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Nowcasting global economic growth: A factor-augmented mixed-frequency approach

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KEYWORDS

factor-augmented MIDAS, global growth, IMF, Nowcasting

1 | INTRODUCTION AND MOTIVATION

Assessing world economic growth in real time is a key point for macroeconomists in charge of monitoring global economic issues but also a real challenge for econometricians. There is currently no global statistical institute in charge of providing official quarterly national accounts at a global level, in spite of recent efforts in this direction coordinated by international institutions. In this respect, the OECD now releases real GDP growth rate figures for the G20 aggregate on a quarterly basis, based on a common work with several other institutions, such as IMF, BIS, ECB or Eurostat, within the framework of the G20 Data Gaps Initiative.[1] This G20 GDP has the great advantage of being sampled on a quarterly basis, but presents the drawbacks of: (i) starting only in 2002 which somewhat limits the econometric analysis and (ii) focusing only on G20 countries leaving aside around 15% of world GDP. In addition, GDP figures are released around 70 days after the end of the quarter.

The IMF also provides global estimates that are considered by experts in the field as benchmark figures when aiming at monitoring the world economy.[2] The last available time series of the annual global growth, as provided by the IMF in the October 2016 World Economic Outlook (WEO hereafter), is presented in Figure 1, from 1995 to 2016.

We clearly see that the world economic growth has been strongly affected by the Great Recession in 2009, reaching its lowest level since the start of the series. We also observe a sharp increase in growth since the early 2000s, due to some emerging countries, especially China. Since the bounce back in 2010, it seems that the world economy was rather sluggish, showing a marked deceleration.

Each time the IMF WEO report is published, the IMF releases estimates of annual global growth for the past years but also for the current year (i.e., nowcasts) and the upcoming years (i.e., forecasts). The WEO is released two times per year (usually in April and October), and two other WEO updates also come in January and July, but with much less details. Thus, it turns out that four nowcasts of the world economic growth rate for the current year are available.

[1]For further details, see OECD website.

[2]The IMF WEO estimates and projections account for more than 90% of the world purchasing-power-parity weights and are available in the IMF website.

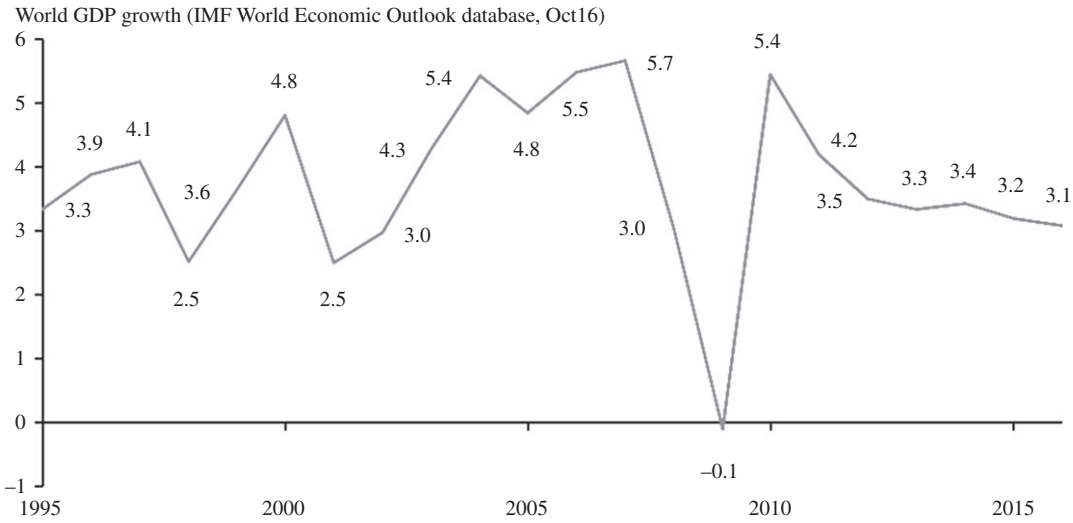

FIGURE 1 Annual global GDP growth estimates (*source:* IMF WEO, 2016)

In Figure 2, we focus on the evolution of IMF WEO nowcasts for global growth over the period 2010–16, and we put on the same graph the first ex post estimates as released just after the end of the reference year, that is in the April's WEO report of the following year.[3] Those ex post estimates are the first estimates taking into account the national accounts publication of the previous year stemming from national statistics institutes. Thus, those ex post estimates will constitute benchmark figures in our empirical analysis and our objective is to track them in a timely and reliable way. It is noteworthy that there is a clear bias at the beginning of each year between the real-time estimates and the ex post realisations, and then, the IMF WEO nowcasts tend to slowly converge to the realised growth rate. However, this bias does not appear to be systematic. Indeed, it turns out that in 2010, the IMF started by largely underestimating global growth: While the final growth is estimated at 5.2%, the first nowcasts were slightly above 3% in the wake of the Great Recession that affected simultaneously all the countries. In opposition, the IMF tended to overestimate growth in their nowcasts in 2011 and 2012.[4] Those optimistic forecasts are partly related to higher-than-expected fiscal multipliers, especially in the euro area in 2011 and 2012 as acknowledged by Blanchard and Leigh (2013). In fact, fiscal consolidation programmes implemented in the main advanced countries strongly weighed on growth, at least much more than expected by standard macroeconomic models. In addition, it is likely that some confidence and uncertainty effects, often neglected in forecasting models, were at play during this specific period of time, acting as a drag on growth, especially on investment (see, e.g., Bussière, Ferrara, & Milovich, 2015).

The main issue with those IMF WEO nowcasts is that they reflect an annual growth rate and are released at a quarterly frequency, while obviously economists have at disposal a large set of information on the world economy available on a higher frequency. For example, for many

[3]Regarding the year 2016, we consider estimate from (IMF WEO update, 2017) as the first ex post release, as the April estimate was not yet released at time of writing.

[4]Those growth forecast errors have been spotted and analysed in IMF WEO (2014).

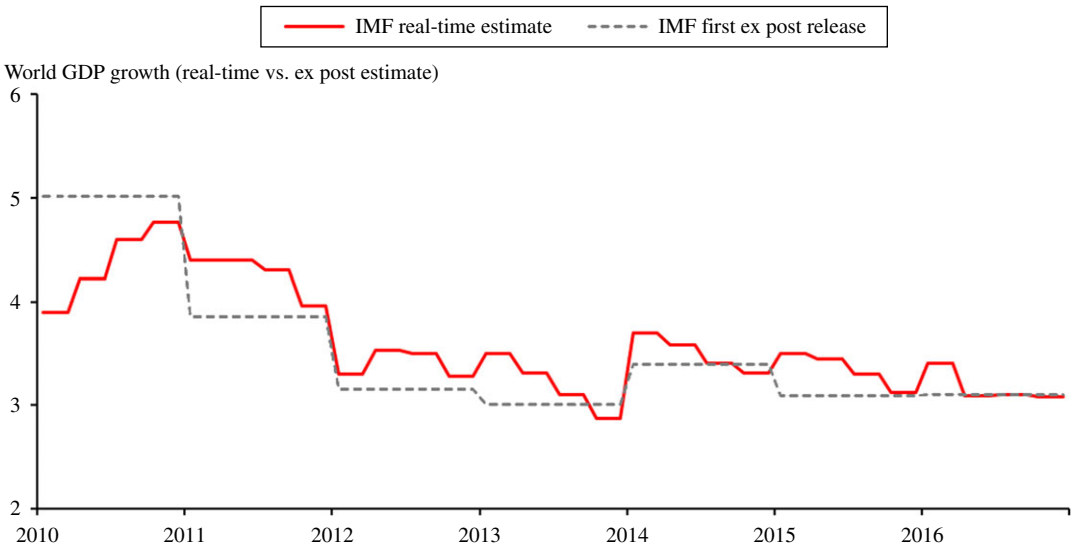

FIGURE 2 Global GDP growth nowcasts and first ex post estimates from 2010 to 2016, as provided in successive IMFWEO [Colour figure can be viewed at wileyonlinelibrary.com]

countries, practitioners have access to a large volume of data from opinion surveys of households and businessmen as well as various series on prices (e.g., equity prices, housing prices) and real activity, such as the industrial production index (IPI), household consumption, unemployment rate. Some recent papers have tackled this issue by considering various approaches. For example, Golinelli & Parigi (2014) have developed several bridge models to forecast quarterly world GDP growth rates based on monthly indicators for many countries. Rossiter (2010) takes a similar approach but only considers PMI indicators to explain global variables. Matheson (2011) estimates some dynamic factor models for a large panel of countries and then aggregates forecasts to get estimates of the global growth. Drechsel, Giesen, and Lindner (2014) also show that adding monthly leading global indicators (such as OECD composite leading indicators) to the IMF WEO forecasts, through bridge equations, leads to accuracy improvements in some cases.

Against this background, when aiming at nowcasting annual global growth on a high-frequency basis, let us say, monthly, then one faces two major issues, namely: (i) a data-rich environment and (ii) a discrepancy between annual GDP figures, on the one hand, and monthly information, on the other hand. To account for those issues in the econometric framework, we combine dynamic factor models (see among others Forni, Hallin, Lippi, and Reichlin, 2000, 2003 and Stock and Watson, 2002) and a mixed data sampling (MIDAS, see Ghysels, Sinko, & Valkanov, 2007) approach into a factor-augmented MIDAS (FA-MIDAS) model as put forward by Marcellino and Schumacher (2010) when dealing with the German economy. This latter approach is convenient as the two main stylised facts, namely large databases and mixed frequencies, can be accounted for by the FA-MIDAS model.

Section 2 presents the nowcasting approach in general terms. The econometric FA-MIDAS model that we use to track in real time the global GDP growth rate on a monthly basis, starting from a large database of macroeconomic indicators for advanced and emerging countries, is described in Section 3. Section 4 contains our results that are compared with IMF WEO ex post nowcasts over the period 2010–16, and we empirically show that our approach is able to better reflect global economic conditions, by reducing mean squared errors, at least at the beginning of each year, when fewer information is available.

2 | NOWCASTING

The macroeconomic concept of nowcasting has been popularised recently by various researchers and differs from standard forecasting; in that, it involves assessing the real-time performance of an economy. Establishing a precise diagnosis of the current state of the economy is often regarded as a first step towards building a longer term outlook. However, this task is particularly challenging as most countries publish their national accounts, especially the benchmark macroeconomic indicator, namely GDP, after the close of the period, and often with a significant lag. Let us take, for example, the euro area. Eurostat publishes its flash estimate of euro area GDP growth around 42 days after the end of the quarter. Thus, economists looking at first-quarter economic activity in the euro area thus have no official estimate of GDP from 1 January to 12 May. In the interim, however, they have access to several variables released at a higher frequency, that is on a monthly, weekly or daily basis. Evaluating first-quarter GDP growth during the period going from the 1 January to the 31 March can thus be seen as nowcasting. This exercise is made complicated by the fact that data are revised from one publication to another and by the constant flow of new data released at different frequencies. Focusing on annual world GDP growth, the problematic is similar; that is, a full picture of the growth rate for a given year will be only available few months after the end of the year. This points out the relevance of developing a nowcasting tool for world GDP.

Academic literature has taken an interest in nowcasting, and there have been various recent studies of the concept following the seminal papers of Evans (2005) and Giannone, Reichlin, and Small (2008). From an empirical point of view, some issues appear when nowcasting. First of all, there is a mismatch of sampling frequencies within the data at hand. Indeed, we generally aim at nowcasting low-frequency variables (typically annual or quarterly) using high-frequency variables (typically monthly, weekly or even daily). This issue can be solved by first aggregating the highest frequency data to the lowest frequency, for example by averaging. Then, a regression model can be estimated at the lowest frequency. This approach is typically referred to as *bridge approach* and has been carried out in many empirical papers as for example Diron (2008), Ferrara, Guegan, and Rakotomarolahy (2010) or Golinelli and Parigi (2014). Of late, the mixed data sampling (MIDAS hereafter) approach put forward by Ghysels and his co-authors have led to many interesting results in macroeconomic applications (see Ghysels et al., 2007). In order to aggregate the data to the lowest frequency, the idea is to estimate a smoothing function, plug into the regression model, which depends on an hyperparameter θ controlling the shape of this function. The standard averaging process appears thus as a special case. In the forecasting framework, several empirical papers have, for example, shown the ability of financial information to predict macroeconomic fluctuations; we refer for example to Clements and Galvão (2008) or Ferrara, Marsilli, and Ortega (2014) for the US or Ferrara and Marsilli (2013) for the euro. Various types of mixed-frequency models have been then introduced; an empirical comparison of such models can be found in Foroni and Marcellino (2014).

Second, it turns out that a very large number of high-frequency data are available to nowcasters. In this respect, a bunch of econometric methods have been recently proposed in the literature enabling to deal with such data-rich environments. Among the different methodologies, dynamic factor models have grown significantly in popularity since the early 2000s building on the seminal papers of Forni et al. (2000, 2003) and Stock and Watson (2002). These models can be used to summarise the information contained in large databases into a small number of factors common to those variables and have proved very useful in macroeconomic analysis and nowcasting in a data-rich environment (see among others Giannone et al., 2008 for the US economy or Luciani & Ricci,

2014 for Norway). When dealing simultaneously with large databases and mixed frequencies, Marcellino and Schumacher (2010) propose to estimate a factor-augmented MIDAS (FA-MIDAS) model enabling to account for both stylised facts at the same time. Of late, the literature on global business cycle synchronisation has studied the simultaneous importance of global and regional factors within the same dynamic factor model augmented with regional blocks (see among others Kose, Otrok, and Whiteman (2003); Mumtaz, Simonelli, and Surico (2011) or Aastveit, Bjornland, and Thorsrud (2016); Aastveit, Foroni, and Ravazzolo 2017). However, this kind of model has not yet been considered in the nowcasting literature, but we could imagine to develop such a model in order to provide a simultaneous nowcasting for the global economy as well as for some regional economies.[5]

Last, it is not obvious to exploit all the available information, as economic and financial indicators are released in an asynchronous way. Due to these different publication lags, large databases typically exhibit complicated patterns of missing values at the end of the sample and imply unbalanced samples for estimation. This leads to the so-called *ragged-edge* (or *jagged-edge*) data problem in econometrics. A first solution to this issue can be found by realigning all the series. That is, the series with missing data at the end of the sample are shifted forward to get a balance data set that reflects the most recent available information. This realignment strategy has been considered, for example, by Altissimo, Cristadoro, Forni, Lippi, and Veronese (2010). This is the option that we privilege in this paper relying on the empirical results put forward by Marcellino and Schumacher (2010). Instead, auxiliary models can be considered to forecast the missing data points for some variables so that a balanced data set can be reconstructed. This is often the case when dealing with bridge equations (see, e.g., Ferrara et al., 2010). When dealing with dynamic factor models, the estimation step involving a Kalman filtering also provides a way to solve this ragged-edge issue (see Banbura, Giannone, Modugno, & Reichlin, 2013).

3 | A FACTOR-AUGMENTED MIXED-FREQUENCY FRAMEWORK

The econometric methodology implemented in this paper relies on the FA-MIDAS approach put forward by Marcellino and Schumacher (2010). In this approach, the information contained in the large database of monthly macro variables is summarised into few underlying factors that represent the common evolution of all the series. Then, we assume that the annual world GDP growth rate can be explained by a MIDAS regression enabling to explain this low-frequency variable by exogenous monthly variables, without any aggregation procedure and within a parsimonious framework.

To exploit a large database including various variables for different countries of the world economy, we implement first a factor analysis that reduces the dimension of the problem. Thus, assume the $1 \times n$ time vector of monthly macroeconomic variables, X_τ, can be represented as the sum of two mutually orthogonal unobservable components: the common component χ_τ and the idiosyncratic component ξ_τ. For a given month τ, the static factor model is defined by:

$$X_\tau = \Lambda f_\tau + \xi_\tau, \tag{1}$$

where $X_\tau = (x_{\tau 1} \dots x_{\tau n})'$ has zero mean and covariance matrix $\Gamma(0)$, Λ is the loading matrix such that $\Lambda = (\lambda_1 \dots \lambda_n)'$, the common components $\chi_\tau = \Lambda f_\tau$ are driven by a small number r of factors f_τ

[5]We thank a referee for this suggestion. However, this would require a huge amount of work to specify and estimate such a model, outside the scope of the paper. We leave this suggestion for further research.

common to all the variables in the model such that $f_\tau = (f_{\tau 1} \ldots f_{\tau r})'$, and $\xi_\tau = (\xi_{\tau 1} \ldots \xi_{\tau n})'$ is a vector of n idiosyncratic mutually uncorrelated components, driven by variable-specific shocks.

Once the r common monthly factors from the original database have been extracted, we relate them to the annual global growth y_t sampled on a yearly frequency described by the index t. Thus, we observe m times the explanatory factor over the period $[t-1,t]$, which corresponds to $[\tau/m - 1, \tau/m]$, where $m = 12$. The standard multivariate MIDAS regression for explaining a stationary low-frequency variable y_t, augmented with a first order autoregressive component, is given by:

$$y_t = \beta_0 + \sum_{i=1}^{r} \beta_i m_K(\theta_i, L) \hat{f}_{i,t}^{(m)} + \lambda y_{t-1} + \varepsilon_t, \tag{2}$$

where $f_{i,t}^{(m)} = f_{i,\tau}$ is one of the exogenous stationary common factor sampled at a monthly frequency. The MIDAS function $m_K(\theta, L)$ controls the polynomial weights that allows the frequency mixing. Indeed, the MIDAS specification consists in smoothing the K past values of $f_t^{(m)}$ on which the regression is based. As in Ghysels, Santa-clara, and Valkanov (2002), we implement the one parameter beta lag polynomial such as:

$$m_K(\theta, L) = \sum_{k=1}^{K} \frac{\theta k (1-k)^{\theta-1}}{\sum_{l=1}^{K} \theta l (1-l)^{\theta-1}} L^{(k-1)}, \tag{3}$$

where L is the lag operator applied on the high-frequency variable $x_t^{(m)}$ such that $L^s x_t^{(m)} = x_{\tau-s}$. In our set-up, we assume that the annual global growth is only influenced by the information conveyed by the last $K = 15$ values of the monthly factor $f_t^{(m)}$; the windows size K being exogenous. It can also be noticed that the parameter θ is part of the estimation problem. Other parameterisations of the weight function can be used, but we choose (3) since it constitutes a parsimonious and reasonable restriction for which the weights are always positive.

Parameter estimation of this model described by Equations (1) and (2) is carried out in two steps. First, factors f_t are estimated using the static principal component analysis (see Stock & Watson, 2002). An eigenvalue decomposition of the estimated covariance matrix $\widehat{\Gamma_0} = T^{-1} \sum_{t=1}^{T} X_t X_t'$ provides the $n \times r$ eigenvector matrix $\hat{S} = (\hat{S}_1 \ldots \hat{S}_r)$ containing the eigenvectors $\hat{S}_i$ corresponding to the r largest eigenvalues for $i = 1, \ldots, r$. The factor estimates are the first r principal components of X_t defined as $\hat{f}_t = \hat{S}' X_t$. Then, the MIDAS equation is estimated using standard nonlinear least squares, assuming factors are known.

A tricky question arising within this kind of framework is related to the number of factors r to include in Equation (2). Several statistical tests are available in the econometric literature. In the forecasting framework, it turns out that some of them lead to more accurate forecasts, as shown in Barhoumi, Darné, and Ferrara (2013). Alessi, Barigozzi, and Capasso (2010) have suggested an information criterion based on Bai and Ng (2002) to determine the number of factors r in the context of an static factor analysis. This criterion can be written as:

$$\mathrm{IC}_p^T(r) = \log V(r,f) + c.r.p(n,T), \tag{4}$$

where $p(\cdot)$ is a penalty function defined as: $p(n,T) = \frac{n+T}{nT} \log \frac{nT}{n+T}$, and $V(\cdot)$ is a goodness-of-fit measurement based on sum of squared errors such as:

$$V(r,f) = (nT)^{-1} \sum_{t=1}^{T} \sum_{i=1}^{n} \left(X_t - \Lambda \hat{f}_t\right)^2, \tag{5}$$

which depends on the estimates of the static factors and on the number r of those factors. Following Alessi et al. (2010) and according to our modelling specifications, we set the exogenous parameters $c = 2$ and $r_{\max} = 5$. The estimated number of factors r^* is defined as the one that

minimises the criterium (4), as follows:

$$r^* = \underset{0 \le r \le r_{\max}}{\arg\min}\ \mathrm{IC}_p^T(r). \tag{6}$$

The selected number of factors are therefore empirically used in (7) for global growth nowcasting purposes. The monthly nowcast of the annual global growth $\hat{y}_{t+1|t+1-h}$ is defined as the conditional expectation of y_t at a given month of the current year. For all forecasting horizon $h < m$, the nowcasting estimate is computed using the following factor-augmented MIDAS equation:

$$\hat{y}_{t+1|t+1-h}(h) = \hat{\beta}_0(h) + \sum_{i=1}^{r^*} \hat{\beta}_i(h)\, m_K(\hat{\theta}_i(h), L)\hat{f}_{i,t+1-h}^{(m)} + \hat{\lambda}(h) y_t, \tag{7}$$

where h is the forecasting horizon expressed in terms of the high frequency ranging from $h = 0$ months (corresponding to December) to $h = 11$ months (for January's forecasts). Equation (7) characterises predictions of the current period involving new intermediary data of the explanatory variables using an update of the factor estimation $\hat{f}_{i,t+h}^{(m)}$. Besides that, the MIDAS parameters also are reestimated at each horizon h via the nonlinear least squares method. It is noteworthy that we allow parameters to depend on the forecasting horizon h.

4 | EMPIRICAL RESULTS

4.1 | Database and factorial analysis

Our methodology is based on a large data set gathering economic indicators from 37 countries, both advanced and emerging. The exhaustive list is enumerated in the Appendix. We can notice that the share of those countries is more than 80% of the world GDP as computed by the IMF WEO. From those 37 economies, we choose monthly variables suppose to convey useful information to assess short-term fluctuations of economic activity. Thus for each country, we select a set of real variables (industrial production, retail sales, new car registrations, etc.), financial variables (exchange rates, stock market indexes, interest rates, etc.) and household confidence index. Constraints are imposed on this choice, in the sense that we aim at having a similar set for each country and that we want to start our analysis in the early nineties. In addition, we incorporate some global indicators of trade, commodity prices, financial uncertainty, etc. Overall, we get a sample of $n = 392$ monthly variables. This database possesses the great advantage of being rapidly updated. All series are monthly sampled, seasonally adjusted (using the X-12 ARIMA method in Eviews) and expressed in either difference or log-difference. The financial ones are sampled as the monthly average of daily quotes and transformed in log-returns. The problem of ragged-edge series and unbalanced database is solved here using the last available data as the contemporaneous one. This approach is referred to as the *realignment strategy* in the empirical literature (see, e.g., Marcellino & Schumacher, 2010 who used this technique in a similar FA-MIDAS approach).

Using principal component analysis defined in Equation (1), we extract one monthly factor that describes variability of the whole data set. The various implemented tests on the number of factors to select led us to choose $r = 1$.[6] The estimated factor is displayed and compared to yearly global growth WEO estimates in Figure 3. Note that the factor is reestimated for each monthly recursion of the nowcasting exercise. Nevertheless, it is noteworthy that this factor, estimated on December

[6]In practice, we also try to include up to three factors in the MIDAS model, but it does not improve the out-of-sample performances we obtain with only one factor.

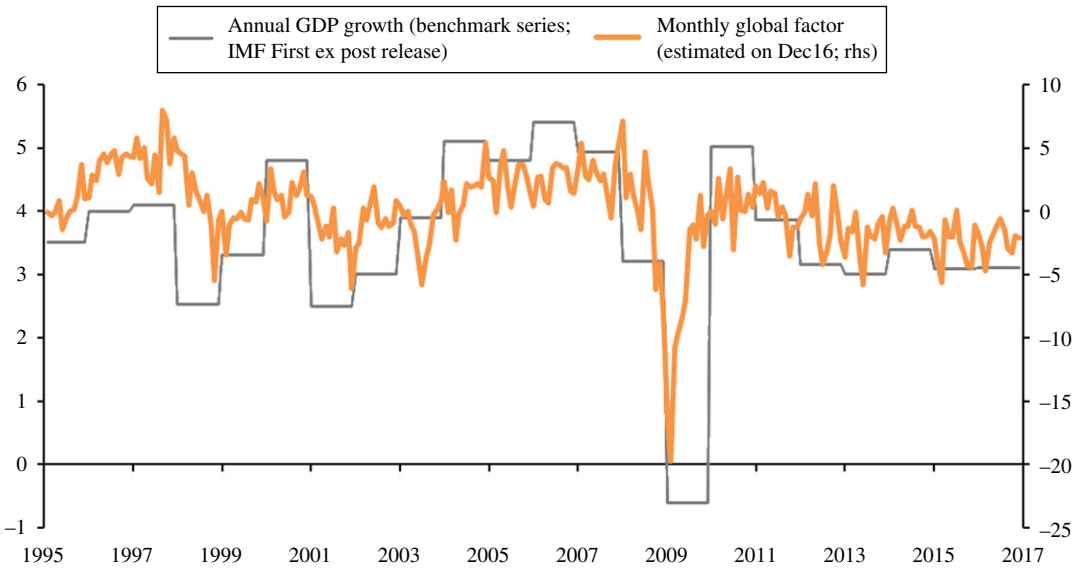

FIGURE 3 Explanatory factor vs. WEO global growth estimates from January 1995 to December 2016 [Colour figure can be viewed at wileyonlinelibrary.com]

2016, has similar pattern than global growth, in spite of some deviations during specific periods of time. The idea is now to formally relate this estimated factor to the global growth using the MIDAS equation (2).

4.2 | Nowcasting global growth from 2010 to 2016

Knowing that financial data are available the last working day of the month, we suppose that nowcasts for a given month are computed at the end of each month, for 12 horizons ranging from $h = 11$ (nowcasts computed 11 months before the end of the reference year, that is January) to $h = 0$ (nowcasts computed the last month of the reference year, that is December). For each date t, the MIDAS regression optimally exploits the monthly fluctuations of the last $K = 15$ data of the $f_t^{(m)}$ series using the weight polynomial given in Equation (3). Estimated weights are presented in Figure 4 with respect to nowcasting horizons. The shape of the weights is in line with what we could expect according to the forecasting horizon. Indeed for long horizons (for instance $h = 9$ in the Figure), the mass is mainly concentrated in previous months and the function rapidly decreases. When the horizon shorten (e.g., $h = 6$ and $h = 3$), the shape spreads out and the maximum value is reached a few months before (both in April for June's and September's nowcast). Finally when the nowcast is made in December ($h = 0$), the shape gives a non-null value to the weights of the reference year.

We implement a quasi-real-time experience over the post-crisis period from January 2010 to December 2016 within a recursive window estimation starting from January 1995. For each month, we estimate the global growth of the current year and we compare it with the real-time estimates stemming from the four IMF WEO reports released per year. Empirical results as well as the ex post estimates are exhibited in Figure 5.

Our nowcast evolves with the monthly flow of conjunctural information that we received within the year, while the IMF WEO nowcast seems to be more related to the release of quarterly national

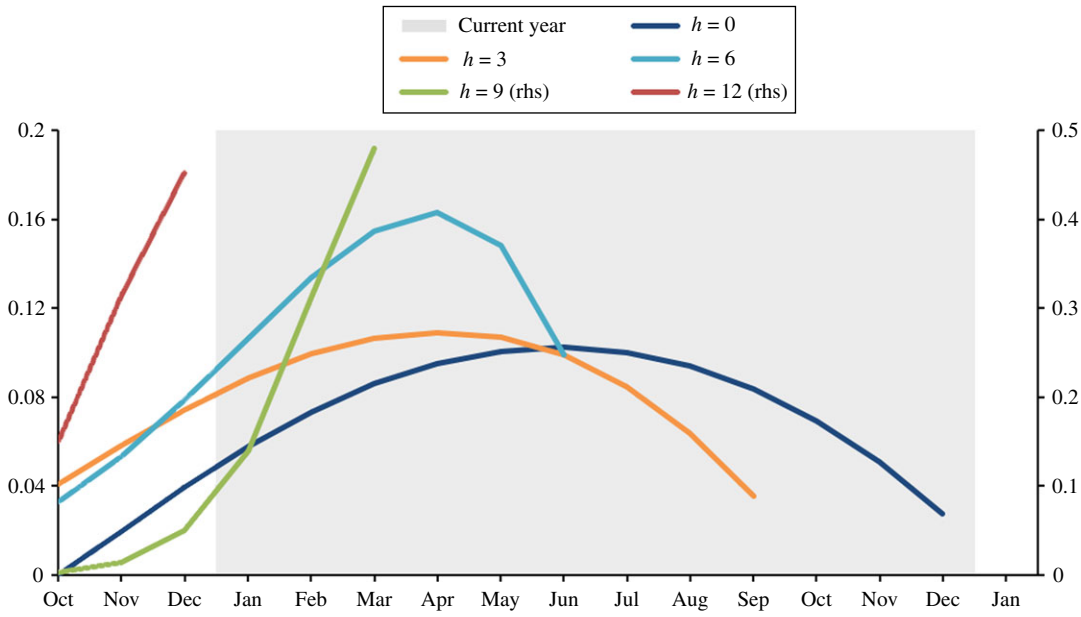

FIGURE 4 In-sample MIDAS weight functions with respect to the forecasting horizon [Colour figure can be viewed at wileyonlinelibrary.com]

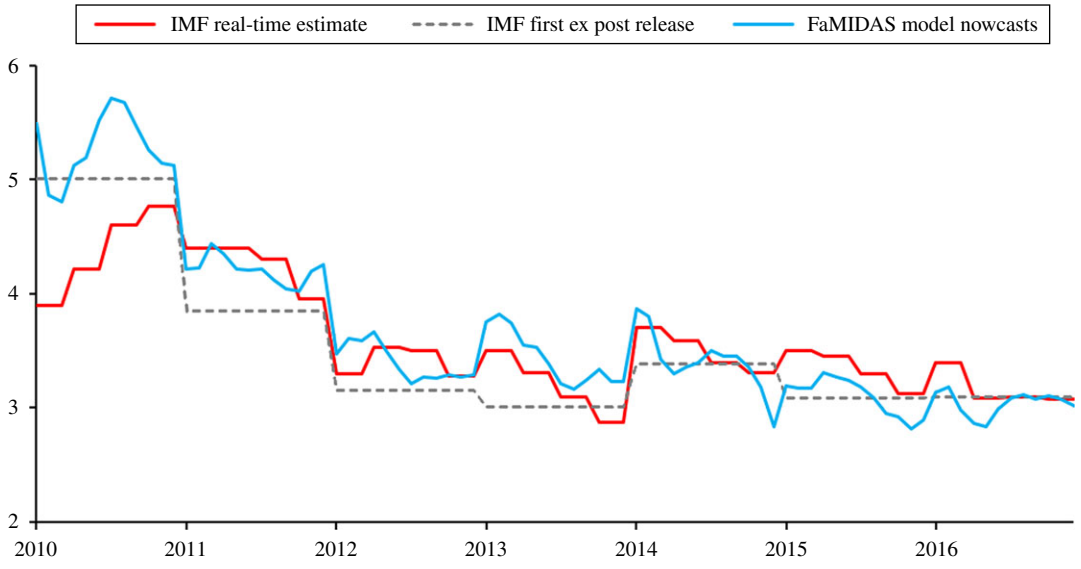

FIGURE 5 WEO vs. FA-MIDAS nowcasts over the period 2010–16 [Colour figure can be viewed at wile yonlinelibrary.com]

accounts for statistical institutes of countries. As expected, real-time estimates tend to convergence to the ex post figures, which is consistent with the fact that more information leads to more accurate estimates. We note that in 2010, the IMF WEO largely underevaluated the bounce back in world GDP growth, especially at the beginning of the year, while our nowcast fluctuated around

the ex post figure since January's estimate. We also note that since 2011, both estimates were generally revised in the same direction.

Although the world economic activity was specially complex to follow in real time during the 2010–16 period as many shocks simultaneously affected the global growth, the model successes in tracking growth deceleration after 2010 and quasi-stability since 2012. A first salient fact was that the business cycle divergence was observed between, on the one hand, the US economy and, on the other hand, some other advanced economies such Japan and the euro area. This macroeconomic divergence, reflected in the stance of monetary policies, led to a strong appreciation of the nominal US dollar in effective terms, weighing on US exports and conversely boosting euro area and Japanese exports. Second, the sharp decline in oil prices starting mid-2014 positively impacted net importer countries but had a negative effect on net exporters countries, including Russia. Also, China experienced a slowdown due to a rebalancing in the engines of growth from exports to internal demand, while we observed growth rates below expectations in some large emerging countries such as Brazil.

Turning to the results for 2015 and 2016, the FA-MIDAS nowcasts clearly flattened at around 3% and is pretty much in line with IMF estimates from the successive WEO reports. One can note that both FA-MIDAS and IMF real-time estimates have followed the same trends over these two periods. Over the year 2015, the flow of poor worldwide economic data pointed out a slight decline in global growth relative to 2014. The lower, but still robust, growth in China, as well as an improving situation in advanced economies, especially in Europe, has offset the economic distress observed in 2015 in Russian, in Brazil and in some countries in Latin America and in the Middle East. In 2016, while IMF projections suggested a broad-based further strengthening of global activity, the disappointing first half of the year, especially in the US, moderated global growth estimate. From July, the FA-MIDAS nowcasts converged to the IMF estimate, which has not been revised after April WEO released.

4.3 | Evaluation

To evaluate the accuracy of our approach, we compute the squared errors of the nowcasts stemming from both the IMF WEO and the FA-MIDAS model. Monthly averages of squared errors over the period 2010–16 are shown in Figure 6. We notice that the forecasting gain obtained using the FA-MIDAS is particularly important from 11 to 4 months ahead, that is from January to September. Indeed, at the beginning of the year, the information available to the WEO update of January is rather scarce. Also, when economists are working on the preparation of the April WEO, they do not have at hand the realised GDP for the first quarter of the current year. In the same way, the release of the second quarter of GDP growth occurs well after the July update. Therefore, it seems that our tool could constitute a reliable and timely complement to the WEO estimates for economists interested in monitoring the world economic growth.

In addition to the point nowcasts, we also develop a non-parametric bootstrapping technique *a la* Efron (1979) in the MIDAS regression context to get confidence intervals around the nowcasts, thus reflecting a measure of the uncertainty related to this estimate. The methodology involves random resampling, with replacement, of elements from the original data to generate a replicate data vector of similar size. This kind of approach has been already used by Aastveit, Bjornland, and Thorsrud et al. (2016) and Aastveit, Foroni, and Ravazzolo (2017) for density forecasts and by Clements and Galvão (2008) for significance tests. Figure 7 show point nowcasts and their 90% confidence intervals. Eyeballing the confidence interval suggests that the uncertainty was shifted downward since the year 2010 and seems to remain broadly constant.

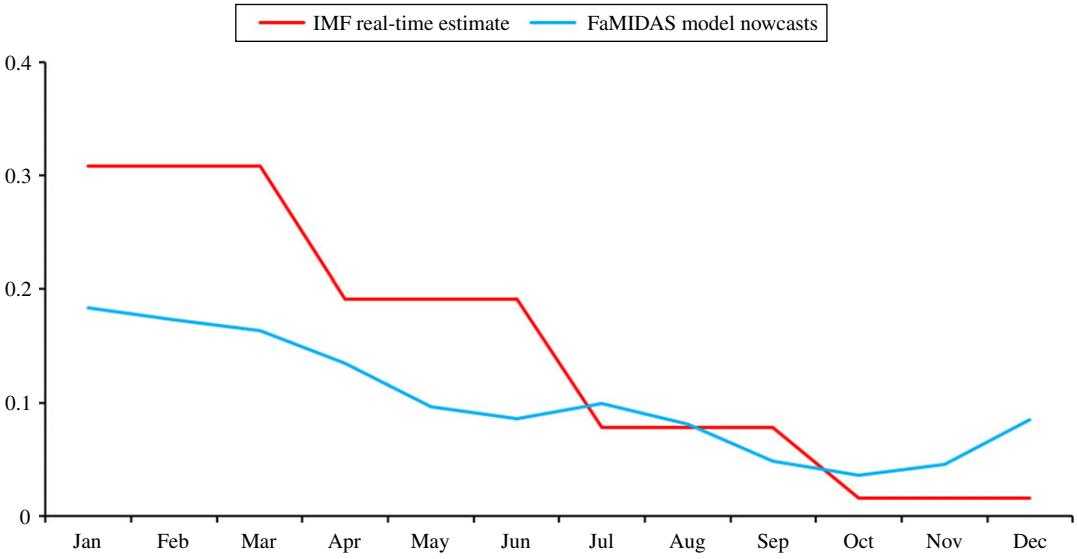

FIGURE 6 Monthly averages of root mean square errors of WEO and FA-MIDAS nowcasts [Colour figure can be viewed at wileyonlinelibrary.com]

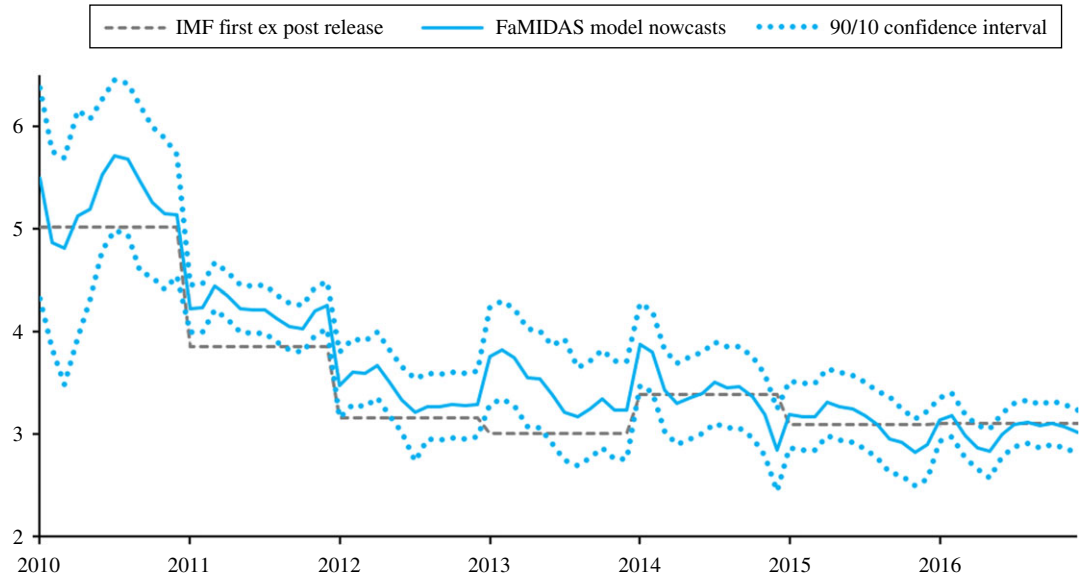

FIGURE 7 WEO vs. FA-MIDAS nowcasts over the period 2010–16 [Colour figure can be viewed at wile yonlinelibrary.com]

5 | CONCLUSION

In this paper, we put forward a new tool to nowcast the global economic growth in real time. We implement a factor-augmented MIDAS approach enabling to explain the annual global growth by a large database of monthly variables. The targeted variable is the annual global growth estimated

by the IMF in its periodic World Economic Outlook assessment. It turns out that our tool is able to efficiently track on a high frequency the global growth. In particular, nowcasts are much more accurate at the beginning of the year when fewer information is available. This tool could be fruitfully used by macroeconomists to monitor global economic developments, in addition to the IMF WEO estimates.

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APPENDIX

DATABASE

Global financial variables	
Crude Oil-Brent Cur. Month FOB USD/BBL	ICIS Pricing
Crude Oil WTI FOB Cushing USD/BBL	Thomson Reuters
Crude Oil Dubai Cash USD/BBL	Thomson Reuters
Baltic Exchange Dry Index (BDI)	Baltic Exchange
WD CPB: Import Prices - World NADJ	Netherlands Bureau for Econ Policy Anal
WD CPB: Export Prices - World NADJ	Netherlands Bureau for Econ Policy Anal
WD CPB: Energy Price Index (HWWI) - World NADJ	Netherlands Bureau for Econ Policy Anal
WD CPB: Other Raw Materials Price Index (HWWI) – World NADJ	Netherlands Bureau for Econ Policy Anal
CBOE SPX VOLATILITY VIX (NEW)	Chicago Board Options Exchange (CBOE)
Effective exchange rate broad index – Nominal NADJ, bank for international settlement	
France, Germany, Italy, Spain, Netherlands, United Kingdom, United States, Japan, Canada, Sweden, Switzerland, Norway, Denmark, China, India, Indonesia, South Korea, Taiwan, Thailand, Hong Kong, Malaysia, Singapore, Brazil, Argentina, Mexico, Colombia, Poland, Czech Republic, Romania, Hungary, Latvia, Lithuania, Bulgaria, Russia, Turkey, South Africa, Saudi Arabia	
Effective exchange rate broad index - Real CPI NADJ, bank for international settlements	
France, Germany, Italy, Spain, Netherlands, United Kingdom, United States, Japan, Canada, Sweden, Switzerland, Norway, Denmark, China, India, Indonesia, South Korea, Taiwan, Thailand, Hong Kong, Malaysia, Singapore, Brazil, Argentina, Mexico, Colombia, Poland, Czech Republic, Romania, Hungary, Latvia, Lithuania, Bulgaria, Russia, Turkey, South Africa, Saudi Arabia	

Money supply M2, national sources		
France	Banque de France	FR money supply - M2 (National Contribution to M2) Curn
Germany	Deutsche Bundesbank	BD money supply-German contribution to Euro M2
Italy	Banca D'italia	IT money supply: M2 - Italian contribution to the Euro Area Curn
Spain	Bank of Spain	ES money supply: M2 - Spanish contribution to Euro M2 Curn
Netherlands	De Nederlandsche Bank (DNB)	NL money supply - M2 Curn
United Kingdom	Bank of England	UK money supply M2: retail deposits and cash in M4 (EP) Curn
United States	Federal Reserve, United States	US money supply M2 Curn
Japan	Bank of Japan	JP money supply: M2 (Metho-Break, Apr. 2003) Curn
Canada	Statistics Canada	CN money supply M2 Cura
Sweden	Statistics Sweden/Sveriges Riksbank	SD harmonised money supply - M2 (EP) Curn

(Continues)

APPENDIX (Continued)

Money supply M2, national sources		
Switzerland	Swiss National Bank (SNB)	SW money supply: M2 Curn
Norway	Norges Bank	NW money supply - M2 Curn
Denmark	Danmarks Nationalbank	DK money supply - M2 (METHOBRKSEP13) Curn
China	People's Bank of China	CH money supply - M2 (METHODBREAK OCT 2011) Curn
India	Reserve Bank of India	IN money supply: M2 (EP) Curn
Indonesia	Bank Indonesia	ID money supply - M2 Curn
South Korea	The Bank of Korea	KO money supply - M2 (EP) Curn
Taiwan	Central Bank of the Republic of China	TW money supply - M2 (EP) (METHOBRK JAN01) Curn
Hong Kong	Hong Kong Monetary Authority	HK money supply: M2 (METHOD BREAK APR1997) Curn
Malaysia	Central Bank of Malaysia	MY money supply - M2 (EP) Curn
Singapore	Ministry of Labour, Singapore	SP money supply: M2 (EP) Curn
Brazil	Banco Central Do Brasil	BR monetary aggregate - M2 (EP) Curn
Argentina	Central Bank of Argentina (BCRA)	AG money supply: M2 - national currency Curn
Mexico	Banco de Mexico	MX money supply: M2 (EP) Curn
Colombia	Banco de la Republica, Colombia	CB money supply - M2 Curn
Poland	National Bank of Poland	PO money supply: M2 Curn
Czech Republic	Czech National Bank	CZ money supply: M2 Curn
Romania	National Bank of Romania	RM money supply: M2 (EP) Curn
Hungary	National Bank of Hungary	HN money supply: M2 Curn
Latvia	Bank of Latvia	LV money supply: M2 Curn
Lithuania	Bank of Lithuania	LN money supply: M2 (EP) Curn
Bulgaria	Bulgarian National Bank	BL money supply: M2 in Levs Curn
Russia	The CNTL. Bank of the Russian Federation	RS money supply: M2 Curn
Turkey	Central Bank of the Republic of Turkey	TK money supply: M2 Curn
South Africa	South African Reserve Bank	SA money supply - M2 Curn
Saudi Arabia	Saudi Arabian Monetary Agency (SAMA)	SI money supply M2 Curn
Stock market, national sources		
France	Euronext Paris	France CAC 40
Germany	Reuters	BD Dax Share Price Index, EP NADJ
Italy	Intesa Sanpaolo (COMIT)	Milan Comit Global

(Continues)

APPENDIX (Continued)

Stock market, national sources		
Spain	BME, Spanish Exchanges	IBEX 35
Netherlands	Euronext Amsterdam	AEX Index (AEX)
United Kingdom	FTSE	FTSE 100
United States	Dow Jones	Dow Jones Industrials
Japan	NIKKEI	NIKKEI 225 Stock Average
Canada	S&P/TSX	S&P/TSX Composite Index
Sweden	Stockholmsborsen	OMX Stockholm 30 (OMXS30)
Switzerland	SWX Swiss exchange	Swiss Market (SMI)
Norway	OSLO exchange all share	Oslo exchange all share
Denmark	Stockholmsborsen	OMX Copenhagen (OMXC20)
China	Shanghai stock exchange	Shanghai SE a Share
India	BSE Ltd	S&P BSE (100) National
Indonesia	Thomson Reuters Datastream	IDX Composite
South Korea	Korea stock exchange	Korea SE Composite (KOSPI)
Taiwan	Taiwan stock exchange	Taiwan SE Weighed Taiex
Thailand	Stock exchange of Thailand 2	Bangkok S.E.T.
Hong Kong	Hang Seng Bank	Hang Seng
Malaysia	FTSE	FTSE Bursa Malaysia KLCI
Singapore	Reuters	SP straits times stock price index (EP) NADJ
Brazil	Reuters	BR Bovespa share price index (EP) NADJ
Argentina	Buenos Aires Stock Exchange	Argentina Merval
Mexico	Reuters	MX Share Price Index or IPC NADJ
Colombia	Reuters	CB Stock Price Index NADJ
Poland	Warsaw stock exchange	Warsaw General Index
Czech Republic	Prague stock exchange PX	Prague SE PX
Romania	BET Indices	Romania Bet (L)
Hungary	Datastream International Ltd.	HN Bux Share Price Index (EP) NADJ
Latvia	Stockholmsborsen	OMX Riga (OMXR)
Lithuania	Stockholmsborsen	OMX Vilnius (OMXV)
Bulgaria	Bulgaria Stock Exchange Sofix	Bulgaria SE Sofix
Russia	Red Star Financial	Russia RTS Index
Turkey	Central Bank of the Republic of Turkey	TK ISE National 100 Share Price Index NADJ
South Africa	Datastream International Ltd.	SA Datastream Total Market Stock Price Index (monthly ave.) NADJ
Saudi Arabia	Saudi Arabian Monetary Agency (SAMA)	SI Stock Price Index NADJ

10Y Government Bond Interest Rate, different sources		
France	Thomson Reuters Datastream	France benchmark bond 10YR (DS)
Germany	Thomson Reuters Datastream	Germany benchmark bond 10YR (DS)
Italy	Thomson Reuters Datastream	Italy benchmark bond 10YR (DS)
Spain	Thomson Reuters Datastream	Spain benchmark bond 10YR (DS)
Netherlands	Thomson Reuters Datastream	Netherland benchmark bond 10YR (DS)
United Kingdom	Thomson Reuters Datastream	UK benchmark bond 10YR (DS)
United States	Thomson Reuters Datastream	US Treas.Benchmark Bond 30 YR (DS)
Japan	Thomson Reuters Datastream	Japan benchmark bond - RYLD. 10YR (DS)
Canada	Thomson Reuters Datastream	Canada benchmark bond 10YR (DS)
Sweden	Thomson Reuters Datastream	Sweden benchmark bond 10YR (DS)
Switzerland	Thomson Reuters Datastream	Switzerland Bnchmrk. Bond 10YR (DS)
Norway	Thomson Reuters Datastream	Norway benchmark bond 10YR (DS)
Denmark	Thomson Reuters Datastream	Denmark benchmark bond 10YR (DS)
China	Thomson Reuters Datastream	CH major loan rate: capital construction - 5 to 10 YR NADJ
India	Thomson Reuters Datastream	INDIA T-Bond 10YR
Indonesia	Thomson Reuters Datastream	ID government bond yield - 10YR (EP)
South Korea	Thomson Reuters Datastream	KO yield 10YR government bonds NADJ
Taiwan	Thomson Reuters Datastream	TW Taiwan Government bond yield 1 YR (EP)
Thailand	Thomson Reuters Datastream	TH government bond yield - 10YR
Hong Kong	Thomson Reuters Datastream	Hong Kong exchange fund note 10YR
Malaysia	Thomson Reuters Datastream	My Government Bond Yield - 10YR

(Continues)

APPENDIX (Continued)

10Y Government Bond Interest Rate, different sources		
Singapore	Thomson Reuters Datastream	SP 10YR government bond yield (EP)
Brazil	Thomson Reuters Datastream	BR government bond yield - 10YR (EP)
Mexico	Thomson Reuters Datastream	MX Udibono rate excluding taxes - 10YR
Poland	Eurostat	PO harmonised government 10YR bond yield
Czech Republic	Thomson Reuters Datastream	Czech benchmark bond 10YR (DS)
Romania	Eurostat	RM harmonised government 10YR bond yield
Hungary	Eurostat	HN harmonised government 10YR bond yield
Latvia	Eurostat	LV harmonised government 10YR bond yield
Lithuania	Eurostat	LN harmonised government 10YR bond yield
Bulgaria	Eurostat	BL harmonised government 10YR bond yield
Russia	Thomson Reuters Datastream	RS long-term government bond yields/10YR NADJ
Turkey	Thomson Reuters Datastream	TK government bond yield - 10YR (EP)
South Africa	Thomson Reuters Datastream	SA redemption yield on long-dated govt.bond (METHOD.BREAK JUN98)

3M Interbank Rate, different sources		
France	Main Economic Indicators, OECD	FR Pibor/Euribor - 3-month (mth.avg.)
Germany	European Banking Federation/The Financial Markets Association	BD Fibor - 3M (mth.avg.)
Italy	Banca d'Italia 2	IT interbank deposit rate-average on 3M deposits
Spain	Analistas Financieros International	Spain Interbank 3M
Netherlands	Prebon Yamane (Nederland) BV	Netherland Interbank 3M
United Kingdom	Financial Times	UK interbank rate - 3M (month avg)
United States	Reuters	US interbank rate - 3M (London) (month avg)
Japan	British Bankers' Association (BBA)	JP 3M interbank rate (month avg)
Canada	Statistics Canada (CANSIM)	CN interest rate: 3M treasury bills (end month)
Sweden	Sveriges Riksbank	Sweden Interbank 3M delayed

(Continues)

APPENDIX (Continued)

3M Interbank Rate, different sources		
Switzerland	Swiss National Bank (SNB)	SW three month interbank rate: BID rate
Norway	Norges Bank	NW Norwegian interbank offer rate - 3M
Denmark	Danmarks Nationalbank	DK interbank offered rate - 3M
China	People's Bank of China	China Interbank 3M
India	Thomson Reuters	India Interbank 3M Mumbai disc
Indonesia	Bank Indonesia	ID interbank call rate (EP)
South Korea	Thomson Reuters	South Korea IBK. 3M Seoul
Thailand	Bank of Thailand	TH Bank of Thailand Bonds 3M
Hong Kong	Hong Kong Monetary Authority	Hong Kong interbank 3M
Malaysia	Central Bank of Malaysia	My interbank rate - 3M (EP)
Singapore	Thomson Reuters	SP interbank 3M Sibor ABS
Brazil	CETIP	Brazilian Real 3M int rate S(Disc)
Argentina	Central Bank of Argentina (BCRA)	Argentina Interbank (BAIBOR) 9 Disc
Mexico	Main Economic Indicators, OECD	MX 91-Day TIIE NADJ
Colombia	Banco de la Republica, Colombia	Colombia CD Rate 90-day
Poland	National Bank of Poland	PO money market offer rate - 3M
Czech Republic	Czech National Bank	CZ Prague interbank offer rate - 3M
Romania	National Bank of Romania	RM Bibor - 3M (EP)
Hungary	Eurostat	HNESEFI3R
Latvia	Bank of Latvia	LATVIA Interbank 3M
Lithuania	Bank of Lithuania	VILNIUS Interbank 3M DISC
Bulgaria	Bulgarian National Bank	Bulgaria Interbank 3M
Russia	The Central Bank of the Russian Federation	RSINTER3
Turkey	Banks Association of Turkey (TBB)	Turkey Interbank 3M
South Africa	Thomson Reuters	South African JIBAR 3M
Saudi Arabia	Thomson Reuters	Saudi Arabia IBK. 3M

Car Registrations, national sources		
France	MNST L'ecologie Du Developpement. France	FR new car registrations (CAL ADJ) VOLA
Germany	Federal motor TRNSP. AUTH. (KBA), GER	BD new passenger car registrations VOLN
Italy	ANFIA, Italy	IT new passenger car registrations VOLN
Spain	Bank of Spain	ES registrations - passenger cars VOLN
Netherlands	European Automobile MFRS. ASSN. (ACEA)	NL new passenger car registrations VOLN

(Continues)

APPENDIX (Continued)

Car Registrations, national sources		
United Kingdom	The soc. of motor MFRS. and traders	UK car registrations VOLN
United States	BEA - Bureau of Economic Analysis	US new passenger cars – retail sales - total vehicles VOLN
Japan	Japan Automobile Dealers Association	JP motor vehicle new registrations: passenger cars excl. below 66
Canada	Statistics Canada	CN new motor vehicle sales - passenger cars VOLN
Sweden	Statistics Sweden (SCB)	SD new motor vehicle registration - passenger cars VOLN
Switzerland	Swiss Federal Statistical Office	SW car registrations - new VOLN
Norway	statistics Norway	NW new registrations of passenger cars VOLN
Denmark	statistics Denmark	DK new registrations of private cars VOLN
China	China Association of Automobile Manufacturers	CH sales - automobile VOLN
India	CMIE - Centre for Monitoring Indian Economy	IN car sales VOLN
Indonesia	PT Astra International TBK	ID domestic vehicle sales - cars VOLN
South Korea	Ministry Land, Transport, Maritime Affairs	KO registered passenger cars VOLN
Taiwan	Ministry of Transp. and Comms., Taiwan	TW motor vehicles registration - passenger car VOLN
Thailand	Bank of Thailand	TH passenger car sales (DISC.) VOLA
Hong Kong	Census and Statistics Dept., Hong Kong	HK private cars: new registrations VOLN
Malaysia	Malaysian Road Transport Department	MY new vehicles registered - motorcars VOLN
Singapore	Land Transport Authority, Singapore	SP new motor vehicles registered VOLN
Brazil	Banco Central do Brasil	BR vehicle sales – domestic & external VOLN
Argentina	ADEFA, Argentina	AG domestic car sales VOLN
Mexico	INEGI, Mexico	MX car sales - domestic VOLN
Colombia	The National Administrative Department of Statistics (DANE), Colombia	CB retail trade index - motor vehicles, incl. motorcycles VOLN
Poland	European Automobile Manufacturers' Association (ACEA)	PO new passenger car registrations VOLN
Czech Republic	European Automobile Manufacturers' Association (ACEA)	CZ new passenger car registrations VOLN
Romania	ACEA	RM new passenger car registrations VOLN
Hungary	European Automobile Manufacturers' Association (ACEA)	HN new passenger car registrations VOLN
Latvia	ACEA)	LV new passenger car registrations VOLN
Lithuania	ACEA	LN new passenger car registrations VOLN
Bulgaria	ACEA)	BL new passenger car registrations VOLN

(Continues)

APPENDIX (Continued)

Car Registrations, national sources		
Turkey	Turkish Statistical Institute (TurkStat)	TK registered road motor vehicles VOLN
South Africa	National Association of Automobile Manufacturers of South Africa	SA new vehicle sales: DOM.- passenger cars (METHOBRK JAN06) VOLN

Retail Sales, national sources		
France	I.N.S.E.E.	FR retail sales - total excl. motor vehicles & motorcycles VOLA
Germany	Deutsche Bundesbank	BD retail sales excl cars VOLA
Italy	National Institute of Statistics, Italy	IT retail sales SADJ
Spain	National Statistics Institute, Spain	ES retail sales excluding service station NADJ
Netherlands	Statistics Netherlands (CBS)	NL retail sales value index NADJ
United Kingdom	Office for National Statistics, U.K.	UK retail sales incl. automotive fuel (method break JAN 96) VOLA
United States	Main Economic Indicators, OECD	US total retail trade (volume) VOLA
Japan	Ministry of Econ., Trade and Ind., Japan	JP wholesale & retail sales index SADJ
Canada	Statistics Canada	CN retail sales: total (constant) CONA
Sweden	Statistics Sweden (SCB)	SD retail sales excl. motor vehicles & repair shops (CAL ADJ) VOLA
Switzerland	Swiss Federal Statistical Office	SW total retail sales SADJ
Norway	Statistics Norway	NW retail sales VOLA
Denmark	Statistics Denmark	DK retail sales VOLA
China	National Bureau of Statistics, China	CH retail sales:GDS-ENTPS above designated size, income (unrevised)
Indonesia	Bank Indonesia	ID retail sales (rebased) VOLN
South Korea	Statistics Korea (KOSTAT)	KO retail sales VOLA
Taiwan	Ministry of Economic Affairs, Taiwan	TW retail sales Curn
Thailand	Bank of Thailand	TH retail sales index NADJ
Hong Kong	Census and Statistics Dept., Hong Kong	HK retail sales VOLN
Singapore	Statistics Singapore	SP retail sales index (constant) VOLA
Brazil	IBGE, Brazil	BR retail sales VOLA
Argentina	INDEC, Argentina	AG retail sales at supermarket chains (Disc.) VOLA
Mexico	INEGI, Mexico	MX retail sales index VOLA
Colombia	DANE, Colombia	CB retail trade index excluding fuels & motor vehicles VOLN
Poland	Central Statistical Office, Poland	PO retail sales NADJ

(Continues)

APPENDIX (Continued)

Retail Sales, national sources		
Czech Republic	Czech Statistical Office (CSU)	CZ retail trade VOLN
Romania	Natl. Institute of Statistics, Romania	RM retail: excl. motor vehicles & motorcycles (VOL) (WDA) VOLA
Hungary	Hungarian Central Statistical Office	HN retail sales (CAL ADJ) VOLN
Latvia	Central Statistical Bureau of Latvia	LV retail trade, including automotive fuel VOLN
Lithuania	Statistics Lithuania	LN retail turnover: excl motor vehicles & motorcycles (PP) VOLN
Bulgaria	National Statistical Institute, Bulgaria	BL retail trade, 2010 = 100 VOLN
Russia	Main economic indicators, OECD	RS total retail trade (volume) VOLA
South Africa	Main economic indicators, OECD	SA total retail trade (volume) VOLA
Employment, national sources		
Germany	Bundesagentur Fur Arbeit, Germany	BD employed persons (residence concept, ILO) VOLA
Italy	National Institute of Statistics, Italy	IT employment VOLN
Spain	Bank of Spain	ESEMCTFTP+ESEMCTSCP
Netherlands	Statistics Netherlands (CBS)	NL employed labour force VOLN
United States	U.S. Bureau of Labor Statistics (BLS)	US employed: health care and social assistance, Dayton, OH VOLN
Japan	Statistics Bureau, Japan	JP employed persons (METHO BREAK MAR 2011) VOLN
Canada	Statistics Canada	CN employment - Canada (15 yrs & over, SA) VOLA
Sweden	Statistics Sweden (SCB)	SD employment (15–74 yrs) VOLN
Norway	Statistics Norway	NW employment (15–74 years) VOLA
South Korea	Statistics Korea (KOSTAT)	KO employment VOLN
Taiwan	DGBAS, Taiwan	TW employed VOLN
Thailand	Bank of Thailand	TH employment VOLN
Hong Kong	Census and Statistics Dept., Hong Kong	HK employment - overall VOLN
Brazil	IBGE, Brazil	BR employment (PME survey) VOLN
Mexico	INEGI, Mexico	MX employment index - manufacturing VOLN
Colombia	DANE, Colombia	CB employed VOLN
Poland	Central Statistical Office, Poland	PO employment in private sector VOLN
Romania	Natl. Institute of Statistics, Romania	RM employment VOLN
Hungary	Hungarian Central Statistical Office	HN employed (New ILO Standard) VOLN

(Continues)

APPENDIX (Continued)

Employment, national sources		
Bulgaria	National Statistical Institute, Bulgaria	BL employed VOLN
Russia	Federal State Statistics Service, Russia	RS economically active population: employed VOLN
Turkey	Turkish Statistical Institute (TURKSTAT)	TK labor force - employed (SA) VOLA

Housing, national sources		
France	Ministere de L'equipement/DAEI/SES	FR housing started VOLN
Germany	Federal Statistical Office, Germany	BD housing permits issued for bldg.cnstr.: bldg.s-resl, new VOLN
Spain	Ministry of Housing, Spain	ES building approvals, value: new buildings Curn
Netherlands	Statistics Netherlands (CBS)	NL new construction permits: houses VOLN
United Kingdom	Office for National Statistics (ONS), U.K.	UK number of property transactions in UK (Above Pounds 40K)
United States	U.S. Census Bureau	US new private housing units started (AR) VOLA
Japan	MLIT, Japan	JP new housing construction started (AR) VOLA
Canada	Canada Mortgage and Housing Corporation	CN housing starts (AR) VOLA
Sweden	Eurostat	SD building permits, resl bldgs, exc residences for communities
Norway	Statistics Norway	NW bldg.cnstr.: utility floor space started, not dwellings (TREND)
Denmark	Statistics Denmark	DK buildings started - one-family houses VOLN
South Korea	Ministry of Land, Transport and Maritime Affairs, South Korea	KO permits authorised - building construction VOLN
Taiwan	Construction and Planning Agency, Ministry of the Interior, Taiwan	TW building permits – total (number of cases) VOLN
Thailand	Bank of Thailand	TH new houses registered in Bangkok and nearby provinces VOLN
Malaysia	Central Bank of Malaysia	MY housing approved VOLN
Argentina	INDEC, Argentina	Agprivate building: floor space permit authorized VOLN
Colombia	DANE, Colombia	CB bldg. approvals: residential, number of units VOLN
Poland	Central Statistical Office, Poland	PO dwellings completed VOLN

(Continues)

APPENDIX (Continued)

Housing, national sources		
Romania	EUROSTAT	RM building permits, resl bldgs, exc residences for communities
Hungary	Hungarian Central Statistical Office (HCSO)	HN new construction permits issued, residential buildings VOLN
Turkey	Turkish Statistical Institute (TurkStat)	TK buildings (no of buildings) VOLN
South Africa	Statistics South Africa	SA building plans passed: residential CONA

Unemployment, national sources		
France	Eurostat	FR unemployment: total - total SADJ
Germany	Deutsche Bundesbank	BD unemployment: % civilian labour (dependent labour to DEC 196
Italy	Eurostat	IT unemployment: total - total SADJ
Spain	Eurostat	ES unemployment: total - total SADJ
Netherlands	Eurostat	NL unemployment: total - total SADJ
United Kingdom	Office for National Statistics, U.K.	UK unemployment rate SADJ
United States	U.S. Bureau of Labor Statistics (BLS)	US unemployment rate SADJ
Japan	Statistics Bureau, Japan	JP unemployment rate (METHO BREAK MAR 2011) SADJ
Canada	Statistics Canada	CN unemployment rate (15 yrs & over) SADJ
Sweden	Eurostat	SD unemployment: total - total SADJ
Switzerland	Seco State Secretariat-Economic Affairs	SW unemployment rate SADJ
Norway	Statistics Norway	NW unemployment rate NADJ
Denmark	Eurostat	DK unemployment: total - total SADJ
South Korea	Statistics Korea (KOSTAT)	KO unemployment rate NADJ
Taiwan	DGBAS, Taiwan	TW unemployment rate SADJ
Thailand	Bank of Thailand	TH unemployment - rate of unemployment NADJ
Hong Kong	Census and Statistics Dept., Hong Kong	HK unemployment rate (3 months ending) SADJ
Malaysia	Department of Statistics, Malaysia	MY unemployment rate SADJ
Brazil	Instituto Brasileiro de Geografia e EstatÃstica (IBGE)	BR unemployment rate (PME survey) NADJ
Mexico	INEGI, Mexico	MX unemployment rate SADJ
Colombia	DANE, Colombia	CB unemployment rate - national NADJ

(Continues)

APPENDIX (Continued)

Unemployment, national sources		
Poland	Central Statistical Office, Poland/Thomson Reuters	PO unemployment rate (methodology break JAN 2003) NADJ
Czech Republic	Ministry of Labour and Social Affairs, Czech Republic	CZ unemployment rate NADJ
Romania	Agentia Nationala Pentru Ocuparea Fortei de Munca (ANOFM), Romania	RM unemployment rate NADJ
Hungary	Central Statistical Office of Hungary/Thomson Reuters	HN unemployment rate NADJ
Latvia	State Employment Agency, Latvia	LV unemployment rate (EP) NADJ
Lithuania	Statistics Lithuania	LN unemployment rate NADJ
Bulgaria	Ministry of Labour and Social Policy Bulgaria	BL unemployment rate NADJ
Russia	The Central Bank of the Russian Federation	RS unemployment rate (% of economically active pop): ILO NADJ
Turkey	Eurostat	TK unemployment: total - total SADJ

Industrial Production, national sources		
France	I.N.S.E.E.	Indus. prod. VOLA
Germany	Federal Statistical Office	Indus. prod. including construction (CAL ADJ) VOLA
Italy	National Institute of Statistics	Indus. prod. VOLA
Spain	Ministry of the Economy and Fin.	Indus. prod. (WDA) VOLA
Netherlands	Statistics Netherlands (CBS)	Indus. prod. excl. constr. VOLA
United Kingdom	Office for National Statistics, U.K.	Index of prod. - all production industries VOLA
United States	Federal Reserve, United States	Indus. prod. - total index VOLA
Japan	Ministry of Econ., Trade and Ind.	Indus. prod. - mining & manuf. VOLA
Canada	Main Economic Indicators, OECD	Prod. - total indus. excl. constr. VOLA
Sweden	Statistics Sweden	IPI: M&Q, MFG, ELECY, gas, steam & AC SUPL, VOL IOP (WDA) VOLN
Norway	Statistics Norway	Prod. index: extraction, mining, MFG & electricity VOLA
Denmark	Main Economic Indicators, OECD	Prod. - total indus. excl. constr. VOLA
China	National Bureau of Statistics	Indus. prod. index VOLN
India	Main Economic Indicators, OECD	Prod. - total industry excl. constr. VOLA
Indonesia	Statistics Indonesia	Indus. prod. VOLN
South Korea	Statistics Korea (KOSTAT)	Indus. prod. VOLA
Taiwan	Ministry of Economic Affairs	Indus. prod. Index VOLA
Thailand	Office of Industrial Economics	Manuf. prod. Index VOLA
Malaysia	Department of Statistics	Indus. prod. VOLN
Singapore	Statistics Singapore	Indus. prod.: Manuf. VOLA

(Continues)

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Industrial Production, national sources		
Brazil	IBGE	Indus. prod. VOLA
Argentina	FIEL	Indus. prod. VOLA
Mexico	INEGI	Indus. prod. Index VOLA
Colombia	Banco de la Republica	Indus. prod. VOLN
Poland	Eurostat	IPI: M&Q, MFG, Elecy, gas, steam & AC supl, VOL IOP (WDA) VOLN
Czech Republic	Main Economic Indicators, OECD	Prod. - total indus. excl. constr. VOLA
Romania	Eurostat	IPI: M&Q, MFG, ELECY, gas, steam & AC Supl, VOL IOP (WDA) VOLN
Hungary	Hungarian Central Statistical Office (HCSO)	Indus. prod. (WDA) VOLA
Latvia	Eurostat	IPI: M&Q, MFG, ELECY, gas, steam & AC SUPL, VOL IOP (WDA) VOLN
Lithuania	Eurostat	IPI: M&Q, MFG, ELECY, gas, steam & AC SUPL, VOL IOP (WDA) VOLA
Bulgaria	Eurostat	IPI: M&Q, MFG, ELECY, gas, steam & AC SUPL, VOL IOP (WDA) VOLA
Russia	Main Economic Indicators, OECD	PROD. - total indus. excl. constr. VOLA
Turkey	Main Economic Indicators, OECD	PROD. - total indus. excl. constr. VOLA
South Africa	Thomson Reuters	INDUS. prod. (manuf.) VOLA

Consumer Confidence Survey, national sources		
France	I.N.S.E.E.	Survey - household confidence indicator SADJ
Germany	DG ECFIN	Consum. confidence indicator - Germany SADJ
Italy	National Institute of Statistics	Household confidence index SADJ
Spain	Ministry of the Economy and Fin.	Indicator of consum. confidence SADJ
Netherlands	Statistics Netherlands (CBS)	CBS consum. confidence survey: INDEX SADJ
United Kingdom	DG ECFIN	Consum. confidence indicator - UK SADJ
United States	The Conference Board, Inc	Consum. confidence index SADJ
Japan	Cabinet Office	Consum. confidence index (excl. 1 PERSON HH.) SADJ
Canada	Main economic indicators, OECD	Consum. confidence indicator SADJ
Sweden	Natl. Institute of Econ Research	Consum. survey: consumer confidence indicator SADJ
Switzerland	Main Economic Indicators, OECD	Consum. confidence indicator SADJ
Denmark	Main Economic Indicators, OECD	Consum. confidence indicator SADJ
China	Main Economic Indicators, OECD	Consum. confidence indicator SADJ
Indonesia	Main Economic Indicators, OECD	Consum. confidence indicator SADJ

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Consumer Confidence Survey, national sources		
South Korea	Main Economic Indicators, OECD	Consum. - confidence indicator SADJ
Taiwan	The Research Center for Taiwan Econ Dev	Consum. confidence index NADJ
Thailand	Univ. of the Thai Chamber of Commerce	Consum. confidence index NADJ
Brazil	Main economic indicators, OECD	Consum. confidence indicator SADJ
Argentina	Universidad Torcuato Di Tella	Consum. confidence index: national - total NADJ
Mexico	INEGI, Mexico	Consum. confidence index - mexico SADJ
Colombia	FEDESARROLLO	Consum. confidence index NADJ
Poland	DG ECFIN	Consum.: all respondents - confidence SADJ
Czech Republic	DG ECFIN	Consum.: all respondents - confidence SADJ
Romania	DG ECFIN	Consum.: all respondents - confidence SADJ
Hungary	GKI Economic Research CO.	GKI consum. confidence index SADJ
Latvia	DG ECFIN	Consum. confidence indicator - LATVIA SADJ
Lithuania	DG ECFIN	Consum. Confidence (METHO BREAK MAY 2010) SADJ
Bulgaria	DG ECFIN	Consum.: all respondents - confidence SADJ
Russia	Ipsos	RS Thomson Reuters/IPSOS primary consum. sentiment index (CSI)
Turkey	Central Bank of the Republic of Turkey	Confidence Index - Real Sector VOLN
South Africa	Main economic indicators, OECD	Consum. confidence indicator SADJ
Saudi Arabia	IPSOS	Thomson reuters/IPSOS primary consum. Sentiment index (CSI)

Consumer Price Index, national sources		
France	I.N.S.E.E.	FR CPI NADJ
Germany	Federal Statistical Office	BD CPI: total (flash & final) NADJ
Italy	National Institute of Statistics, Italy	IT CPI including tobacco (NIC) NADJ
Spain	National Statistics Institute, Spain	ES CPI NADJ
Netherlands	Statistics Netherlands (CBS)	NL CPI NADJ
United Kingdom	Office for National Statistics, U.K.	UK CPI INDEX 00 : all items-estimated pre-97 2005 = 100 NADJ
United States	U.S. Bureau of Labor Statistics (BLS)	US CPI - all urban sample: all items NADJ
Japan	Thomson Reuters	JP CPI: National measure NADJ
Canada	Statistics Canada	CN CPI NADJ

(Continues)

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Consumer Price Index, national sources		
Sweden	Statistics Sweden (SCB)	SD CPI NADJ
Switzerland	Swiss Federal Statistical Office	SW CPI NADJ
Norway	Statistics Norway	NW CPI NADJ
Denmark	Statistics Denmark	DK CPI NADJ
China	National Bureau of Statistics, CHINA	CH CPI (CPPY=100) NADJ
India	MOSPI - Ministry of Statistics and Programme Implementation, India	IN CPI: rural and urban - general index NADJ
Indonesia	Statistics Indonesia	ID CPI NADJ
South Korea	Statistics Korea (KOSTAT)	KO CPI NADJ
Taiwan	DGBAS, Taiwan	TW CPI NADJ
Thailand	Bureau of Trade & Econ. indices, Thailand	TH CPI NADJ
Hong Kong	Census and Statistics Dept., Hong Kong	HK CPI Composite NADJ
Malaysia	Department of Statistics, Malaysia	MY CPI NADJ
Singapore	Statistics Singapore	SP CPI NADJ
Brazil	IBGE, Brazil	BR broad national CPI OR IPCA NADJ
Argentina	INDEC, Argentina	AG CPI NADJ
Mexico	INEGI, Mexico	MX CPI NADJ
Colombia	DANE, Colombia	CB CPI: National NADJ
Poland	Central Statistical Office, Poland	PO CPI -ALL ITEMS NADJ
Czech Republic	Czech National Bank	CZ CPI (1995 = 100) NADJ
Romania	Natl. Institute of Statistics, Romania	RM CPI (PP=100) NADJ
Hungary	Hungarian Central Statistical Office	HN CPI (1990 = 100) NADJ
Latvia	Central Statistical Bureau of Latvia	LV CPI NADJ
Lithuania	statistics Lithuania	LN CPI (2010 = 100) NADJ
Bulgaria	national Statistical Institute, Bulgaria	BL CPI NADJ
Russia	federal State Statistics Service, Russia	RS CPI NADJ
Turkey	Turkish Statistical Institute (TURKSTAT)	TK CPI NADJ
South Africa	Main economic indicators, OECD	SA consumer prices: all items NADJ
Saudi Arabia	Ministry of Econ. & Plan., Saudi Arabia	SI cost of living index NADJ

Producer Price Index, national sources		
France	Main Economic Indicators, OECD	FR domestic PPI MFG NADJ
Germany	Federal Statistical Office, Germany	BD PPI: indl. products, total, sold on the domestic market NADJ
Italy	National Institute of Statistics (Istat), Italy	IT PPI NADJ
Spain	INE	ES PPI NADJ
Netherlands	Eurostat	NL PPI: manufacturing NADJ
United Kingdom	ONS	UK PPI - output of manufactured products (home sales) NADJ
United States	U.S. Bureau of Labor Statistics (BLS)	US PPI - finished goods NADJ
Japan	Bank of Japan	JP producer price index NADJ
Canada	Statistics Canada	CN industrial product price index (IPPI) - total NADJ
Sweden	Statistics Sweden	SD PPI NADJ
Switzerland	Swiss Federal Statistical Office	SW PPI NADJ
Norway	Statistics Norway/Thomson Reuters	NW PPI (linked & rebased) NADJ
Denmark	Statistics Denmark	DK PPI - manufacturing excl. SHIPS NADJ
China	National Bureau of Statistics, China	CH producer price INDEX (CPPY=100) NADJ
India	International Financial Statistics (IMF)	IN producer prices, all commodities NADJ
Indonesia	Statistics Indonesia	ID PPI/WPI NADJ
South Korea	The Bank of Korea	KO PPI NADJ
Taiwan	Directorate-General of Budget, Accounting and Statistics, Taiwan	TW WPI NADJ
Thailand	International Financial Statistics (IMF)	TH producer prices, all commodities NADJ
Malaysia	International Financial Statistics (IMF)	My producer prices, all commodities NADJ
Singapore	Statistics Singapore	SP PPI - domestic supply NADJ
Brazil	Fundacao Getulio Vargas (FGV)	BR Broad PPI - domestic supply (IPA-EP-DI) NADJ
Argentina	INDEC	AG PPI OR IPP NADJ
Mexico	Main Economic Indicators, OECD	MX domestic PPI MFG NADJ
Colombia	International Financial Statistics (IMF)	CB producer prices, all commodities NADJ
Poland	International Financial Statistics (IMF)	PO producer prices, all commodities NADJ
Czech Republic	Czech Statistical Office (CSU)	CZ PPI NADJ
Romania	National Institute of Statistics (NIS), Romania	RM PPI: total NADJ
Hungary	International Financial Statistics (IMF)	HN producer prices, all commodities NADJ

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Producer Price Index, national sources		
Latvia	International Financial Statistics (IMF)	LV producer prices, all commodities NADJ
Lithuania	International Financial Statistics (IMF)	LN producer prices, all commodities NADJ
Bulgaria	International Financial Statistics (IMF)	BL producer price index (2010 = 100) NADJ
Russia	Federal State Statistics Service, Russia	RS PPI NADJ
Turkey	Turkish Statistical Institute (TurkStat)	TK Domestic PPI NADJ
South Africa	International Financial Statistics (IMF)	SA producer prices, all commodities NADJ