Dimensions and Determinants of Inflation Anchoring

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Abstract: This paper focuses on dimensions and drivers of survey-based measures of inflation anchoring based on a panel of 82 economies over a period from 1995 to 2022. We show that different dimensions of inflation anchoring exhibit a strong co-movement but that standard deviation of inflation forecasts partly displays distinctive dynamics. We find that a weak link between anchoring and impossible trinity indexes mostly reflects variations in realized inflation.

Zusammenfassung: Die vorliegende Studie analysiert Dimensionen und Determinanten von umfragebasierten Maßen zur Verankerung von Inflationserwartungen. Wir analysieren 82 Volkswirtschaften über einen Zeitraum von 1995 bis 2022 und zeigen, dass verschiedene Dimensionen der Inflationsverankerung grundsätzlich stark korreliert sind; die Standardabweichung der Inflationsvorhersagen zeigt jedoch zum Teil eine andere Dynamik. Unsere Ergebnisse deuten zudem an, dass die Verankerung von Inflationserwartungen stark mit der realisierten Inflationsrate korreliert und kaum von der Position einer Volkswirtschaft im Dreieck der Internationalen Finanzmarktarchitektur beeinflusst wird.

→ JEL classification: E31, E52, E58
→ Keywords: Anchoring, Inflation expectations, Monetary policy, Survey data, Uncertainty

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1 Introduction

Credibility of central banks is a crucial condition for a successful monetary policy. The early literature has proposed various measures of central bank independence, arguing that higher central bank independence coincides with lower inflation (Cukierman, 2008). Central bank credibility is also at the core of the rules vs. discretion debate which, in the simplest case, argues that monetary policy rules increase monetary policy credibility and lower inflation expectations, providing one possible solution to the time-inconsistency problem (Barro and Gordon, 1983).

The recent increase in inflation has re-vitalized the debate about the measurement of central bank credibility from a new perspective which reflects expectations about future inflation (Romelli, 2022). In times of inflation rates surpassing inflation targets, a key question is whether market participants belief that the central bank will be able to achieve its inflation target in the medium- and the long-run. This belief is expressed by anchored expectations since they reflect the perception that shocks to inflation are transitory and not permanent (King, 1995). However, if long-run expectations are adjusted as a response to shocks and exceed the central bank target, expectations are de-anchored. A re-anchoring reflects any adjustment on long-run inflation beliefs.

While the underlying concept is intuitive, there is no unique empirical measurement of inflation anchoring with both market- and survey-based measures proposed. The main idea is to analyze the response of inflation expectations to incoming information (Gürkaynak et al., 2005) or to analyze the pass-through of changes in short-run expectations to long-run expectations (Mehrotra and Yetman, 2018).

As a direct measure of credibility, the degree of anchoring is of great relevance for monetary policymakers. Recent work by Beckmann and Czudaj (2023) shows that anchoring also matters for the propagation of uncertainty shocks. However, there is no direct theory which proposes drivers of anchoring. Realized inflation should be closely related to anchoring given that higher inflation should reduce anchoring as it reflects deviations from the inflation target. Another question is whether specific policy choices are related to the degree of anchoring. Exchange rate stability and capital flows should also be closely connected to the degree of anchoring. Open economy trade-offs policymakers face are reflected by the so-called 'impossible trinity' which states that monetary independence, exchange rate stability, and financial openness cannot be achieved simultaneously (Aizenman *et al.*, 2010, 2013). A country which gives up monetary independence to fix the exchange rate loses the interest rate as a policy tool but might for example be able to import credibility via an anchor currency. Economies which pursue exchange rate stability and financial openness are more closely tied to the global financial cycle which results in a modification of the classical 'trilemma' (Rey, 2015; Aizenman, 2019). If the capital account is open, it is impossible to run an independent monetary policy, a dilemma for policymakers, who have two alternative options: (i) to keep the capital account closed and to maintain control of domestic financial conditions, or (ii) to open the capital account and relinquishing control of domestic financial conditions (Habib and Venditti, 2018).[1]

1 Banks of countries which have experienced hyperinflation are often subject to political pressure and increase money supply to finance public government deficits. This pattern is also at the core of first-generation currency crisis models in the spirit of Krugman (1979) and leads to a strong relationship between currency crisis and inflation crisis which should lower anchoring. Furthermore, capital flow restrictions are often adopted in case of volatile capital flows and/or low monetary policy credibility.

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This paper contributes to the literature by assessing and comparing different survey- based anchoring measures. Bems et al. (2021) propose an aggregated anchoring measure which is based on three sub-measures. We compare the three sub-dimensions of anchoring and assess their potential drivers. We also examine whether the degree of anchoring is related to the position of a country within the impossible trinity which reflects the trade-offs between policy choices in an open economy: Monetary policy independence, exchange rate stability, and free capital flows.

Both market- and survey-based measures of inflation expectations are subject to shortcomings. Surveys are often based on non-representative samples and only cover a limited number of participants. In contrast, financial market measures do not reflect pure expectations since they are contaminated by risk-premia and can also reflect liquidity, a problem which is of particular relevance over the long-run. An additional advantage of survey-based measures is that they are available for a larger number of countries than market-based measures.

The remainder of this paper is organized as follows. The following section summarizes the underlying dataset and the empirical methodology. Section 3 presents our empirical results while Section 4 concludes.

2 Data and Methodology

The main database we adopt is provided by Consensus Economics, a company which has a long history for providing survey forecast for a large number of countries. Data by Consensus Economics has been used for several questions, such as understanding the behavior of professional forecasters, modelling uncertainty spillovers or analyzing the transmission of uncertainty or expectation shocks. Consensus Economics provides monthly short-run forecasts for the current and the next year as well as long-run forecasts which are available on a bi-annual or quarterly frequency and include annual forecasts for up to 9 years. Both datasets also provide information on the disagreement among survey participants which is measured via the standard deviation across forecasters.[2]

In general, the dataset we adopt includes, mean and standard deviations of inflation forecasts for a horizon of one-year-head up to seven-years-ahead ($h = 1, ..., 7$), allowing us to compare forecasts over several horizons for a homogeneous sample in terms of countries and sample participants. We disregard forecasts for $h > 7$ since they do not differ from forecasts for $h = 7$. Similar, to Bems et al. (2021) and Beckmann and Czudaj (2023) we mostly focus on the long-run forecasts which are provided for 86 advanced, emerging, and developing economies. Short-term forecasts are affected by various factors and do not reflect long-run beliefs which relate to anchoring of inflation expectations. This becomes for example evident in recent years when survey participants adjusted their belief about short-run inflation without changing the belief that long-run inflation reflects the inflation rate targeted by the central bank.

The dataset for the G7 economies starts in 1989. Over the last decades this survey has been extended by several other economies. Therefore, the data set results in an unbalanced panel. Venezuela is an obvious outlier due to its hyperinflation period and has therefore been omitted for

2 Short-run forecasts also include information about individual forecasts, which is not available for long-run forecasts.

the empirical analysis. Given that our anchoring measure is estimated based on a rolling window with a window size of 12, our sample period effectively starts in April 1995.

The anchoring index introduced by Bems et al. (2021) is based on three sub-indexes: The first dimension reflects the deviation of mean inflation expectations from the inflation target:

$$Metric_{1,i,t}^{h} = \sqrt{\frac{1}{w}\sum_{j=t}^{t-1+w}\left(\pi_{i,j}^{e,h} - \pi_{i}\right)^{2}}, \tag{1}$$

where $\pi_{i,j}^{e,h}$ denotes mean inflation expectations of professionals for country i made in period j for horizon h with $h = 1, \ldots, 7$ years. $\pi_i$represents inflation targets, which have been proxied by the sample means of the forecast for the longest horizon as not every central banks announces a specific inflation target. As outlined by Bems et al. (2021) such proxies are very close to the official inflation targets published by some central banks. $w = 12$ reflects the window size for the rolling window computation. Inflation expectations and official inflation targets should not deviate from each other in case of well anchored expectations which implies that higher differences reflect lower rankings.

The second dimension reflects the variation of inflation expectations over time:

$$Metric_{2,i,t}^{h} = \sqrt{\frac{1}{w-1}\sum_{j=t}^{t-1+w}\left(\pi_{i,j}^{e,h} - \overline{\pi}_{i,w}\right)^{2}}, \tag{2}$$

where $\overline{\pi}_{i,w}$ denotes the time series average of mean inflation expectations for country i over the window size w. The idea behind this metric is that market participants do not need to revise their inflation expectations quite often or quite strongly, if they are well anchored.

The third and final dimension reflects the dispersion of inflation expectations:

$$\text{Metric}_{3,i,t}^{h} = \frac{1}{w}\sum_{j=t}^{t-1+w}\left[\sqrt{\frac{1}{M-1}\sum_{m=1}^{M}(\pi_{m,i,j}^{e,h} - \overline{\pi}_{i,j}^{e,h})^{2}}\right], \tag{3}$$

where $\pi_{m,i,j}^{e,h}$ is the individual inflation forecast for forecaster m for country i made at period j for horizon h and $\overline{\pi}_{i,j}^{e,h}$ is the corresponding mean forecast across forecasters. This dimension reflects a disagreement or uncertainty measure and is based on the idea that forecasters should usually not disagree about future inflation if expectations are well anchored. The anchoring measure proposed by Bems et al. (2021) and also considered by Beckmann and Czudaj (2023) is based on an aggregation of the three anchoring metrics after standardization and changing the sign of each measure:

$$StandardMetric_{n,i,t}^{h} = \frac{-\left(Metric_{n,i,t}^{h} - \overline{Metric}_{n}^{h}\right)}{\sigma(Metric)_{n}^{h}}, n = 1, 2, 3, \tag{4}$$

where $\overline{Metric}_{n}^{h}$ and $\sigma(Metric)_{n}^{h}$ are the sample average and the sample standard deviation of the corresponding metric across countries i and periods t. Multiplication of by -1 facilitate the interpretation of our anchoring measure. A higher (lower) value refers to a higher (lower) degree of anchoring of inflation expectations. Based on these considerations, a simple average across the three standardized metrics is used to compute our measure of anchoring:

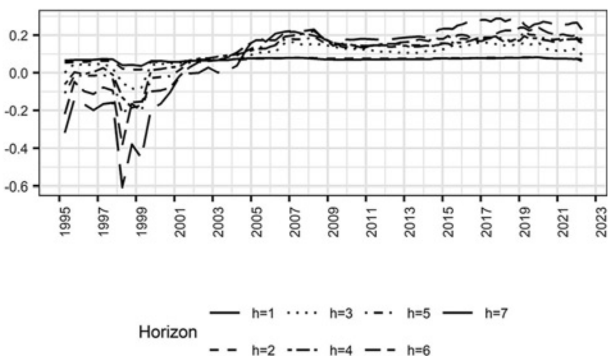
$$Anchor^{h}_{i,t} = \frac{1}{3}\sum\nolimits_{n=1}^{3} StandardMetric^{h}_{n,i,t}, h = 1, \ldots, 7 \qquad (5)$$

Moreover, Aizenman et al. (2010, 2013) have introduced an empirical measure for the sub-dimensions in the impossible trinity. EXS reflects the annual standard deviations of the monthly exchange rate (restricted by a threshold), MI gives the reciprocal of the annual correlation between the monthly interest rates of the corresponding country and the base country. FO is based on restrictions on cross-border financial transactions as reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). All measures are normalized between 0 and 1, with higher numbers reflecting stronger monetary independence (MI), higher exchange rate stability (EXS) or greater financial openness (FO).

3 Results

We start our empirical investigation with Figure 1 and Figure 2 which provide the degree of anchoring over time and across countries for several horizons. Given that your sample period also includes the great moderation, anchoring tends to increase over time for horizons from up to three years. The short-term nature of inflation expectations for 1 and 2 years is reflected in low variation over time (Figure 1) and in the cross-section (Figure 2) illustrating that short-term measures are not a useful reference for anchoring.

Figure 1: Anchoring measure over time



The graph illustrates the anchoring measure along the time axis for each horizon $h = 1, \ldots, 7$. Each line refers to the median across all countries for the corresponding horizon.

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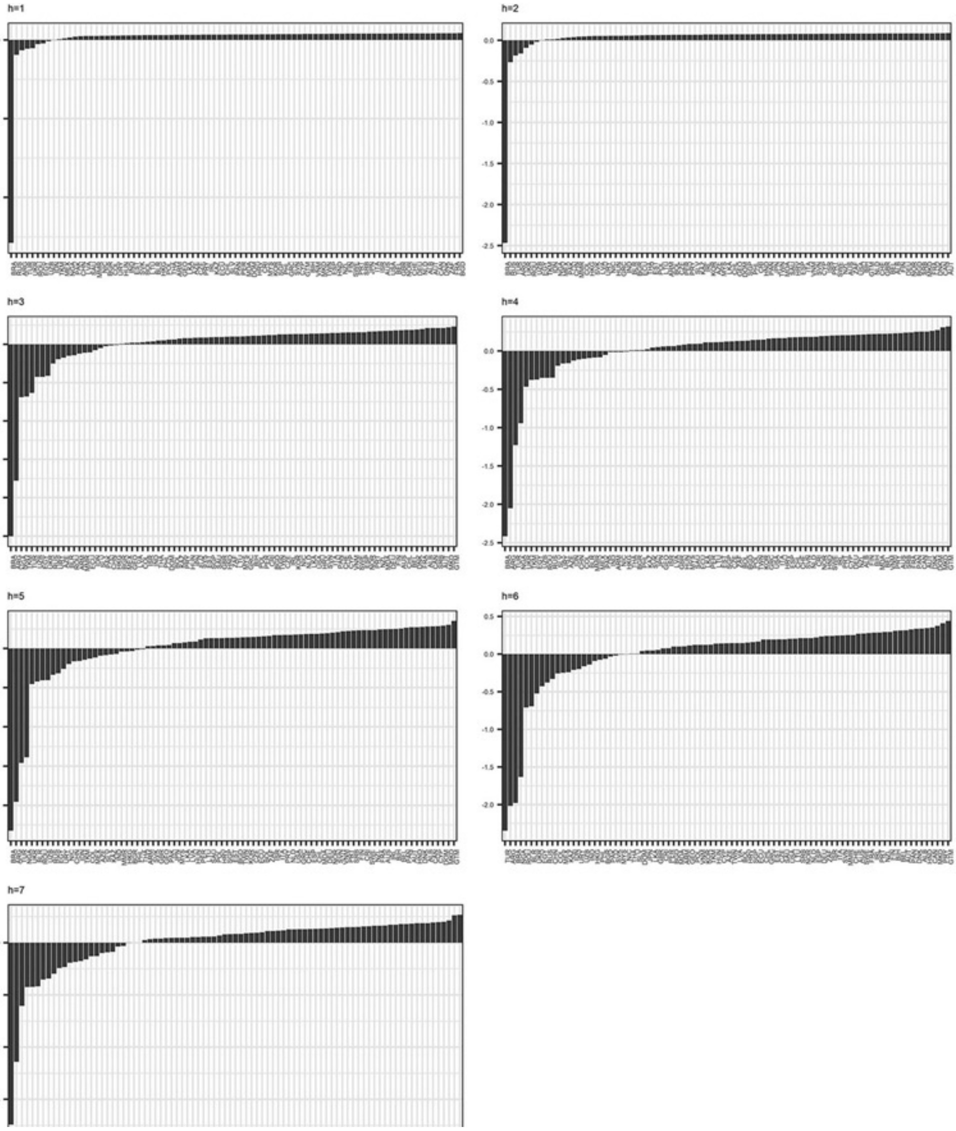
Figure 2: Anchoring measure across countries



The graphs display the average anchoring measure across countries for each horizon $h = 1, \ldots, 7$, which is sorted from lowest to highest.

As a next step, we assess the correlation between the three sub-indexes. This comparison is restricted by the availability of standard deviations which are only available from 2005. Figure 3 illustrates that all the three measures are positively correlated over all horizons, suggesting that a combination of the three measures is useful. There is also a strong convergence towards the end of our sample which reflects the increase in anchoring over time and the lower inflation volatility. We also observe some interesting differences since the third measure based on the cross-sectional

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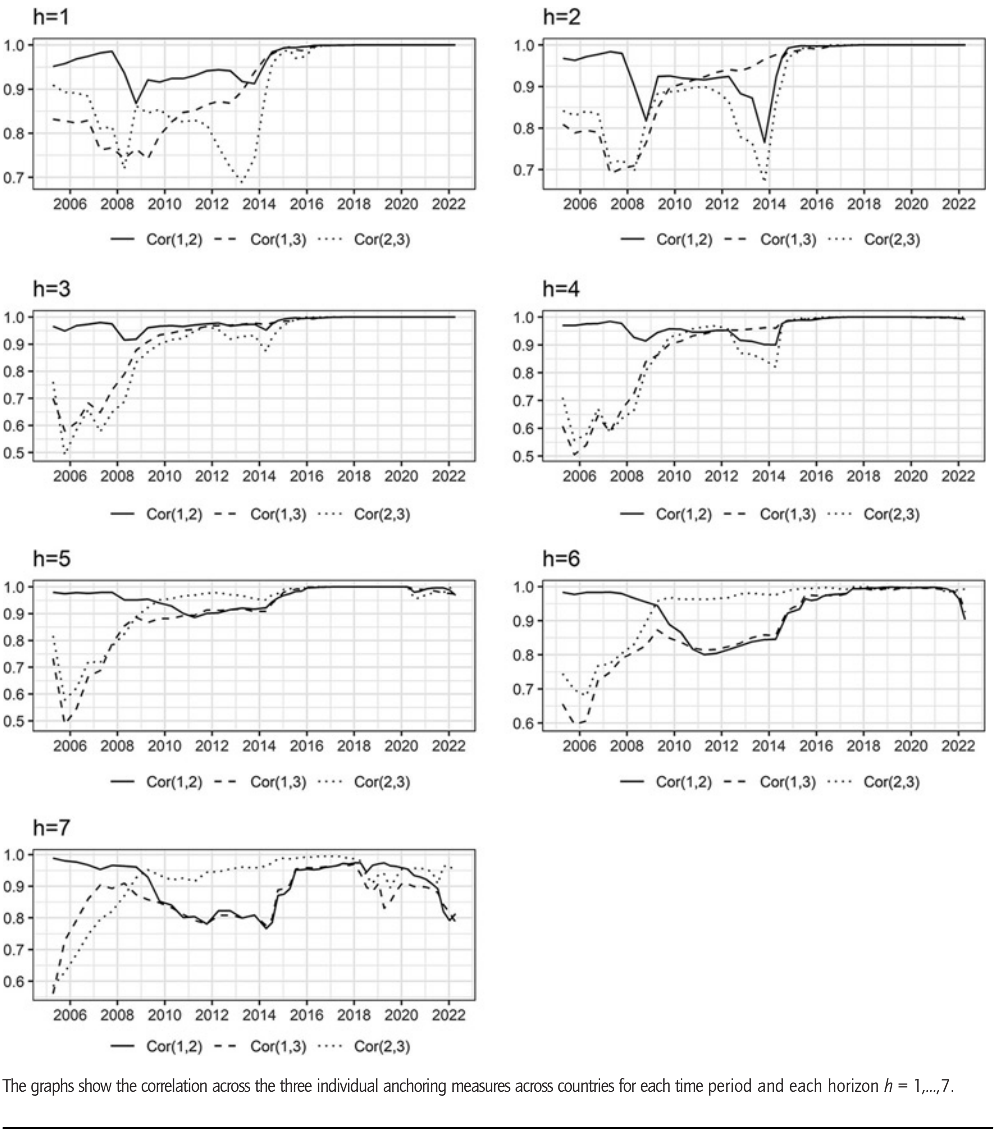
standard deviation displays a relatively low correlation (which still exceeds 50 percent) with the other two measures at the beginning of our sample until 2010. Given that the standard deviations are an established measure of survey-based disagreement, the lower correlation might be due to stronger effects of overall uncertainty on the dispersion. The 2008/2009 crisis had for example increased overall uncertainty which is also reflected in the dispersion but seems to have lower effects on expected long-run inflation. This pattern is in line with evidence by Patton and Timmermann (2010) who show that dispersion among forecasters of Consensus Economics tend to be higher at longer horizons where private information is of limited value. Their work does only focus on 1 to 24 months but the underlying argument can also be applied to higher horizons.

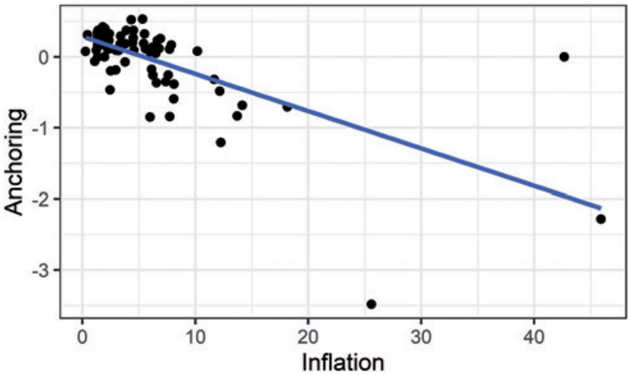
Figure 3: Correlation across sub-measures



The graphs show the correlation across the three individual anchoring measures across countries for each time period and each horizon $h = 1,\dots,7$.

As a next step, we focus on possible drivers of anchoring. For the graphical inspection, we focus on a horizon of seven-years-ahead (h = 7). Figure 4 provides the link between anchoring and realized inflation using country averages while Figures 5 to 7 focus on the relation between anchoring and the three impossible trinity measures.

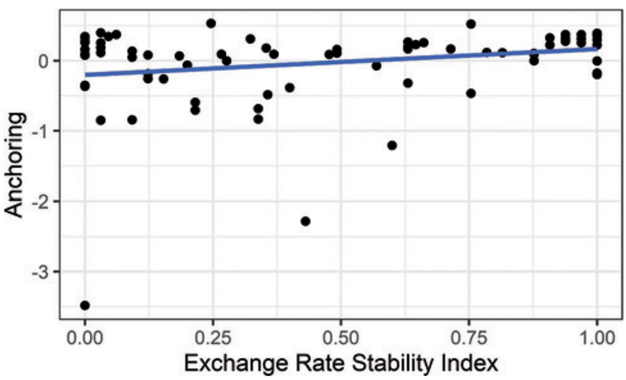
Figure 4: Anchoring measure vs. realized inflation



The graph illustrates a scatter plot for the anchoring measure for horizon $h = 7$ against realized inflation. Each point refers to the time series average of anchoring and inflation for each country and the blue line is fitted by ordinary least squares (OLS).

As expected, Figure 4 shows a strong negative relationship between realized inflation and anchoring. The correlation between the three trinity measures is lower but suggest that anchoring is positively related to financial openness and exchange rate stability while it is negatively related to monetary policy independence.

Figure 5: Anchoring measure vs. exchange rate stability



The graph illustrates a scatter plot for the anchoring measure for horizon $h = 7$ against the exchange rate stability index. Each point refers to the time series average of anchoring and exchange rate stability for each country and the blue line is fitted by ordinary least squares (OLS).

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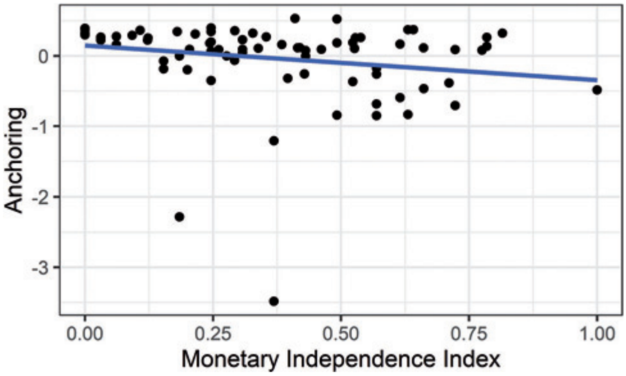
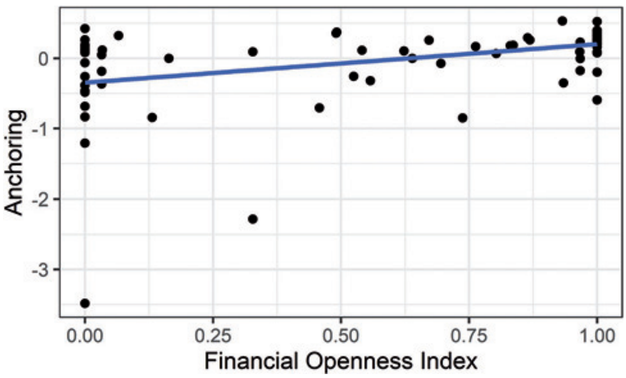
Figure 6: Anchoring measure vs. monetary independence



The graph illustrates a scatter plot for the anchoring measure for horizon $h = 7$ against the monetary independence index. Each point refers to the time series average of anchoring and monetary independence for each country and the blue line is fitted by ordinary least squares (OLS).

Figure 7: Anchoring measure vs. financial openness



The graph illustrates a scatter plot for the anchoring measure for horizon $h = 7$ against the financial openness index. Each point refers to the time series average of anchoring and financial openness for each country and the blue line is fitted by ordinary least squares (OLS).

According to classical impossible trinity, countries can choose either fixed exchange rates or monetary policy independence if the capital account is open. It is important to recall that we use de-facto and not de-jure measures for monetary policy independence and exchange rate stability. Low correlation of domestic interest rates with interest rates of leading central banks tend to coincide with lower anchoring. This essentially resembles the argument by Rey (2015) that countries which are closely related to the financial cycle and do not set interest rates independently. Such a connection relates to a higher degree of anchoring. This is plausible if we take into account that countries who set interest rates independent of major central banks are often forced to do domestic financial conditions, for example when preventing capital outflows. The same argument holds for countries which restrict capital flows. From this perspective, the correlation does not reflect a

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potential causality from de-facto measures to anchoring, it rather suggests that policy choices can occur as a result of low anchoring.

This line of reasoning is also confirmed by our estimation results displayed in Table 1 for the regression model

$$\text{Anchor}_{i,t}^{h} = \beta_1 \text{INF}_{i,t} + \beta_2 \text{EXS}_{i,t} + \beta_3 \text{MI}_{i,t} + \beta_4 \text{FO}_{i,t} + \mu_i + \nu_t + \varepsilon_{i,t}, \qquad (6)$$

where $Anchor_{i,t}^{h}$ denotes the anchoring measure for country i, period t, and horizon $h = 7$, $INF_{i,t}$ represents realized inflation, $EXS_{i,t}$ stands for the exchange rate stability index, $MI_{i,t}$ gives the monetary independence index, and $FO_{i,t}$ is the financial openness index. This is a fixed effects regression model allowing for country heterogeneity denoted by μ_i and for global shocks represented by ν_t.

Table 1: Regression results for anchoring (h = 7)

	(1)	(2)	(3)	(4)	(5)
INF	-0.0924				-0.0941
SE	(0.0510)				(0.0523)
p-value	[0.0701]				[0.0721]
EXS		-0.0625			
SE		(0.1251)			
p-value		[0.6173]			
MI			-0.1023		-0.0020
SE			(0.0419)		(0.0568)
p-value			[0.0148]		[0.9724]
FO				0.3334	-0.0722
SE				(0.1953)	(0.2873)
p-value				[0.0880]	[0.8015]
R^2	0.2960	0.0004	0.0020	0.0066	0.3032
$N \times T$	2949	3081	2994	2737	2480

Note: The table reports coefficient estimates, clustered standard errors (SE) according to Arellano (1987), *p*-values, the R^2 and the number of observations ($N \times T$) for the regression model
$\mathbf{Anchor}_{i,t}^{h} = \beta_1 \mathbf{INF}_{i,t} + \beta_2 \mathbf{EXS}_{i,t} + \beta_3 \mathbf{MI}_{i,t} + \beta_4 \mathbf{FO}_{i,t} + \mu_i + \nu_t + \varepsilon_{i,t}$.
The estimations are carried out for a fixed effects model including country and time fixed effects.

While the association of anchoring with exchange rate stability is insignificant, we find a significantly negative correlation with monetary policy independence and a positive with financial openness at the 10 % level. However, the significance of both disappears when realized inflation is included as shown in the last column. Realized inflation explains roughly 30 percent of anchoring variations.

Table 2 to 4 display similar findings for the three sub-measures of anchoring. The results for the first two measures are closely in line with the findings for the aggregated measure, although the R-squared decreases for the second measure. However, none of the regressors is significant for the third measure which again suggests that dispersion is affected by other factors and reflects a separate dimension.

Table 2: Regression results for metric 1 ($h = 7$)

	(1)	(2)	(3)	(4)	(5)
INF	-0.0941				-0.0957
SE	(0.0484)				(0.0494)
p-value	[0.0521]				[0.0530]
EXS		-0.1319			
SE		(0.0831)			
p-value		[0.1125]			
MI			-0.0772		0.0291
SE			(0.0444)		(0.0472)
p-value			[0.0826]		[0.5372]
FO				0.2700	-0.0444
SE				(0.2006)	(0.2512)
p-value				[0.1785]	[0.8598]
R^2	0.3301	0.0019	0.0012	0.0047	0.3385
$N \times T$	2949	3081	2994	2737	2480
Country FE	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes

Note: The table reports coefficient estimates, clustered standard errors (SE) according to Arellano (1987), *p*-values, the R^2 and the number of observations ($N \times T$) for the regression model

$$\mathbf{Metric}^{h}_{1,i,t} = \beta_1 \mathbf{INF}_{i,t} + \beta_2 \mathbf{EXS}_{i,t} + \beta_3 \mathbf{MI}_{i,t} + \beta_4 \mathbf{FO}_{i,t} + \mu_i + \nu_t + \varepsilon_{i,t}.$$

The estimations are carried out for a fixed effects model including country and time fixed effects.

Table 3: Regression results for metric 2 ($h = 7$)

	(1)	(2)	(3)	(4)	(5)
INF	-0.0813				-0.0824
SE	(0.0478)				(0.0494)
p-value	[0.0890]				[0.0956]
EXS		-0.1286			
SE		(0.1380)			
p-value		[0.3515]			
MI			-0.1242		-0.0470
SE			(0.0528)		(0.0655)
p-value			[0.0187]		[0.4730]
FO				0.2479	-0.0587
SE				(0.1983)	(0.3131)
p-value				[0.2114]	[0.8512]
R^2	0.2006	0.0016	0.0027	0.0034	0.2043
$N \times T$	2881	3006	2924	2660	2419
Country FE	yes	yes	yes	yes	yes

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Table 3: Regression results for metric 2 (h = 7) *(Continued)*

	(1)	(2)	(3)	(4)	(5)
Time FE	yes	yes	yes	yes	yes

Note: The table reports coefficient estimates, clustered standard errors (SE) according to Arellano (1987), p-values, the R^2 and the number of observations ($N \times T$) for the regression model
$\mathbf{Metric}^{h}_{2,i,t} = \beta_1 \mathbf{INF}_{i,t} + \beta_2 \mathbf{EXS}_{i,t} + \beta_3 \mathbf{MI}_{i,t} + \beta_4 \mathbf{FO}_{i,t} + \mu_i + \nu_t + \varepsilon_{i,t}.$
The estimations are carried out for a fixed effects model including country and time fixed effects.

Table 4: Regression results for metric 3 (h = 7)

	(1)	(2)	(3)	(4)	(5)
INF	-0.0006				-0.0006
SE	(0.0085)				(0.0084)
p-value	[0.9483]				[0.9443]
EXS		0.0824			
SE		(0.0942)			
p-value		[0.3823]			
MI			-0.0462		-0.0379
SE			(0.0343)		(0.0308)
p-value			[0.1780]		[0.2194]
FO				-0.2043	-0.0950
SE				(0.1745)	(0.1412)
p-value				[0.2420]	[0.5012]
R^2	0.0000	0.0034	0.0023	0.0092	0.0070
$N \times T$	2339	2354	2267	2030	1900
Country FE	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes

Note: The table reports coefficient estimates, clustered standard errors (SE) according to Arellano (1987), p-values, the R^2 and the number of observations ($N \times T$) for the regression model
$\mathbf{Metric}^{h}_{3,i,t} = \beta_1 \mathbf{INF}_{i,t} + \beta_2 \mathbf{EXS}_{i,t} + \beta_3 \mathbf{MI}_{i,t} + \beta_4 \mathbf{FO}_{i,t} + \mu_i + \nu_t + \varepsilon_{i,t}.$
The estimations are carried out for a fixed effects model including country and time fixed effects.

4 Conclusion

In the present paper we assess survey-based measures of inflation anchoring based on a panel of 82 economies over a period from 1995 to 2022. Different dimensions of inflation anchoring exhibit strong co-movements but the standard deviation of inflation forecasts partly displays distinctive dynamics. We only find a weak link between anchoring and impossible trinity indexes which reflects variations in realized inflation.

It is also important to highlight potential shortcomings of the anchoring measure. First, it is difficult to analyze direct effects of new information due to the low frequency of measurement. Another issue is the comparable low number of forecasters which can also deviate significantly over time.

Overall, the cross-country data is useful for comparisons but combinations of survey- and market-based measures are needed at the country level for analyzing potential effects of specific monetary policy actions. Another shortcoming reflects the need for household measures at the international level. A useful extension for future research would be to investigate whether institutional characteristics can affect the degree of anchoring.

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