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# IMF Working Paper

# A World Trade Leading Index (WTLI)

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**Abstract**

This paper develops a new monthly World Trade Leading Indicator (WTLI) that relies on nonparametric and parametric approaches. Compared to the *CPB World Trade Monitor*'s benchmark indicator for global trade the WTLI captures turning points in global trade with an average lead between 2 and 3 months. We also show that this cyclical indicator is able to track the annual growth rate in global trade, suggesting that the recent slowdown is due in part to certain cyclical factors. This new tool can provide policy makers with valuable foresight into the future direction of economic activity by tracking world trade more efficiently.

JEL Classification Numbers: F17; F47; E37

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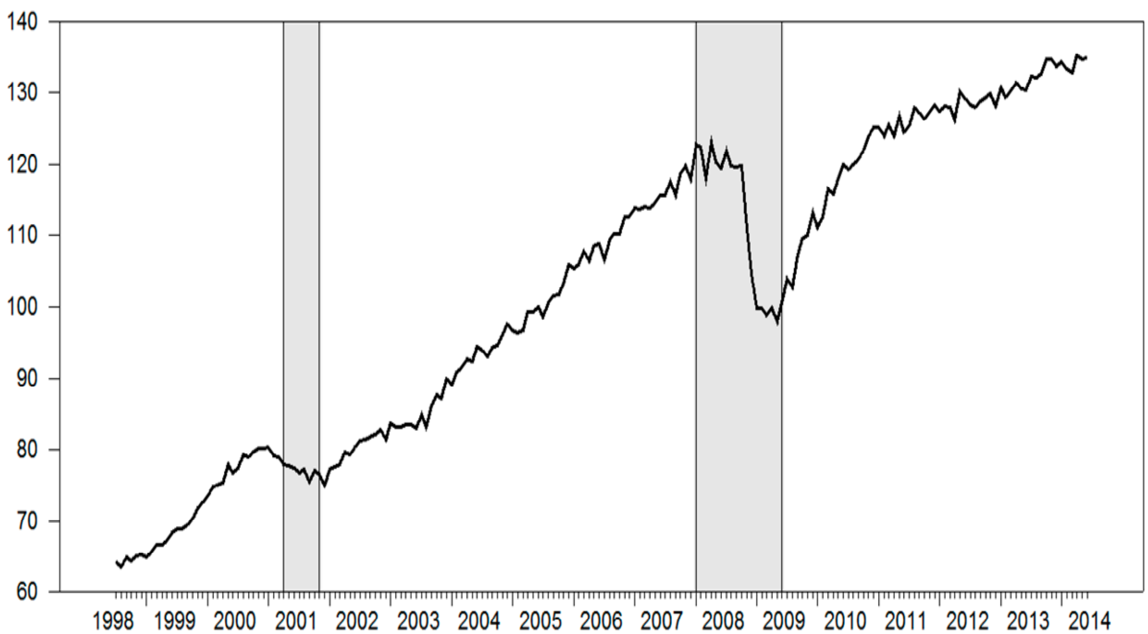
## I. INTRODUCTION

Trade flows during the global crisis fell much more sharply than they did during the Great Depression (Martins and Araujo, 2009, Barry Eichengreen and Kevin O'Rourke 2009, Baldwin, 2009 and Bussière and others, 2013). Although there have been periods of sharp and sudden trade declines in the past, the one that took place at the end of 2008 is unique in its magnitude. After more than six years of positive trade growth, trade started to plummet in October of 2008, reaching a record negative growth of -37% in April of 2009, as shown in Figure 1. Predicting this kind of global crisis is not easy. More recently, global trade experienced a marked slowdown that began in 2011, resulting in the growth rate of trade being equal or even lower than the one of global GDP growth. The factors behind this decline in elasticities to economic growth are not easy to disentangle. Some researchers argue in favor of structural determinants such as the increase in protectionism or the slower pace in global value chains (e.g. Constantinescu et al., 2014). Other papers put forward cyclical reasons related to the composition of GDP growth (e.g. Bussière et al., 2014). These recent discussions have revived the debate over how to accurately forecast developments in international trade.

**Figure 1. World Trade in Volume and Recession Phases in the United States (shaded areas)**




Sources: The Netherlands Bureau for Economic Policy Analysis and authors' calculation

Monitoring world trade in real time is challenging for economists because of delays in data releases. For example, the OECD publishes a quarterly index of world trade using data from national accounts with a one quarter lag (Guichard and Rusticelli, 2011). The Netherlands

Bureau for Economic Policy Analysis (CPB) also publishes a monthly index of global trade.[2] This index, which is currently considered the benchmark indicator for global trade, is available with a lag of two months. The lack of timeliness in releasing these indicators makes it almost impossible to track and predict unexpected and significant changes in international trade.

In this paper, we address timeliness by proposing a monthly leading indicator of international trade or World Trade Leading Index (WTLI). We also show how the WTLI accurately signals large future changes in world trade and how it coincides with actual trade data. Leading indicators prove useful for anticipating short-term macroeconomic fluctuations in aggregate output (e.g. Anas and Ferrara, 2004, Marcellino, 2005, or Matheson, 2011).We carry out two different approaches that rely on nonparametric and parametric methods to construct our composite indicator, starting with a set of selected variables that are often used by practitioners to monitor short-term evolutions in global trade. To the best of our knowledge, we are the first to build such a composite leading indicator for global trade as measured by the CPB.

The rest of the paper is organized as follows: Section 2 outlines the objectives of this analysis and describes the data. Section 3 presents the empirical methodology used to derive our leading indicators of world trade. Section 4 discusses the key results and the main features of our leading indicators. Section 5 concludes the paper.

## II. Objectives and Data

### *A.* Objectives

To deal with the high volatility that is commonly associated with high-frequency data, we use the annual growth rate from the monthly CPB index defined as

$$dCPB_t = (\log(CPB_t) - \log(CPB_{t-12})) \times 100 \ .$$

This annual growth rate, $dCPB_t$, is presented in Figure 2. The main objective is to build a leading indicator that captures turning points in the annual growth rate of the CPB index. To do so, we first establish a chronology of turning points for the specific series by employing the Bry-Boschan algorithm,[3] a pattern-recognition algorithm that aims to identify peaks and troughs in a time series by searching for local maxima. This search is carried out by looking at dates for which there is a change in the sign of the derivative. More specifically, this algorithm detects a peak and a trough at date *t* if the following conditions are verified, respectively:

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[2] The CPB index is built based on the trade series (prices and values) of 85 countries, covering around 97 percent of the world trade volume.

[3] The Bry-Boschan algorithm is typically implemented in business cycle analysis. Among others, see Darné and Ferrara (2011) and Harding and Pagan (2002).

$$\{(\Delta_k \boldsymbol{dCPB_t}, \dots, \Delta \boldsymbol{dCPB_t}) > 0, (\Delta \, \boldsymbol{dCPB_{t+1}}, \dots, \Delta_k \, \boldsymbol{dCPB_{t+k}}) < 0\}$$

and

$$\{(\Delta_k \, dCPB_t, \dots, \Delta dCPB_t) < 0, (\Delta \, dCPB_{t+1}, \dots, \Delta_k \, dCPB_{t+k}) > 0\},$$

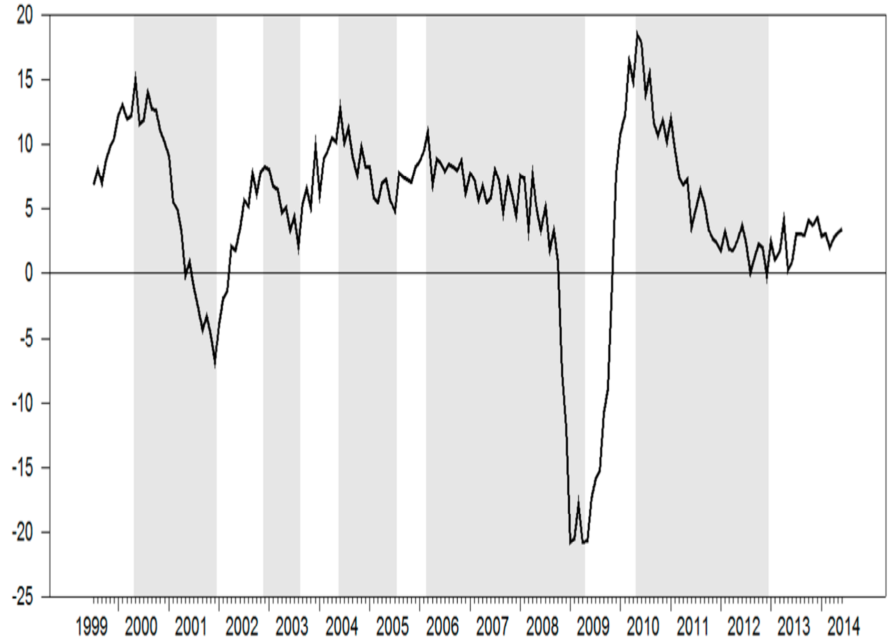
where the operator $\Delta_{\boldsymbol{k}}$ is defined as $\Delta_{\boldsymbol{k}} dCPB_{\boldsymbol{t}} = \boldsymbol{d}CPB_{\boldsymbol{t}} - \boldsymbol{dCPB_{t-k}}$. Following Harding and Pagan (2002), we set k = 5, since we use monthly data, instead of k = 2 in the initial algorithm dealing with quarterly data in order to account for more volatility in the data.

Typically, turning points within six months of the beginning or end of the sample are disregarded. To ensure that peaks and troughs alternate, we impose that, in the presence of a double through (peak), only the lowest (largest) value is kept. Also, we impose some rules to require that a phase must last at least 6 months and a complete cycle from peak to peak must last at least 15 months.

Using this algorithm, we identify peaks and troughs as shown in Table 2 and Figure 2, where shaded areas correspond to periods from peak to trough that are characterized by decelerating global trade activity. Thus, turning points in this specific series define the acceleration cycle in global trade, following the terminology adopted by Darné and Ferrara (2011).

The next step consists in building an index able to anticipate in real time the turning points previously identified, based on the Bry-Boschan algorithm. For this purpose, we implement two different approaches, a nonparametric one—often used in business cycle analysis—and a parametric one—based on a dynamic factor model—using the set of leading indicators described below. We will refer to this index as the World Trade Leading Index (WTLI).

**Figure 2. Annual Growth Rate of the Monthly CPB Index from 1999:7 to 2014:7 and Chronology of Turning Points (shaded areas)**




## B. Data

Assessing the quality of trade indicators requires more than simple correlations. We consider a set of potential leading indicators for the annual growth rate of world trade and focus on seven of them[4] based on the (i) timeliness of the indicators and (ii) their dynamic correlation with the CPB (Figure 3). These indicators are presented below:

- The Baltic Dry Index (BDI) is compiled by the London-based Baltic Exchange using a panel of international shipbrokers and measures the average cost of shipping bulk raw materials on a daily basis. Assuming a fixed supply of cargo vessels in the short run, higher expected industrial production and global trade is associated with an increasing BDI.[5]
- Oil price (Brent) is related to world trade, both of which reflect evolutions in global demand.
- The Commodity Research Bureau index (CRB) gauges the collective price trend of the commodities markets. Derived by the Commodities Research Bureau, this index is published by Thomson Reuters/Jefferies and comprises 19 commodities: aluminum, cocoa, coffee, copper, corn, cotton, crude oil, gold, heating oil, lean hogs,

[4] In our initial sample, we start with 10 variables.

[5] An alternative shipping price index is the Harper Petersen Charter Rate Index (HARPEX), which is now readily available on a weekly basis, but only for the past three years.

live cattle, natural gas, nickel, orange juice, silver, soybeans, sugar, unleaded gas, and wheat.

- The Purchasing Managers' Index (PMI), produced by both the Markit Group and the Institute for Supply Management, is an indicator of financial activity reflecting purchasing managers' acquisition of goods and services. The Markit Group and the Institute for Supply Management compile PMIs on a monthly basis by polling businesses that represent the makeup of the respective sectors. PMIs cover only private sector companies and are seen as a good proxy for global GDP.
- The Ifo Business Climate Index is a leading indicator for economic activity in Germany and is prepared by the Leibniz Institute for Economic Research at the University of Munich (Ifo Institute). The Ifo Business Climate Survey is based on approximately 7,000 monthly responses of firms in manufacturing, construction, wholesale, and retail. As the largest economy in the European Union, Germany's business climate impacts the rest of the European Union. We only consider two components of the Ifo index: the business climate and expectations.
- The U.S. dollar nominal effective exchange rate, since most trade transactions around the globe are expressed in U.S. dollars.[6]

The above indicators have been included because they are all released in a timely manner. For the same reason, two important monthly indicators are not included in our analysis: the IATA-International air freight indicator—available four weeks after month-end—and the Suez Canal traffic indicator—available approximately two weeks after month-end.

**Table 1. Selected Variables, Frequency, and Release Date**

| Variables | Frequency | Availability |
|---|---|---|
| CRB | Monthly | Around the 3rd day of month m+1 |
| Brent | Daily | End of month m |
| USD | Daily | End of month m |
| BDI | Daily | End of month m |
| IFO Climate | Monthly | Around the 21st day of month m |
| IFO Expectation | Monthly | Around the 21st day of month m |
| PMI | Monthly | Around the3rd day of month m+1 |

[6] In some cases, the U.S. dollar appreciation may indicate a strong demand from the United States or a weak demand from the rest of the world.

**Figure 3. Dynamic Correlations[7] of CPB and the Selected Variables**

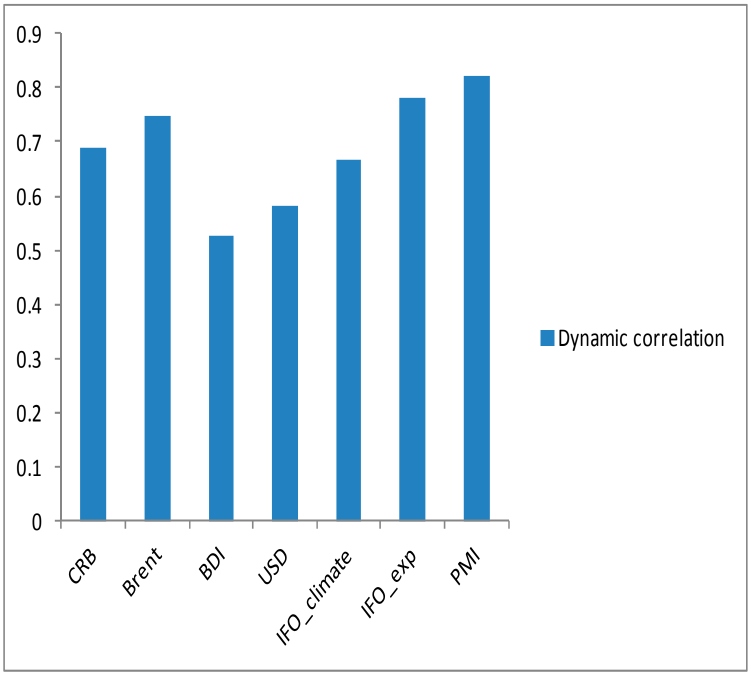



Table 1 summarizes the publication date of each individual indicator. There are clear advantages relative to the CPB index in that, as of the beginning of month m+1, we can compute the WTLI for month m. Thus, the automatic gain in time or minimization of the operational delay— is about 2 months compared to the release of the CPB.

## III. Methodology

In this section, we present the two approaches we implemented to build the composite leading indicator of trade based on the series presented above. The first approach is purely nonparametric and relies on a standard procedure often used in business cycle analysis. The second approach is based on a parametric factor model. Due to data availability, our analysis covers the period July 1998–July 2014.

### A. A Nonparametric Indicator (WTLI_np)

This first approach is based on a standard methodology used by the Conference Board[8] in the development of their leading and coincident indicators. This approach is in fact a weighted

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[7] Dynamic correlations are the best alternative to static analysis for they capture the comovement between variables. For further details, see Croux et al (2001).

[8] For further details, see Stock and Watson (2010).

average of several components, the weight of each component being inversely related to its standard deviation. Let's note $X_{it}$, i=1, …, 7, the pre-selected variables at each date t. We use log differentiation to get stationary variables $y_{it} = \Delta(\log(X_{it}))$.

The nonparametric index, referred to as WTLI_np, is very simple to implement and is constructed in two steps:

(i) For each variable, the weights are computed based on differentiated data. The weight for any variable *i* is given by

$$\alpha_i = s_i^{-1} / \sum_{i=1}^{7} s_i^{-1} \ ,$$

where $s_i$ is the standard error of $y_{it}$.

(ii) Then, the composite indicator is computed as

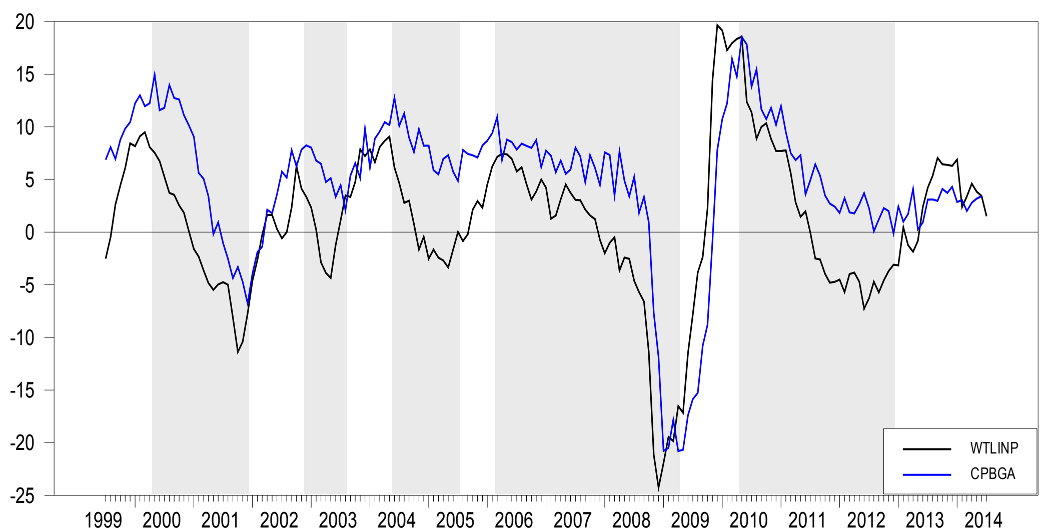
$$CI_t = \exp(\sum_{i=1}^{7} \alpha_i \log(X_{it})) \ .$$

Now, the differences over 12 months of Index $CI_t$ can be compared directly with the annual growth rate of the CPB index of trade in volume. We refer to this index as the nonparametric version of the World Trade Leading Index (*WTLI_np*), defined by

$$WTLI\_np = CI_t - CI_{t-12}.$$

WTLI_np and annual CPB growth rate are presented in Figure 4. We clearly see that our index tracks the global trade cycle as measured by the CPB. In addition, we observe that the index seems to lead turning points in the trade cycle.

**Figure 4. World Trade Leading Index (Nonparametric) and CPB Annual Growth**



### B. A Parametric, Factor-based Indicator (WTLI_f)

In the second approach, we estimate a factor model similar to Stock and Watson's (2002),[9] which uses a static Principal Component Analysis (PCA) to estimate the factors $F_t$ from the initial database of the differentiated series ($y_{it}$). An eigenvalue decomposition of the estimated covariance matrix $\hat{\Gamma}_0 = T^{-1}\sum_{t=1}^{T} X_t X_t'$ provides the $(n \times r)$ eigenvector matrix $\hat{S} = (\hat{S}_1, \ldots, \hat{S}_r)$, containing the eigen-vectors $\hat{S}_j$, corresponding to the $r$ largest eigenvalues for $j = 1, \ldots, r$. The factor estimates are the first $r$ principal components of ($y_t$), defined as $F_t^{SW} = \hat{S}' y_t$. To integrate dynamics in the factors, Stock and Watson (2002) propose an autoregressive model for the factors but, alternatively, some other dynamic factors can be implemented (e.g. Doz et al., 2012).

All series are first stationarized by taking the log differences over one month or differences over one month for survey data. Then, a standard PCA is applied to the normalized time series to obtain the estimated first factor $\widehat{f_t}$ that is intended to reflect the global-trade growth rate over one month. To be comparable with the annual growth rate of CPB, this factor is integrated with a basis of 100 in July 1998.

The index $I_t$ is thus defined as

$$I_t = \widehat{f_t} + I_{t-1} \ .$$

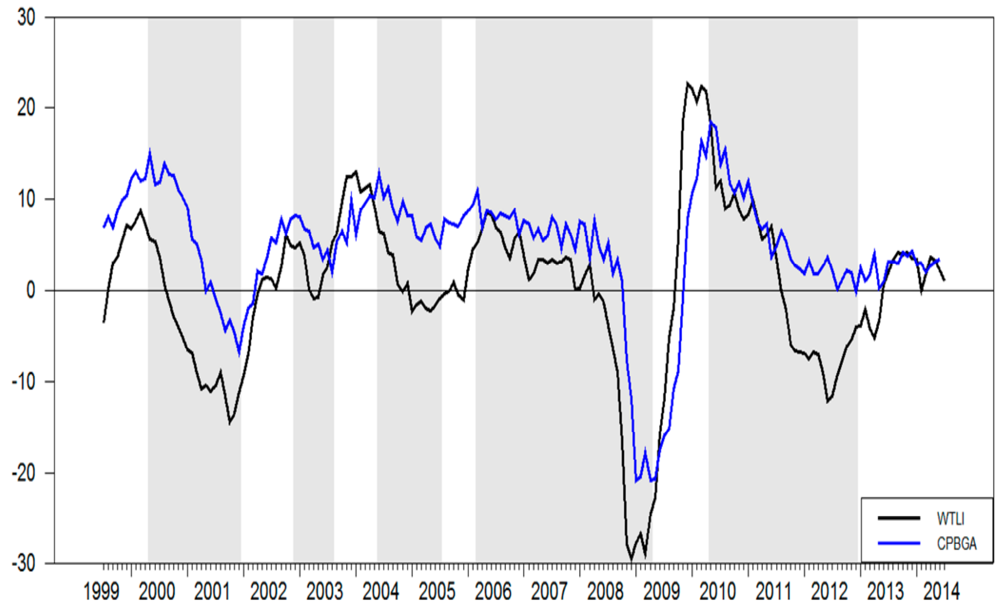
Therefore, differences over 12 months of this index $I_t$ can be compared directly to the annual growth rate of the CPB index of trade in volume. We refer to this index as the World Trade Leading Index Factor (*WTLI_f*), defined by

$$WTLI\_f = I_t - I_{t-12}.$$

Both the *WTLI_f* and the CPB annual growth are presented in Figure 5. Again, we note that the *WTLI_f* index tracks trade cycles as measured by the CPB and tends to lead peaks and troughs in the trade cycle.

[9] See Barhoumi, Darné, and Ferrara (2013) for further details.

**Figure 5. World Trade Leading Index (Factor) and CPB Annual Growth**




## IV. Turning point analysis

In order to more formally evaluate the lead of our indicator of global trade, we carry out a lead/lag analysis by comparing peaks and troughs over the entire sample. To do so, we apply the Bry-Boschan algorithm to both the WTLI_np and the WTLI_f. Results are presented in Table 2 as are the turning points for the CPB annual growth.

Table 2 clearly shows that the *WTLI_np* is leading the CPB with an average lead of 2.8 months, the maximum lead being six months. We note that the lead is quite stable over time.

Results are very similar for the *WTLI_f*, which leads the trade cycle with an average lead of 2.7 months, the maximum lead being five months.

In both instances, the two WTLI versions signal a trough in June 2014, indicating that a trough in the trade cycle is likely to occur in 2014.

**Table 2. Dates of Turning Points for the WTLI_np and WTLI_f Compared to the Annual Growth of the CPB (in months)**

| | CPB | WTLI NP | Lead (+) / Lag (-) | WTLI Factor | Lead (+) / Lag (-) |
|---|---|---|---|---|---|
| **Peak** | May 2000 | Mar. 2000 | 2 | Mar. 2000 | 2 |
| **Trough** | Dec. 2001 | Oct. 2001 | 2 | Oct. 2001 | 2 |
| **Peak** | Dec. 2002 | Oct. 2002 | 2 | Oct. 2002 | 2 |
| **Trough** | Aug. 2003 | May. 2003 | 5 | Apr. 2003 | 4 |
| **Peak** | June 2004 | May 2004 | 1 | Jan. 2004 | 5 |
| **Trough** | July 2005 | May 2005 | 2 | May 2005 | 2 |
| **Peak** | Mar. 2006 | Apr. 2006 | -1 | May 2006 | -2 |
| **Trough** | Apr. 2009 | Dec. 2008 | 4 | Dec. 2008 | 4 |
| **Peak** | May 2010 | Dec. 2009 | 5 | Dec. 2009 | 5 |
| **Mean** | | | 2.4 | | 2.7 |
| **Standard deviation** | | | 1.9 | | 2.2 |

## V. Conclusion

In this paper we develop a monthly leading indicator for global trade (WTLI) using both a simple nonparametric approach and a factor model. We find that the two approaches lead to very similar results. We show that this indicator closely tracks the trade cycles as measured by the CPB. In particular, we find that the WTLI leads turning points in the trade cycle with an average lead of two to three months. Overall, it seems that this cyclical indicator is very effective in tracking the annual growth of trade. This is particularly true for the last period, which suggests that the recent slowdown is at least partly related to cyclical factors.

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