

## The Role of Survey Data in the Construction of Short-term GDP Growth Forecasts\*

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### Abstract

The aim of this paper is to investigate the role of Business and Consumer Survey data, published by the European Commission, in the construction of short-term gross domestic product (GDP) growth forecasts. A pseudo out-of-sample forecasting exercise is conducted in which the availability of data mimics real-time releases. A sequence of GDP growth estimates is computed starting 5½ months prior to the publication of GDP growth and ending about 10 days before the release of the actual figure. The focus of the analysis is on Cyprus and some of its key trading partners. Due to the openness of the Cypriot economy, timely information on the expected economic performance of Cyprus's main trading partners is crucial to the assessment of domestic prospects and challenges. The analysis for Cyprus reveals that the use of survey data improves the accuracy of GDP growth estimates, but the forecasting gains are not always statistically significant. The improvements in forecast accuracy from the use of survey data are larger and more significant for the euro area, the European Union and Greece compared to those for Cyprus, while survey predictors are not found to enhance the precision of GDP growth estimates for the United Kingdom. Thus, survey information for the European Union and the euro area as a whole, as well as for Greece, can be used by practitioners to extract reliable signals for the short-term growth prospects of these economies and identify risks to the outlook for the Cypriot economy. The use of survey data for Cyprus resulted in large forecasting gains during the international financial crisis and its aftermath and predicted the depth of the recession in 2009 and 2013 fairly accurately. Moreover, information from the Business and Consumer Surveys correctly signalled the moderation of the recession in Cyprus in 2013–2014.

**Keywords:** Business and Consumer Surveys, GDP growth forecasting.

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## 1. Introduction

The construction of gross domestic product (GDP) growth forecasts for the present and the short term is an essential task for Central Banks, governments and other organisations as the official GDP data are published with a considerable delay. Thus, policy decisions, which rely on assessments of current and future economic conditions, render the publication of timely information regarding the state of the economy a vital tool. Such timely information could be in the form of survey-based economic confidence indicators, which could also be employed in the construction of GDP growth forecasts on a monthly basis. Survey data, which cover different sectors of the economy, are typically released at the end of the reference month and therefore could constitute useful predictors of activity growth.

Because of the importance of survey data in assessing the state of the economy, the European Commission runs harmonised monthly surveys in the member states of the European Union (EU) and in the candidate countries and publishes the country-specific data as well as the results at the EU and euro area (EA) level. The data include aggregate responses to individual survey questions, composite indicators for industry, construction, services and the retail trade sector, a consumer confidence indicator and an economic sentiment indicator for the economy as a whole (European Commission, 2016).

The release of confidence indicators is widely covered by the media and the evolution of economic sentiment is closely monitored by practitioners. Nonetheless, empirical evidence for the information that survey data convey about future aggregate activity is not clear-cut. Batchelor and Dua (1998) conclude that the sharp drop in consumer confidence was helpful in predicting the 1991 recession in the United States (US), but movements in consumer confidence were not found to improve consensus forecasts for other years. Ludvigson (2004) finds that the Michigan and Conference Board Indices of consumer confidence increase modestly the predictive power for consumption growth beyond baseline indicators, such as income, the interest rate, stock market returns and past consumption growth; moreover, the two indices are associated with higher forecasting power than their expectation components. Using data for large European countries and the US, Al-Eyd et al. (2009) find that the information content of confidence indicators in explaining consumption growth is limited when other macro series are taken into account. Claveria et al. (2007) augment various time series models for EA macroeconomic variables with information from business and consumer surveys and conclude that the inclusion of survey variables in the models leads to statistically significant

forecast gains only in a limited number of cases. Cotsomitis and Kwan (2006) examine the ability of different measures of confidence from EU business and consumer surveys to predict real consumption expenditure across nine EU countries; they conclude that the out-of-sample predictive power of the measures considered is weak.

More recent research, however, stresses the importance of the timeliness of survey information for real-time forecasting, especially for the construction of short-term forecasts, also known as nowcasts. Giannone et al. (2008) advocate the use of large datasets of monthly economic and financial series for updating nowcasts of GDP growth within a quarter with newly released monthly data. Their application for the US demonstrates that as from the second month of the quarter, new releases, including survey data, increase the precision of the GDP growth nowcast. A large monthly dataset of real activity, survey and financial series is employed by Bańbura and Rünstler (2011) for forecasting EA GDP growth; they find an important role for survey data due to their timely availability, while real activity indicators become less relevant once their publication lags are taken into account. Angelini et al. (2011) and Girardi et al. (2014) exploit the information in large monthly datasets, which also contain survey data, and take into consideration asynchronous data releases in the construction of short-term forecasts for EA GDP growth. The aforementioned works that use extensive datasets attain parsimonious model specifications by using factor models, which summarise the information from a large number of series in a small number of common factors, or by combining forecasts from many small models.

The aim of this paper is to investigate the role of business and consumer survey data published by the European Commission in the construction of short-term GDP growth forecasts. A pseudo out-of-sample forecasting exercise is conducted in which the availability of data mimics real-time releases and GDP growth forecasts are updated at the beginning of each month, i.e. right after the publication of the European survey data at the end of the previous month. At the beginning of each month, two forecasts are computed: one for the previous (backcast) and one for the current (nowcast) quarter or one for the current and one for the next quarter, depending on the month (first, second or third) of the quarter when the forecasts are computed. The focus of the analysis is on Cyprus and some of its key trading partners, namely the EU, the EA, the United Kingdom (UK) and Greece. Due to the openness of the Cypriot economy, timely information on the expected economic performance of Cyprus's trading partners is crucial to the assessment of the domestic economic outlook.

In the case of Cyprus, the idea of updating short-term forecasts for GDP and its demand components on a monthly basis, using a large number of monthly variables, is applied in Papamichael et al. (2014) and in Papamichael and Pashourtidou (2014). No evidence of substantial improvements in forecasting performance with the arrival of new monthly information within the quarter is found; however, forecast combinations based on the models' historical performance, especially factor-augmented models, improve upon the accuracy of the naïve forecasts. Furthermore, the inclusion of forecasts from models with business and consumer survey predictors in a large pool of forecasts constructed using macroeconomic and financial predictors is not found to increase the precision of combination forecasts in Papamichael et al. (2014).

The paper is organised as follows. Section 2 describes the data and provides some preliminary results. Section 3 describes the methodology used for constructing forecasts employing monthly information, prior to the release of the GDP growth flash estimate. Section 4 presents the results of the pseudo out-of-sample forecasting exercise in which the GDP growth forecasts are updated every month with the arrival of new monthly survey data. Section 5 investigates the evolution of the forecasting performance of survey data during the recent crises. Section 6 summarises the key findings and concludes.

## 2. Data

Monthly data from the European Commission's Business and Consumer Surveys (BCS) over the period 2000–2015 and quarterly GDP (constant prices) data over 2000Q1–2015Q3 for Cyprus, the EU, the EA, the UK and Greece are used. More specifically, in the analysis we use the Economic Sentiment Indicator (ESI), the composite confidence indicators for industry, construction, services, retail trade and consumers, as well as the aggregate responses of firms or consumers to BCS questions. The aggregate responses are in the form of differences between the percentages of optimistic and pessimistic replies.<sup>1</sup>

In the Business Surveys firms are asked, *inter alia*, to assess recent trends in the following: production (industry), demand (services), sales (retail trade), building activity (construction), employment (services), order books (industry and construction) and stocks (industry and retail trade). Respondents also state their expectations concerning production (industry), demand (services), sales (retail trade), orders to suppliers (retail

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<sup>1</sup> All variables are seasonally adjusted and transformed into stationary series.

trade), selling prices and employment. In the Consumer Survey interviewees are asked, among other things, to state their perceptions and expectations regarding the financial situation of the household, the economic conditions in the country and prices. Consumers also report their expectations concerning unemployment, as well as their intentions to save money and make major purchases in the short term. The business confidence indicators reflect firms' assessments over the past three months and expectations over the next three months; the consumer confidence indicator is based on consumers' expectations over the next 12 months. The overall index, ESI, is composed of all the components of the composite confidence indicators and thus can be viewed as summarising recent and future trends in the economy as a whole.

Figure 1 plots the percentage changes in real GDP expressed with respect to the previous quarter, i.e. quarter-on-quarter (q-o-q), together with the quarterly changes in the ESI. For the largest part of the period shown, there is a similarity between fluctuations in economic sentiment and changes in activity. At the outbreak of the global financial crisis, economic sentiment declined prior to or at the same time as GDP. The largest drop in the sentiment index was registered in the final quarter of 2008, but the largest quarterly GDP decline over 2008–2009 was experienced first in the UK (2008Q4), then in the EU and in the EA, including Greece (2009Q1), followed by Cyprus (2009Q2). The heightened uncertainty triggered by the financial crisis led to increased variability in GDP growth and economic sentiment. The debt crisis in 2010–2013 that affected the EA, mostly Greece, is well reflected in the movements of the ESI in all cases, although the evolution of real output differs. Real GDP in the EA was contracting (q-o-q) over 2011Q2–2013Q1; the recession in Greece continued after the end of the downturn in the EA, while the recession in Cyprus deepened later. Real output growth in the EU turned negative in 2011Q4–2012Q2 and again in 2012Q4–2013Q1, while activity in the UK was expanding, albeit rather irregularly. The economic sentiment in Cyprus recovered rather quickly after the trough in 2013, indicating the easing of the recession. The increase in economic and political uncertainty in Greece at the end of 2014 and in 2015 is depicted by the consecutive declines in the country's economic sentiment. The rise in uncertainty in Greece had a limited effect on economic confidence in Cyprus and no impact on the EA-wide ESI.

FIGURE 1

## GDP growth and ESI changes

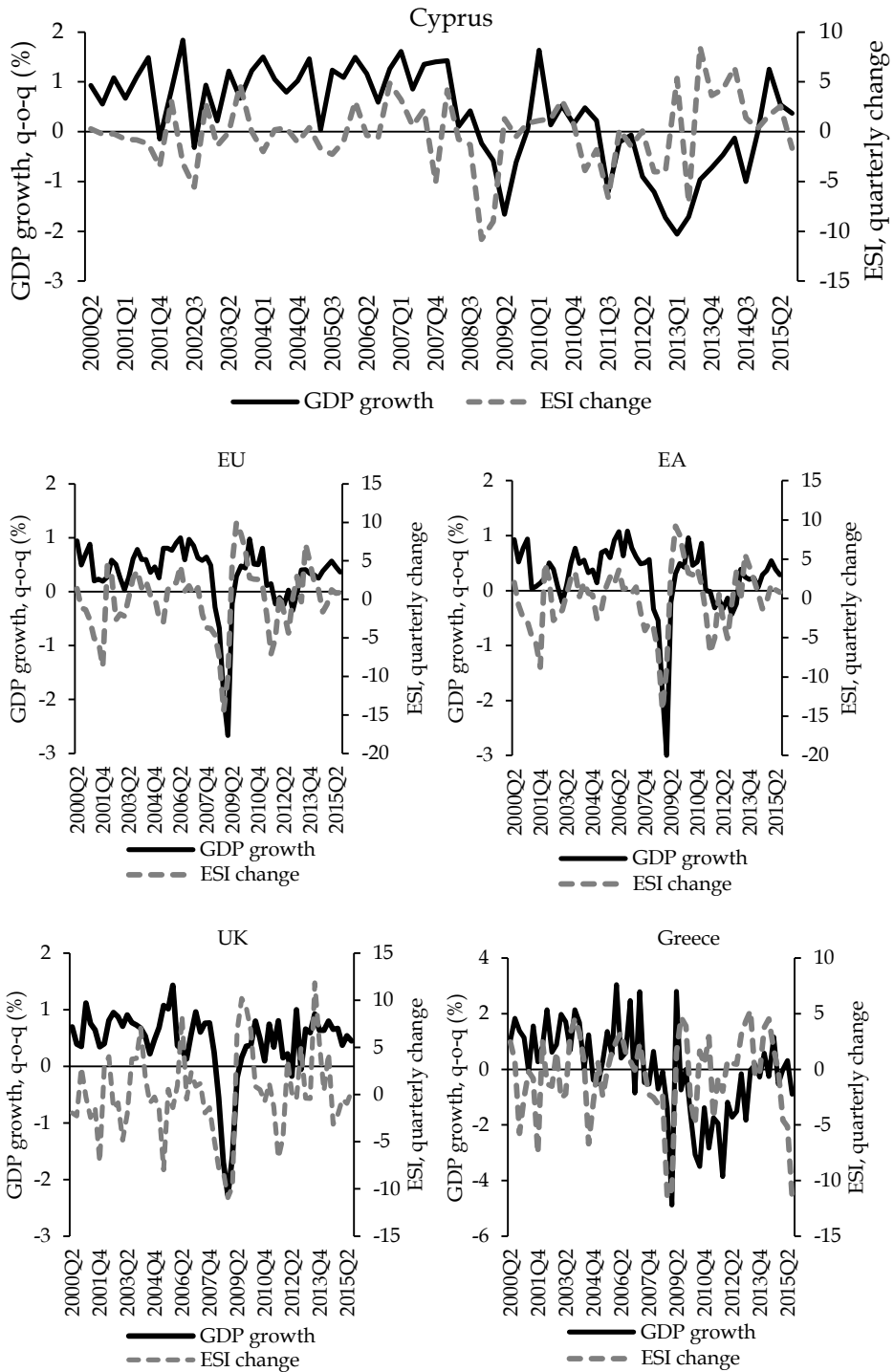


Table 1 shows the correlation between GDP growth (q-o-q) and the quarterly ESI changes at different lags of the ESI changes for two sub-sample periods, before 2008 and from 2008 onwards, as well as for the full sample period. Prior to 2008 the linear relationship between the two indicators was rather weak. The correlation coefficient is significant only for the EU and the EA, with some evidence of the leading and coinciding properties of sentiment with respect to GDP growth.

TABLE 1  
*Correlation coefficient between GDP growth and ESI changes<sup>1</sup>*

	ESI changes lagged by:				
	4 quarters	3 quarters	2 quarters	1 quarter	0 quarters
<i>2000-2007</i>					
Cyprus	0.07	0.20	0.03	0.26	0.28
EU	-0.03	0.06	0.31*	0.46*	0.49*
EA	0.04	0.15	0.40*	0.46*	0.47*
UK	-0.03	-0.08	-0.37*	-0.11	-0.22
Greece	-0.03	-0.21	0.03	0.26	0.19
<i>2008-2015</i>					
Cyprus	0.03	0.25	0.36*	0.15	0.17
EU	0.27	0.37*	0.53*	0.74*	0.69*
EA	0.23	0.32*	0.50*	0.76*	0.68*
UK	0.25	0.39*	0.57*	0.58*	0.54*
Greece	0.04	-0.01	-0.05	0.18	0.30*
<i>2000-2015</i>					
Cyprus	0.03	0.20	0.24*	0.16	0.15
EU	0.21	0.30*	0.46*	0.63*	0.58*
EA	0.18	0.27*	0.45*	0.64*	0.57*
UK	0.18	0.27*	0.36*	0.41*	0.36*
Greece	0.01	-0.06	0.00	0.20	0.27*

Note: <sup>1</sup> The symbol \* denotes statistical significance at 10% level.

As shown in Table 1, over the period 2008–2015, the relationship between activity growth and changes in economic sentiment strengthens and becomes statistically significant. After 2007, the country blocs (EU and EA) and the UK are associated with the highest correlations between the two series; the corresponding correlation coefficients peak at the first lag, suggesting that the ESI changes in the current quarter are strongly linked to the growth rate of GDP in the next quarter. For Cyprus, the correlation is highest at the second lag of the ESI changes, indicating that economic sentiment provides signals for GDP growth as early as two quarters ahead.

For Greece, the relationship between economic sentiment movements and GDP growth appears to be contemporaneous. The correlation patterns for the full sample are the same as in the post-2007 period.

Looking at the correlation of sectoral confidence indicators with GDP growth for the full sample period provides an idea of the main drivers of the relationship between economic sentiment and growth. For Cyprus, changes in confidence in the retail trade and industry sectors are more strongly correlated with GDP growth than confidence movements in other sectors; nevertheless, after 2007 fluctuations in economic activity are more closely linked to changes in economic sentiment in services and construction. For the EU and the EA, the confidence indicators for industry and construction are found to track future GDP growth more closely than other confidence indicators. Economic activity movements in the UK are strongly associated with changes in confidence in the construction sector. For Greece, the retail trade and consumer confidence indicators are significantly correlated with output growth; the consumer and services confidence indicators gain further significance after 2007.<sup>2</sup>

In addition to the in-sample properties of survey data, it is useful to evaluate their out-of-sample forecasting power for GDP growth by taking into account the timeliness of their availability.

### 3. Forecasting exercise

The early signs of changes in economic conditions contained in the monthly BCS data can be exploited to construct GDP growth estimates well ahead of the publication of official data. Early GDP growth estimates can be obtained using bridge models that link monthly variables, the publication lag of which is relatively short, with quarterly data, such as GDP growth, which are released much later (e.g. Angelini et al., 2011; Barhoumi et al., 2012).

#### 3.1. Forecasting schedule

The exact form of the forecasting equation and therefore the amount of monthly leading information incorporated in the model depends on the schedule set for the construction of the forecasts. Here, we assume that the computation of early GDP growth estimates is carried out in the first couple of days of each month, i.e. right after the release of monthly BCS data for the previous month. This schedule implies that in each monthly forecast round in a given quarter,  $Q$ , the available GDP data that can be

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<sup>2</sup> The results for sectoral confidence indicators are available upon request.

used for estimation lag either two quarters or one quarter with respect to  $Q$ . When the forecasts are computed in the first and second month of  $Q$ , the available GDP data are two quarters behind  $Q$ . When the estimates are computed in the final month of  $Q$ , the most recent GDP data cover the previous quarter.<sup>3</sup> Moreover, in each monthly forecast round, the GDP growth estimates are computed for one and two quarters ahead.

Table 2 shows the available data at the beginning of each month when the growth estimates are constructed, the forecast horizon and the number of months to the official release of actual GDP growth. According to our forecasting schedule, the growth estimates computed in the second month of each quarter – and therefore closer to the publication of the actual figure – use the greatest amount of BCS information, while the opposite holds for nowcasts and forecasts produced in the final month of the quarter. As indicated in Table 2, the forecasting schedule has the following features:

- (i) In the first couple of days of the *first* month of each quarter, we produce GDP growth estimates for the *previous* and the *current* quarter; therefore, these estimates are computed at most  $1\frac{1}{2}$  and  $4\frac{1}{2}$  months prior to the publication of GDP growth respectively.
- (ii) The above procedure is repeated in the first couple of days of the *second* month of each quarter when the construction of growth estimates for the *previous* and the *current* quarter precedes the release of GDP growth by at most  $\frac{1}{2}$  and  $3\frac{1}{2}$  months respectively.
- (iii) Early in the *third* month of the quarter, growth estimates for the *current* and the *next* quarter are computed, thus obtaining nowcasts and forecasts at most  $2\frac{1}{2}$  and  $5\frac{1}{2}$  months prior to the official announcement respectively.

This forecasting schedule suggests that we compute six different forecasts (i.e. one in each month) for the growth rate of GDP in a given quarter. The first forecast is produced at most  $5\frac{1}{2}$  months prior to the official release and the last estimate is computed about 10 days before the GDP release. The highlighted rows of Table 2 provide an example of the sequence of the six consecutive forecasts.

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<sup>3</sup> This schedule employs the GDP flash estimate published 45 days after the end of the reference quarter as the official release of GDP growth. For the UK, a preliminary flash estimate is available 25 days after the end of the reference quarter; this estimate is used in the construction of the EU GDP flash estimate published 45 days after the end of the reference quarter (Eurostat, 2003).

### 3.2 Modelling

In each monthly forecast round, the growth rate of GDP is modelled as a function of its past values and one survey indicator at a time. As new BCS data are released every month, the information set regarding the survey predictor and therefore the model used in each monthly forecast round changes. A detailed description of the model is given in the Appendix. The estimation of the parameters and the selection of the number of lags in the estimated models are carried out in a pseudo out-of-sample setup using recursive ordinary least squares (OLS) and recursive determination of the lag length based on the Akaike information criterion (AIC) and the Bayesian information criterion (BIC). For comparison purposes, we also estimate simple autoregressive models for GDP growth. The forecasting performance of each model is evaluated using the mean squared forecast error (MSFE).

As different bridge equations can be estimated using alternative survey variables, the resulting forecasts can be combined using a forecast combination method (e.g. Stock and Watson, 2004). Forecast combinations are weighted averages of individual model forecasts; they can result in more accurate forecasts by using evidence from all the models considered rather than relying on a specific model (e.g. Stock and Watson, 2004, 2008). Forecast combinations reduce the uncertainty resulting from the specification of individual models due to their different sets of predictors, lag structures and modelling approaches. Simple combinations, such as the mean or median forecast, rely on fixed weights. More complex combinations use weights that depend on the historical forecasting performance of each model assessed through its MSFE; the resulting combinations are known as discounted MSFE forecasts as forecast errors that occurred in the distant past are typically discounted more heavily than recent ones. Details can be found in the Appendix.

TABLE 2

*Forecasting schedule: data availability, forecast horizon and number of months to the official release of GDP growth*

Quarter i in year Y: Qi(Y)	Q1(Y)			Q2(Y)			Q3(Y)			Q4(Y)		
Month j in year Y: Mj(Y)	M1(Y)	M2(Y)	M3(Y)	M4(Y)	M5(Y)	M6(Y)	M7(Y)	M8(Y)	M9(Y)	M10(Y)	M11(Y)	M12(Y)
<i>Data availability when the estimates are computed</i>												
GDP, reference quarter	Q3(Y-1)	Q3(Y-1)	Q4(Y-1)	Q4(Y-1)	Q4(Y-1)	Q1(Y)	Q1(Y)	Q1(Y)	Q2(Y)	Q2(Y)	Q2(Y)	Q3(Y)
BCS data, reference month	M12(Y-1)	M1(Y)	M2(Y)	M3(Y)	M4(Y)	M5(Y)	M6(Y)	M7(Y)	M8(Y)	M9(Y)	M10(Y)	M11(Y)
<i>GDP growth forecast horizon</i>												
<u>One quarter ahead</u>												
Quarter forecasted:	Previous Q4(Y-1)	Previous Q4(Y-1)	Current Q1(Y)	Previous Q1(Y)	Previous Q1(Y)	Current Q2(Y)	Previous Q2(Y)	Previous Q2(Y)	Current Q3(Y)	Previous Q3(Y)	Previous Q3(Y)	Current Q4(Y)
No. of months to the GDP growth official release <sup>1</sup>	1-1½	< ½	2-2½	1-1½	< ½	2-2½	1-1½	< ½	2-2½	1-1½	< ½	2-2½
<u>Two quarters ahead</u>												
Quarter forecasted:	Current Q1(Y)	Current Q1(Y)	Next Q2(Y)	Current Q2(Y)	Current Q2(Y)	Next Q3(Y)	Current Q3(Y)	Current Q3(Y)	Next Q4(Y)	Current Q4(Y)	Current Q4(Y)	Next Q1(Y+1)
No. of months to the GDP growth official release <sup>1</sup>	4-4½	3-3½	5-5½	4-4½	3-3½	5-5½	4-4½	3-3½	5-5½	4-4½	3-3½	5-5½

Notes: <sup>1</sup> The growth estimates are computed early in each month.

<sup>2</sup> The GDP growth official release refers to the publication of the flash estimate 45 days after the end of the reference quarter.

#### 4. Forecasting performance

We use data for 38 monthly BCS variables, including composite confidence indicators, with the availability pattern shown in Table 2.<sup>4</sup> At the beginning of each monthly forecast round, survey data may capture developments in the economy that have not yet been reflected in the available GDP data. The sample for the forecasting exercise covers the period 2000Q1 to 2015Q3; monthly BCS data from October to December 2015 are also used. The pseudo out-of-sample forecasts for the growth rate of GDP are constructed over the period 2006Q2–2015Q3.

Tables 3 and 4 present the results of the forecasting exercise, comparing the forecasting performance (forecast error) of models using BCS predictors to that of the simple autoregressive model.<sup>5</sup> According to the forecasting schedule, two GDP growth estimates, for a horizon of one quarter and two quarters ahead, are constructed every month, using the latest monthly BCS information. This schedule results in three different sets of forecast errors for each horizon: one for each month of the quarter. The autoregressive model produces one forecast per quarter and thus the error remains unchanged within a quarter.

Table 3 and Table A1 (Appendix) show the square root of the MSFE (RMSFE) of models that include the key survey confidence indicators (one at a time), relative to the RMSFE of the autoregressive model. The results for one-quarter-ahead forecasts, computed less than two weeks to 2½ months prior to the GDP release, are presented in the top panel; the lower panel shows the relative errors for two-quarter-ahead forecasts, estimated 3 to 5½ months before the GDP release. The relative errors are ordered in columns according to the available information set in each monthly forecast round, starting from that with the most information (first column) and moving towards the round with the least information (third column). The results in the first (second, third) column relate to the forecasts computed less than two weeks (1–1½ months, 2–2½ months) before the GDP publication date.

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<sup>4</sup> We use revised GDP data of current vintages that might differ from the flash estimate releases. For the EA, Diron (2008) finds that the use of revised as opposed to real-time data in forecasting exercises does not seem to bias the reliability of the assessments.

<sup>5</sup> Tables 3 and 4 continue in Tables A1 and A2, provided in the Appendix, respectively.

TABLE 3  
Forecasting performance of key survey indicators

Forecasts estimated early in:	Cyprus			EU			EA		
	Feb	Jan	Mar	Feb	Jan	Mar	Feb	Jan	Mar
	May	Apr	Jun	May	Apr	Jun	May	Apr	Jun
	Aug	Jul	Sep	Aug	Jul	Sep	Aug	Jul	Sep
	Nov	Oct	Dec	Nov	Oct	Dec	Nov	Oct	Dec
One quarter ahead									
No. of months to the GDP growth official release	<½	1-1½	2-2½	<½	1-1½	2-2½	<½	1-1½	2-2½
Autoregression (benchmark) <sup>1</sup>	0.93	0.93	0.93	0.50	0.50	0.50	0.59	0.59	0.59
<i>BCS confidence indicators, AIC for lag length selection<sup>2</sup></i>									
Economic Sentiment	1.09	1.06	1.00	0.94	0.89	1.00	0.91	0.90	0.91
Industry	1.10	1.10	1.11	1.01	0.97	0.98	0.95	0.93	0.93
Construction	1.02	1.01	0.92	1.11	0.97	0.98	0.99	0.98	1.02
Services	1.09	1.07	1.06	0.97	1.00	1.05	0.90	0.90	0.93
Retail Trade	0.92	0.98	0.96	1.06	1.04	1.05	1.08	1.06	1.05
Consumer	1.14	1.11	1.17	1.13	1.02	1.03	1.04	1.11	1.13
<i>BCS confidence indicators, BIC for lag length selection<sup>2</sup></i>									
Economic Sentiment	1.09	1.09	1.12	0.94	0.85	0.86	0.89	0.87	0.90
Industry	1.07	1.12	1.28	0.98	0.87	0.97	0.90	0.85*	0.84*
Construction	1.05	1.06	1.04	0.97	0.98	0.98	0.98	0.97	0.98
Services	1.09	1.08	1.07	0.87*	0.86*	1.02	0.87*	0.86*	0.90
Retail Trade	1.08	1.04	1.06	1.04	1.03	0.97	0.99	0.98	1.01
Consumer	1.15	1.11	1.17	1.04	0.94	0.96	1.04	1.09	1.09
Two quarters ahead									
No. of months to the GDP growth official release	3-3½	4-4½	5-5½	3-3½	4-4½	5-5½	3-3½	4-4½	5-5½
Autoregression (benchmark) <sup>1</sup>	1.91	1.91	1.91	1.24	1.24	1.24	1.29	1.29	1.29
<i>BCS confidence indicators, AIC for lag length selection<sup>2</sup></i>									
Economic Sentiment	0.99	0.95	1.00	0.91	0.90	0.94	0.67*	0.76*	0.82
Industry	0.93	0.91	0.95	0.94	1.01	0.83	0.70*	0.78	0.73*
Construction	0.85*	0.95	0.95	0.74*	0.77*	0.78	0.89	0.89	0.91
Services	1.01	1.00	1.00	0.81	0.86	0.98	0.81	0.89	0.93
Retail Trade	0.80*	0.87	0.89	0.97	0.98	1.01	0.81	0.80	0.87
Consumer	1.04	1.01	1.08	1.03	0.94	0.96	0.95	0.92	0.92
<i>BCS confidence indicators, BIC for lag length selection<sup>2</sup></i>									
Economic Sentiment	1.01	1.03	1.05	0.93	0.94	0.93	0.75*	0.74	0.82
Industry	0.94	1.17	1.05	0.93	0.97	0.93	0.80	0.81	0.77*
Construction	0.89	1.00	1.03	0.74*	0.76*	0.78*	0.86	0.85	0.79*
Services	1.02	1.03	1.04	0.93	0.93	1.02	0.79	0.82	0.92
Retail Trade	0.91	1.07	1.06	0.99	0.98	1.00	0.80*	0.81	0.86
Consumer	1.06	1.04	1.06	1.04	0.99	0.98	0.96	0.92	0.97

Notes: <sup>1</sup> An autoregressive model of order four for Cyprus; a first order autoregressive model for the EU and the EA.

<sup>2</sup> The symbol \* denotes statistical significance at 10% level of the modified Diebold-Mariano test of equal forecast accuracy (Diebold and Mariano, 1995; Harvey et al., 1997). The tests compare the forecasts errors from the benchmark model to those from the models with survey variables.

For one-quarter-ahead growth forecasts for Cyprus, no statistically significant gains are achieved from the use of any of the key domestic BCS indicators; nevertheless, the inclusion of the retail trade confidence indicator in the model seems to improve on the autoregressive benchmark. Models that include the confidence indicators for retail trade and construction outperform the benchmark in the case of two-quarter-ahead forecasts for Cyprus; however, the difference in predictive accuracy is statistically significant only when the estimates are computed 3 to 3½ months before the GDP growth release.

The use of the EU services confidence indicator significantly enhances the forecasting precision of the simple autoregression when the estimates are calculated at most 1½ months before the GDP growth announcement. For longer horizons, i.e. 3 to 5½ months before the release, the use of the construction confidence indicator is associated with the lowest forecast error.

The accuracy of the EA growth estimates is improved when the confidence indicator for industry or services is exploited for forecasting at most 2½ months before the GDP publication. Models that include the ESI or the industry confidence indicator are significantly better than the benchmark for EA growth forecasts estimated 3 to 5½ months before the release.

Looking at Cyprus's two key European trading partners, we find that survey indicators provide signals for future GDP growth in Greece, but the autoregressive benchmark beats survey-based forecasts almost uniformly in the case of the UK (Table A1). The Greek industrial confidence indicator improves significantly on the benchmark for both horizons, while the ESI is associated with significantly smaller forecast errors than the autoregressive model when the estimates are constructed less than 2½ months prior to the release of the actual figure.

Table 4 and Table A2 (Appendix) compare the performance of forecast combinations based on models with BCS variables to that of the autoregressive benchmark. The tables show the RMSFE values of forecast combinations relative to those of the autoregressive model. Four different combination methods are considered, namely the median and the mean forecasts, as well as the weighted averages of forecasts for which the weights depend on past forecasting performance (i.e. MSFE). The results are ordered according to the time interval between the construction of the estimate and the GDP release, starting from the shortest interval in the first column. We consider combinations of forecasts from models that include the following: (a) composite sectoral confidence indicators; (b) variables related to all individual BCS questions; (c) variables concerning BCS

questions on current conditions; (d) variables concerning BCS questions on expectations.

In the case of Cyprus, combining forecasts from models with sectoral confidence indicators or variables based on individual BCS questions is not found to lead to more accurate predictions vis-à-vis the autoregressive benchmark when the estimates are computed at most 2½ months before the release of GDP. Forecast combinations that incorporate information from the composite confidence indicators or the individual survey questions concerning expectations generate some gains against the benchmark for forecasts calculated 3 to 5½ months prior to the release of GDP. However, only the gains from forecast combinations using the mean and discounted MSFE methods constructed 3 to 3½ months before the GDP release are statistically significant.

TABLE 4  
*Forecasting performance of forecast combinations*

	Cyprus			EU			EA		
	Feb May Aug Nov	Jan Apr Jul Oct	Mar Jun Sep Dec	Feb May Aug Nov	Jan Apr Jul Oct	Mar Jun Sep Dec	Feb May Aug Nov	Jan Apr Jul Oct	Mar Jun Sep Dec
Forecasts estimated early in:									
	One quarter ahead								
No. of months to the GDP growth official release	<½	1-1½	2-2½	<½	1-1½	2-2½	<½	1-1½	2-2½
Autoregression (benchmark) <sup>1</sup>	0.93	0.93	0.93	0.50	0.50	0.50	0.59	0.59	0.59
<i>Forecast combinations<sup>2</sup></i>									
<i>Sectoral confidence indicators</i>									
Median	1.01	1.01	1.01	0.95	0.91	0.97	0.94	0.91	0.90*
Mean	1.01	1.01	0.99	0.95	0.91	0.95	0.91	0.91	0.92*
Discounted MSFE <sup>3</sup>	1.01	1.01	0.98	0.96	0.93	0.96	0.93	0.91*	0.92*
Squared discounted MSFE <sup>3</sup>	1.01	1.01	0.97	0.97	0.93	0.97	0.95	0.91*	0.93*
<i>BCS questions: all</i>									
Median	1.04	1.03	1.04	1.00	0.99	1.00	0.91*	0.92*	0.94*
Mean	1.03	1.03	1.04	0.99	0.97	0.99	0.91	0.92	0.93
Discounted MSFE <sup>3</sup>	1.03	1.03	1.04	0.98	0.96	0.98	0.89*	0.91	0.90*
Squared discounted MSFE <sup>3</sup>	1.03	1.03	1.05	0.99	0.95	0.98	0.89*	0.90*	0.89*
<i>BCS questions: current conditions</i>									
Median	1.03	1.03	1.04	1.01	1.00	1.03	0.94	0.93*	0.95*
Mean	1.03	1.02	1.05	0.98	0.97	1.01	0.93	0.94	0.96
Discounted MSFE <sup>3</sup>	1.03	1.03	1.04	0.97	0.96	1.01	0.92*	0.95	0.95*
Squared discounted MSFE <sup>3</sup>	1.04	1.03	1.05	0.97	0.96	1.01	0.92*	0.94*	0.95*
<i>BCS questions: expectations</i>									
Median	1.05	1.05	1.04	1.00	1.00	0.99	0.90*	0.91	0.90
Mean	1.04	1.04	1.04	1.00	0.97	0.97	0.91	0.90	0.90
Discounted MSFE <sup>3</sup>	1.03	1.04	1.04	0.99	0.96	0.96	0.88	0.87*	0.88
Squared discounted MSFE <sup>3</sup>	1.03	1.04	1.05	1.00	0.95	0.95	0.87	0.86*	0.86

TABLE 4

*Continued*

	Cyprus			EU			EA		
	Feb May Aug Nov	Jan Apr Jul Oct	Mar Jun Sep Dec	Feb May Aug Nov	Jan Apr Jul Oct	Mar Jun Sep Dec	Feb May Aug Nov	Jan Apr Jul Oct	Mar Jun Sep Dec
Forecasts estimated early in:									
Two quarters ahead									
No. of months to the GDP growth official release	3-3½	4-4½	5-5½	3-3½	4-4½	5-5½	3-3½	4-4½	5-5½
Autoregression (benchmark) <sup>1</sup>	1.91	1.91	1.91	1.24	1.24	1.24	1.29	1.29	1.29
<i>Forecast combinations</i> <sup>2</sup>									
<i>Sectoral confidence indicators</i>									
Median	0.90	0.94	0.98	0.92	0.90*	0.92	0.76*	0.77*	0.80*
Mean	0.87*	0.93	0.94	0.84*	0.85*	0.87*	0.70*	0.74*	0.78*
Discounted MSFE <sup>3</sup>	0.85*	0.91	0.93	0.83*	0.83*	0.86*	0.71*	0.74*	0.77*
Squared discounted MSFE <sup>3</sup>	0.85*	0.91	0.92	0.82*	0.82*	0.85*	0.72*	0.74*	0.77*
<i>BCS questions: all</i>									
Median	0.99	1.00	1.00	0.85*	0.92*	0.93*	0.80*	0.85*	0.88*
Mean	0.98	0.98	0.98	0.87*	0.91*	0.93*	0.79*	0.84*	0.87*
Discounted MSFE <sup>3</sup>	0.97	0.97	0.97	0.85*	0.90*	0.93*	0.75*	0.83*	0.86*
Squared discounted MSFE <sup>3</sup>	0.97	0.97	0.97	0.84*	0.88*	0.92*	0.73*	0.83*	0.85*
<i>BCS questions: current conditions</i>									
Median	1.01	1.01	1.00	0.91*	0.94*	0.95	0.85*	0.89*	0.92*
Mean	1.00	1.00	1.00	0.89*	0.93*	0.94*	0.84*	0.89*	0.90*
Discounted MSFE <sup>3</sup>	1.00	1.00	1.00	0.89*	0.93*	0.94	0.85*	0.90*	0.90*
Squared discounted MSFE <sup>3</sup>	1.00	1.00	1.00	0.90*	0.94*	0.95	0.87*	0.92*	0.91*
<i>BCS questions: expectations</i>									
Median	0.97	0.99	0.98	0.83*	0.87*	0.92*	0.76*	0.81*	0.84*
Mean	0.96	0.97	0.97	0.86*	0.89*	0.92*	0.75*	0.80*	0.84*
Discounted MSFE <sup>3</sup>	0.95	0.95	0.95	0.83*	0.87*	0.91*	0.70*	0.79*	0.82*
Squared discounted MSFE <sup>3</sup>	0.94	0.94	0.94	0.83*	0.85*	0.90*	0.68*	0.80*	0.81*

Notes: <sup>1</sup> An autoregressive model of order four for Cyprus; a first order autoregressive model for the EU and the EA.

<sup>2</sup> The symbol \* denotes statistical significance at 10% level of the modified Diebold-Mariano test of equal forecast accuracy (Diebold and Mariano, 1995; Harvey et al., 1997). The tests compare the forecasts errors from the benchmark model to those from the forecast combinations based on survey variables.

<sup>3</sup> The discount factor,  $\delta$ , is set equal to 0.95 (see Appendix).

The accuracy of forecast combinations for EU GDP growth is not found to outperform that of the autoregressive model for one-quarter-ahead forecasts. For two-quarter-ahead EU growth estimates, forecast combinations from models with composite confidence indicators or individual BCS questions are clearly superior to the benchmark. Forecasts from models that include sectoral confidence indicators or survey

questions related to expectations are the best performers when combined using the squared discounted MSFE method.

For the EA, forecast combinations incorporating information from composite confidence indicators or from individual BCS questions significantly enhance the forecast accuracy of the benchmark for both one- and two-quarter-ahead forecasts. The forecast precision is maximised when the growth estimates for the EU and the EA are computed 3 to 3½ months prior to the publication of GDP growth.

Sectoral confidence indicators or individual survey questions used to estimate the Greek GDP growth rate through forecast combinations, at most 1½ months before its official publication, lead to significantly lower forecast error compared to the autoregressive model (Table A2, Appendix). When the estimates are computed 3 to 5½ months before the release of GDP, combinations of forecasts from models with composite confidence indicators are associated with the highest precision. For the UK, survey information does not seem to improve the forecast accuracy of models compared to the benchmark (Table A2).

Overall, the improvements in the relative forecast accuracy from the use of survey information appear to be smaller for Cyprus compared to those for the EA, the EU and Greece. No model with a composite confidence indicator as a predictor is found to significantly outperform the benchmark in all monthly forecast rounds and over all horizons. The results vary with the economy considered and – to a lesser extent – the time interval between the estimation date and the GDP release date. The inclusion of the consumer confidence indicator in the forecasting models for GDP growth does not yield significant gains over the autoregressive model. Forecast combinations based on models with individual survey variables uniformly outperform the benchmark for EA growth forecasts. Exploiting the information in sectoral composite confidence indicators through forecast combinations appears to be a promising strategy for the computation of GDP growth estimates for the EU, Greece and Cyprus.

## **5. Performance during crises**

In this section, we consider the forecasting properties over time of some models and forecast combinations that were found to perform well in the previous section by examining the evolution of their recursive RMSFE relative to that of the benchmark model. Figures 2 and 3 plot the relative RMSFE for Cyprus and the EA respectively over the pseudo out-of-sample forecasting period, which includes the dates at the onset of the international financial crisis and during the Eurozone crisis. The

corresponding graph for Greece is given in Figure A1 (Appendix). The evolution of the relative RMSFE for each model or forecast combination is juxtaposed with the actual year-on-year (y-o-y) percentage change in GDP over the same period. The dates on the horizontal axis correspond to the quarter in which the forecast was computed.<sup>6</sup>

For Cyprus, the use of information from sectoral confidence indicators for the computation of GDP growth estimates on a monthly basis resulted in a reduction in the RMSFE during the financial crisis and the 2009 recession that followed in Cyprus. The inclusion of confidence indicators in the forecasting models, particularly of the retail trade confidence indicator, continued to yield gains over the benchmark during the brief upswing in 2010 and at the onset of the economic crisis in 2011–2012. However, forecasts based on confidence indicators failed to generate substantial gains when the Cypriot economy troughed in 2013, as well as during the recovery that followed.

The use of confidence indicators resulted in larger gains for two-quarter-ahead forecasts, especially when growth estimates were computed 3 to 3½ months prior to the GDP release. For one-quarter-ahead forecasts, exploiting the information in all confidence indicators by combining forecasts resulted in less stable performance compared to solely using the retail trade indicator. After 2012, GDP growth estimates for Cyprus computed via the retail trade indicator and just before the release (<½ month), were associated with larger gains relative to the benchmark.

For the EA, the information contained in the ESI and in the individual survey variables considerably enhanced the performance of the simple autoregressive benchmark during the international financial crisis and its aftermath. The forecast gains due to the inclusion of survey data in the forecasting models declined at the onset of the EA sovereign debt crisis, but remained quite stable afterwards. The predictive accuracy of the ESI model and the forecast combination based on all BCS variables was higher for two-quarter-ahead forecasts, particularly when the EA GDP growth rate was estimated 3 to 3½ months prior to the release. When the EA growth projections were constructed less than 2½ months before the publication date, no improvements in the predictive accuracy occurred through the inclusion of new survey information in each monthly forecast round.

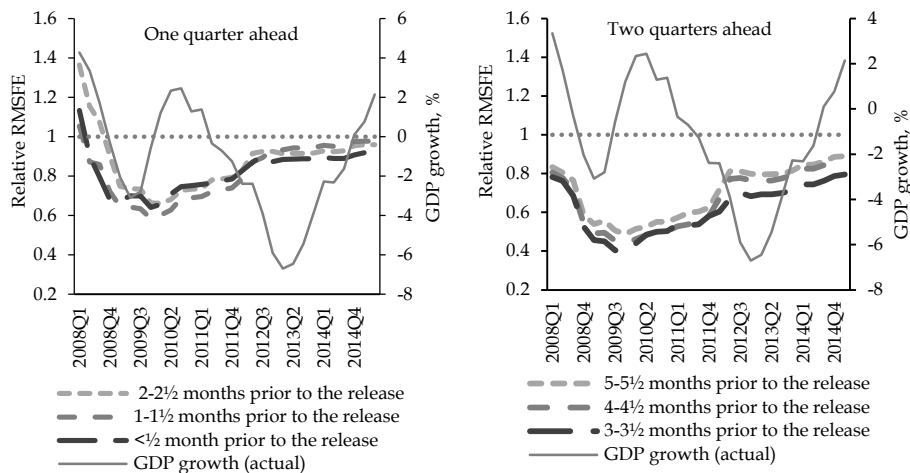
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<sup>6</sup>The values of the actual GDP growth rate in the plots are shifted backwards one or two quarters depending on the forecast horizon to correspond to the RMSFE in the quarter in which the forecast was computed.

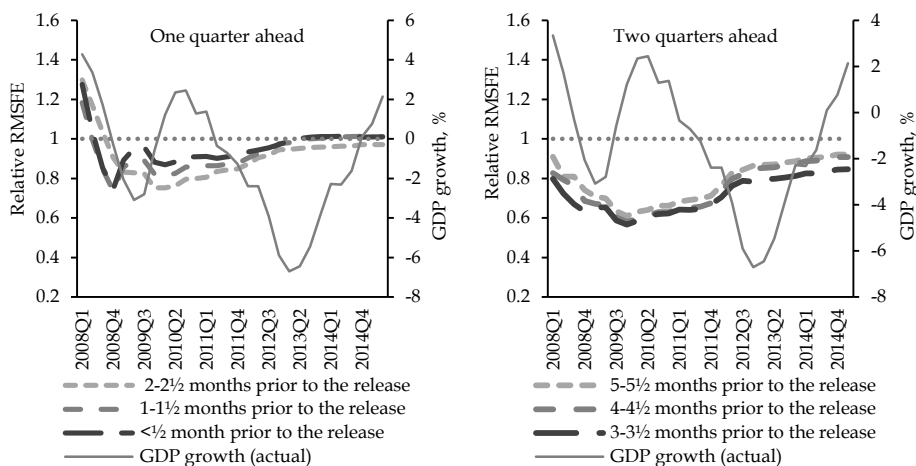
FIGURE 2

*Relative RMSFE of models with survey predictors, and GDP growth, Cyprus<sup>1</sup>*

2.1 Predictor: Retail Trade Confidence Indicator for Cyprus<sup>2</sup>



2.2 Predictors: All sectoral confidence indicators for Cyprus<sup>3</sup>



Notes: <sup>1</sup> The dotted line denotes the performance of the benchmark model.

<sup>2</sup> The AIC was used for lag length selection.

<sup>3</sup> Forecasts were combined using the squared discounted MSFE method.

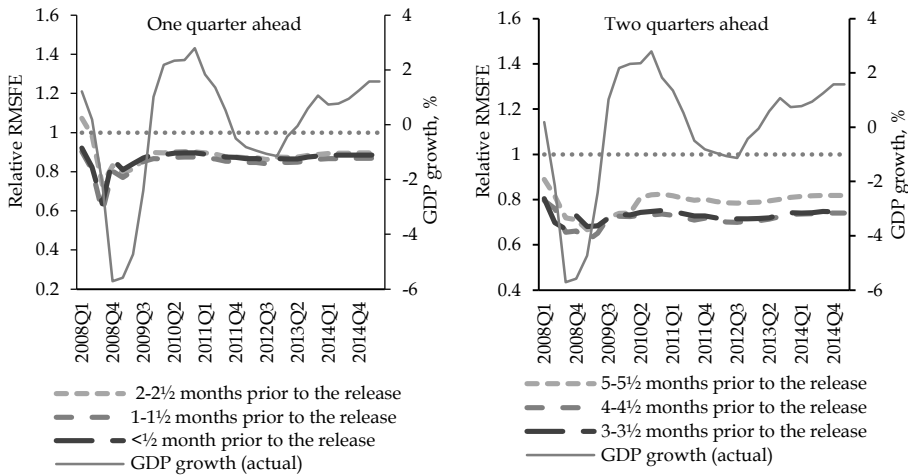
Estimates of GDP growth for Greece computed from models with confidence indicators were associated with increasing forecast accuracy during the international financial crisis. Despite the turbulent economic conditions that followed due to the sovereign debt crisis, the performance of growth projections based on either the Greek industry confidence indicator or forecast combinations using all confidence indicators

remained quite stable, generating gains over the autoregressive benchmark. The forecast gains were similar for one- and two-quarter-ahead forecasts. Moreover, new monthly information incorporated in the growth estimates in the final forecast round before the GDP release was not found to lower the forecast error.

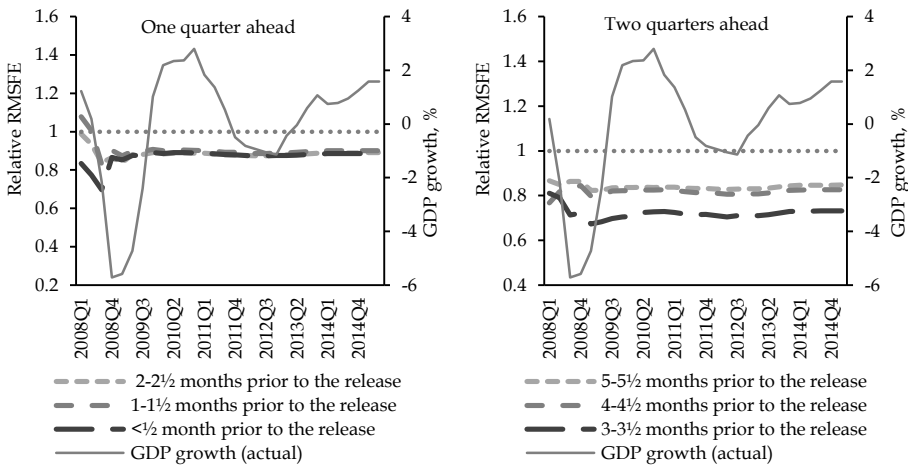
FIGURE 3

*Relative RMSFE of models with survey predictors, and GDP growth, EA<sup>1</sup>*

3.1 Predictor: Economic Sentiment Indicator for the EA<sup>2</sup>



3.2 Predictors: All individual BCS variables for the EA<sup>3</sup>



Notes: <sup>1</sup> The dotted line denotes the performance of the benchmark model.

<sup>2</sup> The BIC was used for lag length selection.

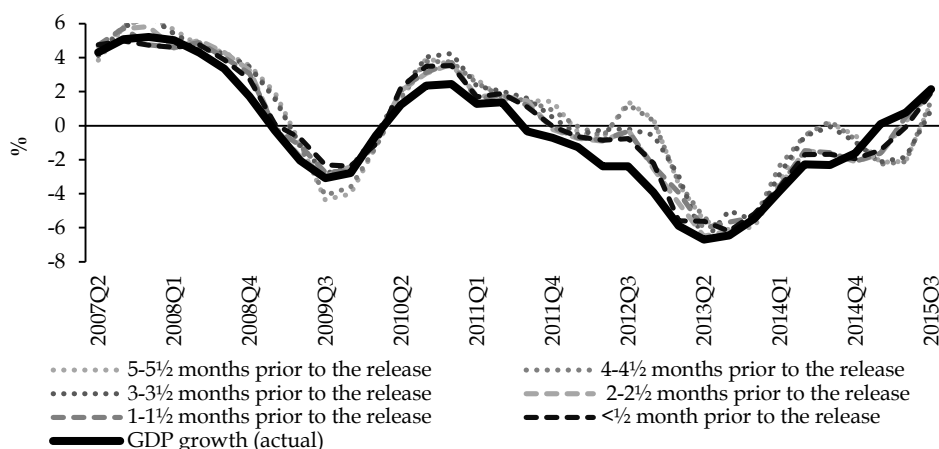
<sup>3</sup> Forecasts were combined using the squared discounted MSFE method.

Figure 4 shows the actual rate of GDP growth (y-o-y), together with the six growth forecasts computed in six different monthly rounds starting 5 to 5½ months prior to the GDP publication and ending about 10 days prior to the release.

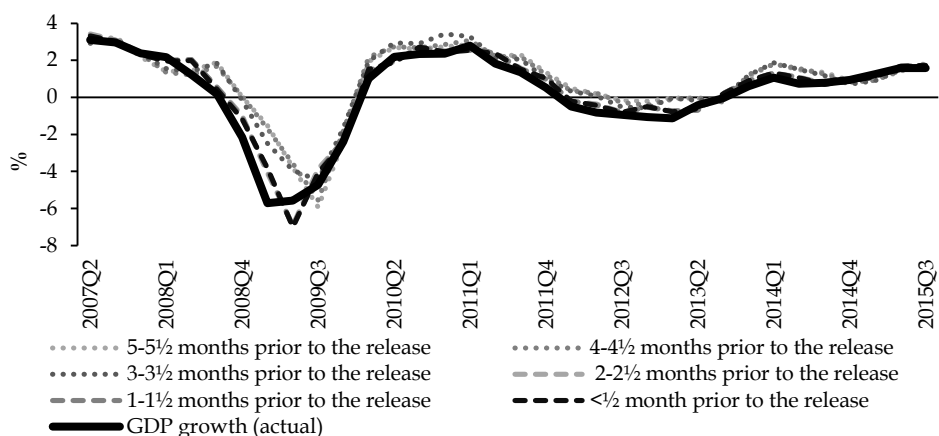
FIGURE 4

*GDP growth and forecasts*

4.1 Predictor: Retail Trade Confidence Indicator for Cyprus; GDP growth: Cyprus



4.2 Predictors: All individual BCS variables for the EA; GDP growth: EA



For Cyprus, the forecasts shown are obtained from the model that includes the retail trade confidence indicator, which is the best performing survey predictor. For the EA, the growth estimates plotted are obtained from forecast combinations based on all individual survey questions; these forecast combinations are chosen on the basis of their superior

performance in different forecast rounds compared to other combinations or survey predictors. Similarly, for Greece the estimates in Figure A2 (Appendix) come from forecast combinations using all sectoral confidence indicators.<sup>7</sup>

The slowdown preceding the international financial crisis was forecasted quite accurately by survey data, particularly for the EA and Cyprus. As the economies were slipping into recession, the survey predictors were generating more optimistic forecasts compared to the actual growth rates. The information in the EA and Greek BCS data failed to provide an accurate forecast for the trough quarter. For Cyprus, the initial forecast rounds were also unsuccessful in predicting the trough, but the growth projections computed 2 to 2½ months prior to the release estimated the rate of output contraction accurately. The EA-wide survey variables provided quite accurate forecasts for the brief upturn in the bloc's activity that followed in 2010, while the retail trade confidence indicator for Cyprus tended to overestimate the short-lived recovery. The extent of overestimation of the growth rate was even larger for Greece early in 2010.

The debt crisis increased uncertainty not only in Greece but also in Cyprus due to the links between the financial systems of the two countries that existed then, as well as in the EA at large. The deepening of the Greek recession following the sovereign debt crisis was forecasted as less severe by confidence indicators, but the subsequent easing of output contraction was predicted fairly accurately. The actual economic performance in the second half of 2013 was underestimated by the Greek confidence indicators.

For Cyprus, the retail trade confidence indicator traced closely the downturn in 2011–2012, although it produced more optimistic predictions compared to the actual figures. The depth of the 2013 recession in Cyprus was projected accurately about 2 to 2½ months prior to the release of the actual growth rate. The beginning of the recovery of the Cyprus economy was correctly forecasted by the confidence indicator, but survey information failed to predict the first positive growth rate registered after the recession (i.e. in 2015Q1).

During the EA crisis and subsequent recovery, forecast combinations that used the information from all EA-wide survey variables resulted in revisions to the EA growth projections towards the actual growth rates, indicating the usefulness of the timely available BCS data for forecasting the bloc's short-term economic conditions.

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<sup>7</sup> The relative accuracy of these forecasts is shown in Figure 2 (2.1), Figure 3 (3.2) and Figure A.1 (A1.2) for Cyprus, the EA and Greece respectively.

## 6. Summary and conclusions

This paper aims to evaluate the information content of BCS data for the computation of a sequence of GDP growth estimates. The first estimate is computed 5½ months prior to the publication of GDP growth and the last forecast is constructed about 10 days before the release of the actual figure. The construction of GDP growth forecasts for the short term constitutes a valuable tool for macroeconomic surveillance and policy making because quarterly National Accounts data are published with a considerable time lag; BCS data, on the other hand, are available on a monthly basis, typically at the end of the reference month.

The focus of the analysis is on Cyprus and some of its key trading partners, namely the EU, the EA, the UK and Greece. Due to the openness of the Cypriot economy, timely information on the expected economic performance of Cyprus's trading partners is crucial to the assessment of the domestic economic outlook. The forecasting performance of survey-based models over the recent financial and debt crises is also explored.

The evaluation of the predictive ability of BCS data is carried out via a pseudo out-of-sample forecasting exercise with a data availability pattern that mimics real-time releases. The results in the case of Cyprus show that the use of confidence indicators significantly improves on the accuracy of autoregressive forecasts when the growth estimates are computed 3 to 3½ months prior to the release of GDP growth. Specifically, the relative forecast precision is significantly higher in the case of composite confidence indicators for retail trade and construction, as well as in the case of forecast combinations using information from all sectoral confidence indicators. Some forecast gains over the univariate benchmark are attained in other forecast rounds, but are not found to be statistically significant. Moreover, the improvements in forecast accuracy due to the use of survey data are larger and more significant for the EA, the EU and Greece compared to those in the case of Cyprus. Interestingly, survey predictors are not found to improve on the autoregressive GDP growth estimates for the UK. Thus, survey information for the EU, the EA and Greece can be used to extract reliable signals concerning the short-term growth prospects of these economies and therefore identify risks to the outlook for the Cypriot economy. Gauging future economic conditions in the UK should be based not only on BCS data but also on other short-term indicators.

Our results for the EA are along the lines of findings in other studies that simulate the real-time data availability pattern and demonstrate the

importance of timely available survey data for short-term GDP growth forecasting (e.g. Angelini et al., 2011; Bańbura and Rünstler, 2011).

The use of survey data for Cyprus resulted in large forecasting gains over the benchmark during the international financial crisis and its aftermath and predicted the depth of the recession in 2009 and 2013 fairly accurately. Also, BCS indicators provided early signals of the Cypriot economy approaching turning points. Nevertheless, the relative benefits from the use of BCS data began diminishing at the onset of the economic crisis in Cyprus. Moreover, survey information correctly signalled the moderation of the recession in Cyprus, but failed to predict the turnaround in the growth rate in the first quarter of 2015.

The swift release of BCS data, typically at the end of the reference month, the absence of data revisions and the wide coverage of different sectors of the economy render survey variables ideal candidate predictors for the short-term forecasting of the growth rate of aggregate and sectoral output. An extension of the current analysis would be to compare the forecasting performance of BCS data with that of other timely available macroeconomic/financial series, such as stock market indices, exchange rates, international commodity prices (e.g. oil), European interest rates, the number of registered unemployed, credit card use, etc. Some of the abovementioned series have been found to be useful GDP growth predictors when employed for short-term forecasting (e.g. Bańbura and Rünstler, 2011; Giannone et al., 2008).

The monthly revisions of the growth estimates resulting from the inflow of new BCS data tend to correct forecasts in the right direction, providing more accurate predictions when the estimation date approaches the publication date of GDP growth. Overall, BCS data provide early and useful information for monitoring movements in economic activity, thus enabling policymakers to react in a timely manner. Additional domestic and foreign leading indicators should also be employed to gain even more reliable and complete insight into the outlook for the Cypriot economy.

## Appendix

### Model and forecast combinations

#### A.1. Model

We define  $y_{t+h}^h = \frac{400}{h} \ln\left(\frac{Y_{t+h}}{Y_t}\right)$ , where  $Y_t$  ( $t = 1, 2, \dots, T$ ) is the quarterly level of real GDP and  $h = 1, 2$  shows the forecast horizon in quarters ahead of the latest available GDP data for quarter  $t$ ; in other words,  $y_{t+h}^h$  gives the annualised growth rate of GDP. Let  $y_t^Q$  denote the quarter-on-quarter growth rate of real GDP. Let  $s_t$  be a stationary monthly BCS variable such that its quarterly aggregate is denoted by  $s_t^Q$  and  $s_{t+k}^{M_j}$  represents the monthly values of the indicator observed in the  $j$ -th month of quarter  $t+k$  ( $k > 0$ ). The form of the model depends on the available data during the first couple of days of each month when the forecasts are computed. Thus,

$$y_{t+h}^h = a_0 + \sum_{l=0}^p \beta_l y_{t-l}^Q + \sum_{i=0}^q \gamma_i s_{t+1-i}^Q + \mu_1 s_{t+2}^{M_1} + \varepsilon_{t+h}^Q \quad (\text{A1})$$

$$y_{t+h}^h = a_0 + \sum_{l=0}^p \beta_l y_{t-l}^Q + \sum_{i=0}^q \gamma_i s_{t-i}^Q + \mu_1 s_{t+1}^{M_1} + \mu_2 s_{t+1}^{M_2} + \varepsilon_{t+h}^Q \quad (\text{A2})$$

where  $\varepsilon_{t+h}^Q$  denotes the forecast error.

Equation (A1) with the restriction  $\mu_1 = 0$  is used when the GDP growth projections are computed in the first month of each quarter (January, April, June and October); these projections cover the previous and the current quarter and are estimated 1 to 1½ months and 4 to 4½ months prior to the GDP release respectively. The unrestricted form of Equation (A1) is employed in the second month of each quarter (February, May, August and November) to update the growth estimates for the previous and the current quarter computed in the previous month by incorporating the maximum possible leading information from survey data. The second forecast round produces GDP growth estimates for the previous quarter some days before the release of the actual figure, as well as nowcasts 3 to 3½ months before the flash estimate announcement.

Equation (A2) is used for the construction of GDP growth projections for the current and next quarters in the final month of each quarter (March, June, September and December). The forecast round conducted in the last month of the quarter is associated with the smallest information set as the estimates for the current quarter employ the most recent survey data within the quarter that cover just the first two months; estimates for the next quarter employ, at best, information on the first two months of the current quarter.

The forecasts constructed in period  $t$  for period  $t+h$  are computed using data available up to date  $t$ , thus no additional projections for predictors are required; these forecasts are known as ‘direct’ forecasts (see e.g. Stock and Watson, 2004, 2008). The choice of the number of lags for predictor  $s_t^Q$  is between one and four, whereas for the dependent variable the lag length is between zero and four.

The models are estimated using the first  $T_0$  observations of the sample and the first pseudo out-of-sample forecast is computed in period  $t = T_0 + h$ . The recursive

procedure requires increasing the sample size by one observation, re-estimating the models and computing the forecast. The procedure is repeated up to the end of the sample period  $T$  so that the pseudo out-of-sample forecast computed in period  $t = T - h$  refers to period  $T$ , which is the last date for which we have observed data. The  $h$ -quarter-ahead forecast for  $y_{t+h}^h$ , based on quarterly GDP data up to period  $t$ , is given by  $\hat{y}_{t+h|t}^h$ . Then, the MSFE used to evaluate the forecasting performance of each model for horizon  $h$  is given by:

$$MSFE = \frac{1}{(T-h)-(T_0+h)+1} \sum_{t=T_0+h}^{T-h} (y_{t+h}^h - \hat{y}_{t+h|t}^h)^2 \quad (A3)$$

where  $T$  denotes the number of observations in the sample.

## A.2. Forecast combinations

Equations (A1) and (A2) include only one survey indicator (predictor); therefore, different equations for  $y_{t+h}^h$  can be estimated using alternative survey variables and the resulting forecasts can be combined using a forecast combination method (e.g. Stock and Watson, 2004). Given  $M > 1$  models and associated forecasts, a combination forecast, denoted by  $\hat{F}_{t+h|t}^h$ , is the weighted average of individual forecasts and the weights can be fixed or time varying:

$$\hat{F}_{t+h|t}^h = \sum_{i=1}^M w_{i,t} \hat{y}_{i,t+h|t}^h \quad (A4)$$

where  $\hat{y}_{i,t+h|t}^h$  is the  $h$ -step-ahead forecast from model  $i$  computed in period  $t$  and  $w_{i,t}$  is the weight assigned to that forecast. In general, the weight  $w_{i,t}$  depends on the historical forecasting performance of model  $i$ ; however  $w_{i,t}$  can be fixed, leading to simple forecast combinations, such as the mean ( $w_{i,t} = 1/M$ ), the median, or some type of trimmed mean. In cases in which  $w_{i,t}$  depends on models' past forecasting performance, the resulting combination forecasts are known as discounted MSFE forecasts (Stock and Watson, 2004). In particular, the weights can be inversely proportional to the discounted MSFE (or the square of the discounted MSFE) of the individual models, i.e.:

$$w_{i,t} = \frac{v_{i,t}}{\sum_{j=1}^M v_{j,t}} \quad (A5)$$

or

$$w_{i,t} = \frac{(v_{i,t})^2}{\sum_{j=1}^M (v_{j,t})^2} \quad (A6)$$

where  $v_{i,t} = [\sum_{s=T_0+h}^{t-h} \delta^{t-h-s} (y_{s+h}^h - \hat{y}_{i,s+h|s}^h)^2]^{-1}$  and  $\delta$  is the discount factor, so forecast errors made in the distant past are of smaller importance. Thus, larger weights are assigned to forecasts from models with a lower MSFE (i.e. better historical forecasting performance).

## Forecasting performance

TABLE A1

*Forecasting performance of key survey indicators*

Forecasts estimated early in:	UK			Greece		
	Feb	Jan	Mar	Feb	Jan	Mar
	May	Apr	Jun	May	Apr	Jun
	Aug	Jul	Sep	Aug	Jul	Sep
	Nov	Oct	Dec	Nov	Oct	Dec
One quarter ahead						
No. of months to the GDP growth official release	<1/2	1-1½	2-2½	<1/2	1-1½	2-2½
Autoregression (benchmark) <sup>1</sup>	0.54	0.54	0.54	1.83	1.83	1.83
<i>BCS confidence indicators, AIC for lag length selection<sup>2</sup></i>						
Economic Sentiment	1.37	1.36	1.14	0.90	0.80*	0.83*
Industry	1.28	1.30	1.27	0.91	0.85*	0.80*
Construction	1.65	1.51	1.77	1.20	1.15	1.17
Services	1.31	1.31	1.21	1.02	0.99	0.98
Retail Trade	1.27	1.19	1.20	0.95	0.86	0.91
Consumer	1.24	0.97	1.00	1.15	1.13	1.17
<i>BCS confidence indicators, BIC for lag length selection<sup>2</sup></i>						
Economic Sentiment	1.29	1.29	1.04	0.87*	0.86*	0.89
Industry	1.22	1.17	1.20	0.86*	0.81*	0.91
Construction	1.63	1.45	1.72	1.18	1.14	1.13
Services	1.16	1.17	1.16	1.04	1.00	1.05
Retail Trade	1.26	1.14	1.16	0.93	0.88	0.99
Consumer	1.02	0.88	0.88	1.16	1.15	1.19
Two quarters ahead						
No. of months to the GDP growth official release	3-3½	4-4½	5-5½	3-3½	4-4½	5-5½
Autoregression (benchmark) <sup>1</sup>	1.43	1.43	1.43	2.94	2.94	2.94
<i>BCS confidence indicators, AIC for lag length selection<sup>2</sup></i>						
Economic Sentiment	1.72	1.70	1.95	0.92	0.89	0.91
Industry	1.68	1.62	1.84	0.94	0.89	0.91
Construction	1.56	1.64	1.70	1.02	1.01	1.02
Services	1.77	1.76	1.70	0.93	0.94	0.95
Retail Trade	1.70	1.66	1.67	0.78	0.80	0.96
Consumer	1.29	1.28	1.36	1.04	1.05	1.04
<i>BCS confidence indicators, BIC for lag length selection<sup>2</sup></i>						
Economic Sentiment	1.57	1.35	1.77	0.88	0.90	0.96
Industry	1.34	1.32	1.70	0.85*	0.86*	0.90
Construction	1.43	1.66	1.66	0.96	0.99	1.02
Services	1.68	1.66	1.63	1.05	1.06	1.07
Retail Trade	1.59	1.40	1.55	0.74	0.80	0.94
Consumer	1.15	1.16	1.08	1.09	1.03	1.05

*Notes:* <sup>1</sup> A first order autoregressive model for the UK; an autoregressive model of order four for Greece.

<sup>2</sup> The symbol \* denotes statistical significance at 10% level of the modified Diebold-Mariano test of equal forecast accuracy (Diebold and Mariano, 1995; Harvey et al., 1997). The tests compare the forecasts errors from the benchmark model to those from the models with survey variables.

TABLE A2

*Forecasting performance of forecast combinations*

	UK			Greece		
	Feb May Aug Nov	Jan Apr Jul Oct	Mar Jun Sep Dec	Feb May Aug Nov	Jan Apr Jul Oct	Mar Jun Sep Dec
Forecasts estimated early in:						
One quarter ahead						
No. of months to the GDP growth official release	<1/2	1-1½	2-2½	<1/2	1-1½	2-2½
Autoregression (benchmark) <sup>1</sup>	0.54	0.54	0.54	1.83	1.83	1.83
<i>Forecast combinations<sup>2</sup></i>						
<i>Sectoral confidence indicators</i>						
Median	1.20	1.16	1.17	0.92	0.89	0.92
Mean	1.23	1.15	1.18	0.89*	0.87*	0.90
Discounted MSFE <sup>3</sup>	1.23	1.11	1.09	0.89*	0.86*	0.90
Squared discounted MSFE <sup>3</sup>	1.22	1.06	1.03	0.89*	0.86*	0.90
<i>BCS questions: all</i>						
Median	1.17	1.14	1.13	0.96	0.95	0.95
Mean	1.22	1.16	1.17	0.92*	0.90*	0.93
Discounted MSFE <sup>3</sup>	1.21	1.15	1.13	0.92*	0.90*	0.94
Squared discounted MSFE <sup>3</sup>	1.21	1.14	1.08	0.92*	0.90*	0.93
<i>BCS questions: current conditions</i>						
Median	1.19	1.14	1.13	0.99	0.97	0.96
Mean	1.24	1.18	1.17	0.92*	0.91*	0.94
Discounted MSFE <sup>3</sup>	1.23	1.17	1.13	0.93*	0.91*	0.94
Squared discounted MSFE <sup>3</sup>	1.22	1.14	1.09	0.92*	0.90*	0.93
<i>BCS questions: expectations</i>						
Median	1.17	1.14	1.15	0.93	0.94	0.95
Mean	1.21	1.15	1.17	0.92	0.91	0.93
Discounted MSFE <sup>3</sup>	1.20	1.14	1.14	0.93	0.91*	0.93
Squared discounted MSFE <sup>3</sup>	1.20	1.12	1.11	0.93	0.91	0.92

TABLE A2

*Continued*

	UK			Greece		
	Feb May Aug Nov	Jan Apr Jul Oct	Mar Jun Sep Dec	Feb May Aug Nov	Jan Apr Jul Oct	Mar Jun Sep Dec
Forecasts estimated early in:						
Two quarters ahead						
No. of months to the GDP growth official release	3-3½	4-4½	5-5½	3-3½	4-4½	5-5½
Autoregressive model (benchmark) <sup>1</sup>	1.43	1.43	1.43	2.94	2.94	2.94
<i>Forecast combinations<sup>2</sup></i>						
<i>Sectoral confidence indicators</i>						
Median	1.54	1.56	1.60	0.86*	0.88*	0.90
Mean	1.49	1.49	1.55	0.84*	0.85*	0.87*
Discounted MSFE <sup>3</sup>	1.50	1.52	1.56	0.84*	0.84*	0.89*
Squared discounted MSFE <sup>3</sup>	1.51	1.54	1.57	0.84*	0.85	0.91*
<i>BCS questions: all</i>						
Median	1.39	1.36	1.44	0.92	0.94	0.93
Mean	1.43	1.40	1.44	0.90*	0.92	0.92*
Discounted MSFE <sup>3</sup>	1.43	1.40	1.44	0.90*	0.92	0.92*
Squared discounted MSFE <sup>3</sup>	1.45	1.41	1.45	0.90*	0.93	0.93*
<i>BCS questions: current conditions</i>						
Median	1.38	1.36	1.37	0.91	0.94	0.92
Mean	1.41	1.39	1.39	0.89*	0.92	0.91
Discounted MSFE <sup>3</sup>	1.41	1.39	1.38	0.88*	0.92	0.91
Squared discounted MSFE <sup>3</sup>	1.41	1.39	1.37	0.88*	0.92	0.91
<i>BCS questions: expectations</i>						
Median	1.38	1.37	1.50	0.93	0.95	0.94
Mean	1.45	1.41	1.50	0.93	0.93	0.94
Discounted MSFE <sup>3</sup>	1.47	1.42	1.51	0.93	0.93	0.94
Squared discounted MSFE <sup>3</sup>	1.49	1.44	1.53	0.94	0.93	0.94

Notes: <sup>1</sup>A first order autoregressive model for the UK; an autoregressive model of order four for Greece.

<sup>2</sup>The symbol \* denotes statistical significance at 10% level of the modified Diebold-Mariano test of equal forecast accuracy (Diebold and Mariano 1995; Harvey et al. 1997). The tests compare the forecasts errors from the benchmark model to those from the forecast combinations based on survey variables.

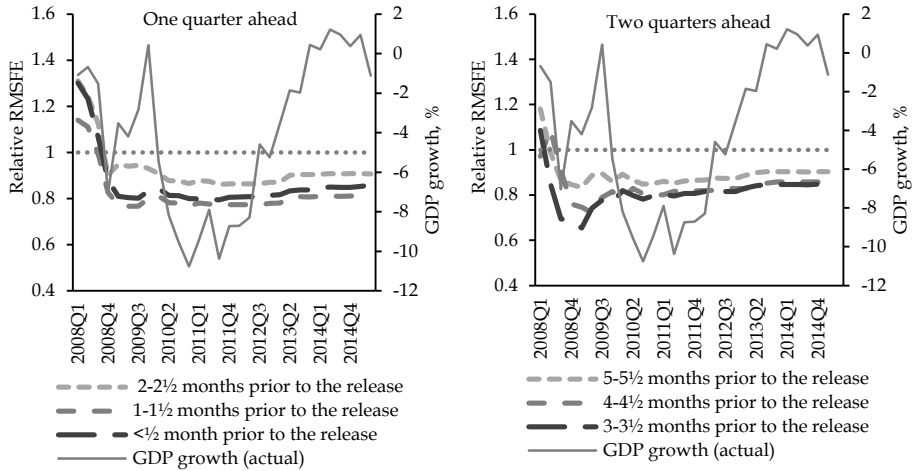
<sup>3</sup>The discount factor,  $\delta$ , is set equal to 0.95.

Performance during crises

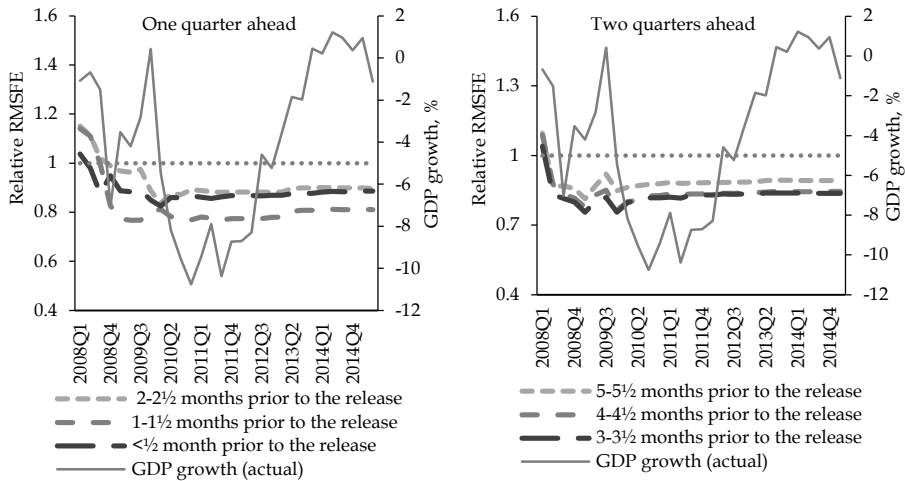
FIGURE A1

Relative RMSFE of models with survey predictors, and GDP growth, Greece<sup>1</sup>

A1.1 Predictor: Industry Confidence Indicator for Greece<sup>2</sup>



A1.2 Predictors: All sectoral confidence indicators for Greece<sup>3</sup>



Notes: <sup>1</sup> The dotted line denotes the performance of the benchmark model.

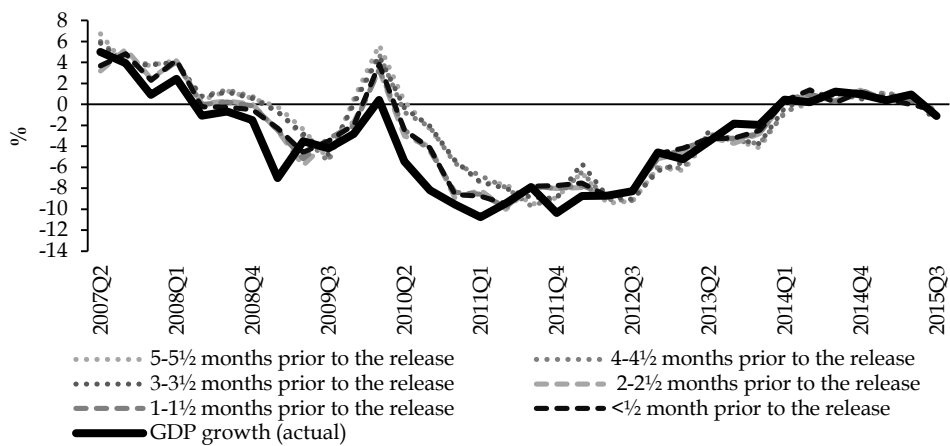
<sup>2</sup> The AIC was used for lag length selection.

<sup>3</sup> Forecasts were combined using the discounted MSFE method.

FIGURE A2

*GDP growth and forecasts, Greece*

Predictors: All sectoral confidence indicators for Greece



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