UNIVERSITY OF CYPRUS
ECONOMICS RESEARCH CENTRE

Economic Analysis Papers

Forecasting Cyprus GDP and its demand components: Applications of dynamic factor models

Christos Papamichael
Economics Research Centre, University of Cyprus

Nicoletta Pashourtidou
Economics Research Centre, University of Cyprus

No. 11-14

December 2014

Publication Editor: Christos Koutsampelas

ERC Sponsors (in alphabetical order)

Association of Cyprus Banks

Central Bank of Cyprus

Economics Department, University of Cyprus

Ministry of Finance

Ministry of Labour and Social Security

Planning Bureau

University of Cyprus

Forecasting Cyprus GDP and its demand components: Applications of dynamic factor models*

Christos Papamichael and Nicoletta Pashourtidou**

Executive Summary

This paper provides applications of dynamic factor models to balanced and unbalanced quarterly and monthly datasets for the construction of quarterly and monthly common factor series. The estimated quarterly factors are used to augment simple single equation dynamic models such as the autoregressive model (AR) and the autoregressive distributed lag model (ADL). The forecasting performance of the factor-augmented models is evaluated and conclusions on the usefulness of factors for forecasting GDP and its demand components are drawn. Monthly factors from an unbalanced dataset are included in bridge equations for GDP and its demand components in order to construct forecasts for the previous and current quarter (also known as back-casts and now-casts respectively) at the beginning of each month. The forecasting performance of bridge equations is assessed. The paper also investigates whether factor-based indicators extracted from the dataset of all monthly Business and Consumer Survey questions could constitute more informative leading indicators for activity in Cyprus than the Economic Sentiment Indicator computed from a subset of the Survey questions.

Quarterly and monthly common factors computed from large datasets of domestic and foreign/international variables are found to form useful predictors for forecasting GDP growth as well as the growth rate of demand components of GDP such as private consumption and investment. The factors can enhance the accuracy of short-term forecasts from simple dynamic single equation models as well as the precision of projections for the previous and current quarter constructed prior to the official publication of the National Accounts. Furthermore, factor-based indicators could supplement the Economic Sentiment Indicator for monitoring developments in economic activity in Cyprus.

* The Research Project with Protocol No. ΑΝΘΡΩΠΙΣΤΙΚΕΣ/ΟΙΚΟΝ/0311(BIE)/03 is co-funded by the Republic of Cyprus and the European Regional Development Fund of the EU.

** We thank Adamos Andreou and Charalampos Karagiannakis for providing excellent research assistance.

CONTENTS

Πρόβλεψη του ΑΕΠ και των συνιστωσών ζήτησής του για την Κύπρο: εφαρμογές δυναμικών μοντέλων παραγόντων*

ΠΕΡΙΛΗΨΗ

Σκοπός του άρθρου είναι η εφαρμογή δυναμικών μοντέλων παραγόντων (dynamic factor models) σε βάσεις δεδομένων με μεγάλο αριθμό τριμηνιαίων και μηνιαίων μακροοικονομικών και χρηματοοικονομικών μεταβλητών για τον υπολογισμό ενός μικρού αριθμού χρονοσειρών κοινών παραγόντων (common factors). Οι κοινοί παράγοντες συνοψίζουν τις πληροφορίες που υπάρχουν στις εκτεταμένες βάσεις δεδομένων. Οι τριμηνιαίοι παράγοντες που εκτιμούνται περιλαμβάνονται ως ανεξάρτητες μεταβλητές σε απλά δυναμικά μοντέλα μιας εξίσωσης και στη συνέχεια αξιολογείται η ικανότητα αυτών των μοντέλων να προβλέψουν το ρυθμό μεταβολής του ΑΕΠ, ιδιωτικής και δημόσιας κατανάλωσης, επενδύσεων, εισαγωγών και εξαγωγών. Ως εκ τούτου μπορούν να εξαχθούν συμπεράσματα για τη χρησιμότητα των κοινών παραγόντων για σκοπούς πρόβλεψης. Οι μηνιαίοι κοινοί παράγοντες που υπολογίζονται από μια βάση δεδομένων που λαμβάνει υπόψη τις υστερήσεις στη δημοσίευση των μηνιαίων μεταβλητών, χρησιμοποιούνται σε μηνιαία βάση για την κατασκευή προβλέψεων για το προηγούμενο (back-casts) και το τρέχον (now-casts) τρίμηνο, πριν από τη δημοσίευση των Εθνικών Λογαριασμών. Οι προβλέψεις αυτές κατασκευάζονται με μοντέλα που συνδέουν μηνιαίους δείκτες με τριμηνιαία στοιχεία Εθνικών Λογαριασμών (bridge equations) και η ακρίβεια των προβλέψεων αξιολογείται. Το άρθρο διερευνά επίσης, κατά πόσο δείκτες βασισμένοι σε κοινούς παράγοντες, που εκτιμούνται από μια βάση δεδομένων που περιλαμβάνει όλες τις μεταβλητές από τις Έρευνες Οικονομικής Συγκυρίας της Κύπρου, θα μπορούσαν να αποτελέσουν πιο αξιόπιστους προπορευόμενους δείκτες για την οικονομική δραστηριότητα από τον Δείκτη Οικονομικής Συγκυρίας (Economic Sentiment Indicator) που κατασκευάζεται από ένα υποσύνολο μεταβλητών.

Η ανάλυση δείχνει ότι οι τριμηνιαίοι και μηνιαίοι κοινοί παράγοντες που υπολογίζονται από εκτεταμένες βάσεις δεδομένων εγχώριων και ξένων/διεθνών μεταβλητών μπορούν να αποβούν χρήσιμοι για σκοπούς πρόβλεψης του ΑΕΠ καθώς και διαφόρων συνιστωσών ζήτησης του ΑΕΠ όπως ιδιωτική κατανάλωση και επενδύσεις. Οι κοινοί παράγοντες βελτιώνουν την ακρίβεια των προβλέψεων από απλά δυναμικά μοντέλα μιας εξίσωσης καθώς και την αξιοπιστία των προβλέψεων για το προηγούμενο και τρέχον τρίμηνο που διενεργούνται πριν από την επίσημη δημοσίευση των Εθνικών Λογαριασμών. Επιπρόσθετα, οι δείκτες που βασίζονται σε κοινούς παράγοντες μπορούν να χρησιμοποιηθούν σε συστηματική βάση για σκοπούς παρακολούθησης των μεταβολών στην οικονομική δραστηριότητα συμπληρώνοντας τις πληροφορίες από το Δείκτη Οικονομικής Συγκυρίας.

* Το Ερευνητικό Έργο με Αρ. Πρωτοκόλλου ΑΝΘΡΩΠΙΣΤΙΚΕΣ/ΟΙΚΟΝ/0311(ΒΙΕ)/03 συγχρηματοδοτείται από την Κυπριακή Δημοκρατία και το Ευρωπαϊκό Ταμείο Περιφερειακής Ανάπτυξης της ΕΕ.

1. Introduction

Rapid developments in information technology allow researchers and practitioners to easily access numerous economic and financial time series data that can be exploited for economic analysis and forecasting. Time series models that are traditionally used for forecasting and policy analysis, such as VAR models, can only handle a small number of variables. This limitation of traditional time series models can be tackled with the application of factor models. Factor models summarise the information from a large number of economic/financial time series by a small number of estimated indexes known as common factors. Thus, the dynamics of a vector of many economic time series can be driven by a small number of common shocks and a vector of idiosyncratic components. The estimated factors can then be used to analyse and forecast variables of interest, such as output growth or inflation (e.g. Stock and Watson 2002a).

Theoretical research on dynamic factor models deals with identification, estimation and the asymptotic properties of estimators (e.g. Forni et al. 2000; Stock and Watson 2002b) as well as with the estimation and properties of forecasts (Forni et al. 2005; Stock and Watson 2002b). Theoretical papers show essentially that common factors can be estimated consistently by applying principal component analysis. Doz et al. (2012) propose a quasi-maximum likelihood method for the estimation of dynamic factor models and discuss also the connection of the quasi-maximum likelihood estimator with that based on principal components. On the empirical front, there are numerous applications where dynamic factor models are employed to extract a small number of common factors from large datasets and the factors are then used for forecasting key macroeconomic variables (e.g. Artis et al. 2005; Banerjee et al. 2005; Forni et al. 2003; Stock and Watson 2002a). [1]

The use of extensive datasets of monthly macroeconomic and financial series gives rise to missing values at the end of the sample due to the asynchronous data releases. The extraction of common factors from unbalanced datasets, also known as datasets with jagged edges, is tackled with the use of iterative methods (e.g. Stock and Watson 2002a; Doz et al. 2011). The estimation of common factors from a large dataset of unbalanced monthly variables has been used in the construction of short-term forecasts for GDP growth and in particular forecasts for the previous and the current quarter since National Accounts are published with a considerable delay with respect to the reference quarter. Such forecasts, also known as now-casts, are constructed by bridging quarterly GDP with monthly

[1] Applications of dynamic factor models in the case of Cyprus can be found in Andreou et al. (2010) and Papamichael and Pashourtidou (2012).

factors and can be revised with the release of new monthly information (e.g. Altissimo et al. 2010; Angelini et al. 2011; Giannone et al. 2008; Doz et al. 2011).

This paper provides applications of dynamic factor models on balanced and unbalanced quarterly and monthly datasets for the construction of quarterly and monthly common factor series. The estimated quarterly factors are used to augment simple single equation dynamic models such as the autoregressive model (AR) and the autoregressive distributed lag model (ADL). The forecasting performance of the factor-augmented models is evaluated, and conclusions on the usefulness of factors for forecasting GDP and its demand components are drawn. Monthly factors from an unbalanced dataset are included in bridge equations for GDP and its demand components in order to construct forecasts for the previous and current quarter at the beginning of each month; the forecasting performance of bridge equations is assessed. The paper also investigates whether factor-based indicators extracted from a dataset of all monthly questions from Business and Consumer Survey could constitute more informative leading indicators for activity than the Economic Sentiment Indicator computed from a subset of the Survey questions.

In the next section a description of the models used in the estimation of common factors from balanced and unbalanced datasets is given and the results from factor analysis are presented. Section 3 presents the results of a forecast evaluation exercise where quarterly common factors are used. Section 4 investigates the usefulness of monthly factors for now-casting GDP growth and the demand-side aggregates of National Accounts using bridge equations. Section 5 discusses the application of factor models for the construction of an alternative economic sentiment indicator for Cyprus. Section 6 concludes.

2. Dynamic factor models

A description of the dynamic factor models used in the derivation of common factors from balanced and unbalanced datasets is given and the estimation results are presented and discussed.

2.1 Factors from a balanced dataset

First we describe the approximate dynamic factor model which connects the variable to be forecasted to a set of unobserved common factors that drive a large dataset of predictors. Stock and Watson (2002a, 2002b) develop a two-step procedure that leads to the computation of forecasts for the variable of interest:

- the time series of factors are estimated;
- the relation between the variable to be forecasted and the estimated factors (and possibly other observed variables) is estimated.

Let y_{t+h} be the variable to be forecasted (e.g. the growth rate of GDP, consumption, investment etc.) and let $X_t = (X_{1t}, X_{2t}, \dots, X_{Nt})'$ be a vector of predictors available for $t = 1, 2, \dots, T$ then

$$X_{it} = \lambda_i(L) f_t + \eta_{it} \quad i = 1, 2, \dots, N \tag{1}$$

$$y_{t+h} = \beta(L) f_t + \gamma(L) W_t + \varepsilon_{t+h} \tag{2}$$

where f_t denotes the vector of $\tilde{r}$ common *dynamic* factors, η_{it} is the idiosyncratic error associated with the i −th predictor, W_t is a $k \times 1$ vector of observed variables and the lag polynomials $\lambda_i(L)$, $\beta(L)$, $\gamma(L)$ are at most of order q with $\lambda_i(L) = \sum_{j=0}^{q} \lambda_{ij} L^j$, $\beta(L) = \sum_{j=0}^{q} \beta_j L^j$. The idiosyncratic errors are allowed to be correlated across time periods and different predictors in the dataset, i.e. errors are serially and cross-sectionally correlated (Stock and Watson 2002a, 2002b).

Let $F_t = (f_t', f_{t-1}', \dots, f_{t-q}')'$ be $r \times 1$ where $r \leq \tilde{r}(q+1)$, and let Λ be the matrix of factor loadings with its i −th row given by $(\lambda_{i0}, \lambda_{i1}, \dots, \lambda_{iq})$, then the static representation of the dynamic factor model in (1)-(2) is

$$X_t = \Lambda F_t + \eta_t \tag{3}$$

$$y_{t+h} = \beta' F_t + \gamma(L) W_t + \varepsilon_{t+h} \tag{4}$$

where $\beta = (\beta_0, \beta_1, \dots, \beta_q)'$ and $\eta_t = (\eta_{1t}, \eta_{2t}, \dots, \eta_{Nt})'$. Under some assumptions about the factor loadings and the moments of the idiosyncratic errors, factors can be consistently estimated using the principal components method whereby the estimated factors $\hat{F}$ are given by the first r eigenvectors of the $T \times T$ data matrix XX' and the estimated factor loadings are computed as $\hat{\Lambda} = T^{-1} X' \hat{F}$, where $X = (X_1' \, X_2' \dots X_T')'$ and $\hat{F} = (\hat{F}_1' \, \hat{F}_2' \dots \hat{F}_T')'$. In order for the factors to be uniquely identified the normalisation $T^{-1} \hat{F}' \hat{F} = I_r$ is required.[2, 3]

[2] Further details about estimation and asymptotic properties of the estimators can be found in Stock and Watson (2002b).

[3] Alternatively factors and factor loadings can be computed from the $N \times N$ matrix $X'X$, but when $N > T$, which is the case in the empirical application, it is computationally easier to follow the approach described (see Stock and Watson 2002b).

Next we apply the principal components method to a dataset of 83 quarterly series over the period 1995Q1-2013Q2. The series relate to the real economy and include activity indicators for Cyprus (e.g. consumption, investment, imports, exports, real gross value added for different sectors, building permits, cement sales, electricity production and consumption, registration of motor vehicles indices of industrial production and retail trade, tourist arrivals) and for some of its trading partners as well as labour market variables (e.g. employment, unemployment rate, registered unemployed); see Table A1. Thus we seek to summarise the information on the real economy using a small number of factors which will be then used for forecasting the growth rate of GDP and its demand components.

Table 1 shows the results from the application of the principal component method on the dataset of real economy variables. In particular, the table shows the estimated 12 largest eigenvalues ranked in descending order, and the marginal contribution of each factor (i.e. principal component) in explaining the total variance in the 83 series. This contribution decreases substantially after the second factor. The first factor explains about 18% of the cross-section variation in the data, while the first and second factor jointly contribute 26% to the total variance; the first 12 factors account for 62% of variance in the dataset.

Table 1: Estimation of common factors (quarterly), balanced dataset

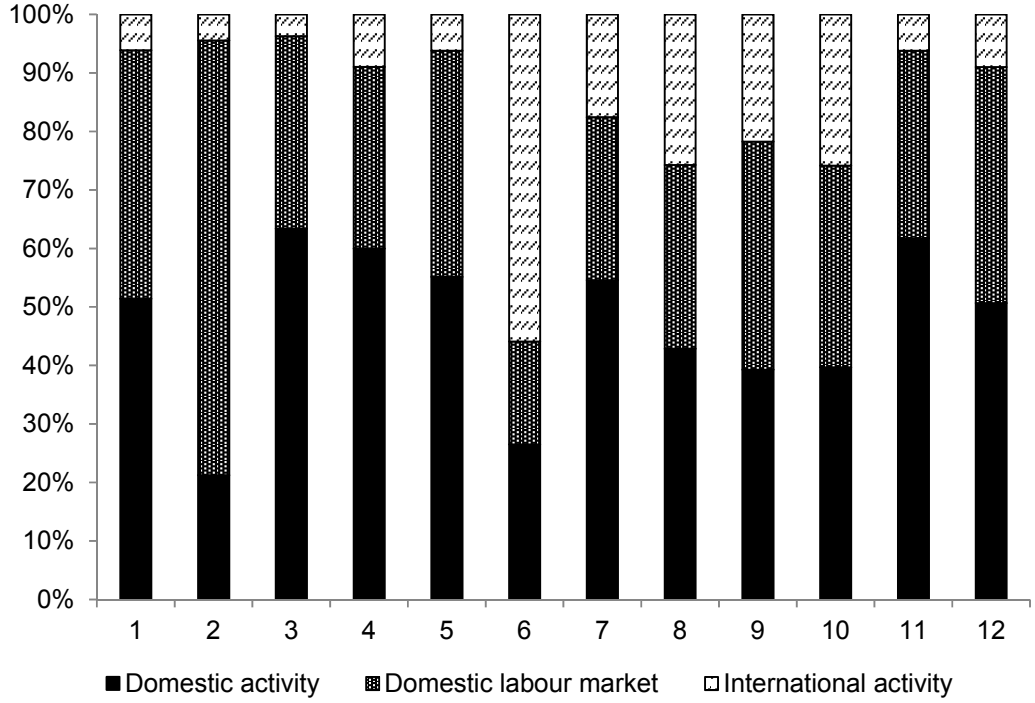
Number of factors	Estimated eigenvalues	Marginal contribution of factor to total variance	Information criteria		
			ICP1	ICP2	ICP3
0			-0.014	-0.014	-0.014
1	1088	18.2	-0.121	-0.104	-0.156
2	460	7.7	-0.125	-0.093	-0.196
3	302	5.0	-0.101	-0.053	-0.208
4	267	4.5	-0.074	-0.009	-0.216
5	263	4.4	-0.050	0.031	-0.228
6	240	4.0	-0.025	0.073	-0.238
7	223	3.7	0.001	0.114	-0.247
8	192	3.2	0.032	0.162	-0.252
9	183	3.1	0.062	0.208	-0.257
10	172	2.9	0.092	0.254	-0.263
11	163	2.7	0.121	0.300	-0.269
12	151	2.5	0.151	0.346	-0.275
			Number of factors estimated by information criteria		
			2	1	12

Notes: (i) The number of series in the balanced panel is 83 and the number of time periods is 72 after transforming the series to induce stationarity.
(ii) The percentage of total variance accounted for by the first 12 factors is 62%.
(iii) The sum of squared residuals (idiosyncratic components) is 2275.

Table 1 also shows three alternative information criteria (ICP1, ICP2, ICP3) for the choice of the number of factors (see Bai and Ng 2002). The number of factors estimated by each criterion is the one that corresponds to the smallest value of the criterion. ICP1 and ICP2 suggest a small number of factors, namely two and one respectively, whereas ICP3 estimates 12 factors.

Figure 1 shows how each one of the 12 factors relates to the different categories of variables in the dataset. Loosely speaking, Figure 1 can be interpreted as how the R^2's from regressions of factors on each of the series in the dataset (i.e. the percentage of the variation in each factor explained by each variable) are distributed among the various categories of variables. For example, the first factor correlates mostly with domestic real activity indicators, while the second loads mainly on labour market variables; the sixth factor represents to a great extent international activity series.

Figure 1: Relation between factors and group of variables in the dataset



Note: The figure shows the distribution of squared factor loadings over the different categories of variables in the dataset.

2.2 Factors from an unbalanced dataset

A large number of financial and macroeconomic series are available at a monthly frequency and long before the publication of the National Accounts for a reference period. However, even monthly data vary considerably in terms of the timeliness of their releases. For example, financial data (which are also available at higher frequencies e.g.

daily) can be obtained at any time during a reference month, while business and consumer survey data are available at the end of each month. Other monthly series such are consumer price indices, vacancies, loans and deposits are published with a short delay; for series such as registered unemployed, registration of motor vehicles and tourist arrivals, the publication lag is even longer. Thus, in summarising the bulk of monthly information with a few factors, one has to deal with the problem of jagged-edge sample due to the publication delays in the different monthly variables in the dataset. Moreover, the inclusion of a large number of series in the dataset gives rise to missing values at the beginning of the sample as there are differences in the start dates of the different variables.

The standard principal component analysis used to extract factors from a balanced dataset can be modified to deal with the estimation of common factors from unbalanced datasets. In the balanced panel case the ordinary least squares estimation of factors F_t and factor loadings Λ in equation (3)

$$X_t = \Lambda F_t + \eta_t$$

involves the minimisation of the following expression

$$\min_{F,\Lambda} \sum_{i=1}^{N} \sum_{t=1}^{T} (X_{it} - \lambda_i' F_t)^2 \quad (5)$$

achieved by application of principal component methods on the data matrix X_t (λ_i is the i −th row of Λ). In the case of unbalanced panels the minimisation problem becomes

$$\min_{F,\Lambda} \sum_{i=1}^{N} \sum_{t=1}^{T} I_{it} (X_{it} - \lambda_i' F_t)^2 \quad (6)$$

where $I_{it} = 1$ if observation for X_{it} is available and $I_{it} = 0$ otherwise. To solve the minimisation problem in (6) an iterative method such as the Expectation Maximisation (EM) algorithm needs to be employed. At the j −th iteration of the algorithm, the minimisation problem becomes

$$\min_{F,\Lambda} \sum_{i} \sum_{t} (\hat{X}_{it} - \lambda_i' F_t)^2 \quad (7)$$

where $\hat{X}_{it} = E(X_{it}|X^*, \hat{F}^{(j-1)}, \hat{\Lambda}^{(j-1)})$, X^* is the matrix of observed data, $\hat{F}^{(j-1)}, \hat{\Lambda}^{(j-1)}$ are the estimates of factors and loadings respectively computed at iteration $(j-1)$. Thus, at the j −th iteration the missing observations are estimated by their expected values conditional on the available observations and the parameter estimates computed at the previous iteration. Then the minimisation of (7) is solved by applying principal

component analysis to $\hat{X}_t$. The initial values of the factors and loadings are calculated by applying principal component analysis to the balanced-panel part of the dataset.

The EM algorithm is applied to an unbalanced dataset of 193 monthly domestic and international/foreign series covering the period 2001M1-2013M8. More specifically, the dataset includes stock market indices, exchange rates, interest rates, consumer price indices, international commodity prices, business and consumer survey data, loans, deposits, vacancies, registered unemployed, unemployment rates, arrivals of tourists, building permits, cement sales, industrial production indices, retail trade indices, etc. (see Table A6).

The idea is to use the unbalanced monthly dataset to compute monthly factors early each month, for example on the 10th of each month. Estimated factors will subsequently be used for the construction of forecasts for quarterly GDP growth and its components. This setup results in the following data availability pattern: early in month $t+1$ about 77% of the series in the dataset are observed up to month t, about 14% of the variables are available up to month $t-1$, and the remaining 9% of the series are observed until month $t-2$. The estimation of the monthly factors from the unbalanced dataset will give monthly series with observations up to month t.

The number of factors used for the application of the EM algorithm is 12, i.e. 12 common components of the data are used at each iteration of the algorithm for the estimation of the missing values in the unbalanced part of the dataset and subsequently in updating the factor estimates. Estimation results are given in Table 2.

Table 2: Estimation of common factors (monthly), unbalanced dataset

Number of factors	Estimated eigenvalues	Marginal contribution of factor to total variance
1	4174	14.6
2	1898	6.7
3	1345	4.7
4	1202	4.2
5	1029	3.6
6	976	3.4
7	879	3.1
8	806	2.8
9	753	2.6
10	679	2.4
11	657	2.3
12	640	2.2

Notes: (i) The number of series in the unbalanced panel is 193 and the number of time periods is 150 after transforming the series to induce stationarity.
(ii) The percentage of total variance accounted for by the first 12 factors is 52.7%.
(iii) The sum of squared residuals (idiosyncratic components) is 13480.

The 12 factors jointly account for 53% of the variance in the dataset. As reported in Table 2, the first factor alone explains about 15% of the of the variance in the 193 series, while each one of the remaining factors captures much smaller proportion of the variation in the data.

Table 3 presents the distribution of the sum of squared loadings over the different categories of variables in the dataset. The first factor loads mainly on economic sentiment series, interest rates and prices; the second and third factor represent mostly activity and labour market variables, economic sentiment series and prices. Overall, most of the factors correlate highly with economic sentiment, prices as well as with activity and labour market series.

Table 3: Distribution of squared factor loadings over groups of variables

Factor	Activity & labour market	Prices	Interest rates	Exchange rates	Stock market indices	Economic sentiment indicators
1	2	15	19	4	3	58
2	34	24	2	0	4	36
3	27	14	7	2	12	38
4	9	28	5	2	15	41
5	16	38	8	4	2	31
6	43	12	2	1	2	39
7	12	46	15	2	11	15
8	13	17	12	6	18	34
9	40	18	4	3	15	20
10	22	25	16	3	7	26
11	6	36	10	5	16	27
12	29	15	13	2	10	32

3. Forecasting performance: factor-augmented models

In this section we discuss how the factors extracted from the balanced dataset of quarterly variables can be used in forecasting models. A forecasting exercise is conducted to assess whether the inclusion of factors in the models enhances the forecasting performance.

3.1 Models and forecast combinations

The estimated quarterly factors are used to extend simple dynamic models, such as the AR and ADL that are subsequently used for forecasting; the resulting models are known as factor-augmented AR (FAR) and factor-augmented ADL (FADL) models. The variable

to be forecasted is defined as $y_t = \ln Z_t - \ln Z_{t-1}$ where Z_t can be the level of GDP, or the level of any of the GDP demand components, i.e. private consumption, government consumption, gross fixed capital formation, exports or imports.[4] Moreover, in the forecasting models the variable of interest is expressed at an annual rate and as a function of the forecasting horizon, h. Specifically, $y_{t+h}^h = (400/h)(\ln Z_{t+h} - \ln Z_t)$ for $h = 1,2,3,4$ which denotes annualised GDP (or any of its demand components) over the next h quarters. We consider the following models:

$$y_{t+h}^h = \alpha + \sum_{i=0}^{q} \beta_i y_{t-i} + \sum_{i=0}^{p} \gamma_i \hat{f}_{t-i} + \delta_1 z_{t+1}^{M1} + \delta_2 z_{t+1}^{M2} + e_{t+h}^h \quad (8a)$$

$$y_{t+h}^h = \alpha + \sum_{i=0}^{q} \beta_i y_{t-i} + \sum_{i=0}^{p} \gamma_i x_{t-i} + \delta_1 x_{t+1}^{M1} + \delta_2 x_{t+1}^{M2} + \sum_{i=0}^{s} \phi_i \hat{f}_{t-i} + \psi_1 z_{t+1}^{M1} + \psi_2 z_{t+1}^{M2} + \varepsilon_{t+h}^h \quad (8b)$$

where, $\hat{f}_t$ is one of the estimated factors summarising a large dataset of real economy series, z_{t+1}^{M1} and z_{t+1}^{M2} are the monthly values of variables used in the construction of factors covering the first and second month respectively of quarter $t+1$; x_t is a candidate predictor series other than the real economy series used in factor estimation, x_{t+1}^{M1} and x_{t+1}^{M2} are the monthly values of variable x_t covering the first and second month respectively of quarter $t+1$ (the sample ends at time t).

Apart from the large number of series relating to the real economy, the dataset employed contains a large number of candidate predictors which cover other aspects of the economy, such as stock market indicators, interest rates, exchange rates, consumer prices, international commodity prices, economic sentiment indicators, loans, deposits, fiscal variables, etc. Such series are published on a monthly basis and well before the publication of the National Accounts data. These monthly values, known as monthly leads, can be used in estimation and forecasting as they provide more timely information than the quarterly series. Monthly leads cover the first, second and in some cases even the third month (i.e. whole quarter) following the reference quarter of the most recent National Accounts data. [5]

The estimation of the parameters and the selection of the number of lags in (8a) and (8b) is carried out in a pseudo out-of-sample setup using recursive OLS and recursive determination of the lag length based on the Akaike Information Criterion (AIC) and

[4] In the analysis that follows we consider modelling and forecasting separately (i) gross capital formation (i.e. fixed investment plus changes in inventories), (ii) gross fixed capital formation (i.e. fixed investment) and (iii) changes in inventories.

[5] For some candidate predictor series such as stock market indicators, exchange rates and business and consumer survey variables quarterly leads (up to one quarter ahead) might be available.

Bayesian Information Criterion (BIC). For comparison purposes we also estimate simple univariate models such as the random walk for GDP (and its demand components). The forecast constructed at date t for period $t+h$ is computed using data up to date t, thus no additional projections for predictors are required; this type of forecast is known as 'direct' forecast (see e.g. Stock and Watson 2004, 2008). The choice of the number of lags for predictor x_t is between one and three, and for the dependent variable y_t between zero and three.

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 in period $t = T_0 + h + 1$. 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 computed in period t is given by $\hat{y}_{t+h|t}^h$. Then the Mean Squared Forecast Error (MSFE) used for evaluating the forecasting performance of each model at horizon h is given by

$$MSFE = \frac{1}{(T-h)-(T_0+h)+1} \sum_{t=T_{0+h}}^{T-h} (y_{t+h}^h - \hat{y}_{t+h|t}^h)^2 \quad (9)$$

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

The numerous alternative predictors in the dataset in combination with the factors and leads, allow us to estimate a large number of different models and to obtain numerous alternative forecasts for the variables of interest. This large number of forecasts can be further exploited by constructing combinations of forecasts.

There is a large and growing literature that suggests that forecast combinations can provide 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 different set of predictors, lag structures and modelling approaches. Although there is a consensus that forecast combinations improve forecast accuracy there is no consensus concerning how to form the forecast weights. Given M models and associated forecasts, combination forecasts are weighted averages of individual forecasts where the weights can be fixed or time-varying:

$$\hat{F}_{t+h|t}^h = \sum_{i=1}^{M} w_{i,t}\, \hat{y}_{i,t+h|t}^h \quad (10)$$

where $\hat{y}_{i,t+h|t}^{h}$ is the $h-$step ahead forecast from model i made at time 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 a trimmed mean. In cases where $w_{i,t}$ depends on model's 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.

$$w_{i,t} = \frac{v_{i,t}}{\sum_{j=1}^{M} v_{j,t}}, \text{ or,} \tag{11}$$

$$w_{i,t} = \frac{(v_{i,t})^2}{\sum_{j=1}^{M} (v_{j,t})^2} \tag{12}$$

where $v_{i,t} = [\sum_{s=T_0+h}^{t-h} \delta^{t-h-s} (y_{s+h}^{h} - \hat{y}_{i,s+h|s}^{h})^2]^{-1}$;

δ is the discount factor so that forecast errors made in the distant past are of smaller importance. Thus, larger weights are assigned to forecasts from models with lower MSFE (i.e. better historical forecasting performance).

Another forecast combination based on past historical performance is the 'recent best' where the forecast from the model with the lowest MFSE, on average, the last n periods is used.

3.2 Forecasting exercise

The forecasting exercise uses the same dataset as that employed for exploring the forecasting performance of single equation dynamic models and forecast combinations in the absence of common factors in Papamichael et al. (2014). Thus, this exercise allows us to examine whether augmenting the single equation dynamic models with estimated common factors results in forecasting gains. As previously, we employ the following samples:

- Dataset A which covers the period 1995Q1-2013Q2 and does not include BCS data for Cyprus as BCS series start after 2000;
- Dataset B which covers the period 2001Q1-2013Q2 and includes all the variables of Dataset A plus BCS data for Cyprus
- Dataset C which covers the period 2001Q1-2013Q2 and includes all the variables of Dataset A.

We therefore investigate whether using a dataset with shorter time series but with additional predictors, namely BCS indicators for Cyprus could lead to an improved forecasting performance conditioning also for real economy factors in the models.[6] The forecasting horizon is four quarters and the pseudo out of sample period is common for the Dataset A, B and C, i.e.:

2008Q1-2013Q1 for $h = 1$

2008Q3-2012Q4 for $h = 2$

2009Q1-2012Q3 for $h = 3$

2009Q3-2012Q2 for $h = 4$.

The presentation of the results is similar to that in Papamichael et al. (2014) for comparison purposes. Tables A3-A5 present the results of the forecasting competition for FAR and FADL models estimated using the datasets (a) – (c). The forecasting exercise is conducted for alternative forecast combination methods over a horizon of up to four quarters.[7] Moreover, the forecasting performance is evaluated for different values of the intercept correction discount factor, ranging from $\alpha = 0$ (i.e. no intercept correction is applied to the forecasts obtained from the single equation models) to $\alpha = 1$ (i.e. model-based forecasts are adjusted by the full amount of the previous period's forecast error). Regarding forecast combination methods we consider the following:

(a) simple methods namely the median, mean and trimmed mean, i.e. the mean after discarding the highest and lowest 5% of the distribution of individual forecasts;

(b) methods based on models' past forecasting performance and in particular on discounted MSFE and squared MSFE with weights given by equation (11) and (12) respectively, with discount factors $\delta = 0.9, 0.95, 1$;

(c) the forecast from the model with the best performance during the previous four quarters (smallest average MSFE over the previous four periods), henceforth 'recent best'.

[6] The results of the estimation of common factors for the period 2001Q1-2013Q2 are given in Table A2.
[7] The MSFE for all individual models whose forecasts were used in the computation of forecast combinations are available upon request.

The tables present the square root MSFE (RMSFE) of the different forecast combinations of purely model-based forecasts or 'intercept corrected' forecasts relative to the random walk benchmark. A random walk benchmark for each variable of interest (GDP, private consumption, etc.) is estimated using data from 2001Q1 onwards.

The main findings are summarised below:

- The inclusion of dynamic factors summarising real economic variables in the models does not improve the forecast accuracy of simple AR models (with intercept corrections) for the growth rate of GDP for horizons of one and two quarters (Dataset A). Forecast combinations from factor-augmented models outperform univariate forecast combinations for one- and two-quarter ahead GDP growth forecasts. In forecasting GDP growth three and four quarters ahead, combinations of factor-augmented model forecasts lead to higher gains than the forecasts from the univariate models.

- Using the longer dataset (Dataset A), factor-augmented models for the growth rate of private consumption and fixed investment are, in general, associated with smaller forecast errors compared to univariate models and forecast combinations. For the growth rate of government consumption FADL and FAR models outperform univariate models only for horizons of one and three quarters; for two-quarter ahead forecasts univariate and factor-augmented model forecast combinations perform similarly. In the case of gross capital formation (i.e. fixed investment plus inventory changes) simple AR models are associated with smaller forecast errors than combinations from FADL and FAR models for all horizons. Forecast combinations from factor-augmented models improve upon univariate forecast combinations for three- and four-quarter ahead forecasts for gross capital formation.

- In forecasting the growth rate of exports, using the longer dataset (Dataset A) in factor-augmented models or univariate forecast combinations does not result in gains over the random walk. Nevertheless, the application of the same dataset for forecasting the growth rate of imports using factor-augmented models improves upon the forecast accuracy of the univariate models for horizons of one and four quarters; the performance of factor-augmented and univariate forecast combinations is about the same for two- and three-quarter ahead forecasts.

- The application of the longer dataset (Dataset A) to investigate the forecasting performance of factor-augmented models vis-à-vis the performance of ADL

models leads to the following findings. Factor-augmented models for the growth rate of GDP improve the forecast accuracy of ADL forecast combinations for all horizons by 5% to 10%. Forecast combinations from factor-augmented models for private consumption growth outperform combinations from ADL models for all horizons but the improvement is larger for four-quarter ahead forecasts. For government consumption growth neither factor-augmented nor ADL forecast combinations can beat the random walk for horizons of one and three quarters; nevertheless, forecast combinations from factor-augmented models are more accurate than those from ADL forecast combinations and the random walk for horizons of two and four quarters. The inclusion of factors in ADL models enhances their forecast accuracy as forecast combinations from factor-augmented models outperform combinations from ADL models in forecasting the growth rate of fixed investment and gross capital formation for all horizons and three to four quarters ahead respectively. No gains over the random walk are found in constructing combination forecasts for the growth rate of exports from ADL or factor-augmented models. In the case of the growth rate of imports, combinations of factor-augmented model forecasts without intercept corrections perform about the same as combinations of intercept corrected forecasts from ADL models for horizons of one and two quarters; for three- and hour-quarter ahead forecasts the use of factors improves marginally the performance of simple ADL models.

- Using the dataset with the shorter time series (2001Q1 onwards) which contains BCS data (Dataset B), we find that factors improve the forecasting performance of ADL models for the growth rate of GDP, private consumption, gross capital formation and imports, for all quarters considered. In the case of government consumption forecast gains from the use of factors appear only at the end of the forecast horizon, while in forecasting the growth rate of fixed investment the inclusion of factors in AR and ADL models enhances the precision of one-quarter and two-quarter ahead forecasts. In the case of the growth rate of exports, the combinations of forecasts from factor-augmented models yield gains over the random walk and ADL models only for one quarter ahead.

- Comparing the results from factor-augmented models estimated using datasets with and without BCS data, we do not find substantial differences in the forecast gains (with respect to the random walk) between the two datasets. Thus, the use of BCS predictors does not seem to lead to gains in forecasting the growth rate of GDP or its demand components, possibly because of the short time series dimension.

- The forecast gains from the application of forecast combinations based on discounted (or squared discounted) MSFE are only marginally higher than the gains achieved using simple combinations (e.g. mean, median).

- The use of intercept corrections can improve forecast accuracy, especially for longer horizons.

4. Bridge equations using monthly factors

As discussed in section 2.2 the timely information in a large number of financial and survey data can be exploited by computing factors from an extensive unbalanced dataset of monthly series, i.e. a dataset where the observations of some variables at the end of the sample are missing due to the asynchronous data publication dates. Monthly factors from the unbalanced dataset can be computed on a monthly basis and subsequently used in forecasting models for projecting quarterly GDP and its demand components. National Accounts data are published in quarterly frequency and with a considerable delay with respect to the reference quarter; the factors can be estimated every month to capture the most recent monthly information. Bridge Equations which link (bridge) quarterly and monthly variables will be employed to construct forecasts for the demand-side aggregates of the National Accounts by utilising the information in monthly factors. The forecasts can be computed every month and updated with the arrival of new information. Thus, forecasts of GDP and its demand components can be revised every month in order to incorporate the latest available information from leading indicators.

Next the setup of the forecasting exercise is described. Early in month M, about 77%, 14% and 9% of the series in the dataset are available up to month $M-1$, $M-2$ and $M-3$ respectively; the variables can be divided into three groups, A, B and C according to the abovementioned availability pattern (a detailed list of the variables by group is given in Table A6). Given the monthly data availability pattern, the factors computed early in month M will contain information up to the previous month ($M-1$) as iterative methods for factor estimation using the unbalanced dataset are employed. Furthermore, given that National Accounts are published about 2 ½ months after the end of the reference quarter, one can compute quarterly National Accounts forecasts for the previous and current quarter early in each month, using within-quarter information summarised by the monthly factors.

Depending on the month when the forecasts are computed, one- two- or three-month ahead projections of factors are needed for the construction of forecasts for the current

quarter. Table 4 shows the reference quarter and reference month for which National Accounts data and monthly series respectively, are available at the beginning of each month when the forecasts are computed. The table also shows the month covered by the estimated factor together with the number of factor projections required at every monthly forecast round.[8]

Let y_t^Q denote quarterly GDP growth or some GDP demand component expressed as a quarterly growth rate (i.e. the quarter-on-quarter growth rate) and let $\hat{F}_m = \left(\hat{f}_{1m}^M, \hat{f}_{2m}^M, \dots, \hat{f}_{km}^M\right)'$ be a vector monthly factors extracted from an extensive unbalanced dataset of monthly indicators. The quarterly aggregates of the monthly factors are denoted by $\hat{f}_{it}^Q \; i = 1,2,\dots,k$ where $\hat{f}_{it}^Q = \frac{1}{3}\left(\hat{f}_{i,\bar{m}}^M + \hat{f}_{i,\bar{m}-1}^M + \hat{f}_{i,\bar{m}-2}^M\right)$ and $\bar{m}$ is the final month of quarter t; the bridge equation is given by

$$y_t^Q = \alpha_0 + \sum_{j=0}^{p} \alpha_i \hat{f}_{it-j}^Q + \varepsilon_t^Q, \quad \text{for } i = 1,2,\dots,k. \tag{13}$$

The bridge equation can be extended to include past values of the dependent variable,

$$y_t^Q = \beta_0 + \sum_{j=0}^{p} \beta_i \hat{f}_{it-j}^Q + \sum_{l=1}^{q} \gamma_l y_{t-l}^Q + \eta_t^Q, \quad \text{for } i = 1,2,\dots,k. \tag{14}$$

Equations (13) and (14) are estimated every month using quarterly data for $t = 1,2,\dots,T-2$ where $T-2$ is the last quarter for which we have published National Accounts data (i.e. the delay between the current quarter and the official publication of the corresponding National Accounts data is typically two quarters).[9] The lag length for the predictors is selected using AIC from a maximum of four lags.

The estimated parameters together with the previously constructed quarterly values of the factors $\hat{f}_{iT-1}^Q$ and $\hat{f}_{iT}^Q$ are used to compute forecasts for GDP growth (or its demand components) for the previous and the current quarter denoted by $T-1$ and T respectively. In the case of equation (14), the forecast for y_t^Q at $t = T$ necessitates a value for y_t^Q at $t = T-1$ which is not observed thus the forecast for y_t^Q at $t = T-1$ is used. The use of 12 different monthly factors as predictors results in alternative forecasts that are then combined using the different forecast combination methods discussed in section 3.1.

[8] An AR model for each monthly factor series is estimated and the required monthly forecasts are computed. The order of the AR model is selected using the Akaike Information Criterion (AIC) from a maximum of 12 lags.

[9] For example, in January the available National Accounts data cover the third quarter of the previous year.

Table 4: Data releases and forecast horizons for monthly factors used in bridge equations

Quarter i in year Y: Qi(t)	**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)**
Data releases												
National Accounts (reference quarter i and year Y: Qi(Y))			**Q4(Y-1)**			**Q1(Y)**			**Q2(Y)**			**Q3(Y)**
Monthly series (reference month j and year Y: Mj(Y))												
Group A	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)
Group B	M11(Y-1)	M12(Y-1)	M1(Y)	M2(Y)	M3(Y)	M4(Y)	M5(Y)	M6(Y)	M7(Y)	M8(Y)	M9(Y)	M10(Y)
Group C	M10(Y-1)	M11(Y-1)	M12(Y-1)	M1(Y)	M2(Y)	M3(Y)	M4(Y)	M5(Y)	M6(Y)	M7(Y)	M8(Y)	M9(Y)
Monthly factors												
Forecast horizon: months ahead	3	2	1	3	2	1	3	2	1	3	2	1
Number of monthly values forecasted to construct quarterly counterparts												
Previous quarter	Q4(Y-1); 0	Q4(Y-1); 0	Q4(Y-1); 0	Q1(Y); 0	Q1(Y); 0	Q1(Y); 0	Q2(Y); 0	Q2(Y); 0	Q2(Y); 0	Q3(Y); 0	Q3(Y); 0	Q3(Y); 0
Current quarter	Q1(Y); 3	Q1(Y); 2	Q1(Y); 1	Q2(Y); 3	Q2(Y); 2	Q2(Y); 1	Q3(Y); 3	Q3(Y); 2	Q3(Y); 1	Q4(Y); 3	Q4(Y); 2	Q4(Y); 1

The monthly data used to extract factors cover the period from 2001M1 to 2013M8 and are described in section 2.2. The quarterly data for GDP and its demand components cover the period from 2001Q1 to 2013Q2. The data used in the analysis are seasonally adjusted and transformed into stationary variables. The forecasting period for the growth rate of GDP and its demand components is from 2006Q2 to 2013Q2 and from 2006Q3 to 2013Q1 for forecasts about the previous and current quarter respectively. In the forecasting exercise, both the monthly factors and forecasting models are estimated recursively by adding an additional month at each recursion. [10] Using the newly estimated monthly factors every month, one can compute a revised forecast for the growth rate of GDP and its demand components. Thus in each quarter three forecasts for the previous and current quarter can be constructed with the arrival of new monthly information.

Table 5 presents the RMSFEs of forecast combinations based on forecasts from equation (13) and (14) relative to the random walk benchmark. At the beginning of each month forecasts for GDP (or consumption, investment, etc.) growth for the previous quarter and the current quarter can be constructed prior to the release of the official National Accounts data.[11] This is because the reference quarter for the latest available National Accounts data at the beginning of each month relates to two quarters back. The forecasts computed in the first month of a quarter are based on less information from monthly variables compared to those computed in the second month that incorporate less monthly information than the forecasts constructed in the final month of a quarter. The table also reports the number of months between the time (month) of the estimation of the forecast and the relevant National Account release.[12]

Bridge equations and more specifically models which also include lags of the dependent variable improve upon the naive model in terms of forecast accuracy, especially in the case of GDP (previous and current quarter), private consumption (previous and current quarter), government consumption (previous quarter), investment (current quarter) and exports (previous and current quarter). Bridge equations augmented by lags of the dependent variable lead to higher gains than bridge equations which include only factors

[10] The initial monthly and quarterly samples for the estimations are respectively 2001M1 – 2006M6 and 2001Q1 – 2006Q1.
[11] As the forecasts refer to the previous and current quarter they are also known as back-casts and now-casts respectively.
[12] For example, early in January we estimate forecasts for the last quarter of the previous year (i.e. previous quarter) and the first quarter of the current year (i.e. current quarter). National Accounts for the aforementioned quarters are released in mid-March and mid-June respectively; hence the distance between the month when the forecasts are computed and the publication of the National Accounts is two and five months respectively.

when the former are used for constructing forecasts for both the previous and current quarter's growth rate of GDP, private consumption, fixed investment and exports as well as for forecasting the growth rate of government consumption for the previous quarter.

Table A5: RMSFE of combination forecasts from bridge equations (relative to the RMSFE of the random walk)

Forecasts are estimated early in:	**Jan/Apr/Jul/Oct**				**Feb/May/Aug/Nov**				**Mar/Jun/Sep/Dec**			
Quarter for which forecast is estimated	**Previous**		**Current**		**Previous**		**Current**		**Previous**		**Current**	
No of months to National Accounts release	*2*		*5*		*1*		*4*		*0*		*3*	
Lagged dependent variables in forecasting model	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
GDP												
RMSFE	1.11	1.11	1.19	1.19	1.11	1.11	1.19	1.19	1.11	1.11	1.19	1.19
Median	0.74	1.03	0.90	1.01	0.74	1.04	0.90	1.01	0.73	1.02	0.88	0.98
Mean	0.71	0.98	0.86	0.95	0.70	0.98	0.86	0.95	0.71	0.98	0.87	0.96
Trimmed mean (5% trimming)	0.73	1.01	0.88	0.98	0.72	1.01	0.88	0.97	0.73	1.00	0.88	0.97
Discounted MSFE (0.90)	0.67	0.93	0.83	0.90	0.66	0.91	0.81	0.90	0.67	0.91	0.82	0.91
Discounted MSFE (0.95)	0.68	0.94	0.83	0.91	0.67	0.93	0.82	0.91	0.68	0.93	0.83	0.92
Discounted MSFE (1.00)	0.68	0.95	0.84	0.92	0.68	0.94	0.83	0.92	0.68	0.94	0.84	0.92
Squared discounted MSFE (0.90)	0.62	0.87	0.78	0.85	0.62	0.84	0.77	0.84	0.62	0.84	0.78	0.85
Squared discounted MSFE (0.95)	0.63	0.90	0.79	0.87	0.63	0.87	0.78	0.86	0.64	0.87	0.79	0.87
Squared discounted MSFE (1.00)	0.65	0.92	0.80	0.89	0.64	0.90	0.79	0.88	0.65	0.90	0.80	0.89
Recent best (past four quarters)	0.57	0.68	0.76	0.76	0.58	0.66	0.75	0.70	0.61	0.69	0.76	0.74
PRIVATE CONSUMPTION												
RMSFE	2.12	2.12	2.16	2.16	2.12	2.12	2.16	2.16	2.12	2.12	2.16	2.16
Median	0.85	0.98	0.91	0.99	0.83	0.95	0.92	0.99	0.84	0.97	0.94	0.98
Mean	0.81	0.91	0.91	0.97	0.81	0.91	0.90	0.96	0.81	0.91	0.90	0.94
Trimmed mean (5% trimming)	0.82	0.93	0.91	0.98	0.82	0.93	0.91	0.97	0.83	0.93	0.91	0.96
Discounted MSFE (0.90)	0.80	0.89	0.90	0.95	0.80	0.89	0.89	0.94	0.80	0.88	0.88	0.92
Discounted MSFE (0.95)	0.80	0.89	0.90	0.96	0.80	0.89	0.89	0.95	0.80	0.89	0.88	0.93
Discounted MSFE (1.00)	0.80	0.90	0.90	0.96	0.80	0.90	0.89	0.95	0.81	0.90	0.89	0.93
Squared discounted MSFE (0.90)	0.79	0.87	0.89	0.94	0.78	0.86	0.88	0.92	0.79	0.85	0.87	0.90
Squared discounted MSFE (0.95)	0.79	0.88	0.89	0.95	0.79	0.88	0.88	0.93	0.79	0.87	0.87	0.91
Squared discounted MSFE (1.00)	0.79	0.89	0.90	0.96	0.79	0.89	0.89	0.94	0.80	0.88	0.88	0.92
Recent best (past four quarters)	0.68	0.72	0.81	0.86	0.67	0.78	0.74	0.80	0.59	0.60	0.75	0.77
GOVERNMENT CONSUMPTION												
RMSFE	8.10	8.10	7.91	7.91	8.10	8.10	7.91	7.91	8.10	8.10	7.91	7.91
Median	0.84	1.00	1.04	0.99	0.83	1.00	1.04	1.00	0.85	0.99	1.03	1.01
Mean	0.84	1.03	1.04	0.98	0.84	1.03	1.04	0.99	0.85	1.03	1.03	1.01
Trimmed mean (5% trimming)	0.84	1.01	1.04	0.99	0.84	1.02	1.04	0.99	0.85	1.01	1.03	1.01
Discounted MSFE (0.90)	0.83	1.01	1.02	0.98	0.82	1.00	1.02	0.98	0.84	1.00	1.01	1.00
Discounted MSFE (0.95)	0.84	1.01	1.03	0.98	0.83	1.00	1.02	0.98	0.84	1.00	1.01	1.00
Discounted MSFE (1.00)	0.84	1.01	1.03	0.98	0.83	1.00	1.02	0.99	0.85	1.00	1.01	1.00
Squared discounted MSFE (0.90)	0.82	0.99	1.01	0.97	0.81	0.97	1.00	0.98	0.83	0.98	0.99	1.00
Squared discounted MSFE (0.95)	0.83	0.99	1.02	0.97	0.81	0.98	1.01	0.98	0.84	0.98	0.99	1.00
Squared discounted MSFE (1.00)	0.83	1.00	1.02	0.97	0.82	0.98	1.01	0.98	0.84	0.99	1.00	1.00
Recent best (past four quarters)	0.72	0.87	0.83	0.88	0.70	0.81	0.96	0.89	0.74	0.84	0.85	0.87
GROSS FIXED CAPITAL FORMATION												
RMSFE	4.69	4.69	5.15	5.15	4.69	4.69	5.15	5.15	4.69	4.69	5.15	5.15
Median	1.01	1.06	0.91	1.01	1.02	1.08	0.91	1.01	1.01	1.07	0.90	0.99
Mean	0.99	1.04	0.89	0.97	1.00	1.05	0.89	0.97	0.99	1.04	0.90	0.97
Trimmed mean (5% trimming)	1.00	1.05	0.90	0.99	1.02	1.06	0.90	0.99	1.00	1.05	0.90	0.98
Discounted MSFE (0.90)	0.95	1.00	0.87	0.94	0.95	1.00	0.86	0.93	0.94	0.99	0.86	0.94
Discounted MSFE (0.95)	0.96	1.01	0.88	0.94	0.96	1.01	0.87	0.94	0.94	1.00	0.87	0.95
Discounted MSFE (1.00)	0.96	1.01	0.88	0.95	0.97	1.01	0.87	0.94	0.95	1.01	0.87	0.95
Squared discounted MSFE (0.90)	0.91	0.97	0.86	0.90	0.89	0.95	0.83	0.89	0.89	0.95	0.84	0.92
Squared discounted MSFE (0.95)	0.92	0.98	0.87	0.91	0.91	0.96	0.84	0.90	0.90	0.97	0.84	0.93
Squared discounted MSFE (1.00)	0.93	0.99	0.87	0.92	0.93	0.98	0.85	0.91	0.91	0.98	0.85	0.94
Recent best (past four quarters)	0.88	0.81	0.75	0.73	0.70	0.72	0.68	0.73	0.75	0.75	0.76	0.76

Table 5: Continued

Forecasts are estimated early in:	Jan/Apr/Jul/Oct				Feb/May/Aug/Nov				Mar/Jun/Sep/Dec			
Quarter for which forecast is estimated	Previous		Current		Previous		Current		Previous		Current	
No of months to National Accounts release	*2*		*5*		*1*		*4*		*0*		*3*	
Lagged dependent variables in forecasting model	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO
GROSS CAPITAL FORMATION												
RMSFE	13.57	13.57	13.19	13.19	13.57	13.57	13.19	13.19	13.57	13.57	13.19	13.19
Median	1.15	1.02	1.01	1.02	1.14	1.02	1.01	1.02	1.13	1.03	1.01	1.01
Mean	1.15	1.02	1.00	1.00	1.13	1.01	1.01	1.01	1.13	1.01	1.02	1.02
Trimmed mean (5% trimming)	1.15	1.02	1.01	1.01	1.14	1.02	1.01	1.01	1.13	1.02	1.01	1.02
Discounted MSFE (0.90)	1.14	1.01	0.98	0.99	1.12	1.00	1.00	1.00	1.11	1.00	1.00	1.01
Discounted MSFE (0.95)	1.14	1.01	0.98	0.99	1.12	1.00	1.00	1.00	1.12	1.00	1.01	1.01
Discounted MSFE (1.00)	1.14	1.02	0.99	0.99	1.12	1.00	1.00	1.00	1.12	1.00	1.01	1.01
Squared discounted MSFE (0.90)	1.12	1.01	0.96	0.98	1.10	0.98	0.99	1.00	1.10	0.99	0.99	1.00
Squared discounted MSFE (0.95)	1.13	1.01	0.97	0.98	1.11	0.99	1.00	1.00	1.10	0.99	1.00	1.01
Squared discounted MSFE (1.00)	1.13	1.01	0.98	0.99	1.11	0.99	1.00	1.00	1.11	0.99	1.00	1.01
Recent best (past four quarters)	1.05	0.94	0.79	0.82	0.90	0.85	0.88	0.92	0.92	0.82	0.91	0.94
EXPORTS												
RMSFE	2.39	2.39	2.33	2.33	2.39	2.39	2.33	2.33	2.39	2.39	2.33	2.33
Median	0.88	0.97	0.98	1.01	0.88	0.94	0.98	1.01	0.89	0.96	0.98	1.01
Mean	0.88	0.96	0.96	0.99	0.87	0.94	0.95	0.99	0.87	0.94	0.97	1.01
Trimmed mean (5% trimming)	0.89	0.97	0.97	1.01	0.87	0.95	0.97	1.00	0.88	0.96	0.98	1.01
Discounted MSFE (0.90)	0.86	0.93	0.91	0.95	0.84	0.92	0.89	0.93	0.85	0.92	0.92	0.96
Discounted MSFE (0.95)	0.86	0.93	0.92	0.96	0.85	0.93	0.90	0.94	0.85	0.93	0.93	0.96
Discounted MSFE (1.00)	0.87	0.94	0.92	0.96	0.85	0.93	0.91	0.94	0.86	0.93	0.93	0.97
Squared discounted MSFE (0.90)	0.83	0.91	0.85	0.89	0.82	0.90	0.82	0.86	0.83	0.90	0.87	0.91
Squared discounted MSFE (0.95)	0.84	0.92	0.86	0.90	0.83	0.91	0.83	0.87	0.83	0.91	0.88	0.92
Squared discounted MSFE (1.00)	0.85	0.92	0.87	0.91	0.83	0.92	0.85	0.88	0.84	0.92	0.89	0.93
Recent best (past four quarters)	0.68	0.73	0.82	0.84	0.78	0.73	0.77	0.81	0.76	0.84	0.80	0.82
IMPORTS												
RMSFE	5.38	5.38	5.61	5.61	5.38	5.38	5.61	5.61	5.38	5.38	5.61	5.61
Median	1.12	1.05	0.99	1.00	1.06	1.04	0.99	0.99	1.11	1.04	0.98	0.99
Mean	1.08	1.02	0.98	0.98	1.05	1.01	0.98	0.98	1.06	1.00	0.97	0.98
Trimmed mean (5% trimming)	1.09	1.03	0.98	0.99	1.06	1.02	0.98	0.98	1.07	1.01	0.98	0.99
Discounted MSFE (0.90)	1.05	1.00	0.97	0.98	1.03	0.99	0.97	0.97	1.03	0.98	0.96	0.96
Discounted MSFE (0.95)	1.06	1.01	0.97	0.98	1.03	0.99	0.97	0.98	1.04	0.99	0.96	0.96
Discounted MSFE (1.00)	1.06	1.01	0.97	0.98	1.04	1.00	0.98	0.98	1.05	0.99	0.96	0.97
Squared discounted MSFE (0.90)	1.03	0.99	0.96	0.97	1.01	0.97	0.96	0.97	1.01	0.96	0.94	0.94
Squared discounted MSFE (0.95)	1.03	0.99	0.97	0.97	1.02	0.98	0.97	0.97	1.02	0.97	0.94	0.95
Squared discounted MSFE (1.00)	1.04	1.00	0.97	0.98	1.02	0.99	0.97	0.97	1.03	0.98	0.95	0.96
Recent best (past four quarters)	0.91	0.88	0.82	0.86	0.79	0.77	0.83	0.83	0.83	0.80	0.79	0.79

The 'recent best' combination method which uses the forecast of the model with the lowest forecast error in the last four quarters results in the smallest relative RMSFE. Forecast combinations with weights based on the squared discounted MSFE are also found to perform relatively well in general.

The results of the analysis do not provide evidence of improved forecasting performance with the arrival of new monthly information within a quarter. In the case of GDP and private consumption, RMSFEs remain broadly unchanged between forecast rounds carried out in the first, second and third month of a quarter. For previous quarter's government consumption growth forecasts, a marginal deterioration in the performance is found in the final month of the quarter. Similarly for exports, no improvement in forecast accuracy is found in the forecasts computed in the final month of the quarter.

Comparing the results of bridge equations with factors to those from bridge equations with individual monthly series as predictors discussed in Papamichael et al. (2014), we find that simple forecast combinations and combinations based on the discounted (or squared discounted) MSFE computed from forecasts from factor-based bridge equations, outperform the corresponding combination methods computed from simple bridge equations with monthly series as predictors (see Table A7).[13] The 'recent best' method applied to bridge equations with monthly leading indicators (as opposed to factors) generally outperforms the 'recent best' forecasts from factor-based bridge equations.

Bridge equations which include factors that incorporate more cross-sectional information but for a shorter time period compared to the bridge equations based on observed predictors only, provide noticeable improvements over the random walk, across all forecast combination methods; bridge equations which include only monthly macroeconomic/financial series generate sizable forecasting gains only when the 'recent best' combination method is applied.

5. A composite leading indicator

The dynamic factor model described in section 2 is applied to a monthly dataset of Business and Consumer Survey variables, in order to extract factors which could work as composite leading indicators of activity. The composite indicators can provide an alternative to the monthly Economic Sentiment Indicator (ESI) produced by the European Commission (European Commission 2014). ESI is the weighted average of a limited number of questions from BCS and the weights assigned to the questions from the industry (40%), services (30%), consumer (20%), construction (5%) and retail trade (5%) surveys are the same for all European countries. However, these weights are not representative of the Cyprus economy. The indicators, which are estimated using the dynamic factor model (see section 2.1), utilise information from all monthly questions from the BCS carried out in Cyprus. The factor-based indicators are not flawed by the non-representative weights assigned to the replies from the different sectors. The properties of the estimated factor-based composite indicator are compared to those of the ESI.

[13] Data for bridge equations with individual monthly series cover the period 1995Q1-2013Q2 as in Papamichael et al. (2014). However, the forecasting periods are the same as those used here for the factor-based bridge equations.

The dataset consists of all monthly aggregate BCS variables for Cyprus are available from May 2002 onwards and cover the sectors of industry, construction, retail trade, services as well as households/consumers. The variables are in the form of balances, i.e. the difference between the percentages of positive and negative responses and relate to aspects such as firms' activity (production and orders in industry, turnover/sales in services and retail trade, building activity and order books in construction), prices and employment. Moreover, the variables represent consumer's opinions about their current and future financial situation, savings and major purchases intentions, trends in consumer prices, and the general economic situation in the country, including the evolution of unemployment.

The results of the principal component analysis applied to the dataset of the 35 BCS series (2002Q2-2014Q3) are presented in Table 6. In particular, the table shows the 12 largest estimated eigenvalues ranked in descending order together with the marginal contribution of each factor in explaining the total variance in the dataset. The first factor captures a considerable part of the cross section variation in the data (58%), while the marginal contribution of each one of the following factors is much lower ranging from about 11% to 1%. The three information criteria ICP1, ICP2, ICP3 for the choice of the number of factors suggest 12, 7 and 12 factors respectively. Jointly the first seven factors account for 88% of the data variance, while the first 12 factors taken together explain 93% of the data variability.

Table 6: Estimation of common factors from monthly BCS data, 2002M6-2014M9

Number of factors	Estimated eigenvalues	Marginal contribution of factor to total variance	Information criteria		
			ICP1	ICP2	ICP3
0			0.01	-0.01	-0.01
1	3010	58.1	-0.77	-0.76	-0.78
2	559	10.8	-0.95	-0.94	-0.99
3	339	6.5	-1.08	-1.06	-1.13
4	268	5.2	-1.20	-1.17	-1.27
5	159	3.1	-1.27	-1.23	-1.35
6	116	2.2	-1.30	-1.26	-1.40
7	84	1.6	-1.31	-1.26	-1.43
8	67	1.3	-1.31	-1.25	-1.44
9	59	1.1	-1.31	-1.24	-1.46
10	54	1.0	-1.31	-1.23	-1.47
11	51	1.0	-1.32	-1.23	-1.50
12	42	0.8	-1.32	-1.23	-1.52
			Number of factors estimated by information criteria		
			12	7	12

Notes: (i) The number of series in the dataset is 35 and the number of time periods is 148.
(ii) The percentage of total variance accounted for by the first 12 factors is 93%.
(iii) The sum of squared residuals (idiosyncratic components) is 337.

The BCS series in the dataset can be separated in groups with respect to: (a) the horizon they describe i.e. current or future trends, and (b) the economic variables they refer to i.e. activity, prices or employment/unemployment. Thus, in Figure 2, we can examine which groups of variables explain the bulk of variation in each factor. The majority of factors (8 out of 12) load mainly on variables relating to firms' and consumers' expectations about activity/finances, prices, employment etc. as opposed to their assessments of current trends. Furthermore, over 50% of the variation in seven factors is explained by activity-related BCS variables; three factors load on both activity and prices and one factor correlates primarily with employment/unemployment expectations.

As the estimated factors seem to summarise adequately the dataset of BCS series they are likely to form leading indicators for economic activity in Cyprus. We, therefore, investigate whether the estimated factors have leading indicator properties with respect to real GDP growth. In particular, we explore the properties of the first factor which accounts for a larger proportion of the data variation than the remaining 11 factors altogether. Furthermore, as the information criteria suggest that seven or 12 factors are needed to capture adequately the variation in the data, we examine the weighted average of the first seven and first twelve factors. The weights are based on the estimated eigenvalues ordered in descending order thus the first factor is assigned the largest weight and the factors that follow are given smaller weights depending on their order. The ability of factor-based indicators to track future movements in aggregate output is compared to that of the widely cited ESI.

Figure 2: Relation between factors and group of BCS variables in the dataset

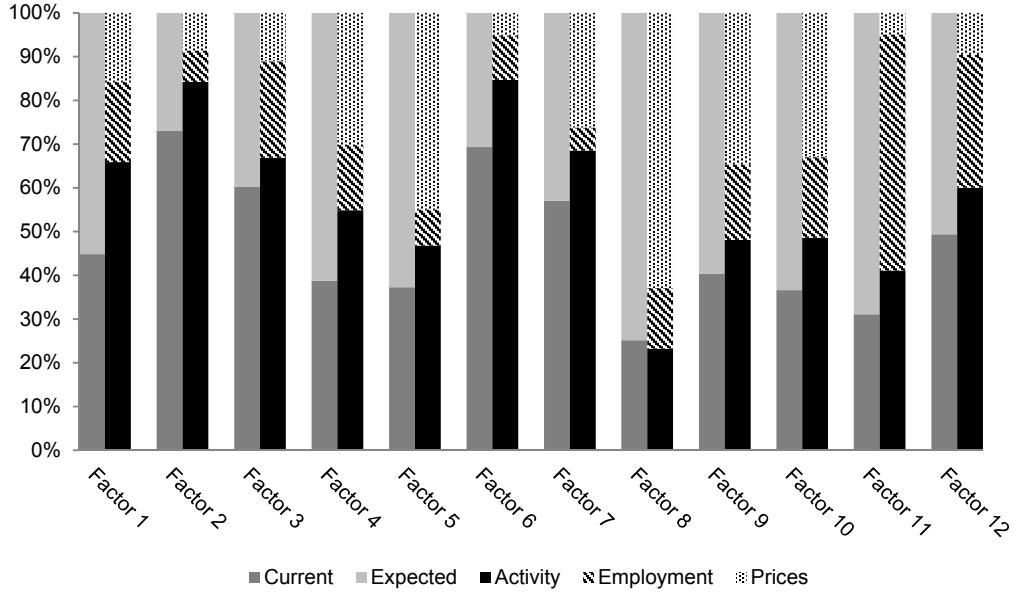


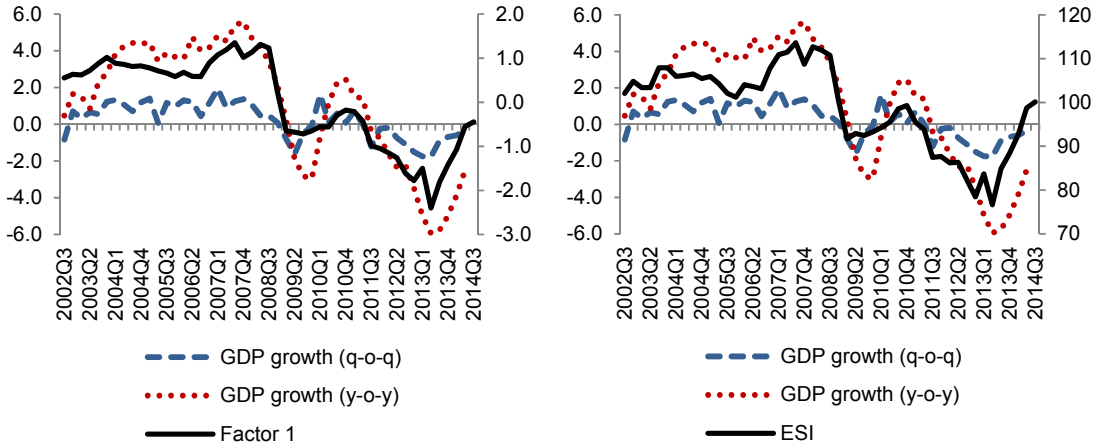
Table 7 shows the correlation coefficient between factor-based indicators and GDP growth (q-o-q and y-o-y). The table also shows the percentage of observations for which each indicator and moved in the same direction GDP growth contemporaneously; in other words, the percentage measures the directional coherence between the indicator and output growth (see Carriero and Marcellino 2007, 2011). This percentage can be viewed as measuring the success of each indicator in tracking the turning points in growth and therefore the economic cycles.

Table 7: Correlation and directional coherence of indicators with GDP growth

	Factor 1	Weighted average of Factor 1 to Factor 7	Weighted average of Factor 1 to Factor 12	ESI
Correlation[1]				
GDP growth (q-o-q)	0.82	0.80	0.80	0.81
GDP growth (y-o-y)	0.92	0.91	0.91	0.89
Directional coherence				
GDP growth (q-o-q)	68%	64%	70%	51%
GDP growth (y-o-y)	64%	51%	62%	55%

Note: [1.] Correlation coefficients are statistically significant at 1% level

Figure 3: Fist factor, ESI and GDP growth



All indicators exhibit strong and positive correlation with q-o-q and y-o-y GDP growth; a somewhat higher correlation of indicators with y-o-y growth than with q-o-q growth is found. The first factor exhibits marginally higher correlation with GDP growth than the indicators given by the weighted averages of the factors or the ESI. Moreover, the weighted average of the 12 factors and the first factor are the most successful in capturing the direction of movement of q-o-q and y-o-y GDP growth respectively. In 70%

of quarters over the period 2002Q3-2014Q2, the q-o-q growth rate of GDP changed in the same direction as the weighted average of the 12 factors, while in 64% of quarters over the same period the y-o-y growth rate of GDP moved in the same direction as the first factor. The directional coherence between growth and the ESI is weaker with percentages 51% and 55% for q-o-q and y-o-y GDP growth. Figure 3 presents the evolution of the first factor and ESI together with the growth rate of GDP. Although both indicators have captured the economic slowdown and recessions over the period 2008-2014 well, the ESI appears more volatile.

The forecasting performance of each indicator with respect to GDP growth is also evaluated. We use simple ADL models for GDP growth where the first factor, the weighted averages of seven or 12 factors, and the ESI are used, one at a time, as predictors. The models also include a quarterly lead of the indicators as BCS data are available at the end of each reference month and therefore published BCS data are ahead of National Accounts releases by two to five months. The setup of the forecasting exercise is as follows. Models for the growth rate (q-o-q) of GDP are estimated recursively on the first month of each quarter when the available GDP data cover the previous quarter, while the BCS data are observed for the current quarter. Then forecasts for a horizon of one to four quarters are constructed.[14] , [15] The quarterly data for GDP used in the estimation span 2001Q2 to 2014Q2 and the pseudo out of sample forecasts are computed from 2007Q1$+h$ to 2014Q2$-h$ where h denotes the quarter(s) forecasted.

Table 8 shows the RMSFE from the different ADL models that include as predictors the indicators, relative to that from a random walk model for GDP. The models are estimated using predictors in levels. i.e. the level of the ESI or factors extracted from the levels of the BCS series (known as balances). Furthermore, the models are estimated using the first differences of the ESI or factors computed using the first differences of BCS data.

For horizons of one and two quarters, forecast gains up to 40-45% upon the naive model can be achieved using a factor-based indicator (weighted averages of Factor 1-7 or 1-12) extracted from the levels of survey data. The use of the ESI in levels results in improvements of 30-40% over the random walk for one- and two-quarter ahead forecasts. For three-quarter ahead forecasts, the ADL model with the ESI in first differences outperforms models with factor-based indicators (extracted from first

[14] The data on GDP are obtained from the quarterly National Accounts publications.
[15] Factor-based indicators are computed at each iteration of the pseudo out of sample forecasting exercise.

differences of BCS variables), albeit marginally, while the opposite is found for four-quarter ahead forecasts.

Overall, the analysis showed that factor-based indicators from a dataset of all available monthly BCS variables for Cyprus can form useful leading indicators for GDP growth as BCS data are released at the end of each reference month and therefore much earlier than the release of National Accounts. The information from factor-based indicators can supplement the signals from the ESI as the former are found to be consistent with the direction of movement of GDP growth more often.

Table 8: Forecasting performance of factor-based indicators and ESI

Horizon (quarters)	1	2	3	4
Models[1]				
Random walk for GDP (RMSFE)	1.39	2.98	4.02	5.06
ADL (AIC) with predictors in levels				
Factor 1	0.64	0.68	1.25	1.77
Weighted average of Factor 1 to Factor 7	0.55	0.65	0.86	1.09
Weighted average of Factor 1 to Factor 12	0.65	0.60	0.85	1.07
ESI	0.60	0.70	0.86	1.07
ADL (AIC) with predictors in first differences [2]				
Factor 1	1.08	0.89	0.79	0.70
Weighted average of Factor 1 to Factor 7	0.82	0.87	0.77	0.67
Weighted average of Factor 1 to Factor 12	0.79	0.87	0.81	0.75
ESI	0.69	0.72	0.73	0.67
ADL (BIC) with predictors in levels				
Factor 1	0.63	0.64	1.19	1.76
Weighted average of Factor 1 to Factor 7	0.60	0.70	0.83	1.02
Weighted average of Factor 1 to Factor 12	0.70	0.71	0.81	1.05
ESI	0.65	0.78	0.89	1.14
ADL (BIC) with predictors in first differences [2]				
Factor 1	1.09	0.88	0.79	0.70
Weighted average of Factor 1 to Factor 7	0.80	0.83	0.77	0.65
Weighted average of Factor 1 to Factor 12	0.79	0.83	0.81	0.69
ESI	0.71	0.74	0.77	0.70

Note: [1] The lag length for ADL models is selected using the Akaike (AIC) and Bayesian (BIC) Information Criteria.
[2] Factors are extracted from a dataset with BCS variables in first differences.

6. Summary and conclusion

This paper provides applications of dynamic factor models in the case of Cyprus. First, common factors from a large balanced quarterly dataset that capture the co-variation in real economy series were included in single equation dynamic models (AR and ADL) for

forecasting the growth rate of GDP, private and government consumption, investment, exports and imports. The results of the forecasting exercise showed that the use of common factors as predictors improves the forecast accuracy of univariate and ADL models for the growth rate of GDP, private consumption and fixed investment. In the case of private consumption and fixed investment, factors lead to improvements upon the univariate and ADL models for all horizons. For GDP growth, forecast combinations from factor-augmented models outperform combinations from univariate and ADL models for all horizons; nevertheless for horizons of one and two quarters, intercept corrected GDP growth forecasts from simple AR models are associated with the highest forecasting gains. Using a shorter time series dimension for the sample to include the database of Business and Consumer Survey data for Cyprus, we find that factors improve the forecasting performance of ADL models for the growth rate of GDP, private consumption, gross capital formation and imports, for all quarters considered. In the case of government consumption, fixed investment and exports the forecast gains from the use of factors are not present over the entire horizon considered.

Second, factors from an unbalanced dataset of monthly variables were used in bridge equations for forecasting the growth rate of GDP and its demand components. Monthly factors were estimated using iterative methods to take into account missing values due to publication lags. The use of monthly factors in bridge equations for computing projections of GDP for the previous and current quarter is a widely used technique by organisations, such as central banks (e.g. Angelini et al. 2011) since National Accounts are published with a delay with respect to the reference quarter. The analysis showed that bridge equations improve upon the naive model in terms of forecast accuracy, especially in the case of GDP, private consumption, government consumption, investment and exports. Furthermore, bridge equations augmented by lags of the dependent variable lead to higher gains than bridge equations which include only factors.

Third, the paper examined whether factor-based indicators extracted from a dataset of all monthly Business and Consumer Survey questions can constitute more informative leading indicators for activity than the ESI computed from a subset of the Survey questions. The analysis revealed that factor-based indicators generate very similar gains in forecasting GDP as the ESI. However, factor-based indicators are more successful in capturing the direction of movement of GDP growth than the ESI. Hence, factor-based indicators can form a useful tool for tracking future movements in real output on a monthly basis.

The applications of dynamic factor models in the case of Cyprus undertaken here showed that common factors computed from large datasets of domestic and foreign/international variables can constitute useful predictors for forecasting GDP growth as well as demand components of GDP such as private consumption and investment. Furthermore, factor-based indicators could supplement the Economic Sentiment Indicator for monitoring developments in economic activity in Cyprus.

Future research aims at investigating the usefulness of common factors for forecasting other macroeconomic variables, such as inflation, employment growth and unemployment. The ability of factors extracted from different blocks of variables (e.g. financial, business and consumer surveys, foreign/international) to forecast key macroeconomic series for Cyprus will also be explored in future work. Furthermore, future research will examine the volatility of factor-based indicators computed from survey data by computing measures such as the months of cyclical dominance, i.e. the number of months needed, on average, for the cyclical component to dominate the irregular fluctuations. The volatility of the factor-based indicators can be compared to that of the ESI.

Appendix

Table A1: List of variables included in factor estimation, balanced dataset

Description
NATIONAL ACCOUNTS
Gross Domestic Product (€million – constant prices)
Value added: Agriculture, hunting, forestry and fishing (€million – constant prices)
Value added: Mining, quarrying, manufacturing, and electricity, gas & water supply (€million – constant prices)
Value added: Construction (€million – constant prices)
Value added: Wholesale & retail trade, hotels &restaurants, transport, storage and communication (€million – constant prices)
Value added: Financial intermediation, real estate, renting and business activities (€million – constant prices)
Value added: Public administration &defence, education, health & social work, other community social, personal services and private households with employed persons (€million – constant prices)
Final Consumption Expenditure (€million – constant prices)
Final Consumption Expenditure of Households (€million – constant prices)
Final Consumption Expenditure of Non-Profit Institutions Serving Households (€million – constant prices)
Final Consumption Expenditure of General Government (€million – constant prices)
Exports of goods and services (€million – constant prices)
Imports of goods and services (€million – constant prices)
Total Gross Fixed Capital Formation (GFCF) (€million – constant prices)
Gross Fixed Capital Formation: Products of agriculture, fisheries and aquaculture (€million – constant prices)[1]
Gross Fixed Capital Formation: Equipment: metal product and machinery (€million – constant prices)
Gross Fixed Capital Formation: Equipment: transport equipment (€million – constant prices)
Gross Fixed Capital Formation: Construction: housing (€million – constant prices)
Gross Fixed Capital Formation: Construction: other construction (€million – constant prices)
Gross Fixed Capital Formation: Other products (€million – constant prices)
RETAIL, MANUFACTURING, MINING
Turnover Value Index of retail trade (2005=100)
Turnover Volume Index of retail trade (2005=100)
Registration of motor vehicles (passenger cars)
Registration of motor vehicles (light goods vehicles, except for public use)
Volume Index of Manufacturing Production act (2005=100)
Production Volume Index of Mining and Quarrying act (2005=100)
ENERGY
Electricity consumption(€000's)
Electricity consumption (act 000's kWh)
Electricity production (act 000's kWh)
Total Sales of Petroleum Products (000's m.t.)
CONSTRUCTION
Local cement sales (million tons)
Building permits authorised (act no)
Building permits authorised (€000's)
LABOUR MARKET
Total Registered Unemployed (act number)
Vacancies Notified (act number)
Vacancies Outstanding (act number)
Employment-Total (000's)
Employment-Agriculture, Hunting and Forestry (000's)
Employment-Fishing (000's)
Employment-Mining and Quarrying (000's)
Employment-Manufacturing (000's)
Employment-Electricity, Gas and Water (000's)
Employment-Construction (000's)

Employment-Wholesale and Retail Trade; Repair of motor vehicles, motorcycles and personal household goods (000's)
Employment-Hotels and Restaurants (000's)
Employment-Transport Storage and Communication (000's)
Employment-Financial Intermediation (000's)
Employment-Real estate, renting and business activities (000's)
Employment-Public administration and defence; Compulsory social security (000's)
Employment-Education (000's)
Employment-Health and social work (000's)
Employment-Other community, social and personal service activities (000's)
Employment- Education (000's)
Employment- Human health and social work activities (000's)
Employment- Arts, entertainment and recreation (000's)
Employment- Other service activities (000's)
Employment- Activities of households as employers; undifferentiated goods and services producing activities of households for own use (000's)
Total foreign workers in Cyprus
Registered Unemployed-Agriculture, Forestry and Fishing (act number)
Registered Unemployed-Mining and Quarrying (act number)
Registered Unemployed-Manufacturing Total (act number)
Registered Unemployed-Electricity, Gas &Water(act number)
Registered Unemployed-Construction(act number)
Registered Unemployed-Wholesale & Retail Trade (act number)
Registered Unemployed-Restaurants & Hotels (act number)
Registered Unemployed-Transport, Storage & Communication (act number)
Registered Unemployed-Newcomers (act number)
Unemployment Rate (Eurostat)I[2]
Index of labour cost in construction (2005=100)
TRADE AND TOURISM
Total imports (act €million)
Total exports (incl. shipstores) (act €million)
Re-exports (act €million)
Imports of Petroleum for home consumption (€000's)
Tourist arrivals
FOREIGN ECONOMIC ACTIVITY INDICES
EU27-Gross Domestic Product (€millions – constant prices)
EA-Gross Domestic Product (€millions – constant prices)
UK-Gross Domestic Product (€millions – constant prices)
Industry production index: Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply EU27
Industry production index: Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply EA
Industry production index: Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply GR
Industry production index: Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; construction EU27
Industry production index: Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; construction EA
Industry production index: Mining and quarrying; manufacturing; electricity, gas, steam and air conditioning supply; construction GR

Table A2: Estimation of common factors, 2001Q1-2013Q2

Number of factors	Estimated eigenvalues	Marginal contribution of factor to total variance	Information criteria		
			ICP1	ICP2	ICP3
0			-0.021	-0.021	-0.021
1	885	22.2	-0.161	-0.146	-0.192
2	308	7.7	-0.154	-0.124	-0.218
3	205	5.1	-0.119	-0.074	-0.215
4	200	5.0	-0.088	-0.028	-0.216
5	189	4.7	-0.059	0.016	-0.219
6	181	4.5	-0.034	0.056	-0.225
7	156	3.9	-0.003	0.102	-0.226
8	143	3.6	0.028	0.148	-0.227
9	136	3.4	0.056	0.192	-0.230
10	127	3.2	0.084	0.235	-0.234
11	122	3.1	0.108	0.273	-0.243
12	112	2.8	0.131	0.312	-0.251
			Number of factors estimated by information criteria		
			1	1	12

Notes: (i) The number of series in the balanced panel is 83 and the number of time periods is 48 after data transforming the series to induce stationarity.
(ii) The percentage of total variance accounted for by the first 12 factors is 69%.
(iii) The sum of squared residuals (idiosyncratic components) is 1220.

Table A3: RMSFE of combination forecasts relative to random walk (dataset 1995Q1 to 2013Q2)

Intercept correction	0				0.3				0.5				0.7				0.9				1			
Horizon	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
GDP																								
RMSFE Random walk	1.36	2.44	3.84	5.56	1.36	2.44	3.84	5.56	1.36	2.44	3.84	5.56	1.36	2.44	3.84	5.56	1.36	2.44	3.84	5.56	1.36	2.44	3.84	5.56
Median	0.65	0.63	0.70	0.82	0.58	0.59	0.67	0.81	0.58	0.59	0.61	0.75	0.58	0.60	0.53	0.64	0.58	0.64	0.46	0.46	0.58	0.66	0.44	0.36
Mean	0.64	0.62	0.68	0.79	0.59	0.59	0.65	0.77	0.59	0.59	0.59	0.72	0.59	0.62	0.52	0.61	0.59	0.66	0.46	0.43	0.59	0.69	0.44	0.33
Trimmed mean (5% trimming)	0.64	0.63	0.69	0.80	0.59	0.59	0.65	0.79	0.59	0.59	0.60	0.73	0.59	0.61	0.52	0.62	0.59	0.65	0.45	0.44	0.59	0.68	0.43	0.34
Discounted MSFE (0.90)	0.62	0.61	0.68	0.79	0.58	0.57	0.65	0.78	0.58	0.57	0.60	0.73	0.58	0.58	0.53	0.62	0.58	0.61	0.44	0.43	0.58	0.64	0.41	0.31
Discounted MSFE (0.95)	0.63	0.62	0.69	0.80	0.58	0.57	0.66	0.78	0.58	0.57	0.60	0.73	0.58	0.59	0.52	0.62	0.58	0.62	0.44	0.43	0.58	0.65	0.41	0.31
Discounted MSFE (1.00)	0.64	0.62	0.69	0.80	0.59	0.58	0.66	0.78	0.59	0.57	0.60	0.73	0.59	0.59	0.52	0.62	0.59	0.63	0.45	0.42	0.59	0.66	0.42	0.31
Squared discounted MSFE (0.90)	0.61	0.60	0.68	0.79	0.56	0.56	0.65	0.78	0.56	0.55	0.61	0.74	0.56	0.55	0.53	0.64	0.56	0.58	0.44	0.43	0.56	0.60	0.40	0.30
Squared discounted MSFE (0.95)	0.61	0.60	0.68	0.79	0.56	0.56	0.65	0.78	0.56	0.55	0.61	0.74	0.56	0.55	0.53	0.64	0.56	0.58	0.44	0.43	0.56	0.60	0.40	0.30
Squared discounted MSFE (1.00)	0.64	0.61	0.70	0.81	0.58	0.57	0.67	0.80	0.58	0.56	0.61	0.75	0.58	0.57	0.53	0.63	0.58	0.61	0.44	0.42	0.58	0.63	0.41	0.30
Recent best (past four quarters)	0.67	0.74	0.66	0.61	0.69	0.82	0.78	0.65	0.69	0.79	0.69	0.60	0.69	0.82	0.66	0.77	0.69	0.54	0.51	0.40	0.69	0.58	0.41	0.39
PRIVATE CONSUMPTION																								
RMSFE Random walk	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40
Median	0.56	0.62	0.63	0.72	0.84	0.59	0.59	0.71	0.84	0.59	0.52	0.65	0.84	0.62	0.44	0.52	0.84	0.66	0.38	0.30	0.84	0.69	0.38	0.19
Mean	0.56	0.61	0.61	0.70	0.84	0.58	0.56	0.68	0.84	0.59	0.49	0.62	0.84	0.62	0.41	0.47	0.84	0.68	0.36	0.25	0.84	0.71	0.38	0.20
Trimmed mean (5% trimming)	0.56	0.61	0.62	0.72	0.85	0.58	0.57	0.70	0.85	0.59	0.50	0.63	0.85	0.62	0.41	0.49	0.85	0.67	0.37	0.26	0.85	0.71	0.38	0.19
Discounted MSFE (0.90)	0.55	0.60	0.60	0.71	0.83	0.59	0.57	0.69	0.83	0.60	0.50	0.63	0.83	0.63	0.42	0.50	0.83	0.69	0.37	0.24	0.83	0.72	0.40	0.21
Discounted MSFE (0.95)	0.56	0.61	0.61	0.71	0.83	0.59	0.57	0.69	0.83	0.60	0.50	0.63	0.83	0.63	0.42	0.49	0.83	0.69	0.37	0.24	0.83	0.72	0.40	0.20
Discounted MSFE (1.00)	0.56	0.61	0.61	0.71	0.83	0.59	0.57	0.69	0.83	0.60	0.50	0.63	0.83	0.63	0.41	0.49	0.83	0.68	0.37	0.24	0.83	0.72	0.39	0.20
Squared discounted MSFE (0.90)	0.54	0.60	0.60	0.70	0.81	0.60	0.57	0.69	0.81	0.61	0.52	0.64	0.81	0.64	0.43	0.51	0.81	0.70	0.38	0.23	0.81	0.73	0.42	0.22
Squared discounted MSFE (0.95)	0.54	0.60	0.60	0.70	0.81	0.60	0.57	0.69	0.81	0.61	0.52	0.64	0.81	0.64	0.43	0.51	0.81	0.70	0.38	0.23	0.81	0.73	0.42	0.22
Squared discounted MSFE (1.00)	0.56	0.62	0.61	0.71	0.81	0.60	0.58	0.70	0.81	0.60	0.51	0.64	0.81	0.63	0.43	0.50	0.81	0.69	0.37	0.23	0.81	0.72	0.40	0.19
Recent best (past four quarters)	1.07	0.86	0.70	0.82	0.77	1.03	0.62	0.83	0.77	0.88	0.71	0.67	0.77	0.96	0.63	0.46	0.77	0.79	0.73	0.58	0.77	0.77	0.96	1.02
GOVERNMENT CONSUMPTION																								
RMSFE Random walk	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50
Median	0.99	0.84	1.12	0.80	1.44	1.04	1.10	0.79	1.44	1.21	1.08	0.76	1.44	1.40	1.10	0.71	1.44	1.61	1.21	0.73	1.44	1.71	1.31	0.82
Mean	1.00	0.82	1.09	0.78	1.42	1.01	1.07	0.77	1.42	1.19	1.06	0.75	1.42	1.39	1.11	0.72	1.42	1.61	1.25	0.77	1.42	1.72	1.37	0.87
Trimmed mean (5% trimming)	1.00	0.82	1.08	0.77	1.43	1.02	1.07	0.76	1.43	1.20	1.06	0.73	1.43	1.40	1.10	0.70	1.43	1.61	1.24	0.75	1.43	1.72	1.36	0.85
Discounted MSFE (0.90)	1.00	0.83	1.12	0.81	1.43	1.01	1.10	0.80	1.43	1.18	1.07	0.77	1.43	1.38	1.09	0.73	1.43	1.59	1.21	0.76	1.43	1.70	1.33	0.86
Discounted MSFE (0.95)	1.00	0.83	1.12	0.81	1.43	1.02	1.09	0.81	1.43	1.19	1.07	0.77	1.43	1.38	1.09	0.73	1.43	1.60	1.22	0.77	1.43	1.71	1.34	0.86
Discounted MSFE (1.00)	1.00	0.83	1.11	0.81	1.43	1.02	1.09	0.80	1.43	1.19	1.07	0.77	1.43	1.39	1.10	0.74	1.43	1.60	1.23	0.77	1.43	1.71	1.35	0.87
Squared discounted MSFE (0.90)	1.01	0.85	1.15	0.84	1.44	1.02	1.12	0.83	1.44	1.18	1.08	0.80	1.44	1.36	1.08	0.75	1.44	1.57	1.18	0.77	1.44	1.68	1.29	0.85
Squared discounted MSFE (0.95)	1.01	0.85	1.15	0.84	1.44	1.02	1.12	0.83	1.44	1.18	1.08	0.80	1.44	1.36	1.08	0.75	1.44	1.57	1.18	0.77	1.44	1.68	1.29	0.85
Squared discounted MSFE (1.00)	1.01	0.84	1.12	0.84	1.44	1.02	1.10	0.83	1.44	1.19	1.07	0.80	1.44	1.39	1.09	0.76	1.44	1.60	1.21	0.78	1.44	1.71	1.33	0.87
Recent best (past four quarters)	1.32	1.43	1.03	0.89	1.14	1.33	0.81	0.96	1.14	1.22	0.84	0.81	1.14	1.35	1.52	0.74	1.14	1.43	1.23	0.97	1.14	1.69	1.91	1.07
FIXED INVESTMENT																								
RMSFE Random walk	7.07	12.17	19.53	28.54	7.07	12.17	19.53	28.54	7.07	12.17	19.53	28.54	7.07	12.17	19.53	28.54	7.07	12.17	19.53	28.54	7.07	12.17	19.53	28.54
Median	0.64	0.55	0.63	0.72	0.63	0.44	0.59	0.70	0.63	0.37	0.51	0.65	0.63	0.32	0.41	0.53	0.63	0.29	0.31	0.39	0.63	0.28	0.29	0.36
Mean	0.63	0.53	0.60	0.69	0.64	0.42	0.56	0.67	0.64	0.36	0.49	0.62	0.64	0.31	0.39	0.51	0.64	0.28	0.30	0.37	0.64	0.28	0.28	0.36
Trimmed mean (5% trimming)	0.63	0.53	0.61	0.70	0.64	0.43	0.57	0.68	0.64	0.36	0.50	0.63	0.64	0.32	0.40	0.52	0.64	0.29	0.31	0.38	0.64	0.28	0.29	0.36
Discounted MSFE (0.90)	0.62	0.51	0.59	0.69	0.64	0.42	0.56	0.68	0.64	0.36	0.50	0.63	0.64	0.32	0.40	0.53	0.64	0.29	0.31	0.39	0.64	0.28	0.28	0.37
Discounted MSFE (0.95)	0.63	0.51	0.60	0.69	0.64	0.42	0.56	0.68	0.64	0.36	0.50	0.63	0.64	0.32	0.40	0.53	0.64	0.29	0.30	0.39	0.64	0.28	0.28	0.37
Discounted MSFE (1.00)	0.63	0.52	0.61	0.70	0.64	0.42	0.57	0.68	0.64	0.36	0.50	0.63	0.64	0.31	0.40	0.53	0.64	0.29	0.30	0.38	0.64	0.28	0.28	0.36
Squared discounted MSFE (0.90)	0.61	0.49	0.58	0.69	0.64	0.41	0.55	0.67	0.64	0.36	0.49	0.63	0.64	0.32	0.41	0.55	0.64	0.29	0.31	0.41	0.64	0.29	0.28	0.39
Squared discounted MSFE (0.95)	0.61	0.49	0.58	0.69	0.64	0.41	0.55	0.67	0.64	0.36	0.49	0.63	0.64	0.32	0.41	0.55	0.64	0.29	0.31	0.41	0.64	0.29	0.28	0.39
Squared discounted MSFE (1.00)	0.63	0.52	0.61	0.70	0.64	0.42	0.57	0.69	0.64	0.36	0.51	0.64	0.64	0.32	0.41	0.54	0.64	0.29	0.30	0.40	0.64	0.28	0.27	0.37
Recent best (past four quarters)	0.56	0.40	0.50	0.60	0.71	0.41	0.58	0.57	0.71	0.37	0.50	0.79	0.71	0.35	0.49	0.61	0.71	0.36	0.41	0.44	0.71	0.44	0.46	0.54

Table A3: continued

Intercept correction	0				0.3				0.5				0.7				0.9				1			
Horizon	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
GROSS CAPITAL FORMATION																								
RMSFE Random walk	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70
Median	1.01	0.91	0.85	0.96	0.89	0.89	0.82	0.95	0.89	0.89	0.78	0.91	0.89	0.89	0.74	0.82	0.89	0.90	0.71	0.70	0.89	0.91	0.70	0.64
Mean	1.01	0.90	0.83	0.93	0.91	0.88	0.81	0.92	0.91	0.88	0.77	0.88	0.91	0.88	0.73	0.80	0.91	0.90	0.70	0.68	0.91	0.91	0.70	0.64
Trimmed mean (5% trimming)	1.01	0.90	0.84	0.94	0.91	0.88	0.82	0.93	0.91	0.88	0.78	0.88	0.91	0.89	0.73	0.80	0.91	0.90	0.70	0.69	0.91	0.91	0.70	0.64
Discounted MSFE (0.90)	1.00	0.89	0.83	0.93	0.91	0.88	0.80	0.92	0.91	0.88	0.77	0.88	0.91	0.88	0.73	0.80	0.91	0.90	0.70	0.68	0.91	0.90	0.70	0.61
Discounted MSFE (0.95)	1.01	0.89	0.83	0.93	0.91	0.88	0.81	0.92	0.91	0.88	0.77	0.88	0.91	0.88	0.73	0.80	0.91	0.90	0.70	0.68	0.91	0.91	0.70	0.62
Discounted MSFE (1.00)	1.01	0.90	0.83	0.93	0.91	0.88	0.81	0.92	0.91	0.88	0.78	0.88	0.91	0.88	0.73	0.80	0.91	0.90	0.70	0.68	0.91	0.91	0.70	0.63
Squared discounted MSFE (0.90)	1.00	0.88	0.81	0.93	0.90	0.88	0.80	0.92	0.90	0.88	0.77	0.89	0.90	0.88	0.73	0.80	0.90	0.89	0.70	0.67	0.90	0.90	0.70	0.60
Squared discounted MSFE (0.95)	1.00	0.88	0.81	0.93	0.90	0.88	0.80	0.92	0.90	0.88	0.77	0.89	0.90	0.88	0.73	0.80	0.90	0.89	0.70	0.67	0.90	0.90	0.70	0.60
Squared discounted MSFE (1.00)	1.01	0.89	0.83	0.94	0.90	0.88	0.81	0.93	0.90	0.88	0.78	0.89	0.90	0.88	0.74	0.81	0.90	0.90	0.71	0.68	0.90	0.91	0.70	0.62
Recent best (past four quarters)	1.10	1.07	0.73	0.89	0.88	0.88	0.70	0.85	0.88	0.95	0.60	0.91	0.88	0.99	0.53	0.76	0.88	0.97	0.65	0.59	0.88	0.96	0.67	0.54
EXPORTS																								
RMSFE Random walk	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46
Median	1.02	1.12	1.24	1.62	1.23	1.20	1.25	1.61	1.23	1.30	1.29	1.60	1.23	1.44	1.36	1.59	1.23	1.58	1.47	1.64	1.23	1.66	1.55	1.71
Mean	1.02	1.17	1.33	1.89	1.24	1.23	1.34	1.88	1.24	1.33	1.36	1.86	1.24	1.46	1.41	1.81	1.24	1.62	1.50	1.76	1.24	1.70	1.56	1.75
Trimmed mean (5% trimming)	1.02	1.15	1.30	1.81	1.24	1.22	1.31	1.81	1.24	1.32	1.34	1.78	1.24	1.45	1.40	1.74	1.24	1.61	1.50	1.72	1.24	1.69	1.57	1.72
Discounted MSFE (0.90)	1.02	1.14	1.31	1.89	1.24	1.21	1.32	1.89	1.24	1.31	1.35	1.89	1.24	1.43	1.40	1.88	1.24	1.58	1.47	1.78	1.24	1.67	1.53	1.67
Discounted MSFE (0.95)	1.02	1.15	1.32	1.91	1.24	1.22	1.33	1.91	1.24	1.32	1.36	1.89	1.24	1.44	1.41	1.86	1.24	1.60	1.48	1.77	1.24	1.68	1.54	1.67
Discounted MSFE (1.00)	1.02	1.16	1.34	1.92	1.24	1.23	1.35	1.91	1.24	1.32	1.37	1.89	1.24	1.45	1.41	1.85	1.24	1.61	1.49	1.75	1.24	1.69	1.54	1.68
Squared discounted MSFE (0.90)	1.01	1.12	1.28	1.94	1.24	1.19	1.30	1.94	1.24	1.28	1.33	1.93	1.24	1.41	1.39	1.92	1.24	1.56	1.45	1.81	1.24	1.64	1.49	1.61
Squared discounted MSFE (0.95)	1.01	1.12	1.28	1.94	1.24	1.19	1.30	1.94	1.24	1.28	1.33	1.93	1.24	1.41	1.39	1.92	1.24	1.56	1.45	1.81	1.24	1.64	1.49	1.61
Squared discounted MSFE (1.00)	1.03	1.15	1.34	1.97	1.24	1.22	1.35	1.96	1.24	1.32	1.37	1.94	1.24	1.44	1.41	1.89	1.24	1.59	1.48	1.75	1.24	1.68	1.52	1.60
Recent best (past four quarters)	1.06	1.16	1.48	2.31	1.31	1.48	1.21	2.35	1.31	1.35	1.61	2.23	1.31	1.12	1.87	1.98	1.31	1.15	2.11	2.28	1.31	1.23	1.79	2.47
IMPORTS																								
RMSFE Random walk	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69
Median	0.96	0.95	0.94	1.01	0.99	0.95	0.93	1.00	0.99	0.96	0.92	0.96	0.99	0.99	0.93	0.89	0.99	1.03	0.95	0.81	0.99	1.05	0.98	0.78
Mean	0.96	0.95	0.94	1.02	1.02	0.95	0.93	1.01	1.02	0.96	0.92	0.97	1.02	0.99	0.92	0.88	1.02	1.04	0.95	0.79	1.02	1.06	0.99	0.77
Trimmed mean (5% trimming)	0.96	0.95	0.94	1.02	1.02	0.95	0.93	1.01	1.02	0.96	0.92	0.97	1.02	0.99	0.92	0.88	1.02	1.04	0.95	0.79	1.02	1.06	0.99	0.77
Discounted MSFE (0.90)	0.96	0.95	0.94	1.02	1.02	0.95	0.93	1.01	1.02	0.97	0.92	0.97	1.02	0.99	0.92	0.89	1.02	1.04	0.95	0.75	1.02	1.06	0.98	0.70
Discounted MSFE (0.95)	0.96	0.95	0.94	1.02	1.02	0.95	0.93	1.01	1.02	0.96	0.92	0.97	1.02	0.99	0.92	0.89	1.02	1.04	0.95	0.76	1.02	1.06	0.99	0.71
Discounted MSFE (1.00)	0.97	0.95	0.94	1.03	1.02	0.95	0.93	1.02	1.02	0.96	0.92	0.97	1.02	0.99	0.92	0.89	1.02	1.04	0.95	0.76	1.02	1.06	0.99	0.72
Squared discounted MSFE (0.90)	0.95	0.95	0.93	1.01	1.02	0.95	0.92	1.00	1.02	0.97	0.92	0.97	1.02	0.99	0.91	0.89	1.02	1.03	0.94	0.72	1.02	1.06	0.97	0.65
Squared discounted MSFE (0.95)	0.95	0.95	0.93	1.01	1.02	0.95	0.92	1.00	1.02	0.97	0.92	0.97	1.02	0.99	0.91	0.89	1.02	1.03	0.94	0.72	1.02	1.06	0.97	0.65
Squared discounted MSFE (1.00)	0.97	0.94	0.94	1.03	1.02	0.95	0.93	1.02	1.02	0.96	0.92	0.98	1.02	0.99	0.92	0.89	1.02	1.04	0.95	0.74	1.02	1.06	0.99	0.69
Recent best (past four quarters)	1.02	0.92	1.09	1.16	1.37	0.98	1.15	1.14	1.37	1.12	0.81	1.32	1.37	1.43	1.05	1.16	1.37	1.54	1.02	0.87	1.37	1.56	0.84	0.56

Table A4: RMSFE of combination forecasts relative to random walk (dataset 2001Q1 to 2013Q2, BCS data for Cyprus included)

Intercept correction	0				0.3				0.5				0.7				0.9				1			
Horizon	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
GDP																								
RMSFE Random walk	1.36	2.45	3.84	5.56	1.36	2.45	3.84	5.56	1.36	2.45	3.84	5.56	1.36	2.45	3.84	5.56	1.36	2.45	3.84	5.56	1.36	2.45	3.84	5.56
Median	0.58	0.60	0.70	0.78	0.70	0.55	0.66	0.77	0.70	0.54	0.60	0.71	0.70	0.55	0.51	0.59	0.70	0.58	0.43	0.40	0.70	0.60	0.40	0.29
Mean	0.58	0.60	0.68	0.76	0.70	0.55	0.65	0.74	0.70	0.54	0.59	0.69	0.70	0.56	0.51	0.56	0.70	0.59	0.43	0.36	0.70	0.61	0.40	0.27
Trimmed mean (5% trimming)	0.58	0.59	0.69	0.76	0.70	0.55	0.65	0.74	0.70	0.54	0.59	0.69	0.70	0.55	0.51	0.56	0.70	0.58	0.43	0.37	0.70	0.60	0.40	0.27
Discounted MSFE (0.90)	0.57	0.58	0.67	0.75	0.69	0.53	0.64	0.73	0.69	0.51	0.59	0.68	0.69	0.51	0.50	0.57	0.69	0.53	0.40	0.36	0.69	0.55	0.36	0.24
Discounted MSFE (0.95)	0.57	0.58	0.67	0.75	0.69	0.53	0.64	0.74	0.69	0.51	0.58	0.68	0.69	0.52	0.50	0.57	0.69	0.54	0.40	0.36	0.69	0.56	0.36	0.24
Discounted MSFE (1.00)	0.58	0.58	0.67	0.75	0.69	0.53	0.64	0.74	0.69	0.52	0.58	0.68	0.69	0.52	0.50	0.57	0.69	0.55	0.41	0.36	0.69	0.57	0.37	0.24
Squared discounted MSFE (0.90)	0.56	0.57	0.65	0.74	0.67	0.51	0.63	0.73	0.67	0.49	0.58	0.68	0.67	0.48	0.51	0.57	0.67	0.50	0.40	0.36	0.67	0.52	0.35	0.22
Squared discounted MSFE (0.95)	0.56	0.57	0.65	0.74	0.67	0.51	0.63	0.73	0.67	0.49	0.58	0.68	0.67	0.48	0.51	0.57	0.67	0.50	0.40	0.36	0.67	0.52	0.35	0.22
Squared discounted MSFE (1.00)	0.57	0.57	0.66	0.75	0.67	0.52	0.63	0.74	0.67	0.50	0.58	0.69	0.67	0.49	0.50	0.57	0.67	0.52	0.41	0.36	0.67	0.54	0.37	0.23
Recent best (past four quarters)	0.56	0.64	0.62	0.66	0.69	0.65	0.86	0.66	0.69	0.64	0.55	0.62	0.69	0.61	0.69	0.54	0.69	0.60	0.70	0.51	0.69	0.67	0.72	0.43
PRIVATE CONSUMPTION																								
RMSFE Random walk	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40
Median	0.58	0.67	0.72	0.71	1.05	0.62	0.68	0.69	1.05	0.63	0.62	0.62	1.05	0.66	0.55	0.48	1.05	0.71	0.54	0.35	1.05	0.74	0.58	0.42
Mean	0.57	0.65	0.68	0.65	1.03	0.63	0.65	0.63	1.03	0.64	0.59	0.56	1.03	0.68	0.55	0.43	1.03	0.73	0.56	0.34	1.03	0.76	0.61	0.43
Trimmed mean (5% trimming)	0.57	0.66	0.69	0.66	1.04	0.63	0.65	0.64	1.04	0.64	0.60	0.57	1.04	0.67	0.55	0.43	1.04	0.72	0.55	0.33	1.04	0.75	0.60	0.42
Discounted MSFE (0.90)	0.56	0.62	0.63	0.60	0.99	0.61	0.60	0.59	0.99	0.62	0.56	0.53	0.99	0.64	0.51	0.41	0.99	0.68	0.50	0.29	0.99	0.70	0.55	0.42
Discounted MSFE (0.95)	0.56	0.62	0.63	0.61	0.99	0.61	0.60	0.59	0.99	0.62	0.56	0.53	0.99	0.65	0.51	0.40	0.99	0.68	0.51	0.30	0.99	0.71	0.55	0.42
Discounted MSFE (1.00)	0.56	0.62	0.63	0.61	0.99	0.61	0.60	0.59	0.99	0.62	0.56	0.53	0.99	0.65	0.51	0.40	0.99	0.69	0.51	0.30	0.99	0.71	0.56	0.42
Squared discounted MSFE (0.90)	0.56	0.59	0.56	0.56	0.95	0.59	0.54	0.54	0.95	0.60	0.52	0.49	0.95	0.62	0.48	0.38	0.95	0.65	0.47	0.25	0.95	0.67	0.53	0.42
Squared discounted MSFE (0.95)	0.56	0.59	0.56	0.56	0.95	0.59	0.54	0.54	0.95	0.60	0.52	0.49	0.95	0.62	0.48	0.38	0.95	0.65	0.47	0.25	0.95	0.67	0.53	0.42
Squared discounted MSFE (1.00)	0.56	0.59	0.57	0.57	0.97	0.59	0.55	0.56	0.97	0.60	0.52	0.50	0.97	0.63	0.48	0.37	0.97	0.66	0.48	0.26	0.97	0.68	0.54	0.41
Recent best (past four quarters)	0.94	1.11	0.54	0.84	0.87	0.87	0.56	0.86	0.87	0.70	1.12	0.69	0.87	1.10	0.70	0.67	0.87	0.97	0.87	0.73	0.87	0.87	1.00	0.81
GOVERNMENT CONSUMPTION																								
RMSFE Random walk	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50
Median	0.99	0.90	1.22	0.97	1.37	1.07	1.17	0.96	1.37	1.24	1.11	0.91	1.37	1.42	1.09	0.82	1.37	1.63	1.16	0.78	1.37	1.74	1.26	0.84
Mean	0.97	0.88	1.21	0.92	1.38	1.05	1.16	0.91	1.38	1.21	1.11	0.87	1.38	1.40	1.08	0.79	1.38	1.60	1.16	0.76	1.38	1.71	1.25	0.81
Trimmed mean (5% trimming)	0.98	0.89	1.21	0.95	1.38	1.06	1.16	0.94	1.38	1.22	1.11	0.89	1.38	1.41	1.08	0.81	1.38	1.62	1.16	0.77	1.38	1.72	1.26	0.83
Discounted MSFE (0.90)	0.98	0.87	1.21	0.92	1.37	1.02	1.17	0.91	1.37	1.17	1.11	0.87	1.37	1.35	1.07	0.79	1.37	1.55	1.13	0.74	1.37	1.66	1.21	0.79
Discounted MSFE (0.95)	0.98	0.87	1.21	0.92	1.37	1.02	1.17	0.91	1.37	1.18	1.11	0.87	1.37	1.36	1.08	0.79	1.37	1.56	1.13	0.74	1.37	1.66	1.22	0.79
Discounted MSFE (1.00)	0.98	0.87	1.21	0.92	1.37	1.02	1.17	0.91	1.37	1.18	1.11	0.87	1.37	1.36	1.08	0.79	1.37	1.56	1.14	0.75	1.37	1.67	1.22	0.79
Squared discounted MSFE (0.90)	0.99	0.86	1.22	0.92	1.36	1.00	1.18	0.91	1.36	1.14	1.12	0.87	1.36	1.31	1.08	0.80	1.36	1.51	1.10	0.74	1.36	1.61	1.17	0.76
Squared discounted MSFE (0.95)	0.99	0.86	1.22	0.92	1.36	1.00	1.18	0.91	1.36	1.14	1.12	0.87	1.36	1.31	1.08	0.80	1.36	1.51	1.10	0.74	1.36	1.61	1.17	0.76
Squared discounted MSFE (1.00)	0.99	0.85	1.22	0.93	1.36	1.00	1.18	0.91	1.36	1.15	1.12	0.87	1.36	1.33	1.08	0.80	1.36	1.52	1.12	0.74	1.36	1.63	1.20	0.77
Recent best (past four quarters)	1.84	0.95	1.68	1.49	1.98	1.68	1.56	1.55	1.98	1.74	1.19	1.14	1.98	1.57	1.35	0.95	1.98	1.43	0.75	1.25	1.98	1.49	1.99	1.61
FIXED INVESTMENT																								
RMSFE Random walk	7.08	12.17	19.53	28.54	7.08	12.17	19.53	28.54	7.08	12.17	19.53	28.54	7.08	12.17	19.53	28.54	7.08	12.17	19.53	28.54	7.08	12.17	19.53	28.54
Median	0.65	0.60	0.68	0.75	0.73	0.46	0.62	0.73	0.73	0.37	0.53	0.66	0.73	0.29	0.40	0.53	0.73	0.23	0.29	0.36	0.73	0.22	0.28	0.35
Mean	0.65	0.59	0.66	0.72	0.74	0.45	0.60	0.70	0.74	0.37	0.51	0.64	0.74	0.29	0.38	0.50	0.74	0.23	0.27	0.33	0.74	0.21	0.26	0.34
Trimmed mean (5% trimming)	0.65	0.59	0.66	0.73	0.74	0.45	0.60	0.71	0.74	0.37	0.51	0.64	0.74	0.29	0.39	0.50	0.74	0.22	0.27	0.33	0.74	0.21	0.26	0.34
Discounted MSFE (0.90)	0.64	0.56	0.63	0.72	0.73	0.44	0.58	0.70	0.73	0.37	0.51	0.64	0.73	0.30	0.40	0.52	0.73	0.24	0.29	0.38	0.73	0.22	0.28	0.37
Discounted MSFE (0.95)	0.64	0.56	0.63	0.72	0.73	0.44	0.58	0.70	0.73	0.37	0.51	0.64	0.73	0.29	0.40	0.52	0.73	0.24	0.29	0.37	0.73	0.22	0.27	0.37
Discounted MSFE (1.00)	0.64	0.57	0.63	0.72	0.74	0.44	0.58	0.70	0.74	0.36	0.50	0.64	0.74	0.29	0.39	0.52	0.74	0.24	0.29	0.37	0.74	0.22	0.27	0.36
Squared discounted MSFE (0.90)	0.64	0.52	0.60	0.72	0.73	0.43	0.56	0.70	0.73	0.37	0.50	0.65	0.73	0.30	0.40	0.54	0.73	0.25	0.30	0.41	0.73	0.23	0.29	0.40
Squared discounted MSFE (0.95)	0.64	0.52	0.60	0.72	0.73	0.43	0.56	0.70	0.73	0.37	0.50	0.65	0.73	0.30	0.40	0.54	0.73	0.25	0.30	0.41	0.73	0.23	0.29	0.40
Squared discounted MSFE (1.00)	0.64	0.53	0.60	0.72	0.73	0.43	0.56	0.71	0.73	0.36	0.49	0.65	0.73	0.30	0.40	0.54	0.73	0.25	0.29	0.40	0.73	0.23	0.28	0.39
Recent best (past four quarters)	1.04	0.50	0.53	0.72	0.84	0.48	0.77	0.72	0.84	0.45	0.41	0.64	0.84	0.37	0.65	0.68	0.84	0.34	0.36	0.48	0.84	0.38	0.44	0.35

Table A4: continued

Intercept correction	0				0.3				0.5				0.7				0.9				1			
Horizon	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
GROSS CAPITAL FORMATION																								
RMSFE Random walk	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70
Median	1.00	0.94	0.95	1.00	0.94	0.91	0.93	0.98	0.94	0.91	0.90	0.93	0.94	0.91	0.87	0.81	0.94	0.92	0.86	0.62	0.94	0.93	0.87	0.51
Mean	0.99	0.93	0.92	0.96	0.96	0.92	0.90	0.94	0.96	0.92	0.88	0.89	0.96	0.93	0.85	0.78	0.96	0.94	0.83	0.60	0.96	0.95	0.84	0.49
Trimmed mean (5% trimming)	0.99	0.93	0.93	0.97	0.95	0.92	0.91	0.95	0.95	0.92	0.88	0.90	0.95	0.92	0.85	0.79	0.95	0.94	0.84	0.61	0.95	0.95	0.84	0.50
Discounted MSFE (0.90)	0.98	0.93	0.91	0.94	0.94	0.92	0.90	0.93	0.94	0.91	0.87	0.89	0.94	0.92	0.85	0.78	0.94	0.93	0.82	0.60	0.94	0.94	0.82	0.48
Discounted MSFE (0.95)	0.98	0.93	0.91	0.95	0.95	0.92	0.90	0.93	0.95	0.92	0.87	0.89	0.95	0.92	0.84	0.78	0.95	0.93	0.82	0.60	0.95	0.94	0.82	0.48
Discounted MSFE (1.00)	0.98	0.93	0.92	0.95	0.95	0.92	0.90	0.94	0.95	0.92	0.87	0.89	0.95	0.92	0.84	0.78	0.95	0.94	0.82	0.60	0.95	0.95	0.82	0.48
Squared discounted MSFE (0.90)	0.97	0.93	0.90	0.92	0.93	0.92	0.89	0.91	0.93	0.91	0.87	0.87	0.93	0.92	0.85	0.78	0.93	0.93	0.81	0.60	0.93	0.93	0.80	0.47
Squared discounted MSFE (0.95)	0.97	0.93	0.90	0.92	0.93	0.92	0.89	0.91	0.93	0.91	0.87	0.87	0.93	0.92	0.85	0.78	0.93	0.93	0.81	0.60	0.93	0.93	0.80	0.47
Squared discounted MSFE (1.00)	0.98	0.93	0.91	0.94	0.93	0.92	0.89	0.92	0.93	0.92	0.87	0.88	0.93	0.92	0.84	0.78	0.93	0.94	0.82	0.60	0.93	0.94	0.81	0.47
Recent best (past four quarters)	1.01	1.04	0.92	0.93	1.03	0.71	0.92	0.91	1.03	1.22	0.87	0.89	1.03	0.91	0.93	0.83	1.03	0.89	1.07	0.75	1.03	0.94	0.97	0.45
EXPORTS																								
RMSFE Random walk	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46
Median	0.94	1.03	1.04	1.10	1.26	1.13	1.06	1.10	1.26	1.24	1.11	1.12	1.26	1.38	1.21	1.19	1.26	1.52	1.37	1.40	1.26	1.60	1.47	1.59
Mean	0.94	1.03	1.03	1.28	1.27	1.13	1.05	1.29	1.27	1.24	1.09	1.29	1.27	1.37	1.16	1.32	1.27	1.52	1.28	1.39	1.27	1.61	1.36	1.47
Trimmed mean (5% trimming)	0.94	1.04	1.04	1.23	1.27	1.13	1.06	1.24	1.27	1.24	1.10	1.25	1.27	1.37	1.18	1.28	1.27	1.53	1.31	1.39	1.27	1.61	1.40	1.50
Discounted MSFE (0.90)	0.93	1.05	1.07	1.31	1.24	1.12	1.09	1.32	1.24	1.21	1.14	1.35	1.24	1.33	1.23	1.43	1.24	1.48	1.37	1.52	1.24	1.56	1.47	1.54
Discounted MSFE (0.95)	0.93	1.05	1.07	1.32	1.25	1.12	1.09	1.33	1.25	1.22	1.14	1.36	1.25	1.34	1.23	1.42	1.25	1.49	1.37	1.51	1.25	1.57	1.47	1.53
Discounted MSFE (1.00)	0.93	1.05	1.07	1.33	1.25	1.13	1.09	1.33	1.25	1.22	1.14	1.36	1.25	1.34	1.23	1.42	1.25	1.49	1.37	1.50	1.25	1.57	1.47	1.52
Squared discounted MSFE (0.90)	0.93	1.06	1.08	1.39	1.21	1.11	1.11	1.41	1.21	1.19	1.16	1.47	1.21	1.30	1.27	1.63	1.21	1.45	1.43	1.78	1.21	1.53	1.53	1.72
Squared discounted MSFE (0.95)	0.93	1.06	1.08	1.39	1.21	1.11	1.11	1.41	1.21	1.19	1.16	1.47	1.21	1.30	1.27	1.63	1.21	1.45	1.43	1.78	1.21	1.53	1.53	1.72
Squared discounted MSFE (1.00)	0.93	1.06	1.08	1.42	1.23	1.12	1.11	1.43	1.23	1.20	1.17	1.47	1.23	1.32	1.27	1.58	1.23	1.46	1.43	1.67	1.23	1.54	1.53	1.63
Recent best (past four quarters)	1.24	1.70	0.97	2.45	1.62	1.39	1.18	2.34	1.62	2.04	1.53	1.39	1.62	1.75	1.66	2.07	1.62	1.75	1.61	2.79	1.62	2.42	2.13	2.19
IMPORTS																								
RMSFE Random walk	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69
Median	0.92	0.95	0.89	0.94	1.01	0.95	0.88	0.93	1.01	0.96	0.87	0.89	1.01	0.99	0.87	0.81	1.01	1.03	0.89	0.71	1.01	1.06	0.92	0.69
Mean	0.88	0.92	0.85	0.90	1.01	0.93	0.84	0.89	1.01	0.95	0.83	0.85	1.01	0.99	0.83	0.77	1.01	1.04	0.85	0.66	1.01	1.06	0.88	0.62
Trimmed mean (5% trimming)	0.88	0.93	0.86	0.90	1.01	0.94	0.85	0.89	1.01	0.96	0.84	0.85	1.01	0.99	0.84	0.77	1.01	1.04	0.86	0.67	1.01	1.06	0.89	0.64
Discounted MSFE (0.90)	0.87	0.93	0.83	0.84	1.01	0.95	0.83	0.83	1.01	0.97	0.83	0.80	1.01	1.00	0.84	0.73	1.01	1.04	0.88	0.61	1.01	1.07	0.92	0.55
Discounted MSFE (0.95)	0.88	0.94	0.83	0.84	1.01	0.95	0.83	0.83	1.01	0.97	0.83	0.80	1.01	1.00	0.85	0.73	1.01	1.05	0.88	0.61	1.01	1.07	0.92	0.56
Discounted MSFE (1.00)	0.88	0.94	0.83	0.84	1.02	0.95	0.83	0.83	1.02	0.97	0.83	0.80	1.02	1.00	0.85	0.73	1.02	1.05	0.88	0.61	1.02	1.07	0.92	0.56
Squared discounted MSFE (0.90)	0.87	0.95	0.80	0.78	1.01	0.96	0.81	0.78	1.01	0.98	0.83	0.75	1.01	1.01	0.86	0.69	1.01	1.06	0.91	0.57	1.01	1.09	0.95	0.50
Squared discounted MSFE (0.95)	0.87	0.95	0.80	0.78	1.01	0.96	0.81	0.78	1.01	0.98	0.83	0.75	1.01	1.01	0.86	0.69	1.01	1.06	0.91	0.57	1.01	1.09	0.95	0.50
Squared discounted MSFE (1.00)	0.88	0.95	0.81	0.79	1.03	0.96	0.82	0.78	1.03	0.98	0.83	0.75	1.03	1.01	0.86	0.69	1.03	1.06	0.91	0.57	1.03	1.09	0.96	0.51
Recent best (past four quarters)	0.93	1.21	1.11	0.91	1.32	0.89	1.33	1.08	1.32	0.95	1.57	1.27	1.32	1.01	1.10	1.49	1.32	1.14	1.23	0.65	1.32	1.24	0.99	1.27

Table A5: RMSFE of combination forecasts relative to random walk (dataset 2001Q1 to 2013Q2, BCS data for Cyprus excluded)

Intercept correction	0				0.3				0.5				0.7				0.9				1			
Horizon	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
GDP																								
RMSFE Random walk	1.36	2.45	3.84	5.56	1.36	2.45	3.84	5.56	1.36	2.45	3.84	5.56	1.36	2.45	3.84	5.56	1.36	2.45	3.84	5.56	1.36	2.45	3.84	5.56
Median	0.59	0.59	0.69	0.77	0.70	0.54	0.65	0.75	0.70	0.52	0.59	0.70	0.70	0.53	0.51	0.57	0.70	0.56	0.42	0.38	0.70	0.58	0.40	0.28
Mean	0.58	0.59	0.68	0.75	0.70	0.54	0.64	0.73	0.70	0.54	0.58	0.68	0.70	0.55	0.50	0.55	0.70	0.57	0.42	0.35	0.70	0.60	0.39	0.25
Trimmed mean (5% trimming)	0.59	0.59	0.68	0.75	0.70	0.54	0.64	0.73	0.70	0.53	0.58	0.67	0.70	0.54	0.50	0.55	0.70	0.57	0.42	0.35	0.70	0.59	0.39	0.25
Discounted MSFE (0.90)	0.58	0.58	0.66	0.74	0.69	0.53	0.63	0.73	0.69	0.51	0.58	0.68	0.69	0.51	0.50	0.56	0.69	0.53	0.41	0.35	0.69	0.54	0.37	0.23
Discounted MSFE (0.95)	0.58	0.58	0.66	0.74	0.69	0.53	0.63	0.73	0.69	0.51	0.58	0.68	0.69	0.51	0.50	0.56	0.69	0.53	0.41	0.35	0.69	0.55	0.37	0.23
Discounted MSFE (1.00)	0.58	0.58	0.67	0.74	0.69	0.53	0.63	0.73	0.69	0.51	0.58	0.67	0.69	0.52	0.50	0.55	0.69	0.54	0.41	0.34	0.69	0.56	0.38	0.23
Squared discounted MSFE (0.90)	0.57	0.57	0.64	0.74	0.67	0.52	0.62	0.72	0.67	0.49	0.58	0.68	0.67	0.48	0.51	0.56	0.67	0.50	0.41	0.35	0.67	0.52	0.37	0.22
Squared discounted MSFE (0.95)	0.57	0.57	0.64	0.74	0.67	0.52	0.62	0.72	0.67	0.49	0.58	0.68	0.67	0.48	0.51	0.56	0.67	0.50	0.41	0.35	0.67	0.52	0.37	0.22
Squared discounted MSFE (1.00)	0.58	0.57	0.65	0.75	0.68	0.52	0.62	0.73	0.68	0.50	0.58	0.68	0.68	0.50	0.51	0.56	0.68	0.52	0.42	0.35	0.68	0.54	0.38	0.23
Recent best (past four quarters)	0.55	0.60	0.74	0.73	0.76	0.50	0.81	0.73	0.76	0.55	0.53	0.61	0.76	0.52	0.58	0.54	0.76	0.55	0.61	0.55	0.76	0.71	0.70	0.43
PRIVATE CONSUMPTION																								
RMSFE Random walk	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40	1.64	2.68	4.33	6.40
Median	0.58	0.66	0.69	0.68	1.02	0.62	0.65	0.66	1.02	0.63	0.59	0.60	1.02	0.66	0.52	0.45	1.02	0.71	0.51	0.30	1.02	0.74	0.54	0.35
Mean	0.57	0.64	0.66	0.62	0.99	0.62	0.62	0.61	0.99	0.64	0.57	0.54	0.99	0.67	0.52	0.40	0.99	0.72	0.52	0.29	0.99	0.75	0.56	0.37
Trimmed mean (5% trimming)	0.57	0.65	0.67	0.63	1.01	0.62	0.63	0.61	1.01	0.64	0.57	0.55	1.01	0.67	0.52	0.41	1.01	0.71	0.52	0.28	1.01	0.75	0.55	0.36
Discounted MSFE (0.90)	0.56	0.61	0.60	0.59	0.96	0.61	0.58	0.57	0.96	0.62	0.53	0.51	0.96	0.64	0.48	0.38	0.96	0.67	0.47	0.25	0.96	0.70	0.51	0.37
Discounted MSFE (0.95)	0.56	0.61	0.60	0.59	0.96	0.61	0.58	0.57	0.96	0.62	0.53	0.51	0.96	0.64	0.48	0.38	0.96	0.68	0.47	0.25	0.96	0.70	0.51	0.37
Discounted MSFE (1.00)	0.56	0.61	0.61	0.59	0.96	0.61	0.58	0.57	0.96	0.62	0.53	0.51	0.96	0.64	0.48	0.38	0.96	0.68	0.47	0.25	0.96	0.71	0.51	0.37
Squared discounted MSFE (0.90)	0.56	0.58	0.54	0.54	0.92	0.59	0.52	0.53	0.92	0.60	0.50	0.48	0.92	0.62	0.45	0.36	0.92	0.65	0.44	0.22	0.92	0.67	0.49	0.36
Squared discounted MSFE (0.95)	0.56	0.58	0.54	0.54	0.92	0.59	0.52	0.53	0.92	0.60	0.50	0.48	0.92	0.62	0.45	0.36	0.92	0.65	0.44	0.22	0.92	0.67	0.49	0.36
Squared discounted MSFE (1.00)	0.56	0.58	0.55	0.56	0.94	0.59	0.53	0.55	0.94	0.60	0.49	0.49	0.94	0.63	0.45	0.36	0.94	0.66	0.44	0.21	0.94	0.68	0.49	0.36
Recent best (past four quarters)	1.02	1.11	0.54	0.84	0.80	0.81	0.56	0.85	0.80	0.67	1.12	0.69	0.80	1.16	0.69	0.67	0.80	1.33	0.87	0.73	0.80	1.11	1.03	0.93
GOVERNMENT CONSUMPTION																								
RMSFE Random walk	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50	5.94	6.07	4.43	6.50
Median	0.99	0.89	1.22	0.97	1.38	1.08	1.18	0.96	1.38	1.25	1.13	0.91	1.38	1.43	1.12	0.84	1.38	1.64	1.21	0.81	1.38	1.75	1.31	0.87
Mean	0.98	0.88	1.21	0.93	1.39	1.05	1.18	0.92	1.39	1.22	1.13	0.87	1.39	1.41	1.11	0.81	1.39	1.61	1.21	0.78	1.39	1.72	1.31	0.84
Trimmed mean (5% trimming)	0.98	0.89	1.22	0.96	1.39	1.06	1.18	0.94	1.39	1.23	1.13	0.90	1.39	1.42	1.12	0.83	1.39	1.63	1.22	0.80	1.39	1.74	1.32	0.86
Discounted MSFE (0.90)	0.98	0.86	1.22	0.93	1.38	1.02	1.18	0.91	1.38	1.18	1.13	0.88	1.38	1.36	1.11	0.81	1.38	1.57	1.19	0.77	1.38	1.67	1.28	0.82
Discounted MSFE (0.95)	0.98	0.86	1.22	0.93	1.38	1.02	1.18	0.91	1.38	1.18	1.13	0.88	1.38	1.37	1.11	0.81	1.38	1.57	1.19	0.77	1.38	1.68	1.29	0.82
Discounted MSFE (1.00)	0.98	0.86	1.22	0.93	1.38	1.02	1.18	0.92	1.38	1.18	1.13	0.88	1.38	1.37	1.12	0.81	1.38	1.58	1.20	0.77	1.38	1.68	1.29	0.82
Squared discounted MSFE (0.90)	1.00	0.85	1.22	0.92	1.37	0.99	1.19	0.91	1.37	1.14	1.14	0.87	1.37	1.32	1.12	0.81	1.37	1.52	1.18	0.76	1.37	1.63	1.26	0.79
Squared discounted MSFE (0.95)	1.00	0.85	1.22	0.92	1.37	0.99	1.19	0.91	1.37	1.14	1.14	0.87	1.37	1.32	1.12	0.81	1.37	1.52	1.18	0.76	1.37	1.63	1.26	0.79
Squared discounted MSFE (1.00)	0.99	0.84	1.23	0.93	1.37	1.00	1.20	0.91	1.37	1.15	1.15	0.88	1.37	1.34	1.13	0.81	1.37	1.54	1.20	0.77	1.37	1.65	1.29	0.80
Recent best (past four quarters)	1.82	1.41	1.65	1.55	2.18	1.48	1.56	1.60	2.18	1.74	1.41	1.03	2.18	1.46	1.98	1.19	2.18	1.36	1.11	1.35	2.18	1.51	1.13	1.65
FIXED INVESTMENT																								
RMSFE Random walk	7.08	12.17	19.53	28.54	7.08	12.17	19.53	28.54	7.08	12.17	19.53	28.54	7.08	12.17	19.53	28.54	7.08	12.17	19.53	28.54	7.08	12.17	19.53	28.54
Median	0.65	0.61	0.67	0.74	0.73	0.45	0.61	0.72	0.73	0.36	0.52	0.65	0.73	0.29	0.39	0.51	0.73	0.23	0.28	0.34	0.73	0.22	0.27	0.34
Mean	0.65	0.59	0.65	0.72	0.74	0.46	0.60	0.70	0.74	0.37	0.51	0.63	0.74	0.29	0.38	0.49	0.74	0.23	0.26	0.32	0.74	0.21	0.25	0.34
Trimmed mean (5% trimming)	0.65	0.59	0.65	0.72	0.74	0.45	0.60	0.70	0.74	0.36	0.51	0.63	0.74	0.29	0.38	0.49	0.74	0.23	0.26	0.32	0.74	0.21	0.25	0.34
Discounted MSFE (0.90)	0.64	0.56	0.62	0.71	0.73	0.44	0.58	0.69	0.73	0.37	0.50	0.64	0.73	0.30	0.39	0.52	0.73	0.24	0.29	0.37	0.73	0.22	0.27	0.37
Discounted MSFE (0.95)	0.64	0.56	0.63	0.71	0.73	0.44	0.58	0.69	0.73	0.37	0.50	0.64	0.73	0.30	0.39	0.51	0.73	0.24	0.28	0.36	0.73	0.22	0.27	0.36
Discounted MSFE (1.00)	0.64	0.56	0.63	0.71	0.74	0.44	0.58	0.70	0.74	0.37	0.50	0.64	0.74	0.29	0.39	0.51	0.74	0.24	0.28	0.36	0.74	0.22	0.27	0.36
Squared discounted MSFE (0.90)	0.64	0.52	0.60	0.72	0.72	0.43	0.56	0.70	0.72	0.37	0.49	0.65	0.72	0.31	0.40	0.54	0.72	0.25	0.30	0.40	0.72	0.24	0.28	0.40
Squared discounted MSFE (0.95)	0.64	0.52	0.60	0.72	0.72	0.43	0.56	0.70	0.72	0.37	0.49	0.65	0.72	0.31	0.40	0.54	0.72	0.25	0.30	0.40	0.72	0.24	0.28	0.40
Squared discounted MSFE (1.00)	0.64	0.53	0.60	0.72	0.73	0.43	0.56	0.70	0.73	0.36	0.49	0.65	0.73	0.30	0.39	0.54	0.73	0.25	0.29	0.39	0.73	0.24	0.28	0.39
Recent best (past four quarters)	1.04	0.46	0.56	0.71	0.84	0.47	0.78	0.71	0.84	0.45	0.50	0.62	0.84	0.37	0.58	0.63	0.84	0.40	0.38	0.56	0.84	0.34	0.44	0.35

Table A5: continued

Intercept correction	0				0.3				0.5				0.7				0.9				1			
Horizon	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
GROSS CAPITAL FORMATION																								
RMSFE Random walk	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70	19.56	28.08	38.17	46.70
Median	1.00	0.94	0.95	1.00	0.95	0.92	0.93	0.98	0.95	0.91	0.90	0.93	0.95	0.91	0.87	0.81	0.95	0.93	0.85	0.61	0.95	0.93	0.86	0.50
Mean	0.99	0.93	0.92	0.95	0.97	0.92	0.91	0.94	0.97	0.92	0.88	0.89	0.97	0.93	0.85	0.78	0.97	0.95	0.83	0.59	0.97	0.96	0.84	0.48
Trimmed mean (5% trimming)	0.99	0.93	0.93	0.97	0.96	0.92	0.91	0.95	0.96	0.92	0.88	0.90	0.96	0.93	0.85	0.79	0.96	0.94	0.84	0.60	0.96	0.95	0.84	0.48
Discounted MSFE (0.90)	0.98	0.93	0.91	0.94	0.95	0.92	0.90	0.92	0.95	0.92	0.88	0.88	0.95	0.92	0.85	0.77	0.95	0.93	0.83	0.59	0.95	0.94	0.82	0.47
Discounted MSFE (0.95)	0.98	0.93	0.91	0.94	0.96	0.92	0.90	0.93	0.96	0.92	0.88	0.88	0.96	0.93	0.85	0.77	0.96	0.94	0.83	0.59	0.96	0.95	0.83	0.47
Discounted MSFE (1.00)	0.98	0.93	0.91	0.94	0.96	0.92	0.90	0.93	0.96	0.92	0.88	0.88	0.96	0.93	0.85	0.77	0.96	0.94	0.83	0.59	0.96	0.95	0.83	0.47
Squared discounted MSFE (0.90)	0.97	0.93	0.90	0.91	0.94	0.92	0.89	0.90	0.94	0.92	0.87	0.86	0.94	0.92	0.85	0.76	0.94	0.93	0.82	0.59	0.94	0.94	0.80	0.46
Squared discounted MSFE (0.95)	0.97	0.93	0.90	0.91	0.94	0.92	0.89	0.90	0.94	0.92	0.87	0.86	0.94	0.92	0.85	0.76	0.94	0.93	0.82	0.59	0.94	0.94	0.80	0.46
Squared discounted MSFE (1.00)	0.98	0.93	0.90	0.92	0.95	0.92	0.89	0.91	0.95	0.92	0.87	0.87	0.95	0.93	0.85	0.77	0.95	0.94	0.82	0.59	0.95	0.95	0.81	0.46
Recent best (past four quarters)	1.08	1.04	0.92	0.93	1.18	0.69	0.93	0.90	1.18	1.21	0.87	0.89	1.18	0.91	0.93	0.83	1.18	0.89	1.07	0.82	1.18	0.82	0.97	0.45
EXPORTS																								
RMSFE Random walk	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46	2.51	3.22	3.95	3.46
Median	0.96	1.03	1.04	1.08	1.26	1.13	1.07	1.08	1.26	1.24	1.12	1.10	1.26	1.37	1.23	1.17	1.26	1.52	1.40	1.36	1.26	1.60	1.50	1.54
Mean	0.96	1.03	1.01	1.24	1.27	1.13	1.03	1.24	1.27	1.24	1.07	1.24	1.27	1.37	1.15	1.26	1.27	1.53	1.28	1.33	1.27	1.61	1.36	1.39
Trimmed mean (5% trimming)	0.96	1.04	1.02	1.19	1.28	1.13	1.04	1.19	1.28	1.24	1.09	1.20	1.28	1.38	1.17	1.23	1.28	1.53	1.31	1.32	1.28	1.61	1.40	1.41
Discounted MSFE (0.90)	0.95	1.06	1.05	1.26	1.25	1.12	1.08	1.26	1.25	1.21	1.13	1.28	1.25	1.33	1.23	1.34	1.25	1.48	1.38	1.42	1.25	1.56	1.48	1.44
Discounted MSFE (0.95)	0.95	1.06	1.05	1.26	1.26	1.13	1.08	1.27	1.26	1.22	1.13	1.29	1.26	1.34	1.23	1.34	1.26	1.49	1.38	1.41	1.26	1.57	1.48	1.44
Discounted MSFE (1.00)	0.95	1.06	1.05	1.27	1.26	1.13	1.08	1.27	1.26	1.22	1.13	1.29	1.26	1.35	1.23	1.33	1.26	1.49	1.38	1.40	1.26	1.58	1.48	1.43
Squared discounted MSFE (0.90)	0.95	1.07	1.07	1.34	1.23	1.12	1.10	1.35	1.23	1.19	1.16	1.39	1.23	1.30	1.26	1.50	1.23	1.45	1.43	1.60	1.23	1.53	1.54	1.55
Squared discounted MSFE (0.95)	0.95	1.07	1.07	1.34	1.23	1.12	1.10	1.35	1.23	1.19	1.16	1.39	1.23	1.30	1.26	1.50	1.23	1.45	1.43	1.60	1.23	1.53	1.54	1.55
Squared discounted MSFE (1.00)	0.95	1.08	1.07	1.35	1.24	1.13	1.10	1.36	1.24	1.21	1.16	1.39	1.24	1.32	1.27	1.46	1.24	1.47	1.43	1.52	1.24	1.55	1.55	1.49
Recent best (past four quarters)	1.31	1.72	0.99	1.52	1.70	1.39	0.99	1.36	1.70	2.03	1.58	1.39	1.70	1.75	1.71	1.76	1.70	1.63	2.14	2.61	1.70	2.36	1.79	2.37
IMPORTS																								
RMSFE Random walk	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69	4.95	7.67	10.79	13.69
Median	0.93	0.95	0.88	0.91	1.01	0.96	0.87	0.90	1.01	0.98	0.87	0.86	1.01	1.02	0.87	0.77	1.01	1.06	0.90	0.67	1.01	1.09	0.94	0.64
Mean	0.89	0.93	0.84	0.88	1.01	0.95	0.84	0.87	1.01	0.97	0.83	0.82	1.01	1.01	0.83	0.74	1.01	1.06	0.86	0.63	1.01	1.09	0.90	0.59
Trimmed mean (5% trimming)	0.89	0.94	0.85	0.88	1.01	0.95	0.84	0.87	1.01	0.97	0.84	0.83	1.01	1.01	0.84	0.74	1.01	1.06	0.87	0.63	1.01	1.09	0.91	0.60
Discounted MSFE (0.90)	0.88	0.94	0.82	0.81	1.01	0.96	0.82	0.81	1.01	0.99	0.83	0.77	1.01	1.02	0.85	0.70	1.01	1.07	0.90	0.59	1.01	1.10	0.94	0.54
Discounted MSFE (0.95)	0.89	0.94	0.82	0.82	1.02	0.96	0.82	0.81	1.02	0.99	0.83	0.77	1.02	1.02	0.85	0.70	1.02	1.07	0.90	0.59	1.02	1.10	0.94	0.54
Discounted MSFE (1.00)	0.89	0.94	0.82	0.82	1.03	0.96	0.83	0.81	1.03	0.99	0.83	0.77	1.03	1.02	0.85	0.70	1.03	1.07	0.90	0.59	1.03	1.10	0.95	0.55
Squared discounted MSFE (0.90)	0.88	0.96	0.79	0.76	1.02	0.98	0.80	0.75	1.02	1.00	0.83	0.73	1.02	1.04	0.86	0.67	1.02	1.09	0.93	0.56	1.02	1.12	0.98	0.51
Squared discounted MSFE (0.95)	0.88	0.96	0.79	0.76	1.02	0.98	0.80	0.75	1.02	1.00	0.83	0.73	1.02	1.04	0.86	0.67	1.02	1.09	0.93	0.56	1.02	1.12	0.98	0.51
Squared discounted MSFE (1.00)	0.90	0.96	0.80	0.77	1.04	0.97	0.81	0.76	1.04	1.00	0.83	0.73	1.04	1.04	0.87	0.66	1.04	1.09	0.94	0.56	1.04	1.11	0.99	0.52
Recent best (past four quarters)	0.94	1.11	0.66	0.96	1.31	0.85	1.32	1.21	1.31	1.06	1.49	1.20	1.31	1.02	0.76	1.49	1.31	1.11	1.26	0.65	1.31	1.24	1.11	1.23

Table A6: List of variables included in factor estimation, unbalanced dataset

Group A	Group B	Group C
CSE All Share Composite	Domestic interest rate: personal Lending Rate	Registration of motor vehicles (passenger cars)
FTSE/SE-20	Domestic interest rate: 1-year Time Deposits	Local cement sales (million tons)
CSE Banks Index	Gold Bullion Price-New York (€/Ounce) Price	Tourist arrivals Total
CSE Hotels Index	Silver Cash Price (€/Ounce) -Commodity Prices	Tourist arrivals Greece
SE Investment Companies	Harmonised Index of Consumer Prices - Greece	Tourist arrivals Germany
ATHEX Composite- Price Index	Harmonised Index of Consumer Prices – UK	Tourist arrivals United Kingdom
DAX 30 Performance - Price Index	Vacancies Notified (act number)	Tourist arrivals Russia
FTSE 100 - Price Index	Vacancies Outstanding (act number)	Tourist arrivals Travellers
France CAC 40 - Price Index	MFI loans to domestic residents, outstanding amounts	Unemployment Rate Cyprus
S&P 500 Composite - Price Index	Total MFI loans to non-MFIs, outstanding amounts	Unemployment Rate United Kingdom
S&P 100 - Price Index	Deposits of non-MFIs held with MFIs, domestic	Unemployment Rate European Union
NYSE Composite - Price Index	Total deposits of non-MFIs held with MFIs	Volume Index of Manufacturing Production
Europe, Euro, Dow Jones Stoxx 50 Price Index	Mining and quarrying Cyprus	Volume Index of General Production
Euro, Dow Jones Euro Stoxx Price Index	Mining and quarrying United Kingdom	Retail Trade-Value Index
Euro, Dow Jones Stoxx 50 Price Index	Mining and quarrying Greece	Building permits authorised (act number)
Euro, Dow Jones Euro Stoxx Industrials Index	Mining and quarrying European Union	Building permits Area
Euro, Dow Jones Euro Stoxx Basic Materials E Index	Mining and quarrying Euro Area	Price Index of construction materials
Euro, Dow Jones Euro Stoxx Consumer Goods Index	Harmonised Index of Consumer Prices – CY	Price Index of Manufacturing Production
Euro, Dow Jones Euro Stoxx Consumer Services Index	Harmonized Consumer Prices-Communications - CY	
Euro, Dow Jones Euro Stoxx Financials Index	Harmonized Consumer Prices-Electricity – CY	
Euro, Dow Jones Euro Stoxx Healthcare Index	Harmonized Consumer Prices-Energy – CY	
Euro, Dow Jones Euro Stoxx Oil & Gas Energy Index	Harmonized Consumer Prices-Food – CY	
Euro, Dow Jones Euro Stoxx Telecommunications Index	Harmonized Consumer Prices-Health – CY	
Euro, Dow Jones Euro Stoxx Utilities E Index	Harmonized Consumer Prices-Industrial - CY Goods	
Euro, Dow Jones Euro Stoxx Technology E Index	Harmonized Consumer Prices-Motor Cars – CY	
United States, US dollar, Standard & Poors 500 Composite Index	Harmonized Consumer Prices-Pharmaceutical Products - CY	
Japan, Nikkei 225 Stock Average Index	Harmonized Consumer Prices-Transport – CY	
Exchange rate EUR to US dollar	Consumer Price Index (Statistical Service) – CY	
Exchange rate EUR to Pound sterling	CPI-Food and non-alcoholic beverages – CY	
Exchange rate EUR to Swiss franc	CPI-Alcoholic beverages and tobacco – CY	
Exchange rate EUR to Canadian dollar	CPI-Clothing and footwear – CY	
Exchange rate EUR to Russia Ruble	CPI-Housing, water, electricity and gas – CY	
Exchange rate EUR to Japanese yen	CPI-Furnishings, household equipment and supplies - CY	
Brent Crude Oil (€)-Commodity Prices	CPI-Health – CY	
Europe 3-month EURIBOR	CPI-Transport – CY	
Europe 6-month EURIBOR	CPI-Communication – CY	
Europe 12-month EURIBOR	CPI-Recreation and culture - CY	
Europe Central Bank Lending Rate	CPI-Education - CY	
Greece 10 -year Government Note Yield (GNYGR10)	CPI-Restaurants and hotels - CY	
Greece 3-month Treasury Bill Yield ITGRC3M)		
Spain 10-year Government Bond Yield (SP10Y)		
Spain 3-month Treasury Bill Yield (SP3M)		
Italy 10-year Government Bond Yield (IT10Y)		
Italy 3-month Treasury Bill Yield (IT3M)		
France 10-year Government Bond Yield (IGFRA10D)		
France 3-month Treasury Bill Yield (ITFRA3D)		
Germany 10 -year Gov. Benchmark Bond Yield (GBBG10)		
Germany 3-month Treasury Bill Yield (ITDEU3D)		
UK 10 -year Government Bond Yield (GBYUK10)		
UK 3-month Treasury Bill Yield (ITGBR3D)		

Table A6: continued

Group A	
Spread Greece (GNYGR10 - ITGRC3M)	*Business and Consumer Survey Variables: Cyprus*
Spread Spain (SP10Y - SP3M)	Services: Business situation development over the past 3 months
Spread Italy (IT10Y - IT3M)	Services: Evolution of the demand over the past 3 months
Spread France (IGFRA10D - ITFRA3D)	Services: Expectation of the demand over the next 3 months
Spread Germany (GBBG10 - ITDEU3D)	Services: Evolution of the employment over the past 3 months
Spread UK(GBYUK10 - ITGBR3D)	Services: Expectations of the employment over the next 3 months
Moody's Aaa Corporate Yield (MACY)	Services: Expectations of the prices over the next 3 months
Moody's Baa Corporate Yield (MBCY)	Retail trade: Business activity (sales) development over the past 3 months
Spread Moody's (MACY - MBCY)	Retail trade: Volume of stock currently hold
ECB Commodity Price index Euro denominated, import weighted, Food	Retail trade: Orders expectations over the next 3 months
ECB Commodity Price index Euro denominated, import weighted, Non-food	Retail trade: Business activity expectations over the next 3 months
ECB Commodity Price index Euro denominated, import weighted, Total non-energy commodity	Retail trade: Employment expectations over the next 3 months
ECB Commodity Price index Euro denominated, use-weighted, Food	Retail trade: Prices expectations over the next 3 months
ECB Commodity Price index Euro denominated, use-weighted, Non-food	Industry: Production trend observed in recent months
ECB Commodity Price index Euro denominated, use-weighted, Total non-energy commodity	Industry: Assessment of order-book levels
Total Registered Unemployed (act number)	Industry: Assessment of export order-book levels
Registered Unemployed -Manufacturing	Industry: Assessment of stocks of finished products
Registered Unemployed -Construction	Industry: Production expectations for the months ahead
Registered Unemployed -Wholesale and Retail Trade	Industry: Selling price expectations for the months ahead
Registered Unemployed -Restaurants and Hotels	Industry: Employment expectations for the months ahead
EU Industry Confidence Indicator	Construction: Building activity development over the past 3 months
EU Services Confidence Indicator	Construction: Evolution of your current overall order books
EU Consumer Confidence Indicator	Construction: Employment expectations over the next 3 months
EU Retail Trade Confidence Indicator	Construction: Prices expectations over the next 3 months
EU Construction Confidence Indicator	Consumer: Financial situation over last 12 months
EU Economic Sentiment Indicator	Consumer: Financial situation over next 12 months
EA Industry Confidence Indicator	Consumer: General economic situation over last 12 months
EA Services Confidence Indicator	Consumer: General economic situation over next 12 months
EA Consumer Confidence Indicator	Consumer: Price trends over last 12 months
EA Retail Trade Confidence Indicator	Consumer: Price trends over next 12 months
EA Construction Confidence Indicator	Consumer: Unemployment expectations over next 12 months
EA Economic Sentiment Indicator	Consumer: Major purchases at present
GR Industry Confidence Indicator	Consumer: Major purchases over next 12 months
GR Services Confidence Indicator	Consumer: Savings at present
GR Consumer Confidence Indicator	Consumer: Savings over next 12 months
GR Retail Trade Confidence Indicator	Consumer: Statement on financial situation of household
GR Construction Confidence Indicator	
GR Economic Sentiment Indicator	
UK Industry Confidence Indicator	
CY Industry Confidence Indicator	
CY Services Confidence Indicator	
CY Consumer Confidence Indicator	
CY Retail Trade Confidence Indicator	
CY Construction Confidence Indicator	
CY Economic Sentiment Indicator	
UK Industry Confidence Indicator	
UK Services Confidence Indicator	
UK Consumer Confidence Indicator	
UK Retail Trade Confidence Indicator	
UK Construction Confidence Indicator	
UK Economic Sentiment Indicator	

Table A7: RMSFE of combination forecasts from bridge equations with individual predictors (relative to the RMSFE of the random walk)

Forecasts are estimated early in:	Jan/Apr/Jul/Oct		Feb/May/Aug/Nov		Mar/Jun/Sep/Dec	
Quarter for which forecast is estimated	Previous	Current	Previous	Current	Previous	Current
Number of months to National Accounts release	*2*	*5*	*1*	*4*	*0*	*3*
GDP						
RMSFE	1.11	1.19	1.11	1.19	1.11	1.19
Median	1.05	1.07	1.06	1.07	1.05	1.07
Mean	1.06	1.07	1.06	1.07	1.06	1.08
Trimmed mean (5% trimming)	1.04	1.06	1.04	1.06	1.03	1.06
Discounted MSFE (0.90)	0.99	1.02	1.00	1.02	1.00	1.02
Discounted MSFE (0.95)	1.01	1.03	1.01	1.03	1.01	1.03
Discounted MSFE (1.00)	1.02	1.04	1.02	1.04	1.01	1.04
Squared discounted MSFE (0.90)	0.95	0.98	0.95	0.98	0.94	0.98
Squared discounted MSFE (0.95)	0.98	1.00	0.98	1.01	0.97	1.00
Squared discounted MSFE (1.00)	1.01	1.02	1.01	1.03	1.01	1.03
Recent best (past four quarters)	0.57	0.53	0.49	0.55	0.48	0.59
PRIVATE CONSUMPTION						
RMSFE	2.12	2.16	2.12	2.16	2.12	2.16
Median	0.96	0.98	0.96	0.98	0.96	0.97
Mean	0.96	0.98	0.96	0.98	0.96	0.98
Trimmed mean (5% trimming)	0.95	0.97	0.95	0.97	0.95	0.96
Discounted MSFE (0.90)	0.93	0.95	0.93	0.95	0.92	0.94
Discounted MSFE (0.95)	0.93	0.95	0.93	0.96	0.93	0.95
Discounted MSFE (1.00)	0.94	0.96	0.94	0.96	0.94	0.95
Squared discounted MSFE (0.90)	0.90	0.93	0.90	0.94	0.89	0.92
Squared discounted MSFE (0.95)	0.92	0.94	0.92	0.94	0.91	0.93
Squared discounted MSFE (1.00)	0.93	0.95	0.93	0.95	0.93	0.94
Recent best (past four quarters)	0.57	0.62	0.57	0.67	0.56	0.59
GOVERNMENT CONSUMPTION						
RMSFE	8.10	7.91	8.10	7.91	8.10	7.91
Median	1.00	1.00	1.01	1.00	1.00	1.00
Mean	1.02	1.01	1.02	1.00	1.02	1.00
Trimmed mean (5% trimming)	1.02	1.00	1.02	1.00	1.01	1.00
Discounted MSFE (0.90)	1.01	1.00	1.01	1.00	1.01	1.00
Discounted MSFE (0.95)	1.01	1.00	1.01	1.00	1.01	1.00
Discounted MSFE (1.00)	1.01	1.00	1.02	1.00	1.01	1.00
Squared discounted MSFE (0.90)	1.00	1.00	1.01	1.00	1.01	1.00
Squared discounted MSFE (0.95)	1.01	1.00	1.01	1.00	1.01	1.00
Squared discounted MSFE (1.00)	1.01	1.00	1.01	1.00	1.01	1.00
Recent best (past four quarters)	0.79	0.87	0.79	0.88	0.79	0.78
GROSS FIXED CAPITAL FORMATION						
RMSFE	4.69	5.15	4.69	5.15	4.69	5.15
Median	0.99	1.02	0.98	1.02	0.97	1.02
Mean	0.98	1.03	0.98	1.03	0.98	1.03
Trimmed mean (5% trimming)	0.98	1.02	0.98	1.02	0.98	1.01
Discounted MSFE (0.90)	0.95	0.99	0.95	0.99	0.95	0.98
Discounted MSFE (0.95)	0.96	1.00	0.96	1.00	0.96	0.99
Discounted MSFE (1.00)	0.96	1.01	0.97	1.00	0.96	0.99
Squared discounted MSFE (0.90)	0.93	0.97	0.92	0.97	0.92	0.96
Squared discounted MSFE (0.95)	0.95	0.99	0.95	0.98	0.94	0.97
Squared discounted MSFE (1.00)	0.96	1.00	0.96	1.00	0.95	0.99
Recent best (past four quarters)	0.53	0.62	0.62	0.59	0.61	0.60

Table A7: Continued

Forecasts are estimated early in:	Jan/Apr/Jul/Oct		Feb/May/Aug/Nov		Mar/Jun/Sep/Dec	
Quarter for which forecast is estimated	Previous	Current	Previous	Current	Previous	Current
Number of months to National Accounts release	*2*	*5*	*1*	*4*	*0*	*3*
GROSS CAPITAL FORMATION						
RMSFE	13.57	13.19	13.57	13.19	13.57	13.19
Median	1.10	1.10	1.09	1.10	1.09	1.10
Mean	1.09	1.12	1.09	1.12	1.09	1.10
Trimmed mean (5% trimming)	1.09	1.10	1.09	1.10	1.09	1.10
Discounted MSFE (0.90)	1.08	1.10	1.08	1.10	1.08	1.09
Discounted MSFE (0.95)	1.08	1.10	1.08	1.10	1.08	1.09
Discounted MSFE (1.00)	1.08	1.10	1.08	1.10	1.08	1.09
Squared discounted MSFE (0.90)	1.07	1.09	1.07	1.09	1.07	1.08
Squared discounted MSFE (0.95)	1.08	1.09	1.08	1.09	1.08	1.09
Squared discounted MSFE (1.00)	1.08	1.10	1.08	1.10	1.08	1.09
Recent best (past four quarters)	0.84	0.95	0.84	0.95	0.84	0.90
EXPORTS						
RMSFE	2.39	2.33	2.39	2.33	2.39	2.33
Median	1.02	1.04	1.01	1.02	1.00	1.03
Mean	1.00	1.01	1.00	1.00	0.99	1.01
Trimmed mean (5% trimming)	1.00	1.02	1.00	1.01	0.99	1.01
Discounted MSFE (0.90)	0.97	0.99	0.97	0.98	0.96	0.98
Discounted MSFE (0.95)	0.98	1.00	0.98	0.99	0.98	0.99
Discounted MSFE (1.00)	0.99	1.01	0.99	1.00	0.98	1.00
Squared discounted MSFE (0.90)	0.95	0.97	0.95	0.95	0.94	0.95
Squared discounted MSFE (0.95)	0.97	0.99	0.96	0.98	0.96	0.98
Squared discounted MSFE (1.00)	0.98	1.00	0.98	0.99	0.97	0.99
Recent best (past four quarters)	0.67	0.54	0.69	0.62	0.68	0.59
IMPORTS						
RMSFE	5.38	5.61	5.38	5.61	5.38	5.61
Median	0.98	1.00	0.97	0.99	0.96	0.99
Mean	0.98	1.01	0.97	1.00	0.97	1.00
Trimmed mean (5% trimming)	0.97	0.99	0.97	0.99	0.96	0.98
Discounted MSFE (0.90)	0.95	0.99	0.95	0.98	0.94	0.97
Discounted MSFE (0.95)	0.96	0.99	0.96	0.99	0.95	0.97
Discounted MSFE (1.00)	0.97	0.99	0.96	0.99	0.96	0.98
Squared discounted MSFE (0.90)	0.94	0.98	0.94	0.97	0.93	0.95
Squared discounted MSFE (0.95)	0.95	0.98	0.95	0.98	0.94	0.96
Squared discounted MSFE (1.00)	0.96	0.99	0.96	0.98	0.96	0.97
Recent best (past four quarters)	0.68	0.78	0.66	0.70	0.66	0.71

References

Altissimo, F., Cristadoro R., Forni M., Lippi M. and Veronese G. (2010), "New Eurocoin: Tracking economic growth in real time", Review of Economics and Statistics 92, 1024-1034.

Andreou, E., Kourtellos A. and Pashourtidou N. (2010), "Forecasting toolbox for Cyprus GDP growth", Economic Analysis Paper 10-10, Economics Research Centre, University of Cyprus.

Angelini, E., Camba-Méndez G., Giannone D., Reichlin L. and Rünstler G (2011), "Short-term forecasts of euro area GDP growth", Econometrics Journal 14, C25-C44.

Artis, M. J., Banerjee A. and Marcellino M. (2005), "Factor forecasts for the UK", Journal of Forecasting 24, 279-298.

Bai, J., Ng S. (2002), "Determining the number of factors in the approximate factor models", Econometrica 70, 191-221.

Banerjee, A., Marcellino M. and Masten I. (2005), "Leading indicators for Euro-area inflation and GDP growth", Oxford Bulletin of Economics and Statistics 67, 785-813.

Carriero, A., and Marcellino M. (2007), "Sectoral survey-based confidence indicators for Europe", Working Paper Series, No 320, Università Bocconi.

Carriero, A., and Marcellino M. (2011), "Sectoral survey-based confidence indicators for Europe", Oxford Bulletin for Economics and Statistics 73, 175-206.

Doz, C., Giannone D. and Reichlin L. (2011), "A two-stage estimator for large approximate dynamic factor models based on Kalman filtering", Journal of Econometrics 164, 188-205.

Doz, C., Giannone D. and Reichlin L. (2012), "A quasi–maximum likelihood approach for large, approximate dynamic factor models", Review of Economics and Statistics 94, 1014-1024.

European Commission (2014), "The joint harmonised EU programme of Business and Consumer Surveys: User guide", Directorate-General for Economic and Financial Affairs. Available at: http://ec.europa.eu/economy_finance/db_indicators/surveys/documents/bcs_user_guide_en.pdf

Forni, M., Hallin M., Lippi M. and Reichlin L. (2000), "The generalized dynamic-factor model: Identification and estimation", Review of Economics and Statistics 82, 540-554.

Forni, M., Hallin M., Lippi M. and Reichlin L. (2003), "Do financial variables help forecasting inflation and real activity in the euro area", Journal of Monetary Economics 50, 1243-1255.

Forni, M., Hallin M., Lippi M. and Reichlin L. (2005), “The generalized dynamic-factor model: One-sided estimation and forecasting”, Journal of the American Statistical Association 100, 830-840.

Giannone, D., Reichlin L. and Small D. (2008), “Nowcasting: The real-time informational content of macroeconomic data”, Journal of Monetary Economics 55, 665-676.

Papamichael, C. and Pashourtidou N. (2012), “A monthly indicator for GDP growth in Cyprus”, Economic Analysis Paper No. 06-12, Economics Research Centre, University of Cyprus.

Papamichael, C., Pashourtidou N. and Kourtellos A. (2014), “Forecasting Cyprus GDP and its demand components: Single equation models and forecast combinations”, Economic Analysis Paper No. 06-14, Economics Research Centre, University of Cyprus.

Stock, J., and Watson M. (2002a), “Macroeconomic forecasting using diffusion indexes”, Journal of Business and Economic Statistics 20, 147-162.

Stock, J., and Watson M. (2002b), “Forecasting using principal components from a large number of predictors”, Journal of the American Statistical Association 97, 1167-1179.

Stock, J. and Watson M. (2004), “Combination forecasts of output growth and in a seven-country dataset”, Journal of Forecasting 23, 405-430.

Stock, J. and Watson M. (2008), “Phillips curve inflation forecasts”, NBER Working Paper.

RECENT ECONOMIC POLICY/ANALYSIS PAPERS

10-14 Mamuneas, T. and E. Ketteni “Multilateral Comparisons of Productivity among European Countries”, December 2014.

09-14 Theodorou, M. “Testing the waters for GeSY: Patients’ opinion of cost-sharing arrangements in the public health care system in Cyprus”, December 2014.

08-14 Clerides, S. “The Collapse of the Cypriot Banking System: A Bird’s Eye View”, December 2014.

07-14 Andreou, E., and A. Kourtellos, “The State of Cyprus Macroeconomic Forecasting”, November 2014.

06-14 Papamichael, C., Pashourtidou, N., and A. Kourtellos, “Forecasting Cyprus GDP and its demand components: Single equation models and forecast combinations”, July 2014.

05-14 Karagiannakis, C., Ketteni, E., Mamuneas, T. P. and P. Pashardes, “Public vs Private: Electricity and Telecommunications in Europe”, July 2014.

04-14 Glushenkova, M. and M. Zachariadis, “Cypriot LOP Deviations Before and After the Euro”, June 2014.

03-14 Zachariadis, T., “The Effect of Energy Efficiency Policies on the Medium-Term Energy Outlook of Cyprus”, June 2014.

02-14 Andreou, S., Koutsampelas, C. and P. Pashardes, “Estimating the Value and Distributional Effects of Free State Schooling”, April 2014.