A New Monthly Indicator of Global Real Economic Activity

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Abstract

In modelling macroeconomic time series, often a monthly indicator of global real economic activity is used. We propose a new indicator, named World steel production, and compare it to other existing indicators, precisely the Kilian's index of global real economic activity and the index of OECD industrial production. We develop an econometric approach based on desirable econometric properties in relation to the quarterly measure of World gross domestic product to evaluate and to choose across different alternatives. The method is designed to evaluate short-term, long-term and predictability properties of the indicators. World steel production is proven to be the best monthly indicator of global economic activity in terms of our econometric properties. Kilian's index of global real economic activity also accurately predicts World GDP growth rates. When extending the analysis to an out-of-sample exercise, both Kilian's index of global real economic activity and the World steel production produce accurate forecasts for World GDP, confirming evidence provided by the econometric properties. Specifically, forecast combinations of the three indices produce statistically significant gains up to 40% at nowcast and more than 10% at longer horizons relative to an autoregressive benchmark.

Motivation

In time series macroeconomic analysis often an indicator of global real economic activity is used to represent the World economy. World gross domestic product (GDP), measured at quarterly frequency in United States (US) dollars using purchasing power parity, is broadly accepted and frequently used as a measure of global economic activity. However, there is a lack of degrees of freedom associated with quarterly data. To address this issue, economic modellers commonly turn to a monthly indicator of global economic activity. Consequently, several monthly indicators of activity have been used in the literature to measure real economic activity (at both country and global level).

Evaluating monthly indicators of real economic activity: Proposed methodology

Long-run properties

Property 1: The global monthly indicator of real economic activity ($GREA_t^q$), when converted to quarterly frequency has to be cointegrated with World GDP ($GGDP_t$). If both series are non-stationary and integrated of the same order and there exists a parameter α such that:

$u_t = \log(GREA_t^q) - \alpha\log(GGDP_t)$ (1) is a stationary process.

Where: u_t is the error term, $GREA_t^q$ is the global monthly indicator of real aggregate demand. The superscript q is used to denote that the monthly series was converted to a quarterly series using the simple average. $GGDP_t$ is World GDP and α is a parameter to be estimated.

Aggregate distance properties

Property 2: When $GGDP_t$ and $GREA_t^q$ are indexed from the same start period, the square aggregated distance between these two series should be minimised. Formally;

$$Min \sum_{i=1}^{n} \sqrt{\left(\log(GGDP)_t - \log(GREA_t^q)\right)^2} \quad (2)$$

Property 3: When $GGDP_t$ and $GREA_t^q$ are first differenced and indexed from the same start period, the square aggregate distance between these two series should be minimised. Formally;

$$Min \sum_{i=1}^{n} \sqrt{\left(\Delta\log(GGDP_t) - \Delta\log(GREA_t^q)\right)^2} \quad (3)$$

Where: Δ is the first difference operator and log is short for logarithm.

Property 4: When $GGDP_t$ and $GREA_t^q$ are detrended and indexed from the same start period, the square aggregate distance between these two series should be minimised. Formally;

$$Min \sum_{i=1}^{n} \sqrt{\left[(GGDP_t - \beta t) - (GREA_t^q - \delta t)\right]^2} \quad (4)$$

Where $t = (1,2,\dots,n)$ is a time trend and β and δ are parameters to be estimated using ordinary least square regression.

Correlation properties

Property 5: Maximise correlation between $\Delta GGDP_t$ and $\Delta GREA_t^q$. Formally;

$$Max\left[\frac{n\sum \Delta GGDP_t * \Delta GREA_t^q - (\sum \Delta GGDP_t) * (\sum \Delta GREA_t^q)}{\sqrt{n\sum(\Delta GGDP_t)^2 - \sum(\Delta GGDP_t)^2}\ \sqrt{n\sum\left(\Delta GREA_t^q\right)^2 - \sum\left(\Delta GREA_t^q\right)^2}}\right] \quad (5)$$

Property 6: Maximise correlation between $dGGDP_t$ and $dGREA_t^q$. Formally:

$$Max\left[\frac{n\sum dGGDP_t * dGREA_t^q - (\sum dGGDP_t) * (\sum dGREA_t^q)}{\sqrt{n\sum(dGGDP_t)^2 - \sum(dGGDP_t)^2}\ \sqrt{n\sum\left(dGREA_t^q\right)^2 - \sum\left(dGREA_t^q\right)^2}}\right] \quad (6)$$

Where $dGGDP_t = GGDP_t - \beta T$ and $dGREA_t^q = GREA_t^q - \delta T$, where T is a lineal trend.

Predictability Properties

Property 7: This property states that: a desirable feature of the global real economic activity monthly indicator is to be able to predict quarterly World GDP when both series are transformed to a stationary process by using first

Properties results

Table 6: Econometric property results

	Kilian's rea index	OECD IP	Steel Production
Property 1	-	Yes	Yes
Property 2	3	2	1
Property 3	2	3	1
Property 4	3	2	1
Property 5	1	3	2
Property 6	3	2	1
Property 7	2	2	1
Property 8	2	3	1
First difference properties (average)	1.66	2.66	1.33
Detrended properties (average)	2.66	2.33	1
All properties (average)	2.28	2.42	1.14

Forecasting World GDP

We split the full quarterly sample 1991Q1-2013Q1 into two periods: an initial in-sample period 1991Q1-1999Q4 and the out-of-sample (OOS) period 2000Q1-2013Q1. We use a recursive window to estimate the models and produce the forecasts over the different vintages. For each of the 53 OOS values, we produce from 1- to 8-step ahead forecasts using several different models based on the indicators of Global real economy. Precisely, we apply the following models:

$$dGGDP_t = \alpha + \beta\ dGGDP_{t-1} + \gamma\ X_{i,t-1} + \varepsilon_t \quad (9)$$

where $X_{i,t-1}$ is one of the three indicators of Global real economy activity, that is Kilian's rea index, OECD industrial production and World steel production; and ε_t is the error term with zero mean and σ^2 variance. Each model produces an h-step ahead forecast of detrended World GDP, $dGGDP_{t+h}$, our preferred measure of value added GDP, as:

$$\widehat{dGGDP}_{i,t+h} = a + b\ dGGDP_t + c\ X_{i,t} \quad (10)$$

where a, b and c are the OLS estimates of unknown parameters α and β in equation (9). The indicators are monthly variables and we convert them to quarterly observation $X_{i,t}$ using the most updated available information We fix the autoregressive lag to 1 because this model outperforms models with more lags. Irrespectively, results are qualitative similar for models with more autoregressive lags. Moreover, the linear framework in equation (10) ignores that indicators are available at higher frequency than World GDP. We leave for future research to investigate regression methods that allows for estimation with mixed frequency data, such as MIDAS models, see e.g. Ferrara and Marsilli (2014).

$$\widehat{dGGDP}_{c,t+h} = \sum_i w_{i,t+h}\ \widehat{dGGDP}_{i,t+h} \quad (11)$$

where $w_{i,t} > 0$, $\sum_i w_{i,t} = 1$ are forecast combination weights. We consider two types of weights. First, we assume equal weights, $w_{i,t} = 1/3$. We label it as FC_EW. Second, we compute the weights $w_{i,t}$ as the inverse SPE of model i up to time (t-1) for horizon h.

Table 7: Forecasting World detrended GDP: MSPE

Hor	1	2	3	4	5	6	7	8
AR	0.017	0.065	0.134	0.211	0.284	0.347	0.402	0.455
Kilian's rea index	**0.695***	**0.708**	**0.693**	**0.715**	**0.747**	**0.763**	**0.781**	**0.816***
OECD IP	**0.828**	**0.922**	1.030	1.131	1.218	1.287	1.332	1.355
Steel Production	**0.734****	**0.732***	**0.687***	**0.664***	**0.710**	**0.828**	**0.948**	1.014
FC_EW	**0.599*****	**0.612*****	**0.627****	**0.671*****	**0.739****	**0.811***	**0.876**	**0.920**
FC_SPE	**0.596*****	**0.609*****	**0.605****	**0.624*****	**0.680****	**0.762***	**0.837**	**0.884**

Conclusions

In this paper we propose a new monthly indicator of Global real economic activity, named World steel production, and compare it to Kilian's rea index and the OECD industrial production index using a new econometric approach based on desirable properties of monthly global real economic activities. This novel approach proposes seven properties that evaluate four important features of the data: Long-term, aggregate distance, correlation and predictability properties of the data.

Averaging all the properties, World steel production is proven to be the best monthly indicator of global economic activity. In particular, in averaging results for all numerical exercises where a lower score indicates better performance, World steel production prevails with a lower average score of 1.14, while both Kilian's rea index and OECD industrial production have an average score of 2.28 and 2.42 respectively. Using either detrended or first difference data, World steel production outperforms both; Kilian's rea index and OECD industrial production index.

We test our in-sample econometric evidence in an out-of-sample exercise and confirm in-sample ranking with both Kilian's rea index and World steel production producing accurate forecasts for World GDP. Moreover, forecast combinations of the three indices produce statistically significant gains up to 40% at nowcast and more than 10% at longer horizons relative to an autoregressive benchmark. However, indicators of global real activity perform poorly at longer horizons after the US financial crisis in the recovery phase. The US financial crisis has been a global event, but the recovery has varied across countries and a global economic factor reduces predictability in such period.