Cross-section time series: Inflation and Exchange Rate in Latin America (2017-2023)

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IPSA-USP Summer School 2024

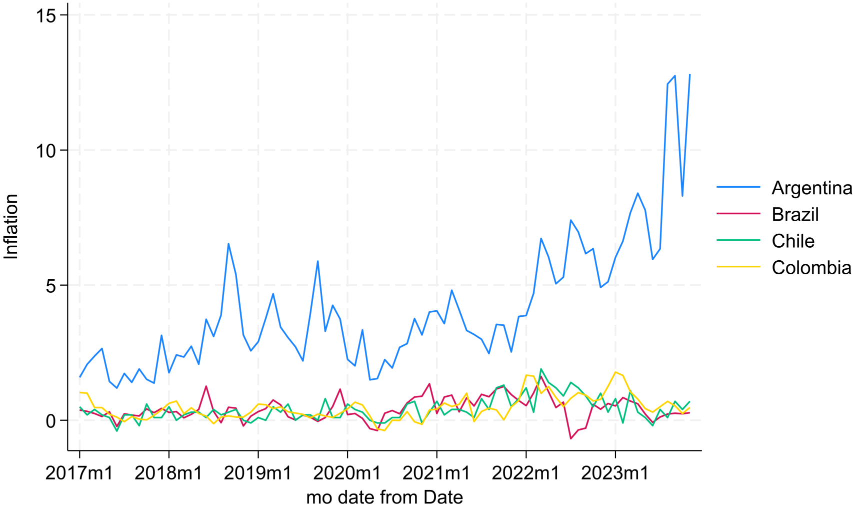
Esquema de presentación

1. Problem description
2. Modelling
3. Conclusions

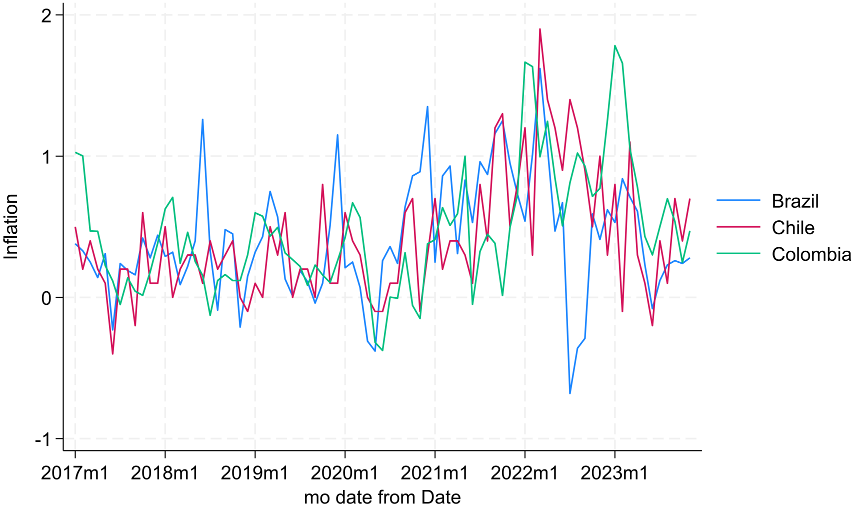
What we have until now

1. In the first week, we observed how **the exchange rate is the variable with the greatest relevance in explaining variations in monthly inflation in Argentina between 2017 and 2023.**
2. In the second week, we observed that **the same phenomenon is not observed in other Latin American countries.** Additionally, they behave very similarly among themselves in terms of stationarity.
3. Furthermore, we noticed that.**Argentina has restrictions on the purchase and sale of foreign currency**, which is visually evident in the graph.
4. **Objective:** to test whether the link between the exchange rate and short-term inflation appears to be different in Argentina compared to the rest of the countries.

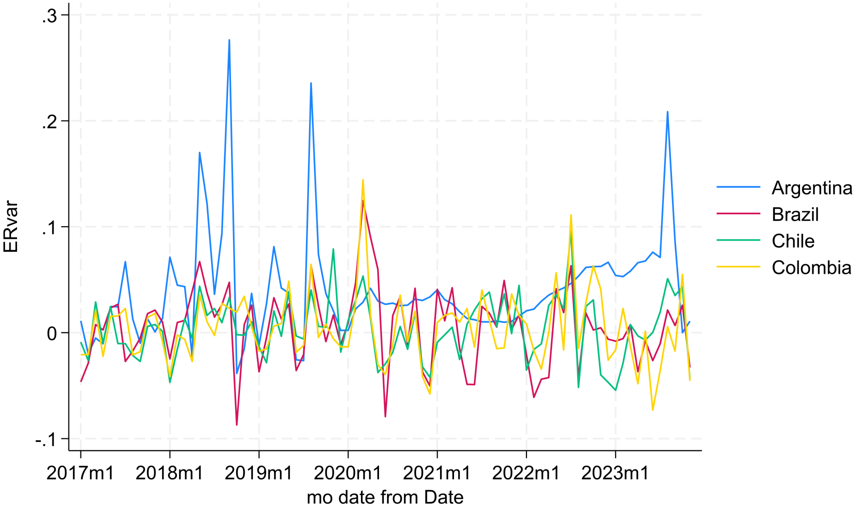
Timelines Inflation



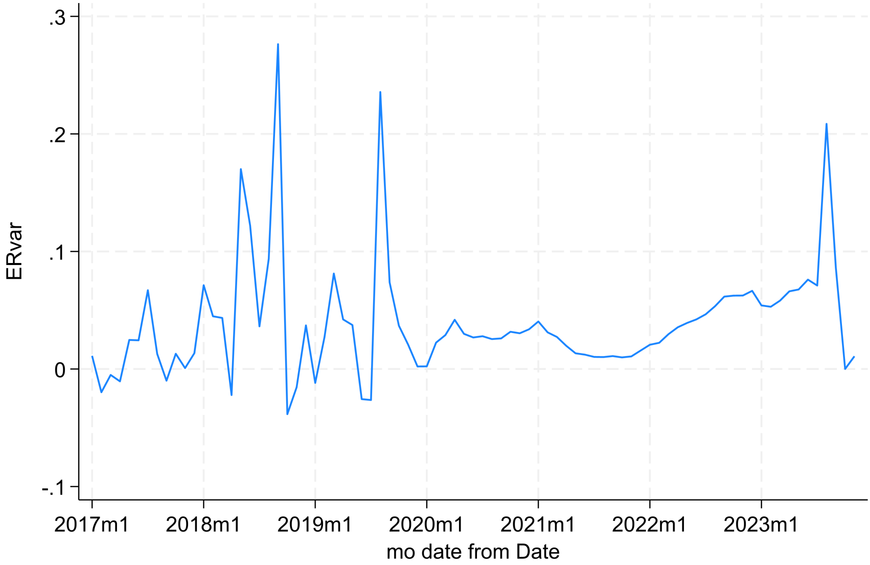
Timelines Inflation without ARG



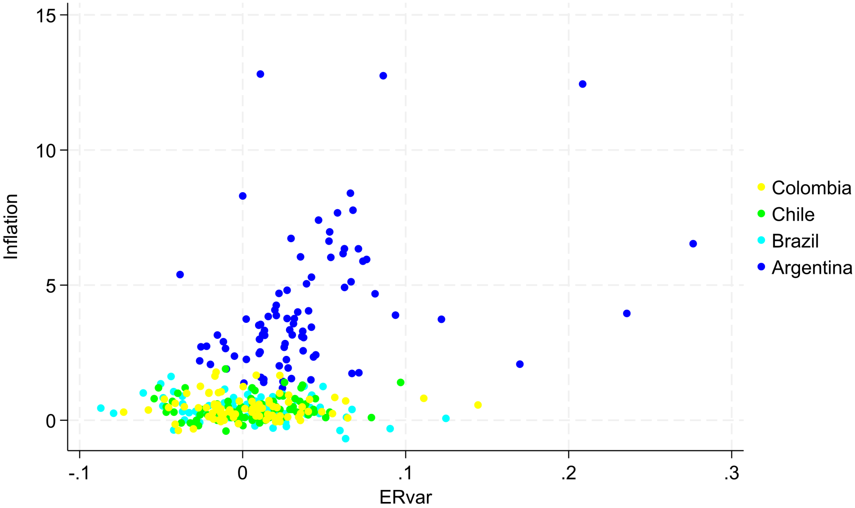
Timelines Exchange Rate



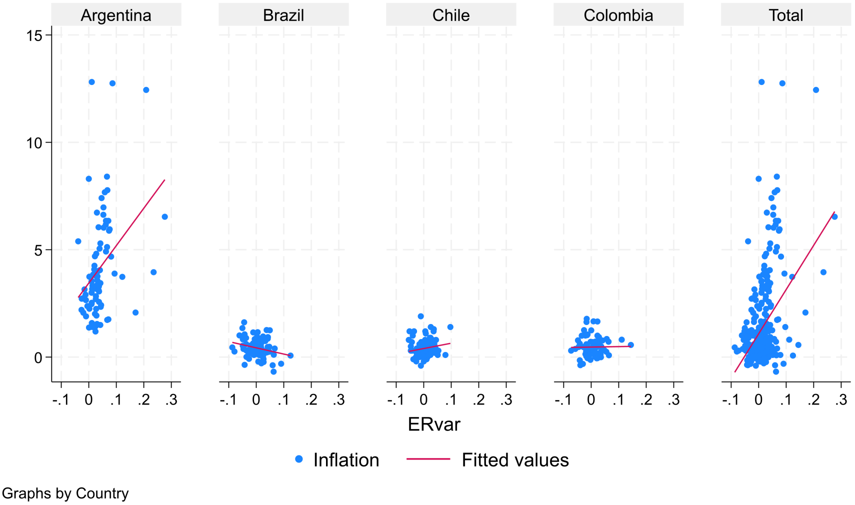
Timeline Exchange Rate ARG



Scatterplot



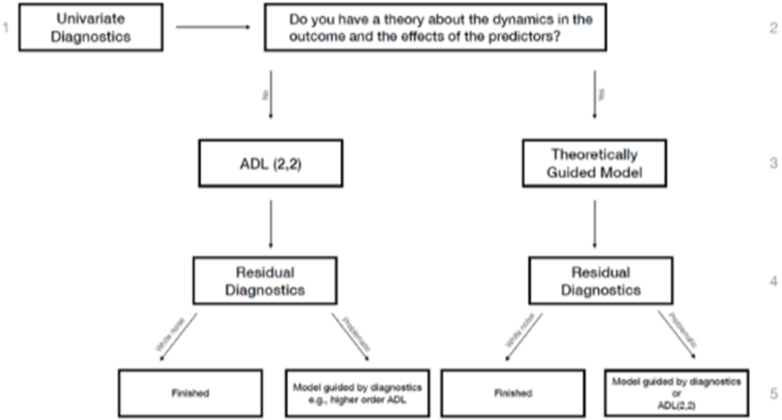
Scatterplots with regression lines



Conclusions

- The inflation distribution in Argentina is notably different and right-skewed compared to that of Brazil, Chile, and Colombia.
- In general terms, the exchange rate is much more similar, but it experiences recurrent and abrupt devaluations. This allows us to hypothesize about the pass-through effects.
- At first glance, the relationship between inflation and the exchange rate appears stronger in Argentina (with a steeper slope), yet at the same time, it exhibits greater variance.

Modelling Strategy



Model 1: results

$$Inf_t = \phi_1 Inf_{t-1} + \phi_2 Inf_{t-2} + \beta_0 ER_t + \beta_1 ER_{t-1} + \beta_2 ER_{t-2} + \alpha + \epsilon_t$$

Inflation	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
Inflation						
L1.	.696208	.0584557	11.91	0.000	.5816369	.8107791
L2.	.2745546	.0569868	4.82	0.000	.1628626	.3862466
ERvar						
--.	4.909608	1.050818	4.67	0.000	2.850042	6.969173
L1.	2.197005	1.115761	1.97	0.049	.0101534	4.383856
L2.	-2.959047	1.113745	-2.66	0.008	-5.141946	-.7761471
_cons	.0171449	.0494823	0.35	0.729	-.0798386	.1141283
sigma_u	0					
sigma_e	.72630644					
rho	0	(fraction of variance due to u_i)				

Model 1: residuals

$$\hat{u}_t = \rho\hat{u}_{t-1} + \phi_1 Inf_{t-1} + \phi_2 Inf_{t-2} + \beta_0 ER_t + \beta_1 ER_{t-1} + \beta_2 ER_{t-2} + \alpha + \epsilon_t$$

u_hat	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
u_hat						
L1.	-.9112978	.1996589	-4.56	0.000	-1.304141	-.5184545
Inflation						
L1.	.866253	.1985541	4.36	0.000	.4755835	1.256922
L2.	-.7908041	.1822725	-4.34	0.000	-1.149438	-.4321699
ERvar						
--.	-.442073	1.029881	-0.43	0.668	-2.468438	1.584291
L1.	-4.500857	1.470377	-3.06	0.002	-7.39393	-1.607784
L2.	-1.170049	1.11513	-1.05	0.295	-3.364148	1.02405
_cons	-.0392956	.0492996	-0.80	0.426	-.1362961	.057705

Model 2: results

$$Inf_t = \phi_1 Inf_{t-1} + \phi_2 Inf_{t-2} + \phi_2 Inf_{t-3} +$$
$$\beta_0 ER_t + \beta_1 ER_{t-1} + \beta_2 ER_{t-2} + \beta_2 ER_{t-2} + \alpha +$$

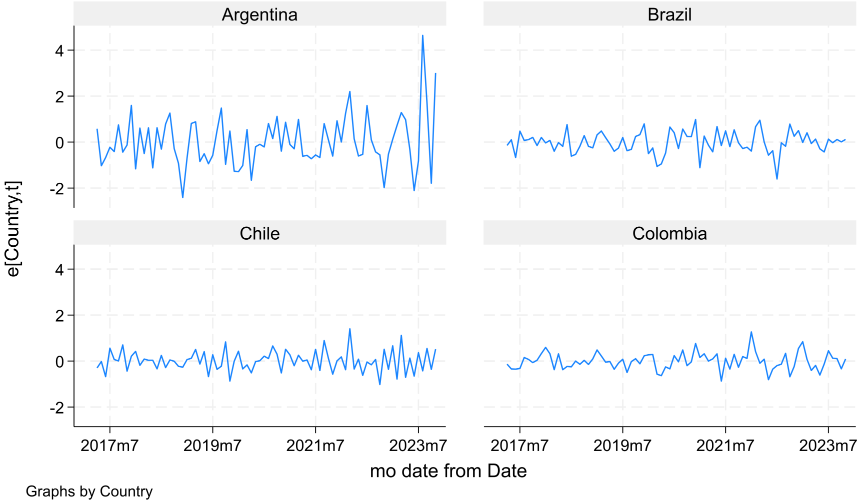
Inflation	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
Inflation						
L1.	.6724736	.0558635	12.04	0.000	.5629832	.781964
L2.	-.0593884	.0723118	-0.82	0.411	-.2011168	.0823401
L3.	.3847951	.0592471	6.49	0.000	.268673	.5009172
ERvar						
--.	3.897599	.9988074	3.90	0.000	1.939973	5.855226
L1.	2.347607	1.052538	2.23	0.026	.28467	4.410544
L2.	-2.363224	1.066206	-2.22	0.027	-4.452949	-.2734998
L3.	1.784166	1.059496	1.68	0.092	-.292408	3.86074
_cons	-.0244033	.0471503	-0.52	0.605	-.1168162	.0680097

Model 2: residuals

$$\hat{u}_t = \rho \hat{u}_{t-1} + \phi_2 Inf_{t-2} + \phi_2 Inf_{t-3} +$$
$$\beta_0 ER_t + \beta_1 ER_{t-1} + \beta_2 ER_{t-2} + \beta_2 ER_{t-2} + \alpha + \epsilon_t$$

u_hat	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
u_hat						
L1.	-.0841215	.1569984	-0.54	0.592	-.3930506	.2248075
Inflation						
L1.	.0703348	.1481498	0.47	0.635	-.2211827	.3618524
L2.	-.0517618	.1204421	-0.43	0.668	-.2887583	.1852348
L3.	-.0173669	.0700938	-0.25	0.804	-.155292	.1205583
ERvar						
--.	.0255532	1.007911	0.03	0.980	-1.957736	2.008842
L1.	-.3090993	1.264452	-0.24	0.807	-2.797188	2.17899
L2.	-.1398896	1.119711	-0.12	0.901	-2.343168	2.063389
L3.	.1873813	1.145481	0.16	0.870	-2.066605	2.441368
_cons	-.0008981	.0478378	-0.02	0.985	-.0950295	.0932333

Model 2: residuals plot



Interaction model 1

$$
\begin{aligned}
& Inf_t = \\
& \phi_1 Inf_{t-1} + \phi_2 Inf_{t-2} + \\
& \beta_{00} ER_t + \beta_{10} ER_{t-1} + \beta_{20} ER_{t-2} + \cdots \\
& \beta_{01} ER_t \cdot Arg_t + \beta_{11} ER_{t-1} \cdot Arg_{t-1} + \beta_{21} ER_{t-2} \cdot Arg_{t-2} + \cdots \\
& \beta_{02} ER_t \cdot Restr_t + \beta_{12} ER_{t-1} \cdot Restr_{t-1} + \beta_{22} ER_{t-2} \cdot Restr_{t-2} + \cdots \\
& \alpha + \epsilon_t
\end{aligned}
$$

Where

- Arg_t is a dummy that indicates whether the country is Argentina
- $Restr_t$ is a dummy that indicates whether there are restrictions on currency purchase.

Interaction Model 1: results

Inflation	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
Inflation						
L1.	.593122	.0638674	9.29	0.000	.4674567	.7187872
L2.	.2605303	.0555259	4.69	0.000	.1512777	.3697829
ERvar						
--.	-.8290176	1.20623	-0.69	0.492	-3.202391	1.544355
L1.	-.2964177	1.229366	-0.24	0.810	-2.715314	2.122478
L2.	-.1529946	1.222017	-0.13	0.900	-2.55743	2.251441
ERArg						
--.	8.36299	1.863335	4.49	0.000	4.696698	12.02928
L1.	6.335711	1.991589	3.18	0.002	2.417067	10.25435
L2.	-4.87484	1.99413	-2.44	0.015	-8.798482	-.9511971
ERArg_Restrictions						
--.	23.90019	3.475736	6.88	0.000	17.06135	30.73904
L1.	-10.84425	4.575723	-2.37	0.018	-19.84743	-1.841074
L2.	.3056484	3.98185	0.08	0.939	-7.529026	8.140323
_cons	.0754862	.0466634	1.62	0.107	-.0163285	.167301

Interaction Model 1: residuals

u_hat2	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
u_hat2						
L1.	-.2456149	.2014062	-1.22	0.224	-.6419261	.1506964
Inflation						
L1.	.2214553	.1989851	1.11	0.267	-.1700919	.6130024
L2.	-.1729229	.1548895	-1.12	0.265	-.4777023	.1318566
ERvar						
--.	.0527616	1.210949	0.04	0.965	-2.330049	2.435572
L1.	.1875131	1.251028	0.15	0.881	-2.274162	2.649188
L2.	-.0159205	1.230293	-0.01	0.990	-2.436795	2.404954
ERArg						
--.	.1492504	1.873011	0.08	0.937	-3.536313	3.834813
L1.	-1.957588	2.689102	-0.73	0.467	-7.248991	3.333815
L2.	-.9989135	2.184049	-0.46	0.648	-5.296514	3.298687
ERArg_Restrictions						
--.	-1.6475	3.728567	-0.44	0.659	-8.984282	5.689281
L1.	-4.906806	6.162962	-0.80	0.427	-17.0338	7.220186
L2.	2.993243	4.616555	0.65	0.517	-6.090851	12.07734
_cons	-.0272051	.0525866	-0.52	0.605	-.1306808	.0762706

Everything OK with the residuals, but...

There are too many covariates

Interaction model 2

Let's prune the non-significant variables one by one, taking care not to remove intermediate lags. We obtain the new model:

$$
\begin{aligned}
&Inf_t = \\
&\phi_1 Inf_{t-1} + \phi_2 Inf_{t-2} + \\
&\beta_{01} ER_t \cdot Arg_t + \beta_{11} ER_{t-1} \cdot Arg_{t-1} + \beta_{21} ER_{t-2} \cdot Arg_{t-2} + \cdots \\
&\beta_{02} ER_t \cdot Restr_t + \beta_{12} ER_{t-1} \cdot Restr_{t-1} + \cdots \\
&\alpha + \epsilon_t
\end{aligned}
$$

Interaction Model 2: results

Inflation	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
Inflation						
L1.	.5926512	.0632333	9.37	0.000	.4682397	.7170626
L2.	.2630334	.051155	5.14	0.000	.162386	.3636808
ERArg						
--.	7.540546	1.416725	5.32	0.000	4.75314	10.32795
L1.	6.040346	1.532948	3.94	0.000	3.024271	9.05642
L2.	-5.004374	1.547442	-3.23	0.001	-8.048965	-1.959783
ERArg_Restrictions						
--.	23.90909	3.456632	6.92	0.000	17.10817	30.71001
L1.	-10.68526	3.940572	-2.71	0.007	-18.43833	-2.932189
_cons	.0683878	.0443225	1.54	0.124	-.0188166	.1555922

Interaction Model 2: residuals

u_hat2	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
u_hat2						
L1.	-.1611861	.1728075	-0.93	0.352	-.5012058	.1788337
Inflation						
L1.	.1403644	.1715316	0.82	0.414	-.1971448	.4778735
L2.	-.1020026	.1248088	-0.82	0.414	-.347579	.1435737
ERArg						
--.	.0533991	1.420752	0.04	0.970	-2.742102	2.8489
L1.	-1.208566	2.143805	-0.56	0.573	-5.426762	3.009629
L2.	-.5619098	1.674873	-0.34	0.737	-3.857425	2.733605
ERArg_Restrictions						
--.	-1.060386	3.641773	-0.29	0.771	-8.226016	6.105244
L1.	-2.028315	4.62178	-0.44	0.661	-11.12223	7.065598
_cons	-.0217083	.0507426	-0.43	0.669	-.1215504	.0781339

Comparison

Model	AIC	BIC	df
Model 1	721	742	6
Model 2	672	701	8
Model 1 with interactions	622	668	12
Model 2 with interactions	615	645	8

Possible explanations of results

In principle, it is unlikely that the exchange rate only affects inflation in one country. We have several hypotheses as to why this occurs:

1. **Data frequency:** When inflation accelerates, the pass-through to prices is faster. However, if we were to look at the results on an annual basis over a longer period, we should discover a link between exchange rates and inflation in other countries.
2. **Omitted variables:** There could be omitted variables that explain the difference.

Frame Title

We consider an inflation to be in the **Moderate** *range as long as people who live through it generally remain content to quote the inflation rate in per cent per year. In* **High inflations**, *people measure inflation in per cent per month, and consider annual figures meaningless except for historical purposes.(...) High inflations are invariably associated with short planning horizons.*[1]

[1] Heynmann and Leijonhufvud, 1995. "High Inflation: The Arne Ryde Memorial"

Obrigado!!