PRACE I MATERIAŁY
Instytutu Rozwoju Gospodarczego SGH
97

Economic cycles and uncertainty

Edited by Konrad Walczyk

Szkoła Główna Handlowa w Warszawie
Warszawa 2015

ul. Madalińskiego 6/8, 02-513 Warszawa
http://www.sgh.waw.pl/irg/

Artykuły zawarte w publikacji zostały zrecenzowane zgodnie z wytycznymi MNiSW.

Wydanie I
Wersja papierowa czasopisma jest wersją pierwotną
http://www.sgh.waw.pl/instytuty/irg/publikacje/pimirg/

Wydawnictwo:
Szkoła Główna Handlowa w Warszawie – Oficyna Wydawnicza
02-554 Warszawa, al. Niepodległości 162
www.wydawnictwo.sgh.waw.pl
e-mail: wydawnictwo@sgh.waw.pl

ISSN 0866-9503
Nr rej. PR 18413

QUICK-DRUK s.c
tel. 42 639 52 92
e-mail: quick@druk.pdi.pl

Nakład 200 egz.

Zamówienie 90/VI/15

Contents

Preface

The volume contains five papers and the introductory speech by prof. Andrzej Sławiński, all of which were presented at the workshop jointly organized by the Centre for International Research on Economic Tendencies, Zürich (CIRET), Konjunkturforschungsstelle, Zürich (KOF), and the Research Institute for Economic Development, Warsaw, held at the Warsaw School of Economics on 9-10 October, 2015. The workshop was dedicated to interrelations between business cycles and uncertainty, esp. in the recent years marked by the Great Recession and the subsequent sovereign debt crisis in the euro area.

The following is a selection of papers presented mainly by Polish participants of the workshop, covering many aspects of the essential problem. They deal with the issues of turning points detection (Bernardelli & Dędys), constructing composite indicators of real economic activity (Kitrar *et al*.), an impact of the structure of an economy on business cycles (Pater), and how survey questionnaire phrasing (Gaca *et* al.) or data revisions (Tomczyk) influences survey results.

For detail information about the workshop agenda and the participants, as well as the CIRET organization and other CIRET conferences and workshops see https://www.ciret.org/workshops/warsaw-2015/.

Andrzej Sławiński[‡]

Introduction: Understanding uncertainty

Uncertainty is a term all of us use in everyday life. Its meaning is informally motivated by an appeal to intuition and our experience. In the recent period it has been often used by economists.

When analyzing macroeconomic problems we cannot treat uncertainty as a primitive (generic) notion that does not require defining. Without any definition we are exposed to confusion resulting from different understanding and dependency on the analytical context. Hence, when defining uncertainty it is essential to characterize its nature – to determine whether it is the uncertainty resulting from natural variability and randomness, or the *epistemic uncertainty* associated with insufficient knowledge of the investigated phenomenon. This distinction is important because different types of uncertainty require different treatments, as pointed out by Frank Knight already 100 years ago. Knight wrote about *measurable uncertainty*, which he called risk, and *immeasurable uncertainty*. By the measurability he understood the possibility of describing the phenomenon by means of objective probability. When writing about quantifying the *immeasurable uncertainty* Knight used the term 'subjective probability'.

It should be underlined that the nature of variability observed in economic systems is different from the uncertainty arising from limitations we face in the area of understanding, measuring and modeling economic phenomena. The *knowledge uncertainty* is a property of the observers, and variability is a feature of the investigated system (somehow external to the observer).

Recognizing the nature of uncertainty is also very important to answer the question whether and how uncertainty can be reduced and what strategy should be adopted in the face of uncertainty. We are not able to reduce the part of uncertainty that arises from randomness. We can only impact reduction of the *knowledge uncertainty*.

Central banks are used to face uncertainty in monetary policy decisions – both in assessing current state of economies as well as in forward-looking considerations. That is why we, as central bankers, try to fill the gap between what we already know and what we need to know to make adequate decisions.

[‡] National Bank of Poland, Economic Institute.

For this reason we develop research and analytical capabilities aiming at reduction of the *knowledge uncertainty*. We also try to improve methods of communication to reduce uncertainty for the public.

Studying an impact of uncertainty on an economy and on a business cycle is rather difficult, because it requires taking into account both variability of economic environment and uncertainty experienced by economic agents. As in the case of decision making processes it is necessary to specify sources of uncertainty relevant to analyzed problems, and to apply appropriate methods of its quantification. In testing volatility in the economic system we have at our disposal statistical methods and econometrics models. Quantifying the *epistemic uncertainty* seems to be more difficult. When analyzing its impact on the behavior of economic agents one should take into account their individual characteristics.

The modern monetary policy is often described as the management of expectations. Central banks attempt to influence expectations of the private sector, especially to anchor inflation expectations with the means of announced inflation targets and central bank communication. From this perspective understanding uncertainty faced by economic agents is extremely relevant for central banks. For this reason the National Bank of Poland monitors expectations or forecasts of different groups of economic agents, trying to quantify uncertainty they face. Business surveys conducted by the National Bank of Poland contain a question related explicitly to their subjective assessment of uncertainty. In order to have an adequate view on the uncertainty that accompanies macroeconomic forecasts of professional experts, in 2011 we launched the NBP Survey of Professional Forecasters. The results of the NBP Survey of Professional Forecasters enlarge considerably our understanding of the formation process of expectations by our experts.

At the same time we feel that research in this area, making us realize sources and the nature of uncertainty as well as its impact on the behavior of economic agents, is still required. I am sure that the papers to be presented at the workshop will enlarge our knowledge and help us design an ambitious research agenda on this topic. Being aware of the fact that the first necessary step in the research related to uncertainty concerns its definition, let me wish that one of the outcomes of the workshop was to reduce uncertainty as to the meaning of the term ‘uncertainty’ and thus, reducing the *linguistic uncertainty*.

Michał Bernardelli, Monika Dędys[‡]

The Viterbi paths in an analysis of business cycle synchronization

Abstract

In the paper we investigate possibility of using the Viterbi paths to analyze two-dimensional macroeconomic time series. We build a two-dimensional Gaussian Markov-switching model with a four-state hidden Markov chain. The model is tested with two pairs of monthly indexes of industrial production for: Poland vs. France, and Poland vs. Germany. The most likely sequence of states of the hidden Markov chain is found for each pair. We compare that sequence with analogous sequences determined for a one-dimensional model with a two-state hidden Markov chain. The results of the comparison suggests the four-state Viterbi path provides more valuable information about business cycle synchronization between the two economies than two separate two-state Viterbi paths.

Keywords: Markov switching models, Viterbi path, business cycle synchronization

JEL classification: C63, E37, E27

[‡] Warsaw School of Economics, Collegium of Economic Analysis.

1. Introduction

The paper proposes the so-called Viterbi paths to analyze business cycle synchronization. The Viterbi path is the most probable sequence of a hidden Markov chain in a Markov switching model (MS model). It is widely used for speech recognition and DNA analysis, but almost absent in econometrics despite its great usefulness in non-linear modeling. The advantage of the proposed method is, among others, simple interpretation of results. This is important especially when a hidden Markov chain has more than two states. The usefulness of the method for a business cycle analysis has been confirmed empirically in case of univariate time series (Bernardelli & Dędys, 2012). In this paper we show that the Viterbi path can also be a valuable tool when analyzing bivariate time series. We consider two time series of the sold industrial production index for two economies: 'weaker' and 'stronger'. The states of the unobservable Markov chain reflect changes in business climate in both economies. For this purpose we use a model with four hidden states.

This paper is organized as follows. In the second section the brief history and literature overview is done. In the third section the theory of switching Markov models, as well as the description of the data used in the study are presented. The results of the empirical analysis are given in the fourth section. The paper ends with conclusions.

2. Markov switching models and the synchronization of the business cycles

The application of Markov switching models to analyze business cycles has been long present in econometric modeling (Hamilton, 1989). These models are mainly used to determine the rates of growth or to detect business cycle turning points. A variety of types of such models is impressive and concerns both an observable and an unobservable component. It is often assumed that an observable component, roughly speaking, is generated by autoregressive (AR) or vector autoregressive (VAR) processes with time-varying parameters (in these cases we say about MS-AR and MS-VAR, respectively).

The unobservable component can be either a homogeneous or heterogeneous Markov chain. In the heterogeneous case logistic functions of some exogenous variables are assumed to be transition probabilities. Such models are called the Markov switching models with time-varying transition probabilities (MS-TVTP) (Moolman, 2004; Simpson *et al.*, 2001). More importantly, in vast majority of models two hidden states are considered, where the transition probabilities change in time or not. In a natural way these states correspond to two phases of a business cycle. However, in some studies three states are considered. This aims to distinguish a recession,

post-recession rapid recovery and moderate growth (Boldin, 1996), or recession, normal growth and high-growth episodes (Artis *et al*., 2004).

As mentioned, the turning points detection is one of the most important applications of MS models in a business cycle analysis. In general, the identification of different phases of a business cycle is provided by estimates of filtered or smoothed probabilities (Chauvet & Hamilton, 2005). These probabilities could also give a basis for an analysis of business cycle synchronization of different economies. One way to make such a comparison is fitting MS-AR models to data for each country separately, estimating the mentioned probabilities and inference using appropriate measures (Smith & Summers, 2005). In some research, which is focused on determining a common business cycle, MS-VAR models are applied. An interesting alternative is provided by MS-TVTP models of the AR type. In these models the observable component is associated with a business cycle of one economy, while the potential relation to business fluctuations of another economy is reflected in the unobservable component. More specifically, the transition probabilities of the hidden Markov chain in such a model are functions of the latter (Dufrénot & Keddad, 2014). Another approach to an analysis of business cycle synchronization for a pair of economies is to consider the bivariate observable component and the hidden Markov chain with four states reflecting economic climate in both economies (Phillips, 1991). In our study we use that approach.

3. Model description and data characteristics

In this paper we focus on the simplest kind of MS model. Namely, we deal with conditionally independent observable variables with parameters of distribution that are driven by a homogenous Markov chain. More precisely, we consider partially observable process $\{(X_t, Y_t)\}_{t=1}^{\infty}$ satisfying the following condition:

1. Unobservable component $\{X_t\}_{t=1}^{\infty}$ is a homogenous Markov chain with finite state space S_X.
2. Observable random variables Y_1, Y_2, …, Y_t given $(X_1, X_2, \dots, X_t)$ are conditionally independent, and distribution of Y_t given this condition depends only on the random variable X_t.

Markov chain $\{X_t\}_{t=1}^{\infty}$ is called the hidden Markov chain. Models of this type are known as hidden Markov models (HMM), and appeared in the literature in the 1960s, that is much earlier than the first work of Hamilton (Cappé *et al*., 2005).

One of the major issues in the application of MS is as follows. Having information about the realization of observable variables Y_t in some period of time (say from 1 to *T*), one could try to estimate the state of the unobservable MC at fixed time t, where $t \leq T$. The most common approach is to use the smoothed probability:

$$w_t(i) = P(X_t = i|Y_1 = y_1, Y_2 = y_2, .., Y_T = y_T) \tag{1}$$

or the filtered probability:

$$f_t(i) = P(X_t = i|Y_1 = y_1, Y_2 = y_2, .., Y_n = y_n) \tag{2}$$

to deal with this problem.

There are several procedures for obtaining the assessment of the state of the hidden Markov chain at time *t*, which use estimates of filtered or smoothed probabilities (Chauvet & Hamilton, 2005; Harding & Pagan, 2002). In the simplest case $\underset{i}{\operatorname{argmax}}\, w_t(i)$ or $\underset{i}{\operatorname{argmax}}\, f_t(i)$ gives this assessment. Unfortunately, such 'local decoding' or 'step-by-step decoding- of the path of the states of the hidden Markov chain may be ineffective, especially in the case of larger state space. In this paper we use an alternative method to solve this problem. Specifically, we look for the most likely path of MC in the whole period covered in the analysis. Formally speaking, we determine the path $(x_1^*, x_2^*, \dots, x_T^*) \in S_X^T$ such that:

$$\begin{gathered} P(X_1 = x_1^*, \dots, X_T = x_T^*|Y_1 = y_1, .., Y_T = y_T) = \\ \max_{(x_1, x_2, \dots, x_T) \in S_X^T} \{P(X_1 = x_1, \dots, X_T = x_T|Y_1 = y_1, \dots, Y_T = y_T)\}. \end{gathered} \tag{3}$$

This most likely sequence is called the Viterbi path after Andrew Viterbi, the author of the algorithm used to determine the path.

For the estimation of the parameters of hidden Markov models the iterative Baum-Welch algorithm are used (Cappé *et al.*, 2005). However, results of this deterministic algorithm depend on initial values of the probabilities. Therefore, they may be far from optimal. In order to increase chances of finding the optimal solution, the calculation can be repeated several times for the same set of data and different initial values. This is equivalent to performing a Monte Carlo simulation. For each *k*-state HMM model preselecting of the following values is required:

- initial distribution of an unobserved Markov chain (*k* parameters),
- transition probabilities of unobserved Markov chain parameters

(k^2 parameters),

- means and covariances of the conditional distribution of an observed variable in the given state (2*k* parameters).

In this research the initial values were chosen randomly using independent and identically distributed draws from the univariate distribution. The number of draws used for the parameters estimation of the time series under the study varied between 1000 and 5000. The number of draws depend on a number of HMM's states and the numerical stability of computations.

The best estimates of parameters of models were chosen with selection criteria which take into account the following indicators (Bernardelli, 2015; Bernardelli & Dędys, 2014):

- Akaike's information criterion (AIC),
- Bayesian information criterion (BIC),
- the log likelihood value,
- frequency of obtaining certain solution of the Baum-Welch algorithm (with an accuracy of one decimal place).

The HMM model, considered as the best for the particular input data set, was used to compute the most likely path which consists of the sequence of states of MC (throughout the whole period under consideration). These paths are outputs of the Viterbi algorithm (Cappé *et al*., 2005). It is worth noting that despite of the deterministic nature of both algorithms, the method of 'decoding' states of unobserved MC as a whole has a non-deterministic character.

In this paper we consider MS with observable variable Y_t having univariate or bivariate Gaussian conditional distribution and two or four hidden states. MS model with two unobservable states we use for modeling univariate time series. In this case $S_X = \{0,1\}$ and:

$$Y_t|_{X_t=0} \sim N(\mu_0, \sigma_0), \quad Y_t|_{X_t=1} \sim N(\mu_1, \sigma_1), \tag{4}$$

where $\mu_0 < \mu_1$. State 0 corresponds to the periods of contraction, and state 1 relates to the periods of expansion.

In order to capture possible interactions between pairs of economies we introduce a model similar to the model proposed in (Phillips, 1991). We focus on bivariate time series with components corresponding to individual economies under the study. By considering the hidden Markov chain with state space $S_X = \{(0,0), (0,1), (1,0), (1,1)\}$, we expect that the state (0,0) should relate to the periods in which both economies are in the contraction

phase. The interpretation of other states should be analogous. In contrast to the model presented in (Phillips, 1991) we consider the simplest MS model with conditional Gaussian distributions. We put no restrictions on the vectors of expected values of these distributions. In addition, conclusions about the possible interactions between economies are drawn on the basis of the Viterbi paths, and not on the basis of the matrix of transition probabilities.

In this paper we analyze the monthly index of industrial production[1] (IIP) of Germany, France and Poland. The data are taken[2] from the Eurostat database, and the research covers the period from January 2002 to January 2015. The percentage change compared to the same month of the previous year was chosen as the unit. It helps to avoid necessity of seasonal adjustment and possible problems that can be caused by such data transformation (Matas-Mir A. *et al*., 2008).

4. Results of empirical analysis

It is worth emphasizing that the Gaussian MS model and Viterbi paths could not be treated as a universal tool for an analysis of time series. To examine the effectiveness of the proposed method on data under the study, some comparisons are made. First, we confront the Viterbi paths obtained for the hidden MC with two states with the business cycle turning points dated by OECD on the basis of Composite Leading Index (Figures 1-3).

Unfortunately, in the case of Germany (Figure 2) and France (Figure 3) the strong effects of the financial crisis in 2008 disrupted the decomposition. Therefore, the decision was made to perform some 'local smoothing' of the time series data. This was done by a proportional increase of the value of IIP in relation to other crises in the years preceding 2008. The results of the procedure are given in Figure 4 (Germany) and Figure 5 (France). Transformed in such a way, time series were taken for further analysis.

[1] More exactly, a percentage change compared to the same period in the previous year (data adjusted by working days, covering mining and quarrying, manufacturing, electricity, gas, steam, air conditioning supply, and construction).
[2] Accessed 23 November 2015.

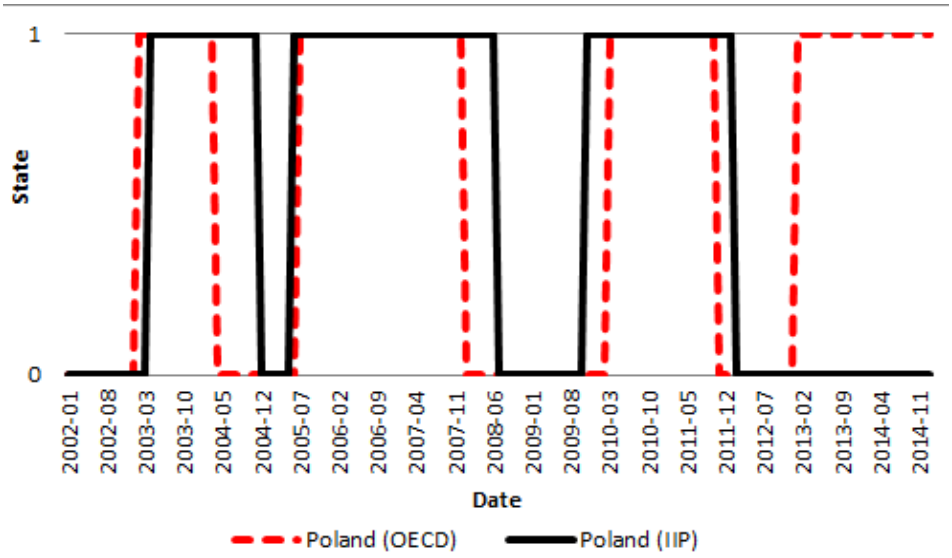


Figure 1. Comparison of the Viterbi path of the two state HMM for the indexes of industrial production in Poland with the OECD reference time series.

Source: own calculations.

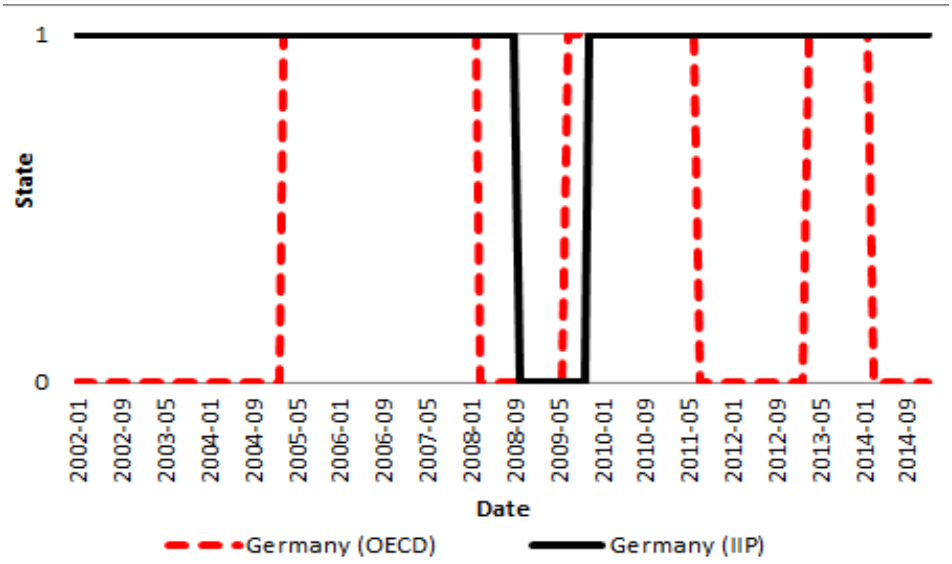


Figure 2. Comparison of the Viterbi path of the two state HMM for the indexes of industrial production in Germany with the OECD reference time series.

Source: own calculations.

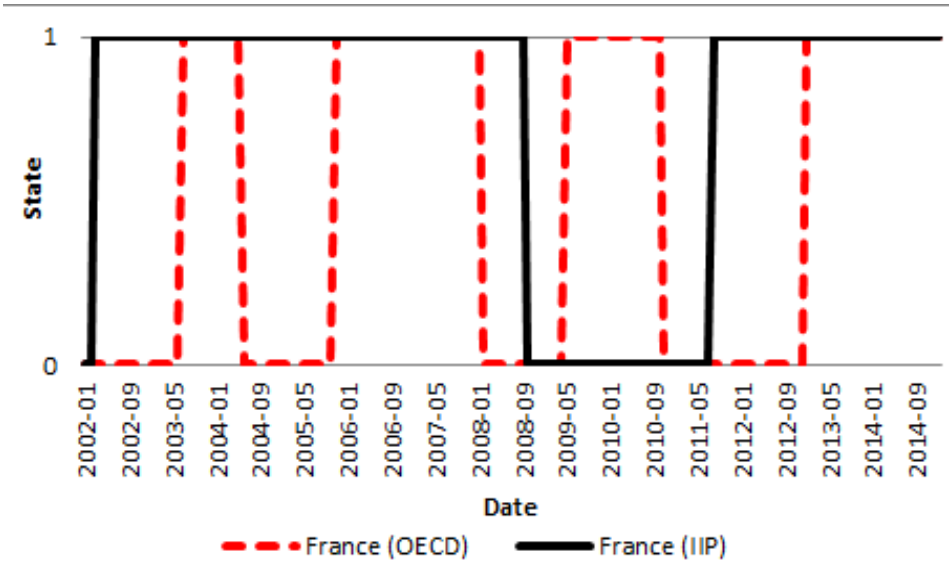


Figure 3. Comparison of the Viterbi path of the two state HMM for the indexes of industrial production in France with the OECD reference time series.

Source: own calculations.

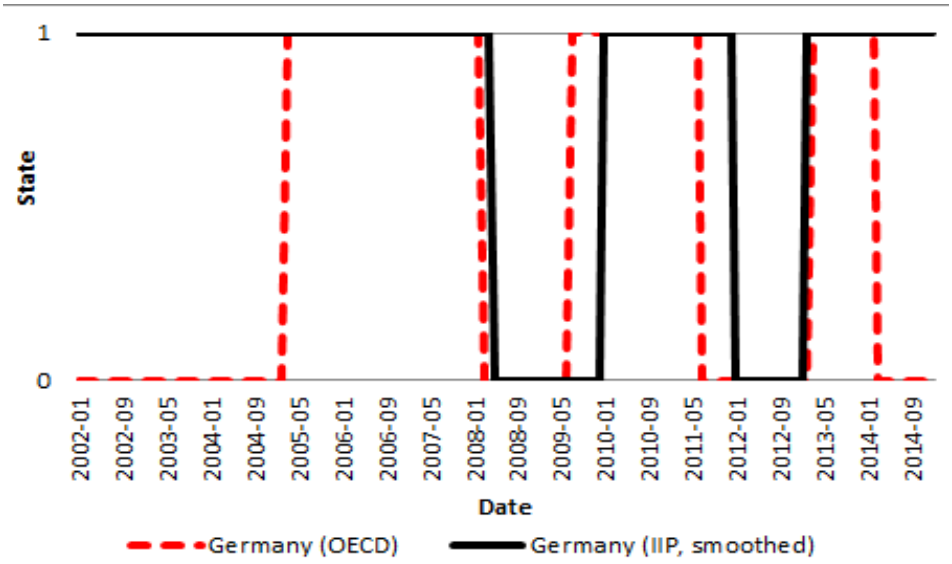


Figure 4. Comparison of the Viterbi path of the two state HMM for the locally smoothed indexes of industrial production in Germany with the OECD reference time series.

Source: own calculations.

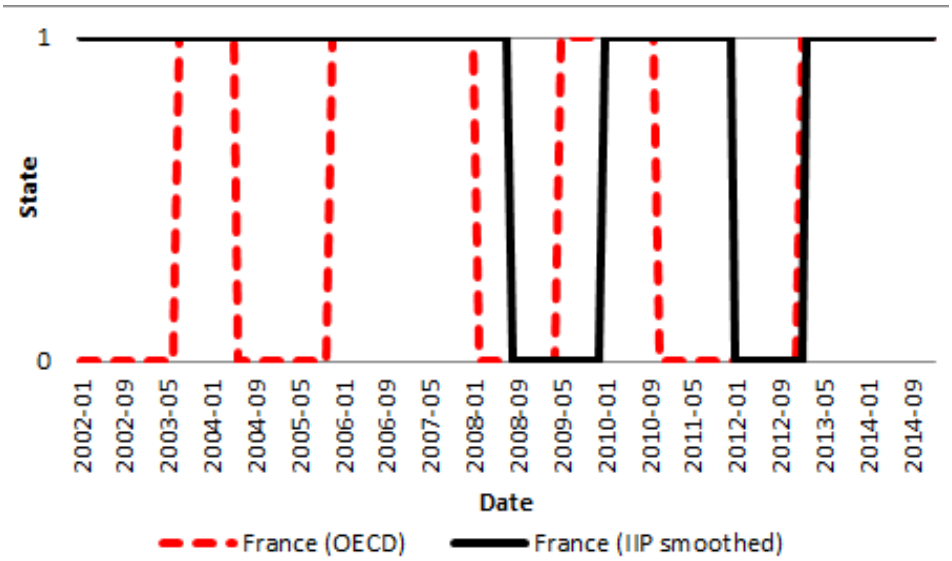


Figure 5. Comparison of the Viterbi path of the two state HMM for the locally smoothed indexes of industrial production in France with the OECD reference time series.
Source: own calculations.

The results show that almost all turning points dated by the OECD are reflected in the Viterbi paths. One turning point is missed in the path of Poland, and two are missed in the case of Germany. And all turning points before 2008 are not present in the Viterbi path of Poland. In general, signals about turning points appear in the Viterbi paths with some delay. These lags are equal to 2-8 months (Poland), 1-6 months (Germany) or 1-14 months (France). Only in the case of Poland and Germany some turning points are signaled by the Viterbi path in advance.

In this paper the business cycle analysis is carried out only on the basis of Viterbi paths. In order to examine an impact of the stronger economy on the weaker economy, another kind of comparison was made. Based on the Viterbi path for one-dimensional series of IIP and two state hidden Markov chains, we constructed 'compound paths' as follows. States 0 and 1 were assigned in the case of consistent indications: if in both considered paths the situation was identified as contraction, then in the constructed compound path the state was taken as 0. The procedure was analogous for the state 1: if there is an agreement in each of two paths about expansion in a particular period, then in the compound path the state 1 was assumed. State ⅔ was introduced to reflect an expansion phase of the weaker economy and the contraction

phase of the stronger economy. State ⅓ was established to describe the opposite. The compound paths may give information from the business cycles considered separately. These compound paths against the background of paths determined on the basis of univariate models for the weaker economy are shown in Figures 6 (Poland vs. Germany) and 7 (Poland vs. France).

The main goal of the study was to explore applicability of the bivariate HMM case to an analysis of business cycles synchronization. Therefore, for the decomposition of time series of pairs of considered countries we used MS model with four hidden states, which was introduced in the previous section. For the clarity of the visualization of the Viterbi paths, we renumbered the states of the hidden Markov chain. State (0,0) is denoted by 0, and state (1,1) by 1. States (0,1) and (1,0) correspond to middle states ⅓ and ⅔. However the results of estimation, especially for means of Gaussian distribution, suggest that interpretation of these middle states should be slightly different compared to the original assumptions. In Figure 8 (Poland and Germany) and Figure 9 (Poland and France) the Viterbi paths obtained for bivariate MS models are shown against the weaker economies, while the stronger economies are presented as a background in the Figure 10 (Germany) and Figure 11 (France).

At least two comparisons should be discussed. The first is the confrontation of the results from models with two states and HMM with four states (both compound paths and the Viterbi paths of bivariate models). It seems that the Viterbi path connected with 4-state models enrich inference about business cycle turning points. Two middle states may signal the turning points. What is more, those signals seem to indicate clearly the direction of the change when the strongly linked economies are considered (Germany and Poland). It accounts for the usefulness of the models with states extended to more than two.

The resulting paths from the bivariate models over the compound paths are advantageous. They are definitely smoother and usually give signals earlier than the analogous announcement in the corresponding compound path. They simply better reflect changes in the economy.

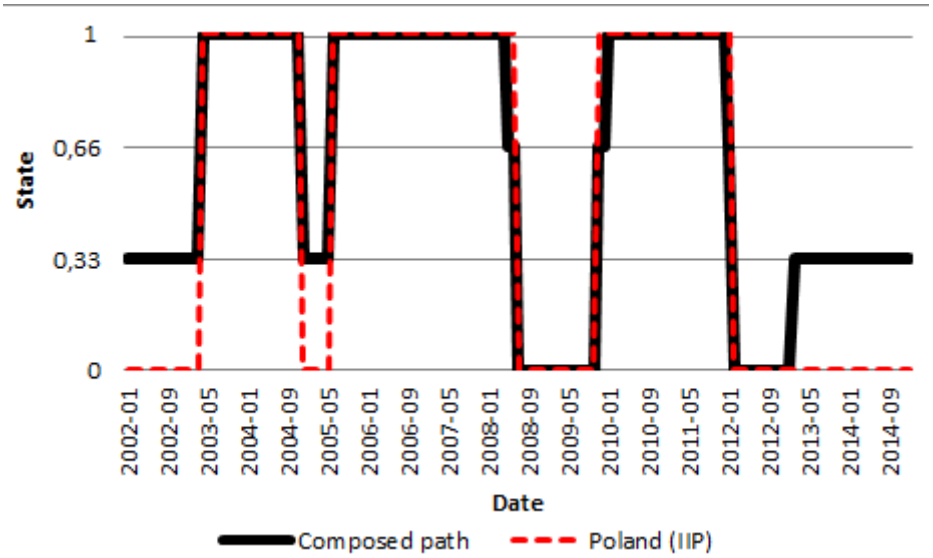


Figure 6. Comparison of the compound Viterbi path calculated based on the two state HMMs for the indexes of industrial production in Poland and Germany with the Viterbi path of the two state HMM for IIP of Poland.
Source: own calculations.

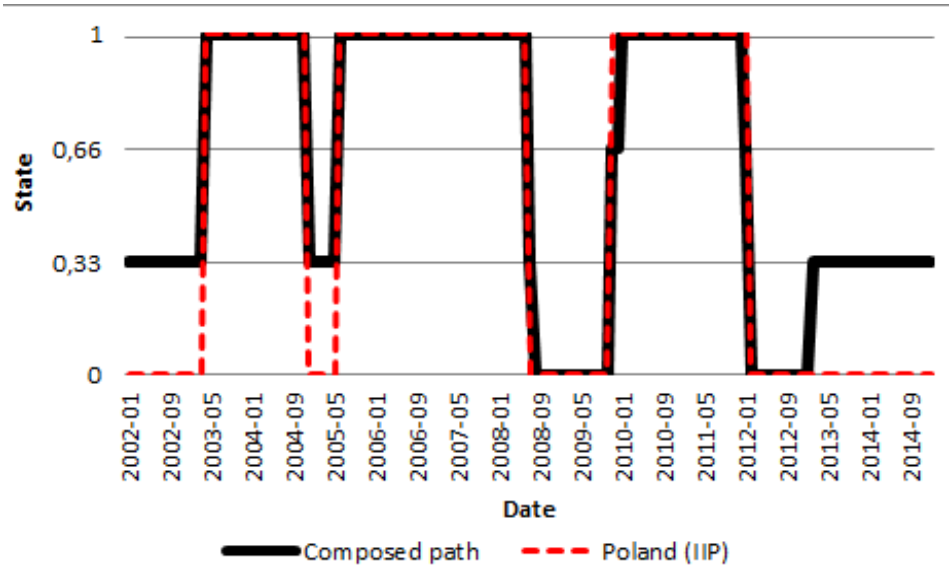


Figure 7. Comparison of the compound Viterbi path calculated based on the two state HMMs for the indexes of industrial production in Poland and France with the Viterbi path of the two state HMM for IIP of Poland.
Source: own calculations.

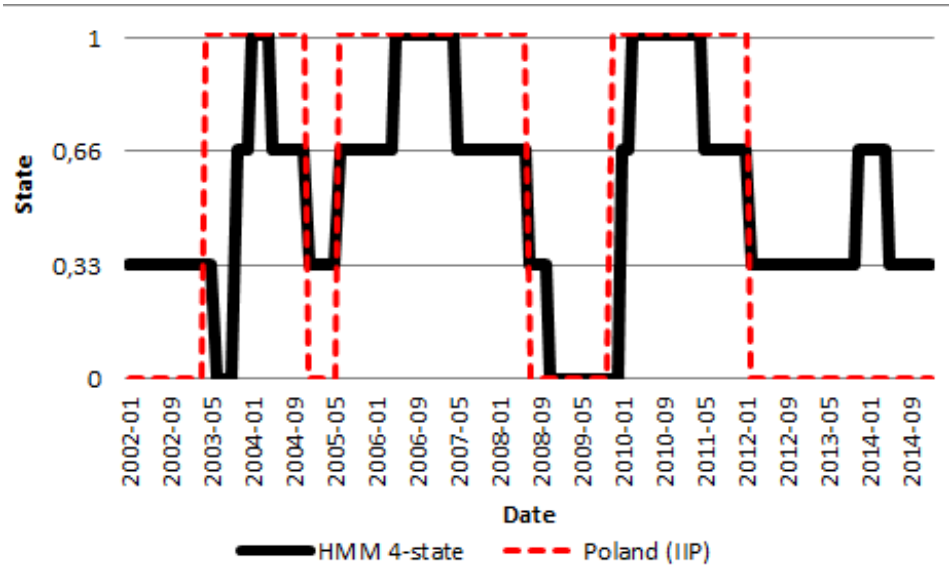


Figure 8. Comparison of the Viterbi path of the four state HMM for the indexes of industrial production in Poland and Germany with the Viterbi path of the two state HMM for IIP of Poland.
Source: own calculations.

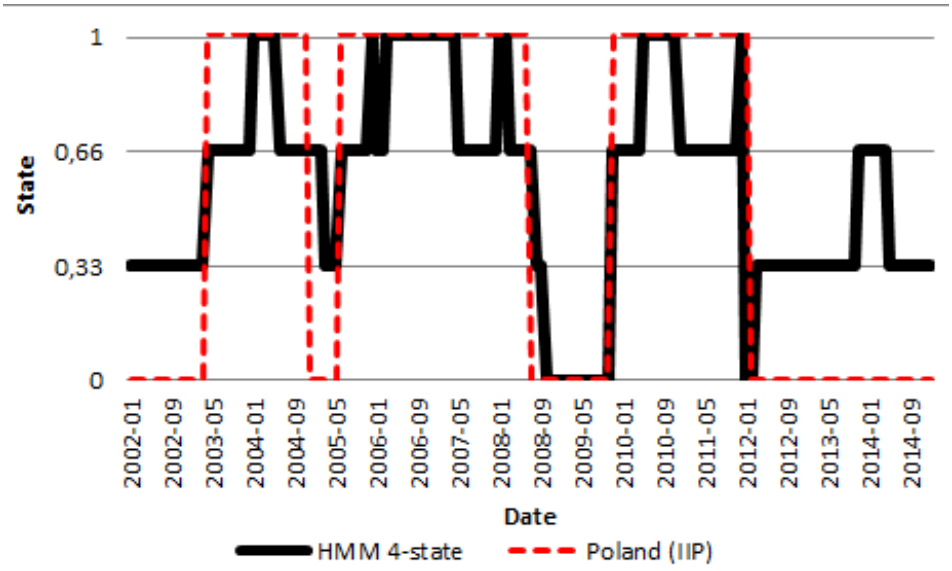


Figure 9. Comparison of the Viterbi path of the four state HMM for the indexes of industrial production in Poland and France with the Viterbi path of the two state HMM for IIP of Poland.
Source: own calculations.

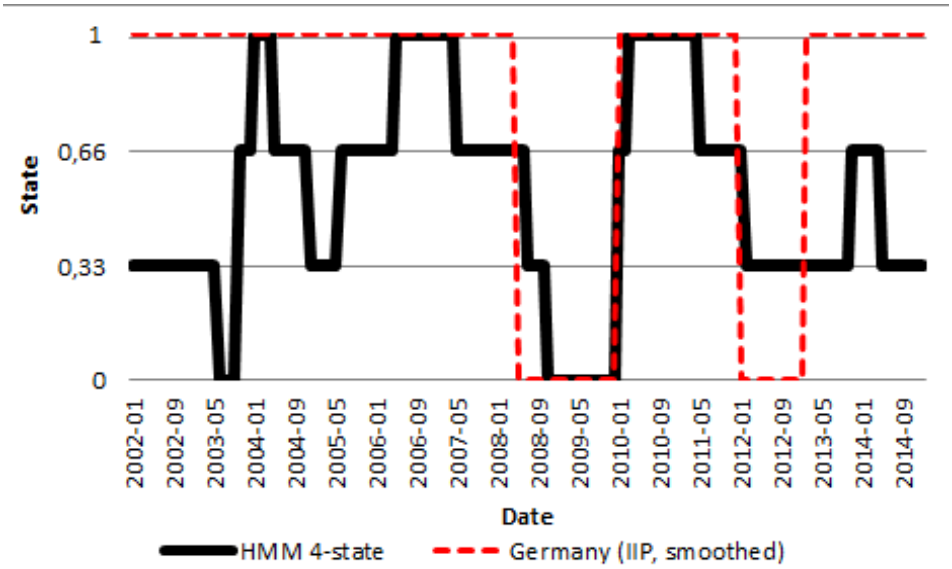


Figure 10. Comparison of the Viterbi path of the four state HMM for the indexes of industrial production in Poland and Germany with the Viterbi path of the two state HMM for IIP of Germany.
Source: own calculations.

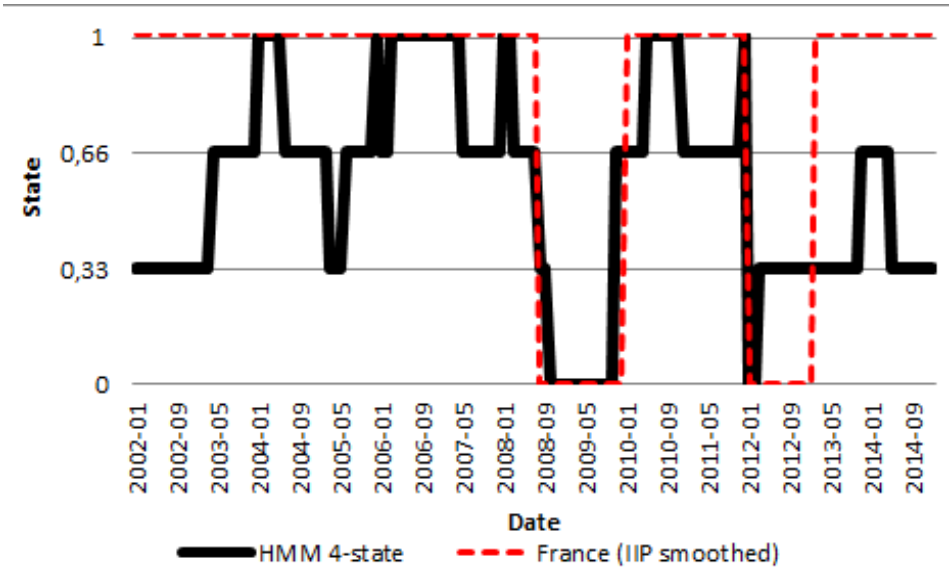


Figure 11. Comparison of the Viterbi path of the four state HMM for the indexes of industrial production in Poland and France with the Viterbi path of the two state HMM for IIP of France.
Source: own calculations.

5. Conclusions

The results of the study suggest that the Viterbi paths can be a valuable tool for an analysis of bivariate time series whose components correspond to macroeconomic time series of two interconnected economies. The method was found useful for studying industrial production of the following pairs of economies: Germany and Poland, and France and Poland. Two-dimensional Gaussian Markov switching models with four-state hidden Markov chains were used in the analysis. The Viterbi paths generated by these models give more valuable information in comparison to the paths provided by the separated models with univariate observable components.

References

Artis, M. J., Krolzig, H-M., Taro, J. (2004). The European business cycle, *Oxford Papers*, 56 (1), 1-44.

Bernardelli, M. (2015). The procedure of business cycle turning points identification based on hidden Markov models, *Prace i Materiały Instytutu Rozwoju Gospodarczego IRG*, 96, 5-23.

Bernardelli, M., Dędys, M. (2012). Ukryte modele Markowa w analizie wyników testu koniunktury gospodarczej, *Prace i Materiały Instytutu Rozwoju Gospodarczego SGH*, 90, 159-181.

Boldin M. D. (1996). A check on the robustness of Hamilton's Markov Switching Model Approach to the Economic Analysis of the business cycle, *Studies in Nonlinear Dynamics and Econometrics*, 1 (1), 1-14.

Boldin, M. (1994). Dating turning points in the business cycle, *Journal of Business*, 67 (1), 97-131.

Çakmaklı, C., Paap, R., van Dijk, D. (2013). Measuring and predicting heterogeneous recessions, *Journal of Economic Dynamics & Control*, 37 (11), 2195-2216

Cappé, O, Moulines, E., Rydén, T. (2005). *Inference in hidden Markov models*, New York: Springer.

Chauvet, M., Hamilton, J. D. (2005). *Dating business cycle turning points*, NBER Working Paper no. 11422.

Dufrénot, G., Keddad, B. (2014). Business cycle synchronization in East Asia: A Markov switching approach, *Economic Modelling*, 42, 186-197.

Hamilton, J. D. (1989). A new approach to the economic analysis of non-stationary time series and business cycle, *Econometrica*, 57 (2), 357-384.

Hamilton, J. D. (1994). *Time series analysis*, Princeton, NJ.

Harding, D., Pagan, A. (2012). A comparison of two business cycle dating methods, *Journal of Economics & Control*, 27 (9), 1681-1690.

Matas-Mir, A., Osborn, D. R., Lombardi, M. J. (2008). The effect of seasonal adjustment on the properties of business cycle regimes, *Journal of Applied Econometrics*, 23 (2), 257-278.

Moolman, E. (2004). A Markov switching regime model of South African business cycle, *Economic Modelling*, 21 (4), 631-646.

Phillips, K. L. (1991). A two-country model of stochastic output with changes in regime, *Journal of International Economics*, 31 (1-2), 121-142.

Simpson, P. W., Osborn, D. R., Sensier, M. (2001). Modelling business cycle movements in the UK economy, *Economica*, 68 (270), 243-267.

Smith, P. A., Summers, P. M. (2005). How well do Markov switching models describe actual business cycles? The case of synchronization, *Journal of Applied Econometrics*, 20 (2), 253-274.

Olga Gaca, Hanna Sękowska, Magdalena Święcka, Katarzyna Walkowska[‡]

The impact of phrasing of selected questions on the results of the business tendency surveys conducted by the Central Statistical Office of Poland

Abstract

Precise wording of qualitative questions poses substantial problem because frequently even small lack of accuracy or inappropriate word used in a question may bias surveys' results. We analyze an impact of the wording on results of the qualitative business tendency surveys conducted by CSO of Poland. The relationship between the way survey questions are formulated and obtained replies is pointed out, e.g. the influence of adding explanatory notes and taking into account a kind of activity respondents perform.

Keywords: business tendency surveys, wording of survey questions

JEL classification: C81, E32

[‡] Central Statistical Office, Poland.

1. Introduction

The business tendency surveys program was launched by the Central Statistical Office of Poland (CSO) in the beginning of the 1990s. In June 1992 the survey of business tendency in manufacturing was introduced as the first, then, in July 1993, the survey of business tendency in construction, and in October of the same year – the survey of business tendency in retail trade. In 1999 questions concerning investment activities of companies were separated from the business tendency surveys' questionnaire in manufacturing and construction to form a separate survey. Their scope was broadened to be consistent with the harmonized form of the European Commission survey in manufacturing. In January 2003 the survey of business tendency in services started, and later, in 2011, the business tendency survey in wholesale trade. Additionally, in 2011 the sampling scheme was changed to allow for regional comparison.

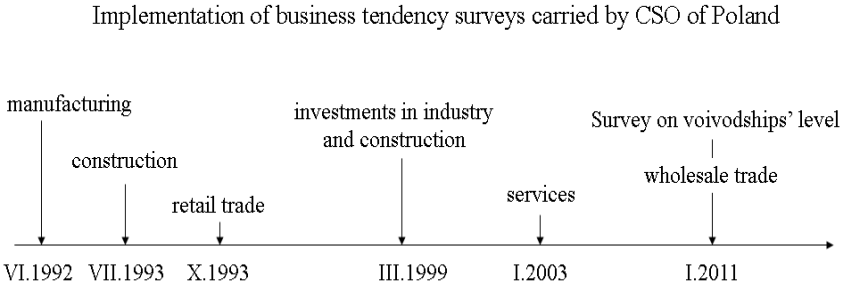


Figure 1. The evolution of business tendency surveys at CSO.

The scope and variables of particular business tendency surveys were subject to modifications in the subsequent years, resulting both from changes in the legal and economic environment, as well as from changes in user needs. Furthermore, the business tendency surveys conducted by the Central Statistical Office take into account the scope and variables valid in the *Joint Harmonised EU Programme of Business and Consumers Surveys* (Commission decision C(97) 2241 of 15 July 1997; Commission communication COM(2006) 379 of 12 July 2006). As the result, the changes introduced at the European level also affected the surveys carried out by CSO.

2. Formulation of questions in qualitative surveys

The business tendency surveys conducted by CSO collect subjective opinions of entrepreneurs about current and future situation of the companies managed

by them, related to such elements of business activities as, e.g. order books, production, financial situation, employment, prices, investments. While filling in a questionnaire, the respondents rely on their evaluation concerning current situation of the company and its expected development without referring to accounting records. It enables faster collection of answers than in the case of quantitative surveys, as well as quicker elaboration and publication of results, providing, in a short time, with the first and general information about trends in the economy. The collected qualitative information may refer not only to data acquired afterwards in quantitative surveys, but also to phenomena not observed by quantitative statistics, such as, e.g., opinions about barriers to economic activity. As a result, business tendency surveys data complements quantitative survey results. An important element of business tendency surveys are prognostic questions, providing information about entrepreneurs' forecasts concerning firms' situation and its selected elements in the months to come.

Due to the subjective nature of business tendency surveys, qualitative questions, to a much greater extent than the variables contained in quantitative questionnaires, should be formulated in such a way so as to ensure that they are clear and fully understandable for the respondent. Precise formulation of questions is a fairly important problem, as even a minor understatement or incorrect word used in a question may affect the results. The author of the survey must know the target group of the survey – the type and the unique character of their activities, the scope of information possessed by the respondents, as well as the language used by the respondents. Any problems in understanding or interpretation of the questions may affect the answers, and, as a consequence, also the obtained results.

Proper phrasing of the question is an important issue that bothers survey authors – that can be seen in many publications analyzing different aspects of questionnaire designing or formulation of questions within them. For example, Presser and Schuman (1977) analyze how different ways of wording of the same question can influence survey results, i.e. question's length and complexity as well as introducing neutral response. The conducted analysis also takes into account respondents' level of education and answers for different question's variant. On the other hand, Kalton and Schuman (1982) describe alternative solutions tested in surveys – questions phrasing, choice of answers, questions order in a questionnaire – and their influence on obtained results.

Krosnick (1991) analyzes situations when respondents are unwilling to respond to survey questions and give answers that are not optimal, but rather select the first acceptable response alternative, not putting much effort into

answering. He points out that a respondent of lower level of education who is tired or doesn't understand the question, chooses more often the answer 'does not change' or 'don't know'. Hardy (2015) analyzes the length of the questionnaire and the precision of response to quantitative questions in surveys. He draws attention to the place of the question in the questionnaire, especially in the context of respondent tiredness and tendency to give easy, fast and neutral answers.

To avoid such problems as much as possible, the questions' drafts, before being introduced to the survey, are analyzed and tested in detail. However, identification of some problems related to questions may be possible only after their introduction to the survey and after collection of the first results.

The paper presents some examples of how the phrasing of the questions of the business tendency surveys conducted by CSO impact the results.

3. Methodology of the CSO business tendency surveys

The business tendency surveys conducted by CSO are based on subjective opinions of entrepreneurs. A typical question of the BTS questionnaire is phrased in the way that a respondent could pinpoint how has situation (e.g. demand, production, employment, financial situation) changed in comparison to the past (i.e. increased, remained unchanged or decreased) and will change in the future (will increase, will not change, will decrease). There can only be one answer to these types of questions.

In the questionnaire there are also two other kinds of question – one where the respondent can choose several answers from a given set (e.g. question concerning factors limiting production), and another one, where the respondent is asked for an exact number reflecting her/his situation (a quantitative type of question, e.g. on capacity utilization).

In the case of the first type of questions, a balance is calculated as a difference between the percentage of the respondents choosing the first variant (increase/improvement) and the percentage of those who choose the third one (decrease/deterioration). In the second case an indicator is calculated separately for each variant as the percentage of the respondents choosing it. Indicators referring to the quantitative type of questions are calculated as an arithmetic mean out of all answers to the particular question.

Next, the balances and indicators are weighted by the shares of sold production to receive results representative for all the country.

4. Question about capacity utilization in services

The degree of capacity utilization informs about the level of involvement of production capacity of a firm, the maintenance of which entails costs, as well as about the possibility of a firm to produce more, or whether it should increase employment or undertake investments, which would make it possible to fulfill submitted or expected orders. It also indicates economic situation, including situation of consumers, as well as whether and to what extent produced goods and services match – also in terms of innovation – demand, and therefore the relation between supply and demand.

The information on capacity utilization is not available in quantitative statistics. The question is asked in business tendency surveys only and is one of few questions of quantitative nature. It was included in the first Polish business tendency surveys in the early 1990s – in the quarterly questionnaire sent to manufacturing companies, as well as in the monthly questionnaire sent to construction and assembly companies. It has been decided that the survey addressed to service companies should also contain a question about capacity utilization, in identical wording as in the questionnaire addressed to companies conducting activities related to manufacturing (section C according to NACE Rev.2) and construction (section F).

As the result of analysis of data on capacity utilization acquired on the basis of the business tendency survey in services, it has been observed that these results, in spite of the fact that they were obtained on the basis of the question formulated in the same way as in the manufacturing and construction surveys, raise some doubts in terms of quality of the answers. The level of capacity utilization in services, indicated by the respondents, was significantly lower than the level reported by manufacturers and construction companies. In the case of service companies it reached the range of 20-30%, whereas in the case of the two remaining surveyed groups of firms – 60-90%.

Therefore, an attempt to solve this problem was made by changing the phrasing of the question, assuming that, due to the character of the activities conducted by service firms, the respondents may have a problem with correct interpretation of the question, which results in giving incorrect answers. When preparing the new question, the diversity of the types of service activities covered by the CSO survey was analyzed, which required taking into account various factors typical that affect service activities.

The business tendency survey in services covers entities classified according to the NACE Rev.2 to the section:

- Transportation and storage (section H)
- Accommodation and food service activities (section I)

- Information and communication (section J)
- Financial and insurance activities (section K) – only banks, credit unions, insurance companies, brokerage houses and offices, universal pension fund (management) companies and investment fund companies
- Real estate activities (section L)
- Professional, scientific and technical activities (section M)
- Administrative and support service activities (section N)
- Education (section P) – without tertiary education
- Human health and social work activities (section Q) – without health maintenance organizations
- Arts, entertainment and recreation (section R) – without juridical cultural institutions
- Other services activities (section S)

Finally, it was decided to formulate the question with additional explanation of what should be taken into account when providing answers:

What capacity (persons employed, equipment, means of transport, space etc.) is your company currently operating at (as a percentage of full capacity)?

Such a change introduced in the questionnaire of the business tendency survey in services, since January 2010, radically affected the obtained answers. The reported level of capacity utilization in services exceeded the level indicated by manufacturing and construction and assembly companies, reaching values between 80% and 90%.

In 2010, on the basis of the modified question in the businesses tendency survey in services, the questions addressed to manufacturing and construction entities were also clarified. However, in these cases, clarification of answers did not affect the results.

Figure 2 presents the answers to the question about capacity utilization for three types of activities – manufacturing, construction and services, before and after rephrasing of the question.

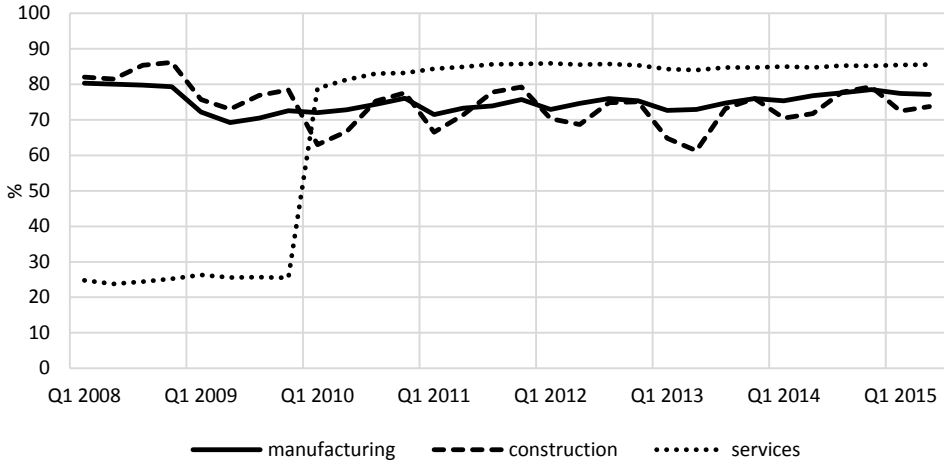


Figure 2. Capacity utilization in manufacturing, construction and services.

Changes also come out when analyzing data for different types of service activities covered by the survey. Figure 3 presents, for instance, the results for the following sections: transportation and storage (section H), accommodation and food service activities (section I), information and communication (section J), human health and social work activities (section Q).

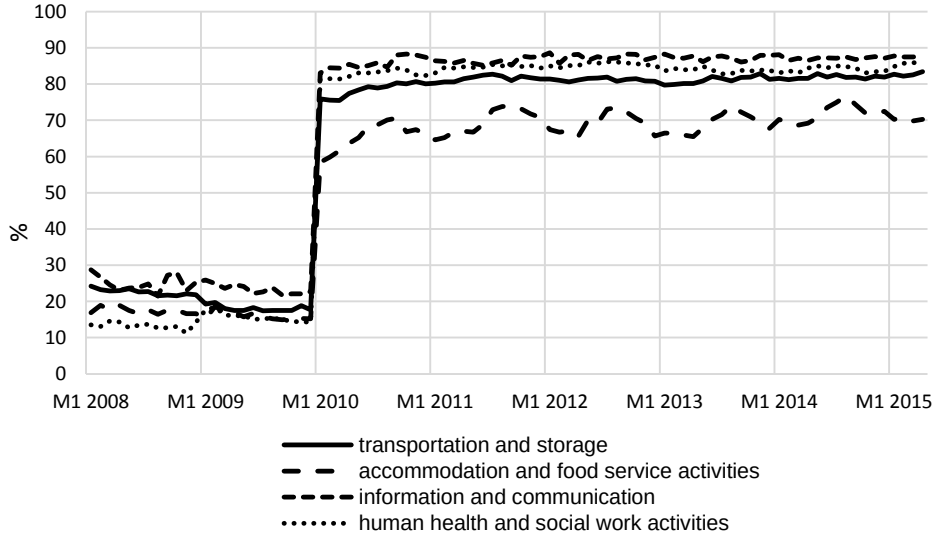


Figure 3. Capacity utilization in selected types of services.

The change in the phrasing of the question had a significant impact on the obtained results. As long as the question did not explain how the respondents conducting service activities were supposed to understand the term of the capacity utilization, associated first of all with manufacturing, the relevant indicators, both at the total and section levels, achieved low values. After the question had been clarified, the respondents started to take into account, among others, 'employees, means of transport, equipment, space etc.', and the values of the indicators for services increased to the level comparable with manufacturing and construction.

Although more explanations were added to the questions, respondents were not daunted by its length. Correcting the question wording gave more reliable outcome that was consistent with the conclusion of Kalton and Schuman (1982) that 'difficulties from long questions probably derive from their complexity rather than their length *per se*'.

5. Questions about competition/competitive position

Competitiveness is one of the significant challenges of the contemporary economy, both at the national and international levels. The competitive position of a firm depends on internal as well as various other factors resulting from its legal and economic environment. For this reason, different aspects of competitiveness of firms themselves or of economies can be measured by means of indicators processed on the basis of available statistical data.

Under the *Joint Harmonised EU Programme of Business and Consumers Surveys* conducted by the European Commission three new questions were added to the quarterly survey of manufacturing firms. Specifically, these are the questions concerning competitive position on the domestic market, the European Union market and markets outside the European Union.

The questions were also introduced in 2002 to the quarterly business tendency surveys in manufacturing conducted by CSO. A decision was made to ask the respondents the following questions:

1. How has your company's competition changed on the domestic market in the last three months: increased, remained unchanged, deteriorated.

2. How has your company's competition changed on foreign markets inside the EU in the last three months: increased, remained unchanged, deteriorated.

3. How has your company's competition changed outside the EU in the last three months: increased, remained unchanged, deteriorated.

The obtained results indicated that the respondents properly interpreted the questions about the encountered competition, indicating high level of competition, in particular, on the domestic market. However, during further works on harmonization of the questionnaire it was decided that the questions should be rephrased just as in the European questionnaire in order to ensure the international consistency and comparability of the survey data. As a result, additional questions related to the competitive position of companies on three specified markets were introduced to the questionnaire for 2003. At the same time, it has been decided not to ask previous questions about competition so as not to excessively burden the respondents with questions of similar nature.

New questions have been formulated as follows:

1. How has your company's position in comparison to competitors changed on the domestic market: increased, remained unchanged, deteriorated

2. How has your company's position in comparison to competitors changed on foreign markets inside the EU: increased, remained unchanged, deteriorated

3. How has your company's position in comparison to competitors changed outside the EU: increased, remained unchanged, deteriorated

Just as expected, the change in the phrasing of questions significantly affected the obtained answers. Specifically, since 2003 the balances, as compared to the figures of 2002, decreased from the value of +30 to +50 points to the level of -10 to +10 pts. The questions asked in 2002 and later changed are logically related. In reply to the question about a change of competition on three specified markets, asked in 2002, the respondents indicated that competition on the particular types of markets was significantly increasing (this means problems with entering the market by enterprises and difficulties in their later activities there) - the balances calculated for 2002 were at a high positive level. Since 2003, after the introduction of the questions about the competitive position of a firm, the balances have significantly decreased (to ca. 0 pts). That means the entrepreneurs assessed their competitive position substantially did not change much (taking into account the high level of competition reported in 2002).

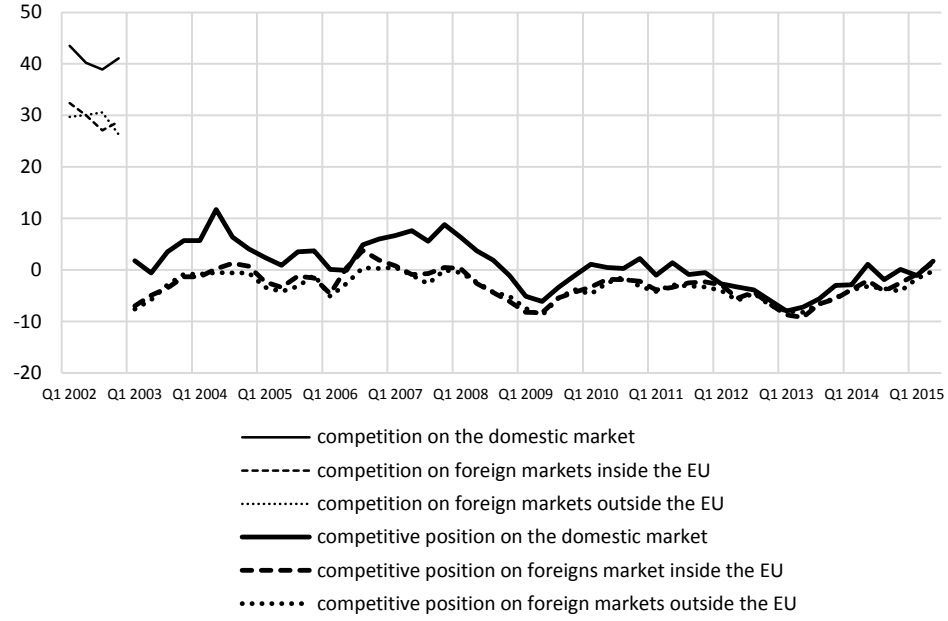


Figure 4. Manufacturing – competition on the market and competitive position.

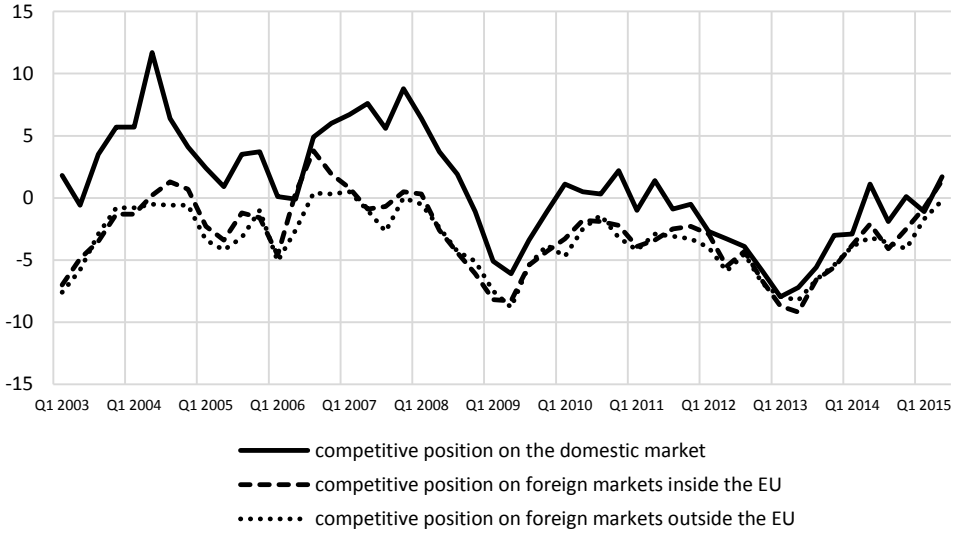


Figure 5. Manufacturing – competitive position.

In order to compare survey data with quantitative statistics, we present below several charts illustrating respondents' opinions on their competitive position on the EU market together with data on exports to the EU market, in years 2009-2014. We selected the types of manufacturing activities in which the share of exports is significantly higher, i.e.:

- manufacture of motor vehicles, trailers and semi-trailers;
- manufacture of food products, beverages, tobacco products;
- manufacture of rubber and plastic products;
- manufacture of fabricated metal products, except for machinery and equipment;
- manufacture of electrical equipment; and
- manufacture of furniture.

For these industries one can note a relationship between the respondents' feelings with regard to their competitive position and the size of exports (of each industry). Specifically, in the period of 2009-2010, in some divisions, the competitive position of firms improved in line with a rise in exports, and then, in 2012-2014, deterioration of the competitive position was accompanied by a decline in exports.

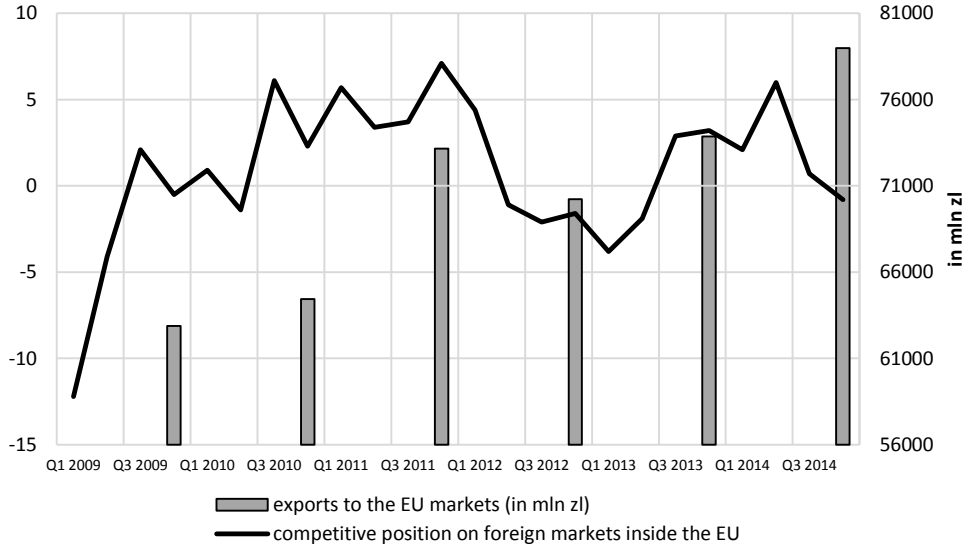


Figure 6. Manufacture of motor vehicles, trailers and semi-trailers – the balance of competitive position on the EU market and exports to the EU market in million zlotys (current prices).

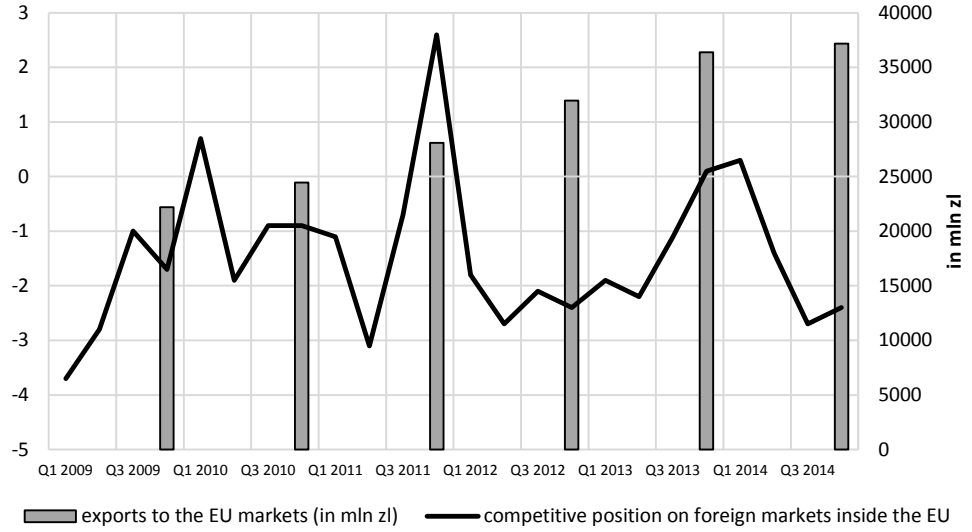


Figure 7. Manufacture of food products, beverages and tobacco products – the balance of competitive position on the EU market and exports to the EU market in million zlotys (current prices).

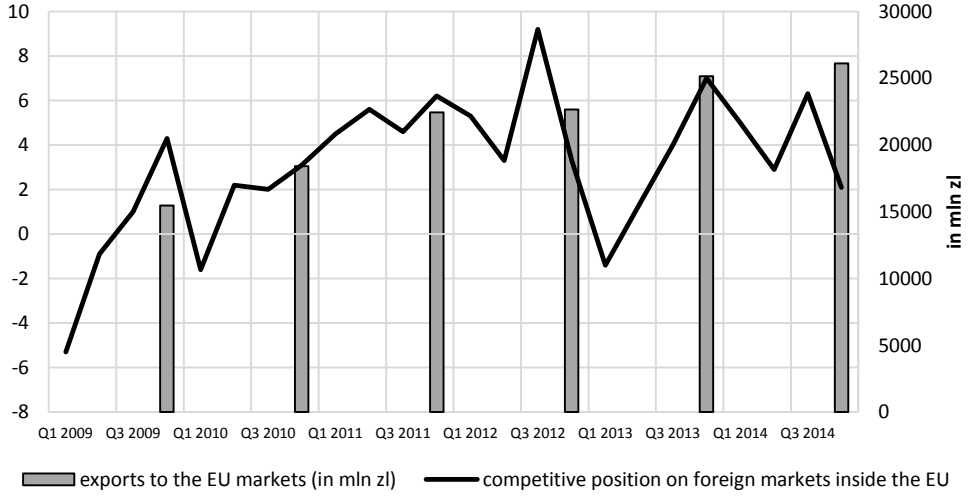


Figure 8. Manufacture of rubber and plastic products – the balance of competitive position on the EU market and exports to the EU market in million zlotys (current prices).

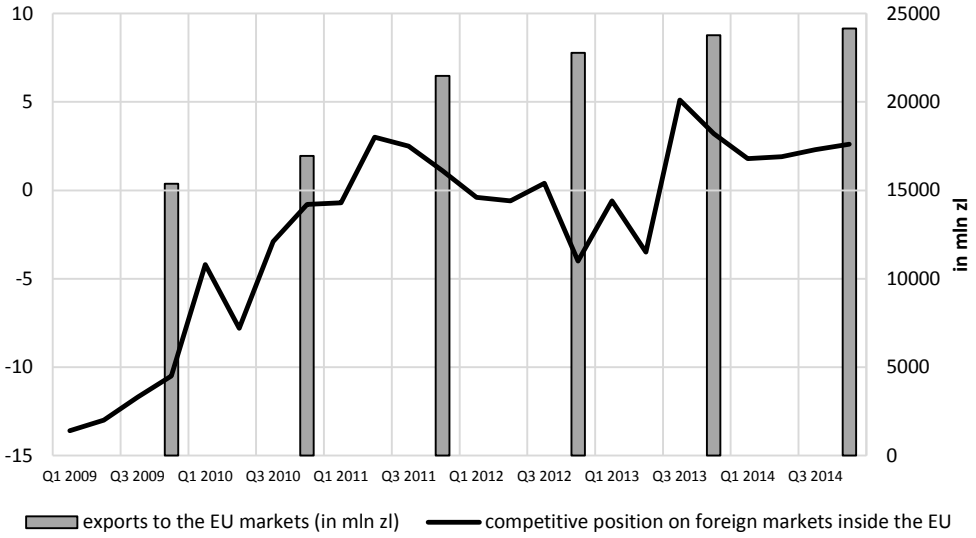


Figure 9. Manufacture of metal products – the balance of competitive position on the EU market and exports to the EU market in million zlotys (current prices).

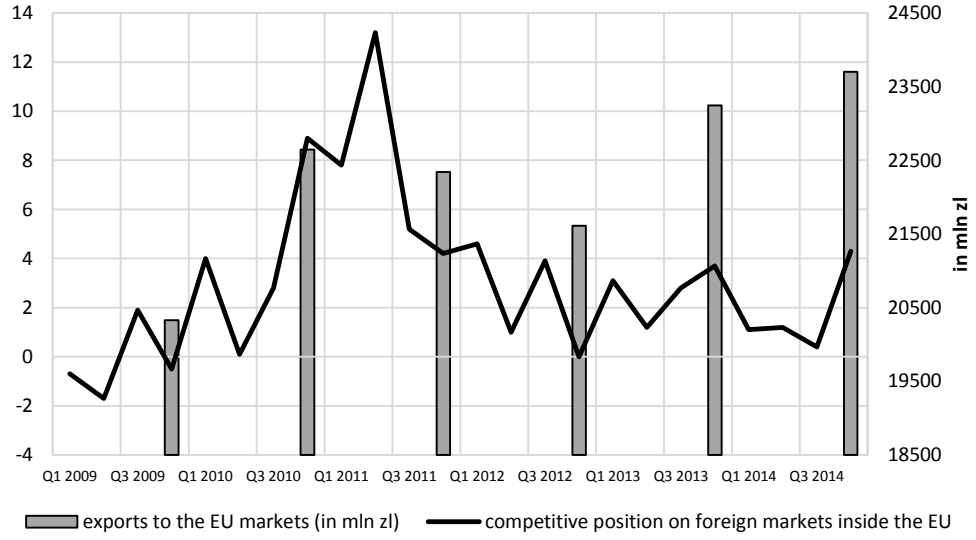


Figure 10. Manufacture of electrical equipment – the balance of competitive position on the EU market and exports to the EU market in million zlotys (current prices).

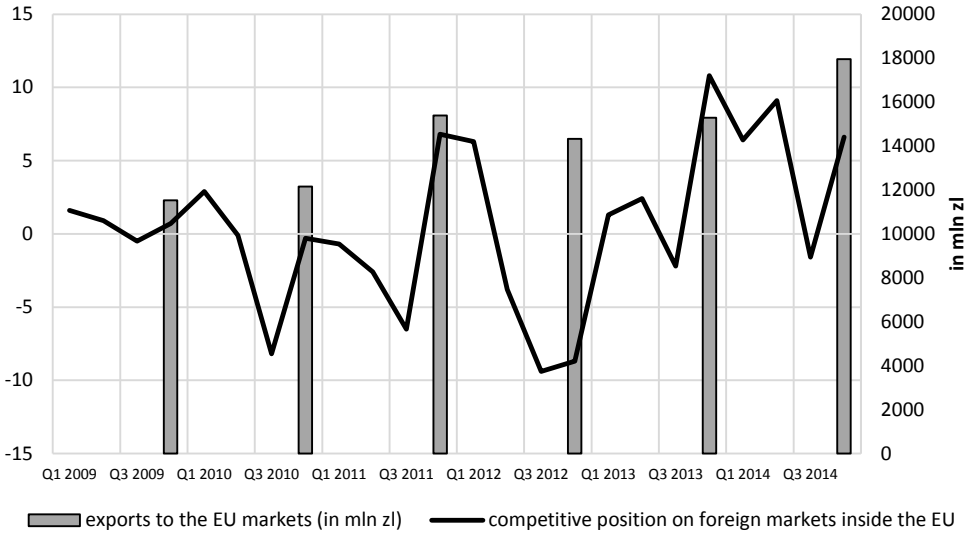


Figure 11. Manufacture of furniture – the balance of competitive position on the EU market and exports to the EU market in million zlotys (current prices).

The possibility of a significant influence of marginal changes to a question on the response was indicated, *inter alia*, by Kalton and Schuman (1982). According to them, there is a chance that a slight change in formulating survey questions may not seem significant to respondents, and be disregarded by them, when the words used before and after the rephrasing are very similar.

At the beginning of 2003, in the first period of using by CSO the questions in the present version, there was a risk that the respondents, after answering an apparently similar question in 2002, may not notice the new phrasing, which would negatively affect the quality of the response. However, our results show that, in this case, the respondents carefully read and correctly understood both the previous questions about competition on the markets as well as the subsequent questions about their competitive position.

6. Shortage of (skilled) labor

Human capital is one of the significant factors of business activity that influences its performance indicators, as well as, among others, its competitiveness and innovativeness. It can be defined as professional knowledge, experience and skills accumulated by employees. The investment in the personnel to increase their effectiveness and efficiency involves not

only providing them with necessary equipment to perform the work, but also employing qualified staff and training employees.

Business tendency surveys contain, among others, questions about factors limiting economic activity, which provide information about difficulties encountered by firms when running a business. This type of questions have been introduced to all business tendency surveys conducted by CSO: quarterly survey of manufacturing and monthly surveys of construction, trade and services. Since the early days of the former (in 1992) the questionnaire has contained the list of limitations which respondents can choose from, including the 'shortage of *skilled* labor' (italics added by the authors). In 2003, as a result of adjustment of the business tendency surveys to the *Joint Harmonised EU Programme of Business and Consumers Surveys*, several new factors restricting business activity, including the barrier of 'shortage of labor', were added to the old ones. It was decided to keep the previous option in the questionnaire due to, among others, the need of continuation of the ten-year time series and the presumption that, in spite of similar notion, the response may not be identical.

An analysis of the obtained answers confirmed that, despite of some similarities, the respondents, while filling in survey questionnaires, clearly distinguish between 'shortage of labor' and 'shortage of skilled labor'. Figure 12 presents the results. According to the respondents, the 'shortage of skilled labor' is, for them, a significantly more serious problem than the general 'shortage of labor'. An increase in the percentage of firms indicating the shortage of skilled labor can be noted after the accession of Poland to the EU in 2004, and in the expansion period of 2006-2008, with a subsequent rapid decrease during the global financial and economic crisis of 2007-2009. Recently, the respondents have reported this limitation again, and the percentage of the firms reporting 'shortage of skilled labor' has been greater than those reporting 'shortage of labor'. When comparing both with quantitative data on average employment in (total) manufacturing, a strong correlation is noticed.

Figure 13 shows the percentage of the respondents reporting the shortages of labor and skilled labor, and uncertainty of economic environment, together with the manufacturing confidence indicator. By thorough inspection of the graph one can conclude a negative correlation between the percentage of the firms reporting the shortage of skilled labor and the confidence indicator. A weaker correlation can be noted for the percentage of the surveyed firms reporting the shortage of labor (which is less volatile).

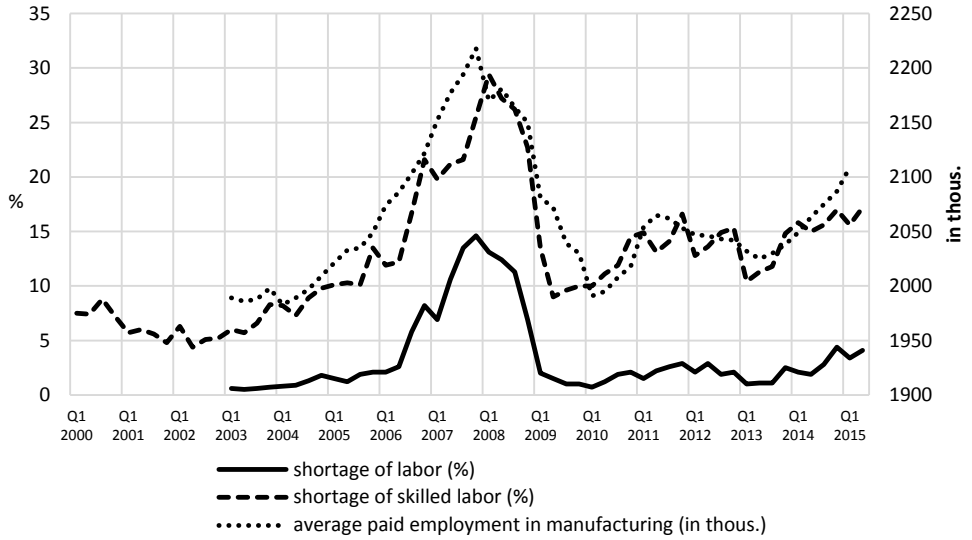


Figure 12. Factors limiting business activity (survey data, in %) and average paid employment in manufacturing (in thousands).

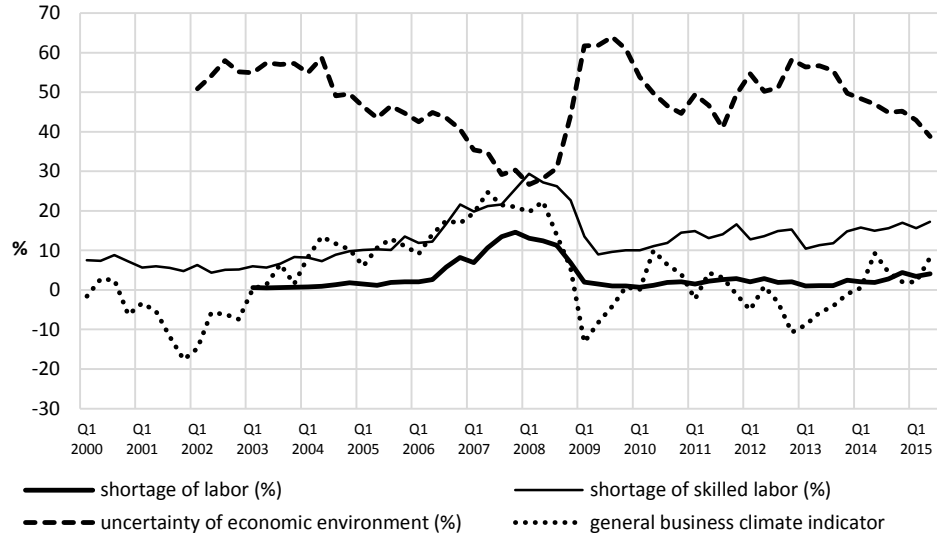


Figure 13. Factors limiting business activity in manufacturing (in %) and the general business climate indicator in manufacturing (survey data).

The difference between the percentages of the respondents reporting the two barriers can also be seen at the level of the manufacturing sections. For instance, taking into consideration two manufacturing sections classified as

Knowledge Intensive Activities, i.e. manufacture of basic pharmaceutical products and pharmaceutical preparations, and manufacture of computer, electronic and optical products, it comes out that by studying the response on the shortage of labor a researcher could be misled. In the case of manufacture of basic pharmaceutical products and pharmaceutical preparations, over the past six years the respondents did not report any problems related to the shortage of labor, whereas in the case of skilled labor such a deficiency has been reported, though with diminishing intensity (see Figure 14). In the case of manufacture of computer, electronic and optical products, the similar difference can be noted. In both cases, during the crisis of 2007-2009, in spite of the fact that labor demand significantly decreased, skilled labor was undersupplied.

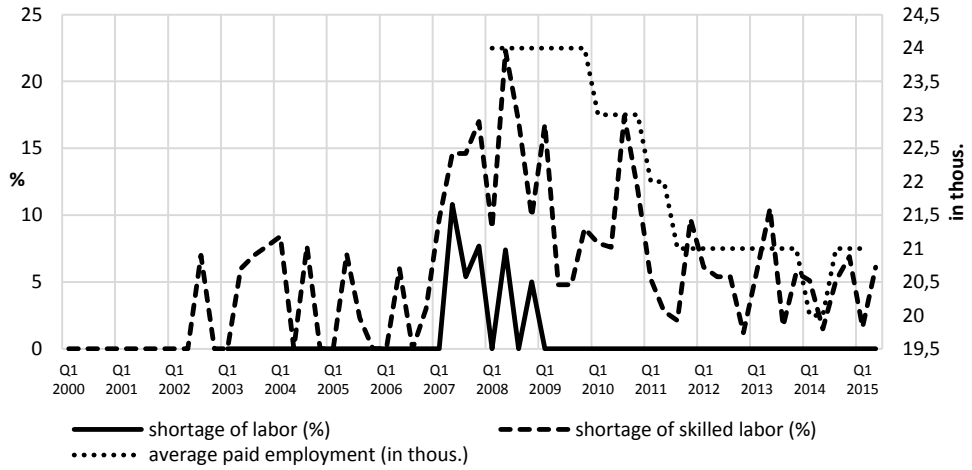


Figure 14. Manufacture of pharmaceutical products – factors limiting business activity (survey data, in %) and average paid employment (in thousands).

To summarize we found that, although both indicators have similar tendencies, the respondents distinguish between them and more often report the shortage of skilled labor as being more troublesome. When designing the questionnaire, it is therefore crucially important to be precise as much as possible as even slight differences in the wording of questions may bias survey results.

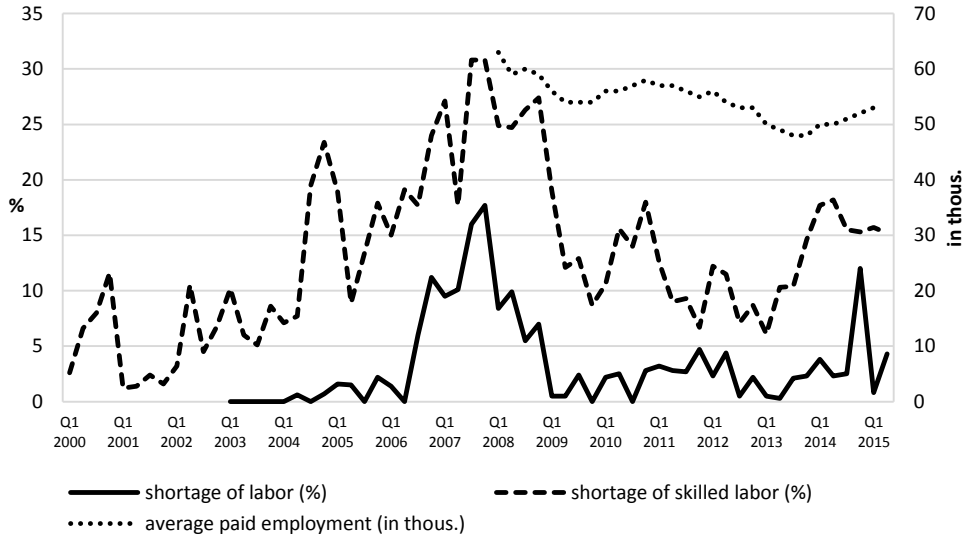


Figure 15. Manufacture of computer, electronic and optical products – factors limiting business activity (survey data, in %) and average paid employment (in thousands).

7. Summary

The above paper presents several case studies showing how rephrasing of a business tendency survey questionnaire affects the response.

In the first case, concerning capacity utilization, failure to adjust the question to the specific nature of business activities resulted in obtaining incorrect results. The clarification of the question had a positive impact on its understanding by the respondents and resulted in more adequate answers. At this point of the study there were no actions taken to increase the comparability of the data before and after the question was rephrased.

In the second case, a slight change in the question wording, however significant for the substance of its content, has been correctly understood by the respondents who adjusted their answers to the question.

The last example provokes a reflection on the level of detail which questions should have in order to, on the one hand, not focus on excessively detailed issues, and on the other – capture the phenomena essential for the data users.

It is worth noting that, due to the observed sensitivity of response to phrasing of survey questions, it is important to ensure – as far as possible – their stability, and to carefully consider any change to be introduced as they

may affect results of the survey and, therefore, lead to structural breaks in time series.

References

European Commission, *The Joint Harmonised EU Programme of Business and Consumer Surveys. User guide*, 21 March 2014.

Hardy, W. (2015). Długość kwestionariusza a precyzja odpowiedzi na pytania ilościowe w badaniach ankietowych, *Ekonomista*, 5 (160), 707-726.

Kalton, G., Schuman, H. (1982). The effect of the question on survey responses: A review, *Journal of the Royal Statistical Society*, Series A, 145 (1), 42-73.

Krosnick, J. A. (1991). Response strategies for coping with the cognitive demands of attitude measures in surveys, *Applied Cognitive Psychology*, 5 (3), 213-236.

Presser, S., Schuman, H. (1977). Question wording as an independent variable in survey analysis, *Sociological Methods & Research*, 6 (2), 151-170.

Badanie koniunktury gospodarczej, CSO, Departament Przedsiębiorstw, Warszawa 2015.

Ludmila Kitrar, Tamara Lipkind, Inna Lola,
Georgy Ostapkovich, Dmitry Chusovlyanov‡

The HSE ESI and the business cycle in the Russian economy

Abstract

As the Russian economy is presently characterized by high uncertainty of doing business and a growing gap between opinions and actions of firms and decision makers, the importance of qualitative business surveys as a source of information is significantly rising. The paper investigates the ability of Russian business tendency surveys to identify business cycle turning points. For this purpose we have constructed an algorithm to build economic indicators which cover all information contained in the sectoral business surveys data. Identification of the turning points of these indicators allows us to track the stylized 'averaged' chronology of the business cycle. In addition, we have evaluated *ex post* the turning points in the GDP growth on the basis of the extracted cyclical component of the composite Economic Sentiment Indicator.

Keywords: business cycle, business tendency surveys, turning points, economic tracer, economic sentiment indicator

JEL classification: E32, C81, C82

‡ Higher School of Economics, Institute for Statistical Studies and Economics of Knowledge, Centre for Business Tendency Studies, Moscow, Russian Federation.
lkitrar@gmail.com, tel.: 7 905 710 64 34.

The paper was prepared within the framework of the Basic Research Program at the National Research University Higher School of Economics (HSE) and supported within the framework of the subsidy granted to the HSE by the Government of the Russian Federation for the implementation of the Global Competitiveness Program. Any opinions or claims contained in this paper do not necessarily reflect the view of National Research University Higher School of Economics.

1. Introduction

At present, the Russian economy is facing increasing uncertainty of doing business, and a gap between opinions and actions of firms and decision makers is growing. This is largely determined by unfavorable global context, the escalation of external shocks and risks, which challenge using relevant statistical methods to monitor and analyze the economy's performance.

Russia needs to change the economic model now more than ever. The reindustrialization process should reduce gradually the country's dependence on the resources-based growth and promote innovation activity. As nationwide structural and cyclical changes advance, the importance of business tendencies surveys (BTS) as a source of information substantially increases. Despite weaknesses of cognitive perception of reality by economic agents, this method of measuring their behavior and changing business sentiments is a recognized source of economic data in many countries worldwide. This information comes in hand before 'hard' quantitative data is available, and is statistically reliable.

In Russia, such research program was launched in 1993 in the framework of the TASIC program 'Statistics 2, 3, 5'. Since 1998 the regular large-scale sectoral BTS have been carried out by the Centre for Economic Analyses of the Government of the Russian Federation in co-operation with the Federal State Statistics Service of the Russian Federation (Rosstat). Since 2009 all methodological support and databases have been transferred to the Centre for Business Tendency Studies, the Institute for Statistical Studies and Economics of Knowledge, Higher School of Economics (HSE ISSEK CBTS).

The accumulated large-scale dynamics of such 'soft' statistics aggregating entrepreneurial assessments not only meets the increased demand of experts for economic data but also contributes to the expansion of managers and decision makers competencies. Such databases can combine real-time entrepreneurs' estimations of current and expected economic development in various sectors and reflect external shocks, internal barriers and their significant socio-economic consequences. The regular monitoring of economic agents' opinions allows collecting qualitative data on business and investment climate, business trends and environment, business confidence and economic sentiments.

The BTS program developed by HSE allows for measuring many sectoral development paths and short-term fluctuations, while traditional statistics is insufficient, not prompt enough or subject to frequent revisions. We define the main advantages of joint HSE–Rosstat BTS as:

- accumulated data set over a long time period;

- coverage of a wide range of regions, sectors and economic activities;
- frequency, promptness; synchronization and harmonization of programs;
- possibility of sectoral benchmarking;
- unified approach to data collection, data processing and database maintenance;
- availability of results;
- statistically significant compatibility of survey results with quantitative statistics;
- compliance with international standards and classifications.

We have found short-term indicators based on business surveys data useful in monitoring business cycles and forecasting turning points (Kitrar *et al*., 2003; Kitrar & Ostapkovich, 2013a; Kitrar & Ostapkovich, 2013b; Kitrar *et al*., 2014).

This study focuses on whether the aggregate dynamics of business confidence conforms to the real economic situation in Russia. We aim to determine to what extent business surveys data are sensitive to the phase alternating in the cyclical development of the national economy. For this purpose we have constructed an algorithm to build economic indicators which cover all information contained in the sectoral business surveys data. Identification of the turning points of these indicators allows us to track the stylized 'averaged' chronology of the business cycle. In particular, we

- define criteria for aggregating each BTS indicator in one of the composite blocks;
- develop an iterative procedure for building a structured set of composite indicators according to the direction, average duration and chronology of the phases of unobserved cyclical components;
- build an algorithm that tests the indicators for cyclical sensitivity through decomposition of their dynamics in the iterative procedure.

To demonstrate expected outcomes, we test the cyclical volatility of the composite indicator according to the proposed built-in algorithm. For this purpose we use the HSE Economic Sentiment Indicator (HSE ESI), which already exists in Russia and is almost harmonized with its European analogue, from Q1 1998 to Q2 2015. The results show a significant degree of compatibility and a leading nature of this composite BTS indicator with the cyclical component of GDP. Based on the extracted HSE ESI cyclical component, we retrospectively evaluate GDP turning points.

The empirical basis of the study is BTS data on assessments and expectations of economic agents in the industry, construction, trade, and

services, with stratified random sampling of about 25.000 observations from almost all regions of Russia.

2. Background

In international practice composite indicators are widely used for interpretation and presentation of generalized BTS information (European Commission, 2014a; OECD, 2003, 2008). We define a composite indicator (CI) as an aggregate quantitative measure of a non-quantitative information about economic phenomena like, for example, competitiveness, innovation and investment, integration and structural processes, economic sentiments, consumer confidence or business climate.

To convert BTS data into CIs it requires to select variables that:

- measure early stages of the production process (for example, changes in new orders or total order books);
- react quickly to changes in economic activity (e.g. finished products inventories);
- measure expectations (e.g. expected tendency of production).

As a rule, it is easy to extract a cyclical component of such time series because they do not contain long-term trend, as they in fact represent a deviation from it[1].

Moreover, such indicators are related to economic agents' judgements that are capable to record possible cyclical changes ahead of relevant statistical indicators. The Russian BTS data are available from a single source (Rosstat) and published regularly at the same time. This means that the CIs are not revised. Finally, we form all survey programs for Rosstat to capture information that is impossible to record using conventional methods of statistical observation – for example, capacity utilization, bottlenecks in production, level and change in sectoral economic activity, effects of external shocks and internal barriers. These advantages enhance significantly the information capacity of BTS data to identify the cyclical phases and turning points.

In our practice we make use of publications available at the European Commission website, which regularly publishes the methodology and time series of composite indices of economic sentiments, business confidence and business climate.

In Russia, the best known research on business cycles and composite indicators is done by the 'Centre of Development' Institute, Higher School of

[1] In the Russian BTS program, ordinal a three-option scale (up/unchanged/down) is used for all variables.

Economics (Smirnov, 2001, 2006, 2012) and Center for Business Tendency Surveys, Higher School of Economics (Kitrar & Ostapkovich, 2013b). Thus, in our study we are primarily guided by the fact that for a long time international community has tended to aggregate complex and partly undisclosed to quantitative statistics processes and behavioral patterns of economic agents into a single measure of national economic activity.

3. Basic algorithm for building composite indicators of cyclical nature

Let us consider the main stages of constructing CIs based on the BTS results for measuring economic activity fluctuations and turning points identification. The used approach basically presupposes building a flexible set of CIs, including the BTS results, at sectoral and national level. They are classified into three groups: coincident, leading and lagging indicators, depending on the direction and the timing of reference time series.

What is specific about the approach is a built-in algorithm that tests each CI and its components for cyclical sensitivity by decomposing their dynamics, extracting a short-cycle component with smooth amplitude and assessing its approximation to the reference indicator. This procedure is based on the OECD guidelines (European Commission, 2014a; OECD, 2008, 2012; Nilsson & Guidetti, 2008).

The construction procedure of CIs aims to cover relevant information on HSE business surveys as much as possible, regardless of their cyclical properties. Further, according to an integrated test, the cyclical sensitivity of CIs time series is checked in regard to the cyclical dynamics of the reference series. On this basis, the dates of turning points are estimated for all indicators that highly correlate with the reference series. Their 'average' values represent the desired chronology of both actual and expected changes in the cycle (Chauvet & Hamilton, 2005)[2].

In our opinion, the cyclical CIs for Russia may consist entirely of qualitative variables[3] if they have a high cyclical sensitivity and significant

[2] We consider this concept, which can be interpreted as a 'date then average' approach, more appropriate when the cyclical analysis is to be carried out using the set of composite indicators (not an integrated construction). The opposite method, proposed by Stock and Watson (2010), is 'average then date', which is prevalent in building the OECD single leading composite indicator.

[3] The most successful experience of using qualitative information in a short-term analysis is a system of cyclical composite indicators published by the European Commission as 'European Business Cycle Indicators' (European Commission, 2014b).

correlation with aggregate economic activity (expressed in GDP dynamics or other appropriate indicators).

Within the growth cycle concept, the main criteria to determine the sequence of steps in an iterative procedure of constructing a set of cyclical CIs are:

- correspondence to the cyclical nature of a reference macroeconomic indicator of aggregate economic activity in a specific sector or in the Russian economy as a whole (for example, the GDP index or the industrial production index);
- providing leading, coincident or lagging (so-called control) signals of turning points.

Ideally, we can obtain three CI clusters which would be able to:

- lead the trajectory of the reference indicators with a sufficient degree of probability in real time;
- provide evidence of the sustainable coincidence with the reference indicators trajectory;
- approximate the retrospective trajectory of the reference indicators, confirming or refuting the cyclical correspondence.

With this definition, we determine a generalized trajectory of the cyclical components of all analyzed time series, being adjusted deviations from the long-term trend. In this context, the reliability of the CI depends on theoretical assumptions about the cyclical nature of the selected potential variables and the statistical characteristics of their cyclical sensitivity.

The general logic of the assertions above leads to the following iterative procedure:

I. *Formation of the initial conditions* – the well-grounded selection of the reference indicator and qualitative indicators that can potentially form CI. It requires selecting qualitative BTS indicators which highly correlate with the growth rate of quantitative statistics. The main selection criteria are: economic feasibility and relevance, reliability of the statistical base, frequency, availability and timeliness of the information sources, broad coverage and long-time series, and absence of pronounced volatility in the dynamics.

II. *Statistical analysis of the reference series cyclical behavior:*

1. Decomposition of dynamics: the double use of the Hodrick-Prescott (HP) filter is recommended (Nilsson & Guidetti, 2008; Nilsson & Gyomai, 2011). In this study we investigate short-term growth cycles that most closely match the informational nature of BTS results. Therefore, we use chain growth rates (the relative value of each month/quarter to the corresponding

month/quarter of the previous year) as a reference quantitative series, because they correlate the best with time series of qualitative indicators. This reporting format presupposes that the basic fluctuations in both quantitative and qualitative series occur relative to long-term average values (e.g. = 0, = 100). However, the test for stationarity revealed that they have significant power at low frequencies (the augmented Dickey-Fuller test identified non-stationarity with high *p*-value). Filtering such unsteady low-frequency components allows the transformation of these series into a form with time-independent statistical properties when the expected value and variance of alternating sections of such series are close to the stable time-constant values. The proposed decomposition of dynamics makes the remaining high-frequency component more consistent with the short-term cyclical changes of the time series with an unsmoothed amplitude. In this study, the low-frequency component is defined as a medium-term cycle of a reference indicator (identification of a long-term cycle requires longer time series). This implies the need of:

- identification of the medium-term cycle (MC) with a frequency up to 15 years by using the HP filter for the first time;
- extraction of the unsmoothed short-term cyclical component (USC) – detrended reference series representing the growth cycle (due to revealed non-stationarity of raw series the obtained USC should be tested for cointegration with qualitative variables);
- smoothing the short-term cyclical component with the use of the HP filter for the second time.

2. Constructing the 'basic chronology' of the smoothed short-term reference cycle (SSC) – identifying turning points by using the simplified version of Bry-Boschan (1971) procedure. The criteria for dating the smoothed dynamics are:

- alternation of peaks and troughs;
- minimum duration of the cycle (if alternation from peak to peak or trough to trough is present) of 15 months;
- minimum duration of the cycle phase of 5 (6) months;
- identification of the maximum value (for peaks) or minimum value (for troughs) as a turning point if no explicit turning point comes up or no turning points alternate;
- exclusion of extreme points whose effect is short and completely reversible.

III. *Statistical analysis of time series of indicators that can potentially be aggregated in CI (including a test for their cyclical sensitivity):*

1. Statistical treatment of time series: seasonal adjustment, elimination of insignificant outliers, recovery of missing values, standardization (if necessary).

2. Decomposition of dynamics (the double use of the Hodrick-Prescott filter is recommended). Statistical studies of the accumulated BTS dynamics do not indicate stationarity, although indicators are already deviations from the long-term average according to their information content. Therefore, pre-filtering unsteady components should be done to identify a short-term cycle (first with an unsmoothed amplitude) in the maximum accordance with the trajectory of similar components in the reference series. The lack of stationarity in BTS series and the possible presence of long-term fluctuation, not related to the short-term cycle, are largely due to the increasing optimism or pessimism in the economic agents behavior that is dominant at specific time intervals. In this item we recommend the same steps as those described above for the reference series decomposition.

3. Assessing the cyclical correspondence of the smoothed short-term cycle (SSC) of the selected indicators with the SSC of the reference series:

- finding significant cross-correlation coefficients;
- classifying the indicators according to leading, coinciding or lagging turning points of the reference SSC;
- 'primary dating' of the SSC for all selected and classified indicators;
- final selection of indicators for aggregation.

The main selection criteria are as follows:

- significant cross-correlation statistics (provides evidence about the cyclical sensitivity and consistency with the cyclic path of aggregate economic activity, which is represented by the reference time series);
- the benchmark for this type of structuring indicators is the analysis of time periods (months, quarters) with the maximum cross-correlation coefficients;
- the highest possible correspondence of 'primary dates' with basic chronology of the cycle (using the simplified Bry-Boschan procedure).

We recommend performing the built-in algorithm (see Table 1) for testing not only potential qualitative components for aggregation but also for CI, including those built in the framework of the harmonized European system of business and consumer surveys. It is expedient to test CI for cyclical sensitivity to determine the feasibility to include them in the system of relevant composite short-term cyclical indicators.

Table 1. The built-in algorithm for testing the BTS indicators dynamics $X(t)$ to further include them into the system of short-term cyclical indicators after step-by-step assessment jointly with the reference indicator dynamics $Y(t)$.

Step 1	Selection of the type of the compared indicators $X(t)$ and $Y(t)$ (possible representation of $X(t)$ – raw balances; $Y(t)$ – index): 1.1. Graphical comparison of $X(t)$ and $Y(t)$. 1.2. Calculation of the $X(t)$ and $Y(t)$ cross-correlation coefficients.
Result	Choosing potential CI components and reference series.
Step 2	Decomposition of the selected time series $X(t)$ and $Y(t)$: estimation of medium-term cycle (MC) and unsmoothed short-term cycles (USC): 2.1. Extraction of the 8-, 10- and 15-year MC for $X(t)$ and $Y(t)$: first HP filtering. 2.2. Graphical comparison (common X-axis) of 8-, 10- and 15-year MC $X(t)$ and $Y(t)$ with initial $X(t)$ and $Y(t)$. 2.3. Graphical comparison of USC $X(t)$ and $Y(t)$ with different MCs (8, 10, 15 years). 2.4. Calculation of cross-correlation coefficients of $X(t)$ and its USC with various MCs (8, 10, 15 years). 2.5. Calculation of cross-correlation coefficients of $Y(t)$ and its USC with various MCs (8, 10, 15 years). 2.6. Joint cross-correlation of USC $X(t)$ and USC $Y(t)$ with various MCs (8, 10, 15 years). 2.7. Test for cointegration of USC $X(t)$ and USC $Y(t)$ with selected MCs.
Result	Selection of the desired MC and USC for $X(t)$ and $Y(t)$.
Step 3	Selecting the smoothing short-term cycle (SSC) for $X(t)$ and $Y(t)$: 3.1. Smoothing the USC amplitude for $X(t)$ and $Y(t)$: the second HP filtering to extract short cycles (18, 24 and 30 months). 3.2. Graphical comparison of the smoothed short-term cyclical components (SSC) $X(t)$ and $Y(t)$ with different periods of smoothing (18, 24 and 30 months). 3.3. Joint cross-correlation of SSC $X(t)$ and SSC $Y(t)$ at different smoothed amplitudes (18, 24 and 30 months): SSC $Y(t)$ at 18-month smoothing with SSC $X(t)$ at 18-, 24- and 30-month smoothing, etc.
Result:	Selection of the most comparable SSC $X(t)$ and $Y(t)$ and their graphical representation.

IV. *Generation of final results:*

1. Identifying the cyclical phases and the average turning points dates for the each group of the indicators.

2. Secondary dating of the SSC of structured indicators followed by the determination of the average dates of turning points for each group of the indicators.

3. Normalization (standardization) of the indicators selected for aggregation: setting their SSC to the same amplitude[4].

Aggregation through various models of averaging the normalized SSC, presented in the form of standardized indices[5].

4. Decomposition and joint analysis of the growth cycles of the Economic Sentiment Indicator and GDP

We investigate the dynamics of the composite Economic Sentiment Indicator (HSE ESI) for its cyclical sensitivity and statistically significant consistency with the short-term cyclical trajectory, phases and turning points of the aggregate economic activity, represented by the reference statistics – the real GDP index. The empirical study is conducted according to the algorithm described above and covers period from Q1 1998 to Q4 2014.

The HSE ESI is a composite indicator that combines the dynamics of the BTS results, which cover about 22.000 industrial, construction, retail trade, and service firms as well as 5.000 consumers. The total contribution of these sectors to the domestic gross value added is about 70%. To calculate HSE ESI, we select 12 indicators according to EC guidelines[6], which reflect economic fluctuations in Russia the most adequately and promptly:

- in industry: current order books, production expectations and level of finished products inventories;
- in construction: current order books and employment expectations;
- in retail trade: current and expected business situation, level of stocks;

[4] For normalizing time series we propose to subtract the average value from SSC of each *X(t).* The difference is divided by the mean absolute deviation of the series and 100 is added to this value. The result is dimensionless and comparable with each other SSC of all *X(t).* Level 100 is equal to the long-term equilibrium level; values above indicate a positive deviation from equilibrium, and the values below 100 – a negative deviation.

[5] Steps 3 and 4 are performed only to create a single composite indicator from a set of indicators classified with respect to the timing of the phase.

[6] In the European Union a similar index – Economic Sentiment Indicator (ESI) – is calculated by the Directorate General for Economic and Financial Affairs of the European Commission since 1985 (European Commission, 2014a).

– in services: current and expected demand, current business situation;
– consumer confidence.

In order to harmonize HSE ESI with international standards and allow for international comparison we use an iterative aggregation procedure, virtually identical to the European system of similar indicators. It includes standardization and average weighted aggregation of selected components and normalization CI with the average for the period =100 and a standard deviation of 10. As a result, the HSE ESI values about 100 mean the 'normal' (neutral) sentiment in business environment, notably higher than 100 – favorable and optimistic, markedly below 100 – depressive, crisis mood. Considering the timeliness of HSE ESI (1.5-2 months before publication of the GDP official statistics), its analysis can be very useful for short-term assessing the Russian economic development.

We empirically study HSE ESI and GDP, and test their cyclical sensitivity. We estimated short-term cyclical components with a smoothed amplitude (SSC) of both CI and the reference indicator.

According to the described above algorithm, the first step of the procedure is graphical comparison of HSE ESI and GDP, and calculation of the cross-correlation coefficients. They revealed statistically significant, stable comovement, with the correlation coefficient of 0.886 coincident and of 0.820 with the one-quarter lead. As mentioned above, the augmented Dickey-Fuller test identified non-stationarity of these variables with *p*-value 0.73 for GDP growth and 0.58 for HSE ESI that requires checking the final indicators for cointegration. Figure 1 represents the joint dynamics of HSE ESI (seasonally adjusted) and the real GDP index (yoy) for the period Q1 1998 – Q4 2014.

Then, we decomposed the analyzed time series by estimating medium-term cycle (MC) and unsmoothed short-term cycles (USC) with the use of the HP filter for the first time. Parameter λ was equal to 677.130; 1649.327 and 8330.659 for medium-term cycles of 8, 10 and 15 years[7]. Figures 2-5 show the results of this iteration: identified MC and USC of HSE ESI and GDP.

[7] Estimation of 8, 10 and 15 year cycles as a medium-term ones is based on duration of the accumulated BTS results.

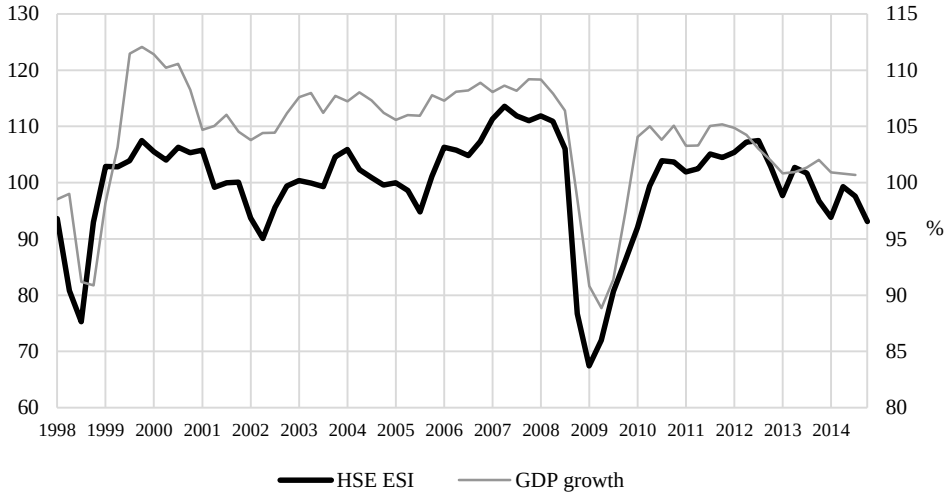


Figure 1. Economic sentiment indicator (HSE ESI, the left scale) and the yearly real GDP growth rate (the right scale, Rosstat data).

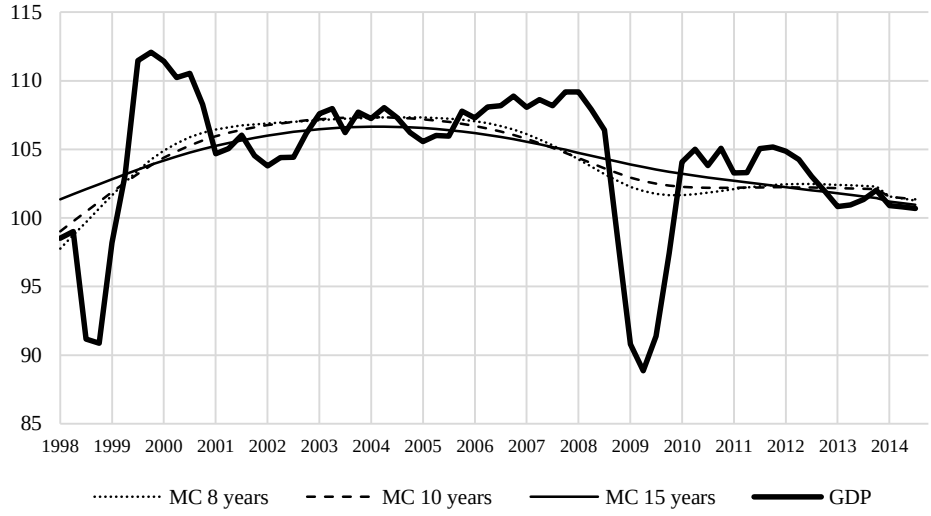


Figure 2. Medium-term cycle (MC) of the real GDP growth rate.

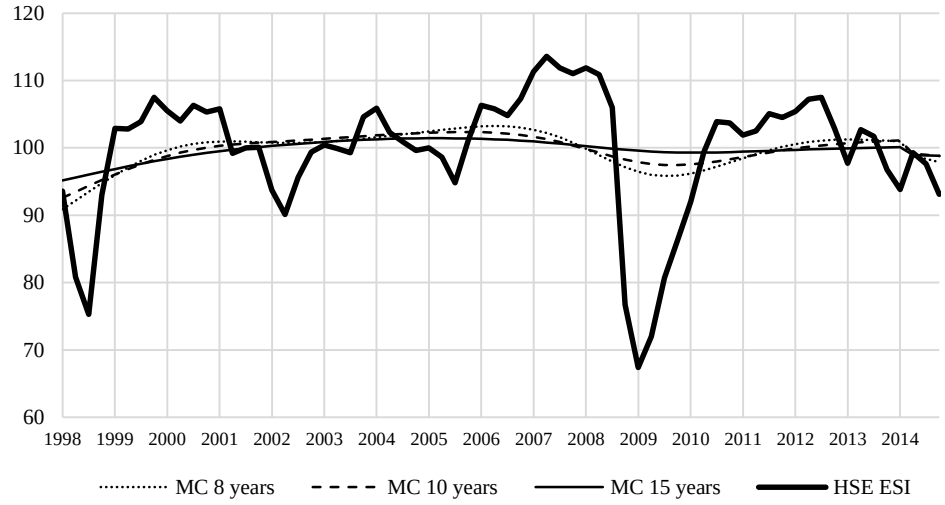


Figure 3. Medium-term cycle (MC) of HSE ESI.

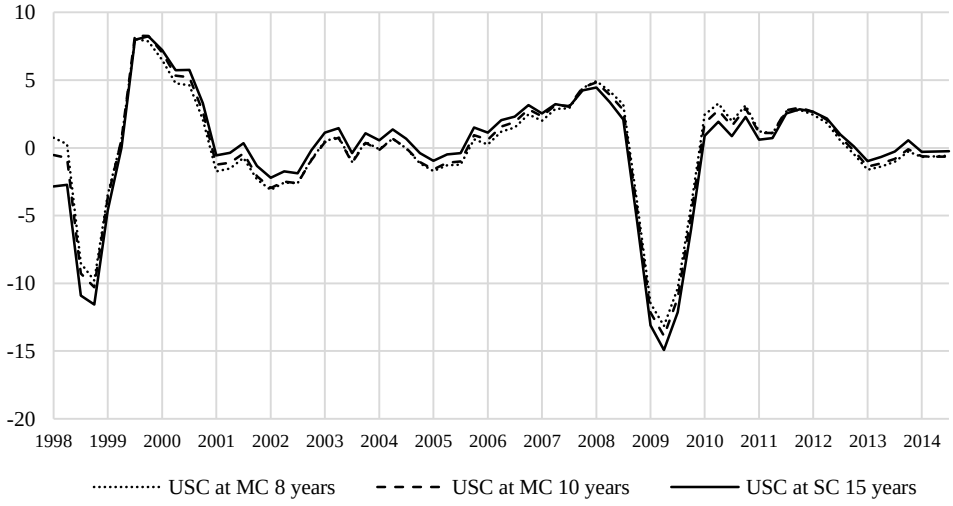


Figure 4. Unsmoothed short-term cycle (USC) of the real GDP growth rate.

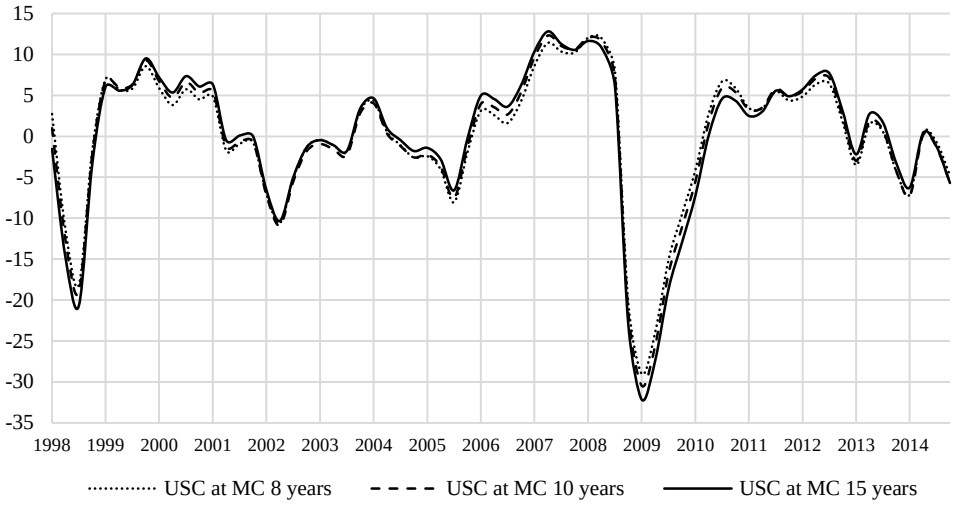


Figure 5. Unsmoothed short-term cycle (USC) of HSE ESI.

The joint decomposition of HSE ESI and the real GDP index and the results of the cross-correlation analysis allow for the identification of the cyclical components that are the most significant for subsequent comparison. These components are USCs, which are the residual left after separating 15-year-long MC from the series. This way, we obtained the highest coincident cross-correlation coefficients (0.989 for HSE ESI, and 0.943 for the GDP index). Based on the results of the cross-correlation analysis of USCs of HSE ESI and GDP, we chose USCs without the 15-year-long cycle removed for the subsequent comparative analysis[8].

Due to non-stationarity of initial data, USCs with eliminated 15-year-long cycle of HSE ESI and the GDP index were tested for cointegration. The results of unrestricted cointegration rank test indicated cointegration of these time series (see Table 2). The test results confirm a long-term equilibrium between the variables, which allows us to draw conclusions about conformity of these indicators cyclical profile based on the correlation coefficients. This also suggests possible inclusion of these variables in regression models for short-term forecasting. Construction of

[8] These steps of the testing algorithm associated with identification of the length of the medium-term cycles are appropriate mainly in primary decomposition of the retrospective dynamics of each indicator. During subsequent identification of short-term cycles phases at the ends of time series, this step can be omitted, while dynamics should be controlled periodically.

forecasting models using HSE ESI and other business tendency surveys indicators is left for our future work, and it is beyond the scope of this study.

Table 2. Unrestricted cointegration rank test (trace)

Hypothesized no. of CE(s)	Eigen value	Trace statistic	0.05 critical value	Prob.**
None*	0.476419	53.13748	15.49471	0.0000
At most 1*	0.146194	10.43135	3.841466	0.0012
Trace test indicates 2 cointegrating equations at the 0.05 level				

* denotes rejection of the hypothesis at the 0.05 level
** MacKinnon-Haug-Michelis (1999) p-values

The next step is the selection of the most comparable smoothing short-term cycle (USC). By Hodrick-Prescott filtering for the second time (parameter λ was equal to 1; 2.914; 6.854), we obtained smoothed short-term cycles (SSCs) of the analyzed series with filtration of the 18-, 24- and 30-month amplitude. Figures 6 and 7 show these components extracted from the original time series by primary filtration of 15-year-long cycles and subsequent smoothing the amplitude corresponding to the specified short-term cycles.

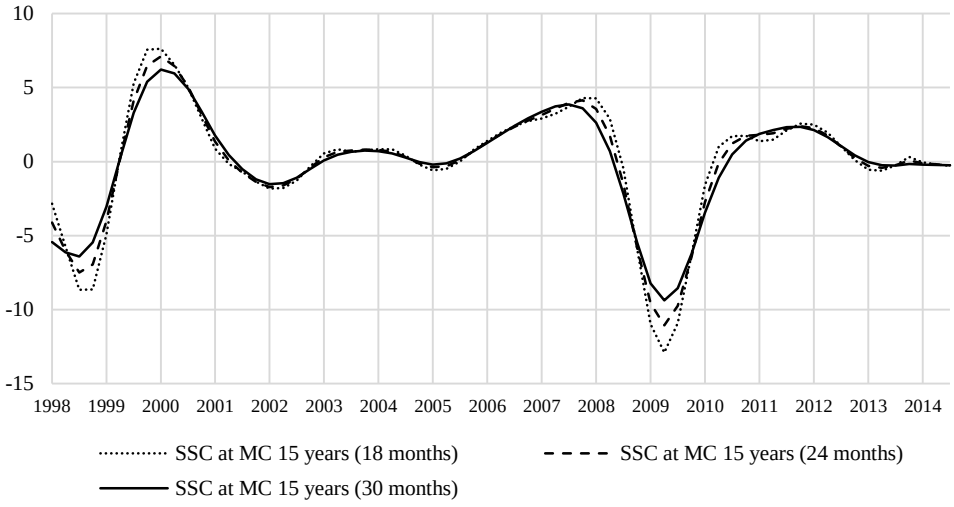


Figure 6. Smoothed short-term cycle (SSC) of the real GDP growth rate.

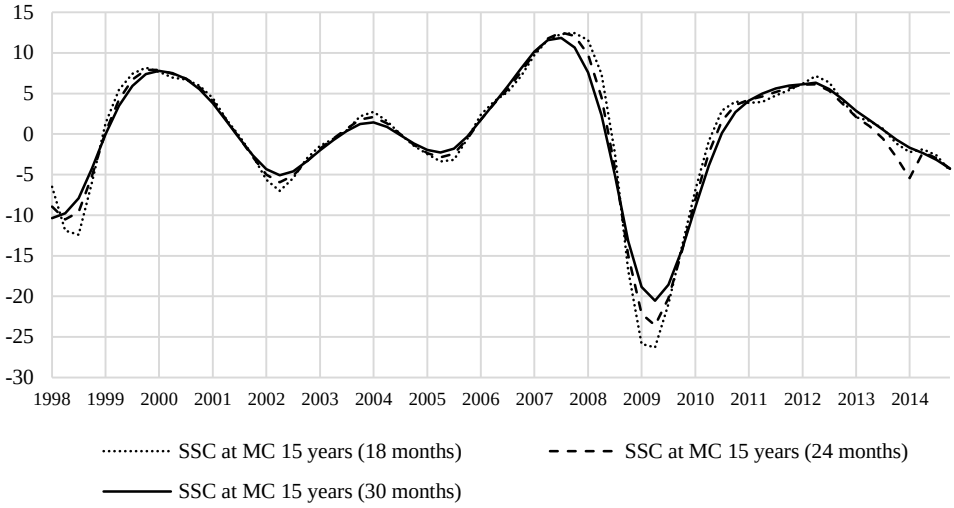


Figure 7. Smoothed short-term cycle (SSC) of HSE ESI.

Then, we calculate the cross-correlation coefficient for SSCs of HSE ESI and the GDP index to find the most stable in time and statistically significant comovement. For the period Q1 1998 – Q4 2014, the cyclical fluctuations within a short interval (on average 2.5 years), with the separated impact of the 15-year-long medium-term cycle, is the most obvious.

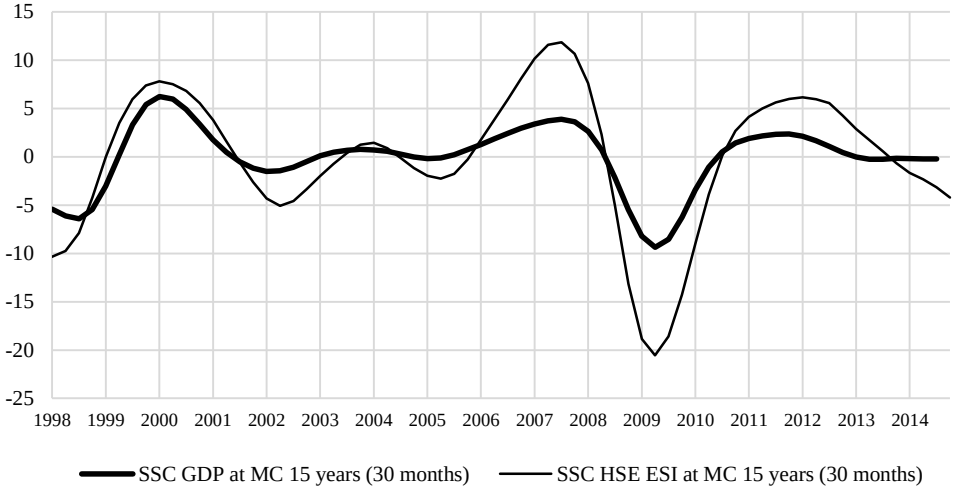


Figure 8. Smoothed short-term cycle (SSC) in the HSE ESI and the GDP growth.

This conclusion is drawn by the highest correlations, statistically significant for coincident and leading up to 2 quarters comovement of SSCs of HSE ESI and GDP: lag (0) with the correlation coefficient of 0.941; lag (-1) with 0.892; and lag (-2) with 0.720.

Finally, we have detected turning points of the smoothed short-term cycle using the Bry-Boschan method (Table 3).

Table 3. Indication of the short-term growth cycles, their phases and turning points in the dynamics of GDP and HSE ESI for the period Q1 1998 – Q4 2014.

Cycles	Phases	GDP growth					HSE ESI				
		Dates of turning points			*Duration (quarters)*		*Dates of turning points*			*Duration (quarters)*	
		Peak	*Trough*	*Peak*	*Phases*	*Cycles*	*Peak*	*Trough*	*Peak*	*Phases*	*Cycles*
I	down	Q2 1997*	-	Q1 2000	5*	11	Q2 1997	-	Q1 2000	3	11
	up	-	Q3 1998	-	6		-	Q1 1998	-	8	
II	down	Q1 2000	-	IV Q 2003	8	15	Q1 2000	-	Q1 2004	9	16
	up	-	Q2 2002	-	7		-	Q2 2002	-	7	
III	down	IV Q 2003	-	Q3 2007	6	15	Q1 2004	-	Q3 2007	5	14
	up	-	Q2 2005	-	9		-	Q2 2005	-	9	
IV	down	Q3 2007	-	Q3 2011	7	16	Q3 2007	-	Q1 2012	8	19
	up	-	Q2 2009	-	9		-	Q2 2009	-	11	
V	down	Q4 2011	Q4 2013	-	13	-	Q1 2012	Q1 2014	-	12	-

* provisionally

The results of the joint procedures for smoothing the amplitude of short-term cyclical components, cross-correlation and dating of turning points mainly provide evidence about:

- the leading cyclical nature of HSE ESI;
- for the period of Q1 1998 – Q4 2014, the predominance in the dynamics of the reference indicator (GDP growth) and the composite indicator (HSE ESI) of the 15-year-long medium-term cycles and

2.5-year-long (on average) short-term cycles. They include four peaks and four troughs with eight phases of different duration (from 9 to 33 months). Maximum deceleration (27 months) is in the cycle II with a peak in Q1 2000 and a trough in Q2 2002;

– the ninth deceleration phase in the growth cycle V began in Q1 2012, after the rapid increase in economic sentiments (according to the BTS data). This phase is in progress now.

In addition, we constructed a tracer to visualize the cyclical character of HSE ESI (Figure 9), especially in the last phase of deceleration (Gayer, 2008; European Commission, 2014b). The Y-axis in such a graphical representation characterizes the level values of time series corresponding to the growth rate, whereas the X-axis shows their quarterly changes (in absolute terms). Thus, the tracer displays both the level and change in the dynamics of the short-term cycle of the business surveys indicators, with the four quadrants corresponding to the following four phases of the cycle:

– quadrant I (upper right; expansion phase) – intensive growth of the indicator at an above-average level (for HSE ESI, this is a phase of high optimism);
– quadrant II (upper left; downswing phase, rotation to recession, growth retardation) – reduced growth of the indicator at an above-average level (for HSE ESI, this is a phase of increasing pessimism);
– quadrant III (lower left; contraction phase, recession, sharp reduction) – decline of the indicator at a below-average level (for HSE ESI, this is a phase of depression, crisis of sentiments);
– quadrant IV (lower right; upswing phase, recovery, upturn) – growth of the indicator at a below-average level (for HSE ESI, a phase of increasing optimism).

The four tracer quadrants correspond to the four cyclic phases and are crossed counter-clockwise. The cyclical peaks are located in the top center of the graph area, whereas the cyclical troughs are situated in the bottom center. In this study, the tracer is constructed to visualize the short-term growth cycles with neutralized influence of the medium-term cycle (15-year long) and the smoothed amplitude to eliminate oscillations.

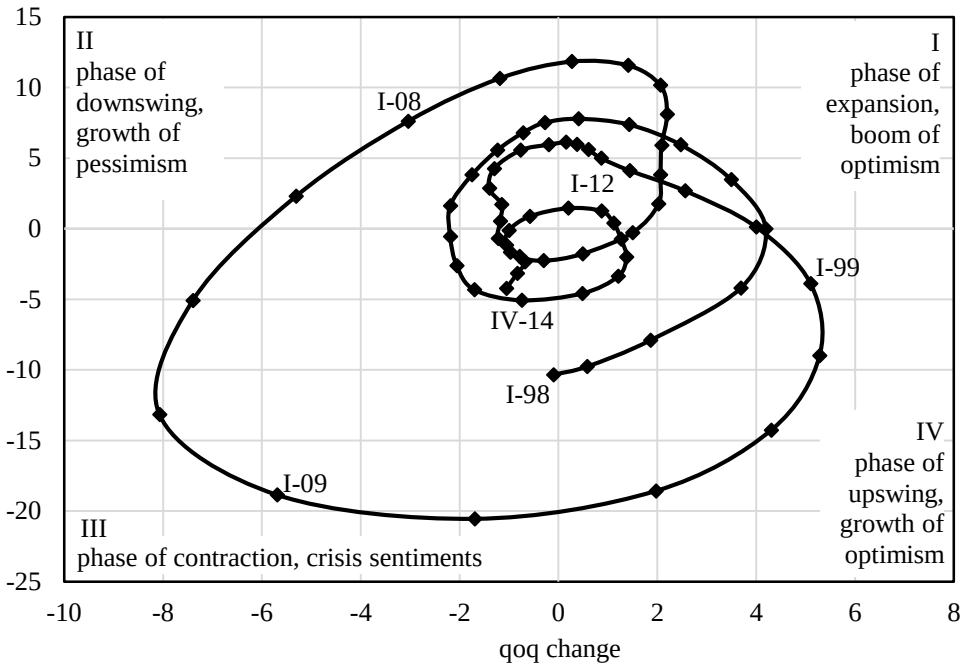


Figure 9. Tracer of the short- term cyclical component of HSE ESI (Q1 1998 – Q4 2014).

The tracer of the HSE ESI short-term cycle recorded almost synchronously all turning points of the GDP short-term cycle. After the beginning of 2012, the HSE ESI cycle entered the downward phase, demonstrating the stable slowdown with equal intensity, characterized by pessimistic economic sentiments of Russian entrepreneurs and consumers. In the beginning of 2014, HSE ESI started to recover, indicating a possible increase of optimism. In the middle of 2014 business and consumer confidence dropped again, and the tracer turned in the opposite direction – economic contraction.

5. Conclusions

The paper explores the ability of Russian BTS results to track the cyclical development of the national economy. The study is focused on the issue: whether the aggregate indicator of business and consumer confidence in Russia conforms to the real economic situation?

First, we constructed an integrated algorithm to test potential qualitative components for aggregation in CI that cover as much as possible all information contained in the sectoral business surveys results. This algorithm

can also be used to test CI for the cyclical sensitivity. Such testing is expedient to determine the feasibility of including CI in the national system of relevant composite short-term cyclical indicators.

Second, by using this algorithm, we investigated the dynamics of the composite economic sentiments indicator (HSE ESI) for its cyclical sensitivity and statistically significant consistency with the short-term cyclical trajectory of aggregate economic activity, represented by the real GDP index. The results allowed us to draw the conclusion of HSE ESI and GDP cyclical comovement in the period from Q1 1998 to Q4 2014 and leading nature of HSE ESI. This makes HSE ESI an indicator of turning points and phases of the GDP growth cycle.

Finally, we visualized the results with the tracer of the short-term cycle of HSE ESI. The tracer recorded almost synchronously all turning points of the short-term GDP cycle. The study shows that Russian business surveys data is capable to measure efficiently the cyclical development of the national real economy.

References

Bry, G., Boschan, C. (1971). *Cyclical analysis of time series: Selected procedures and computer programs*. NBER Technical Paper 20.

Chauvet, M., Hamilton, J. D. (2005). *Dating business cycle turning points*. NBER Working Paper No. 11422.

European Commission (2014a). *The joint harmonised EU programme of business and consumer surveys. User guide*. URL: http://ec.europa.eu/economy_finance/db_indicators/surveys/documents/bcs_user_guide_en.pdf (usage date: 10.03.2015).

European Commission (2014b). *European business cycle indicators*. URL: http://ec.europa.eu/economy_finance/publications/cycle_indicators/2014/pdf/ebci_2_en.pdf.

Fulop, G., Gyomai, G. (2012). *Transition of the OECD CLI system to a GDP-based business cycle target*. URL: http://www.oecd.org/std/leading-indicators/49985449.pdf (usage date: 10.04.2015).

Gayer, C. (2008). *Report: The Economic Climate Tracer. A tool to visualise the cyclical stance of the economy using survey data*. URL: http://ec.europa.eu/economy_finance/db_indicators/surveys/documents/studies/economic_climate_tracer_en.pdf (usage date: 14.03.2015).

Kitrar, L., Lipkind, T., Ostapkovich, G. (2014). Decomposition and joint analysis of growth cycles in time series of the Economic Sentiment Indicator and the Gross Domestic Product. *Voprosy statistiki* (*Statistical Issues*), 9, 41-46 (in Russian).

Kitrar, L., Ostapkovich, G. (2013a). Special features and implementation of the indicator approach to cyclical monitoring of economic dynamics. *Voprosy statistiki* (*Statistical Issues*), 8, 42–50 (in Russian).

Kitrar, L., Ostapkovich, G. (2013b). Integrated approach to construction of composite indicators with built-in algorithm for cycle evaluation in time series of the business tendencies monitoring results. *Voprosy statistiki* (*Statistical Issues*), 12, 23–34 (in Russian).

Kitrar, L., Pogosova, L., Nilsson, R. (2003). *Business cycles and cyclical indicators in Russia*. URL:http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=CCNM/STD(2003)2&docLanguage=En (usage date 20th Aug 2014).

Mitchell, J., Smith, R. J., Weale, M. R. (2002). *Aggregate versus disaggregate survey-based indicators of economic activity*. National Institute of Economic and Social Research Discussion Paper, 194.

Lucas, R. E. (1981). *Studies in business cycle theory*. Cambridge, Mass.

Nilsson, R., Guidetti, E. (2008). Predicting the business cycle. *Statistics Brief*, 14, 1-14.

Nilsson, R., Gyomai, G. (2011). *Cycle extraction. A comparison of the PAT method, the Hodrick-Prescott and Christiano-Fitzgerald filters*. URL: http://www.oecd.org/std/leading-indicators/41520591.pdf (usage date 10.03.2015).

OECD (2014a). *Main economic indicators (MEI)*. URL: http://www.oecd.org/std/oecdmaineconomicindicatorsmei.htm (usage date 20.05.2015).

OECD (2014b). *The OECD economic outlook*. URL: http://www.oecd.org/eco/economicoutlook.htm (usage date 20.05.2015).

OECD (2012). *System of composite leading indicators*. URL: http://www.oecd.org/std/leading-indicators/41629509.pdf (usage date 20.05.2015).

OECD (2008). *Handbook on constructing composite indicators*. URL: http://www.oecd.org/std/leading-indicators/42495745.pdf (usage date 20.05.2015).

OECD. (2003). *Business tendency survey. A handbook*. URL: http://www.oecd.org/std/leading-indicators/31837055.pdf (usage date 15.04.2015).

Smirnov, S. (2001). A system of leading indicators for Russia. *Voprosy Economiki* (*Economic Issues*), 2, 23-42 (in Russian).

Smirnov, S. (2006). *A new system of leading indicators for Russia*. 28th CIRET Conference paper, Rome. URL: http://www.hse.ru/data/2012/05/31/1252356146/48.pdf (usage date 15.05.2015).

Smirnov, S. (2014). Russian cyclical indicators and their usefulness in real time: an experience of the 2008-09 recession. *Journal of Business Cycle Measurement and Analysis*, 1, 103-128.

Stock, J. H., Watson, M.W. (2010). *Estimating turning points using large data sets*. NBER Working Paper 16532.

Robert Pater[‡]

The UK business cycle and the structure of the economy

Abstract

It is widely known that various sectors of an economy may react differently to the business cycle, and, on the other hand, it may be affected by sector-specific shocks. Not much light has been shed so far on the impact of the business cycle on the structure of an economy, and *vice versa*. This study models and empirically tests the relationship, using data on the United Kingdom economy, 1963Q1-2011Q4. The structure of the economy is analyzed taking into account gross value added and employment in NACE Rev1.1 sections (6-branch division). Gross value added is additionally analyzed from the expenditure point of view. The unobserved component model and SVAR/SVEC models are used. The business cycle is found to influence and be influenced by the structure of the economy. Some effects may persist longer than one cycle, affecting the long-run path of the economy.

Keywords: business cycle, economy structure, sectoral cycle, sectoral comovement

JEL Classification: E32

[‡] University of Information, Technology and Management in Rzeszów, Department of Macroeconomics

rpater@wsiz.rzeszow.pl

1. Introduction

Business cycles are commonly viewed as short-run fluctuations around the trend, lasting 1.5-8 years (Baxter and King, 1999). On the other hand, changes to potential GDP or natural unemployment etc. are considered as changes in the long-run trend. Such business cycles are called deviation cycles (Zarnowitz & Ozyildirim, 2006) or growth cycles (Mintz, 1969). They can be extracted with the use of *ad hoc* filters or unobserved component models (see e.g. Mills 2003). However, both short-run and long-run fluctuations may interfere with each other. This is the case of classical cycles (Burns & Mitchell, 1946), which are analyzed without prior detrending, and are longer and more profound than the growth cycles. They are carefully dated mainly by the National Bureau of Economic Research, and follow the definition of recession being 'a significant decline in activity spread across the economy, lasting more than a few months, visible in industrial production, employment, real income, and wholesale-retail trade' (Leamer, 2008). Severe recessions or crises may have long-lasting influence on the real economy in addition to having an impact on its structure. This type of a business cycle more accurately corresponds to the real business cycle (RBC) endogenous short-run fluctuations in which the trend and the cycle are caused by the same factors and may possibly influence each other (see e.g. Fukuda, 2008). Not only recessions may have a severe impact on the economy, as steep expansions may cause faster capital accumulation, technology improvement or labor force changes which raises the long-run trend. These factors may also cause changes in the structure of an economy like changes in the propensity to invest and consume, the labor force participation rate and, eventually, shifts in the sectoral contribution to GDP and employment. Such changes can also be effected by the fact that various sectors of the economy are leading or lagging.

There have been numerous analyses of business cycles but the question remains open as to the effects they have on the structure of an economy. This article raises the following question: Is there any relation between the business cycle and changes in the structure of the economy? To answer this question the United Kingdom economy is analyzed in the period 1963Q1-2011Q4. The structure of the economy is presented in two areas: gross value added and employment distributed according to NACE Rev1.1 sections (6 branches). Gross value added is additionally analyzed from the expenditure point of view. The interdependence of economic fluctuations and structural changes is tested and modeled. The paper is structured as follows. Section I contains literature review. Modeling strategy is explained in Section

II. In Section III data and limitations of the analysis are presented. Section IV follows with discussion of the results, and Section V finally concludes.

2. Literature review

Real business cycle models, while typically assuming homogenous sectors of the economy, pose strong cyclical comovement between them (Hornstein, 2000). Long and Plosser (1983) demonstrate that under standard RBC assumptions comovement between sectors is a result of the propagation mechanism (decision rules and production technology), not a common (serially correlated) shock or shocks. However, Rebelo (2005) claims that 'comovement properties of business cycle models are an important, but under-researched, topic in macroeconomics'. New monetarist models account for the heterogeneity of production and service sector (Alexopoulos, 2007). According to the Austrian economists, the heterogeneity of the economy is an important factor behind the cyclicality of investments (see e.g. Mulligan, 2002). The sectoral heterogeneity due to different sectoral marginal costs and relative prices is one of the challenges faced by New Keynesian economists in achieving a better explanation for the business cycle (Saroliya, 2007). As a matter of fact, the majority of New Keynesian analyses found heterogeneity in price durations across sectors and types of goods (Galí, 2008).

There are various empirical analyses of the cyclicality of economies from the expenditure point of view. Lucas (1977) shows that production of (producer and consumer) durable goods is more volatile than that of nondurable goods, agriculture exhibits less volatile cycles, and business profits are more procyclical than other profits. Hornstein and Praschnik (1997) and Tang (2007) confirm the result of higher volatility of cyclical fluctuations for the durable goods sector than the nondurable goods sector, and found it also for employment. Kydland and Prescott (1990) report that in the US economy during the period 1954-1989, consumption and investments were coincident with GNP, with higher correlation between investments and GNP. They also found that exports were lagging and moderately correlated, and that imports were coincident and highly correlated with GNP. Both consumer durable and nondurable products as well as services were procyclical, with the exception of acyclical government purchases. They did not find, however, any appealing differences in the cyclicality of these types of goods. Inventories were less correlated with GNP than fixed capital investment. Burda and Wyplosz (2000) find importing procyclical, and government consumption acyclical. Backus *et al*. (1992) and Backus and Kehoe (1992) find that consumption of nondurable goods is approximately 0.5 less volatile than output. They also observe slightly countercyclical

behavior of net exports. According to them, it is mainly expenditure of durables that increases the volatility of consumption – without them, the cyclicality is of even lower amplitude. Blackburn and Ravn (1992) confirm the results for the types of goods for the UK economy. Canova (1998) uses different methods to check the volatility of consumption and investment, and finds that the cyclical component of the former accounts for 34%-98% of output variability, and for the latter the figure is 216%-672%. He also demonstrates that if a cyclical shock to US GNP occurs, it affects investments and consumption at approximately the same time and, again, investments are much more volatile. Perez (2001) concludes that in major European economies exports are procyclical and coincident, and its cyclical component is more volatile than output (by 1.7 to 3 times higher). He also finds industrial production to be strongly procyclical, coincident and more volatile than GDP. Its cyclical component accounts for 1.7-2.8 times higher amplitude than that of output. He notes that the service sector is more stable than the industrial sector. Montgomery (2006) analyzes the lagged response of investment spending to changes in its determinants and explains it by the heterogeneity of capital goods.

Going deeper into the sectoral breakdown of an economy, we know that the majority of business sectors are synchronized by gross value added and employment over the business cycle, but their productivity exhibits weak correlation. This phenomenon is called a comovement puzzle (Veldkamp and Wolfers 2007). Shea (2002) and Basu *et al*. (2006) find that in the US economy the majority of aggregate output fluctuations is a result of industry comovement, while the rest is due to changes in total factor productivity. The importance of sector-specific shocks is underlined by Stockman (1988) and Durlauf (1989). The latter argues that technological shocks may not be the same in all sectors. Engle and Issler (1995) show that sectoral cycles in the US economy are almost identical in timing and seem to share a common component. However, business cycles generating transitory shocks are the most important for manufacturing and trade. Caporale (1997) studies UK sectoral shocks, and finds limited evidence for an impact of asymmetric shocks, although sufficient evidence is found for the impact of aggregate shocks on the sectors of the economy. Hughes (1997) shows various industries exhibit different behavior in the business cycle. Harvey and Mills (2002) analyze UK sectoral output, and find significant transitory shocks in manufacturing and construction and prevalent permanent shocks in agriculture and services. They also note that manufacturing and the sectors of electricity, gas and water supply are cyclically coincident, services are characterized by cycles with a significantly smaller amplitude, and

construction and agriculture cycles differ significantly from the others. The cycles of mining and quarrying and, to a lesser degree, agriculture, behave countercyclically and exhibit large amplitude. Studies for Korea confirm the general findings for other countries that manufacturing is leading in the business cycle, especially in heavy and chemical industries (Yang & Kim 2005). Skrzypczyńska (2012) points that the patterns of the sectoral cycles in Poland differ from each other. Pater (2011) shows that employment lags in comparison to GDP.

Cheung and Westermann (2003) reach inconclusive results on the interactions between various sectors of the German economy in the short and long run. Using seasonally adjusted time series, they find the limited long-run relationship between the output of manufacturing, mining and agriculture and GDP, and considerable evidence of short-run interactions. In the case of seasonally unadjusted time series, they present quite opposite findings. Eickmeier (2007) indicates sectoral transitions between cyclical fluctuations across countries, with the examples of the USA and Germany. Cheng (2011) finds evidence that the new-firm formation rate over the business cycle is different across states and sectors in the USA, and that in the US economy the national share of new firms is the highest (in comparison to the regional one), implying that the business cycle may be the key factor behind firm formation. However, the latter conclusion was not the case of the UK economy (see Ashcroft *et al*., 1991). Buch and Lipponer (2005) find different, for the most part negative, effects of the world business cycle on German sectors. Mulligan (2002) analyzes the relationship between employment in production sectors and government security interest rates in the US economy. He observes different reactions of employment in different stages of production: a positive relationship between interest rates and sectors representing the late stage of production (countercyclical sectors), and a negative relation for the early stage of production sectors (procyclical sectors). Cubadda *et al*. (2002) find long-run relationships between some of sectors of the Italian economy, hence challenging the RBC assumption of independent sectoral productivity shocks. They find however weak evidence of any short-run relationships. Liu and Spector (2005) argue that non-production employment changes lag over the business cycle, and its amplitude is smaller than in the case of production workers. Finally, Jaimovich and Siu (2012) indicate the direct impact of business cycle phases, i.e. recession and jobless recoveries, on the structure of the labor market, i.e. job polarization. This is a visible example for the importance of the relationship between the business cycle and the structure of an economy. Recent studies by Burren and Neusser (2013) conclude that approximately

30% of the decline in US GDP volatility observed over the period 1949-2005 was due to the shift of production to services. This indicates a relation between business cycle properties and long-run sectoral shifts.

It may therefore seem that much has been said about the cyclicality of sectors of an economy. It is not however clear how the business cycle affects its structure. This article is aimed to analyze changes of the structure of an economy over the business cycle, their causes and effects. In this article testing and modelling procedures are applied which have some advantages over more popular *ad hoc* filtering techniques.

3. Modelling strategy

To analyze the dynamic relationship between the business cycle and the structure of the UK economy, a vector autoregressive (VAR) model is used which takes the following reduced form:

$$\begin{bmatrix} Y_t \\ \psi_t \end{bmatrix} = \delta + \sum_{i=1}^{j} A_i \begin{bmatrix} Y_{t-i} \\ \psi_{t-i} \end{bmatrix} + Dt + \begin{bmatrix} \upsilon_{Y,t} \\ \upsilon_{\psi,t} \end{bmatrix} \tag{1}$$

where Y_t is a vector of $n-1$ shares of components of GDP or employment (the main components of GDP are determined by an expenditure category or NACE branches, and employment components are determined by the NACE branches), δ is a deterministic terms vector, t is a vector of deterministic trend components, while A_i and D are matrices of parameters of endogenous and time trend variables, respectively, and v_t is an n-dimensional zero-mean process with positive and definite covariance matrix Σ_v. The purpose of the deterministic trend component is to test whether long-run changes occurred in the structure of the UK economy. Because only stationary time series should remain in the model (1), it is impossible to include a stochastic trend[1]. ψ_t is an unobserved business cycle estimated with the use of an unobserved components model in the form (Harvey, 1989):

$$y_t = \mu_t + \psi_t + \varepsilon_t, \qquad \varepsilon_t \sim N(0, \sigma_\varepsilon^2), t = 1, \dots, T, \tag{2.1}$$

where y_t is UK GDP, μ_t is a local linear trend consisting of a stochastic level and a slope (drift) of a signal, and representing the stochastic long-run trend:

[1] Constructing a VAR model with non-stationary time series causes serious problems because of the unit roots they contain. The most appropriate situation seems to be when there are as many cointegrating vectors as endogenous variables in the system (see Seddighi *et al*., 2000).

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t, \qquad \eta_t \sim N(0, \sigma_\eta^2) \tag{2.2}$$

$$\beta_t = \beta_{t-1} + \xi_t, \qquad \xi_t \sim N(0, \sigma_\xi^2), \tag{2.3}$$

and ψ_t is a stochastic cycle:

$$\begin{bmatrix} \psi_t \\ \psi_t^* \end{bmatrix} = \rho \begin{bmatrix} \cos\lambda_c & \sin\lambda_c \\ -\sin\lambda_c & \cos\lambda_c \end{bmatrix} \begin{bmatrix} \psi_{t-1} \\ \psi_{t-1}^* \end{bmatrix} + \begin{bmatrix} \kappa_t \\ \kappa_t^* \end{bmatrix}. \tag{2.4}$$

In the above model, the irregular ε_t, level η_t and slope ξ_t disturbances are mutually independent. κ_t and κ_t^* are also mutually independent Gaussian white-noise disturbances with zero means and common variance σ_κ^2. λ_c is a cycle frequency in radians with a period of $2\pi/\lambda_c$, and ρ is a damping factor, for which higher values represent the sharper spectrum peak of the cycle. With $\rho \neq 1$ and $\sigma_\kappa^2 \neq 0$, the cycle is stochastic with a changing amplitude and phase. The goodness of fit of the unobserved components models was evaluated on the basis of prediction error variance and the R_D^2 coefficient. The former is the variance of one-step-ahead prediction errors measured in the steady state. The latter is a variant of the coefficient of determination and informs how much information is gained by the model in comparison to a random walk (in the case of a random walk model $R_D^2 = 0$).

According to the frequency response function, the estimator (2.4) is much more accurate in business cycle extraction than the differences of logarithms of GDP (Harvey, 1989). *Ad hoc* filters such as the Hodrick-Prescott (HP), Baxter-King (BK) or Christiano-Fitzgerald (CF) filters can also be applied to extract short- and long-run components of UK GDP. However, it is not recommended if the component is then used for further modeling, as it does not give any information on statistical inference.

The analysis is performed on seasonally adjusted data. To build model (1), a sequential testing procedure is used. The augmented Dickey-Fuller test with GLS detrending (ADF-GLS) is used to test for the unit roots in time series, while the KPSS test is applied to test for stationarity and confirm the results of the previous test. Both tests are said to have more power than the traditional augmented Dickey-Fuller test. The automatic lag-length selection procedure for the ADF-GLS test is applied. The lag-length depends on the significance of the last lag. Lag truncation for the KPSS test is 4. Because the article addresses the structure of the economy, it is crucial to test for possible structural breaks. As Perron (1989) states, they may cause a bias in the standard unit root tests toward the acceptance of the unit root hypothesis.

Similar to the suggestions in Perron (1997), three types of exogenous structural breaks in every time series are tested: the level change, slope change and additive outlier. The Saikkonen and Lütkepohl (2002) and Lanne *et al*. (2002) tests are used to confirm the hypothesis of a unit root in the case of the variables thus far found to be non-stationary in which the intervention analysis indicated a structural break. In the case of non-stationary time series, the Johansen trace test is used to test for a number of cointegrating relations. This gives a model that is a kind of a VAR model on differences, a vector error correction (VEC) model on differences and a VAR model on levels (see Seddighi *et al*., 2000). Next, information criteria are used to choose the optimal endogenous variables lag length *j*.

One way to include the non-stationary and cointegrated variables in the model is a VEC model developed by Lütkepohl (2005). It is of the form:

$$\begin{bmatrix}\Delta Y_t \\ \Delta\psi_t\end{bmatrix} = \tau + \Pi\begin{bmatrix}Y_{t-1} \\ \psi_{t-1} \\ F_{t-1}\end{bmatrix} + \sum_{k=1}^{p-1}\Gamma_k\begin{bmatrix}\Delta Y_{t-k} \\ \Delta\psi_{t-k}\end{bmatrix} + \begin{bmatrix}\upsilon_{Y,t} \\ \upsilon_{\psi,t}\end{bmatrix}, \tag{3}$$

where $\Pi = \sum_{k=1}^{p} \mathrm{A}_k - I$, $\Gamma_k = -\sum_{l=k+1}^{p} \mathrm{A}_l$, $\Pi = \alpha\beta'$, α is a loading matrix, β is a cointegrating matrix, and both matrices have $n \times r$ dimentions with r as the cointegrating rank, and F_{t-1} is a vector of deterministic variables in the cointegrating equation, which may consist of a linear trend and a constant. τ, Γ_k, Π and E are parameter matrices.

In the VAR or VEC model building causality tests is applied to reveal instantaneous as well as lagged dependence. Two types of causality are tested: the instantaneous as well as Granger-causality, with the use of the methods proposed by Toda and Yamamoto (1995) as well as Dolado and Lütkepohl (1996). The results not only reveal information on the dependence between the business cycle and the structure of the UK economy, but also are used to impose specific instantaneous and long-run restrictions on the structural matrices of the models.

The structural restrictions imposed on the models are based on the Blanchard and Quah (1989) and Lütkepohl (2005) methods. As main emphasis has been put to short-run analysis, long-run restrictions are mostly used to identify models, with some noticeable exceptions. It assures that the short-run analysis is not biased by any assumptions. The innovation to the cyclical component of GDP in every model is interpreted as 'pure' cyclical shock. Innovations to the shares of GDP or employment are interpreted as sectoral shocks.

4. Data

The data come from the Eurostat database. Quarterly GDP for the period 1963Q1-2011Q4 and its components are taken as seasonally adjusted and adjusted by working days given in millions of pounds in chain-linked volumes. The structure of the economy is analyzed in two areas: goods market and labor market. The demand side of the goods market breaks down into final consumption expenditure, gross capital formation, and exports and imports of goods and services. The supply side is categorized by NACE Rev1.1 sections into:

- agriculture and fishing,
- industry (except construction),
- construction,
- wholesale and retail trade,
- hotels and restaurants and transport,
- financial intermediation and real estate,
- public administration and community services, and
- activities of households.

The reference years are 2005 and 2000 for the demand and supply time series, respectively. The labor market is addressed based on the NACE Rev1.1 sections too. To analyze the structure of the economy, not the level of variables, all components of GDP and employment are transformed into percentages.

The results of unit root and stationarity tests displayed in Table 1 indicate that GDP and nearly all of its components are I(1). There are some differences in the results of both tests that require a comment. The KPSS stationarity test indicates that the shares of employment and gross value added in public administration are trend-stationary. According to the ADF-GLS test they have unit roots. The standard ADF test confirms that the former is a trend-stationary I(0) process and the latter is a non-stationary I(1) process. This test also confirms the results of the KPSS test, in contrast to the ADF-GLS test, that consumption expenditure as a percentage of GDP is stationary. In addition, the KPSS test results, indicating that the percentage of employment in construction is I(1), is also confirmed by the standard ADF test. All non-stationary time series prove to have one unit root, i.e. to be I(1) processes according to the KPSS test. However, the ADF-GLS test states that some of them, including GDP, have more than one unit root, although the ADF test does not confirm this, indicating on $p = 1\%$ that all of the problematic time series are I(1). Moreover, checking for I(2) also fails, indicating integration of a higher order. This is strange as, since the work of

Dickey and Fuller (1979), it has been widely accepted that GDP has one unit root. Our result could be due to the occurrence of structural breaks. Having accounted for a structural break in 1973Q1 (see also Section 5), GDP proves to be I(1). In the case of other variables, accounting for a structural break do not change the result of the test, although in the case of expenditure components of GDP the test indicates this break is statistically significant.

Table 1. Unit root and stationarity tests.

Time series	Test statistic					Level of integration
	ADF-GLS H_0:Y~I(1)	ADF-GLS H_0:dY~I(1)	KPSS H_0:Y~I(0)	KPSS H_0:dY~I(0)	Level shift H_0:Y~I(1)	
GDP	1.43	-0.28^{ADF}	3.90	0.19*	-0.64	I(1)
Cycle	-6.43***	-	0.05*	-	-	I(0)
$G_{consumption}$	-0.61^{ADF}	-0.33	0.14*	-	-	I(0)
$G_{capital}$	-0.34	-0.20^{ADF}	1.42	0.08*	-2.70* (1973Q1)	I(0)
$G_{foreign\ trade}$	-1.57	-1.13^{ADF}	2.07	0.07*	-1.70	I(1)
$G_{agriculture}$	-0.37	-2.45**	2.15	0.14*	-0.63	I(1)
$G_{industry}$	3.09	-3.97***	3.07	0.35**	0.54	I(1)
$G_{construction}$	0.13	-0.93^{ADF}	2.21	0.14*	-2.46	I(1)
G_{trade}	1.05	-3.52***	3.07	0.25*	0.21	I(1)
$G_{financial\ services}$	2.37	-1.66*	3.24	0.22*	0.99	I(1)
$G_{public\ services}$	$0.23^{ADF(*t)}$	-4.26***	$0.15^{**.\ t}$	-	-	$I(0)^t$
$L_{agriculture}$	-0.32	-1.02^{ADF}	2.40	0.19*	-0.56	I(1)
$L_{industry}$	0.14	-2.65***	2.53	0.69***	-2.35	I(1)
$L_{construction}$	$-2.29^{**.\ non}$	$-^{ADF}$	0.76	0.13*	-2.54	I(1)
L_{trade}	-0.29	-8.32***	1.84	0.73***	-1.04	I(1)
$L_{financial\ services}$	-0.26	-1.89*	2.62	0.37**	-1.89	I(1)
$L_{public\ services}$	1.68	-2.90***	$0.16^{t.\ non}$	-	-0.44	I(1)

G – gross value added; L – employment; *** stationary at p=0.01; ** stationary at p=0.05; *stationary at p=0.10; ^{t} – trend-stationary; ^{non} – H_0 accepted in the ADF test; ^{ADF} – H_0 rejected in the ADF test with p<0.01; $^{()}$ concerns (details) the superscript given before the parenthesis.

Having confirmed the non-stationarity of almost all of the percentages, it seems obvious that the UK economy has strongly evolved since the 1960s. During this time, its structure changed in a stochastic manner and persistently, i.e. the long-run trend could have affected this structure.

5. Discussion of results

By looking at the structure of the UK economy with NBER recessions (contractions) in the background (Figures 1), we find certain regularities. The majority of them are known as *stylized facts*. Recession was almost always accompanied by a decrease in the share of gross capital formation in GDP, with the exception of the beginning of the 1970s when it slightly increased. In the mid-1970s it decreased by 3.9 percentage points, and in the beginning of 1980 by 2 pps. In the next more than 20 years the impact of recession on capital formation decreased to below 1 pps. In the 2008-2009 recession it decreased again by 4 pps. In addition, to the beginning of the 1970s the share of consumption expenditures increased almost proportionately to the decrease in the share of capital formation during the next two recessions. During the 1980s and 1990s it changed only slightly, while during the 2000s it increased again – by 1.2 and 2.5 pps, respectively. The share of trade balance increased during the recessions in the mid-1970s, early 1980s and 1990s, but the growth became smaller. During the 2008-2009 recession it increased by 1.5 pps, similar to the mid-1970s. During the early 1970s, the second recession of the 1980s and the early 2000s, it decreased.

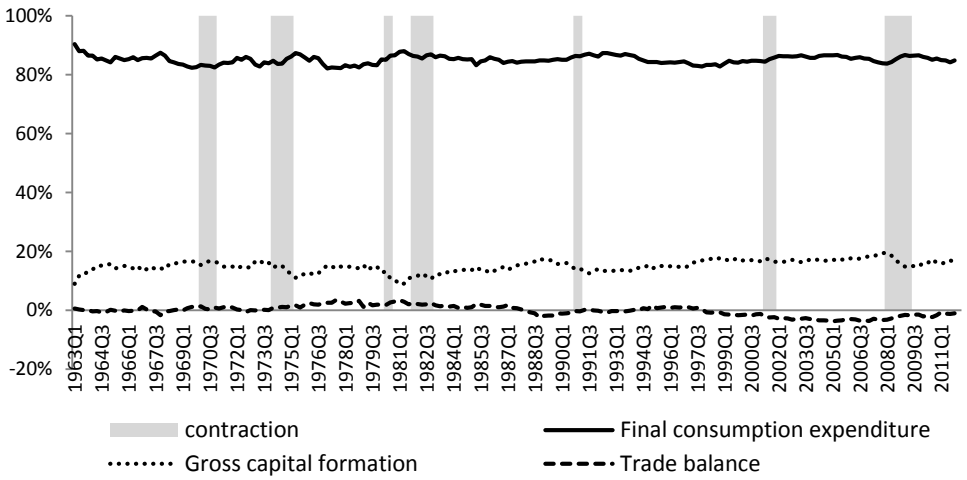


Figure 1. The UK expenditure structure and the NBER contractions.

As for the output structure, the share of industry in gross value added was found to be the most procyclical and largely substituted by public services, which appeared to be clearly countercyclical (Figure 2). The share of trade in GVA was slightly less procyclical, while the share of financial services held its position during recessions, being less countercyclical than

public services. The changes of the shares of industry and public services in GVA were the highest during the 1970s, and then were constantly decreasing, reaching the minimum during the 1990s, and again increasing during the 2000s. These sectors again became more cyclical during the last recession. In the case of trade and financial services such evidence was not found, and the cyclicality of the shares decreased in the beginning of the 1970s. The share of agriculture changed over the business cycle only slightly, showing no sign of the cyclicality.

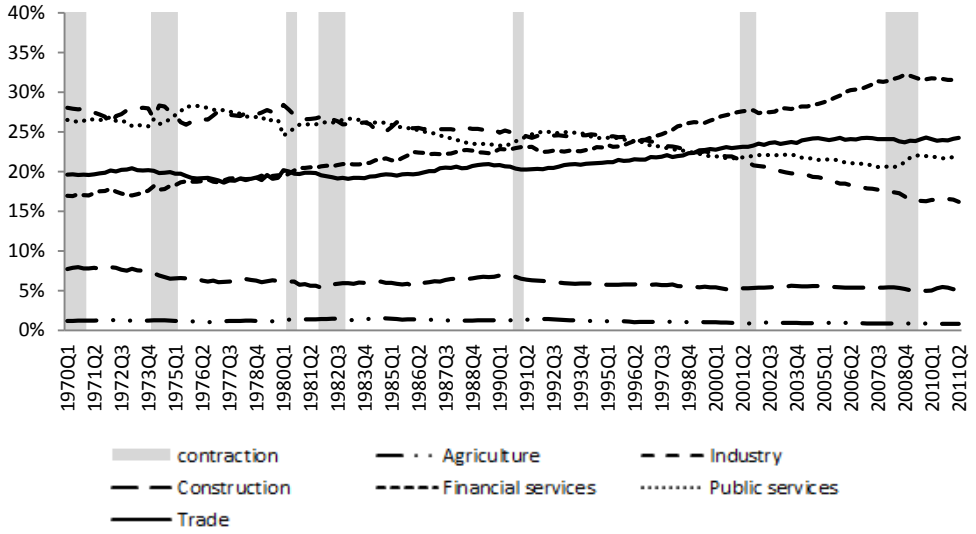


Figure 2. The UK output structure (by GVA) and the NBER contractions.

Raw data do not give any clear indication as to changes of the share of employment across branches of economic activity over the business cycle (see Figure 3). The share of employment in the industry fell over the years, and the importance of financial services grew. There is also an apparent growth of the share of public services, which significantly increased during the 2008-2009 recession, while the employment share of the rest of the branches in GVA decreased (with agriculture being the only exception).

The above picture of the structure of the UK economy gives only a general idea of the impact of recessions, i.e. classical cycles. In the next step, growth cycles were extracted with the use of BK filter. Correlation coefficients between the cyclical components of gross value added (GVA) and employment in sectors did not give any indication of possible leads or lags between them.

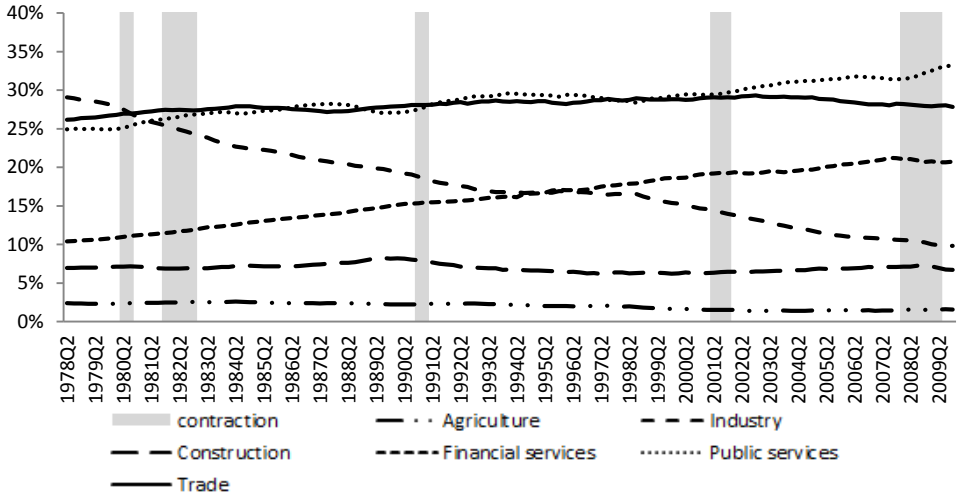


Figure 3. The UK output structure (by employment) and the NBER contractions.

In the first step of the modeling procedure the cyclical component of the UK GDP must be extracted. Because it is I(1), model (2.1) in the general case, i.e. with a stochastic level, slope and cycle, seems to be appropriate. However, several restrictions as well as extensions are also tested. Autoregressive terms are statistically highly insignificant. Higher orders of the slope and cycle are also rejected as insignificant and redundant. Hence, the intervention testing procedure is applied. The results reveal a few statistically significant additive outliers and level breaks. A general-to--specific procedure is applied to find the most suitable interventions. The goodness of fit of Models A-D is compared in Table 2.

Table 2. Comparison of the unobserved components models of UK GDP.

Model	Log-lik.	Prediction error variance	AIC	BIC	R_D^2	H(h)	Q(p,q)
Model A	901.12	9.49e-5	-9.20	-9.10	0.04	0.22	10.67
Model B	914.89	9.05e-5	-9.23	-9.10	0.08	0.28	10.05
Model C	900.56	9.56e-5	-9.19	-9.09	0.03	0.20	10.53
Model D	914.71	7.43e-5	-9.43	-9.29	0.25	0.27	10.05

Notes: model A: local linear trend with stochastic cycle; model B: local linear trend with stochastic cycle and interventions; model C: smooth trend with stochastic cycle; model D: smooth trend with stochastic cycle and interventions. For models A and C, the H(22) heteroscedasticity test critical value is F=2.05 at p=0.05, and for models B and D, the H(21) is F=2.08. Box-Ljung Q(12. 9) serial correlation test critical value χ^2=16.92 at p=0.05.

None of the models exhibit serial autocorrelation and heteroscedasticity of residuals. In all of the models, the standard R^2 coefficient is nearly 1. Models B and D seem the most appropriate according to log-likelihood, prediction error variance. Both information criteria AIC and BIC confirm that the best is Model D. In addition, the R_D^2 coefficient is the highest in this model. Based on this, the Model D estimates of the business cycle are chosen as the most appropriate.

Model A exhibits a 5.15-year cycle (Cycle 1) with frequency 0.31. The coefficient of determination recommended for UCM models by Harvey (1989, chap. 5) $R_D^2 = 0.04$ indicates that this model is only slightly better than a random walk with drift, a basic model describing GDP. The damping factor of the cycle equals 0.98, which means that it is close to a deterministic cycle (Figure 4). The amplitude of the cycle was considerably higher during the period 1960-1985 than later. In the beginning of 1980 it became smaller until the period 2007-2011, the period of the pre-crisis cyclical peak. In 2012Q1 the amplitude of the cycle was 9.26e-4. The estimated variance for the cyclical disturbance was 4.25e-6, while the variance of the irregular was 6.70e-6.

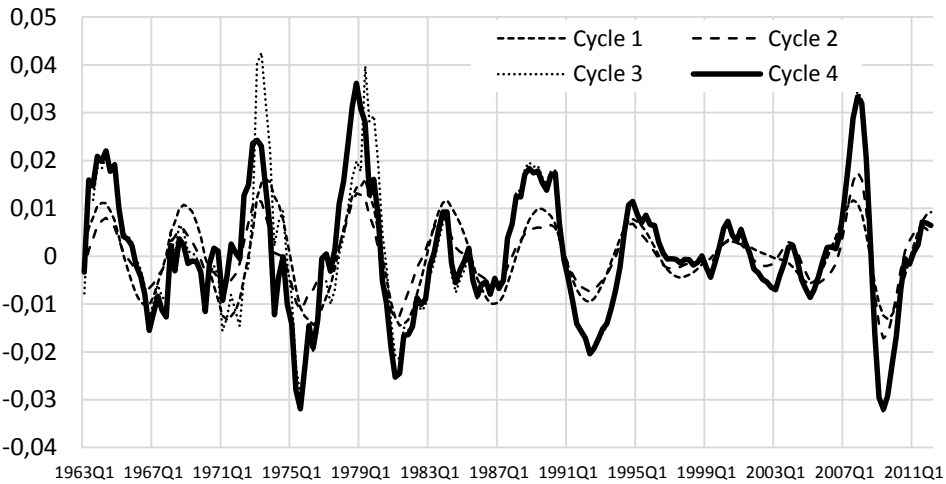
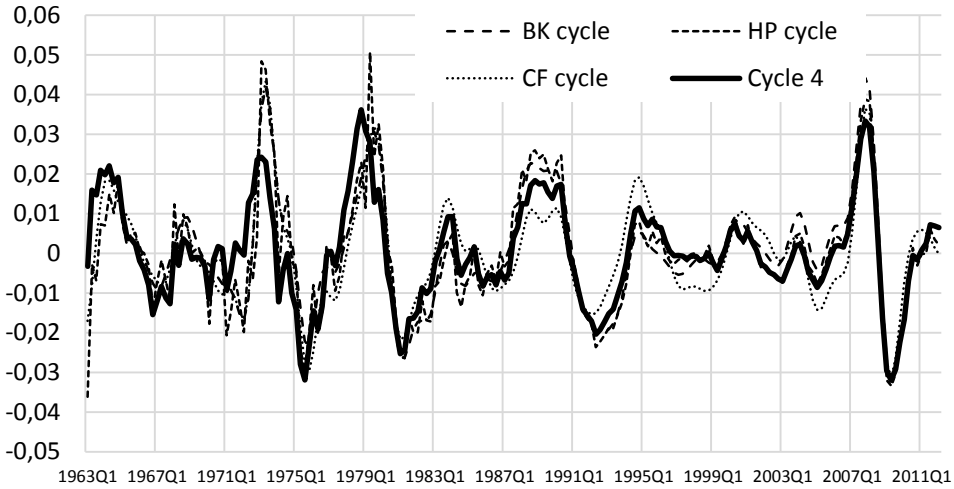


Figure 4. The cyclical component of the UK GDP according to four unobserved components models.

In Model B interventions are tested and modeled. Finally, two statistically significant level changes are accepted. The level increases in 1973Q1 and decreases in 1979Q2. It was a period of high volatility for the UK cycles. The amplitude of Cycle 2 from Model B is smaller than Cycle 1 during the years 1960-2000. In the beginning of 2000 it became higher,

suggesting a higher volatility of the 2007-2009 crisis and pre-crisis period of expansion. The amplitude of the cycle in 2012Q1 equaled 0.01. The variance of cyclical disturbance was, however, two times higher, exceeding the variance of the irregular component. The periodicity of the cycle was found to be a little longer, equaling 5.43 years (0.29 in frequency units), and the cycle became more irregular and less deterministic (damping factor = 0.97).

Of all possible restrictions, the best results are given by imposing $\sigma_\eta^2 = 0$ and a smooth trend with the stochastic cycle (Model C and its variant – Model D – with two interventions introduced into Model B). For both models, the cyclical component is longer than for Models A and B, lasting 6.02 (0.26 in frequency units) for Cycle 3 and 6.32 years (0.25 in frequency units) for Cycle 4. They are also less deterministic, with damping factors of 0.92 for Model C and 0.93 for Model D. The cycles of the 1970s are found to be very volatile according to these models. The variance of disturbance of the cycle is the highest of all of the variances of component disturbances in both models. For Model C it equaled 4.01e-5; for Model D 3.22e-5. In the final period of estimation, 2012Q1, the amplitudes of the cycle are 6.87e-3 and 7.28e-3, respectively.



BK cycle: lag truncation = 12, period = 8-32 quarters
HP cycle: $\lambda = 1600$
CF cycle: asymmetric, GDP assumed I(1) with drift, period = 8-32 quarters.

Figure 4. The cyclical component of the UK GDP: Cycle 4 and *ad hoc* filters.

Cycle 4 can be compared to the most commonly used *ad hoc* filter estimates. Figure 5 shows that all of the cyclical components are quite similar.

In comparison to the HP cycle, the unobserved components cycle is slightly less volatile. The BK and CF estimates are smoother, though similar.

In the second step, three models of type (1) or (3) are built. To estimate the models one sectoral share must be dropped. From the first model trade balance is dropped, because its relation with the business cycle significantly varies in time. During some periods it is positive, while during others – negative. It would require a non-linear model to describe such behavior. From the second and third models agriculture is excluded as a non-cyclical sector. In the case of the model of the expenditure approach (Model 1A), according to the Johansen trace test, all null hypotheses are rejected (see Table 3). This indicates that the VAR model on levels would be appropriate, which confirms the previous tests, as all the variables are stationary. In Model 1B only Cycle 4 and $L_{\text{public services}}$ are stationary. The cointegration test indicates that, with a model including a deterministic trend, there is no stochastic long-run relationship (between the structure of the economy and the business cycle). In Model 1C all variables, with the exception of the estimator of the business cycle, are I(1), and the Johansen trace test indicates the existence of two cointegrating vectors.

Table 3. Johansen trace test for cointegration results.

Model	AIC	BIC	Det. var.	Rank 0 (H_0) [*p*-value]	Rank 1 (H_0) [*p*-value]	Rank 2 (H_0) [*p*-value]
Model 1A	2	2	const, t, 1973Q1	54.16 [0.0001]	25.67 [0.0033]	7.27 [0.0070]
Model 1B	2	1	const, t	102.29 [0.3127]	64.29 [0.7245]	42.01 [0.7755]
Model 1C	2	1	const, t	143.28 [0.0003]	88.30 [0.0522]	48.06 [0.5062]

Model 1A: G_{capital}, $G_{\text{consumption}}$, Cycle 4
Model 1B: Cycle 4, G_{industry}, $G_{\text{financial services}}$, $G_{\text{public services}}$, $G_{\text{construction}}$, G_{trade}
Model 1C: L_{industry}, $L_{\text{financial services}}$, $L_{\text{public services}}$, $L_{\text{construction}}$, L_{trade}, Cycle 4.

In Model 1A, for all instantaneous and lagged types of the causality test, H0 stating that there is no causality is rejected. Thus, the test results do not give any indication of possible structural restrictions. According to the autoregressive part of the model or the model in the reduced form, the business cycle has statistically significant influence on both the capital and consumption to GDP ratios up to the 2nd lag. In addition, both ratios have a significant impact on the cyclical fluctuations of GDP. The deterministic linear trend does not have a significant impact on the system. Thus, a visible

direction cannot be determined for the changes in the variables during the period.

The innovation to the cyclical component of GDP, interpreted as a business cycle shock, resulted in a rise in the share of investments and a fall in the share of consumption. This is understandable because investments are strongly procyclical and consumption is less procyclical. Thus, the structure of the economy changed in favor of capital over the business cycle. However, the reaction of the share of investments and consumption was not instantaneous. It occurred with one-quarter lag. The effects of the shock started to expire after 3 quarters, and after 6 they completely died out (Figure 5). These effects accounted for 4% of the variance of investments and 2% of the variance of consumption.

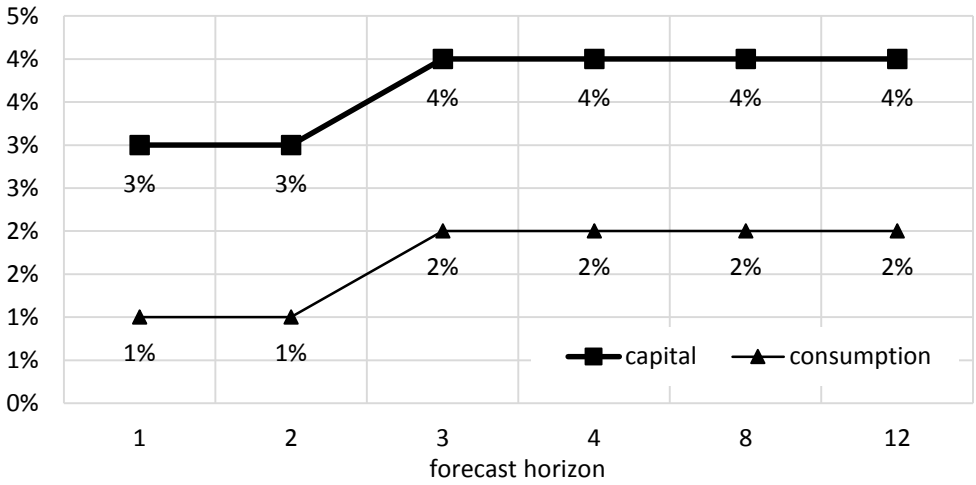


Figure 5. Influence of the business cycle on the variance of investments and consumption.

The changes in the share of investments instantaneously and positively affected the business cycle. The share of consumption affected the business cycle less visibly and negatively but still instantaneously (Figure 6). The effects of the innovation to the share of investments on the business cycle lasted approximately 8 quarters, and the effects of innovation to the share of consumption were expiring very slowly and completely died out after approximately 28 quarters. Therefore, the deficit of investments in relation to consumption over the business cycle can have long-lasting negative effects. The capital share had significant meaning for the business cycle, as it accounted for approximately one-third of the forecast error variance of the business cycle, with the weakest impact in the first quarter after the shock.

The consumption share had some meaning only in the first quarter after the shock; then, the influence was marginal.

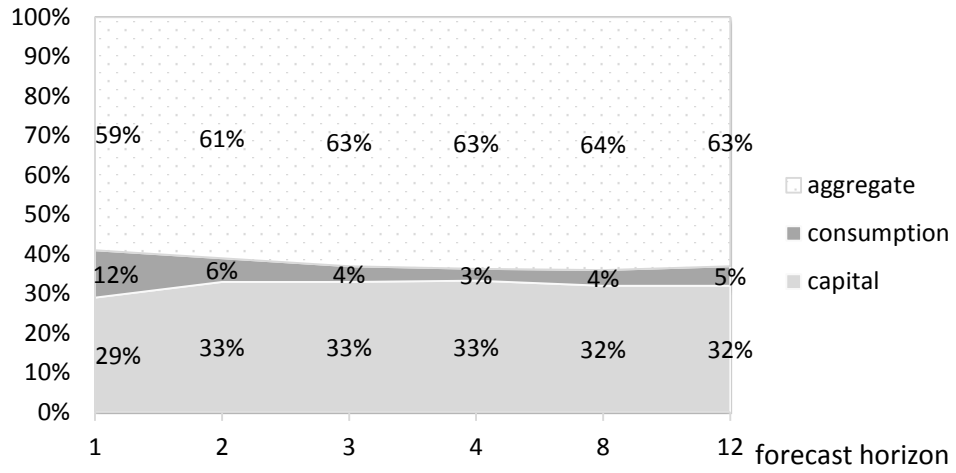


Figure 6. Variance decomposition of the business cycle (by expenditure type).

Next, VAR(2) Model 1B is built on first differences (lag 2 indicates the majority of the information criteria). An instantaneous causality test indicates a relationship between all of the variables in the system. However, the shares of all analyzed branches of the economy do not Granger-cause the others, that is, if the lagged relations are taken into account. Only the cyclical component influences all of them. Having imposed some exclusion restrictions in the reduced form, the model is estimated.

The impact of cyclical fluctuations on the system turned out to be significant for the most part in the short-run. The cyclical shock affected the share of GVA in construction and financial services simultaneously. The effects on construction were the strongest after 4 quarters, and then they died out very slowly (Figure 7). This may indicate that the entrepreneurs noted the changing business cycle phase, but their reaction was distributed in time according to long-run investment outlays and the investment cycle. That is why construction may be seen as a slowly-reacting and sometimes lagging sector. The business cycle explained only up to 5% of the error variance of the GVA share in this sector (Figure 8), because investment-pulled construction is mainly dependent on financial services and industry. The effect of the cyclical shock on financial services was the fastest, though negative. The peak of influence occurred after 1 quarter. The negative effect was a result of the weak cyclicality of this sector. The adjustments of financial services, mainly through monetary policy actions such as an increase in

interest rates, provide fast reactions of these services, but after two years they significantly diminished. The business cycle affected industry to a higher extent than other sectors, with the exception of the long-lasting effects on public services. This is why, in comparison to other sectors, industry is procyclical. However, it reacted with a 2-quarter lag and died out after 3 years. The negative effect of the business cycle shock on the share of public services was lagged and persistent. It also turned out to be an important factor in explaining its error variance. This effect may remain several years in political decisions. The effects of the business cycle on trade were marginal, occurred only after 8 lags and died out very slowly.

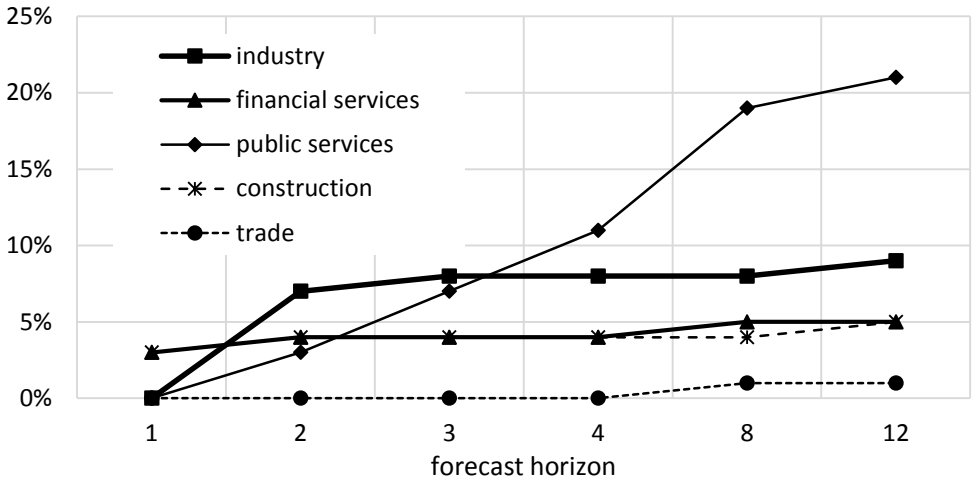


Figure 7. Influence of the business cycle on the variance of production of the UK branches.

Out of the shares of the five sectors, public services and financial services had a significant meaning for the business cycle. Financial services expansion made a visible and positive impact. Moreover, the effect was instantaneous. Public services expansion diminished the short-run growth, which militates against expansionary government policy. We can also observe some negative 'long-run' effects. If the share of GVA in industry had increased, the economic growth in the short run would have generally been slower. Only initially it affected the business cycle in a positive way. The UK economy take an advantage when locating direct investments abroad, which significantly reduces labor costs. Construction sector expansion would not have had much impact on the short-run growth. Similarly, the expansion of trade would have been slight and negative.

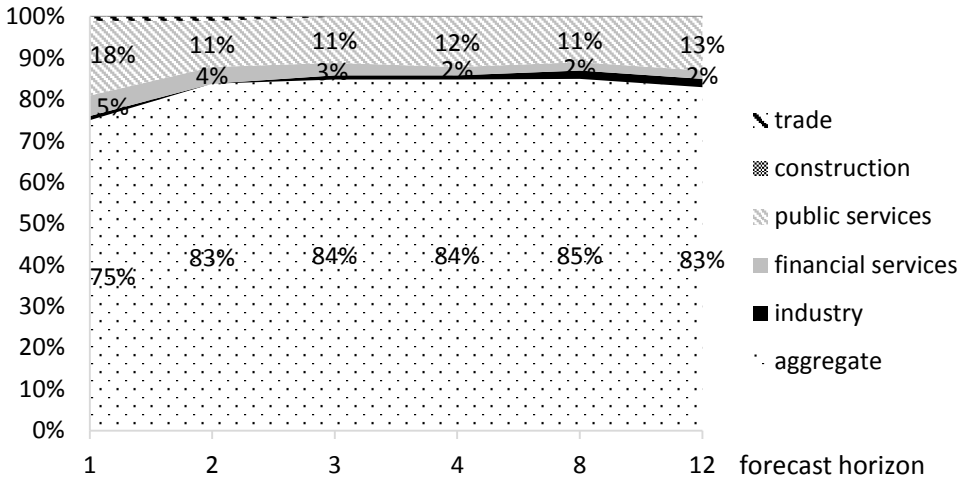


Figure 8. Variance decomposition of the business cycle (by branches).

Another Model (1C) is based on the structure of the UK economy from the point of view of employment in the branches. After some preliminary estimations, it was found that the most suitable model with respect to the assumptions of the error term was the model with 1-lag length in the autoregressive part. Thus, SVEC(1) model type (3) with 2 cointegrating vectors was chosen. In the case of the most of the causality test results, H0 was rejected at p=0.05, indicating that there may be instantaneous as well as lagged causality between the variables of the system. The outlying results of the lagged type of the test indicated that employment in trade and the business cycle did not Granger-cause the rest of the variables, although the other test results indicated that there might have been instantaneous relations.

The first cointegrating relation is the share of employment in industry. According to this, in the long-run, there is a significant negative relationship between the share of industry in the UK economy and construction and trade. There also might be some positive structural interdependence with the business cycle, which turned out to be statistically significant. It may possibly indicate some long-run effects of the business cycle. The second cointegrating vector is the relation of the share of employment in financial services. In the long-run, it is negatively related to public services and positively related to construction and trade. In the case of both variables, the deterministic trend turned out to be statistically significant, indicating that since the late 1970s, both shares of employment – industry and financial services – also changed significantly in a deterministic way.

On the basis of Granger-causality tests restrictions (4) are imposed. At the beginning, the restriction of no long-run impact of the share of

employment in trade on all of the variables is imposed. In addition to this, no long-run impact of the business cycle is allowed, with the exception of the share of industry and financial services. Also no long-run impact of the share of financial services on the business cycle is imposed. Such restrictions are implied by the previous results (i.e. meaningless and negligible long-run impact of trade and financial services). Also, the business cycle should have a transitory effect on the variables of the system. Short-run restrictions are imposed on the basis of the *t*-values, calculated with the use of bootstrapped standard errors. No impact of financial services on the share of administration and construction is allowed. Similarly, no influence of the share of administration on construction and trade, and no influence of construction and trade on the business cycle is assumed. The insignificance of these parameters means that lags in reaction to sectoral shocks between sectors are identified. The structural matrices are as follows:

$$\mathbf{B} = \begin{bmatrix} * & * & * & * & * & * \\ * & * & * & * & * & * \\ * & 0 & * & * & * & * \\ * & 0 & 0 & * & * & * \\ * & * & 0 & 0 & * & * \\ * & * & * & * & 0 & * \end{bmatrix}, \mathbf{\Xi B} = \begin{bmatrix} * & * & * & * & 0 & * \\ * & * & * & * & 0 & * \\ * & * & * & * & 0 & 0 \\ * & * & * & * & 0 & 0 \\ * & * & * & * & 0 & 0 \\ * & 0 & * & * & 0 & 0 \end{bmatrix}, \tag{4}$$

where * means that no restriction is imposed.

The business cycle did not affect the employment shares profoundly. The cyclical shock from aggregate economic activity influenced the share of employment in industry positively and contemporaneously. Although at first it was only marginal, it was the highest amongst all the sectors. Its influence increased, reaching a peak after 8 quarters (Figure 9). The effects on the share of financial sector employment was also simultaneous and, at first, positive but small. After 4 quarters it became negative for the next 3 years. The influence on construction and public services was even smaller and died out very fast. The share of construction behaved in a manner that is quite the opposite. Its reaction for the first 3 quarters was significantly negative but subsequently became positive for over 2 years. The business cycle in a negative way influenced the share of employment in the public services for 2.5 years. Shorter, though still negative, was the effect of the cyclical shock on the share of employment in trade. It might have been a result of insignificant reaction of GVA in this sector. This lasted 5 quarters and expired after this period. These results somewhat resemble those of Mulligan (2002).

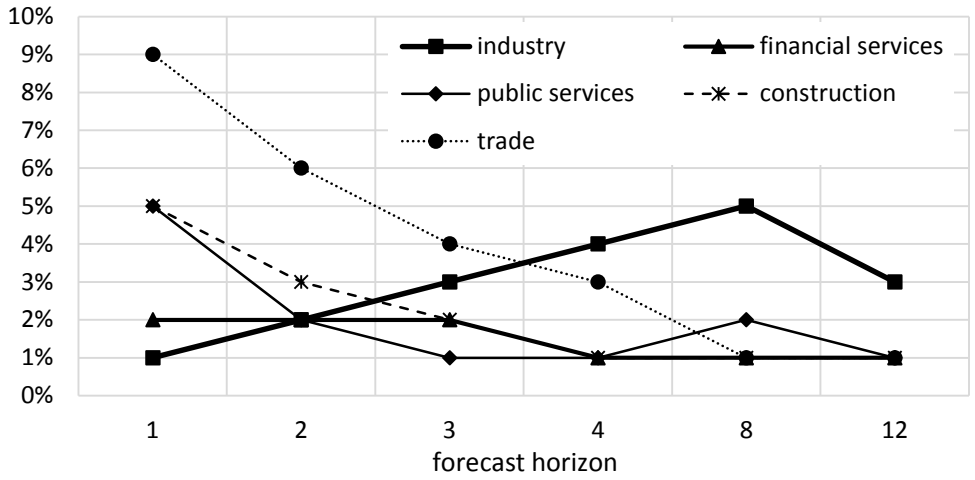


Figure 9. Influence of the business cycle on the variance of production of the UK branches.

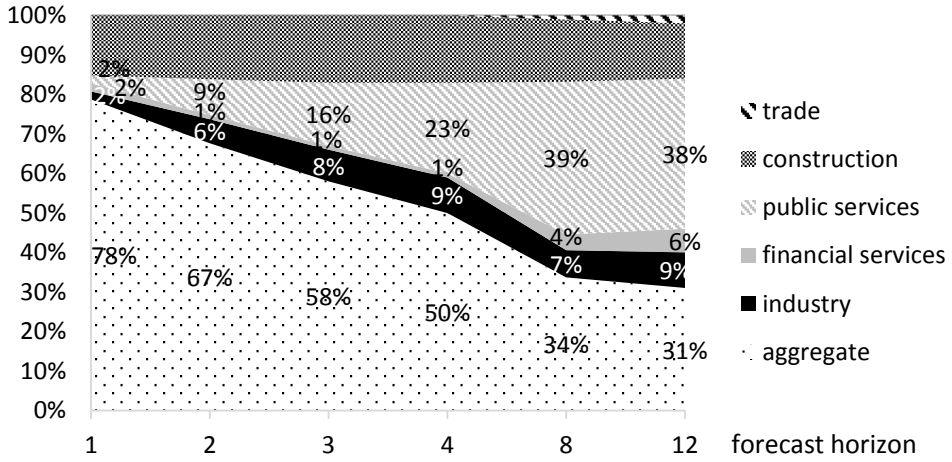


Figure 10. Variance decomposition of the business cycle (by branches).

Although the shares of employment poorly explain the variance of the business cycle, some influence can be seen. Similarly to GVA, public services employment has a significant negative impact on the future business cycle, which can be called a 'long-run impact'. There is a smaller, positive and long-lasting impact of employment in construction on the business cycle. The increase in the share of employment in construction would be a factor behind short-run growth acceleration. The effects of these two sectors are significant. The increase in the share of employment in industry in a direct investment-oriented economy such as the UK would decrease the cyclical

expansion in the first year. The positive effect of accelerating economic growth would occur 5-16 quarters after the shock. However, some negative long-run effects may subsequently occur. This indicates that in the UK economy market services employment is more growth-accelerating than employment in industry.

6. Conclusions

This article contributes to the literature on the heterogeneity of the business cycle from the point of view of economy sectors. The innovation of the paper is the analysis of the interrelation of the business cycle and the structure of the economy. The analysis presents empirical examples supporting the theories of the heterogeneity of the business cycle and the relationship between economic fluctuations and structural changes. It was found that the business cycle both influences and is influenced by the structure of the economy. Not only crises affect the structure of the economy but also fluctuations with a narrower amplitude. The effect is not profound, but in many cases significant. Significant interdependence of cyclical and structural changes was found particularly when sectoral gross value added was analyzed. From the point of view of sectoral employment, only a few significant relations were identified.

Aggregate shocks are the ones that drive business cycles. However, some of the sectoral shocks also have significant meaning for fluctuations. The effects of the share of investments on fluctuations are instantaneous and large. Capital shortage over the business cycle may have severe effects in diminishing economic growth. The impact of fluctuations on employment shares were generally lagged but more persistent than that on gross value added. A rise in the employment shares of public services and industry negatively affects the business cycle, while the employment shares of construction and market services affect it positively. Contrary to the popular belief, financial services and construction sectors are the ones that react first to a business cycle shock. Then industry and public services follow, which are influenced the hardest. Trade lags and responds to a very small extent. The financial services and public services shares in GVA have significant impact on fluctuations. The higher the share of public services in the economy, the lower the economic growth. Financial services share positively affects the business cycle.

Transitions between sectors of the economy over the business cycle have important implications. The most visible is improvement of forecasting of business cycle turning points, and classification of structural changes. Recognition of employment flows between sectors can contribute to the

knowledge on the short-run job-to-job transitions, which influences labor market stickiness. This may direct labor market policy, e.g. unemployment support and demand for training in different business cycle phases. Flows of gross value added between sectors may be taken into account in setting interest rates and financial sector instruments, as they may be more accurately adjusted to particular sectors. Sectoral shifts also result in tax inflow and government expenditure changes, as sectors differ in their participation in fiscal policy measures. Taking this into account may improve government budget predictability.

The United Kingdom is a representative of a developed market economy. The analyzed period was also generic. It contained various macroeconomic breakthroughs as well as periods of relative stability. That is why I argue that major conclusions of this article are universal. However, the UK has its own specificity, e.g. liberal law, developed financial services and foreign direct investment capital inflows. It may determine roles of some sectors of this economy, while in other types of economies, e.g. other European developed countries with more social law or middle-developed countries, their significance could be different. Future research should focus on how certain factors affect these relations. Also, non-linear relations may be taken into account, esp. in the case of foreign trade. Additionally, different or more disaggregated sectors may be analyzed.

References

Alexopoulos, M., 2007. A monetary business cycle model with unemployment, *Journal of Economic Dynamics and Control*, 31 (12), 3904-3940.

Ashcroft, B., Love, J., Malloy, E., 1991. New firm formation in the British counties with special reference to Scotland, *Regional Studies*, 25 (5), 395-409.

Backus, D. K., Kehoe, P. J., Kydland, F. E., 1992. International real business cycles, *Journal of Political Economy*, 100 (4), 745-775.

Backus, D. K., Kehoe, P. J., 1992. International evidence on the historical properties of business cycles, *American Economic Review*, 82 (4), 864-88.

Basu, S., Fernald, J., Kimball, M., 2006. Are technology improvements contractionary?, *American Economic Review*, 96 (5), 1418-1448.

Baxter, M., King, R., 1999. Measuring business cycles: Approximate band-pass filters for economic time series, *Review of Economics and Statistics*, 81 (4), 575-593.

Blackburn, K., Ravn, M. O., 1992. Business cycles in the United Kingdom: Facts and fictions, *Economica*, 59 (236), 383-401.

Blanchard, O. J., Quah, D., 1989. The dynamic effects of aggregate demand and supply disturbances, *American Economic Review*, 79 (4), 655-673.

Buch, C., M., Lipponer, A., 2005. Business cycles and FDI: Evidence from German sectoral data, *Review of World Economics*, 141 (4), 732-759.

Burns, A. F., Mitchell, W. C., 1946. *Measuring business cycles*, New York: National Bureau of Economic Research.

Burren, D., Neusser, K., 2013. The role of sectoral shifts in the decline of real GDP volatility, *Macroeconomic Dynamics*, 17 (3), 477-500.

Caporale, G. M., 1997. Common features and output fluctuations in the United Kingdom, *Economic Modelling*, 14 (1), 1-9.

Cheng, S., 2011. Business cycle, industrial composition, or regional advantage? A decomposition analysis of new firm formation in the United States, *Annals of Regional Science*, 47 (1), 147-167.

Cheung, Y. W., Westermann, F., 2003. Sectoral trends and cycles in Germany, *Empirical Economics*, 28 (1), 141-156.

Canova, F., 1998. Detrending and business cycle facts, *Journal of Monetary Economics*, 41 (3), 475-512.

Cubadda, G., Savio, G., Zelli, R., 2002. Seasonality, productivity shocks, and sectoral comovements in a real business cycle model for Italy, *Macroeconomic Dynamics*, 6 (3), 337-356.

Dickey, D. A., Fuller, W. A., 1979. Estimators for autoregressive time series with a unit root, *Journal of the American statistical Association*, 74 (366), 427-431.

Dolado, J. J., Lütkepohl, H., 1996. Making Wald tests work for cointegrated VAR systems, *Econometric Reviews*, 15 (4), 369-386.

Durlauf, S. N., 1989. Output persistence, economic structure, and the choice of stabilization policy, *Brookings Papers on Economic Activity*, 2, 69-136.

Eickmeier, S., 2007. Business cycle transmission from the US to Germany - A structural factor approach, *European Economic Review*, 51 (3), 521-551.

Engle, R. F., Issler, V., 1995. Estimating common sectoral cycles, *Journal of Monetary Economics*, 35 (1), 83-113.

Fukuda, K., 2008. Differentiating between business cycles and growth cycles: evidence from 15 developed countries, *Applied Economics*, 40 (7), 875-883.

Galí, J., 2008. *Monetary policy, inflation, and the business cycle: An introduction to the new Keynesian framework*, Princeton: Princeton University Press.

Harvey, A. C., 1989. *Forecasting structural time series models and the Kalman filter*, Cambridge: Cambridge University Press.

Harvey, A. C., Mills, T. C., 2002. Common features in UK sectoral output, *Economic Modelling*, 19 (1), 91-104.

Hornstein, A., Praschnik, J., 1997. Intermediate inputs and sectoral comovement in the business cycle, *Journal of Monetary Economics*, 40 (3), 573-595.

Hornstein, A., 2000. The business cycle and industry comovement, *Federal Reserve Bank of Richmond Economic Quarterly*, 86 (1), 27-48.

Hughes, A., M., 1997. The recession of 1990: An Austrian explanation, *Review of Austrian Economics*, 10 (1), 107-123.

Jaimovich, N., Siu, H. E., 2012. *The trend is the cycle: Job polarization and jobless recoveries*, National Bureau of Economic Research Working Paper No. 18334.

Kydland, F. E., Prescott, E. C., 1990. Business cycles: Real facts and a monetary myth, *Federal Bank of Minneapolis Quarterly Review*, 14 (2), 3-18.

Lanne, M., Lütkepohl, H., Saikkonen, P., 2002. Comparison of unit root tests for time series with level shifts, *Journal of Time Series Analysis*, 23 (6), 667-685.

Leamer, E. E., 2008. *What's a recession, anyway?*, National Bureau of Economic Research Working Paper 14221.

Liu, T., Spector, L. C., 2005. Dynamic employment adjustments over business cycles, *Empirical Economics*, 30 (1), 151-169.

Long, J. B., Plosser, C. I., 1983. Real business cycles, *Journal of Political Economy*, 91 (1), 39-69.

Lucas, R E., 1977. Understanding business cycles, *Carnegie-Rochester Conference Series on Public Policy*, 5, 7-29.

Lütkepohl, H., 2005. *New introduction to multiple time series analysis*, Berlin: Springer-Verlag.

Mills, T. C., 2003. *Modelling trends and cycles in economic time series*, New York: Palgrave Macmillan.

Mintz, I., 1969. *Dating Postwar Business Cycles: Methods and Their Application to Western Germany, 1950-1967*, National Bureau of Economic Research Occasional Paper No. 107.

Montgomery, M., R., 2006. Austrian persistence? Capital-based business cycle theory and the dynamics of investment spending, *Review of Austrian Economics*, 19 (1), 17-45.

Mulligan, R., F., 2002. A Hayekian analysis of the term structure of production, *The Quarterly Journal of Austrian Economics*, 5 (2), 17-33.

Pater, R., 2011. Wskaźniki wyprzedzające dla rynku pracy, *Prace i Materiały Instytutu Rozwoju Gospodarczego SGH*, 87, 117-140.

Perez, P. J., 2001. *Cyclical properties in the main western economies*, University of Manchester Discussion Paper Series No. 33.

Perron, P., 1989. The great crash, the oil price shock, and the unit root hypothesis: Erratum, *Econometrica*, 61 (2), 248-249.

Perron, P., 1997. Further evidence on breaking trend functions in macroeconomic variables, *Journal of Econometrics*, 80 (2), 355-385.

Rebelo, S., 2005. Real business cycle models: Past, present, and future, *Scandinavian Journal of Economics*, 107 (2), 217-238.

Saikkonen, P., Lütkepohl, H., 2002. Testing for a unit root in a time series with a level shift at unknown time, *Econometric Theory*, 18 (2), 313-348.

Saroliya, G., 2007. The New Keynesian business cycle achievements and challenges, *Portuguese Economic Journal*, 6 (2), 95-116.

Seddighi, H. R., Lawler, K. A., Katos, A. V., 2000. *Econometrics. A practical approach*, London and New York: Routledge.

Shea, J., 2002. Complementarities and comovements, *Journal of Money, Credit and Banking*, 34 (2), 412-433.

Skrzypczyńska, M., 2012. Cykl koniunkturalny w Polsce – analiza sektorowa, *Bank i Kredyt*, 44 (2), 175-206.

Stockman, A. C., 1988. Sectoral and national aggregate disturbances to industrial output in seven European countries, *Journal of Monetary Economics*, 21 (2-3), 387-409.

Tang, J. H., 2007. Gross job flows and technology shocks in nondurable and durable goods sectors, *Journal of Macroeconomics*, 29 (2), 326-354.

Toda, H. Y., Yamamoto, T., 1995. Statistical inference in vector autoregressions with possible integrated processes, *Journal of Econometrics*, 66 (1-2), 225-250.

Veldkamp, L., Wolfers, J., 2007. Aggregate shocks or aggregate information? Costly information and business cycle comovement, *Journal of Monetary Economics*, 54 (Supplement), 37-55.

Yang, J-M., Kim, T-W., 2005. A search for leading sectors over the business cycle: The case of Korea, *Japan and the World Economy*, 17 (4), 480-495.

Zarnowitz, V., Ozyildirim, A., 2006. Time series decomposition and measurement of business cycles, trends and growth cycles. *Journal of Monetary Economics*, 53 (7), 1717-1739.

Emilia Tomczyk[‡]

Quantification of expectations for general economic situation on the basis of industrial production index with data revisions

Abstract

Use of appropriate data vintages and taking data revisions into account have only recently became a staple of applied econometric analysis. In this paper, the topic of data vintage in regression quantification procedures is readdressed for survey data on general economic situation. From empirical analysis it follows that quantification of survey data on general economic situation on the basis of industrial production index does not present a significant improvement over the use of response balance. Additionally, results obtained for real-time and end-of-sample data are very similar and do not suggest superiority of any of these two data vintages as far as quantification of survey data on general economic situation is concerned.

Keywords: end-of-sample (EOS) data, real time (RTV) data, data revisions, survey data, general economic situation, expectations, quantification, regression method

JEL classification: C82, C83, D84

[‡] Institute of Econometrics, Warsaw School of Economics.

1. Introduction

Every researcher attempting to perform an aggregate analysis of qualitative survey data faces the problem of quantification of qualitative responses into time series data. In this paper, quantification of business survey data on general economic situation is accompanied by evaluating whether data vintage influences results of quantification procedures used to convert categorical questionnaire data into qualitative time series. Data revisions introduce an additional degree of uncertainty to exploration of business tendency survey data, and hence seem to offer an interesting topic of analysis for the 2015 CIRET seminar with a special focus on Economic Cycles and Uncertainty.

Questionnaires on general economic situation, or general business conditions, are a great challenge with respect to quantification of survey data. In both widely used approaches to quantifying survey data, that is, probabilistic and regression methods, it is necessary to define an *objective* economic variable to scale *subjective* survey data. While (more or less) neutral equivalents for series such as production and employment levels, prices, or volume of exports are available in official statistics, there is no *objective* or *unique* measure of general economic conditions. Business tendency indicators available in statistical publications (for example, in Statistical Bulletins published by the Polish Central Statistical Office – CSO) are themselves based on survey data and therefore inappropriate as a source of scaling factors for other surveys.

Two approaches to this problem have been proposed in literature. One of them offers GDP as a proxy for general business conditions and therefore a suitable *objective* equivalent of survey data on business situation. Unfortunately, GDP data are not available with monthly frequency; this drawback limits their usefulness for the purpose of modeling and quantifying monthly business survey data. Also, GDP values production in terms of purchasers' and other final demand sectors' prices, and therefore may not be an optimal measure of business conditions observed in manufacturing sectors.

The other approach recommends the use of industrial production as a proxy for general economic situation. This line of inquiry enjoys a long history: in its *Statistical Releases and Historical Data* section, the Federal Reserve Board points to the industrial production index as a measure of current business conditions dating back to the founding of the Fed system. Since then, indicators of industrial production served as proxies for business conditions in numerous applied economics papers (for an example, from securities markets, see Chen *et al*., 2007). In this paper, I continue this line of research on measures of general economic situation, and employ the volume

index of industrial production sold to scale business survey data on general economic situation.

The analysis of impact of data vintage on quantification procedures constitutes the second dimension of this paper. Various definitions of real-time (RTV) and end-of-sample (EoS) data, along with discussion of advantages of including data revision in quantification models and review of literature, have been presented in my previous publications (see Tomczyk 2013, 2014). In this paper, the topic of data vintage in quantification procedures is readdressed for survey data on general economic situation.

2. Description of data

Reported and expected changes in general economic situation (abbreviated from "General situation of the economy regardless of situation in your sector and enterprise"; see Appendix, question number 8) are taken from the monthly business tendency survey administered by the Research Institute for Economic Development (RIED) at the Warsaw School of Economics. Each survey question requires respondents to evaluate both current situation (as compared to the last month) and expectations for the next 3-4 months by assigning them to one of three categories: increase/improvement, no change, or decrease/decline. Previous studies based on RIED survey data (see Tomczyk, 2008) demonstrate that expectations series defined for three- and four-month forecast horizons do not differ significantly, and the former is used in this paper.

Aggregated survey results are regularly published and commented on in RIED bulletins: each month, a number of respondents is given, along with a percentage of respondents who observed increase/no change/decline and who expect increase/no change/decline in a given area of economic activity, along with a response balance (also called balance statistic) calculated as a difference between the percentage of 'optimists' (those who judge current situation favorably or predict improvement) and 'pessimists' (those who evaluate present situation unfavorably or predict decline).

Let us define the following:

A_t^1 – percentage of respondents who report improvement in general economic situation between t and $t-1$,

A_t^2 – percentage of respondents who report no change in general economic situation between t and $t-1$,

A_t^3 – percentage of respondents who report a decline in general economic situation between t and $t-1$,

P_t^1 – percentage of respondents who expect improvement in general economic situation between t and $t + 3$,

P_t^2 – percentage of respondents who expect no change in general economic situation between t and $t + 3$,

P_t^3 – percentage of respondents who expect a decline in general economic situation between t and $t + 3$.

The response balances calculated for the observed changes:

$$BA_t = A_t^1 - A_t^3, \tag{1}$$

and for the expectations:

$$BP_t = P_t^1 - P_t^3, \tag{2}$$

offer the simplest method of quantification – that is, converting qualitative business survey data into quantitative time series. More sophisticated procedures can be grouped into probabilistic and regressive quantification methods. In this paper, I focus on the regression method which is recommended for quantifying variables over which survey respondents exercise at least limited control (see Nardo, 2003) and which previously had been successfully used to quantify RIED survey data (see Tomczyk, 2008).

Quantification models are not designed to reflect a causal relationship, however, both probabilistic and regression quantification procedures require an *objective* variable to be defined to provide a scaling factor for the *subjective* assessments offered by survey respondents. The extent and frequency of revisions in the volume index of production sold in manufacturing, published by CSO, have been described in Tomczyk (2013, 2014). To summarize, the only regular data revisions in the past two decades were due to changes of the base period in 2004, 2009 and 2013. Apart from these systematic revisions, the index is (occasionally) revised one month after the initial release, and there are no further updates. An illustrative example of the structure of data revisions in the volume index of production for the last six months is shown in Table 1. Each column represents vintage of data and contains data that would have been available at a given moment. The last cell in each column (shaded grey) is the initial release of a value corresponding to a given date. The history of data revisions are represented by rows; data revisions are marked in bold.

Revisions seem regular but small, however, the month-to-month changes in expectations concerning general economic situation and expressed in business tendency surveys also tend to be minute. It is plausible, therefore, that quantification procedures exhibit dependency on even minor updates in

the input data – an effect that has been confirmed in analyses of RIED survey responses concerning changes in production (see Tomczyk, 2014).

Table 1. Revisions of the volume index of industrial production sold (in manufacturing) for November 2014 – April 2015.

	November 2014	December 2014	January 2015	Februar y 2015	March 2015	April 2015
November 2014	119.6	119.6	119.6	119.6	119.6	119.6
December 2014		113.3	113.3	113.3	113.3	113.3
January 2015			112.3	**112.2**	112.2	112.2
February 2015				114.5	**114.7**	114.7
March 2015					131.1	**131.2**
April 2015						120.9

Source: CSO Bulletins.

In Section 3, the results of quantification procedures are reported for quantification models with explanatory variables derived from the RIED business survey, and dependent variables defined as changes in the volume index of production sold, for two data vintages:

- RTV (real time data): initial release available in a given month,
- EoS (end-of-sample): final data which became available one month after the initial announcement.

The sample covers the period of January 2005 to April 2015 (124 observations). Basic statistics for both data vintages are summarized in Table 2.

Table 2. Summary statistics of revisions in the volume index of industrial production sold.

	Initial release (RTV)	Final release (EoS)
mean	97.46	97.47
standard deviation	16.13	16.12
minimum	61.20	61.40
maximum	131.10	131.20

Source: own calculations on the basis of Central Statistical Office data.

Summary characteristics of data vintages exhibit close similarity and suggest that the use of either RTV or EoS data will provide identical empirical results. Situation changes, however, when we consider direction of data

revisions. In Table 3, the structure of revisions in the volume index of industrial production sold is presented.

Table 3. Direction of revisions in the volume index of industrial production.

Direction of revision	Percentage in sample
Initial value larger than final value	26%
Initial value smaller than final value	41%
No revision	33%

Source: own calculations on the basis of Central Statistical Office data.

From Table 3 it follows that upward revisions (that is, corrections from a smaller initial value to a higher final number) are significantly more frequent than downward revisions and also more frequent than no revisions at all. These results suggest that revision process is not unbiased; formal analysis of unbiasedness would be necessary, however, to confirm this initial conclusion.

To conclude description of data, it is worth noting that CSO publishes business tendency indicators (BTIs) in three time series: indicator of the general business tendency climate, BTI diagnosis and BTI forecast, all presented in seasonally adjusted and unadjusted versions and across subsectors. Unfortunately, the full set of data on these indicators is available only from February 2009. As far as data revisions are concerned, a few minor corrections have been introduced between 2005 and 2014 in the indicator of the general business tendency climate; two remaining business conditions series, BTI diagnosis and BTI forecast, have not been revised in the past two decades.

3. Results of quantification procedure

For the purpose of quantifying RIED data on general economic situation, two versions of the regression method are used. In the Anderson model (1952), the following equation is estimated:

$$ {}_t x_{t+1} = \alpha \cdot A_t^1 + \beta \cdot A_t^3 + \nu_t , \tag{3} $$

where ${}_t x_{t+1}$ describes relative changes in value of variable x – in this case, the volume index of industrial production published in CSO Statistical Bulletins – between t and t – 1. Assuming that the same relationship holds for expectations reported in surveys, and that the error term in equation (3) meets

standard OLS assumptions, parameters α and β are estimated, and quantitative measure of expectations is constructed on the basis of the following equation:

$$ {}_t\widehat{x}_{t+1} = \widehat{\alpha} \cdot P_t^1 + \widehat{\beta} \cdot P_t^3 , \tag{4} $$

where $\hat{\alpha}$ and $\hat{\beta}$ are OLS-estimators of (3) and reflect an average change in variable ${}_t x_{t+1}$ for respondents expecting, respectively, an increase or a decrease of the dependent variable. The HAC standard errors are usually used to account for possible serial correlation of the error term in (3) due to inertia often observed in expectations series, and heteroskedasticity likely to result from learning patterns imbedded in expectations formation processes.

A modification of the Anderson model was proposed by Thomas (1995) to allow for a special case in which normal or typical situation that respondents compare their current situation to includes a growth rate:

$$ {}_t x_{t+1} = \gamma + \delta \cdot A_t^3 + \xi_t , \tag{5} $$

where $\delta < 0$. The Thomas quantitative measure of expectations is given by the formula:

$$ {}_t\widehat{x}_{t+1} = \widehat{\gamma} + \widehat{\delta} \cdot P_t^3 , \tag{6} $$

where $\hat{\gamma}$ and $\hat{\delta}$ are estimates obtained on the basis of equation (5). The Thomas model, often used for quantifying data on variables like production or prices, offers an additional advantage of limiting the degree of multicollinearity between percentages of ‘optimistic’ and ‘pessimistic’ respondents which typically occurs in the Anderson model.

The quantification models described above are commonly used in converting survey data into time series needed for further analysis. However, vintage of data on the basis of which the models are estimated is rarely addressed. In the case of real time data (RTV), the dependent variable in the regression quantification models (that is, changes in volume of industrial production) is defined on the basis of the volume index of industrial production sold available in real time, IP_t^{RTV}:

$$ P_t^{RTV} = \frac{IP_t^{RTV}}{IP_{t-1}^{RTV}} - 1 , \quad t = 1, ..., 124. \tag{7} $$

Variable ($P_t^{RTV} \cdot 100$) is interpreted as a percentage change in volume of industrial production as compared to the last month.

For final end-of-sample (EoS) data, the dependent variable in regression quantification models is defined on the basis of the final announcement of the volume index of industrial production sold, IP_t^{EOS}:

$$P_t^{EOS} = \frac{IP_t^{EOS}}{IP_{t-1}^{EOS}} - 1, \quad t = 1, ..., 124. \tag{8}$$

Nonetheless, equations (7) and (8) do not necessarily reflect economic processes that business tendency survey respondents aim to assess or forecast. Another plausible possibility may be offered: that respondents evaluate current changes in production against recent – let us say, observed during the last quarter – averages. Let us define:

$$P_t^{RTV-AV} = \frac{IP_t^{RTV}}{\frac{1}{3}\sum_{s=1}^{3} IP_{t-s}^{RTV}} - 1, \tag{9}$$

for real-time data and:

$$P_t^{EoS-AV} = \frac{IP_t^{EoS}}{\frac{1}{3}\sum_{s=1}^{3} IP_{t-s}^{EoS}} - 1, \tag{10}$$

for end-of-sample data. Variables ($P_t^{RTV-AV} \cdot 100$) and ($P_t^{EoS-AV} \cdot 100$) reflect percentage changes in volume of industrial production as compared to the average calculated on the basis of last three months, for real-time and end-of-sample data, respectively.

In line with the discussion presented above, the Anderson and Thomas quantification models have been estimated for both RTV and EoS data and for both definitions of the dependent variable: relative to the last month, and relative to the average of the last quarter. Two general conclusions emerge from the initial estimates of equations (3) and (5). First, none of the Anderson quantification models exhibit an appropriate sign of the estimated coefficient for explanatory variable A_t^3. In the models for RTV and EoS data, and for dependent variables defined with respect to the last month's or average values, estimated coefficients of A_t^3 are positive instead of negative. On this

basis, the Anderson model must be rejected as a method of quantifying RIED survey data on general economic situation. Second, the only models which remain in accordance with the quantification assumptions are the Thomas models estimated for a dependent variable defined with respect to the average of the last quarter. For both RTV and EoS data, estimated coefficients of δ are negative, as initially expected. Table 4 presents the results of the Thomas quantification model estimated with dependent variables P_t^{RTV-AV} (real-time data) and P_t^{EoS-AV} (end-of-sample data).

Table 4. The Thomas model (3) with HAC standard errors.

dependent variable	P_t^{RTV-AV}	P_t^{EoS-AV}
$\widehat{\gamma}$	2.1785	2.1730
$\widehat{\delta}$	-0.0328	-0.0326

Source: own calculations.

Results presented in Table 4 have the following interpretation: in enterprises that within the last month noted deterioration in general economic situation, an average decline was equal to a little more than 3%. This conclusion holds for both data vintages: there are no perceptible differences between results obtained on the basis of RTV and EoS data. Sizes of coefficient estimates are comparable with those obtained in other quantification models published in literature; however, they are not statistically different from zero.

The final question remains: do expectations time series constructed on the basis of the estimates shown in Table 4 present an improvement over the easily available response balance, expressed by equation (2)? It does not seem so. The correlation coefficient of the Thomas expectations series with simple balance statistics is equal to 0.7235 – a high correlation in the world of quantified survey data. What is more, additional assumptions are required for the use of quantification methods and accurate interpretation of their results. For example, from the pairs of equations describing the Anderson and Thomas quantification procedures, (3)-(4) and (5)-(6) respectively, it is clear that expectations for the next three months are calculated on the basis of estimates obtained on the basis of one-month observed changes. This simplification constitutes a significant weakness of the regression method, shared by all commonly used quantification procedures. Also, there exists no empirical confirmation for the assumption that a relationship between *objective* time series and *subjective* assessments can be described by the same

equation as a relationship between survey expectations and the quantified measure of expectations. To summarize, the expectations series obtained on the basis of the Thomas quantification model do not clearly overpower balance statistics as a measure of general economic situation reported by respondents of the RIED business tendency survey.

4. Conclusions and directions for future research

This paper compares results of regression quantification procedures of general economic situation survey data for two data vintages: real-time and end-of-sample, and for two definitions of a dependent variable in quantification models: relative to the last month, and relative to the average of the last quarter. The conclusions may be summarized as follows: quantification of responses to question 8 in the RIED business tendency survey with CSO data on industrial production does not present a significant improvement over the use of response balances as far as construction of expectations series is concerned. For most of the quantification models considered, survey data on general business situation do not fulfill the basic assumptions as to the signs of estimated coefficients. Only the Thomas model constructed with the dependent variable defined with respect to the last quarter's average exhibits a correct sign of the estimated coefficient. Still, the correlation coefficient of the expectations series obtained on this basis with simple response balance is relatively high (0.7235) and therefore suggests that the use of balance statistics may be of similar research value – and, as an additional advantage, unburdened by supplementary assumptions. Also, the results obtained for RTV and EoS data are very similar and do not suggest superiority of any of these two data vintages as far as quantification of survey data on general economic situation is concerned.

There are several directions of future research worth pursuing. First, economic categories other than industrial production or GDP – for example, changes in levels of orders or financial standing of manufacturing companies – may be considered as possible dependent variables in quantifications models. Second, since upward revisions in the production index are observed more often than downward revisions, and also more frequently than no revisions at all, tests of unbiasedness of CSO data revisions offer an interesting line of research. Third, based on results published in Arnold (2013) it seems worthwhile to test whether differences in empirical results with respect to data vintage, not discernible in this paper, depend on the phase of the business cycle in Poland.

References

Anderson, O. (1952). The business test of the IFO-Institute for Economic Research, Munich, and its theoretical model, *Revue de l'Institut International de Statistique*, 20 (1), 1-17.

Arnold, E. A. (2013). *The role of revisions and disagreement in professional forecasts*, National Bank of Poland Working Paper No. 153.

Chen, M.-H., Chen, S.-J., Kuo, Y.-C. (2007). The Critical Role of Monetary Policy in the Link between Business Conditions and Security Returns in Taiwan, *Asia Pacific Management Review*, 12 (1), 1-12.

Nardo, M. (2003). The quantification of qualitative survey data: A critical assessment, *Journal of Economic Surveys*, 17 (5), 645-668.

Thomas, D. G. (1995). Output expectations within manufacturing industry, *Applied Economics*, 27 (5), 403–408.

Tomczyk, E. (2008). Racjonalność oczekiwań polskich przedsiębiorców: reguła czy wyjątek? Wnioski z testu koniunktury IRG SGH, *Prace i Materiały Instytutu Rozwoju Gospodarczego SGH*, 80, 375-388.

Tomczyk, E. (2013). End-of-sample vs. real time data: perspectives for analysis of expectations, *Prace i Materiały Inastytutu Rozwoju Gospodarczego SGH*, 93, 45-69.

Tomczyk, E. (2014). *Influence of data vintage on quantification of expectations*, Department of Applied Econometrics Working Paper 14-04.

Appendix. Monthly RIED questionnaire in industry

		Observed within the last month	Expected for the next 3-4 months
01	Level of production (value or physical units)	up unchanged down	will increase will remain unchanged will decrease
02	Level of orders	up normal down	will increase will remain normal will decrease
03	Level of export orders	up normal down not applicable	will increase will remain normal will decrease not applicable
04	Stocks of finished goods	up unchanged down	will increase will remain unchanged will decrease
05	Prices of goods produced	up unchanged down	will increase will remain unchanged will decrease
06	Level of employment	up unchanged down	will increase will remain unchanged will decrease
07	Financial standing	improved unchanged deteriorated	will improve will remain unchanged will deteriorate
08	General situation of the economy regardless of situation in your sector and enterprise	improved unchanged deteriorated	will improve will remain unchanged will deteriorate

Source: the RIED database.