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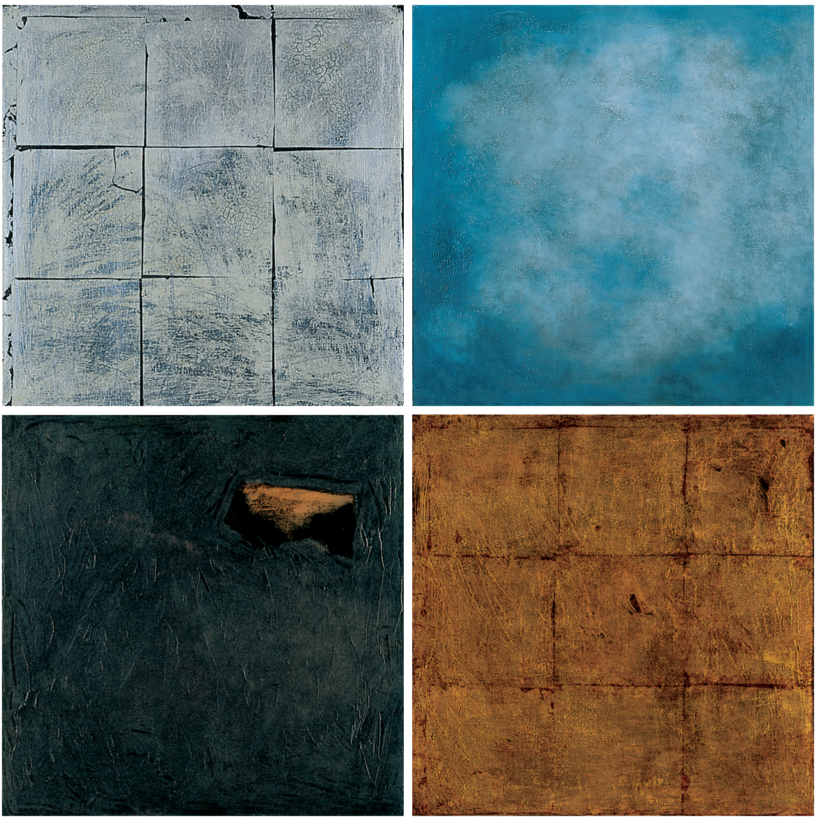
SVETLANA RUSAKOVA

SHORT-TERM FORECASTING OF ECONOMIC DEVELOPMENT IN LATVIA USING BUSINESS AND CONSUMER SURVEY DATA



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ABSTRACT

At any stage of an economic cycle, policy makers and production managers are to make decisions how to benefit from an economic upswing most, or how to mitigate the adverse effects of an economic downturn. An early evaluation of economic development trends in a country will lead to a more favourable translation of policy decisions into economic processes at both microeconomic and macroeconomic levels. An assessment of economic business cycles often involves business and consumer survey results as evidenced, for instance, by rich practices of the EU and other world countries. This paper examines the usefulness of indicators from business and consumer surveys in the short-term forecasting of Latvia's economic development.

Key words: *business and consumer surveys, economic development, short-term forecasting*

JEL classification codes: *C22, C53, E32*

The views expressed in this publication are those of the authors, employees of the Monetary Policy Department of the Bank of Latvia. The authors assume responsibility for any errors or omissions.

Fragments of the painting *Alchemy* by Frančeska Kirke have been used in the design.

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ABBREVIATIONS

ARIMA – Auto Regressive Integrated Moving Average
ARMA – Auto Regressive Moving Average
GDP – Gross Domestic Product
EC – European Commission
EMU – Economic and Monetary Union
EU – European Union
MAPE – Mean Absolute Percent Error
OECD – Organisation for Economic Co-operation and Development
VAR – Vector Auto Regression

INTRODUCTION

Economic development is cyclical, with expansions replacing contractions and vice versa. Latvia is not an exception, and after the country regained independence, its economy has experienced shifts between periods of recovery and prosperity and those of relative decline, when rapid growth alternated with recession during which overall economic activity decelerated. The dynamics of economic growth finds expression in a number of indicators: GDP, employment rate, industrial output, inflation, etc. GDP is regarded as the main indicator of economic cycles.

At any stage of an economic cycle, policy makers and production managers are to make decisions how to benefit from an economic upswing most, or how to mitigate the adverse effects of an economic recession. An early evaluation of economic development trends in a country will lead to a more favourable translation of policy decisions into economic processes at both microeconomic and macroeconomic levels. As the data on GDP and similar indicators best characterising economic development are made available with a relatively large delay, other reliable indicators of the state of the economy that are released without much delay are needed to allow prompter forecasting of the business cycle shifts or at least their accounting.

As Latvia's economy is developing buoyantly and with its structural adjustment still going on, it is difficult to find such other indicators at this point of time. The assessment of economic business cycles often involves business and consumer survey results as evidenced, for instance, by rich practices of the EU and other world countries. This paper examines the usefulness of indicators from business and consumer surveys in the short-term forecasting of Latvia's economic development.

1. BUSINESS AND CONSUMER SURVEYS

Business and consumer surveys of enterprises and households are conducted on a regular basis. Their questionnaires include the so-called qualitative questions offering the respondent to select one answer from the three proposed (usually positive, neutral or negative).[1] Survey results are translated into numerical indicators thus obtaining the relative distribution of answers to each question of the questionnaire. Afterwards, the distribution balance as the difference between the positive and negative answers is computed.

Business and consumer surveys have both their strong points and weaknesses. Speaking about the strong points, their advantage is a more immediate availability of results compared to a great number of statistical macroeconomic indicators that are used for assessing the state of the economy and in the economic policy making. In addition, business surveys comprise information other than provided by statistics (e.g. capacity utilisation in industry, expected demand for output and production activity, etc). They contain a vast amount of data on respondents' economic activity at the time of the survey and communicate their outlook for the near future. As is seen from global practices and the situation in Latvia, business survey indicators are eligible predictors of the economic development trends in the short term.

Business and consumer surveys are characterised by a common weakness that is generally inherent in any survey and consists in the fact that surveys do not deal with an economy or a sector overall but only cover a certain sample. However, the conclusions derived on the basis of survey results usually are generalised and applied to the entire economy or sector. The quality of business and consumer surveys is also affected by respondents' perception of the questions to be answered and how meticulous they are when giving answers. Moreover, timely answers are provided only by a part of the respondents. For Latvia, the ratio of responsive respondents in a sample ranges between 75% and 85%, and it is a better result than in other European countries on average (see Chart 1.1).

The Institute of Statistics of Latvia conducted the very first business survey in 1993 (on industry and construction). Thereafter, consumer surveys were also commenced.[2] Over time, the scope of surveys expanded to incorporate retail trade and agriculture. Since 2001, surveys on investments in industry and construction have been conducted, but in 2002, services sector's surveys were launched. Institutions involved in conducting such surveys used the EU methodology from the very start.

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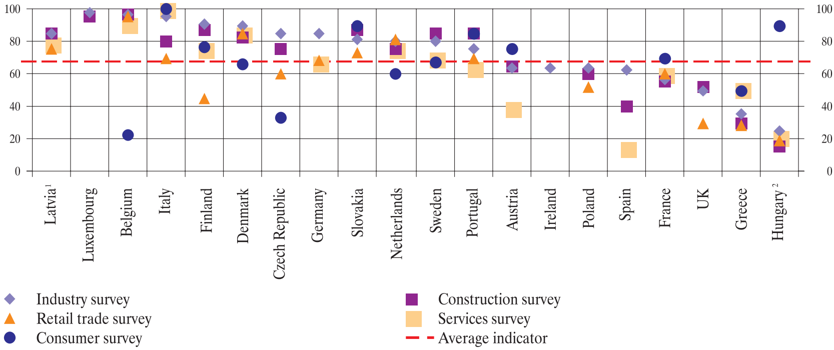
[1] Qualitative questions of the surveys can be split into three groups: questions related to the existing situation (level descriptive statistic), questions about shifts in indicator estimation over the past months (trend descriptive statistic), and questions about change expectations over the up-coming months (future trend descriptive statistic).

[2] Initially, consumer surveys were conducted by the State Committee for Statistics of Latvia. In the data series for the period from 1995 to 1997, two breaks occurred. Since May 2001, consumer surveys have been conducted by the market and social research center *Latvijas Fakti*.

Chart 1.1

RATIO OF TIMELY SUBMITTED QUESTIONNAIRES IN TOTAL SAMPLE

(%)



[1] The fourth quarter of 2004.

[2] Average of the interval.

Sources: OECD, Institute of Statistics of Latvia.

Industry, construction and retail surveys[1] cover a vast range of indicators (see Appendix 1) that measure the factors decisive for the economic development at present and in the future, i.e. the demand, commercial and production activities, employment, etc. These business indicators are used in the calculation of confidence indicators, which, depending on surveys, are the arithmetic mean of either two or four business indicators. Confidence indicators primarily reflect the short-term growth of the respective industries. The leading sector and consumer confidence indicators, in turn, are used when computing the Economic Sentiment Index (ESI) to reflect the short-term changes in the economy.

2. THEORETICAL ASPECTS

A great number of economists have analysed to what extent business indicators are useful in reflecting or forecasting macroeconomic indicators. Relationships between business survey indicators, on the one hand, and GDP or less aggregated indicators, on the other, are estimated.(1; 2; 10; 11; 12; 15; 16, etc) This Chapter deals with a number of different approaches used in the above referred studies.

Some papers assessing the usefulness of business indicators in reflecting economic cycles or in short-term forecasting rely on a simple correlation analysis of these and the statistical indicators that reflect the economic development trends (e.g. 14). Some authors have combined correlation analysis with the Granger causality testing (e.g.

[1] The paper deals with information incorporated in these surveys as the duration of other surveys does not meet the needs of the analysis. For the same reason, the analysis does not cover those business survey indicators that were included in the surveys in 1999 and after.

16). In both cases, annualised changes in statistical indicators reflecting the economic development and the level or annual changes of business indicators are used. Likewise, only assumptions are possible regarding the application of business indicators to reflecting or forecasting the selected quantitative data series, but it is not possible to evaluate how useful business indicators are for the purpose.

Ch. D. Carroll, J. C. Fuhrer and D. W. Wilcox (5), and also L. F. Dunn and I. A. Mirzaie (8) opted for simple linear models to assess the possibility of using business indicators as leading indicators of the economic development. Equation [1] presents the model used in the studies:

$$\Delta \log(Y_t) = \alpha_0 + \sum_{i=1}^{N} \beta_i X_{t-i} + \varepsilon_t \qquad [1]$$

where
Y is the selected statistical indicator;
X is the business indicator to be examined.

In assessing the University of Michigan's Index of Consumer Sentiment, Ch. D. Carroll, J. C. Fuhrer and D. W. Wilcox (5) employed the model presented in equation [2]:

$$\Delta \log(C_t) = \alpha_0 + \sum_{i=1}^{N} \beta_i S_{t-i} + \gamma Z_{t-1} + \varepsilon_t \qquad [2]$$

where
C represents different household consumption indicators (e.g. consumption of services, cars, etc);
S is the Consumer Sentiment Index;
Z is the vector of other control variables.

The income growth rate of the labour force is used as a control variable. Afterwards, J. Bram and S. Ludvigson modified equation [2], replacing the income growth rate of the labour force with the unemployment rate and incorporating various interest rate modifications in the model.(3) Also D. Croushore depended on the models of the given studies when conducting the consumer confidence analysis.(6) Forecasts derived by modified models were compared to Bram–Ludvigson findings by computing the Root Mean Square Forecast Error.

A. Mourougane and M. Roma (12) used another model, which was close to the one described by equation [1] but had one distinction: the authors employed differentiated business indicators. Their paper reviewed the possibility to use EC business survey indicators (the Economic Sentiment Index and the Industrial Confidence Indicator) for real GDP short-term forecasts in six European countries[1]. Out-of-sample model

[1] Belgium, Spain, Germany, France, Italy and the Netherlands.

errors were compared with the ARIMA benchmark model. Of the six countries, the given indicators proved useful for five of them.

N. J. Nahuis and J. W. Jansen (13) used confidence-augmented equations in their analysis of consumer and retail trade confidence[1]:

$$\Delta c_t = \alpha + \sum_{i=1}^{n} \beta_i \Delta c_{t-i} + \sum_{i=0}^{2} \gamma_i \Delta pki_{t-i} + \varepsilon_t \qquad [3],$$

$$\Delta c_t = \alpha + \sum_{i=1}^{n} \beta_i \Delta c_{t-i} + \sum_{i=0}^{2} \varphi_i \Delta mki_{t-i} + \varepsilon_t \qquad [4],$$

$$\Delta c_t = \alpha + \sum_{i=1}^{n} \beta_i \Delta c_{t-i} + \sum_{i=0}^{2} \gamma_i \Delta pki_{t-i} + \sum_{i=0}^{2} \varphi_i \Delta mki_{t-i} + \varepsilon_t \qquad [5]$$

where
c is consumption;
pki is the consumer confidence indicator;
mki is the retail trade confidence indicator.

The auto regressive model of the consumption growth rate was selected as the benchmark model for the comparison of findings. Of the eight examined EU countries,[2] only confidence indicators of France, Italy and Spain proved useful in forecasting consumption.

I. Roberts and J. Simon (15) proposed a new approach how to assess the possibility of using business survey indicators in forecasting. This approach is based on mutual relationship between macroeconomic indicators and business indicators. Using linear models, the authors attempted to extract from the business survey indicators the impact of already existing information about the economic development on respondents' assessment of current and up-coming development dynamics. Thus, the business survey indicators incorporated only information about the current and future economic development trends. Upon assessing the results, the authors came to a conclusion that, in fact, sentiment indicators produced a vague picture of the available economic information (none of the modified indices at the stage of Granger causality testing implied their possible application in forecasting) and that it was risky to overestimate their significance. According to the authors, the application of business survey indicators in forecasting was not an optimal solution.

G. Bruno and C. Lupi (4) used business survey data of three major EMU economies (Germany, France and Italy) when forecasting the EMU industrial output index. To

[1] A similar approach was used also by J. Z. Easaw, D. Garratt and S. M. Heravi (9), and Ch. Aylmer and T. Gill (1).
[2] Belgium, Germany, France, Italy, the Netherlands, Portugal, Spain and the UK.

model industrial output in each country of the selected sample, they used a VAR model[1] and compared the forecast errors with the EMU benchmark model (ARMA and VAR) data. It was concluded that the aggregate forecast is adequately precise for a period of six months.

3. METHODOLOGY AND DATA

Though in general VAR models are widely applied, the relatively short time series weaken their capacity to produce precise and reliable results, therefore macroeconomic research papers (particularly in developing countries) often use simple linear models. In this paper as well, simple linear models have been used in the assessment of business indicators.

Business surveys comprise a large number of indicators characterising the state of the economy and predicting the economic or sector growth. The Economic Sentiment Index, confidence indicators and their components, as well as some other business indicators are used in this paper. Equations [6] and [7] represent the models built for assessing their application in the analysis of the economic activity.

$$\log IKP_t = \beta_1 + \beta_2 \times \log IKP_{t-1} + \beta_3 \times KR_{t-\tau} + \varepsilon_{1,t} \qquad [6],$$

$$\Delta \log IKP_t = \beta_4 + \beta_5 \times \Delta KR_{t-\tau} + \varepsilon_{2,t} \qquad [7]$$

where
IKP_t is real GDP or real value added of the respective sector;
$KR_{t-\tau}$ is quarterly changes in the business survey indicator, and τ obtains a zero (0) value when testing the exogenous variable for the coincident indicator[2], and the value 1 when testing the independent variable for the leading indicator.

The quarterly real value added data (see Appendix 2) and indicators of monthly or quarterly business surveys have been used in the model assessment. The monthly data were converted into the quarterly data calculating the arithmetic mean. The real value added time series was seasonally adjusted via *Census X-12*. Seasonally adjusted time series of business survey indicators were taken from EC databases.

In the process of model building, we used the time series up to the fourth quarter 2002, preserving seven out-of-sample quarters (from the first quarter 2003 to the third quarter 2004) for the verification of the model forecast precision. For the purpose of assessing the forecasting capacity of the created models, benchmark ARMA and ARIMA models were built (see Appendix 3).

[1] This approach has been used also by F. Bouton and H. Erkel-Rousse (2), J. Hansson, P. Jansson and M. Löf (11) and other authors.
[2] Survey data become available for analysis considerably earlier than GDP data, therefore thay can be used as coincident indicators in forecasting.

The model forecast precision is assessed taking into account relative errors of the forecasts (7):

$$p_{t+k,\,t} = \left(y_{t+k} - \hat{y}_{t+k,\,t}\right) / y_{t+k} \qquad [8]$$

where

y_{t+k} is the actual value of the variable in period $t + k$;

$\hat{y}_{t+k,\,t}$ is the value forecast of the variable for period $t + k$ made in period t and calculating model MAPE:

$$MAPE = \frac{1}{T} \sum_{t=1}^{T} \left| p_{t+k,\,t} \right| \qquad [9].$$

The model with a smaller forecast MAPE has a higher average forecast precision. If MAPEs do not differ, preference should be given to the model based on statistical indicators, for the latter more accurately reflect structural changes and economic shocks.

4. ECONOMIC SENTIMENT INDEX AND CONFIDENCE INDICATORS

In this Chapter, the focus is on empirical findings; they are based on the analysis of the selected time series and the models described above. Improvements in confidence indicators and the Economic Sensitivity Index both point to positive short-term development trends in the economy at the given point or in the up-coming period; on this background we can propose a hypothesis that coefficients β_3 and β_5 in equations [6] and [7] are positive.

Stationarity testing of the time series used in this paper shows that the time series of GDP, the economic sensitivity index and confidence indicators are integrated in the first order (see Appendix 4.1). The Granger causality tests indicate that statistically significant relationship exists only between the industry confidence indicator and the levels and differentials of real value added of the goods sector and industry (see Appendix 4.2). Testing for Granger causality does not point to a significant relationship between any other discussed confidence indicator and its respective real value added.

The results of the Johanssen unrestricted cointegration rank tests point to the existence of a single cointegration vector between the time series of the logged real value added of the goods sector ($\log(PV\_A\_F_t)$) and the industry confidence indicator ($KR\_CDE\_99_t$ and $KR\_CDE\_99_{t-1}$), as well as between the time series of the logged real value added of industry ($\log(PV\_A\_F_t)$) and the industry confidence indicator (see Appendix 4.3). This implies that these variables can be used in linear modeling of the levels.

The outcomes of successful modeling are given in Appendix 4.4. The coefficient signs correspond to the proposed hypothesis, and the regression parameters are satisfactory. MAPEs calculated for the purpose of comparing forecast precision are presented in Table 4.1.

Table 4.1

MAPE

	log(PV_A_F_t)	log(PV_CDE_t)	dlog(PV_A_F_t)	dlog(PV_CDE_t)
Benchmark model	1.404	3.383	1.694	1.117
KR_CDE_99_t	1.243	1.158	–	–
KR_CDE_99_{t-1}	1.167	1.047	–	–
d(KR_CDE_99_{t-1})	–	–	1.342	1.200

Information from Table 4.1 suggests that the average precision of the real value added growth forecast for the goods sector (PV_A_F) and industry (PV_CDE) is higher when the industry confidence indicator (KR_CDE_99) is applied than when benchmark model is used in forecasting (except quarterly growth forecast for real value added (PV_CDE) of industry). So we arrive at a conclusion that the forecasting model with the industry confidence indicator produces a more precise result.

Chart 4.1 shows that the forecasts for the goods sector estimated within the sample with the industry confidence indicator model reflect the main trends in it, and out-of-sample forecast precision is higher than the one produced by the benchmark model. Likewise, the precision of out-of-sample forecasts for industry using the industry confidence indicator model is much higher (see Chart 4.2).

Chart 4.1

ANNUAL GROWTH IN ACTUAL AND PROJECTED REAL VALUE ADDED OF THE GOODS SECTOR

(industry confidence indicator level with one month lag has been used; %)

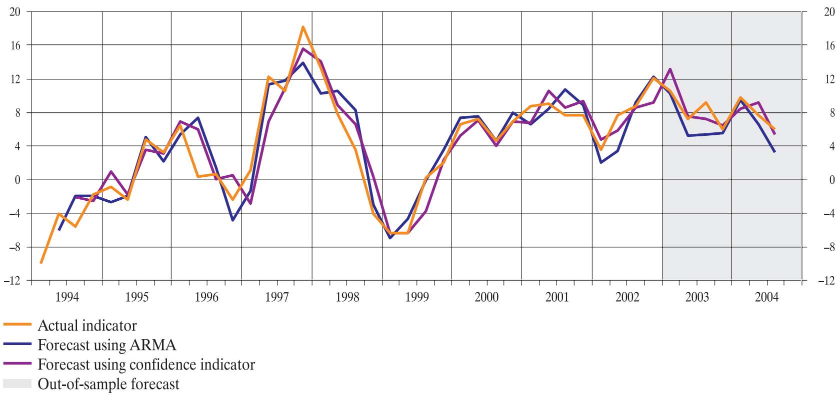
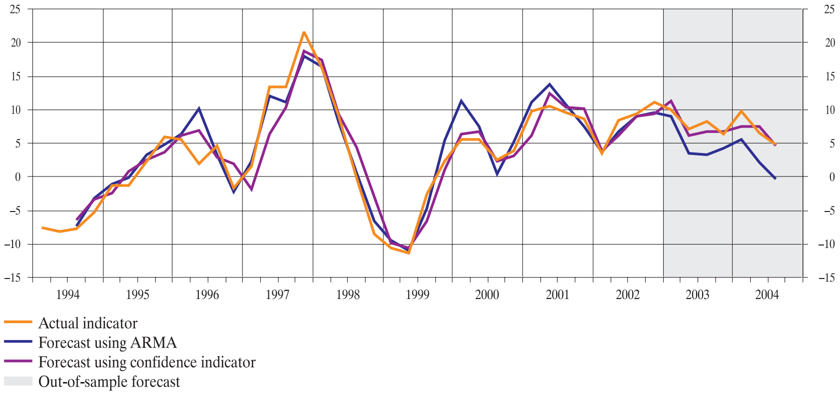


Chart 4.2

ANNUAL GROWTH IN ACTUAL AND PROJECTED REAL VALUE ADDED OF INDUSTRY
(industry confidence indicator level with one month lag has been used; %)



The analysis of confidence indicators demonstrates that only one of them can be used in modeling. The fact that those business indicators that make up confidence indicators are weakly related to the dynamics of the respective value added can be one of the explanations. Therefore, they need to be estimated, and the focus should also be on such business survey indicators that, while not participating in the estimation of confidence indicators, can be useful for econometric estimation of preliminary indicators.

5. BUSINESS INDICATORS

Along with confidence indicators, business surveys comprise a number of other indicators that might be useful in presenting and forecasting the dynamics of real value added (see Appendix 1). Similar to the examination of confidence indicators and the Economic Sensitivity Index, we have focused on indicators with sufficiently long estimation periods for econometric modeling. A hypothesis regarding coefficient signs may be formulated as follows: a negative correlation between the industry survey indicator *stocks of finished products* (KR_CDE_4), the retail trade survey indicator *stocks of goods* (KR_G_2) and value added of the respective sector is expected, i. e. coefficients β_3 and β_5 in equations [6] and [7] should obtain negative signs implying that increases in the *stocks of finished products* and *stocks of goods* point to a likely deceleration of the growth rates in a sector or overall economy in the near term. For all other business indicators, a positive correlation with changes in value added of the respective sector, i.e. positive coefficients β_3 and β_5, are to be expected.

Stationarity tests of the business survey indicator time series demonstrate that they are first order integrated (see Appendices 5.1, 6.1 and 7.1). Granger causality tests (see Appendices 5.2, 6.2 and 7.2) confirm that several industry indicators, one construction indicator and a retail trade indicator are in a statistically significant relationship with the respective value added time series. Furthermore, the Johanssen unrestricted cointegration rank tests confirm the existence of a single cointegration vector only between some industry business indicators and real value added of the goods sector and industry (see Appendix 5.3).

Similar to sector confidence indicators, the sector business indicators were tested for their usefulness in the short-term forecasting of economic growth with econometric models. The results obtained through the application of useful models are given in Appendix 5.4. Coefficient signs in the models are consistent with the proposed hypotheses, and the regression parameters are satisfactory. MAPEs of out-of-sample forecasts obtained by the given models are presented in Table 5.1 (with deciphering of variable codes provided in Appendix 1).

Table 5.1

MAPE

	log(PV_A_F_t)	log(PV_CDE_t)	dlog(PV_A_F_t)	dlog(PV_CDE_t)
Benchmark models	1.404	3.383	1.694	1.117
KR_CDE_2_t	1.285	1.247	–	–
KR_CDE_2_{t-1}	1.157	1.105	–	–
KR_CDE_4_t	1.491	1.316	–	–
KR_CDE_4_{t-1}	1.442	1.205	–	–
KR_CDE_5_t	–	1.237	–	–
KR_CDE_5_{t-1}	1.233	1.177	–	–
KR_CDE_7_t	–	1.164	–	–
KR_CDE_7_{t-1}	–	1.134	–	–
d(KR_CDE_2_{t-1})	–	–	1.249	–
d(KR_CDE_4_{t-1})	–	–	1.347	1.189
d(KR_CDE_12_{t-1})	–	–	0.889	0.943

Information derived from Table 5.1 leads to a conclusion that the average out-of-sample forecast precision is higher than the one obtained by the benchmark model when industry business indicators are used in the modeling of real value added growth for the goods sector and industry (PV_A_F and PV_CDE, respectively).

Chart 5.1 shows that when the model with industry business survey indicator *production activity expectations* is used in forecasting, it reflects the main trends of the goods sector, and the out-of-sample forecasts are generally more precise than the forecasts obtained using the benchmark model. The out-of-sample forecasts of real value added in industry that are obtained using the model with the industry business survey indicator *production activity expectations* are more precise (see Chart 5.2).

Chart 5.1

ANNUAL GROWTH IN ACTUAL AND PROJECTED REAL VALUE ADDED OF THE GOODS SECTOR
(industry business survey indicator *production activity expectations* with one month lag has been used; %)

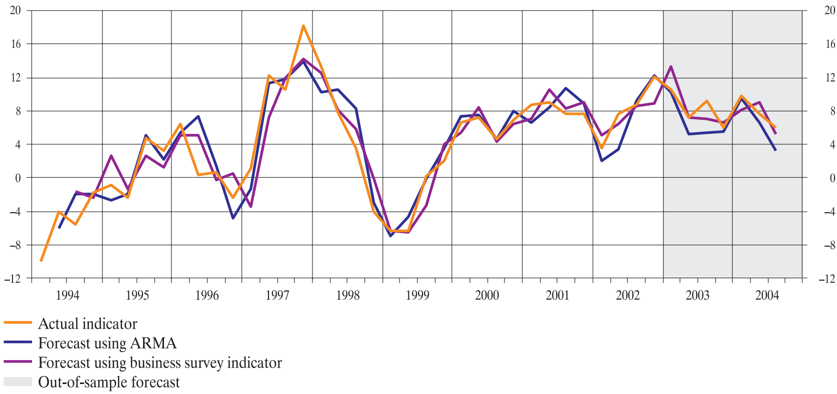
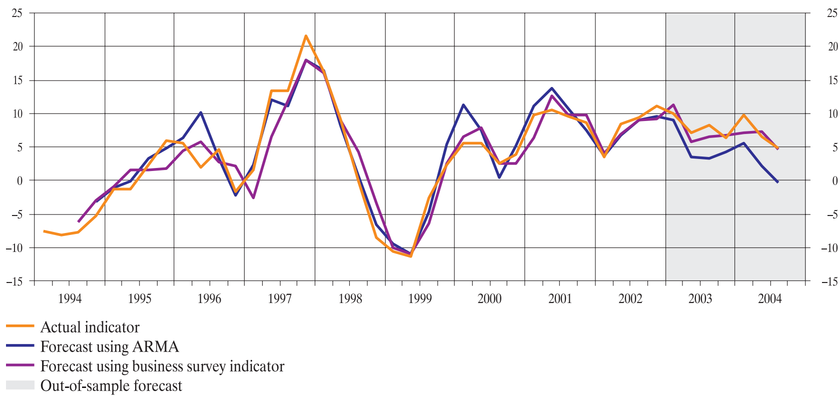


Chart 5.2

ANNUAL GROWTH IN ACTUAL AND PROJECTED REAL VALUE ADDED OF INDUSTRY
(industry business survey indicator *production activity expectations* with one month lag has been used; %)



Data from the analysis indicate that, at the moment, none of the construction or retail trade survey indicators can be used in econometric forecasting.

CONCLUSIONS

The analysis of information obtained from Latvia's business surveys does not point to its ample application opportunities for short term forecasting of real GDP and real value added. The economic sentiment index does not represent the evolution of the selected statistical indicator. Moreover, of the analysed sector confidence indicators, only the application of industry confidence indicator in the econometric model produces a more precise forecast than can be obtained when employing the benchmark model.

Of the estimated business and consumer survey indicators, the application of only some industry survey indicators to econometric modeling allows of forecasting real value added of the industrial and goods sectors with a higher precision than do the benchmark models. The models that build on industry survey data allow of making growth forecasts for industry and the goods sector around 5 months prior to the release of the official value added statistics.

APPENDICES

1. SECTOR SURVEY INDICATORS

Code[1]	Industry survey indicators	Beginning of surveys
Industry		
Monthly data		
KR_CDE_99	**Industry Confidence Indicator**	April 1993
KR_CDE_1	Production activity in the past 3 months (trend)	
KR_CDE_2[2]	Current order books (level)	
KR_CDE_3	Current export order books (level)	
KR_CDE_4[2]	Stocks of finished products (level)	
KR_CDE_5[2]	Production activity expectations for 3 months ahead (future trend)	
KR_CDE_6	Selling price expectations for 3 months ahead (future trend)	
KR_CDE_7	Employment expectations for 3 months ahead (future trend)	
Quarterly data		
KR_CDE_9	Current capacity adequacy for expected order (level)	1993 Q2
KR_CDE_10	Duration of production assured by order books; months (level)	2001 Q1
KR_CDE_11	Total/aggregate order books for the past 3 months (trend)	
KR_CDE_12	Export order books for 3 months ahead (future trend)	1996 Q3
KR_CDE_13	Production capacity uitilisation (%)	1993 Q2
	Competitive position over the past 3 months (trend)	2001 Q1
KR_CDE_14	On the domestic market	
KR_CDE_15	On the foreign market (in EU countries)	
KR_CDE_16	On the foreign market (outside the EU)	
Construction		
Monthly data		
KR_F_99	**Construction Confidence Indicator**	July 1993
KR_F_1	Current construction activity (trend)	
KR_F_3[2]	Current order books in construction (level)	
KR_F_4[2]	Employment expectations for 3 months ahead (future trend)	
KR_F_5	Price expectations for 3 months ahead (future trend)	
Quarterly data		
KR_F_6	Construction works; in months (level)	1999 Q2

[1] Hereinafter, confidence indicators and business and real value added indicators will be coded in the appended tables.
[2] Used for calculating the confidence indicator of the respective sector.

1. SECTOR SURVEY INDICATORS (cont.)

Code	Sector business indicators	Beginning of surveys
Retail trade		
Monthly data		
KR_G_99	**Retail Trade Confidence Indicator**	January 1996
KR_G_1[1]	Business activity over 3 past months (trend)	
KR_G_2[1]	Current stocks of goods (level)	
KR_G_3	Orders placed with suppliers for 3 months ahead (future trend)	
KR_G_4[1]	Expected business activity for 3 months ahead (future trend)	
KR_G_5	Employment expectations for 3 months ahead (future trend)	

2. VALUE ADDED INDICATORS

Code	Real GDP and real value added	Beginning of surveys
Quarterly data		
PV	**Real GDP**	1993 Q1
PV_A_F	Real value added in the goods sector	
PV_CDE	Real value added in industry	
PV_F	Real value added in construction	
PV_G_O	Real value added in the services sector	
PV_G	Real value added in retail trade	

[1] Used for calculating the confidence indicator of the respective sector.

3. RESULTS OF BENCHMARK ARMA AND ARIMA MODELS

Dependent variable	log(PV_A_F)		log(PV_CDE)		dlog(PV_A_F)		dlog(PV_CDE)	
Sample	1993 Q2–2002 Q4		1993 Q3–2002 Q4		1993 Q2–2002 Q4		1993 Q3–2002 Q4	
	coef.	*t*-stat.	coef.	*t*-stat.	coef.	*t*-stat.	coef.	*t*-stat.
Constant	12.262	301.009	11.858	305.842	0.008	1.180	0.011	3.310
Linear trend	0.012	8.439	0.010	6.338				
AR(1)	0.659	6.324	1.794	8.606			0.750	5.628
AR(2)			–1.204	–3.796				
AR(3)			0.311	1.767				
MA(1)			–1.067	–7.907			–0.897	–6.270
MA(2)	0.969	26.942	1.087	10.824	0.946	21.460	0.664	4.035
MA(3)			–0.927	–7.577			–0.695	–5.057
Adjusted determination coefficient	0.973		0.961		0.358		0.205	
S.E. of regression	0.020		0.023		0.022		0.026	
Inverted AR roots	.66		.72 .54–.38i .54+.38i				.75	
Inverted MA roots			.95 .06–.99i .06+.99i				.96–.30–.085i–.03+.85i	
MAPE (2003 Q1–2004 Q3)	1.404		3.383		1.694		1.117	

4. TESTS OF ECONOMIC SENSITIVITY INDEX, CONFIDENCE INDICATORS AND REAL VALUE ADDED

4.1 Time Series Stationarity Test[1]

	ADF(1)	ADF(2)	ADF(3)	ADF(1)	ADF(2)	ADF(3)
Indicator	Level			Difference		
$\log(PV_t)$	2.21	1.99	2.37	–3.82***	–3.45***	–2.84*
$\log(PV\_A\_F_t)$	1.24	0.23	0.40	–3.53***	–3.25**	–4.06***
$\log(PV\_G\_O_t)$	0.69	1.57	2.18	–6.70***	–5.35***	–2.61*
$\log(PV\_CDE_t)$	0.30	–0.23	–0.01	–3.24**	–3.44***	–3.93***
$\log(PV\_F_t)$	–0.01	–0.08	0.73	–6.45***	–6.66***	–7.66***
$\log(PV\_G_t)$	0.69	1.571	2.18	–6.70***	–5.35***	–2.64*
$\log(ESI_t)$	–3.66***	–2.67*	–1.49	–5.72***	–5.38***	–3.66***
$KR\_CDE\_99_t$	–2.70*	–1.86	–0.96	–6.10***	–5.02***	–3.70***
$KR\_F\_99_t$	–1.31	–1.11	–1.27	–4.55***	–3.17**	–3.27**
$KR\_G\_99_t$	–2.25	–1.42	–2.18	–6.39***	–3.98***	–3.30**

*, **, *** Statistical significance of coefficient at 1%, 5% and 10% level, respectively.

4.2 Granger Causality Tests with One Quarter Lag

Level		Difference	
Null hypothesis	Proba-bility	Null hypothesis	Proba-bility
log(ESI) does not GC[2] log(PV)	0.565	dlog(ESI) does not GC dlog(PV)	0.693
KR_CDE_99 does not GC log(PV_A_F)	**0.000**	**d(KR_CDE_99) does not GC dlog(PV_A_F)**	**0.006**
KR_CDE_99 does not GC log(PV_CDE)	**0.000**	**d(KR_CDE_99) does not GC dlog(PV_CDE)**	**0.047**
KR_F_99 does not GC log(PV_A_F)	0.360	d(KR_F_99) does not GC dlog(PV_A_F)	0.998
KR_F_99 does not GC log(PV_F)	0.200	d(KR_F_99) does not GC dlog(PV_F)	0.608
KR_G_99 does not GC log(PV_G_O)	0.116	d(KR_G_99) does not GC dlog(PV_G_O)	0.296
KR_G_99 does not GC log(PV_G)	0.384	d(KR_G_99) does not GC dlog(PV_G)	0.165

[1] Here and hereinafter, the time series stationarity test tables present McKinnon's (1996) one-sided *P*-values of unrestricted Dickey–Fuller test statistics.
[2] Granger Cause.

4.3 Johanssen Unrestricted Cointegration Rank Tests

Log(PV_A_F$_t$) KR_CDE_9$_t$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.539	34.279	19.937
At most 1	0.005	0.238	6.635
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	1% critical value
None[1]	0.539	34.041	18.520
At most 1	0.005	0.238	6.635
log(PV_A_F$_t$) KR_CDE_99$_{t-1}$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.457	26.966	19.937
At most 1	0.017	0.730	6.635
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	1% critical value
None[1]	0.457	26.235	18.520
At most 1	0.017	0.730	6.635
log(PV_CDE$_t$) KR_CDE_9$_t$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.531	33.544	19.937
At most 1	0.004	0.194	6.635
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[2]	1% critical value
None[1]	0.531	33.351	18.520
At most 1	0.004	0.194	6.635
log(PV_CDE$_t$) KR_CDE_99$_{t-1}$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.475	27.755	19.937
At most 1	0.001	0.035	6.635
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	1% critical value
None[1]	0.475	27.720	18.520
At most 1	0.001	0.035	6.635

[1] Denotes rejection of the hypothesis at the 5% (1%) level.
[2] Trace test indicates 1 cointegration equation at the 1% level.
[3] Max-eigen test indicates 1 cointegration equation at the 1% level.

4.4 Results Obtained by Useful Models

Dependent variable	$\log(PV\_A\_F_t)$				$\log(PV\_CDE_t)$			
Sample	1993 Q2–2002 Q4		1993 Q3–2002 Q4		1993 Q2–2002 Q4		1993 Q3–2002 Q4	
	coef.	*t*-stat.	coef.	*t*-stat.	coef.	*t*-stat.	coef.	*t*-stat.
Constant	0.621	0.909	1.233	1.950	0.968	1.410	1.422	2.022
$\log(PV\_A\_F_{t-1})$	0.953	17.585	0.905	18.063				
$\log(PV\_CDE_{t-1})$					0.922	16.315	0.885	15.299
$KR\_CDE\_99_t$	0.001	2.489			0.002	2.881		
$KR\_CDE\_99_{t-1}$			0.002	3.802			0.002	3.523
Adjusted determination coefficient	0.954		0.965		0.944		0.949	
S.E. of regression	0.026		0.023		0.027		0.026	
Durbin–Watson statistic	2.631		1.904		1.894		1.482	
Probability (*F*-statistic)	0.000		0.000		0.000		0.000	
RESET test	0.326		0.506		0.765		0.856	
MAPE (2003 Q1–2004 Q3)	1.243		1.167		1.158		1.047	

Dependent variable	$d\log(PV\_A\_F_t)$		$d\log(PV\_CDE_t)$	
Sample	1993 Q4–2002 Q4			
	coef.	*t*-stat.	coef.	*t*-stat.
Constant	0.008	2.043	0.007	1.516
$D(KR\_CDE\_99_{t-1})$	0.002	2.763	0.001	1.684
Adjusted determination coefficient	0.156		0.049	
S.E. of regression	0.024		0.029	
Durbin–Watson statistic	1.693		1.304	
Probability (*F*-statistic)	0.009		0.101	
RESET test	0.187		0.171	
MAPE (2003 Q1–2004 Q3)	1.342		1.200	

5. INDUSTRY SURVEY INDICATORS

5.1 Time Series Stationarity Tests

	ADF(1)	ADF(2)	ADF(3)	ADF(1)	ADF(2)	ADF(3)
Indicator	Level			Difference		
KR_CDE_1	–4.14***	–3.54***	–2.52	–4.34***	–4.65***	–3.93***
KR_CDE_2	–1.36	–0.97	–0.63	–5.59***	–3.69***	–3.71***
KR_CDE_3	–1.27	–0.91	–0.96	–5.90***	–3.60***	–3.07**
KR_CDE_4	–3.16**	–2.33	–2.06	–5.21***	–4.29***	–4.35***
KR_CDE_5	–4.11***	–3.39**	–2.54	–6.49***	–6.02***	–4.15***
KR_CDE_6	–1.29	–1.58	–1.85	–5.60***	–4.45***	–3.14**
KR_CDE_7	–3.55***	–2.66*	–2.47	–4.88***	–5.01***	–4.57***
KR_CDE_9	–1.76	–1.32	–1.05	–6.27***	–4.51***	–4.48***
KR_CDE_12	–2.47	–2.37	–2.12	–4.95***	–4.10***	–3.60***
KR_CDE_13	–1.33	–1.18	1.30	–6.00***	–4.45***	–4.61***

*, **, *** Statistical significance of coefficient at 1%, 5% and 10% level, respectively.

5.2 Granger Causality Tests with One Month Lag

Level		Difference	
Null hypothesis	Probability	Null hypothesis	Probability
KR_CDE_1 does not GC[1] log(PV_A_F)	0.266	d(KR_CDE_1) does not GC dlog(PV_A_F)	0.783
KR_CDE_2 does not GC log(PV_A_F)	**0.003**	**d(KR_CDE_2) does not GC dlog(PV_A_F)**	**0.002**
KR_CDE_3 does not GC log(PV_A_F)	**0.020**	d(KR_CDE_3) does not GC dlog(PV_A_F)	0.118
KR_CDE_4 does not GC log(PV_A_F)	**0.014**	**d(KR_CDE_4) does not GC dlog(PV_A_F)**	**0.051**
KR_CDE_5 does not GC log(PV_A_F)	**0.001**	d(KR_CDE_5) does not GC dlog(PV_A_F)	0.191
KR_CDE_6 does not GC log(PV_A_F)	0.414	d(KR_CDE_6) does not GC dlog(PV_A_F)	0.513
KR_CDE_7 does not GC log(PV_A_F)	0.238	d(KR_CDE_7) does not GC dlog(PV_A_F)	0.482
KR_CDE_9 does not GC log(PV_A_F)	**0.055**	d(KR_CDE_9) does not GC dlog(PV_A_F)	0.797
KR_CDE_13 does not GC log(PV_A_F)	0.212	d(KR_CDE_13) does not GC dlog(PV_A_F)	0.532
KR_CDE_12 does not GC log(PV_A_F)	**0.002**	**d(KR_CDE_12) does not GC dlog(PV_A_F)**	**0.012**
KR_CDE_1 does not GC log(PV_CDE)	0.268	d(KR_CDE_1) does not GC dlog(PV_CDE)	0.758
KR_CDE_2 does not GC log(PV_CDE)	**0.035**	d(KR_CDE_2) does not GC dlog(PV_CDE)	0.224
KR_CDE_3 does not GC log(PV_CDE)	**0.015**	d(KR_CDE_3) does not GC dlog(PV_CDE)	0.410
KR_CDE_4 does not GC log(PV_CDE)	**0.006**	**d(KR_CDE_4) does not GC dlog(PV_CDE)**	**0.095**
KR_CDE_5 does not GC log(PV_CDE)	**0.001**	**d(KR_CDE_5) does not GC dlog(PV_CDE)**	**0.087**
KR_CDE_6 does not GC log(PV_CDE)	0.515	d(KR_CDE_6) does not GC dlog(PV_CDE)	0.552
KR_CDE_7 does not GC log(PV_CDE)	**0.064**	d(KR_CDE_7) does not GC dlog(PV_CDE)	0.917
KR_CDE_9 does not GC log(PV_CDE)	**0.070**	d(KR_CDE_9) does not GC dlog(PV_CDE)	0.576
KR_CDE_13 does not GC log(PV_CDE)	0.105	d(KR_CDE_13) does not GC dlog(PV_CDE)	0.995
KR_CDE_12 does not GC log(PV_CDE)	**0.002**	**d(KR_CDE_12) does not GC dlog(PV_CDE)**	**0.007**

[1] Granger Cause.

5.3 Johanssen Unrestricted Cointegration Rank Tests

log(PV_A_F$_t$) KR_CDE_2$_t$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.371	21.155	19.937
At most 1	0.017	0.753	6.635
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	1% critical value
None[1]	0.371	20.401	18.520
At most 1	0.017	0.753	6.635
log(PV_A_F$_t$) KR_CDE_2$_{t-1}$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.383	22.199	19.937
At most 1	0.033	1.441	6.635
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	1% critical value
None[1]	0.383	20.757	18.520
At most 1	0.033	1.441	6.635
log(PV_A_F$_t$) KR_CDE_4$_t$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.483	29.547	19.937
At most 1	0.012	0.511	6.635
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	1% critical value
None[1]	0.483	29.036	18.520
At most 1	0.012	0.511	6.635
log(PV_A_F$_t$) KR_CDE_4$_{t-1}$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	5% critical value
None[1]	0.300	16.762	15.495
At most 1	0.032	1.404	3.841
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	5% critical value
None[1]	0.300	15.358	14.265
At most 1	0.032	1.404	3.841
log(PV_A_F$_t$) KR_CDE_5$_t$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.422	24.751	19.937
At most 1	0.014	0.623	6.635
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	1% critical value
None[1]	0.422	24.129	18.520
At most 1	0.014	0.623	6.635

[1] Denotes rejection of the hypothesis at the 5% (1%) level.
[2] Trace test indicates 1 cointegration equation at the 1% level.
[3] Max-eigen test indicates 1 cointegration equation at the 1% level.

5.3 Johanssen Unrestricted Cointegration Rank Tests (cont.)

log(PV_A_F$_t$) KR_CDE_5$_{t-1}$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.445	25.535	19.937
At most 1	0.005	0.226	6.635
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	1% critical value
None[1]	0.445	25.309	18.520
At most 1	0.005	0.226	6.635
log(PV_CDE$_t$) KR_CDE_2$_t$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	5% critical value
None[1]	0.352	19.223	15.495
At most 1	0.002	0.110	3.841
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	5% critical value
None[1]	0.352	19.113	14.265
At most 1	0.002	0.110	3.841
log(PV_CDE$_t$) KR_CDE_2$_{t-1}$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.390	21.254	19.937
At most 1	0.001	0.023	6.635
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	1% critical value
None[1]	0.390	21.230	18.520
At most 1	0.001	0.023	6.635
log(PV_CDE$_t$) KR_CDE_4$_t$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.461	27.194	19.937
At most 1	0.000	0.018	6.635
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	1% critical value
None[1]	0.461	27.176	18.520
At most 1	0.000	0.018	6.635
log(PV_CDE$_t$) KR_CDE_4$_{t-1}$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	5% critical value
None[1]	0.346	18.264	15.495
At most 1	0.000	0.004	3.841
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	5% critical value
None[1]	0.346	18.259	14.265
At most 1	0.000	0.004	3.841

[1] Denotes rejection of the hypothesis at the 5% (1%) level.
[2] Trace test indicates 1 cointegration equation at the 1% level.
[3] Max-eigen test indicates 1 cointegration equation at the 1% level.

5.3 Johanssen Unrestricted Cointegration Rank Tests (cont.)

log(PV_CDE$_t$) KR_CDE_5$_t$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.398	22.300	19.937
At most 1	0.000	0.002	6.635
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	1% critical value
None[1]	0.398	22.298	18.520
At most 1	0.000	0.002	6.635
log(PV_CDE$_t$) KR_CDE_5$_{t-1}$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.407	22.649	15.495
At most 1	0.004	0.161	3.841
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	1% critical value
None[1]	0.407	22.488	14.265
At most 1	0.004	0.161	3.841
log(PV_CDE$_t$) KR_CDE_7$_t$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.429	24.622	19.937
At most 1	0.000	0.001	6.635
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	1% critical value
None[1]	0.429	24.621	18.520
At most 1	0.000	0.001	6.635
log(PV_CDE$_t$) KR_CDE_7$_{t-1}$			
Hypothesised No. of CE(s)	Eigenvalue	Trace statistic[2]	1% critical value
None[1]	0.419	23.322	19.937
At most 1	0.000	0.009	6.635
Hypothesised No. of CE(s)	Eigenvalue	Max-eigen statistic[3]	1% critical value
None[1]	0.419	23.314	18.520
At most 1	0.000	0.009	6.635

[1] Denotes rejection of the hypothesis at the 5% (1%) level.
[2] Trace test indicates 1 cointegration equation at the 1% level.
[3] Max-eigen test indicates 1 cointegration equation at the 1% level.

5.4 Results Produced by Useful Models

Dependent variable	log(PV_A_F$_t$)									
Sample	1993 Q2–2002 Q4		1993 Q3–2002 Q4		1993 Q2–2002 Q4		1993 Q3–2002 Q4		1993 Q3–2002 Q4	
	coef.	*t*-stat.	coef.	*t*-stat.	coef.	*t*-stat.	coef.	*t*-stat.	coef.	*t*-stat.
Constant	1.399	1.242	2.116	2.063	–0.011	–0.021	0.047	0.089	0.035	0.076
log(PV_A_F$_{t-1}$)	0.893	10.134	0.838	10.462	1.002	24.208	0.998	23.656	0.996	26.733
KR_CDE_2$_t$	0.001	1.981								
KR_CDE_2$_{t-1}$			0.002	2.916						
KR_CDE_4$_t$					–0.001	–2.596				
KR_CDE_4$_{t-1}$							–0.001	–2.354		
KR_CDE_5$_{t-1}$									0.001	3.396
Adjusted determination coefficient	0.952		0.960		0.955		0.957		0.963	
S.E. of regression	0.026		0.024		0.025		0.025		0.023	
Durbin–Watson statistic	2.359		1.627		2.562		2.115		2.141	
Probability (*F*-statistic)	0.000		0.000		0.000		0.000		0.000	
RESET test	0.371		0.975		0.176		0.164		0.509	
MAPE (2003 Q1–2004 Q3)	1.285		1.157		1.491		1.442		1.233	
Dependent variable	log(PV_CDE)									
Sample	1993 Q2–2002 Q4		1993 Q2–2002 Q4		1993 Q2–2002 Q4		1993 Q3–2002 Q4		1993 Q2–2002 Q4	
	coef.	*t*-stat.	coef.	*t*-stat.	coef.	*t*-stat.	coef.	*t*-stat.	coef.	*t*-stat.
Constant	1.729	1.536	1.592	1.388	0.327	0.611	0.404	0.685	–0.113	–0.206
log(PV_CDE$_{t-1}$)	0.862	9.427	0.873	9.390	0.975	21.992	0.968	19.882	1.009	22.089
KR_CDE_2$_t$	0.001	2.132								
KR_CDE_2$_{t-1}$			0.001	1.951						
KR_CDE_4$_t$					–0.001	–3.191				
KR_CDE_4$_{t-1}$							–0.001	–2.666		
KR_CDE_5$_t$									0.001	1.830
Adjusted determination coefficient	0.939		0.938		0.946		0.942		0.937	
S.E. of regression	0.028		0.028		0.026		0.027		0.028	
Durbin–Watson statistic	1.673		1.319		1.877		1.538		1.706	
Probability (*F*-statistic)	0.000		0.000		0.000		0.000		0.000	
RESET test	0.761		0.975		0.551		0.413		0.589	
MAPE (2003 Q1–2004 Q3)	1.247		1.105		1.316		1.205		1.237	

5.4 Results Produced by Useful Models (cont.)

Dependent variable	**log(PV_CDE)**					
Sample	1993 Q3–2004 Q4		1993 Q2–2004 Q4		1993 Q3–2004 Q4	
	coef.	*t*-stat.	coef.	*t*-stat.	coef.	*t*-stat.
Constant	0.215	0.421	0.461	0.723	0.379	0.543
log(PV_CDE_{t-1})	0.981	23.055	0.963	18.283	0.970	16.838
$KR\_CDE\_5_{t-1}$	0.002	3.488				
$KR\_CDE\_7_{t}$			0.001	2.279		
$KR\_CDE\_7_{t-1}$					0.001	1.723
Adjusted determination coefficient	0.949		0.940		0.936	
S.E. of regression	0.026		0.028		0.029	
Durbin–Watson statistic	1.542		1.487		1.483	
Probability (*F*-statistic)	0.000		0.000		0.000	
RESET test	0.705		0.704		0.548	
MAPE (2003 Q1–2004 Q3)	1.177		1.164		1.134	

Dependent variable	**dlog($PV\_A\_F_t$)**						**dlog(PV_CDE_t)**			
Sample	1993 Q4–2002 Q4		1993 Q4–2002 Q4		1997 Q1–2004 Q3		1993 Q4–2002 Q4		1997 Q1–2004 Q3	
	coef.	*t*-stat.	coef.	*t*-stat.	coef.	*t*-stat.	coef.	*t*-stat.	coef.	*t*-stat.
Constant	0.008	1.990	0.009	2.164	0.016	3.536	0.008	1.597	0.014	2.526
d($KR\_CDE\_2_{t-1}$)	0.002	3.141								
d($KR\_CDE\_4_{t-1}$)			–0.001	–2.036			–0.001	–1.669		
d($KR\_CDE\_12_{t-1}$)					0.001	1.882			0.002	1.931
Adjusted determination coefficient	0.198		0.080		0.100		0.047		0.106	
S.E. of regression	0.024		0.025		0.023		0.029		0.028	
Durbin–Watson statistic	1.809		1.995		1.336		1.420		0.925	
Probability (*F*-statistic)	0.003		0.049		0.073		0.104		0.067	
RESET test	0.212		0.098		0.588		0.154		0.495	
MAPE (2003 Q1–2004 Q3)	1.249		1.347		0.889		1.189		0.943	

6. CONSTRUCTION SURVEY INDICATORS

6.1 Time Series Stationarity Test

	ADF(1)	ADF(2)	ADF(3)	ADF(1)	ADF(2)	ADF(3)
Indicator	Level			Difference		
KR_F_1	–3.00**	–2.49	–2.03	–5.58***	–5.03***	–4.04***
KR_F_3	–1.12	0.56	–0.96	–6.04***	–3.25**	–2.89*
KR_F_4	–2.39	–2.01	–1.38	–5.87***	–5.19***	–3.85***
KR_F_5	–1.19	–1.03	–0.79	–5.23***	–3.90***	–1.03

***, **, * Statistical significance of coefficient at 1%, 5% and 10% level, respectively.

6.2 Granger Causality Tests with One Month Lag

Level		Differences	
Null hypothesis	Probability	Null hypothesis	Probability
KR_F_1 does not GC[1] log(PV_A_F)	0.671	d(KR_F_1) does not GC dlog(PV_A_F)	0.317
KR_F_3 does not GC log(PV_A_F)	0.527	d(KR_F_3) does not GC dlog(PV_A_F)	0.580
KR_F_4 does not GC log(PV_A_F)	0.333	d(KR_F_4) does not GC dlog(PV_A_F)	0.645
KR_F_5 does not GC log(PV_A_F)	0.298	d(KR_F_5) does not GC dlog(PV_A_F)	0.497
KR_F_1 does not GC log(PV_F)	0.602	d(KR_F_1) does not GC dlog(PV_F)	0.811
KR_F_3 does not GC log(PV_F)	**0.033**	**d(KR_F_3) does not GC dlog(PV_F)**	**0.097**
KR_F_4 does not GC log(PV_F)	0.851	d(KR_F_4) does not GC dlog(PV_F)	0.486
KR_F_5 does not GC log(PV_F)	0.313	d(KR_F_5) does not GC dlog(PV_F)	0.761

[1] Granger Cause.

7. RETAIL TRADE SURVEY INDICATORS

7.1 Time Series Stationarity Test

	ADF(1)	ADF(2)	ADF(3)	ADF(1)	ADF(2)	ADF(3)
Indicator	Level			Difference		
KR_G_1	–2.25	–1.42	–2.18	–6.39***	–3.98***	–3.30**
KR_G_2	–1.42	–1.12	–1.11	–5.83***	–4.08***	–3.46**
KR_G_3	–1.69	–2.25	–2.00	–5.23***	–3.76***	–3.98***
KR_G_4	–2.83*	–2.16	–2.71*	–7.00***	–4.48***	–3.19**
KR_G_5	–2.83*	–2.01	–2.80*	–6.96***	–3.75***	–3.53**

***, **, * Statistical significance of coefficient at 1%, 5% and 10% level, respectively.

7.2 Granger Causality Tests with One Month Lag

Level		Difference	
Null hypothesis	Probability	Null hypothesis	Probability
KR_G_1 does not GC[1] log(PV_G_O)	0.116	d(KR_G_1) does not GC dlog(PV_G_O)	0.296
KR_G_2 does not GC log(PV_G_O)	0.338	d(KR_G_2) does not GC dlog(PV_G_O)	0.229
KR_G_3 does not GC log(PV_G_O)	0.794	d(KR_G_3) does not GC dlog(PV_G_O)	0.763
KR_G_4 does not GC log(PV_G_O)	0.793	**d(KR_G_4) does not GC dlog(PV_G_O)**	**0.077**
KR_G_5 does not GC log(PV_G_O)	0.341	d(KR_G_5) does not GC dlog(PV_G_O)	0.660
KR_G_1 does not GC log(PV_G)	0.384	d(KR_G_1) does not GC dlog(PV_G)	0.165
KR_G_2 does not GC log(PV_G)	0.476	d(KR_G_2) does not GC dlog(PV_G)	0.275
KR_G_3 does not GC log(PV_G)	0.962	d(KR_G_3) does not GC dlog(PV_G)	0.608
KR_G_4 does not GC log(PV_G)	0.636	d(KR_G_4) does not GC dlog(PV_G)	0.957
KR_G_5 does not GC log(PV_G)	0.612	d(KR_G_5) does not GC dlog(PV_G)	0.208

[1] Granger Cause.

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Latvijas Banka (Bank of Latvia)
K. Valdemāra ielā 2A, Riga, LV-1050, Latvia
Phone: +371 702 2300   Fax: +371 702 2420
http://www.bank.lv
info@bank.lv
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