shock to inflation is around 0.07 - 0.13 after one year in six Latin American countries. The impact of the food prices shock on inflation is initially positive, but then gradually decrease. This result is consistent with the evidence of Montes-Rojas and Toledo (2022), who also find that food price shocks exhibit some negative values and greater dispersion on inflation.

Figure 4. Impulse responses of inflation to a food prices shock



(a) Differential response

(b) Cumulative response

Notes: The panels show impulse responses of inflation to a 1 pp increase in food prices (in percentage points). The solid blue lines show the point estimates β_h for each horizon h. Panel (a) reports the differential response of inflation (month-by-month). Panel (b) reports the cumulative response of inflation. Shaded bands correspond to 95% and 68% confidence intervals obtained from 1000 Wild Bootstrap runs.

5. Robustness checks

In this section, we perform a battery of robustness checks to verify the consistency of the baseline model. First, we identify non-linear effects of an exchange rate shock on inflation.

Second, we analyse a subsample that excludes periods of exchange controls in Argentina. This approach enables a more accurate estimation of the exchange rate pass-through to inflation, as it eliminates the distortions associated with dual exchange rate systems or black market for foreign exchange. Third, we use an alternative commodity price index to ensure that the results are not sensitive to the specific index employed. Fourth, we identify non-linear effects of an energy shock on inflation, as Argentina experienced two distinct periods of energy trade balance. Fifth, we use the nominal effective exchange rate rather than the nominal bilateral exchange rate to estimate the exchange rate pass-through to inflation, aligning with the approach used in the recent literature.

5.1 Non-linear effects: Large Depreciations vs Normal Depreciations

We identify non-linear effects of an exchange rate shock using Local Projections. We find that the effects of exchange rate pass-through to inflation can be different between episodes of large depreciations and normal depreciations.

To define episodes of large depreciations, we follow Laeven and Valencia (2020) definition of currency crises. They define currency crises as periods when the annual nominal depreciation rate of a country's currency against the US dollar is at least 30% and is also at least 10% higher than the depreciation rate of the previous year.[7]

The Local Projections easily accommodate non-linear specifications. We adjust the baseline model by incorporating a dummy variable LD equal to one during episodes of large depreciations, along with two interactions terms that capture non-linearities. Additionally, we incorporate further control variables to capture non-linearities more accurately.

The estimate of the cumulative response of inflation takes the following form:

$$p_{t+h-1} - p_{t-1} = \alpha_h + \beta_h^{LD} LD \Delta e_t + \beta_h^{ND}(1 - LD)\Delta e_t + \sum_{i=0}^{k} X'_{t-i}\gamma_h + u_{t,h} \tag{13}$$

Our model provides distinct estimates of exchange rate pass-through depending on the value of LD. The coefficient β_h^{LD} captures the exchange rate pass-through to inflation during episodes of large depreciations when the dummy variable LD is equal to one. Conversely, the coefficient β_h^{ND} captures the exchange rate pass-through to inflation during normal depreciations when the dummy variable LD is equal to zero.

The vector of control variables X includes two additional elements compared to the empirical baseline model. First, the dummy variable LD, which is equal to one during episodes of large depreciations. Second, the exchange rate gap. The exchange rate gap is calculated from the relative variation between an unofficial exchange rate and the official

[7] A recent article by Blanco et al. (2024) use Laeven and Valencia (2020) definition of currency crises to identify large nominal exchange rate devaluations and study the distribution of labour income during large devaluations in Argentina.

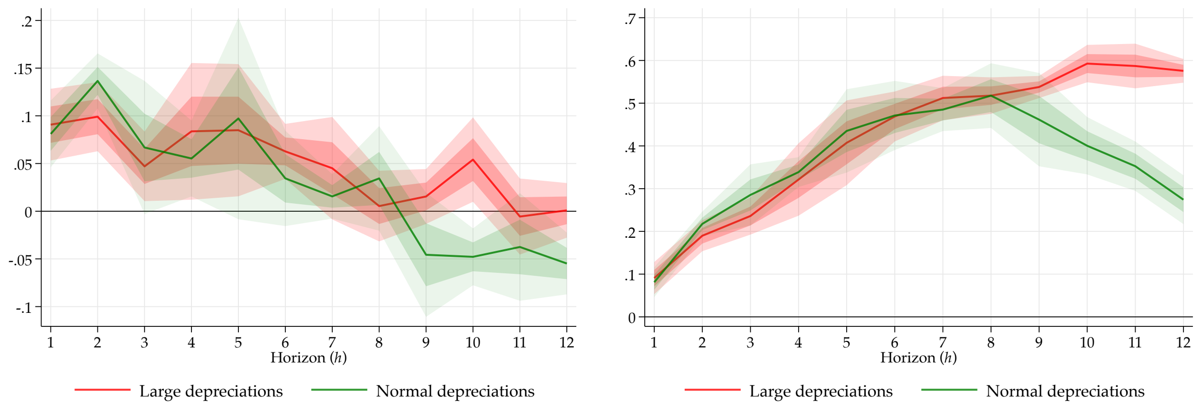
exchange rate.

Figure 5 shows the impulse responses of inflation to a 1 pp increase in the nominal exchange rate (in percentage points). The solid red lines show the point estimates of large depreciations β_h^{LD}, while the solid green lines show the point estimates of normal depreciations β_h^{ND} for each horizon h. The results indicate that during episodes of large depreciations, the inflation response is larger and more persistent than in episodes of normal depreciations.

Panel (a) reports the differential responses of inflation (month-to-month). We can observe that the exchange rate pass-through during episodes of large depreciations is 0.091 pp, compared to 0.081 pp during normal depreciations at the time of the shock. The pass-through of the exchange rate is more persistent in episodes of large depreciations than in episodes of normal depreciations.

Panel (b) reports the cumulative responses of inflation. We can see that the exchange rate pass-through is 0.576 pp in episodes of large depreciations, compared to 0.274 pp in episodes of normal depreciations.

Figure 5. Impulse responses of inflation to a nominal exchange rate shock



(a) Differential response

(b) Cumulative response

Notes: The panels show impulse responses of inflation to a 1 pp increase in nominal exchange rate (in percentage points). The solid red lines show the point estimates of large depreciations β_h^{LD} for each horizon h. The solid green lines show the point estimates of normal depreciations β_h^{ND} for each horizon h. Panel (a) reports the differential responses of inflation (month-by-month). Panel (b) reports the cumulative responses of inflation. Shaded bands correspond to 95% and 68% confidence intervals.

Our results on the non-linear effects of the exchange rate pass-through to inflation are in line with the literature. The higher pass-through of the exchange rate to inflation during episodes of large depreciations can be attributed to two key factors. First, the nominal exchange rate is a variable that reflects expectations about the future, having a fundamental role in the formation of domestic prices (D'Amato & Garegnani, 2009; Frenkel, 1979; Heymann & Leijonhufvud, 1995). Second, consistent with the menu cost model proposed by Golosov and Lucas Jr (2007), firms are more inclined to adjust their prices during episodes of large depreciations due to the substantial increase in costs, thereby overcoming price rigidities that may persist during more moderate depreciation episodes.

5.2 Excluding the periods of exchange rate controls or "*cepo cambiario*"

In October 2011, in response to growing capital flight, the Central Bank implemented restrictions and controls on the foreign exchange market, commonly known as the "*cepo cambiario*".[8] In December 2015, following the presidential elections, the end of these foreign exchange restrictions was announced; however, this measure lasted only a few years. By October 2019, restrictions on the foreign exchange market were gradually reintroduced and remain in place to this day. We use a subsample that excludes the periods of exchange rate controls in Argentina. This approach enables a more accurate estimation of the exchange rate pass-through to inflation, as it eliminates the distortions associated with dual exchange rate systems or black market for foreign exchange.

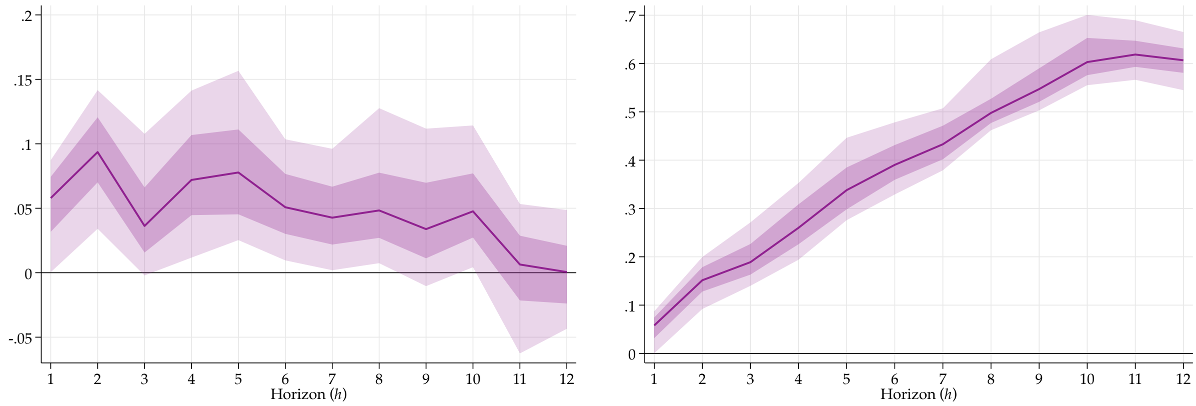
We estimate the impulse response of inflation using a subsample that excludes the periods from October 2011 to December 2015 and from September 2019 to December 2022. The exclusion of exchange controls from the sample enables a more precise estimation of the exchange rate pass-through to inflation for two key reasons. The first reason is that economic agents can freely access the exchange market, eliminating incentives to arbitrate between different dollar rates. The second reason is that agents' expectations are closely aligned with the free exchange rate and economic fundamentals.

Figure 6 shows the impulse responses of inflation to a 1 pp increase in the nominal exchange rate (in percentage points). Panel (a) reports the differential response of inflation (month-to-month). The exchange rate pass-through is 0.058 pp at the time of shock. The largest pass-through to prices is 0.094 pp after the impact. In the following horizons, the result remains positive but gradually decreases over the horizons. Panel (b) reports the cumulative response of inflation. The pass-through is positive and significant at all horizons. After twelve horizons, the cumulative exchange rate pass-through to inflation is 0.607 pp.

The exchange rate pass-through to inflation is larger in the subsample than the baseline model estimate. In our baseline model, the exchange rate pass-through is 0.495 pp after one year. In contrast, for the subsample that excludes periods of exchange rate controls, the exchange rate pass-through is 0.607 pp after one year.

[8] See Mosquera and Sturzenegger (2021) for a model that incorporates the effects of restrictions on access to the foreign exchange market.

Figure 6. Impulse responses of inflation to a nominal exchange rate shock



(a) Differential response

(b) Cumulative response

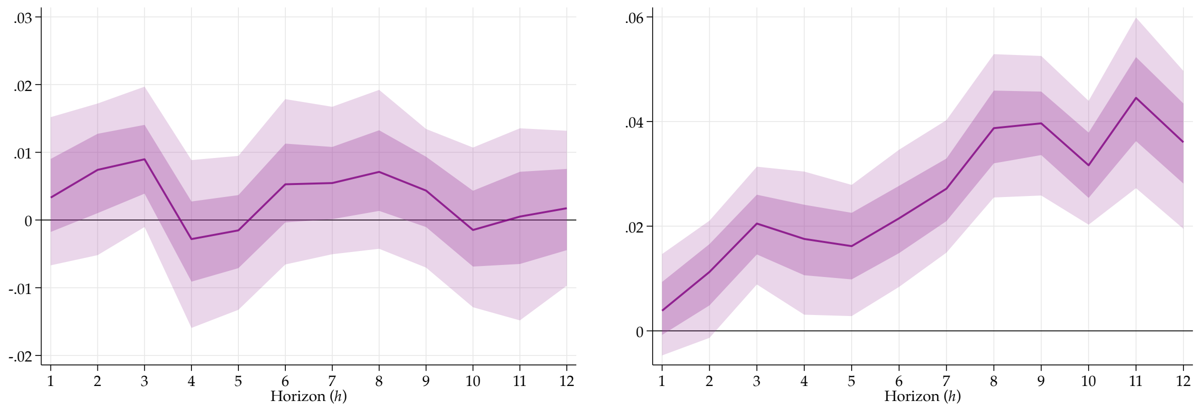
Notes: The panels show impulse responses of inflation to a 1 pp increase in the nominal exchange rate (in percentage points). The solid purple lines show the point estimates β_h for each horizon h. Panel (a) reports the differential response of inflation (month-by-month). Panel (b) reports the cumulative response of inflation. Shaded bands correspond to 95% and 68% confidence intervals obtained from 1000 Wild Bootstrap runs.

5.3 Using BCRA commodity price index

We examine the impact of energy and food price shocks on inflation using the BCRA commodity prices index (IPMP). The results are consistent with those of the baseline model. The IPMP tracks the prices of Argentina's main commodity exports, which represent almost half of total exports. The IPMP considers the prices of the most representative basic agricultural products (corn, wheat, soybean, soybean pellets, soybean oil, barley, beef) and energy (crude oil), weighted by their share of total exports.

Figure 7 shows the impulse responses of inflation to a 1 pp increase in energy prices (in percentage points). Panel (a) shows the differential response of inflation (month by month). We can see a positive impact in the third horizon following the shock. This effect gradually diminishes in the next two horizons, after which we observe a resurgence of positive and increasing trends starting from the fifth horizon and then the impact gradually declines. Panel (b) reports the cumulative response of inflation. We can see that the impact is long-lasting and significant after the shock, with an upward trend that then fades from the eighth horizon onwards. The cumulative response of inflation to an energy prices shock is 0.036 pp after one year.

Figure 7. Impulse response of inflation to an energy prices shock



(a) Differential response

(b) Cumulative response

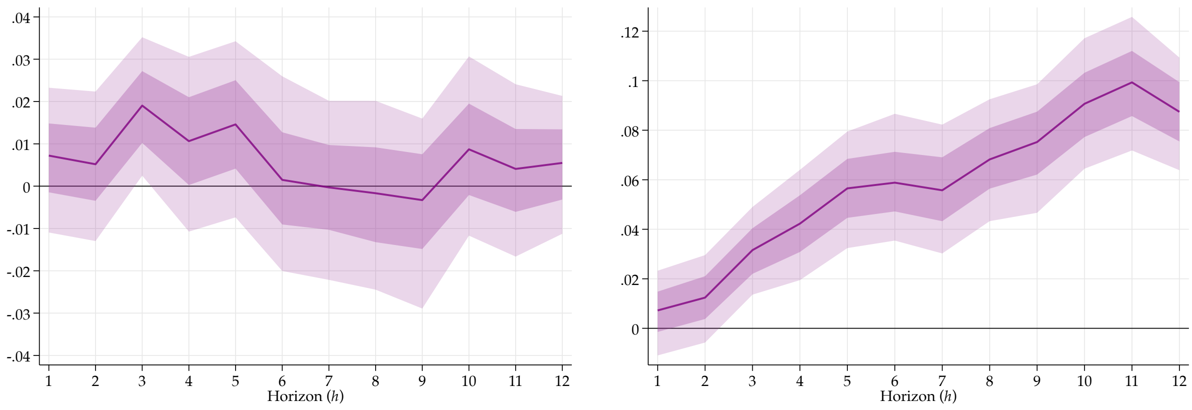
Notes: The panels show impulse responses of inflation to a 1 pp increase in energy prices (in percentage points). The solid purple lines show the point estimates β_h for each horizon h. Panel (a) reports the differential response of inflation (month-by-month). Panel (b) reports the cumulative response of inflation. Shaded bands correspond to 95% and 68% confidence intervals obtained from 1000 Wild Bootstrap runs.

We can see a lower cumulative response of inflation when using the BCRA energy price index compared to the baseline model estimate that uses the World Bank energy price index, but the results are not significantly different. In our baseline model, the cumulative response is 0.055 pp after one year. In contrast, for the robustness exercise that uses the BCRA energy price index, the cumulative response is 0.036 pp after one year.

Figure 8 shows the impulse responses of inflation to a 1 pp increase in food prices (in percentage points). Panel (a) reports the differential response of inflation (month-to-month). We can see a positive impact, but this impact gradually diminishes over time. Panel (b) reports the cumulative response of inflation. The cumulative impact is significant and positive. Finally, the cumulative response is 0.087 pp after one year.

We can see a lower cumulative response of inflation when using the BCRA food price index compared to the baseline model estimate that uses the World Bank food price index, but the results are not significantly different. In our baseline model, the cumulative response is 0.125 pp after one year. In contrast, for the robustness exercise that uses the BCRA energy price index, the cumulative response is 0.087 pp after one year.

Figure 8. Impulse responses of inflation to a food prices shock



(a) Differential response (b) Cumulative response

Notes: The panels show impulse responses of inflation to a 1 pp increase in food prices (in percentage points). The solid purple lines show the point estimates β_h for each horizon h. Panel (a) reports the differential response of inflation (month-by-month). Panel (b) reports the cumulative response of inflation. Shaded bands correspond to 95% and 68% confidence intervals obtained from 1000 Wild Bootstrap runs.

5.4 Non-linear effects: energy trade surplus vs energy trade deficit

We identify non-linear effects of an energy price shock using Local Projections. We find that the impact of an energy price shock on inflation can be different when there is an energy trade surplus or an energy trade deficit.

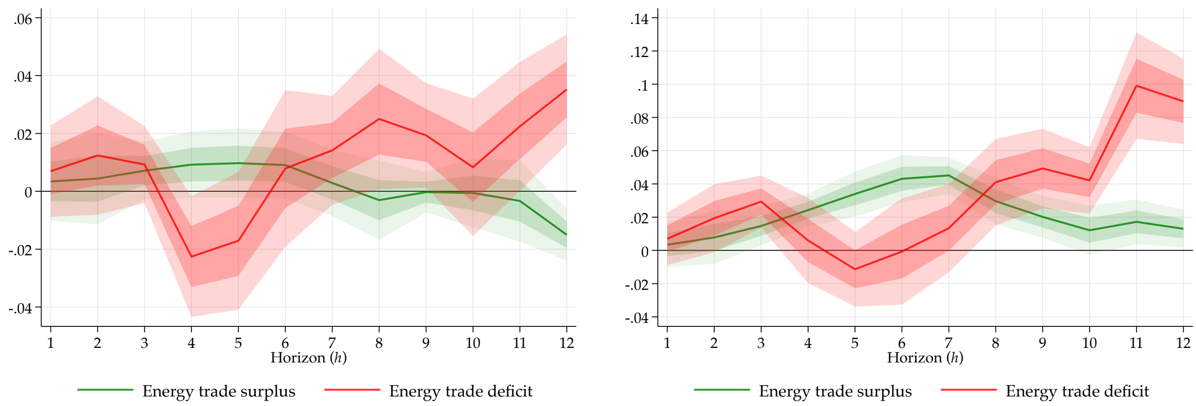
Argentina experienced two distinct phases of energy trade balance. Between 2004 and 2010, the energy trade balance consistently showed a surplus. In contrast, over the last decade, the energy trade balance has been in deficit, with the exception of 2020. That year, an increase in oil exports temporarily improved the trade balance.

We adjust the baseline model by incorporating a dummy variable S equal to one during periods of energy trade surplus, along with two interactions terms that capture non-linearities. Our model provides different estimates of the impact of an energy price shock on inflation depending on the value of S. The coefficient β_h^S captures the impact of an energy prices shock on inflation during periods of energy trade surplus when the dummy variable S is equal to one. Conversely, the coefficient β_h^D captures the the impact of an energy prices shock on inflation during periods of energy trade deficit when the dummy variable S is equal to zero.

Figure 9 shows the impulse responses of inflation to a 1 pp increase in energy prices (in percentage points). The solid red lines show the point estimates in periods of energy trade deficit β_h^D, while the solid green lines show the point estimates in periods of energy trade surplus β_h^S for each horizon h. The results indicate that during periods of energy trade deficit, the inflation response is higher than in periods of energy trade surplus

Panel (a) reports the differential responses of inflation (month-to-month). We can see that the impact of an energy price shock on inflation during periods of energy trade deficit is 0.007 pp, compared to 0.003 pp during periods of energy trade surplus at the time of the shock. Panel (b) reports the cumulative responses of inflation. We can see that the impact of an energy price shock on inflation during periods of energy trade deficit is 0.090 pp, compared to 0.013 pp in periods of energy trade surplus.

Figure 9. Impulse responses of inflation to an energy prices shock



(a) Differential response (b) Cumulative response

Notes: The panels show impulse responses of inflation to a 1 pp increase in energy prices (in percentage points). The solid red lines show the point estimates in periods of energy trade deficit β_h^D for each horizon h. The solid green lines show the point estimates in periods of energy trade surplus β_h^S for each horizon h. Panel (a) reports the differential responses of inflation (month-by-month). Panel (b) reports the cumulative responses of inflation. Shaded bands correspond to 95% and 68% confidence intervals.

Firms use imported production inputs for the production of local goods and services. When a country is a net importer of energy, an increase in international prices significantly increases firms' costs. Firms pass on these increased costs to consumer prices in order to keep their profit margins constant.

5.5 Using nominal effective exchange rate

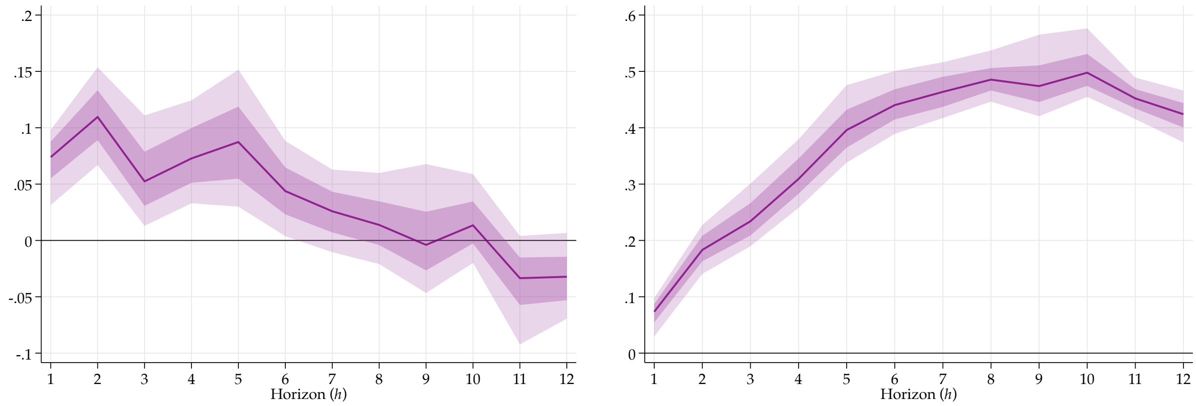
We replace the bilateral exchange rate with the nominal effective exchange rate (NEER) in the baseline model. As Caselli and Roitman (2019) argues, the nominal effective exchange rate is used because it captures the complete set of relative price adjustments that are expected to affect the consumer price index.

In this exercise, we use the nominal effective exchange rate index from Argentina's Central Bank. This index measures the nominal evolution of the Argentine peso against the currencies of the country's twelve main trading partners.

Figure 10 shows the impulse responses of inflation to a 1 pp increase in the nominal effective exchange rate (in percentage points). Panel (a) reports the differential response of inflation (month-to-month). We can see an exchange rate pass-through of 0.074 pp at the time of shock. The largest pass-through to prices is 0.074 pp after the impact. In the following horizons, the result remains positive but gradually decreases over the horizons.

Panel (b) reports the cumulative response of inflation. The exchange rate pass-through to inflation is 0.424 pp after one year.

Figure 10. Impulse responses of inflation to a nominal effective exchange rate shock



(a) Differential response

(b) Cumulative response

Notes: The panels show impulse responses of inflation to a 1 pp increase in the nominal effective exchange rate (in percentage points). The solid purple lines show the point estimates β_h for each horizon h. Panel (a) reports the differential response of inflation (month-by-month). Panel (b) reports the cumulative response of inflation. Shaded bands correspond to 95% and 68% confidence intervals obtained from 1000 Wild Bootstrap runs.

The cumulative response of inflation is 0.424 pp, which is lower compared to the 0.495 pp cumulative response of the baseline model that uses the bilateral exchange rate. This result aligns with the findings of Carriere-Swallow et al. (2021) for Latin American countries for the period 1995-2019. They find that the exchange rate pass-through to inflation is 0.5 after one year.

6. Testing wages as a transmission mechanism

We test the wage transmission mechanism, given its importance in developing countries and small open economies. Specifically, we focus on the transmission of supply shocks to nominal and real wage growth in Argentina. To achieve this, we estimate the impulse responses of wage growth to both domestic and external supply shocks using the Local Projections methodology during the period 2004-2022.[9] To examine the dynamics of wage adjustments in response to these shocks, we introduce two types of impulse responses: the differential response and the cumulative response.

1. Impact of a nominal exchange rate shock to wage growth

The analysis of wages as a transmission channel is relevant for understanding the exchange rate pass-through to inflation in Argentina. Especially since Argentina is characterised by

[9]For nominal wages, we use average remuneration index of registered workers in the private sector (RIPTE). For real wages, we construct the real wage index by calculating the ratio between the nominal wage index (RIPTE) and the consumer price index (CPI).

being an indexed economy with automatic wage adjustment mechanisms and high levels of unionisation (Judzik et al., 2022; Martínez Correa et al., 2018). An exchange rate shock can lead to accelerated wage growth, as workers try to restore their purchasing power to the pre-shock level (second-round effects). This could result in higher labour costs for firms, leading upward pressure on prices if firms pass these higher costs to consumers, potentially leading to a "*wage price spirals*". This channel generates inflationary pressures that may persist over time.

Figure 11 shows the impulse responses of wage growth to a 1 pp increase in the nominal exchange rate (in percentage points). The top panels show the impulse responses of nominal wage growth, while the bottom panels show the impulse responses of real wage growth.

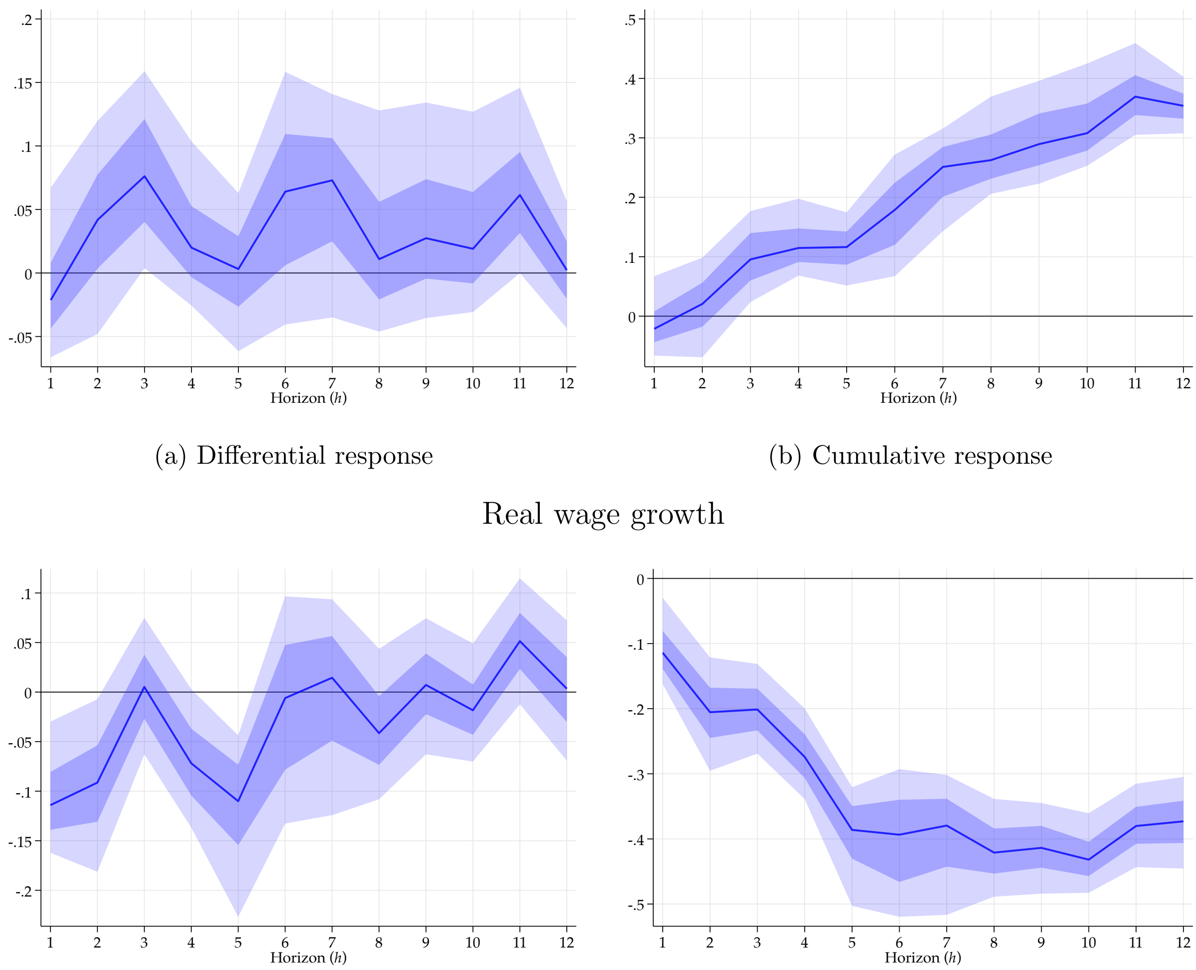
The impact of an exchange rate shock on nominal wage growth is positive. Compared to the cumulative response of inflation in panel (b) of Figure 1, the impact of a nominal exchange rate shock results in nominal inflation in both prices and wages. We can see that the exchange rate pass-through to nominal wage growth is 0.354 pp, compared to a pass-through of 0.495 pp to inflation.

In the bottom panels, we can see the negative impact of an exchange rate shock on real wage growth. In the panel (c), we can see how the real wage gradually recovers from the shock but deteriorates from the fourth horizon onwards. In the following periods, a saw-shaped dynamic emerges, characterised by alternating phases of positive and negative growth with a positive slope. This saw-shaped dynamic reflects the typical behaviour of wage adjustments in Argentina, showing the real wage resistance to decline.

Most contracts in Argentina have automatic clauses for indexation to lagged inflation, a common feature of high inflation regime, which explains the dynamics observed in the figure (Frenkel, 1988). Finally, the cumulative response of real wage growth is -0.373 pp after one year. These results suggest that second-round effects may explain the persistence of the impact of a nominal exchange rate shock on inflation.

Figure 11. Impulse responses of wage growth to a nominal exchange rate shock

Nominal wage growth



(a) Differential response

(b) Cumulative response

Real wage growth

(c) Differential response

(d) Cumulative response

Notes: The panels show impulse responses of wage growth to a 1 pp increase in the nominal exchange rate (in percentage points). The solid blue lines show the point estimates β_h for each horizon h. Panel (a) reports the differential response of nominal wage growth (month-by-month). Panel (b) reports the cumulative response of nominal wage growth. Panel (c) reports the differential response of real wage growth (month-by-month). Panel (d) reports the cumulative response of real wage growth. Shaded bands correspond to 95% and 68% confidence intervals obtained from 1000 Wild Bootstrap runs.

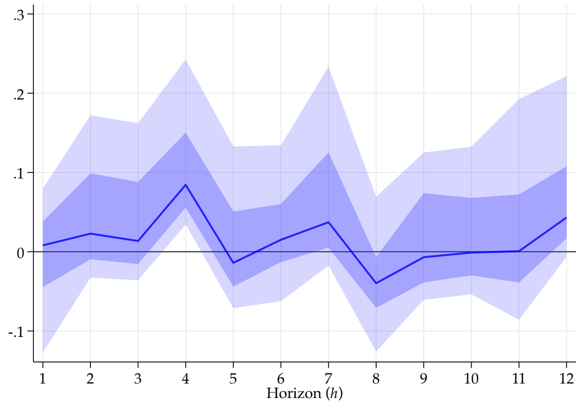
2. Impact of a regulated prices shock to wage growth

Regulated goods and services constitute an important part of the household consumption basket. When regulated prices rise or deregulation occurs, households experience a reduction in their purchasing power. It is essential to examine wage dynamics in response to regulated price shocks, as wages are a key channel through which these shocks transmit to inflation. This process contributes to nominal inflation in both wages and prices.

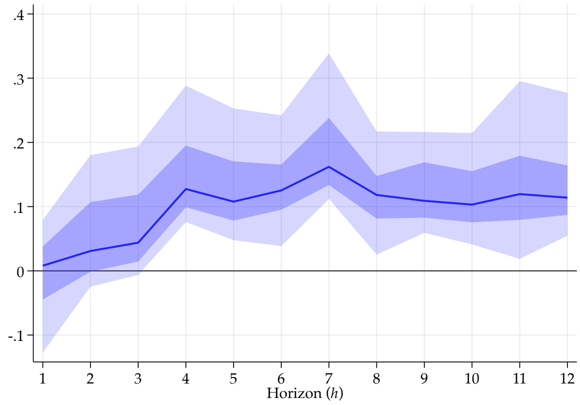
Figure 12 shows the impulse responses of wage growth to a 1 pp increase in regulated prices (in percentage points). The top panels show the impulse responses of nominal wage growth, while the bottom panels show the impulse responses of real wage growth.

Figure 12. Impulse responses of wage growth to a regulated prices shock

Nominal wage growth

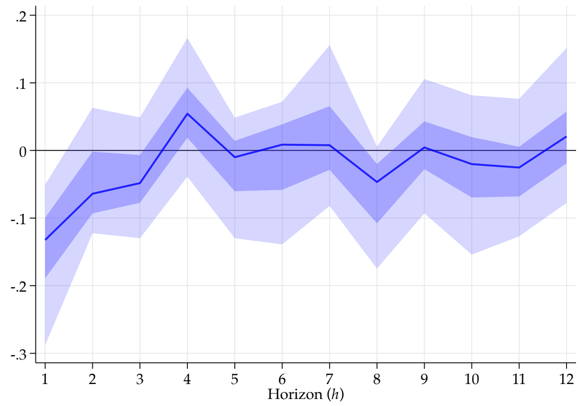


(a) Differential response

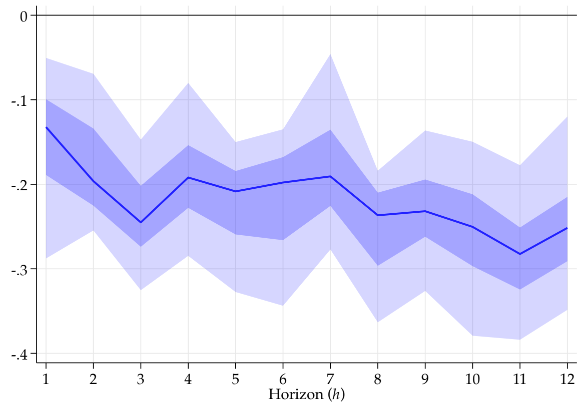


(b) Cumulative response

Real wage growth



(c) Differential response



(d) Cumulative response

Notes: The panels show impulse responses of wage growth to a 1 pp increase in regulated prices (in percentage points). The solid blue lines show the point estimates β_h for each horizon h. Panel (a) reports the differential response of nominal wage growth (month-by-month). Panel (b) reports the cumulative response of nominal wage growth. Panel (c) reports the differential response of real wage growth (month-by-month). Panel (d) reports the cumulative response of real wage growth. Shaded bands correspond to 95% and 68% confidence intervals obtained from 1000 Wild Bootstrap runs.

The impact of a regulated prices shock on nominal wage growth is positive. Compared to the cumulative response of inflation in panel (b) of Figure 2, the impact of a regulated prices shock results in nominal inflation in both prices and wages. We can see that the cumulative response of nominal wage growth is 0.114 pp, compared to the cumulative response of 0.354 pp of inflation.

In the bottom panels, we can see the negative impact of a regulated prices shock on real wage growth. The panel (c) shows that the real wage gradually recovers from the shock over the horizons. The panel (d) shows that the cumulative response of real wage growth is -0.252 pp after one year.

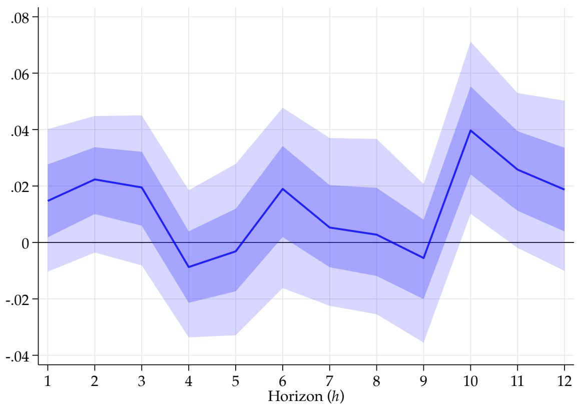
3. Impact of an energy prices shock to wage growth

An increase in energy prices leads to higher production costs for firms. To maintain profitability, firms transfer the rising costs onto consumer prices. As a result, households experience a reduction in their purchasing power.

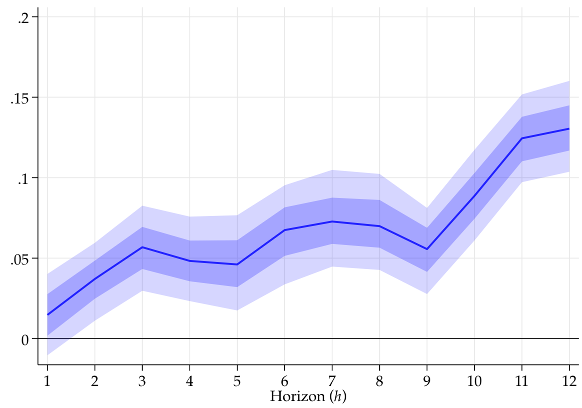
Figure 13 shows the impulse responses of wage growth to a 1 pp increase in energy prices (in percentage points). The top panels show the impulse responses of nominal wage growth, while the bottom panels show the impulse responses of real wage growth.

Figure 13. Impulse responses of wage growth to an energy prices shock

Nominal wage growth

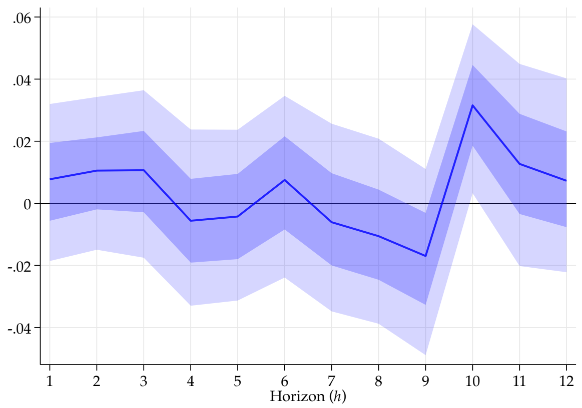


(a) Differential response

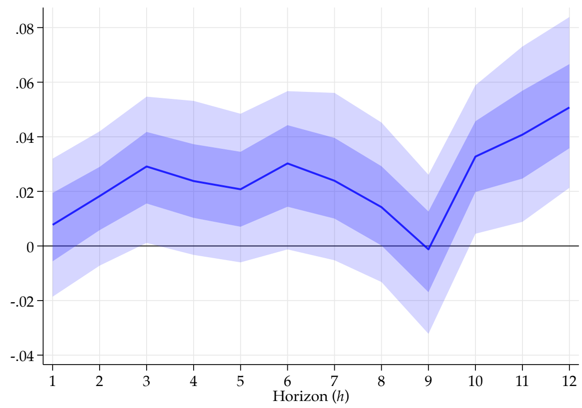


(b) Cumulative response

Real wage growth



(c) Differential response



(d) Cumulative response

Notes: The panels show impulse responses of wage growth to a 1 pp increase in energy prices (in percentage points). The solid blue lines show the point estimates β_h for each horizon h. Panel (a) reports the differential response of nominal wage growth (month-by-month). Panel (b) reports the cumulative response of nominal wage growth. Panel (c) reports the differential response of real wage growth (month-by-month). Panel (d) reports the cumulative response of real wage growth. Shaded bands correspond to 95% and 68% confidence intervals obtained from 1000 Wild Bootstrap runs.

The impact of an energy prices shock on nominal wage growth is positive. Compared to the cumulative response of inflation in panel (b) of Figure 3, the impact of an energy prices shock results in nominal inflation in both prices and wages. In panel (b), we can see that the cumulative response of nominal wage growth is 0.130 pp, compared to the cumulative response of 0.055 pp of inflation.

In the bottom panels, we can see the impact of an energy prices shock on real wage growth. Panel (c) shows that the real wage gradually declines over the horizons after the shock, but then recovers rapidly from the tenth horizon onwards, reversing the cumulative fall in the real wage. Compared to other countries, Argentina has high residential energy subsidies. This may explain why the decline in real wages is mitigated when an energy price shock occurs. Finally, panel (d) shows that the cumulative response of real wage growth is 0.051 pp after one year.

4. Impact of a food prices shock to wage growth

Rising food prices have a direct impact on the household consumption basket. In addition, increasing international prices increase production costs for firms. To maintain their profitability, firms pass the increase in costs to consumers. As a result, households experience a reduction in their purchasing power through these two channels.

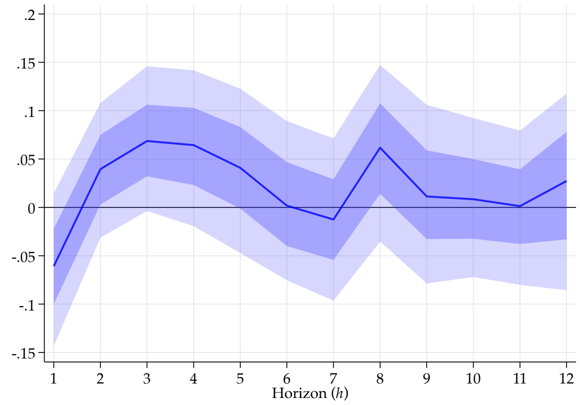
Figure 14 shows the impulse responses of wage growth to a 1 pp increase in food prices (in percentage points). The top panels show the impulse responses of nominal wage growth, while the bottom panels show the impulse responses of real wage growth.

Panel (a) shows that the impact of a food price shock on nominal wage growth is initially negative. Compared to the cumulative response of inflation in panel (b) of Figure 4, the impact of a food prices shock results in nominal inflation in both prices and wages. We can see that the cumulative response of nominal wage growth is 0.310 pp, compared to the cumulative response of 0.125 pp of inflation.

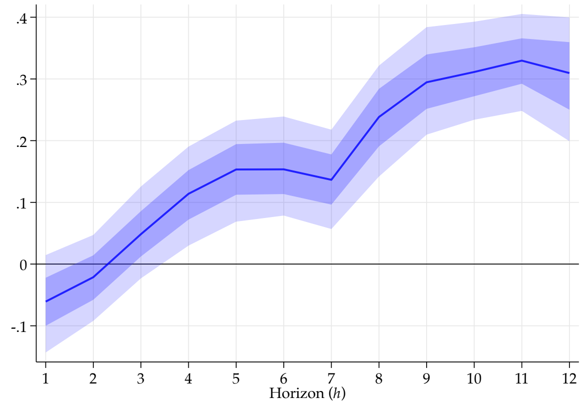
In the bottom panels, we can see the impact of a food prices shock on real wage growth. Panel (c) shows that the real wage declines at the time of the shock, but then recovers quickly and oscillates between positive and negative variations over the horizons. Panel (d) illustrates how the cumulative response of real wage growth recovers after the shock. Finally, the cumulative response of real wage growth is 0.099 pp after one year.

Figure 14. Impulse responses of wage growth to a food prices shock

Nominal wage growth

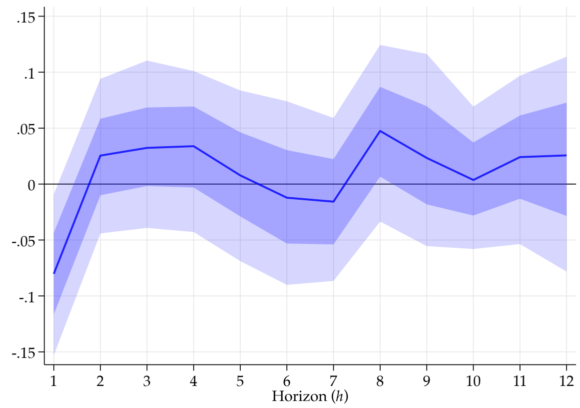


(a) Differential response

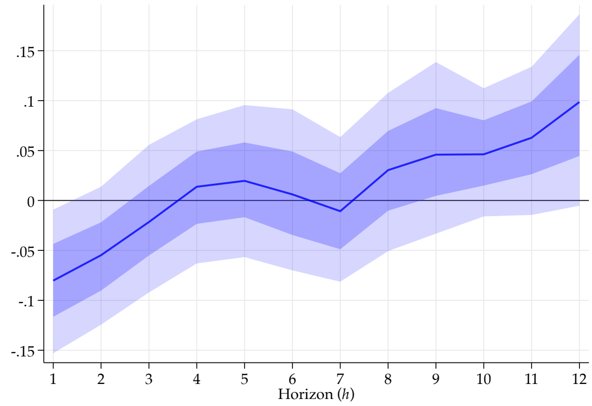


(b) Cumulative response

Real wage growth



(c) Differential response



(d) Cumulative response

Notes: The panels show impulse responses of wage growth to a 1 pp increase in food prices (in percentage points). The solid blue lines show the point estimates β_h for each horizon h. Panel (a) reports the differential response of nominal wage growth (month-by-month). Panel (b) reports the cumulative response of nominal wage growth. Panel (c) reports the differential response of real wage growth (month-by-month). Panel (d) reports the cumulative response of real wage growth. Shaded bands correspond to 95% and 68% confidence intervals obtained from 1000 Wild Bootstrap runs.

7. Conclusion

In this article, we study how domestic and external supply shocks influence inflation in Argentina. Our results show that both domestic and external supply shocks positively influence inflation. The results reveal two main findings: First, both domestic and external supply shocks positively influence inflation. Second, there are significant variations in the magnitude and dynamic of how these supply shocks are transmitted to inflation.

Our empirical baseline model shows four main results. First, the nominal exchange rate shock has a positive and significant impact on inflation, with a pass-through rate of 0.495 pp after one year. Second, increases in regulated prices are inflationary in the short term, but this effect diminishes over time. The cumulative response of inflation to a regulated prices shock is 0.354 pp after one year. Third, we can observe that an energy prices shock exhibit a positive and significant influence on inflation. The cumulative response of inflation to an energy prices shock is 0.055 pp after one year. Finally, the impact of the food prices shock on inflation is positive and significant. The cumulative response of inflation to a food prices shock is 0.125 pp after one year.

These results highlight the complex and heterogeneous nature of supply shocks that affect inflation. Our findings expand the evidence available for developing countries by illustrating the dynamic response of inflation to different supply shocks.

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Appendix

Table 1. Data description and sources of information

Variables	Data description	Sources of information
Consumer price index	Consumer price index (Jan. 2004=100)	INDEC and Provincial Statistics institutes
Nominal exchange rate	Official bilateral exchange rate against the US dollar "Comunicación A 3500"	BCRA
Nominal effective exchange rate	Nominal effective exchange rate index (Jan. 2004=100)	BCRA
Regulated Prices	Regulated Price Index (Jan. 2004=100)	de la Vega et al. (2024), IPCBA, INDEC
Energy prices (WB)	Energy Price Index (Jan. 2004=100)	World Bank Commodities Price Data (The Pink Sheet)
Energy prices (BCRA)	Oil Price Index (Jan. 2004=100)	BCRA (Index of Commodity Prices)
Food prices (WB)	Food Price Index (Jan. 2004=100)	World Bank Commodities Price Data (The Pink Sheet)
Food prices (BCRA)	Agricultural Price Index (Jan. 2004=100)	BCRA (Index of Commodity Prices)
Seasonally Adjusted EMAE	Seasonally adjusted index of monthly economic activity estimator (Jan. 2004=100)	INDEC
Nominal wage index	Average remuneration index of registered workers in the private sector (RIPTE) (Jan. 2004=100)	Subsecretaria de Seguridad Social

Table 2. Unit Root Tests

Variables	Augmented Dickey-Fuller	Deterministic components	Augmented Perron	Deterministic components
Consumer price index	0.000	Trend and Drift	0.000	Trend
Nominal exchange rate	0.000	Trend and Drift	0.000	Trend
Nominal effective exchange rate	0.000	Trend and Drift	0.000	Trend
Regulated Prices	0.000	Trend and Drift	0.000	Trend
Energy prices (WB)	0.000	None	0.000	None
Energy prices (BCRA)	0.000	None	0.000	None
Food price (WB)	0.000	None	0.000	None
Food prices (BCRA)	0.000	None	0.000	None
Seasonally Adjusted EMAE	0.000	None	0.000	None
Nominal wage index	0.000	Trend and Drift	0.000	None

Notes: The table shows the p-values associated with the rejection of the null hypothesis that the series have a unit root. All series have no unit root in first log difference. Variables are expressed in log change with respect to the previous month for the period January 2024 to December 2022.