Emerging Markets Inflation Outlook and Regime Shifts in Global Market Sentiment

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Abstract:

This paper investigates how the impact of economic fundamentals and global financial conditions on inflation forecasts for emerging countries differs across two regime shifts in market sentiment, from Jan 2014 to Oct 2022. I employ a Markov-Switching framework to identify periods of low and high volatility, after which I build a panel fixed-effect regression model, allowing for the interactions of nation-specific and global factors with regime probabilities. From the estimation results, I find that while both groups of explanatory variables play a crucial role in shaping inflation outlook in each sentiment regime, the significance of global factors related to risk aversion, liquidity conditions is most pronounced during high-volatility periods. Further assessment shows that inflationary expectations in fundamentally weaker countries or highly volatile periods tend to be greater, albeit small differences compared to other groups.

Keywords: emerging markets; inflation forecasts; regime shift; macro fundamentals

1. Introduction

The global economy is currently at a cross-intersection of near 40-year high inflation, central banks expeditiously tightening monetary policy amidst ongoing geopolitical tensions, Russia-Ukraine war, and disruptions in supply chain as a result of China's zero-covid lockdowns. According to International Monetary Fund (IMF) forecasts, global growth is on track to slow by 2.7% in 2023, putting millions at the lower spectrum bearing the brunt of inflation inequality and soaring living costs.

Why are we interested in looking specifically at emerging markets? Developing nations are the beneficiaries of globalization, meaning that anything that happens on a global scale - including a slow-down across the globe - is felt directly by these emerging economies. Given that they are such an integral part of the world's ongoing growth and development, the need to understand exactly how they are impacted by different sources of risks is undoubted.

The goal of this paper is thus to help provide policymakers, investors and any like-minded enthusiasts with a breakdown of global risks and the severity of their impact across periods of differing volatility. This understanding can serve as a point of reference for policymakers to better mitigate risks through building robust policies to buffer the impact of inflation, as well as a reminder for policymakers of the importance of strong economic fundamentals. It can also provide investors with a strong basis for their generation of trade ideas and capital-expansion opportunities when looking to invest in emerging markets, especially during periods of distress.

2. Related literature

This paper is based on Balázs Csontó, Emerging market sovereign bond spreads and shifts in global market sentiment, Emerging Markets Review, Volume 20, 2014, Pages 58-74, ISSN 1566-0141, https://doi.org/10.1016/j.ememar.2014.05.003. The original response variable of Csontó's paper - emerging market sovereign bond spreads, is not available for public access, and therefore replaced by emerging market inflation forecasts for practicality, and to better align with my research interests.

3. Data

A balanced panel dataset of monthly observations between January 2014 and October 2022 is constructed for 9 emerging markets: Bulgaria, China, Indonesia, Russia, Brazil, Chile, Colombia, Hungary and Mexico. The response variable is Inflation forecasts (YoY %) from the IMF World Economic Outlook database.

The set of country-specific fundamentals and global financial indicators used as explanatory variables are as followed:

Explanatory Variables		**Definition**	**Source**
Economic Forecasts (Country-specific)	Real GDP Growth (YoY)	Inflation-adjusted economic growth	IMF World Economic Outlook (WEO)
	Current account balance (% of GDP)	Indicator of a country's international competitiveness	

Actual Fundamentals (Country-specific)	Public debt (% of fiscal year GDP)	Gov debt raised both internally and externally	World Bank
	International reserves (% of GDP)	Reserve assets used for country balance payments	
Global Factors	Chicago Board Options Exchange Volatility Index	Proxy for global risk aversion and investors' risk appetite	Yahoo Finance
	US Federal Funds Rate (%)	Proxy for global liquidity conditions	
	10-year US Treasury Yield (%)		

Descriptive statistics of the response and explanatory variables (Table 1) gives us a preliminary sense of the key variables' distribution. Gross debt, real GDP growth, inflation outlook and VIX seem to have greater-than-average data points with higher spreads.

Table 1: Descriptive statistics of explanatory and response variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Gross Debt	954	46.628	23.296	13.6	98.7
International Reserves	954	1.217	1.919	0	9.74
Real GDP Growth	954	2.582	3.648	-8.057	11.716
Inflation Outlook	954	4.161	3.242	-1.601	15.534
Current Account Balance	954	-.685	3.314	-6.702	12.158
Fed Funds Rate	954	.803	.852	.05	3.08
10Y Treasury Yields	954	2.102	.68	.624	3.984
VIX	954	18.184	7.024	10.125	57.737

The correlation matrix (Table 2) suggests that inflation outlook for these emerging markets are positively correlated with country-specific international reserves, supporting the fact that reserve holdings accumulation, which usually occurs in cases of domestic currency depreciation, leads governments to print more money, thus pushing prices higher and fueling inflation/CPI. Inflation expectations are also negatively correlated with GDP, reinforcing the current global decline in economic growth as a result of central banks tightening monetary policy to fight off inflation.

Table 2: Correlation matrix of explanatory and response variables

	Gross Debt	Reserves	GDP	Inflation	Acc. Bal	FFRate	10Y-TYields	VIX
Gross Debt	1							
Reserves	-0.489***	1						
GDP	-0.00402	-0.173***	1					
Inflation	-0.0198	0.187***	-0.125***	1				
Current Acc. Balance	-0.256***	0.618***	-0.142***	-0.0917**	1			
Fed Funds Rate	-0.00314	0.00624	0.0639*	-0.00160	-0.0223	1		
10Y TYields	-0.106**	-0.0923**	0.321***	0.176***	-0.0386	0.538***	1	
VIX	0.136***	0.125***	-0.302***	0.168***	0.0173	-0.105**	-0.349***	1

t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

4. Model

In order to investigate changes in inflation outlook across different global sentiment regimes, a two-step procedure is followed. Firstly, a Markov-switching Dynamic Regression model is applied to identify 2 regimes of low and high volatility. For the second step, a panel fixed-effect regression model takes into account the interaction of these regime probabilities with country-specific and global variables, allowing us to understand how inflation outlook shifts with global sentiment.

4.1. Regime Identification

The Markov-switching model was developed by Hamilton and Susmel (1994) to estimate and illustrate the dynamic behavior of time series variables in the presence of regime changes. Examples of these types of series are economic cycles with points of expansions and contractions (Graph 1), or bipolar disorders with manic and depressive periods.

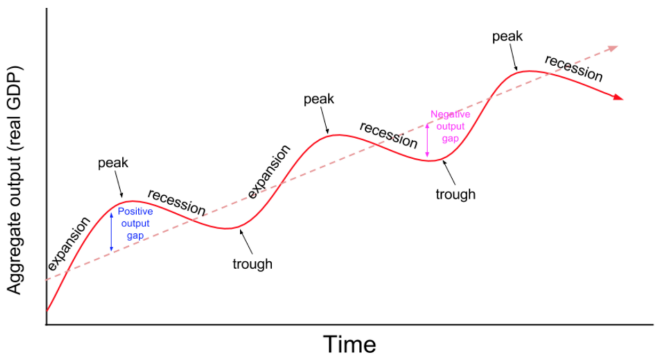

Fig 1: Markov-switching model application - the business cycle (Khan Academy).

These models are used for series whose characteristics transition over a set of unobserved states, which are determined by an underlying stochastic process - Markov-chain. Estimation of the Markov-switching models are based on Maximum Likelihood Estimation (Bayesian Estimation is also commonly used outside the context of this paper). There are two main types of Markov-switching models: Dynamic Regression (DR) and Autoregressive (AR). In this paper, the Dynamic Regression version is used, as it allows for quick adjustments after a regime shift, which is especially suited for our monthly-frequency panel data and the fast-paced nature of the markets.
For the purpose of identifying shifts in global market sentiment and risk behavior, the Markov-switching dynamic regression model is applied on the first difference of VIX series (Chicago Board Options Exchange's CBOE Volatility Index), a common measure of stock market's volatility expectation based on S&P 500 index options. The goal is to identify which period - from Jan 2014 to Oct 2022 - is associated with *low* or *high* volatility. Assume that the movements of the VIX index are not known, but can be estimated based on the model's probabilities of a given period belonging to each of the 2 states.

The Markov-switching Dynamic Regression (MSDR) model with 2 states of VIX (low-volatility and high-volatility) is mathematically expressed as:

$$y_t = \mu_{st} + \varepsilon_t$$

Where $\mu_{st}=\mu_1$ if $st=1$ (low), $\mu_{st}=\mu_2$ if $st=2$ (high). st shows which regime the process is in at date t as described by a Markov chain:

$$p_{ij} = p(s_t = j | s_{t-1} = i, s_{t-2} = k, \ldots, y_{t-1}, y_{t-2}) = p(s_t = j | s_{t-1} = i)$$

pij denotes the transition probabilities - probability of the process being in state j in the current period, given that it was in state i previously. yt denotes IMF inflation outlook for 9 emerging countries. εst indicates that residual errors of the model are normally distributed around a zero mean and unit variance, $N(o, \sigma^2)$.

4.2. Panel fixed-effects estimation

We start out with a simple panel regression model with no interaction terms:

$$inflation_{it} = \gamma'_1 X_{it-1} + \gamma'_2 Z_t + \mu_i + \varepsilon_{it} \quad (1)$$

where $inflation_{it}$ denotes inflation forecasts (IMF WEO). Xit, and Zt denote a ($k1 \times 1$) and a ($k2 \times 1$) vector of country-specific and global explanatory variables. μi is the country fixed effect, while $\gamma 1$ and $\gamma 2$ are ($k1 \times 1$) and ($k2 \times 1$) vectors of coefficients, respectively.

From this, we replace the country-specific and global explanatory variables with their interaction with regime probabilities, which helps us observe how shifts in market sentiment affects the impact of country/global factors on inflationary outlook.

$$inflation_{it} = \sum_{s=1}^{ks} p_{st} \gamma'_1 X_{it-1} + \sum_{s=1}^{ks} p_{st} \gamma'_2 Z_t + \mu_i + \varepsilon_{it} \quad (2)$$

where $\gamma 1s$ and $\gamma 2s$ denote ($k1 \times 1$) and ($k2 \times 1$) vectors of coefficients under regime s. p_{st} is the probability that VIX is in regime s in period t, while $ks = 2$ is the number of regimes.

5. Estimation results

5.1. Regime Identification

As a first step, based on the regime probabilities, the range of dates from January 2014 to October 2022 is split into 8 periods, either belonging to the Low or High volatility category.

The low-volatility regime has the highest probability in the following periods: early 2014 to middle 2015, early 2016 to early 2018, middle to late 2018, early to late 2019. Overall, this relatively extended period of reduced risk is categorized by a low interest rates environment, where monetary policy is expansionary and the economy is well- stimulated.

The high-volatility regime is most prevalent in short periods between 2018 and 2020, amid US-China trade wars and geopolitical tensions. A consistent volatile period started with the first onset of COVID-19 pandemic, which has since then caused a 6-month recession, and after that, outsized inflationary pressures due to pent-up demand exceeding supply post-quarantine eras. The entire period from 2020 to late 2022 is categorized as highly volatile.

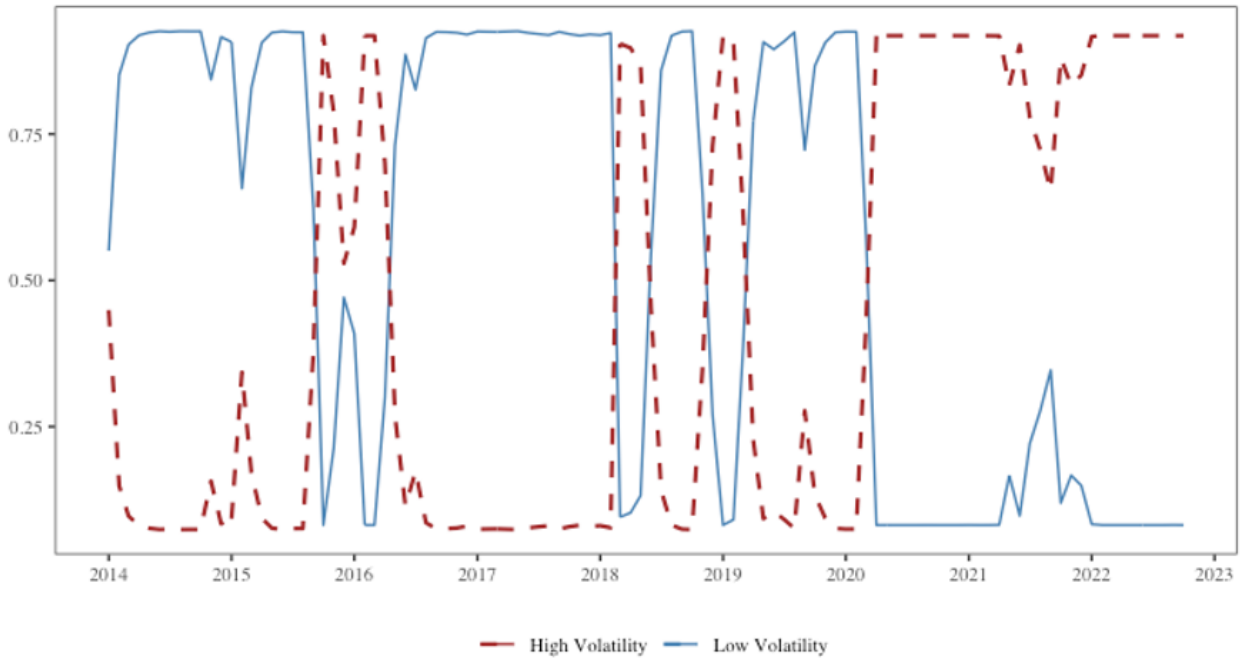

Fig 2: Probability of being in a Low-/High-Volatility regime for a given period.

As shown in Table 3, the high-volatility regime is characterized by elevated average inflationary outlook, higher average government debt, international reserves and greater expected stock market volatility, as measured by the VIX index. It is also in this highly volatile regime that we observe higher spreads in federal funds rate, which can be explained by the recent rate hikes of the Fed (3-3.25% as of October 2022), part of their monetary policy tightening process in an effort to bring down inflation. For the periods of this study, the average federal funds rate in high-volatility periods is somewhat lower than low-volatility, which was possibly weighed down by the extended stretch of near-ZLB federal funds rates from after the Financial Crisis to 2019. In addition, during times of high stress, the results show lower 10-year Treasury Yields, which moves in reverse to rising bond prices as investors - driven by increased fear and risk aversion - move their capital into safer assets like bonds. The significant

difference in average/standard deviation measures of inflation outlook across two regimes suggests that global investors are quick to revise their price expectations upward when indicators point to greater risks in the economy.

Table 3: Descriptive statistics - changes in country/global factors across 2 regimes

	Mean		**SD**		**Min**		**Max**	
	High	Low	High	Low	High	Low	High	Low
Gross Debt	50.563	43.725	24.143	22.230	13.6	13.6	98.7	98.7
International Reserves	1.516	.996	2.307	1.539	.003	.000	9.74	8.073
Real GDP Growth	2.574	2.588	4.562	2.793	-8.057	-8.057	11.716	7.391
Inflation Outlook	4.972	3.564	3.687	2.724	-1.323	-1.601	15.534	15.534
Current Account Balance	-.68	-.689	3.812	2.896	-6.702	-6.372	12.158	6.998
Fed Funds Rate	.674	.898	0.912	0.792	.05	.07	3.08	2.42
10Y Treasury Yields	1.899	2.252	0.862	0.451	.624	.87	3.984	3.152
VIX	22.438	15.045	5.598	6.282	14.125	10.125	41.454	57.737

Table 4 further reinforces the strength of relationships identified above, as proven by the statistically significant correlations in the high-volatility regime between inflationary expectations and (a) perceived volatility by VIX, (b) international reserves, (c) federal funds rates, (d) 10-year Treasury Yields. We also observe an enhanced negative relationship between VIX and GDP, implying greater effect of increased volatility on economic activity. Interestingly, in the face of greater global risks, there is a negative correlation between current account balance and GDP outlook, which underlies a belief that higher export revenue/lower domestic demand may not be able to offset the deteriorating impact of higher food and energy costs - now priced in very strong dollars - on emerging markets' economic growth.

Table 4: Pairwise correlations - changes in correlations of factors across 2 regimes

	Inflation	Gross Debt	Reserves	GDP	Acc.Bal	FFRate	10Y-TY	VIX
Inflation	1							
	1							
Gross Debt	-0.0913*	1						
	-0.0179	1						
Reserves	0.035	-0.543***	1					
	0.249***	-0.511***	1					

GDP	-0.381**	-0.0785	-0.177***	1				
	0.0265	0.0532	-0.174***	1				
Balance	-0.152***	-0.185***	0.620***	0.0829	1			
	-0.0502	-0.331***	0.628***	-0.286***	1			
FFRate	-0.140***	0.0865*	0.0953*	0.0225	-0.018	1		
	0.173***	-0.0604	-0.0315	0.096	-0.0262	1		
10Y-TY	-0.0296	-0.0637	-0.0880*	0.337***	-0.0513	0.116**	1	
	0.394***	-0.0811	-0.0481	0.331***	-0.0343	0.806***	1	
VIX	-0.00689	0.055	0.0508	-0.306***	-0.00234	-0.0244	-0.385***	1
	0.153**	0.0945	0.0836	-0.429***	0.0454	-0.0718	-0.197***	1

First and second rows show correlations during low- and high-volatility regimes.
t statistics in parentheses: * p<0.05, ** p<0.01, *** p<0.001

5.2. Panel fixed-effects estimation

The MSDR model estimation shows a remarkable increase in magnitude and significance of all explanatory variables from the Low- to High-Volatility regime. Global factors have a statistically significant estimated impact on inflationary expectations in both the Non-Switching and Switching models, however it is not until the High-Volatility regime of MSDR do we see a stark jump, especially in the 10-year Treasury Yields which almost triples its original effect. Overall, in the riskiest periods, greater inflationary outlook is associated with higher global risk aversion, lower Federal Funds Rate (which has led to an overstimulated economy with increased lending and consumption), upwardly trended long-term Treasury yields (in contrast to table 3 findings), and worse country-specific fundamentals (rising debt, foreign reserves and current account deficit - which is usually against the norm for export-heavy developing countries).

Table 5: Fixed Effects estimations. Response variable: Inflation Outlook (Jan 2014-Oct 2022)

VARIABLES	(1) Non-Switching	(2) Switching	
		Low Volatility	High Volatility
Actual Country Fundamentals			
Gross Debt	-0.0191	-0.0159**	0.0437***
	(0.0122)	(0.00645)	(0.00897)
International Reserves	0.366***	-0.00516	0.916***
	(0.101)	(0.122)	(0.145)
World Economic Outlook			
GDP Growth	-0.0194	-0.424***	0.272***
	(0.0303)	(0.0460)	(0.0580)
Current Account Balance	-0.326***	-0.129**	-0.250***
	(0.0454)	(0.0528)	(0.0692)
Global Factors			
VIX	0.123***	-0.0465**	0.163***
	(0.0142)	(0.0192)	(0.0321)
Fed Funds Rate	-0.676***	-0.457***	-1.807***
	(0.119)	(0.144)	(0.287)
10-Year Treasury Yields	1.738***	0.456*	3.696***
	(0.172)	(0.274)	(0.391)
Constant	-0.920	5.358***	
	(0.891)	(0.871)	
R-squared	0.1694	0.3889	
Observations	954	954	
Number of Countries	9	9	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Country-specific fundamentals have the most power in explaining EM inflationary expectations during periods of high volatility. Their signs change across regimes and in between models, starting with mixed directions for the preliminary Non-Switching model, transitioning into slight negatives for the low-volatility regime before increasing significantly magnitude-wise to positive coefficients for the high-stress regime. Gross government debt of emerging economies has a negative, significant impact on inflation outlook during normal times, as higher prices are usually believed to reduce the real value of debt. However, for high-risk periods, greater debt burden and deficit financing is particularly inflation-inducing and disadvantageous for developing countries, who would have to bear the brunt of high dollar-denominated import costs. International reserves is observed to have significantly positive effects on expected inflation, as shown in both the Non-Switching and High-Volatility Switching model estimation results. This finding aligns with the above interpretation of Table 3, where the buildup of foreign exchange reserves, which are used to buy depreciated domestic currency, expands the monetary base and over-stimulates demand until it exceeds supply, at which time inflation surfaces.

Forward-looking measures of country-specific economic indicators are, for the most part, significant, although differing in signs across models and regimes. Real GDP growth forecasts have negative coefficients in Non-switching and low-volatility Switching models, which might be because inflation deteriorates the real value of output, and thus hampering real GDP growth. However, we see the opposite relationship at play for the High-Volatility regime, where growth in GDP means more spending power, thus leading to increased demand and rising price levels. Current account balance, on the other hand, remains a constant statistically significant, negative estimated impact on inflation outlook, as

increased imports do not in any way benefit emerging markets, especially given rising federal funds rates that backup persistent dollar strength.

Global factors unfailingly prove to be the most consistently significant drivers of inflation forecasts. The case for VIX is intuitive, with perceived volatility negative for low-volatility regime and positive for high-volatility regime. Fed funds rates maintain below 0 coefficients throughout, but it is during periods of greatest risks that its impact really shine, as the FOMC hike rates expeditiously to combat entrenched inflationary expectations. Yet perhaps the one factor able to cause the largest shifts in investor's inflationary outlook is Treasury yields. During highly volatile periods of steep increases in short-term interest rates, bond supply goes up while its prices fall, making yields much more attractive than before. This possibly implies investors' inclination to switch from equity to fixed income for capital gains, and associate this highly opportunistic period with continued inflationary pressures.

Ultimately, with an R-squared of 0.3889, the MSDR model has a greater explanatory power than its Non-switching counterpart (0.1694). The presence of shifts in global market sentiment has proved to be useful in estimating forecasts of inflation in the 9 emerging economies, from January 2014 to October 2022.

6. Forecasting performance

With 2 different models at hand, further assessment of forecast performance is carried out using the Diebold-Mariano test for predictive accuracy of time series.

Table 6: Diebold-Mariano Test

	Better Forecast Accuracy	**Diebold-Mariano Test**		**Mean Squared Error (MSE)**		
		Test statistic	p-Value	SW	NO SW	Difference
Brazil	SW	1.506	0.1321	4.156	5.28	1.124
Bulgaria	SW	1.885	0.0594	4.185	5.29	1.105
Chile	SW	1.532	0.1256	4.162	5.268	1.105
China	SW	1.198	0.2309	4.549	5.494	.9446
Colombia	SW	1.496	0.1347	4.193	5.243	1.05
Hungary	SW	1.488	0.1369	4.132	5.223	1.092
Indonesia	SW	1.339	0.1807	4.366	5.345	.9785
Mexico	SW	1.438	0.1506	4.199	5.226	1.028
Russia	SW	1.3	0.1936	4.26	5.277	1.017

Results of the test shows that the Markov-Switching Dynamic Regression model consistently outperforms the Non-switching model with lower mean squared error. This re-emphasizes the

importance of market sentiment regime shifts and their respective impact on the relationship between inflation outlook and country-specific/global indicators.

7. Policy implications

According to figure 3 (left), during periods of high-volatility, inflation forecasts are more oriented towards the upside, yet only slightly more so than in the low-volatility regime. This suggests a level of inflation-sensitivity where even with a low aspect of riskiness, investors are strongly precautioned to revise their outlook on the path ahead of CPI.

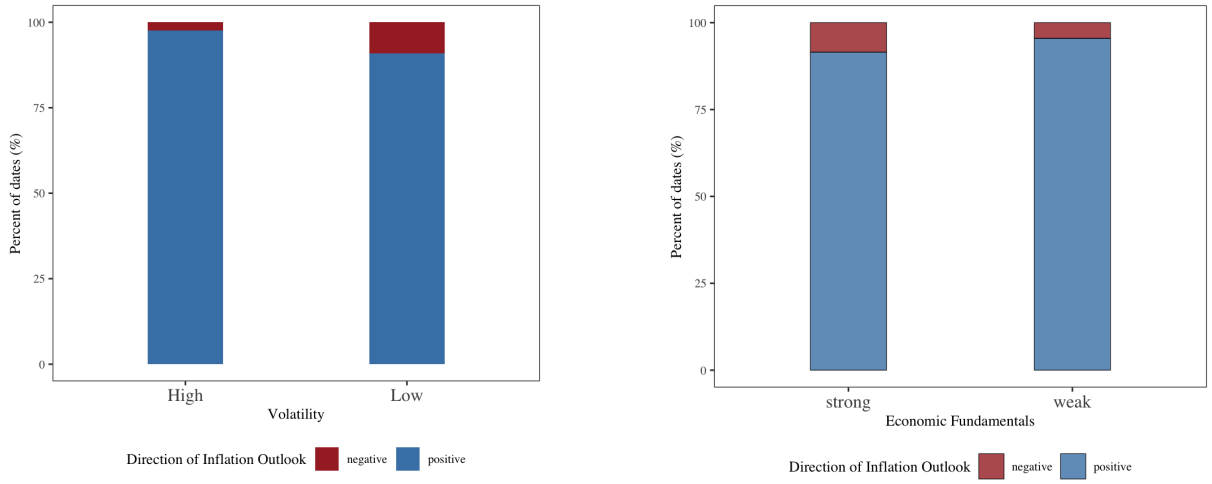

Fig 3. Annual changes of inflation expectations across 2 regimes (left) and fundamental strengths (right).

To further assess the trend in inflation outlook among countries, following a simplified version of Czonto's paper, I determined the strength of each emerging economy's fundamentals by comparing the average country-specific actual and forecast data of each country to the average across the whole sample. Those that enjoy higher real GDP growth rate, international reserves, lower debt and inflation are deemed strong, and vice versa. The following countries are categorized into the strong-fundamentals group: Bulgaria, China, Indonesia, Russia. Weak-fundemantals group consists of Brazil, Chile, Colombia, Hungary and Mexico. Figure 3 (right) shows that investors are more likely to raise their inflation forecasts for countries with weaker fundamentals. However, similar to the left figure, there is not a large dispersion in terms of positive inflationary forecasts among the two groups.

The underwhelming difference in forecasts across Low & High volatility regimes, as well as Strong & Weak fundamentals, signify a phenomenon dreaded by all policymakers and the like-minded, called entrenched inflationary expectations. Unlike "transitory" inflation, prices get to a "sticky" level, where they are unlikely to come down no matter the circumstances, and these new prices would become permanent in people's daily cost of living. The simple bar charts in Figure 3 partly summarize how outlook on inflation stays high regardless of its respective category. This can be a reminder for policymakers to not only stress test, mitigate risks and focus on building strong fundamentals, but also to plan ahead in case inflation actually becomes entrenched across emerging economies and global nations alike.

8. Conclusions

Two regime shifts in global market sentiment - low and high volatility - are identified through the Markov-switching Dynamic Regression model. Results of the panel regression which uses interactions of the explanatory factors with regime probabilities show that, firstly, there are clear differences in the role of country-specific and global indicators across the two regimes. Economic forecasts, such as real

GDP growth or currency account balance, and actual emerging country fundamentals, such as total debt or international reserves, are all key determinants of inflation forecasts, however their estimated significance varies slightly in magnitude and direction. Global factors are found to be more consistent in their impact across regimes, as except for VIX, both Federal funds rates and 10-year Treasury yields remain their original trajectory of effect. Secondly, the importance of all explanatory variables was greatly enhanced during periods of high volatility, with global factors (interest rates, T-yields) again displaying the largest shift. Thirdly, in line with Csontó's paper, the Markov-switching regression outperforms the non-switching model with regards to forecasting accuracy.

In terms of policy implications, investors are likely to revise their inflationary forecasts upward higher in riskier periods, and for countries with weaker economic fundamentals. However, given that the difference in inflation outlook between two global regimes and two groups of fundamentally strong/weak countries is not at all significant, there is a possibility of entrenched inflationary expectations that threatens central banks' efforts to restore price stability, which might be better off hedged against.