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10 February 2023

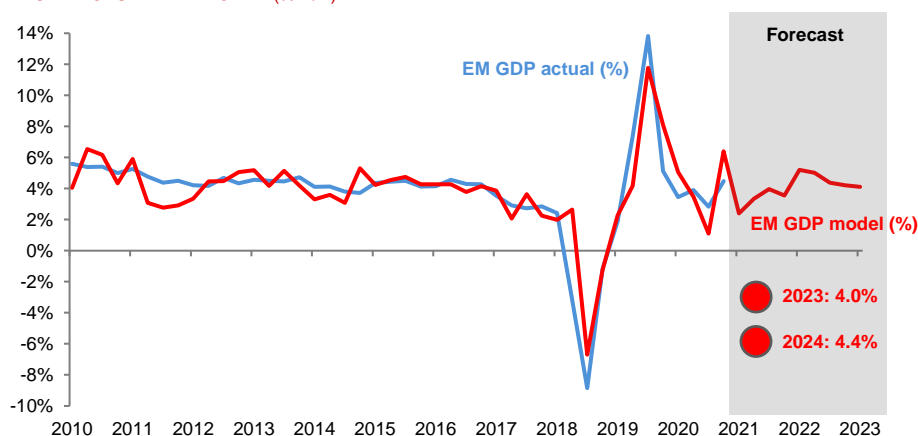
MUFG's approach to modelling economic growth across emerging markets

EXECUTIVE SUMMARY

- Seeing into the future will always be difficult. As the single most important omni-comprehensive measure of economic activity that considers the value of goods and services in the economy, gross domestic product (GDP) is critical to target national economic policies and corporate decision making. Through both a GDP nowcasting and forecasting modelling framework, we decompose GDP estimates and projections for emerging markets (EMs), that endeavours to compellingly map the current and future periods of economic growth. See [here](#) for our comprehensive EM 2023 outlook wherein we further contextualise our EM modelling framework.
- **Nowcast.** In an attempt to better understand the drivers across both EM regions and asset classes, we apply a principal component analysis (PCA) modelling framework to examine performance of EMs from a factor perspective. Our aim is to provide a “nowcast” of the estimated economic growth in EMs prior to their data release – frequency is monthly. Our model estimate for real GDP growth (seasonally adjusted annual rate) in Q1 2023 is 3.0% as on January 2023 (consensus 2.3%). We further breakdown this overall EM estimate into regions: (i) EM Asia; (ii) EM EMEA and; (iii) LatAm and our estimates are 3.7%, -0.2% and 1.8%, respectively.
- **Forecast.** We apply a multiple linear regression model to estimate EM GDP on a quarterly basis. Based on our modelling estimates, EM is expected to grow rise from an estimated 3.1% in 2022, to 4.0% and 4.4% in 2023 and 2024, respectively. This is predominantly owing to robust Chinese growth on the back of reopenings and measures to support the real estate sector. Also, the eventual easing in financial conditions as well as still elevated commodity prices will offer support to growth.

MUFG'S EM FORECAST MODEL SIGNALS GDP GROWTH OF 4.0% IN 2023

EM GDP ACTUAL AND MODEL (% Y/Y)



Source: Bloomberg, CEIC, EM statistical offices, Macrobond, MUFG Research

MUFG'S EM GDP NOWCAST MODEL

A principal component analysis (PCA) modelling framework to examine performance of EMs

MUFG's EM GDP nowcast model represents our estimate of economic growth in the current quarter, before official data becomes available

35 high frequency macro and financial variables classified into three segments

Whilst uncertainty is inherent in nowcasting and surprises are inevitable, these metrics have a 0.95 correlation with EM GDP growth

Nowcasting modelling approach through PCA

In an attempt to strengthen the understanding of drivers across both EM regions and asset classes, we apply a principal component analysis (PCA) modelling framework to examine performance of EMs from a factor perspective. Our aim is to provide a "nowcast" of the estimated economic growth in EMs prior to their data release – frequency is monthly.

To put this into context, MUFG's EM GDP nowcast model represents our estimate of economic growth in the current quarter, before official data becomes available. The nowcast is informed by statistical models, but is ultimately judgemental, reflecting all available information. Users of nowcasts must be aware of the degree of accuracy that can be expected, as this varies across models and time. Models based on survey information tend to be more accurate early in the quarter, whereas high-frequency output data published by official statistics become more useful at a later period in time.

Our toolkit considers 35 high frequency macro and financial variables classified into:

1. **Hard data** – (i) merchandise exports; and (ii) industrial production, for a host of emerging markets.
2. **Financial market indicators** – (i) EM FX; (ii) EM equities; (iii) Bloomberg's industrials metals index; and (iv) crude oil
3. **Sentiment indicators** – (i) US ISM; (ii) world manufacturing PMI; (iii) developed markets composite PMI index; (iv) emerging markets composite PMI index; and (v) euro area's composite PMI index.

We have selected these metrics based on their high correlation with EM GDP growth (0.95). However, uncertainty is inherent in nowcasting and surprises are inevitable. We show that this uncertainty varies both across models and time, and so it is important to understand not only the degree of accuracy that can reasonably be expected in general, but also the confidence bands surrounding any given estimate.

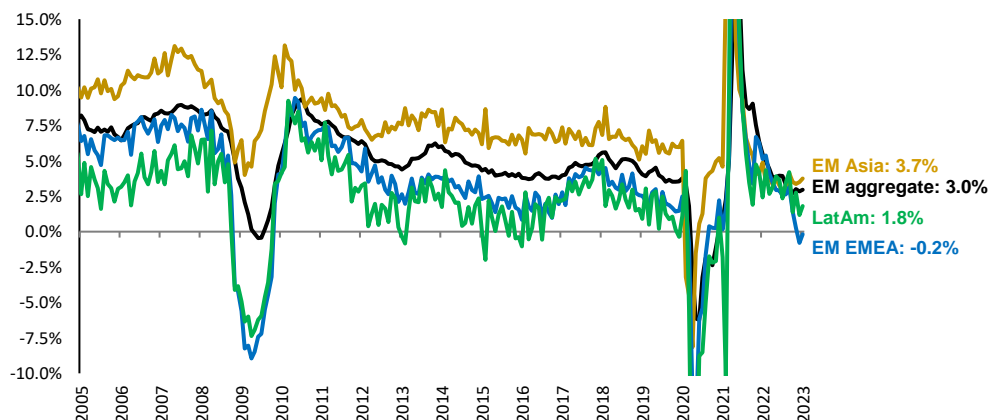
Statistically, we have considered historical quarterly data from the first quarter of 2000 with a total of 89 observations of each series. The countries we have considered in the EM universe are listed in the appendix (see below). We begin the modelling process by normalising our selected variables to thereby extract a common trend of the 35 macroeconomic and financial indicators using the statistical process of PCA:

$$y_i = \sum_{j=1}^k \beta_{ij} x_{ij} \quad [1]$$

where y is a $k \times 1$ vector of principal components, β is a $k \times k$ matrix whose columns are the unit eigenvectors and x is a $k \times 1$ vector of the standardised scores for the

MUFG'S EM NOWCAST MODEL SIGNALS GDP GROWTH OF 3.0% IN Q1 2023

MUFG'S NOWCAST GDP MODEL FOR OVERALL EM, EM EMEA AND LATAM (% Y/Y)



Source: Bloomberg, CEIC, EM statistical offices, Macrobond, MUFG Research

original variables.

We retain four of the 35 principal components given they explain ~75% of the overall movement in the data

In our analysis, we retain four of the 35 principal components given that they explain ~75% of the overall movement in the data. We further regress these principal components as independents to forecast EM GDP growth. Our model estimate for real GDP growth (seasonally adjusted annual rate) in Q1 2023 is 3.0% as on January 2023 (consensus 2.3%).

MUFG'S EM GDP FORECAST MODEL

We model EM GDP through a multiple linear regression model

We build on our GDP nowcasting examination to forecast the GDP trajectory for EMs. We apply a multiple linear regression model to estimate EM GDP on a quarterly basis:

1. We begin by examining key macroeconomic variables – trade balance, interest rates, unemployment, amongst others – that have historically proven critical in predicting GDP growth.

We then regress our explanatory variables ($x_{(i=1-9)}$) on our output variables, i.e. the EM GDP (Y_i) as shown in the equation below:

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_k x_{ik} + \varepsilon_i \quad [2]$$

where y_i is the EM GDP, while the explanatory variables are $x_{(i=1-9)}$.

We utilise seven explanatory variables to forecast GDP

From this, we use the following indicators as explanatory variables in order to forecast GDP: (i) equity market returns; (ii) FX movements; (iii) long/short-term interest rates; (iv) inflation; (v) PMIs; (vi) commodity prices; and (vii) export growth. Given data considerations, we have selected a period of 11 years between 2011-22 with a total of 45 observations for our model which comprises a robust R^2 of 0.72.

Our modelling estimates point to real GDP growth of 4.0% and 4.4% in 2023 and 2024, respectively

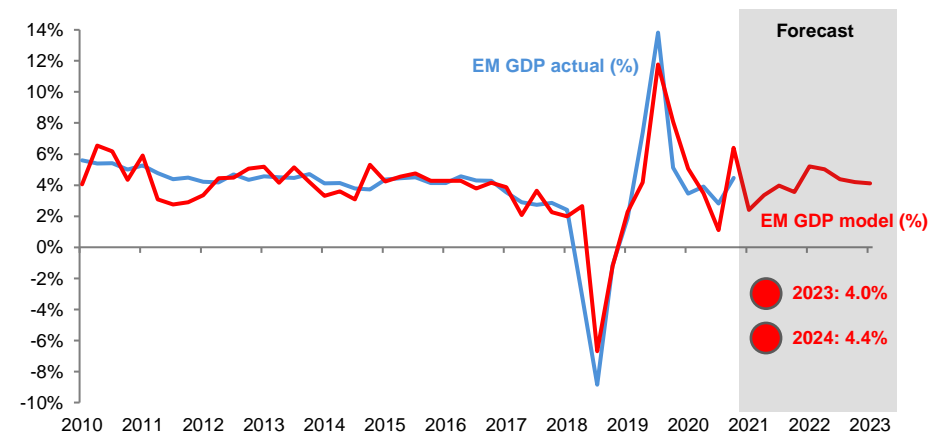
Based on our modelling estimates, EM is expected to grow rise from an estimated 3.1% in 2022, to 4.0% and 4.4% in 2023 and 2024, respectively. This is predominantly owing to robust Chinese growth on the back of reopenings and measures to support the real estate sector. Also, the eventual easing in financial conditions as well as still elevated commodity prices will offer support to growth.

We breakdown EM growth estimates by region on a quarterly basis

We further breakdown this overall EM estimate into regions: (i) EM Asia; (ii) EM EMEA and; (iii) LatAm. For EM EMEA, our modelling estimates point to an expand of 1.4% and 2.9% in 2023 and 2024, respectively.. The near-term outlook remains tepid for all but the strongest of the commodity rich countries. The weakness is marked in the CEE,

MUFG'S EM FORECAST MODEL SIGNALS GDP GROWTH OF 4.0% IN 2023

EM GDP ACTUAL AND MODEL (% Y/Y)



Source: Bloomberg, CEIC, EM statistical offices, Macrobond, MUFG Research

MUFG'S EM GDP QUARTERLY FORECASTS (%)

Date	Q1-23	Q2-23	Q3-23	Q4-23	Q1-24	Q2-24	Q3-24	Q4-23	2023	2024
EM GDP (%)	3.4	4.0	3.5	5.2	5.0	4.4	4.2	4.1	4.4	4.0

Source: Bloomberg, CEIC, EM statistical offices, Macrobond, MUFG Research

due to its greater exposure to the war in Ukraine. While global financial conditions and commodity prices have both eased recently, we expect the lagged effects of policy tightening and the squeeze on household incomes to continue to weigh on growth.

Our forecasts are based on a combination of quantitative model and qualitative judgement of the economic macroclimate in the respective countries alongside the global landscape

For EM countries, we have used a regression study based on each country's economic indicators individually and extrapolated them for 2023 and 2024. The indicators used include CPI, oil price, fiscal data, labour information and consumer spending. The data dissemination and availability determines the quality and richness of model for each country. The forecasts are based on a combination of quantitative model and qualitative judgement of the economic macroclimate in the respective countries alongside the global landscape. For oil exporting countries, oil price expectations (such as Saudi Arabia) form a major part of the expected GDP growth, while for countries that have stable GDP growth rates (such as Poland), inflation expectations and expected labour market strength determines the projected extent of the expansion.

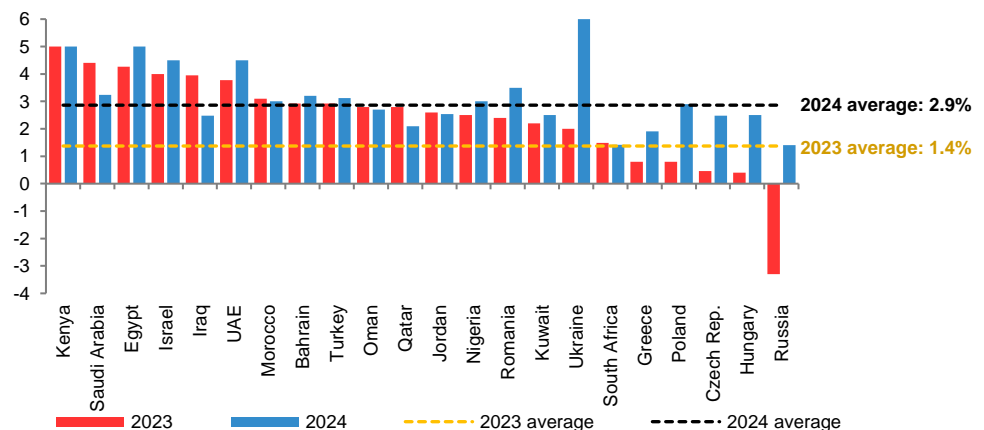
A take of two halves this year for EMs but differentiation remains key across countries

Distressingly high inflation, aggressively elevated interest rates, the war in Ukraine, sticky COVID outbreaks in China and a dominant US dollar dented the performance of EMs in 2022. Whilst EMs continue to grapple with much the same themes at the turn of the year, we view the outlook as a tale of two halves in 2023 – see [here](#) for our EM 2023 outlook. Differentiation has often been a theme in EMs post-COVID, and we expect high dispersion again in 2023 given varied sensitivities across the space to global growth softness, continued commodity buoyancy, and potential further core interest rate pressures. Indeed, there are unambiguous winners and losers:

- On the losing side are economies that import expensive commodities and run trade deficits they must finance at high interest rates. Some have found it difficult to do so. Sri Lanka defaulted on its debt, Egypt has devalued its currency by ~60% since last March and the IMF stepped in to help both countries as well as Pakistan, Tunisia amongst several other smaller EMs that face the fire of sovereign defaults (see [here](#)).
- Commodity exporters remain the winners. The export windfall for these countries – the GCC region and a host of Latin American nations – has helped post sizable surpluses, support government spending and grow rapidly.

EM EMEA WAS RESILIENT IN 2022, BUT GROWTH WILL BITE IN 2023

EM EMEA GDP FORECAST (%)

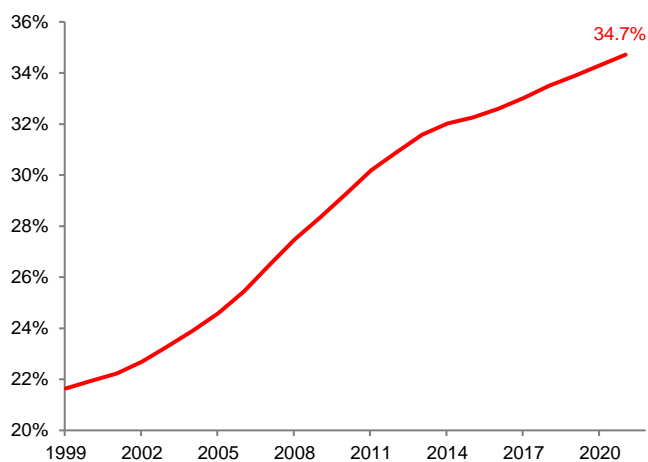


Source: Bloomberg, CEIC, EM statistical offices, Macrobond, MUFG Research

CONTEXTUALISING THE EM GDP MODEL IN KEY CHARTS

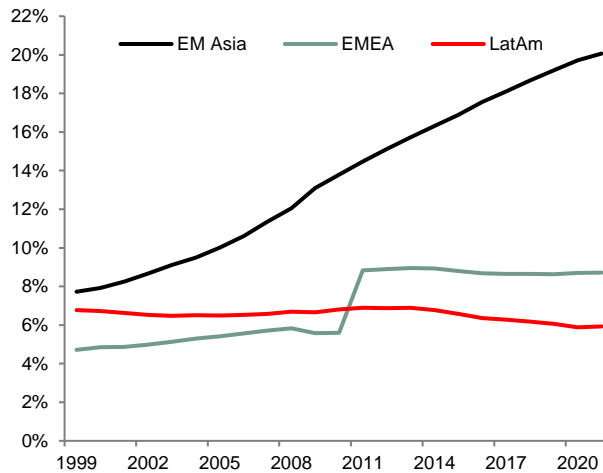
EM'S CONTRIBUTION TO WORLD GDP HAS BEEN ON A CONTINUOUS RISE OVER RECENT DECADES

EM REAL GDP AS A % OF THE WORLD REAL GDP



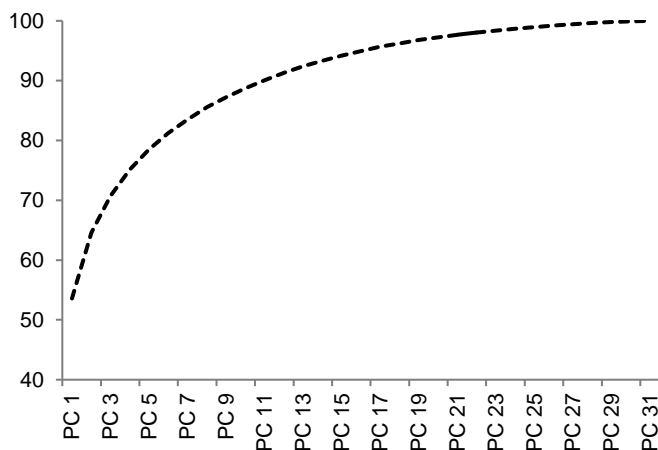
EM COMPOSITION SINGLES OUT EM ASIA – LED BY CHINA – AS THE OUTLIER IN THE SHARE OF TOTAL

EM REGIONAL REAL GDP AS A % OF THE WORLD REAL GDP



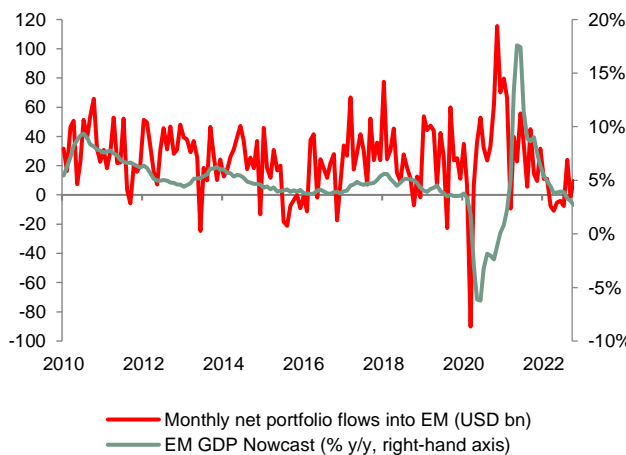
PROPORTION OF THE EIGENVALUES POINTS US TO KEEP 4 OF THE 35 INDICATORS (~75% VARIATION)

EIGENVALUES (CUMULATIVE %)



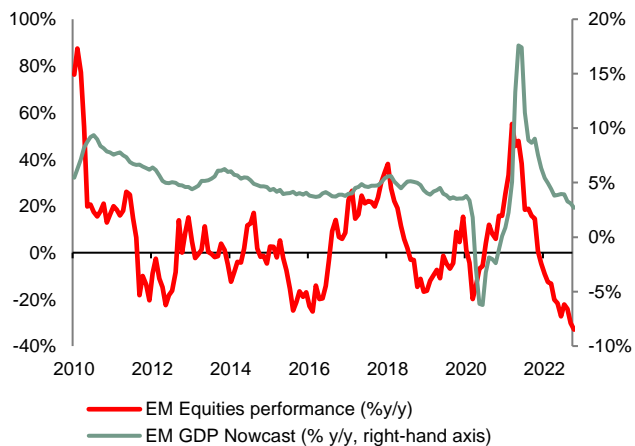
EM GDP NOWCAST IS A ROBUST PREDICTOR OF FUND INFLOWS INTO EM

EM GDP NOWCAST (% Y/Y) AND NET PORTFOLIO INFLOWS (USD BN)



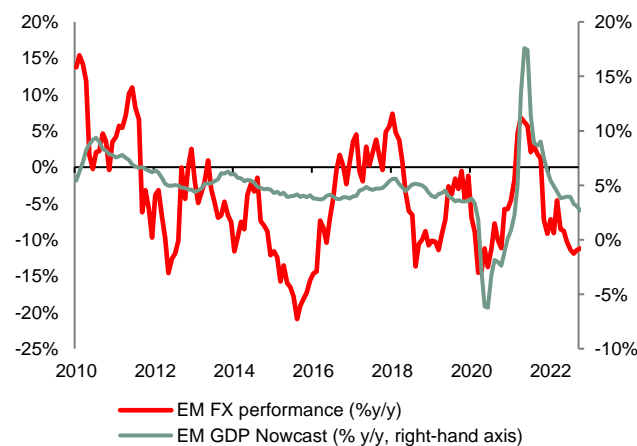
EM GDP NOWCAST CORRELATES WITH THE MOVEMENTS IN EM EQUITY MARKETS

EM GDP NOWCAST (% Y/Y) AND EM EQUITY PERFORMANCE (% Y/Y)


























EM GDP NOWCAST MOVES ALONG WITH THE FLUCTUATIONS IN EM FX

EM GDP NOWCAST (% Y/Y) AND EM FX PERFORMANCE (% Y/Y)



Source: MACROBOND, World Bank, Bloomberg, CEIC and MUFG Research

EM GDP FORECASTS BY COUNTRY

	Q1-23	Q2-23	Q3-23	Q4-23	Q1-24	Q2-24	Q3-24	Q4-24	2023	2024
 Bahrain	4.22	0.99	2.87	5.94	6.55	6.46	5.02	3.93	3.50	5.49
 Czech Rep.	0.34	-0.06	0.10	0.24	0.47	0.62	0.68	0.71	0.16	0.62
 Egypt	5.18	4.11	4.13	3.64	4.49	-2.33	3.77	1.79	4.27	1.93
 Greece	2.64	2.80	3.16	3.48	3.52	3.09	2.85	2.61	3.02	3.02
 Hungary	4.30	3.87	3.52	3.25	3.03	2.74	2.60	2.47	3.00	2.50
 Iraq	--	--	--	--	--	--	--	--	3.96	2.48
 Israel	5.95	5.17	4.71	4.28	4.18	4.31	4.39	4.41	5.03	4.32
 Jordan	1.97	1.94	1.85	1.77	1.73	1.77	1.68	1.61	1.88	1.70
 Kenya	--	--	--	--	--	--	--	--	5.05	5.49
 Kuwait	--	--	--	--	--	--	--	--	2.58	2.65
 Lebanon	--	--	--	--	--	--	--	--	--	--
 Morocco	--	--	--	--	--	--	--	--	3.12	2.96
 Nigeria	--	--	--	--	--	--	--	--	3.00	2.94
 Oman	--	--	--	--	--	--	--	--	4.08	1.93
 Poland	4.45	4.55	4.41	4.25	3.95	3.84	3.73	3.71	4.42	3.81
 Romania	4.01	4.06	4.10	4.13	3.95	3.83	3.76	3.72	4.07	3.81
 Qatar	--	--	--	--	--	--	--	--	2.42	1.73
 Russia	1.61	1.59	1.93	2.36	2.60	2.37	2.08	2.00	1.87	2.26
 Saudi Arabia	7.68	8.61	8.91	9.41	10.04	10.57	10.60	10.62	8.65	10.46
 South Africa	1.38	1.53	1.55	1.50	1.58	1.54	1.38	1.15	1.49	1.41
 Turkey	3.95	3.50	3.17	3.03	3.06	2.88	2.62	2.29	3.41	2.71
 Ukraine	-19.53	-15.31	-11.93	-9.22	-7.23	-5.67	-4.45	-3.51	-14.00	-5.21
 UAE	4.66	3.70	3.41	3.34	3.33	3.32	3.05	2.85	3.78	3.14

EM COVERAGE COUNTRIES INCLUDED IN OUR MODELLING FRAMEWORK

EM Asia	EMEA	LatAm
Cambodia	Albania	Argentina
China	Algeria	Belize
Fiji	Angola	Bolivia
Indonesia	Armenia	Brazil
Lao PDR	Azerbaijan	Chile
Malaysia	Bahrain	Colombia
Mongolia	Belarus	Costa Rica
Myanmar	Benin	Dominica
Papua New Guinea	Bosnia and Herzegovina	Dominican Republic
Philippines	Botswana	Ecuador
Solomon Islands	Bulgaria	El Salvador
Thailand	Burkina Faso	Grenada
Timor-Leste	Burundi	Guatemala
Vietnam	Cabo Verde	Guyana
Afghanistan	Cameroon	Haiti
Bangladesh	Central African Republic	Honduras
Bhutan	Chad	Jamaica
India	Comoros	Mexico
Maldives	Congo, Dem. Rep.	Nicaragua
Nepal	Congo, Rep.	Panama
Pakistan	Côte d'Ivoire	Paraguay
Sri Lanka	Croatia	Peru
	Djibouti	St. Lucia
	Egypt	St. Vincent and the Grenadines
	Equatorial Guinea	Suriname
	Eritrea	Uruguay
	Eswatini	
	Ethiopia	
	Gabon	
	Gambia, The	
	Georgia	
	Ghana	
	Guinea	
	Guinea-Bissau	
	Hungary	
	Iran	
	Iraq	
	Jordan	
	Kazakhstan	
	Kenya	
	Kosovo	
	Kuwait	
	Kyrgyz Republic	
	Lebanon	
	Lesotho	
	Liberia	
	Madagascar	
	Malawi	
	Mali	
	Mauritania	
	Mauritius	
	Moldova	
	Montenegro	
	Morocco	
	Mozambique	
	Namibia	
	Niger	
	Nigeria	
	North Macedonia	
	Oman	
	Poland	
	Qatar	
	Romania	
	Russia	
	Rwanda	
	São Tomé and Príncipe	
	Saudi Arabia	
	Senegal	
	Serbia	
	Seychelles	
	Sierra Leone	
	South Africa	
	South Sudan	
	Sudan	
	Tajikistan	
	Tanzania	
	Togo	
	Tunisia	
	Turkey	
	Turkmenistan	
	Uganda	
	Ukraine	
	United Arab Emirates	
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