



Flossbach von Storch  
RESEARCH INSTITUTE

MACROECONOMICS 11/10/2019

## Introducing the FvS Business Cycle Indicator for Germany

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### Abstract

Economic activity in Germany has been weak since the beginning of 2019. Several leading indicators point to a looming recession. However, so far there has been no unambiguous and methodologically sound single tool to track the business cycle in Germany. This note introduces the FvS Business Cycle Indicator to fill the gap.

Developments of the FvS BCI so far this year suggest that recession could have started in April 2019. But a final judgement based on our methodology will have to wait until we have seen the recession trough.

### Zusammenfassung

Die Konjunktur in Deutschland ist seit Anfang 2019 schwach. Mehrere Frühindikatoren deuten auf eine drohende Rezession hin. Bislang gibt es jedoch kein eindeutiges und methodisch fundiertes Einzelinstrument zur Erfassung des Konjunkturverlaufs in Deutschland. In diesem Paper stellen wir den FvS-Konjunkturindikator für Deutschland vor, um die Lücke zu schließen.

Die Entwicklung des FvS-KI im Verlauf dieses Jahres lässt vermuten, dass die Rezession im April 2019 begonnen haben könnte. Ein endgültiges Urteil ist auf Grundlage unserer Methode jedoch erst möglich, wenn wir den unteren Wendepunkt gesehen haben.



## Introduction

Economic activity in Germany has been weak since the beginning of 2019. Several leading indicators point to a looming recession. But how is “recession” defined? So far, the definition is based only on a rule of thumb, because an unambiguous and methodologically sound single tool to track the business cycle in Germany is missing. This note introduces the FvS Business Cycle Indicator (FvS BCI) to fill the gap.

*At the time of writing, the FvS BCI points to recession in Germany as of April 2019.*

Our indicator has two advantages for the assessment of the business cycle: First, by assessing GDP data against the information obtained from other activity data it can more reliably identify business cycles peaks and troughs. Second, as it is based on monthly data it can more precisely time turning points of the business cycle.

Developments of the FvS BCI so far this year suggest that recession could have started in April 2019. But a final judgement based on our methodology will have to wait until we have seen the recession trough.

## Motivation

Since 1979, the National Bureau of Economic Research (NBER) has documented and officially announced the turning points in the business cycle of the US economy.<sup>1</sup> Based on a thorough analysis of macro indicators of real economic activity, the NBER retrospectively determines the dates of troughs as the starting date of the expansion, and the dates of peaks as the starting date of the recession.<sup>2</sup> Specifically, according to the NBER definition:

*“A recession is a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in production, employment, real income, and other indicators. A recession begins when the economy reaches a peak of activity and ends when the economy reaches its trough. Between trough and peak, the economy is in an expansion.”<sup>3</sup>*

A similar procedure does not exist for Germany or other developed economies.<sup>4</sup> The customarily followed approach is to look at the development of

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<sup>1</sup> Business cycle reference dates for the USA are computed back to 1857, but the official announcements started in 1979. For details, see <https://www.nber.org/cycles.html>.

<sup>2</sup> For a detailed description of the NBER’s approach, see the press releases of the turning points in the business cycles, available at: <https://www.nber.org/cycles.html>.

<sup>3</sup> “Determination of the December 2007 Peak in Economic Activity”, Business Cycle Dating Committee, National Bureau of Economic Research, December 1, 2008, available at <https://www.nber.org/cycles/dec2008.html>.

<sup>4</sup> The German Council of Economic Experts (Sachverständigenrat zur Beurteilung der gesamtwirtschaftlichen Entwicklung) introduced in 2009 a recession criterium, according to which “a recession occurs when a decline in the relative output gap by at least two thirds of the respective potential growth rate is accompanied by a currently negative output gap.” [“Annual report of the German Council of Economic Experts for 2008/2009”, p. 7, available at: <https://web.archive.org/web/20090306123725/http://www.sachverstaendigenrat->



quarter-over-quarter growth rates of real GDP. If at least two consecutive quarters of contraction occur, the economy is said to experience a “technical recession”.<sup>5</sup>

However, this definition has at least two drawbacks. First, by focusing on a two-quarter period, it disregards the momentum of the economy.<sup>6</sup> Second, GDP data are only available on a quarterly basis, with the flash estimates often subject to subsequent revisions. This implies serious time lags for business cycle monitoring.

This paper introduces the FvS Business Cycle Indicator for Germany, which offers a reliable and timely measure of business cycle developments. Our methodology follows the spirit of the NBER’s approach. However, in contrast to the NBER, we place less emphasis on discretion and use a quantitative indicator to assess the evolution of the business cycle.

## Methodology

The NBER’s Business Cycle Committee decides on the turning points (trough and peak) in the US business cycle several quarters after the passing of the turning points. The committee waits until a sufficient number of data is available to avoid the need for major revisions. The idea is to infer from these data on real GDP (and real Gross Domestic Income, GDI), which the Committee regards as the best single measure of aggregate economic activity. By combining monthly data with GDP data, it is not only possible to better assess lasting turning points of GDP, but also to time these turning points more precisely.

For instance, in September 2010, based on real GDP and GDI, which reached their lows in the second quarter of 2009, the Committee concluded that the trough occurred in mid-2009. With the help of several monthly indicators (estimated monthly GDP, manufacturing and trade sales, industrial

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[wirtschaft.de/80/download/gutachten/ga08\\_i.pdf](https://wirtschaft.de/80/download/gutachten/ga08_i.pdf)]. However, it is not specified on which time period the criterion should be applied. Moreover, the concept of output gap is an unobservable concept, which must be estimated. The methodology underlying the estimations of the concept has been often criticized. See, for instance, Tooze, A. (2019), “Output gap nonsense”, Social Europe, available at: <https://www.socialeurope.eu/output-gap-nonsense>.

<sup>5</sup> The origins of the term are unclear, but it is a widely accepted rule of thumb. In line with it, the UK’s economics & finance ministry (the Treasury) recognizes that “the commonly accepted definition of a recession in the UK is two or more consecutive quarters (a period of three months) of contraction in national GDP.”

<sup>6</sup> To give an example, let’s compare two economies. The first experiences quarter-over-quarter growth rates of real GDP of -2% in the first quarter and of -4% in the third quarter, with zero growth in the other quarters of the year. The second faces negative growth of -0.1% in the second and third quarter and positive growth in the first and fourth quarter. According to the conventional definition, only the latter economy was in recession, although the former suffers a more serious overall contraction.



*We use principal component analysis (PCA) to derive a single reliable indicator to capture swings of the business cycle.*

production, real personal income less transfers and labor market indicators), the Committee then was able to identify June as the month of the trough.

Following the NBER's approach, we analyze a wide range of economic indicators to better capture the overall development of the German economy. However, we depart from their approach in two important respects. First, we look at a broader list of monthly indicators, including data covering only a part of the economy. Second, based on these monthly indicators, we use principal component analysis (PCA) to derive a single reliable indicator (which we dub FvS Business Cycle Indicator for Germany) to capture swings of the business cycle.<sup>7</sup>

We use 22 economic indicators, for which we have monthly observations, and which together cover the entire breadth of activity in the economy (**Table 1**). All series are calendar and seasonally adjusted. Since the PCA is scale sensitive, we index all time series to January 2019 = 100. The longest data series are available back to 1991, but some series are available only starting in 2008 (international trade data). For this reason, the operational version of our monthly FvS Business Cycle Indicator, which we will update on a regular basis, is available from January 2008. However, to validate our model prior to 2008 we compare the performance of the Indicator with quarterly real GDP back to 1991 (see next section).

Based on the results of the PCA, the first principal component is responsible for almost 74% of variation in our set of explanatory variables. Each of the remaining 21 principal components is negligible, since their individual contribution to the overall sample variation is under 1%. Thus, we construct our FvS Business Cycle Indicator based on the first principal component.

Since the squares of the estimated coefficients for a principal component add up to one, we use the squared coefficients of the first principal component to weigh the respective explanatory variables (see Appendix). Thus, the FvS Business Cycle Indicator is a weighted average of our monthly indicators, with the weights determined by PCA.

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<sup>7</sup> For methodological details concerning the PCA, see the Appendix.



**Table 1: Monthly data used in the principal component analysis.**

<i>Indicator</i>	<i>Description of raw series and starting date</i>
Sales overall, of which:	
Manufacturing	Constant prices, Index, 2015=100, since Jan. 1991
Intermediate goods	Constant prices, Index, 2015=100, since Jan. 1991
Capital goods	Constant prices, Index, 2015=100, since Jan. 1991
Cars & car parts	EUR, since Jan. 1991
Sales domestic, of which:	
Manufacturing	Constant prices, Index, 2015=100, since Jan. 1991
Intermediate goods	Constant prices, Index, 2015=100, since Jan. 1991
Capital goods	Constant prices, Index, 2015=100, since Jan. 1991
Cars & car parts	EUR, since Jan. 1991
Retail trade	Constant prices, Index, 2015=100, since Jan. 1991
Wholesale trade	Constant prices, Index, 2015=100, since Jan. 1994
Employment	No. of persons, domestic concept, since Jan. 1991
Industrial production, of which:	
Intermediate goods	Constant prices, Index, 2015=100, since Jan. 1991
Capital goods	Constant prices, Index, 2015=100, since Jan. 1991
Consumer goods	Constant prices, Index, 2015=100, since Jan. 1991
Electricity, gas, steam & air-cond.	Constant prices, Index, 2015=100, since Jan. 1991
Vehicle registration, trucks	No., since Jan. 1991
Vehicle turnover	Constant prices, Index, 2015=100, since Jan. 1994
International trade, of which:	
Import value	EUR, since Jan. 1991
Import volume	Index of unit values, 2010=100, since Jan. 2008
Export value	EUR, since Jan. 1991
Export volume	Index of unit values, 2010=100, since Jan. 2008
Service trade, turnover	Constant prices, Index 2015=100, since Jan. 1994



## The FvS Business Cycle Indicator for Germany

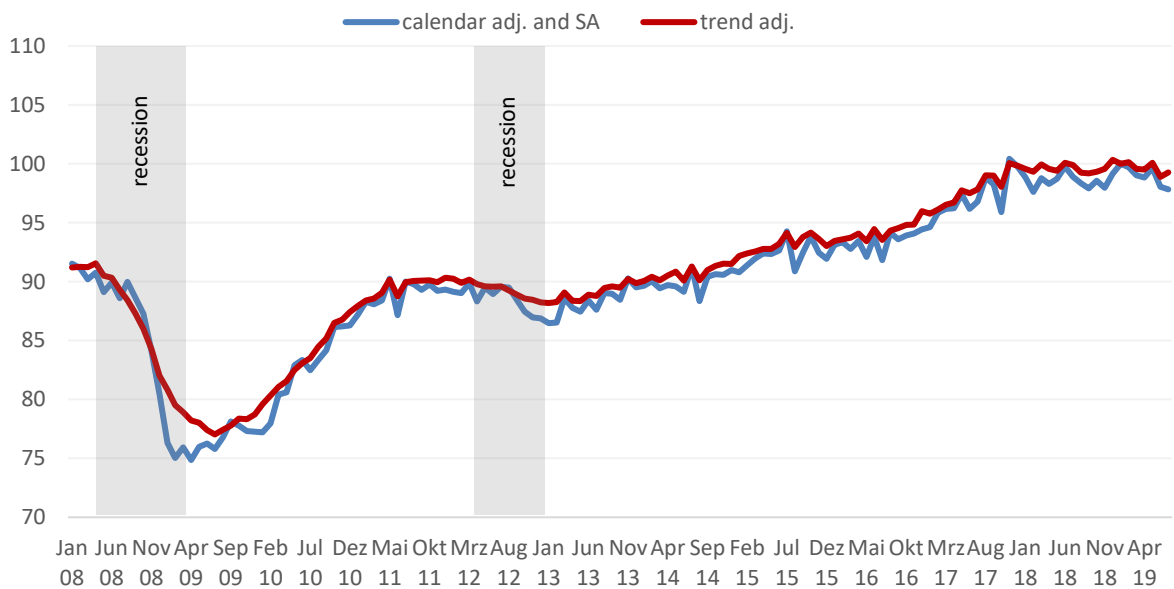
*The FvS Business Cycle Indicator could have anticipated the negative growth rate of real GDP in Q2 2019.*

**Figure 1** shows the monthly FvS Business Cycle Indicator as a calendar and seasonally adjusted series without and with trend adjustment. The Indicator has stagnated since the second quarter of 2018 and it has declined in five out of seven months so far during 2019. This development is much in line with the negative growth rate of real GDP in the second quarter of 2019. The FvS Business Cycle Indicator could have anticipated this.

Looking at the past development of the Indicator around the Great Financial Crisis, it emerges that it would have signaled in a timely way the subsequent recession in Germany. The series of the Indicator reached the peak in May 2008, which indicates the start of the recession. It then reached the trough in February 2009, which marks the end of the recession and the starting point of the next expansion.

Another visible, although rather mild economic recession occurred at the time of the European sovereign debt crisis in mid-2012. The Indicator reached the peak in April 2012 (beginning of the recession) and the trough in December 2012 (end of the recession).

**Figure 1: FvS Business Cycle Indicator for Germany, Index (Jan 2019 = 100).**



Source: Own calculations Flossbach von Storch Research Institute/Macrobond



### How robust is FvS Business Cycle Indicator?

A convincing validation of the Indicator requires that its long-term past performance mirrors the development of real GDP. This is especially important since real GDP is customarily the reference indicator for policy makers and practitioners to assess the business cycle dynamics and recessions.

However, given that real GDP is only available at a quarterly frequency and since we are unable – due to data limitations – to follow the methodology of Stock and Watson from the Business Cycle Dating Committee of the NBER to estimate monthly real GDP data, we tested the robustness of our Indicator based on quarterly data. In doing so, we re-estimated the Principal Component Analysis for the sample of indicators, measured on a quarterly basis and for which data is available since 1991.

From the PCA, we could confirm that the first principal component explains 75% of the sample variation. The second principal component adds 11,4% and the third one 6 %. Thus, cumulatively, the first three components are responsible for almost 93% of the sample variation.

Based on these results, we run a simple regression model of real GDP and the first (three) principal component(s). The results of the estimations in **Table 2** show that the first principal component explains 91% of the variability in real GDP (R-squared adjusted in the first specification). Moreover, the addition of the second and third principal component improves further the goodness of fit of the regression by seven percentage points.

**Table 2: OLS estimation results of real GDP and the principal components (PC).**

	Specification (1)	Specification (2)
<i>PC 1</i>	2.610*** (0.065)	2.610*** (0.037)
<i>PC 2</i>	--	-0.837*** (0.117)
<i>PC 3</i>	--	-2.239*** (0.130)
R-squared adj.	0.911	0.980

Note: \*\*\*, \*\* and \* show 1%, 5% and 10% significance levels. Standard errors are in parentheses. Estimations are with robust standard errors.

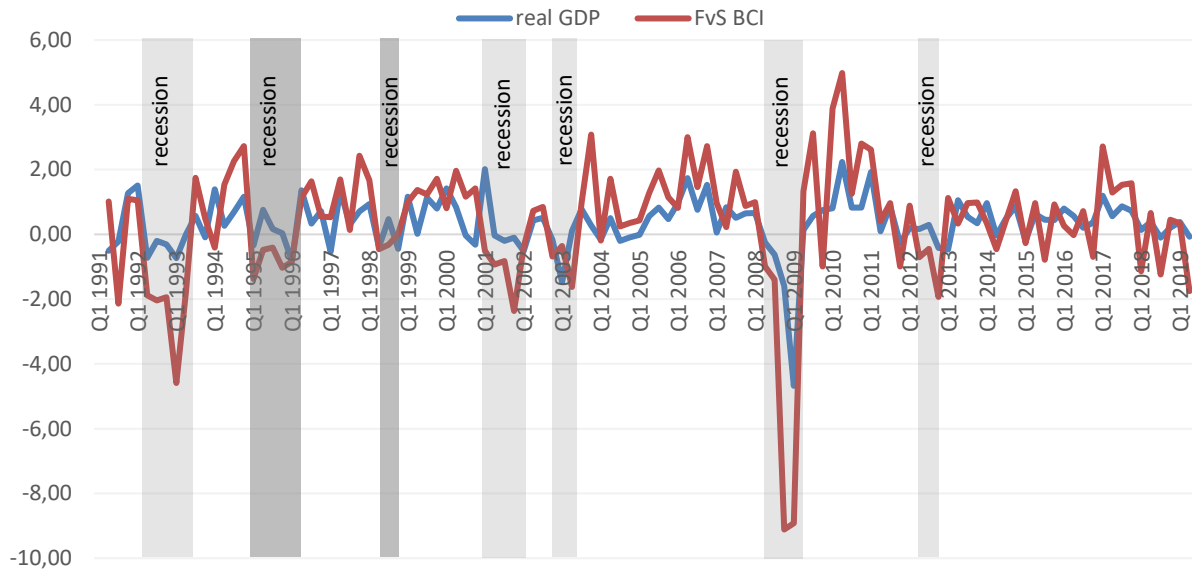
Source: Own estimations Flossbach von Storch Research Institute



*The FvS Business  
Cycle Indicator traces  
with sufficient  
precision real GDP*

**Figure 2** shows the quarterly times series of quarter-over-quarter growth rates of the FvS Business Cycles Indicator and of real GDP. Although the Indicator shows large swings at the extremes (both positive and negative), it tracks with sufficient precision real GDP growth.

**Figure 2: Quarter over quarter growth rates of the FvS Business Cycle Indicator and real GDP in Germany.**



Source: Own calculations Flossbach von Storch Research Institute/Macrobond

We find a general concordance between the technical recession definition based on real GDP and the recession determination based on our quarterly series of the FvS BCI, as shown by the shaded recession areas in **Figure 2**. There is a perfect overlapping between the two recession definitions for the recession 2008/2009. However, there are two non-negligible differences for the other recessions. First, there were two mild recessions (dark grey shadowed areas in **Figure 2**), which we could detect based on FvS BCI but which remained unobserved based on the technical definition, although in both cases there were separate quarters with negative growth rates of real GDP. Second, in the remaining five recessions – in the early 1990s, in 2001/2002, in 2003, and in 2012 – the FvS BCI points to a one- to two-quarter longer recession than the technical definition would suggest. Moreover, the FvS BCI could have anticipated the technical recession both in 2001/2002 and in 2012 by one to two quarters earlier.

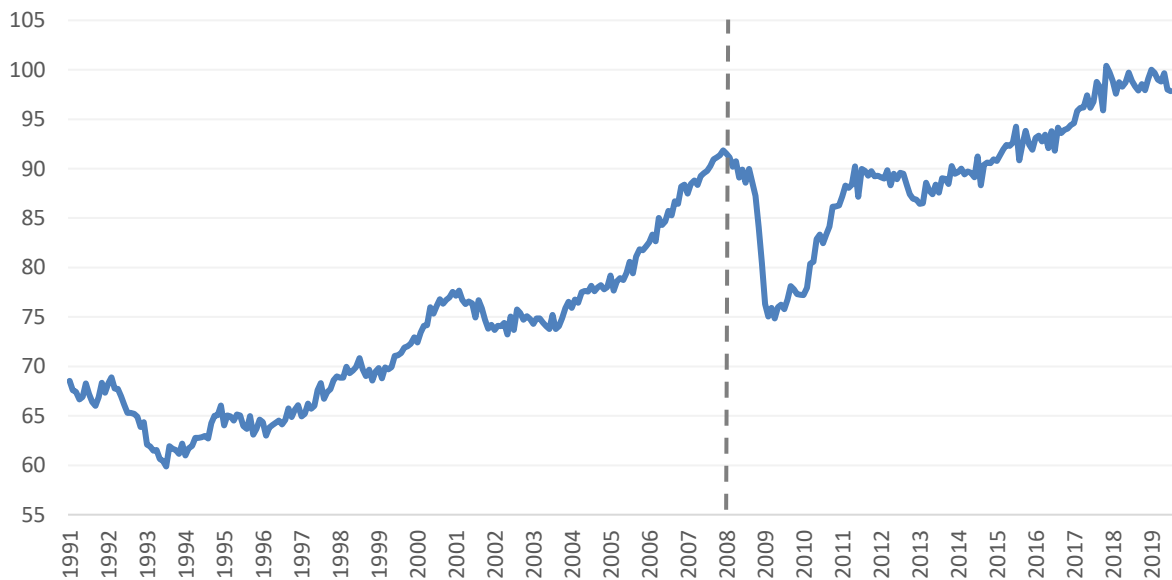




### Recession dates for Germany since unification

As already discussed above, our operational version of the Indicator, which we will continue to update on a monthly basis, is available since 2008. To determine a historical record of recessions of the German economy since 1991 on a monthly basis, we calculate a monthly series for the FvS BCI for the period 1991-2007 based on estimates with the restricted set of data as explained in the previous section and splice this series with the series calculated with the full set of data as of 2008. **Figure 3** shows the time series of the Indicator, with the structural break due to the enlarged set of series marked between December 2007 and January 2008.

**Figure 3: Monthly FvS Business Cycle Indicator for Germany 1991-2019.**



Source: Own calculations Flossbach von Storch Research Institute/Macrobond

Based on the combined series, we determine the monthly dates of the turning points in the business cycle (see **Table 3**). A recession from peak to trough is identified when the FvS BCI shows a sustained decline followed by a sustained recovery. The exact dates of peaks and troughs are then determined based on the monthly observations of the Indicator.



**Table 3: Turning points in the business cycle and the duration of contractions and expansions in Germany.**

Peak	Trough	Duration in months	
		Contraction (recession) - peak to trough -	Expansion - previous trough to peak -
March 1992 (Q1)	June 1993 (Q2)	16	--
January 1995 (Q1)	February 1996 (Q1)	13	17
April 1998 (Q2)	September 1998 (Q3)	6	25
January 2001 (Q1)	January 2002 (Q1)	13	27
October 2002 (Q4)	June 2003 (Q2)	9	6
May 2008 (Q2)	February 2009 (Q1)	12	56
April 2012 (Q2)	December 2012 (Q4)	9	36

Source: Own elaborations Flossbach von Storch Research Institute based on the FvS BCI, Macrobond

### Conclusion

The monthly series of the FvS Business Cycle Indicator is a good proxy for the development of real GDP. Compared to the existing rule of thumb, our indicator has two advantages for the analysis of the business cycle: First, by assessing GDP data against the information obtained from other activity data it can more reliably identify business cycle peaks and troughs. Second, as it is based on monthly data it can more precisely time turning points of the business cycle. Developments of the FvS BCI so far this year suggest that recession could have started in April 2019. But a final judgement based on our methodology will have to wait until we have seen the recession trough.

The present weakness of the FvS BCI is mostly driven by domestic and foreign sales of goods (intermediate, consumption and capital goods) and industrial production - both categories have recorded negative growth rates since the beginning of the year. International trade (imports and exports) and employment have also weakened recently. Demand for vehicles (truck registrations and vehicle sales) and the sale of services are still providing some positive impulses.



## Appendix: Principal Component Analysis (PCA)

PCA, and more generally, factor models are used in frameworks with a large number of closely related variables where multicollinearity is a risk. The aim is to reduce dimensionality of the system by identifying the most important influences from these variables.

Analytically, if there are  $n$  explanatory, closely related variables in the regression model, PCA transforms them into  $n$  uncorrelated new variables (principal components), of the form:

$$p_1 = \alpha_{11}x_1 + \alpha_{12}x_2 + \dots + \alpha_{1n}x_n$$

$$p_2 = \alpha_{21}x_1 + \alpha_{22}x_2 + \dots + \alpha_{2n}x_n$$

...

$$p_n = \alpha_{n1}x_1 + \alpha_{n2}x_2 + \dots + \alpha_{nn}x_n$$

where  $x_i$  and  $p_i$  (with  $i, j = 1, \dots, n$ ) are the original explanatory variables and the newly estimated principal components, respectively, and  $\alpha_{ij}$  are estimation coefficients (so called factor loadings) on the  $j$ th explanatory variable in the  $i$ th principal component. It is required that the sum of the squares of the coefficients for each component is one:

$$\sum_{j=1}^n \alpha_{ij}^2 = 1 \quad \forall \quad i = 1, \dots, n$$

The principal components are derived in descending order of importance. Moreover, in the case of collinearity of the original variables, the first components will account for much of the variation, whereas some of the last principal components will account for little variation and can be disregarded. The stronger the correlation between the original variables, the higher is the explanatory power of the first principal component.

To validate the PCA, the so-called Kaiser-Meyer-Olkin's (KMO) measure of sampling adequacy can be calculated. KMO takes values between 0 and 1, with relatively high values suggesting that variables have sufficient in common to warrant a PCA. Small KMO values suggest that the sample is insufficiently adequate to apply a PCA.

After the PCA, the regression to be estimated for the dependent variable  $y$  is:

$$y_t = \beta_0 + \beta_1 p_{1t} + \dots + \beta_r p_{rt} + \varepsilon_t$$

Where  $\beta_m$  (with  $m = 1, \dots, r$ ) are the estimation coefficients and  $p_{mt}$  are the first  $r$  ( $0 < r < n$ ) principal components deemed sufficiently useful in explaining the variation of  $n$  original variables. The principal component estimates will be biased, but they are more efficient than the OLS estimators since redundant information is excluded.



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