Inflation Regimes in Latin America, 2020-2022: Persistence, Determinants, and Dynamics

Gabriel Sánchez Hernández

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Contenido

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Inflation

- The most regressive tax that exists
- Increasing public interest in it's determinants and repercussions
- Most considerable worry in many countries, including Argentina and Colombia[1]

[1] According to *What Worries the World*, by IPSOS.

Objectives

The countries covered are Argentina, Brazil, Chile, Colombia, Costa Rica, and Mexico. Three main objectives:

1. To define inflationary regimes and measure their persistence
2. To examine the relative influence of a selected group of variables on inflationary processes
3. To identify differences over time between countries

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Inflation Shifts

- The *acceleration* of infation, rather than the rate itself
- Let $\phi_{c,t}$ denote the inflation shift of country c at time t:

$$\phi_{c,t} = \frac{CPI_{c,t}}{CPI_{c,t-12}} - \left(\frac{CPI_{c,t}}{CPI_{c,t-36}} \right)^{\frac{1}{3}} \tag{1}$$

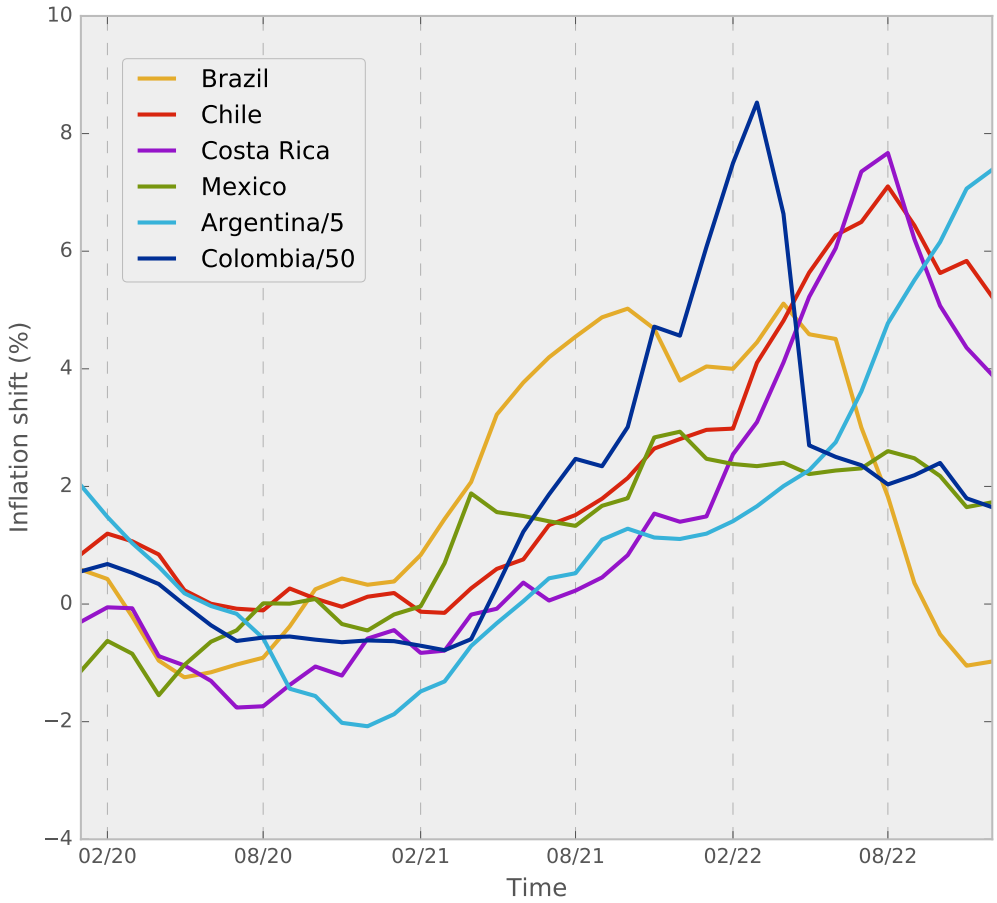


Figure: Inflation shifts (%) in Latin America, according to Equation (1)

Hidden Markov Model

A Hidden Markov Model is a tool for representing probability distributions over sequences of observations (Ghahramani, 2001)
There are two key concepts:

- Stochastic process: temporal sequence of random variables
- Time series: a singular realisation of a stochastic process Romero-Aguilar (2020)

Hidden Markov Model

A Hidden Markov Model has two main components:

- Observations: the inflation shift time series
- **Hidden** states or regimes[2]

Table: Categorisation, inflation shifts of Equation (1)

Inflation Shift	**Category**
$\phi_{c,t} < 0$	Deceleration
$0 \leq \phi_{c,t} < 2$	Normal shift
$2 \leq \phi_{c,t} < 4$	High acceleration
$\phi_{c,t} \geq 4$	Very high acceleration

[2]Which are assumed to follow the same categories as the observations

Hidden Markov Model

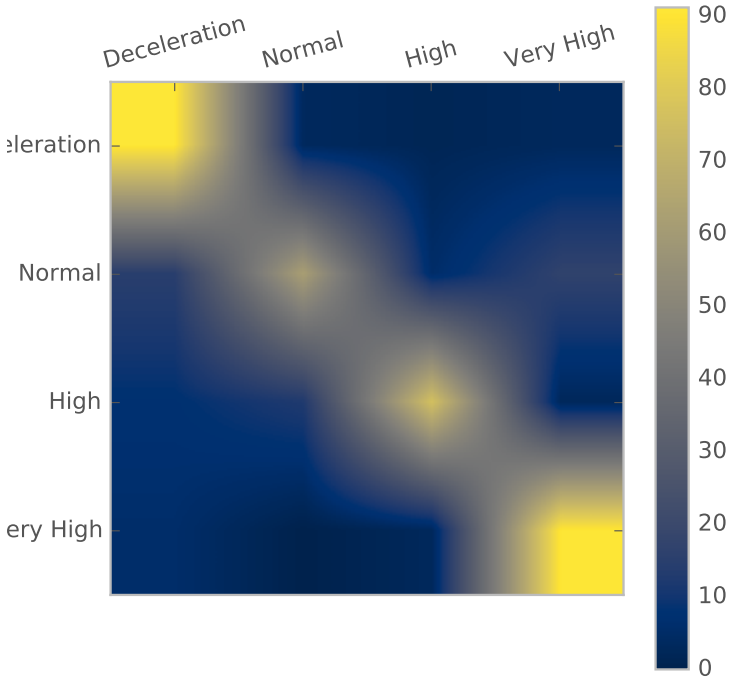
Three required parameters:

- Initial state transition model, A
- Observation model, B
- Initial state distribution, π

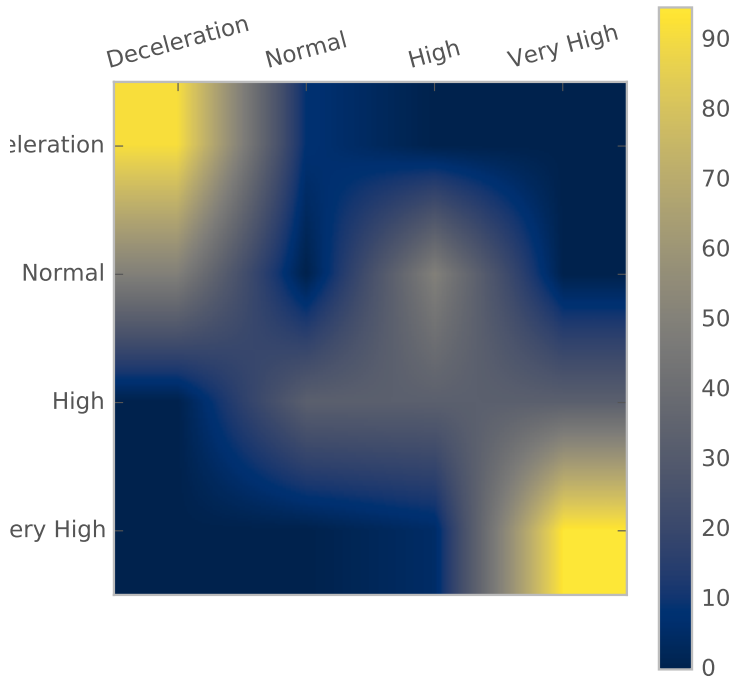
HMM Model

$$\lambda = (A, B, \pi)$$

We are interested in the **stationary** transition model



(a) Colombia



(b) Argentina

Figure: Probability of switching from inflation regime A (vertical axis) to B (horizontal axis).

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What Leads to Inflation?

Table: Theories and variables

Theory	Variable	Data
MP	Money Supply	M2
	Interest Rates	Policy-related interest rate
IF	US Inflation	Consumer Price Index
	Exchange Rates	Nominal ER to $1
DP	Private Consumption	Household's Consumption
CP	Producer Prices	Producer Price Index
IE	Inflation Expectations	Inflation Expectations

Data from FLAR's SIE, FRED and OECD, primarily.

Influence Method

- The Mahalanobis distance is a measure of divergence between groups in terms of multiple characteristics (Mahalanobis, 1936)
- This measure assigns a larger distance to those observations that show a larger variability
- Let the Mahalanobis distance for country c at time t from regime r be denoted as $\delta_{c,t,r}$:

$$\delta_{c,t,r} = (x_{c,t} - \mu_{c,r})^T S_{c,r}^{-1} (x_{c,t} - \mu_{c,r}) \quad (2)$$

Influence Method

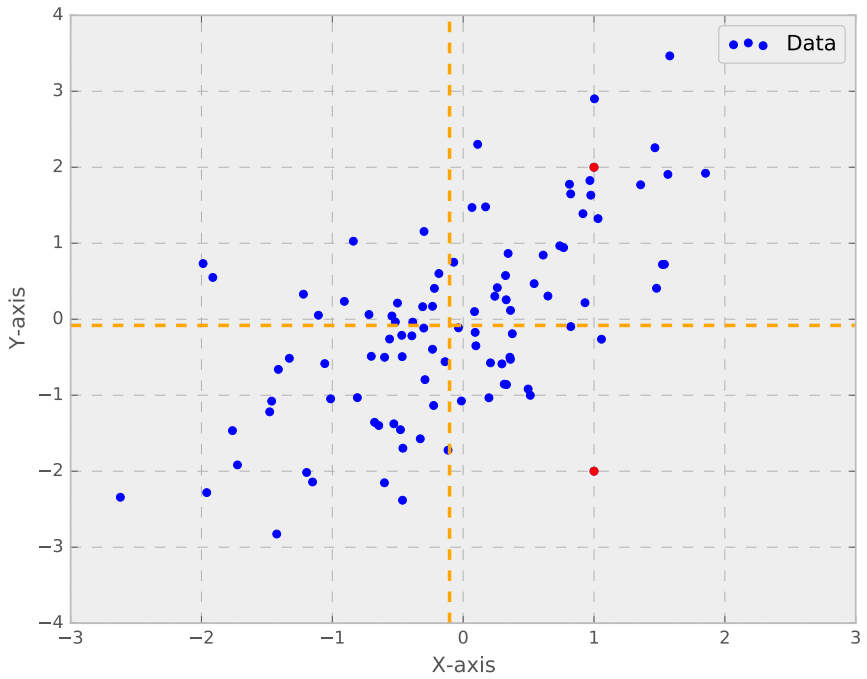

Figure: The Mahalanobis distance

$$\delta_{(1,2)} \approx 1.68 \quad \delta_{(1,-2)} \approx 3.11$$

Influence Method

Likelihood, normal distribution:

$$L_{c,t,r} = \frac{1}{\sqrt{det\left(2\pi S_{c,r}\right)}} exp\left(\frac{-\delta_{c,t,r}}{2}\right) \tag{3}$$

Probability of country c at time t to be in regime r:

$$\rho_{c,t,r} = \frac{L_{c,t,r}}{\sum_{all\ regimes\ r} L_{c,t,r}} \tag{4}$$

Sensitivity vector of regime r to the variables:

$$\frac{\partial \rho_{c,t,i}}{\partial x_{c,t}} = \rho_{c,t,i}\left[\left(\sum_{all\ regimes\ r} \rho_{c,t,r}\frac{\partial \delta_{c,t,r}}{\partial x_{c,t}}\right) - \frac{\partial \delta_{c,t,i}}{\partial x_{c,t}}\right] \tag{5}$$

Influence Method

Total sensitivity of the regimes:

$$\zeta_{c,t} = \frac{1}{4} \sum_{\text{all regimes } r} \left| \frac{\partial \rho_{c,t,r}}{\partial x_{c,t}} \right| \tag{6}$$

Relative importance:

$$\psi_{c,t} = \frac{\zeta_{c,t}\sigma_c}{\sum_{\text{all variables } v} |\zeta_{c,t}\sigma_c|} \tag{7}$$

The implemented method is developed in (Kinlaw, Kritzman, Metcalfe, & Turkington, 2022), who used it to identify inflation shifts in the United States.

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Latin America: A Heterogeneous Region

- Monetary and international factors are the most relevant
- Noticeable tendencies:
  - Costa Rica, 48% of inflation driven by monetary policy
  - International factors with 38% of Argentina's shifts
  - Cost-push in Brasil and Colombia
  - Demand-pull in Chile and Mexico

Latin America: A Heterogeneous Region

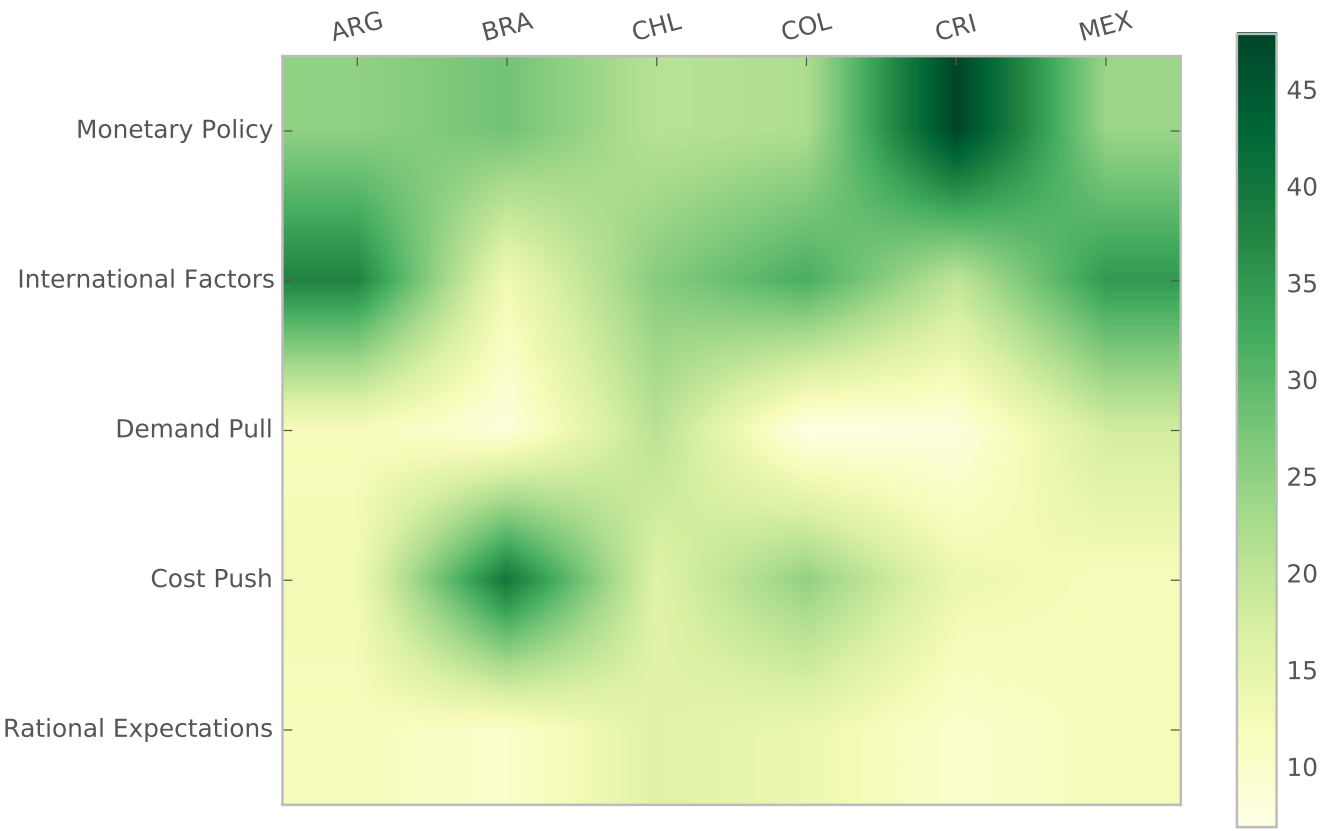


Figure: Inflation theories, average importance (%), 2020-2022

Latin America: A Heterogeneous Region

- All countries, except for Brasil, are more driven by interest rates in contrast with money supply
- Costa Rica and Chile: the most affected by policy rates, the less affected by M2
- Private consumption and inflation expectations show the same relative importance, and Chile leads both
- Consumption driven inflation shifts display a higher standard deviation in contrast with expectations
- The least important determinant: nominal exchange rate, with just 9%

Latin America: A Heterogeneous Region

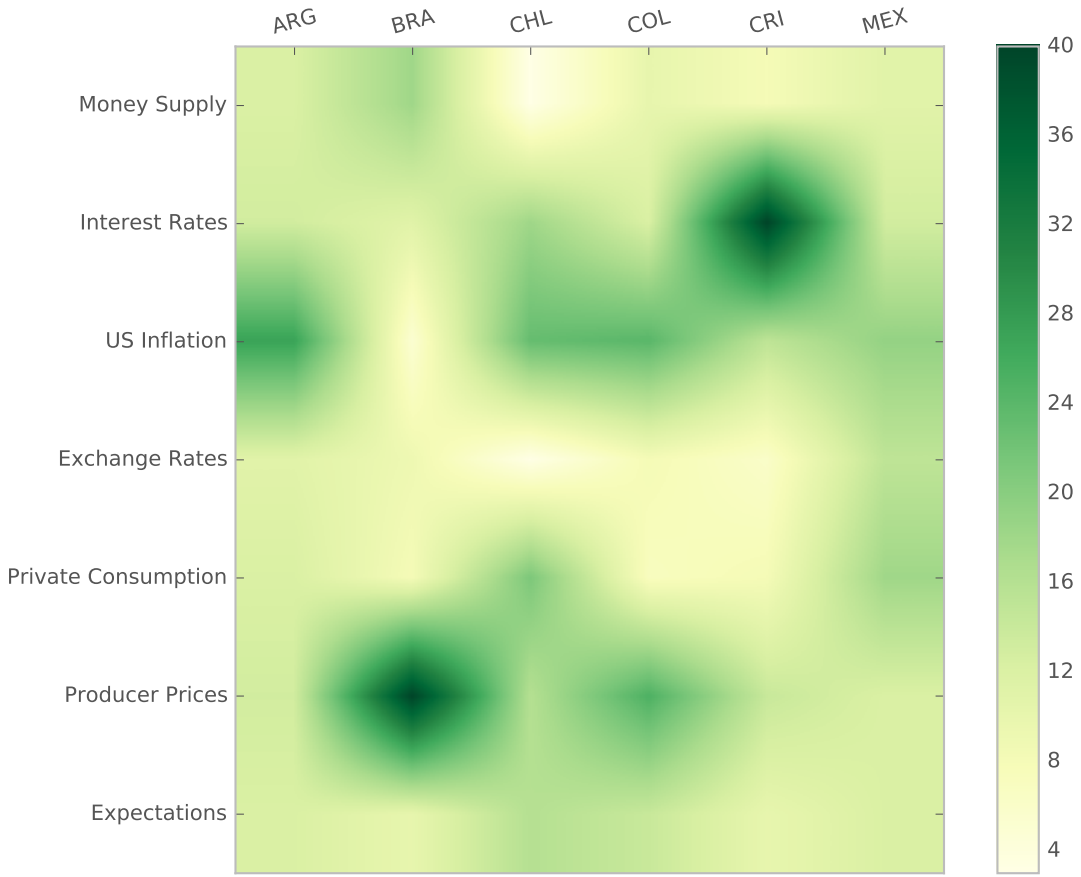


Figure: Inflation determinants, average importance (%), 2020-2022

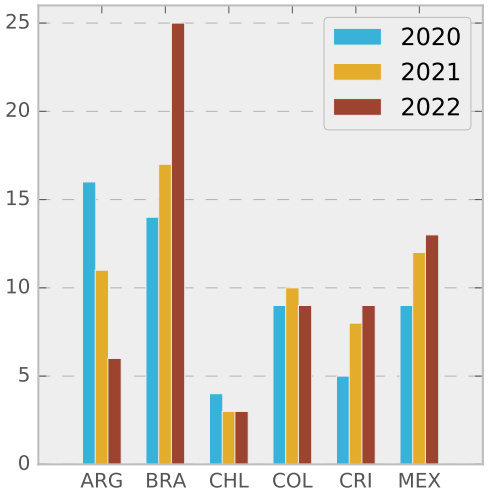
Time-Varying Determinants

Do countries follow a specific path throughout the period? **No.**

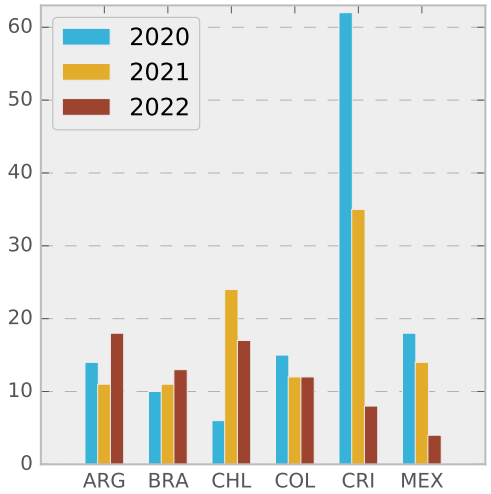
The variables display horizontal differences for each country; i.e. there can be highly marked determinants of inflation in average, but they generally vary from one year to another, even between months

Time-Varying Determinants

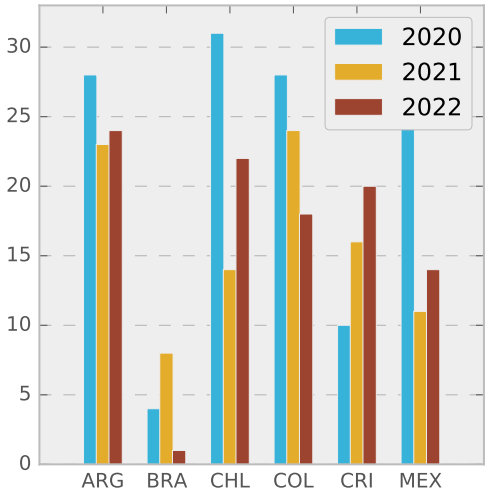
Money Supply



Interest Rates

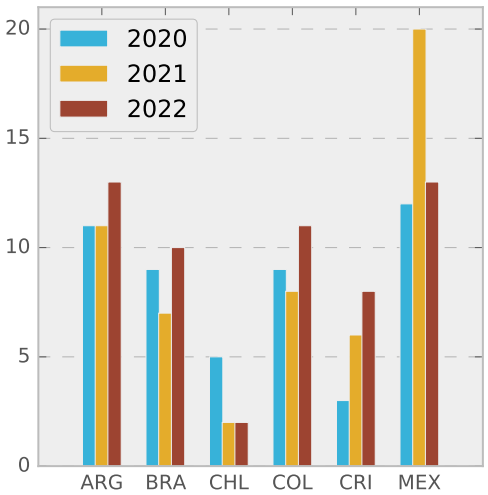


US Inflation

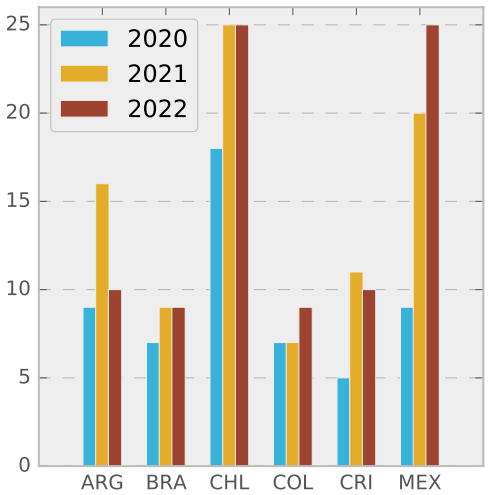


Time-Varying Determinants

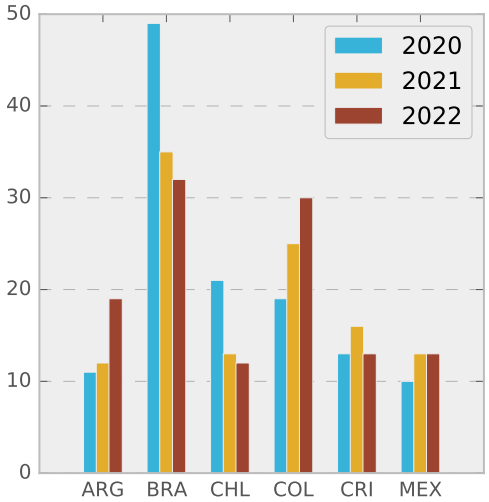
Exchange Rates



Private Consumption

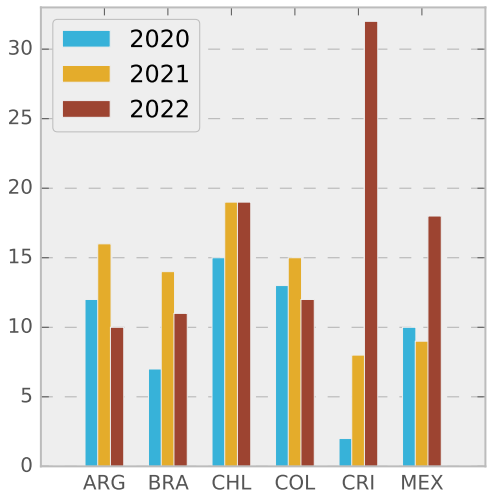


Producer Prices



Time-Varying Determinants

Inflation Expectations



Time-Varying Determinants

- US inflation highly influence LatAm countries, mainly Argentina
- The strongest effect of a single variable: Policy-related rates with 62% in Costa Rica (2020)
- These rates were also important in Chile, where private consumption played a key role with 25% of inflation driven by it in both 2020 and 2021
- Mexico was also highly influenced by demand-pull components
- Producer prices influenced most of the acceleration of inflation in Brazil and Colombia

Conclusion

Undoubtedly, inflation is not only a fluctuating phenomenon but one strongly responsive to current events.

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