BBVA Research

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Estimating R* for selected LatAm countries

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What is r*...?

The natural rate of interest is the “unobservable” short-term real interest rate that allows an economy to operate at its potential level of output while maintaining stable inflation close to its target, in absence of significant shocks.

...and why the need for calculation?

Following the pandemic came a global rise in inflation. From the point of view of macroeconomic theory, everything indicates that interest rates will probably be higher than before the pandemic. **This work intends to determine a possible level (range) for r*, its possible drivers, and therefore its most probable trend** for some LatAm countries.

Main drivers of the natural rate of interest, according to leading literature*

	Theoretical Relationship
Potential Growth: Increases the natural rate by raising investment demand	+
Demographics: Measured by a dependency ratio, a larger working population increases investment demand (if measured by pop. aging, savings increase)	− +
Productivity: Improves the profitability of capital and increases the rate	+
US natural interest rate: Defines a global minimum cost for financing	+
Risk: The possibility of a default increases the precautionary premium by increasing the rate. This is why r* has an inverse correlation with commodity prices in emerging markets	+
Business Cycles: Temporary crises reduce the natural rate	−
Capital Flows: Massive inflows decrease the local natural rate	−

(*): See the annex 1 for the literature.

But they do not have the same impact or operate on the same channel on all economies

	Advanced Economies		Emergent Economies	
Drivers	Channel	Effect: Sign & Intensity	Channel	Effect: Sign & Intensity
Potential Growth	Downward trend due to aging and stagnation of productivity	**(-)**	Dependent on infrastructure and access to capital	**(+)**
Demographics	**Aging** reduces natural rate	**(-)**	**Demographic dividends** raise savings, but decline with population transition	**(+)**
Capital Inflows	Stable inflows	**(-)**	Highly sensitive to external capital flows, which generates volatility	**(-)**
Productivity	Stagnation limits rate increases	**(+)**	Start from lower productivity levels (Tech & management)	**(+)**
Global Monetary Policy	Deep and broad financial markets as buffers	**(+)**	Significant effects from the transmission of global financial shocks	**(+)**

Different set of approaches in the literature to estimate r* and its determinants

	Laubach-Williams	DSGE	Taylor rule
Model Description	This model estimates r*as a function of expected inflation, potential output growth, and an unobserved factor (z) hat captures other structural determinants such as risk premia, technological progress, and demographic trends	Captures the economy's response to shocks and policy changes over time. Uses microfoundation to model agent decisions while considering external factors.	Monetary policy guideline that links the nominal interest rate to deviations from target inflation and output gap. When adjusted for inf. expectations, it can be used to infer an estimate or r* over time.
Considerations	**Advantages:** A reduced number of variables makes it easier to estimate across different economies. This method is widely used in advanced economies due to its reliance on standard macroeconomic relationships. **Disadvantages:** In LatAm economies, inflation expectations are volatile and often do not adjust efficiently due to the lack of an anchor. Recurrent crises or abrupt changes in monetary policy can distort these expectations. The original theoretical design might be unsuitable to include new variables that can be relevant in developing economies.	**Advantages:** Incorporates intertemporal choices and can integrate various economic shocks, making it useful to understand long term equilibrium. **Disadvantages:** Typically require substantial time for calibration and estimation, which was not feasible within tight deadlines.Data limitation and the economy's high volatility make it even tougher.	**Advantages:** The model uses variables that are easily disposable for every economy included in the modeling process. **Disadvantages:** In Latin American economies output gaps are highly volatile due to frequent economic shocks, making the Taylor Rule less effective. Moreover, CBs in these countries may not always follow the rule systematically, especially during periods of crisis, leading to inconsistent estimations of r*.

Different set of approaches in the literature to estimate r* and its determinants

Model Description	ECM	ECM Panel	Time Varying Parameter VAR
	It allows the modelling of long-run relationships between r* and potential structural drivers.	It also enables modelling of long-run relationships between r* and potential structural drivers.	It is a more agnostic model that explains the evolution of economic variables in terms of their lagged values and random shocks.
Considerations	**Advantages:** If there exists a long-run cointegration relationship between a number of unobserved factors and the r*, then there must exist cointegration between the measures of those factors and the observed real interest rate.	**Advantages:** Generates greater flexibility to capture information across similar countries, reducing the limitation of fewer data in some economies and providing greater robustness to estimation.	**Advantages:** Captures the evolution of variables over the time, offering robust estimations even on the presence of structural changes. Its flexibility allows for the inclusion of variables that are more relevant for certain economies. It is a model capable of capturing a large amount of non-linear behaviour, such as asymmetric movements in the course of business cycles.
	Disadvantages: It does not capture structural changes easily. It does not have a predefined theoretical model, so it relies on the existing theoretical literature, allowing errors of misspecification.	**Disadvantages:** The gains in generality of the impact of variables means a loss on specificity on the effect by country, leading to less robust estimations when individual characteristics of a country prevail.	**Disadvantages:** The interpretation of coefficients is more complex. It requires longer times series.

Model selection criteria for this project

01

Data availability

- Frequency, history and quality of data was evaluated in different countries. The length of the historical data was one of the main limitations, as the frequency of most of the exogenous variables was annual or quarterly.

02

Developing economies characteristics

- Developing economies present particular characteristics that usually are not well captured by models originally designed for developed economies.
- Some of the economies to be modeled presented strong changes in some variables.
- Likewise, they face sudden changes in the monetary policy or external factors that deeply affect the economy, which are hard to model.

Empirical approach to estimate r* for Latam countries

TVP-VAR

- We estimate a simple TVP-VAR for three variables - GDP growth rate, inflation rate, and a measure of the real interest rate:

$$y_t = c_t + \sum_{j=1}^{L} A_{j,t}\, y_{t-j} + e_t$$

- **r* is given by the conditional long-horizon forecast (5 years) of the observed real rate**.
- **Flexible framework** for studying the complex relationships among macroeconomic data: model parameters (lag coefficients and variances of shocks) are allowed to vary over time, **capturing a variety of nonlinear behaviours** such as asymmetric movements of variables over the course of the business cycle or changes in economic uncertainty.
- Less on strong theoretical restrictions (as is the case of Holston, Laubach and Williams), offering **agnostic estimation** of co-movements among variables.

Panel ECM

- We estimate the following panel ECM:

$$\Delta r_{i,t} = \alpha\left(r_{i,t-1} - \beta' X_{i,t-1}\right) + \gamma' \Delta X_{i,t} + \varepsilon_{i,t}$$

where each country is denoted by i, $r_{i,t}$ is the observed real interest rate, and $X_{i,t}$ is a vector of indicators of potential drivers of the natural interest rate.

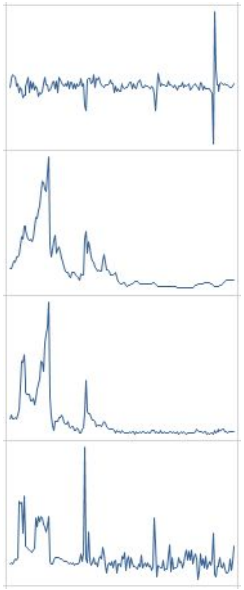
- **r* is given by the estimated linear combination of the observed factors**, β'Xi,t, and **it can then be decomposed** further in terms of the **contributions of each factor**.
- Advantages: (i) captures both long-term and short-term dynamics; (ii) accounts for heterogeneity across countries or regions; (iii) addresses some endogeneity concerns through lagged variables and cointegration.
- Disadvantages: (i) relies on data availability and quality; (ii) interprets as confronting different hypothesis to the data; (iii) an entire set of potential explanations behind r* are not considered.

TVP-VAR approach

Data availability for the selected countries

Country	GDP growth	Inflation (*)	Interest rate
Colombia	2Q80-2Q24	2Q99-3Q24	1Q98-3Q24
Mexico	1Q80 - 2Q24	1Q69 - 2Q24	1Q78 - 2Q24
Peru	1Q02-3Q24	1Q02-3Q24	1Q02-3Q24
Uruguay	3Q80-2Q24	3Q80-2Q24	3Q80-2Q24

High volatility is a greater challenge for applying the model to developing economies' data



Variables used in alternative specifications and tests

Interest rate

— Central bank policy rate
— Short-term government yield

Inflation

— Headline
— Core

Additional variables

— Exchange rate

Panel ECM approach

7 selected LatAm countries as cross-sectional units

- Brazil
- Chile
- Colombia
- Mexico
- Peru
- Uruguay
- Venezuela

Argentina was excluded from the panel ECM analysis
In the case of Venezuela, only data from 2000 to 2014 were included, due to hyperinflation and recession from 2015 to 2020.

Annual dataset spanning 2000-2023 for most countries (unbalanced panel)

n=7 | T=16-30 | N=169

Estimation method

Oneway (individual) effect Within Feasible Generalized Least Squares (FGLS) model

SELECTED VARIABLES

Theoretical var. / driver	Proxy variable	Pred. sign	Sources
Real interest rate (r)	**Real ex-ante policy rate[1]**		**National sources**
Global conditions	US r*	+	Brand & Mazelis (2019)
Demographics	Age dependency ratio[2]	ambiguous	World Bank
Productivity	Output per worker	+	National sources via Oxford Economics
Risk	Premium on USD-denom. debt	ambiguous	Oxford Economics
Commodity-price shock to Current Account	Terms of trade	ambiguous	IMF

[1] Central bank policy rate minus 4-year moving-average inflation. [2] Proportion of dependents (people younger than 15 or older than 64) per 100 working-age population.

Most joint cointegration tests provide evidence of long-run relationships among selected drivers of r* for the panel ECM framework

Kao test for cointegration

H0: No cointegration
Ha: All panels are cointegrated

Number of panels = 7
Avg. number of periods = 22.143

Cointegrating vector: Same
Panel means: Included
Time trend: Not included
AR parameter: Same

Kernel: Bartlett
Lags: 1.57 (Newey-West)
Augmented lags: 1

	Statistic	p-value
Modified Dickey-Fuller t	-4.4982	0.0000
Dickey-Fuller t	-3.8838	0.0001
Augmented Dickey-Fuller t	-4.3810	0.0000
Unadjusted modified Dickey-Fuller t	-7.1464	0.0000
Unadjusted Dickey-Fuller t	-4.5824	0.0000

Pedroni test for cointegration

H0: No cointegration
Ha: All panels are cointegrated

Number of panels = 7
Avg. number of periods = 23.143

Cointegrating vector: Panel specific
Panel means: Not included
Time trend: Not included
AR parameter: Same

Kernel: Bartlett
Lags: 2.00 (Newey-West)
Augmented lags: 1

	Statistic	p-value
Modified variance ratio	1.7885	0.0368
Modified Phillips-Perron t	-0.4317	0.3330
Phillips-Perron t	-1.2898	0.0986
Augmented Dickey-Fuller t	-1.5617	0.0592

Westerlund test for cointegration

H0: No cointegration
Ha: Some panels are cointegrated

Number of panels = 7
Avg. number of periods = 24.143

Cointegrating vector: Panel specific
Panel means: Included
Time trend: Not included
AR parameter: Panel specific

	Statistic	p-value
Variance ratio	-2.1340	0.0164

Westerlund test for cointegration

H0: No cointegration
Ha: All panels are cointegrated

Number of panels = 7
Avg. number of periods = 24.143

Cointegrating vector: Panel specific
Panel means: Included
Time trend: Not included
AR parameter: Same

	Statistic	p-value
Variance ratio	-1.0829	0.1394

The panel ECM analysis reveals common factors shaping r* in LatAm

ESTIMATED PANEL ECM MODELS

(Oneway (individual) effect Within FGLS model)

Variable	Spec. 1	Spec. 2	Spec. 3	Spec. 4
Lag(US r*)	1.065 [0.000]***	1.356 [0.000]***	1.036 [0.000]***	1.422 [0.000]***
Lag(Demographics)	-0.193 [0.002]***	-0.286 [0.000]***	-0.204 [0.001]***	-0.313 [0.000]***
Lag(Productivity)	0.315 [0.000]***	0.246 [0.000]***	0.269 [0.000]***	0.202 [0.000]***
Lag(Risk)	0.053 [0.310]	0.022 [0.621]	0.065 [0.198]	0.036 [0.382]
Lag(Terms of trade)		0.118 [0.058]*		0.169 [0.002]***
Lag(r)[1]	-0.489 [0.000]***	-0.515 [0.000]***	-0.520 [0.000]***	-0.533 [0.000]***
ΔUS r*	0.378 [0.083]*	0.378 [0.163]	0.306 [0.162]	0.262 [0.308]
ΔDemographics	1.030 [0.026]**	0.673 [0.165]		
ΔProductivity	0.702 [0.000]***	0.777 [0.000]***	0.731 [0.000]***	0.794 [0.000]***
ΔRisk	0.481 [0.000]***	0.396 [0.000]***	0.489 [0.000]***	0.377 [0.000]***
ΔTerms of trade		0.015 [0.758]		0.069 [0.053]*

[1] L(r) is the error correction coefficient, which indicates the speed of adjustment to the long-term equilibrium

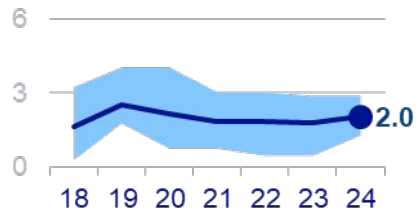
Variable	Predicted	Actual	Comments
US r*	+	+	US r* stands out as **the main driver of LatAm r***. Financial and economic developments driven by the advanced world tend to lead to correspondingly local r* changes in LatAm (a **globalization effect**).
Demographics (age dependency ratio)	ambiguous	-	A negative coefficient for the age-dependency ratio variable is equivalent to a positive relationship of r* to demographic dividends. That is, a lower age dependency ratio driven by **a growing working-age population** (which is still the case in LatAm) **encourages investment and leads to a higher r*.**
Productivity (output per worker)	+	+	As widely suggested by literature elsewhere, the prospect of higher expected returns on investment from **productivity gains** increases demand for investment and leads to upward pressure on r*.
Risk (premium on USD debt)	ambiguous	n.s.	No statistically significant relationship was found.
Terms of trade	ambiguous	+	Favorable ToT **improve profitability expectations in export sectors**, leading to higher investment demand and thus to an upward pressure on r*.

n.s.: not significant

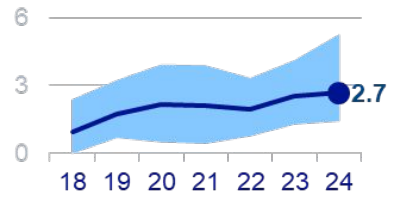
R* has exhibited similar fluctuations across the region

AVERAGE ESTIMATED R* FROM TVP-VAR AND ECM PANEL MODELS*
(%)

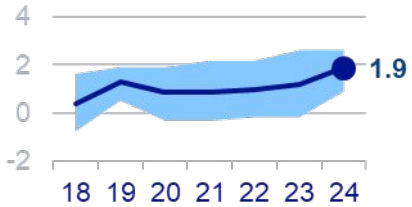
Colombia



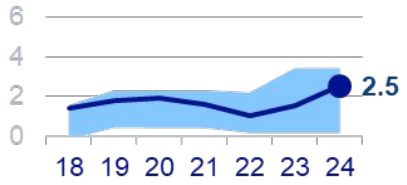
Mexico



Peru



Uruguay



R* for this set of countries in the last couple of years has **seen a slightly upward trend**.

This trend is more clear in the latter part of the sample, particularly in Peru and Uruguay.

In the case of Colombia, we observe a slightly more flat R* but, in alternative exercises with a prolonged set of information, the upward trend becomes more clear.

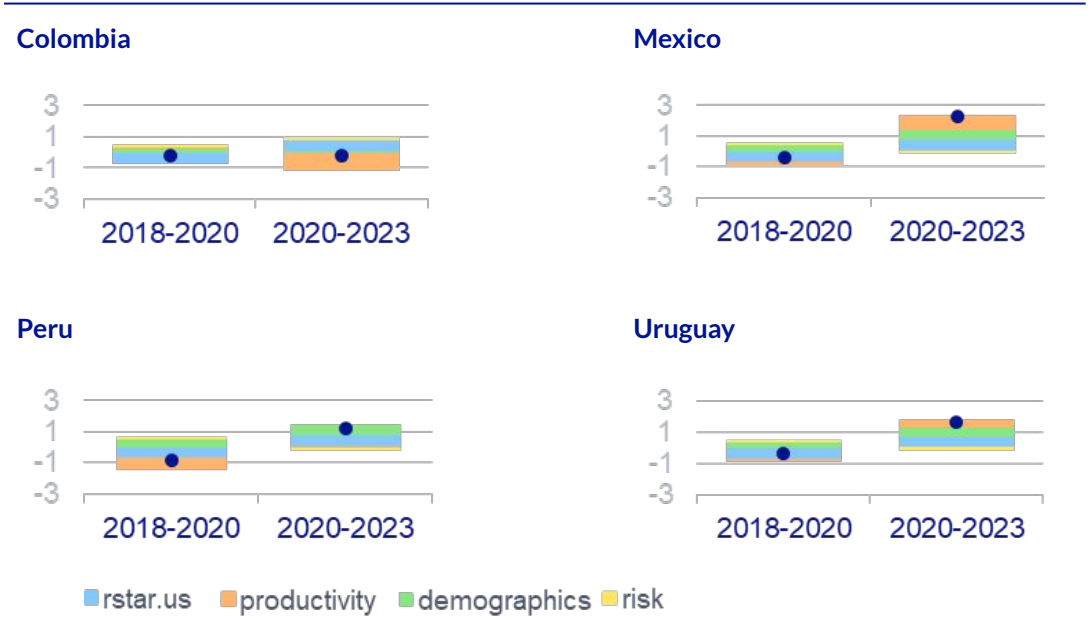
In the case of Mexico, the upward trend materializes earlier, and remains relatively stable by the end of the sample; despite this, the range of estimations does point upward and widens.

(*): The dark line refers to the average estimation, the grey shadow refers to the different range of estimations available.

The movements of the neutral rate in the US have been the main driver of the movements observed in r* in LatAm

CONTRIBUTIONS TO CHANGES IN R* (SPECIFICATION 3)

(%-pts.)



Orange dots represent changes in r*

The post-pandemic increase in policy rates in the US has led to a shift of the marginal contribution to R* in latam countries, with a **positive pressure in all countries in the last couple of years**.

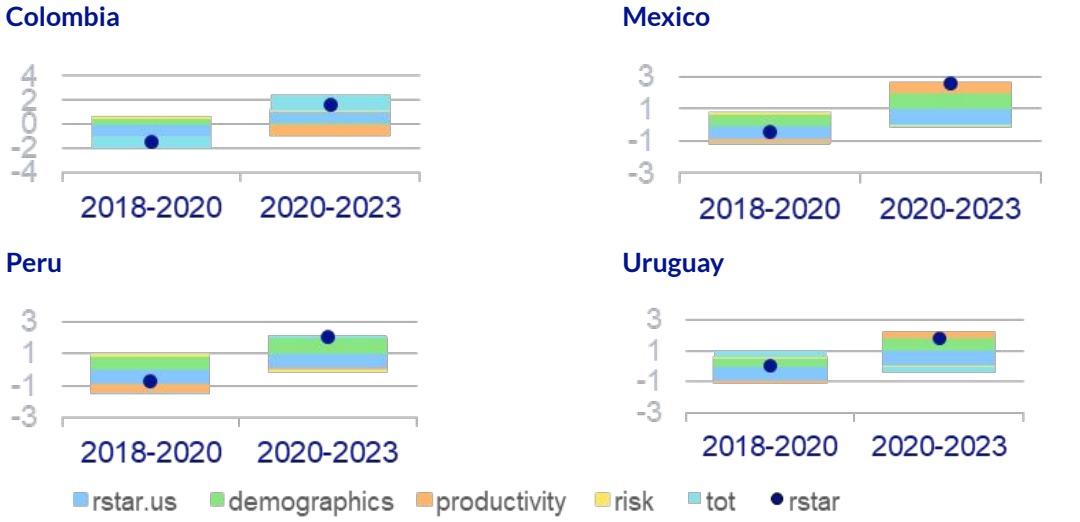
In the case of Peru, Mexico and Uruguay, demographics continues to pressure the R* upward (this is related to still downtrending age-dependency ratios). For Colombia, this factor has diluted already.

Productivity after the pandemic has pushed upward in Mexico and Uruguay, and has seen an improvement in Peru. In the case of Colombia, the reason why the R* remain more stable is related to a negative contribution of productivity

Terms of trade are also a relevant factor in explaining changes in r* in those countries with an export vocation mainly related to commodities

CONTRIBUTIONS TO CHANGES IN R* (SPECIFICATION 4)

(%-pts.)



Orange dots represent changes in r*

Terms of trade are more relevant in Colombia than in the other countries in this period.

We observe a change of contribution between the periods analyzed for Colombia driven by an increase in energy commodity prices due to the Russia-Ukraine war. **This may have pushed for higher investment demand in that period,** but might have since moderated due to the fall in oil prices and to a more negative scenario for fossil fuel investments in the country.

Uruguay, on the contrary, having a net import of commodities, has seen the hike in prices as a deterioration in the capabilities of the economy and thus reduced the investment needs.

Results are generally consistent with available estimates and provide us with an internal tool to assess the monetary policy stance

	BBVA Research			Benchmark				Current monetary policy	
	Low	Mid	High	Source (*)	Low	Mid	High	Real ex-ante rate	Stance
Colombia	1.3	**2.0**	2.9	BanRep (2024)		**2.2**		**4.7**	Contractionary
Mexico	1.4	**2.7**	5.2	Banxico (2024)	1.8	**2.7**	3.6	**4.8**	Contractionary
Peru	0.9	**1.9**	2.6	BCRP (2023)		**2.0**		**2.2**	Contractionary
Uruguay	0.2	**2.5**	3.4	BCU (2024)		**2.5**		**3.5**	Contractionary

(*): In parentheses the year in which the study was conducted.

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There is evidence of heterogeneity among the countries within the footprint, and within the countries throughout time.

Variable	Colombia	Mexico	Peru	Uruguay
US r*	↑ **Capital markets** will maintain the close relation.	↑ **strong integration** with the US despite potential tariffs	**Peru's r* seems to respond less to its US counterpart in recent years**, reflecting lower economic ties	↑ Hikes in the US rates, a failure in lowering inflation below 5% consistently.
Demographics	↓ Reduction in demography (higher dependency ratio) in the long term will decrease the r*.	↑ **Demographic bonus** may still last through the decade	**Demographic bonus** is phasing out in Peru and we estimate its effect on r* is small.	↓ Population ageing, in a society that already has a high propensity to save, could push the natural rate down due to excess aggregate savings.
Productivity	↑ Expected **recovery in investment** will increase the productivity measure, generating an upward pressure in r*.	↑ **Strengthening of the domestic market** and **nearshoring** prospects ↓ **Structural issues** (e.g., violence, informality) and judiciary reform	↓ **Lackluster productivity** will remain the main driver, weighing on investment and having a downward influence on r*. Some rebound in TFP is expected.	
Risk	↑ **Political and fiscal risks** have recently increase, a scenario that looks relatively persistent at the moment.	↑ **Political and fiscal risks** could weigh on country risk premia	**Country risk:** Estimates show that the impact of this variable on r* is minor, but remains the main source of uncertainty.	↑ **Country risk:** Estimates show that the impact of this variable on r* is minor.

Conclusions

1

It is difficult to model a non-observable variable and it is even more challenging in LatAm countries, where data availability is a concern and economic regime changes take place very often.

2

There is evidence of heterogeneity among the countries within BBVA's footprint, and within the countries throughout time.

3

The global r* rate (U.S.) will likely remain at high levels compared to the previous decade, driven by investments in artificial intelligence and the green transition, increased inflation uncertainty, and concerns about U.S. debt.

4

LatAm could see their r* continue trending upward in the next years, due mainly to the aforementioned uncertainties about the US debt sustainability and possible anti inflationary mismanagement, but also due to intrinsic characteristics such as higher investment needs and risk factors. Despite this, current policy stance is contractive, and thus policy rates are expected to moderate, but end up above pre-pandemic levels.

Annex 1: R* Literature

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