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NOWCASTING QUARTERLY GDP IN ALBANIA

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ABSTRACT

The quarterly Gross Domestic Product in Albania is published with a lag of 12 weeks (three months) from the reference quarter. In between, it is important for policy makers to have an evaluation of the aggregate demand and domestic output, to be able to take well-informed decisions and implement economic policy effectively. For this purpose, this study tests the predicting power of different economic indicators that are available before the quarterly GDP publication. The immediate-term forecasting, a.k.a. nowcasting, is obtained with ADL (p, q) equations, and estimated with OLS. Main results reveal that 'auto sales and repairs'- a hard indicator -, has the highest predicting power among all tested variables, followed by qualitative (survey) indicators like 'the industrial sector's evaluation of current demand', 'the industrial sector's evaluation of current production', 'the industrial sector's expectations on next quarter's production', 'the construction sector's evaluation of current production', and 'the services sector's evaluation of current demand'. These qualitative indicators are disaggregated indices of the Bank of Albania's Consumer and Business Surveys. The final nowcasting model includes 'auto sales and repairs' and 'the construction sector's evaluation of current production'. Selected candidate models outperform naïve and ARIMA models.

Keywords: nowcasting, qualitative indicators, Gross Domestic Product, Albania

JEL classification: C22, C53, E17

1. INTRODUCTION

Quarterly economic activity, as measured by Gross Domestic Product (GDP), was first published by the National Statistics Institute (INSTAT) in the beginning of 2009 – a very important step in the compilation and publication of official short-term statistics in Albania. However, the publication lag is about 12 weeks from the reference quarter. During the 'waiting period' policy-making institutions need to have some information on economic performance in order to be able to evaluate the effectiveness of past policies and the decision-making environment for current and future policies[1].

In order to have an evaluation of current economic activity, economic agents and policymakers study related information that is available before the official publication of GDP. Such information is contained in quantitative variables, like real retail sales, auto sales and repairs, energy consumption, industrial production, etc., and qualitative variables, such as business, consumers and banks' surveys, about their estimation and expectations of economic activity, inventory, domestic demand, etc. In Albania's case, the analysis of these indicators before the official publication of GDP is carried out in a qualitative way. The purpose of this paper is to test the relationship and predicting power of quantitative and qualitative variables to estimate real GDP with univariate equations, and provide some grounds for quantitative analysis, rather than just qualitative.

In most countries, real short-term indicators are published with a higher frequency than real GDP – mainly monthly frequency. To have real time forecasts of real GDP and its components, econometricians use the so-called bridge models, which link high frequency (e.g. monthly) indicators with lower frequency (e.g. quarterly) indicators. Trehan (1989) was the first to apply such models in nowcasting

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[1] The monetary regime of the Bank of Albania is Implicit Inflation Targeting, similar to the monetary policy regime of the Deutsche Bundesbank and of the ECB. Decision making is based on two pillars: monetary analysis and economic analysis. Therefore, information on actual/real time economic performance is crucial for policy decisions. For further details, see the "Monetary policy Document for 2009-2011" at http://www.bankofalbania.org/web/Dokumenti_i_Politikes_Monetare_per_periudhen_2009_2011_5204_1.php?kc=0,27,0,0,0.

U.S. GDP. He used monthly data on employment net of agriculture, industrial production and retail sales. Trehan models outperformed the Blue Chip Forecasts[2]. Other authors, such as Ingento (1996), Fitzerald and Miller (1989), Kitchen and Monaco (2003), etc., conclude that bridge models are quite satisfactory in nowcasting U.S. GDP.

At the same time, bridge models have been used to nowcast European GDP, as well. Parigi and Schlizer (1995) nowcast components of GDP individually and then aggregate them to have a GDP nowcast. Rünstler and Sédillot (2003) use survey results and components of leading indices for the Euro Area, along with quantitative indicators. Other authors, like Bafigi, Golinelli and Parigi (2004) nowcast both the aggregate GDP and its components. They find that aggregating the nowcasted components in the end, outperforms the nowcast of total GDP. Among the models of Diron (2006), those that include both contemporaneous explanatory variables (at t) and their lagged values (at t-1) outperform naïve models[3].

In the abovementioned papers, the difference in the frequency of real indicators and real GDP calls for a solution to the mixed frequency problem in the final nowcasting model. To be able to provide a solution, the bridge modeling is carried out in two steps. The first step consists of forecasting monthly indicators (when information for the quarter of interest in incomplete) up to the desired period, with different models. The second step involves aggregating the monthly data into quarterly data and building the nowcasting model. Therefore, the bridge models' performance largely depends on the monthly indicators' quality of forecasts. This is confirmed by Rünstler and Sédillot (2003), who find that "next quarter forecasts based on univariate models' forecasts of monthly indicators do not outperform naïve forecasts." (p.21)

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[2] According to the American Economic Association, *Blue Chip Economic Indicators* is one of the most reputable publication in the U.S.A for combined macroeconomic forecasts. This publication is based on surveys of the largest U.S. companies, where questions include their forecasts on macroeconomic indicators. The Blue Chip Economic Forecast aggregates these forecasts and publishes combined forecasts since 1975.

[3] Econometric literature defines naïve models those in which the current value of the variable depends only on its past value and a shock– *random walk*.

However, in our case most hard indicators are published with a quarterly frequency. The advantage in using them to nowcast GDP is that they are published with a lag of around 7 weeks[4], or 5 weeks earlier than official GDP data. On the other hand, financial indicators-treasury bills' interest rates and exchange rate-are available in real time[5]. The third group of indicators– survey variables (soft indicators) – are available with a 7-week lag[6] from the reference quarter. This study will first test the predicting power of the three groups of variables with univariate equations. Then, we will select the variable with the highest predicting power and test the combination of the "winner" equation with other variables that contain useful information (which come from the first step). Finally, the best-performing equations will be compared to our benchmark Autoregressive Integrated Moving Average model.

The main findings are that the variable with the highest predicting power is "auto sales and repairs". Furthermore, the forecasting performance of this equation is augmented when we include the survey component "the construction sector's evaluation of current production". The final selected equations outperform our ARIMA benchmark.

The structure of the paper is as follows. The next section describes the data; section 3 presents the models and discusses the selection process. Our analysis furthers in section 4, where main results are presented; and section 5 concludes and identifies areas for future research.

4 Source: INSTAT, at www.instat.gov.al.

5 Source: Bank of Albania, at www.bankofalbania.org.

6 Source: Bank of Albania, at www.bankofalbania.org.

2. DATA DESCRIPTION

2.1. THE AVAILABLE DATABASE

The database used to nowcast GDP consists of data from 2003q1 to 2009q2. The begining of our time series is determined by the availability of quarterly GDP. The main criteria for indicator selection are:

1. Time availability – publication has to occur before GDP publication.
2. The degree of theoretical relationship of the indicator and real GDP.
3. Graphical analysis, correlation and Granger Causality tests (see Appendix B.)

Based on an initial analysis, candidate indicators can be categorized in three main groups: hard indicators, financial indicators and soft indicators.

Qualitative indicators with time advantage include real retail sales (r_sales), real auto sales and repairs (r_auto), and business electricity consumption (en_consum). Retail sales and auto sales and repairs are published with a lag of 7 weeks from the reference quarter. Thus, these indicators contain a 5-week information gain on economic activity in the reference quarter. Energy consumption is published with a 4 week lag from the reference quarter. Business Energy consumption is preselected as the most useful component in explaining GDP, as compared to total consumption or household consumption.

Financial indicators include real short-term interest rates–represented by 3, 6, and 12-month Treasury Bills' rates–and real ALL-Euro exchange rate (eur_lek). Treasury Bills are preselected as the most representative short-term interest rates in the economy because: a) the central bank's base rate (repo rate) has very low volatility to capture short-term dynamics of GDP, and; b) typically ALL loan rates in Albania are indexed to Treasury Bills' rates. This can be explained by the possibility that banks in Albania consider

Treasury bills' rates as credit opportunity cost, since the Albanian government Treasury notes and bills have the second highest share (approximately 30% of total assets) in the banking system's total assets[7]. Therefore, short-term interest rates can capture that portion of economic growth that is financed by consumption or investment loans. The ALL-Euro exchange rate is preselected as the most representative exchange rate in the Albanian foreign exchange market, given the relatively high euroization extent of the Albanian economy[8]. These monthly indicators are available with a month lag from the reference month, meaning a maximum lag of 4 weeks from the GDP reference quarter.

Qualitative indicators consist of a range of indicators from the Business and Consumer Surveys[9]. Survey results are published by the Bank of Albania with a lag of 6 and half weeks from the reference quarter. Therefore, the information gain from these indicators is approximately 5 weeks. Once Granger Causality tests and graphical analysis are carried out (see Appendix B) the main candidate indicators that explain real quarterly GDP growth are: The industrial sector's evaluation of current demand (I_demand); the industrial sector's expectations on demand (I_demand*); the industrial sector's evaluation on production (I_production); the industrial sector's expectations on production (I_production*); the construction sector's evaluation of economic activity (C_econ); the construction sector's evaluation of demand (C_demand); the construction sector's expectations on demand (C_demand*) ; the construction sector's evaluation of production (C_production); the construction sector's expectations on production (C_production*); the construction sector's evaluation of employment (C_employment); the services sector's evaluation

[7] See "The Annual Supervision Report 2008", page 35, at http://www.bankofalbania.org/web/Raporti_Vjetor_i_Mbikeqyrjes_2008_5515_1.php?kc=0,27,0,0,0.

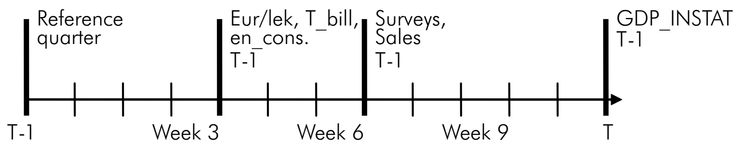
[8] Two basic indicators of the level of euroization in an economy are the ratio of foreign currency deposits and loans to local currency deposits and loans. In Albania these ratios are around 44% and 80%, respectively at year end 2008. See "Bank of Albania's Annual Report 2008", pages 71 and 76, at http://www.bankofalbania.org/web/Raporti_Vjetor_2008_5398_1.php.

[9] Starting from year 2002, the Bank of Albania, through INSTAT, carries out a quarterly survey on Consumer and Business Confidence. For further information see "Business and Consumer Confidence Surveys – methodology explanatory notes" at http://www.bankofalbania.org/web/pub/metodologjia_vbb_vbk_anglisht_2426_1.pdf

of demand (S_demand); and, the services sector's expectations on demand (S_demand*).

The following figure delineates a scheme of candidate indicators' time availability.

Figure 1 The publication scheme of candidate indicators for nowcasting GDP



2.2. TIME SERIES TESTS

All series have been tested for unit roots with the Augmented Dickey Fuller (ADF) test. Results reveal that hard indicators and the real exchange rate are stationary in their first difference (see Appendix B). Soft indicators are stationary at their levels. Therefore, qualitative indicators enter the equation in growth terms (approximated by the first difference of their logs), while qualitative indicators and the exchange rate enter the model in log levels.

Moreover, time series are not seasonally adjusted. This choice is motivated by two reasons:

a) Seasonal adjustment of GDP is costly in terms of losing valuable information contained in the short-term dynamics of economic growth. Since consumer and business surveys ask economic agents directly on their feeling about the economy, we don't expect the answers to be adjusted for seasonality. Therefore, survey answers contain information on unadjusted GDP;

b) Nowcasting models do not aim at establishing structural relationships among variables; they tend to find indicators that have short-term dynamics similar to GDP short-term dynamics. One of these common dynamics is seasonality.

The choice on quarterly growth is motivated by a) the effort to have as much short term information as possible, and b) the effort to have as many degrees of freedom as possible, since annual growth would immediately shorten the sample by 3 observations.

3. THE MODELS

Following the methodology used by Rünstler and Sédillot (2003), quarterly bridge equations are modeled with Autoregressive Distributed Lag (p, q) form–ADL (p, q)–, in which the nowcasted variable is explained by its own past values (autoregressive behavior) and current and past values of independent explanatory variables. According to Gujarati (1995) such models can be estimated via Ordinary Least Squares so long as the estimators are BLUE–the best linear, unbiased estimators. To have such parameters we need to make sure that the models don't suffer from serial correlation, heteroskedasticy and abnormally distributed residuals. Results for these diagnostic tests are presented in Appendix C. We can write the ADL (p, q) as:

$$\rho(L)\Delta y_t = \sum_{j=1}^{k} \delta_j(L)\Delta x_{j,t} + \varepsilon_t \tag{1}$$

where Δyt is quarterly growth of GDP; ρ(L) is the lag operator for the dependent variable with p maximum lags; Δxj,t are different indicators; δj(L) is the lag operator for our j independent variables with q maximum lags.

Estimating the ADL model requires establishing the optimal lag length for both the dependent and independent variables, which is quite complicated. If the model consisted of only the autoregressive term, then Akaike and Schwartz information criteria would be perfect to determine the lag length. However, in the ADL model there are lags of the independent variables as well. As such, a practical approach would be to first determine the lag of the independent variable through AIC and SC, then to add as many lags of the independent variable as required to minimize the same criteria.

Another approach, known in literature as the Hendry approach, or the London School of Economics Approach–a.k.a. the TTT (test, test, test) method–suggests general-to-specific modeling (Gujarati, 1995, p.485). According to this method, the econometrician starts with a maximum lag indicated by economic sense (say, the maximum lag for economic variables' interaction is 4 quarters) and eliminates lags until a statistically significant model results. Rünstler and Sédillot (2003) implement this method through stepwise regressions to find the optimal lag. However, a rigorous econometrician would deem that this approach may result to data mining. To avoid this problem, Hendry and Richard (1983) suggest that the model should fulfill the following pre-requisites:

1. Data should be acceptable – meaning that obtained forecasts need to make economic sense above anything else.
2. Theoretical consistency.
3. Exogenous regressors – meaning, they should not be correlated with the error terms.
4. Constant parameters – meaning, the model needs to be tested for coefficients' stability.
5. Coherent data – meaning that residuals have to be i.i.d. (identically and independently distributed).
6. Encompassing model – meaning that the model should include all rival models in explaining its results. In practical terms, this requires the modeler to make sure that other models do not improve the forecast. (pp. 3-33)

This study follows the same method in determining the optimal lag, making sure that the 6 pre-requisites above are fulfilled.

3.1. EVALUATING THE PREDICTING POWER OF PRESELECTED INDICATORS

To evaluate each indicator's predicting power we have estimated equation (1) for all variables individually. The estimation fulfills the pre-requisites suggested by Hendry and Richard (1983) in determining the optimal lag. The criteria used to discriminate between indicators are: SSR (the Sum of Squared Residuals), RMSE (The Root of Mean Squared Errors), the Theil Coefficient statistic, model statistical significance (F-test statistic) and adjusted R-squared.

RMSE and the Theil Coefficient are the two main statitistics that determine the model's forecasting ability. The first one is a relative measure (the best model is the one with the smallest RMSE), whereas the second measures the superiority of the model to a naive (random walk) model for GDP. Theil's inequality coefficient lies between 0 and 1[10], and the closer to 0 the better the model, as compared to a naive specification. The statistical significance F-test tests the Null Hypothesis that $d_j(L) = 0$, i.e. explanatory variables' coefficients are statistically equal to zero.

Table 1 presents results of our analysis on the information content of preselected indicators in nowcasting GDP. The first column lists all indicators, the second presents the adjusted R-squared; the third column depicts RSS; the fourth–RMSE; the next column reports the Theil Coefficient; the sixth presents the F-statistic; the seventh reports the λ coefficient of encompassing regressions, and; the last column reports the indicators that have value added to the auto sales and repairs equation.

[10] Henri Thiel (1961) developed a statistic to directly compare an economic series with another. The Theil Inequality Coefficient is calculated as: $U = \frac{\sqrt{\frac{1}{h}\sum_{t=T+1}^{T+h}(\hat{Y}_t - Y_t)^2}}{\sqrt{\frac{1}{h}\sum_{t=T+1}^{T+h}\hat{Y}_t^2} + \sqrt{\frac{1}{h}\sum_{t=T+1}^{T+h}Y_t^2}}$; where $\hat{Y}$ is the forecast of the model at hand, and Y is the actual value of the variable; j=T+1, T+2,..., T+h is the forecast sample; For U = 0 the model at hand outperforms a naïve model (random walk).

Table 1 Predicting power of preselected indicators[11]

	Adj. R-squared	SSR (sum squared residuals)	RMSE (in sample)	Theil inequality coefficient	F-test P-value	Encompassing regression, λ and (S.E)	Value Added
Quantitative Indicators							
Auto Sales and Repairs (r_auto)	0.846	0.016	0.032	0.230	39.73 (0.000)	-	
Retail Sales (r_sales)	0.832	0.017	0.038	0.269	37.35 (0.000)		
Non-Household energy consumption (en_consum)	0.551	0.034	0.065	0.556	12.08 (0.000)		
Financial Indicators							
Real T-Bills' Interest rates							
3 month (b_3)	Statistically insignificant; Low correlation; No Granger causality						
6 month (b_6)	Statistically insignificant; Low correlation; No Granger causality						
12 month (b_12)	Statistically insignificant; Low correlation; No Granger causality						
Real exchange rate (reur/lek)	Statistically insignificant; Low correlation; No Granger causality						
Qualitative Indicators							
I_demand	0.802	0.032	0.033	0.264	32.16 (0.000)	0.557 (0.16)	√
I_demand*	0.731	0.037	0.040	0.320	32.2 (0.000)		
I_prodution	0.798	0.021	0.033	0.258	31.38 (0.000)	0.537 (0.11)	√
I_production*	0.757	0.026	0.036	0.287	36.97 (0.000)	0.661 (0.20)	√
I_employment	0.624	0.038	0.104	0.777	12.65 (0.000)		
C_econ	0.608	0.040	0.050	0.443	12.38 (0.000)		
C_demand	0.809	0.019	0.043	0.371	33.62 (0.000)		
C_demand*	0.729	0.029	0.044	0.370	31.94 (0.000)		
C_production	0.862	0.014	0.035	0.264	49.07 (0.000)	0.553 (0.09)	√
C_prodution*	0.712	0.031	0.056	0.439	29.49 (0.000)		
C_employment	0.802	0.020	0.053	0.414	29.32 (0.000)		
S_demand	0.853	0.016	0.034	0.245	67.55 (0.000)	0.567 (0.18)	√
S_demand*	0.661	0.037	0.066	0.606	23.45 (0.000)		

[11] See Appendix C for diagnostic tests.

According to RRS, RMSE and the Theil Inequality Coefficient, r_auto (Auto Sales and Repairs) has the highest predicting power, with the lowest RMSE equal to 0.032. However, other indicators that contain valuable information include i_demand, i_production, i_production*, c_production and s_demand.[12]

Since the abovementioned indicators contain valuable information for predicting GDP, we will test whether the models including these variables add information to the forecast with r_auto. Rünstler and Sédillot (2003, p. 11) propose to test that by using the following encompassing regression:

$$y_t = \lambda \hat{y}_t^{(r\_auto)} + (1-\lambda)\hat{y}_t^{(x)} \quad (2)$$

where y_t is actual GDP, $\hat{y}_t^{(r\_auto)}$ is GDP as estimated with the r_auto model, and $\hat{y}_t^{(x)}$ is GDP as estimated with the rest of "winning" equations according the classification in table 1. The λ coefficient could be equal to or greater than 0. If it is equal to or greater than 1, including indicator x does not add value to the nowcast of GDP. Table 1 reports the results of equation (2) in the column labeled "encompassing regression, λ (S.E.)". Results reveal that all 5 survey indicators add value to the nowcast with r_auto.

3.2. MODEL PERFORMANCE

Given the individual predicting power of the indicators identified in the previous sub-section, we have built 5 nowcasting models for GDP, whose performance is compared to a naive model (via the Theil Coefficient) and an ARIMA (p, d, q) model for quarterly real GDP growth.

3.2.1 ARIMA (p, d, q) as benchmark

The Autoregressive Integrated Moving Average (ARIMA) model – i.e. the Box-Jenkins[13] model – is based on the stochastic properties

[12] See the previous section for variable descriptions.

[13] Box, G. P., and Jenkins, G. M. (1970). Time series analysis: Forecasting and control. Holden Day.

of the series to be nowcasted, where the modeler applies the philosophy "let the data speak by themselves" (Gujarati, 1995, p. 735). Such models are categorized as atheoretical since the modeler pretends she does not have any theoretical economic knowledge, and are often used as benchmarks for theoretical models. As such, an alternative theoretically-founded model is empirically valid only if it outperforms an ARIMA model.

The mathematical representation of an ARIMA (p, d, q) is a generalization of the simple autoregressive (AR) model, where the serial correlation of residuals is modeled through 3 techniques to obtain white noise:

The AR process: $GDP_t = a + r_1 GDP_{t-1} + r_2 GDP_{t-2} + \ldots + r_p GDP_{t-p} + e_t$ (3)

The MA process: $GDP_t = b + e_t + q_1 e_{t-1} + q_2 e_{t-2} + \ldots + q_q e_{t-q}$ (4)

The level of integration (d) indicates how many times the series needs to be differenced to become stationary. In our case, GDP becomes stationary after differencing the series once; hence, it enters the model in first difference of its logged value, an approximation for quarterly growth.

Following the steps suggested by Box and Jenkins (1970)[14] the ARIMA process is estimated as follows:

I. Identifying the auto regressive (p) and moving average (q) orders

To find the p and q orders, we study the correlogram and partial correlogram of the series. According to Gujarati (1995) there are two ways to identify the precise AR and MA processes. In the first approach, the modeler tries processes with different orders (starting from order 1) until the autocorrelation and partial autocorrelation of the series disappear, performing diagnostic tests at each specification. (p. 741) The second approach identifies the statistically significant lags of autocorrelation and partial autocorrelation and

[14] Gujarati, D. N. (1995). *Basic Econometrics* (3rd Ed.). International Edition: McGraw-Hill Inc. f. 738.

determines the order of the AR and MA processes according to the ACF and PACF table below. We have used the second approach in this study.

Figure 2 ACF and PACF of the quarterly growth of GDP
Date: 02/09/10 Time: 16:31
Sample: 2003Q1 2009Q4
Included observations: 25

Autocorrelation	Partial Autocorrelation	Lags	AC	PAC	Q-Stat	Prob.
****| .	****| .	1	-0,569	-0,569	90,965	0,003
. |* .	. *| .	2	0,194	-0,191	10,202	0,006
****| .	******| .	3	-0,554	-0,815	19,625	0,000
. |******	. |* .	4	0,803	0,101	40,363	0,000
***| .	. |* .	5	-0,404	0,128	45,884	0,000
. |* .	. *| .	6	0,156	-0,069	46,746	0,000
****| .	. | .	7	-0,488	-0,046	55,680	0,000
. |*****	. | .	8	0,641	0,008	71,977	0,000
.**| .	. | .	9	-0,272	0,055	75,102	0,000
. |* .	. | .	10	0,112	-0,014	75,670	0,000
***| .	. | .	11	-0,416	0,008	84,004	0,000
. |****	. | .	12	0,485	-0,041	96,241	0,000
. *| .	. *| .	13	-0,185	-0,137	98,157	0,000
. |* .	. | .	14	0,116	-0,031	98,980	0,000
***| .	. | .	15	-0,368	-0,063	108,120	0,000
. |***	. *| .	16	0,374	-0,072	118,630	0,000
. *| .	. *| .	17	-0,135	-0,088	120,160	0,000
. |* .	.**| .	18	0,093	-0,226	120,980	0,000
.**| .	. |* .	19	-0,243	0,077	127,640	0,000
. |* .	. *| .	20	0,209	-0,14	133,560	0,000
. | .	. | .	21	-0,039	-0,022	133,810	0,000
. | .	. | .	22	0,04	0,001	134,170	0,000
. *| .	. | .	23	-0,127	0,028	139,600	0,000
. |* .	. | .	24	0,076	0,012	143,480	0,000

The first column in figure 2 reports the consecutive correlation of lags. For example, we observe that GDP growth at the current quarter is negatively correlated with growth in the previous quarter (t-1); growth in the previous quarter (t-1) is not statistically correlated with growth in (t-2); while the latter is negatively correlated with growth in (t-3). The third column reports the autocorrelation between the current quarter and all other quarters. For example, GDP growth in the current quarter is negatively correlated with growth in (t-1) and growth in (t-3). The autocorrelation and partial autocorrelation coefficients are reported in the columns labeled AC and PAC, respectively. These coefficients range between 0 and 1 and the closer to 1, the higher the correlation or the partial autocorrelation. The last two columns report the Q-statistic of Ljung-Box[15] and the respective probability of accepting or rejecting the null hypothesis H0 that all correlation coefficients are statistically equal to zero until the specific lag. Probabilities lower than 10% imply the rejection of the null hypothesis of lack of correlation at specific lags up to the lag in column 3.

What does this figure reveal? According to Gujarati (1995, p. 742) a modeler should guided by the following general theoretical framework in determining the right AR and MA processes:

Table 2 The general framework for determining the order of the AR and MA processes

Process	The Autocorrelation Structure (ACF)	The Partial Autocorrelation Structure (PACF)
AR(*p*)	Exponential decline, or a sinusoidal decline (seasonality indicator)	*There is statistically significant partial autocorrelation up to lag p*
MA(*q*)	*There is statistically significant autocorrelation up to lag q*	Exponential decline
ARIMA(*p*,*d*,*q*)	Exponential decline	Exponential decline

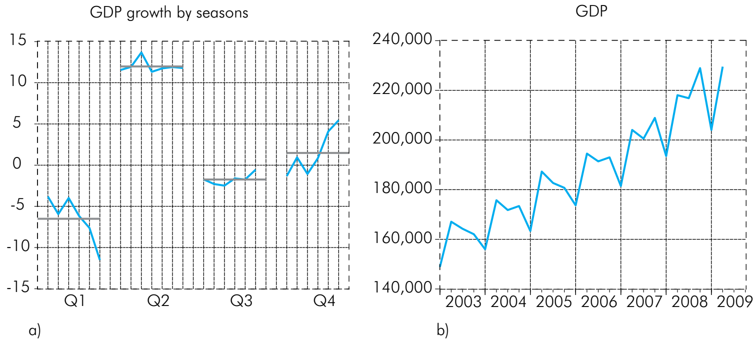
Referring to Figure 2, we can clearly observe that the stochastic process of GDP growth does not depict any MA terms, since the PACF does not decline exponentially. Focusing on the ACF, we observe a seasonality structure, which is confirmed by the graphical representation of GDP and the seasonality graph.

[15] The LB Q-statistic has distribution approximated by $\chi 2$ with *m* degrees of freedom. The mathematical representation is

$$Q_{LB} = n(n+2)\sum_{k=1}^{m}\frac{\rho_j^2}{n-k},$$

where r_j is the correlation coefficient of the *k*-th lag, and *n* is the number of observations. For further information see: Box G.P., and Ljung G. M. (1978). On a Measure of a Lack of Fit in Time Series Models. *Biometrika*. (66). 66-72.

Graph 1 Quarterly GDP growth by seasons and real GDP



II. Estimating the model

To model systematic seasonality we estimate a SARIMA[16] (Seasonal Autoregressive Integrated Moving Average) process. In our case seasonality is present as an autoregressive term with 4 lags; thus, the current quarter is positively correlated with quarter (t-4), i.e. the same quarter in the previous year. Furthermore, graphs 1.a) and 1.b) show that in the first quarter of 2009 GDP slowdown is clearly greater than in first quarters of previous years. This period depicts the quarter in which the Albanian economy began to realize the shocks stemming from the global financial and economic crises. As such, the first quarter of 2009 can be deemed as an abnormal period of economic activity. We account for this deviation by inserting a dummy for 2009q1. Once seasonality is factored in the ARIMA process, the final specification is SARIMA (1,1,0) (1,0,0)[17] (the brackets report t-statistics and standard errors):

[16] Box and Jenkins (1976) recommend using seasonal autoregressive and moving average terms for monthly data, quarterly data, or systematic seasonal patterns.

[17] SARIMA (1,1,0) (1,0,0) represents a process a seasonal ARIMA process with AR terms up to the 1st lag, first order integration, no MA terms, 1 seasonal AR term with 4 lags, no seasonal difference pa (a seasonal difference is equivalent to annual GDP growth in our case), and no seasonal MA terms.

$$\text{GDP\_growth} = \underset{\begin{pmatrix}1.015\\0.046\end{pmatrix}}{0.05} - \underset{\begin{pmatrix}-3.04\\0.013\end{pmatrix}}{0.04}*\text{D109} + [\text{AR(1)}=\underset{\begin{pmatrix}-3.01\\0.21\end{pmatrix}}{-0.63}, \text{SAR(4)}=\underset{\begin{pmatrix}14.58\\0.06\end{pmatrix}}{0.94}] \quad (5)$$

III. Diagnostic tests

SARIMA (1,1,0)(1,0,0) has normal distribution of residuals, and does not suffer from serial correlation and heteroskedasticity. Test results are reported in the next section, while residuals are graphed in Appendix D.

3.2.2 Results

A proper evaluation of the forecasting ability of our final equations requires out-of-sample analysis. However, given the relatively small sample size (25 observations) it is impossible to compare RMSE out of sample, for the time being. Therefore, our final judgment relies on in-sample forecasting performance.

The final combined models (in brackets–t-statistic and standard error) are:

$$\text{R\_AUTO: DLPBB} = \underset{\begin{pmatrix}3.11\\0.006\end{pmatrix}}{0.02} - \underset{\begin{pmatrix}-7.21\\0.09\end{pmatrix}}{0.65}*\text{DLPBB(-1)} + \underset{\begin{pmatrix}7.97\\0.02\end{pmatrix}}{0.18}*\text{DLR\_AUTO} + \underset{\begin{pmatrix}2.04\\0.03\end{pmatrix}}{0.053}*\text{DLR\_AUTO (-3)} \quad (6)$$

$$\text{AIK : DLPBB} = \underset{\begin{pmatrix}3.74\\0.005\end{pmatrix}}{0.02} - \underset{\begin{pmatrix}-5.4\\0.09\end{pmatrix}}{0.47}*\text{DLPBB(-1)} + \underset{\begin{pmatrix}-4.04\\0.03\end{pmatrix}}{0.11}*\text{DLR\_AUTO} + \underset{\begin{pmatrix}3.11\\0.05\end{pmatrix}}{0.16}*\text{IKERKESA} - \underset{\begin{pmatrix}-3.73\\0.04\end{pmatrix}}{0.16}*\text{IKERKESA(-1)} \quad (7)$$

$$\text{AIP : DLPBB} = \underset{\begin{pmatrix}3.83\\0.006\end{pmatrix}}{0.02} - \underset{\begin{pmatrix}-4.42\\0.10\end{pmatrix}}{0.46}*\text{DLPBB(-1)} + \underset{\begin{pmatrix}3.70\\0.03\end{pmatrix}}{0.12}*\text{DLR\_AUTO} - \underset{\begin{pmatrix}-2.48\\0.03\end{pmatrix}}{0.07}*\text{DLR\_AUTO(-1)} + \underset{\begin{pmatrix}2.23\\0.05\end{pmatrix}}{0.117}*\text{IPROD} \quad (8)$$

$$\text{AIP\_1 : DLPBB} = \underset{\begin{pmatrix}0.1\\0.01\end{pmatrix}}{0.001} - \underset{\begin{pmatrix}-4.41\\0.11\end{pmatrix}}{0.49}*\text{DLPBB(-1)} + \underset{\begin{pmatrix}4.09\\0.03\end{pmatrix}}{0.12}*\text{DLR\_AUTO} - \underset{\begin{pmatrix}-1.74\\0.03\end{pmatrix}}{0.05}*\text{DLR\_AUTO(-1)} + \underset{\begin{pmatrix}1.98\\0.07\end{pmatrix}}{0.13}*\text{IPROD\_1(-1)} \quad (9)$$

$$\text{ANP : DLPBB} = \underset{\begin{pmatrix}4.56\\0.004\end{pmatrix}}{0.02} - \underset{\begin{pmatrix}-7.41\\0.08\end{pmatrix}}{0.56}*\text{DLPBB(-1)} + \underset{\begin{pmatrix}3.97\\0.03\end{pmatrix}}{0.11}*\text{DLR\_AUTO} + \underset{\begin{pmatrix}2.86\\0.05\end{pmatrix}}{0.14}*\text{NPROD} - \underset{\begin{pmatrix}-4.57\\0.003\end{pmatrix}}{0.14}*\text{NPROD (-1)} \quad (10)$$

$$\text{ASK : DLPBB} = \underset{\begin{pmatrix}2.10\\0.006\end{pmatrix}}{0.01} - \underset{\begin{pmatrix}-8.82\\0.08\end{pmatrix}}{0.72}*\text{DLPBB(-1)} + \underset{\begin{pmatrix}1.87\\0.04\end{pmatrix}}{0.067}*\text{DLR\_AUTO} + \underset{\begin{pmatrix}3.47\\0.05\end{pmatrix}}{0.18}*\text{SKERKESA} \quad (11)$$

where R_AUTO is the nowcasting equation with auto sales and repairs, AID–a combined equation: auto sales and repairs and industrial sector's evaluation of current demand; AIP–auto sales and repairs and industrial sector's evaluation of current production; AIP_1–auto sales and repairs and industrial sector's expectations on next quarter's production; ACP–auto sales and repairs and construction sector's evaluation of current production; and, ASD–auto sales and repairs and services sector's evaluation of current demand.

Table 3 reports the results of the 5 final models, some diagnostic tests (see Appendix D for residuals and coefficients' stability tests), and the comparison with SARIMA (1,1,0) (1,0,0):

Table 3 Final models comparison

Model/ Main statistic	Adj. R-squared	RMSE (in pp)	Theil Coefficient	LM Serial Correlation (4) F p-value	White HSK test F p-value	Normality (J-Bera and p-value)	Annual GDP growth projection in 2009Q3
SARIMA	0.96	0.026	0.2	0.69	0.45	0.15 0.92	5.40%
R_AUTO	0.84	0.032	0.23	0.82	0.15	1.08 0.58	0.90%
AIK	0.89	0.024	0.17	0.99	0.79	0.82 0.66	4.80%
AIP	0.87	0.025	0.18	0.86	0.32	0.31 0.85	1.44%
AIP_1	0.86	0.029	0.21	0.24	0.3	0.17 0.91	0.43%
ANP	0.92	0.018	0.13	0.14	0.86	0.85 0.65	3.50%
ASK	0.87	0.031	0.22	0.97	0.8	0.58 0.74	1.50%

A comparison in terms of RMSE and Theil Coefficients suggests that the absolutely superior model to SARIMA is ACP–nowcasting GDP with auto sales and repairs and the construction sector's evaluation of current production. The last column of Table 3 shows nowcasts on annual GDP growth for 2009Q3. The projected figure (although it's just one out-of-sample nowcast) confirms that ACP has the best performance. According to INSTAT (2009) real annual GDP growth for 2009Q3 is 4.1%, or 0.6 percentage points higher than the nowcast of ACP.

4. CONCLUSIONS AND FURTHER RESEARCH

The purpose of this study was the estimation of current GDP growth before its official publication, to have more information on current economic activity. To fulfill our purpose, we used real quantitative indicators, financial indicators, and survey results from the Business and Consumer Confidence surveys, whose maximum publication lag is 7 weeks, resulting in an information gain of 5 weeks. We empirically estimate for the first time the relationship between specific components of the confidence surveys and economic activity, and find that the component with the highest predicting power for GDP growth is the construction sector's evaluation of current production.

With regard to qualitative indicators, among all pre-selected variables, the best-performing indicator is auto sales and repairs. Based on economic sense, we would expect retail sales to have a stronger relationship with quarterly GDP, since consumption has a share of approximately 70% in total GDP[18]. However, a similar relationship between auto sales and repairs and GDP is also found in the U.S.A; where auto sales and leasing often explain a high extend of quarterly U.S. GDP[19]. It is important noting that financial indicators, available with higher frequency, are not statistically significant in nowcasting quarterly GDP growth.

The final nowcasting model includes auto sales and repair and the construction sector's evaluation of current production. Its high performance was expected at a certain extent, since construction has had a considerable contribution on economic growth in recent years. The results of this study allow us to have a clearer idea on the current quarter's economic activity during the economic decision-making process and analysis of the impact of past policy decisions. Moreover, an estimate of current quarter GDP is valuable for structure models and short-to-medium-term forecasting models.

The main limitation of our results consist in the robustness of the models, which could be highly affected by the frequent revision of official data by INSTAT.

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18 Author's calculations based on INSTAT data. 10 February. 2010. www.instat.gov.al

19 Federal Reserve of New York. (n.d.). *Economic Indicators (By the Numbers)*. Retrieved on 12 February 2010, from http://www.newyorkfed.org/education/bythe.html#ltwght

Furthermore, the literature suggests that nowcasting components of GDP or production sectors individually and then aggregating them into a figure for GDP, tends to outperform nowcasting total GDP. For example, Bafigi, Golinelli and Parigi (2004) nowcast both total GDP and individual components, and conclude that aggregation of nowcasted components outperform the total GDP nowcast. We will try to nowcast components of GDP in future research. Further, the specification of nowcasting models allows for an extension of the forecasting period up to 1 or 2 quarters, if we forecast business and consumer confidence survey components, which we plan to attempt in future research.

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APPENDIX A DATA AND SOURCES

Table 4 Data and sources

Variable	Frequency	Source
Real GDP*	Quarterly	INSTAT
Retail Sales	Quarterly	INSTAT
Auto Sales and Repairs	Quarterly	INSTAT
Non-household Energy Consumption	Quarterly	The Albanian Energy Corporation
Real T-Bills' Interest Rates	Monthly	Bank of Albania
Real ALL-Euro Exchange Rate	Monthly	Bank of Albania, estimation of the Research Department
Industrial Sector's Evaluation of current Demand	Quarterly	Bank of Albania
Industrial Sector's Expectations on Demand	Quarterly	Bank of Albania
Industrial Sector's Evaluation of current Production	Quarterly	Bank of Albania
Industrial Sector's Expectations on Production	Quarterly	Bank of Albania
Industrial Sector's Evaluation of current Employment	Quarterly	Bank of Albania
Construction sector's Evaluation of current Economic Activity	Quarterly	Bank of Albania
Construction sector's Evaluation of current Demand	Quarterly	Bank of Albania
Construction sector's Expectations on Demand	Quarterly	Bank of Albania
Construction sector's Evaluation of current Production	Quarterly	Bank of Albania
Construction sector's Expectations on Production	Quarterly	Bank of Albania
Construction Sector's Evaluation of current Employment	Quarterly	Bank of Albania
Services Sector's Evaluation of current Demand	Quarterly	Bank of Albania
Services Sector's Expectations on Demand	Quarterly	Bank of Albania

*The GDP used in this study is not seasonally adjusted. These figures are not published, but they are available institutionally.

APPENDIX B VISUAL ANALYSIS OF THE SERIES, STATIONARITY AND GRANGER CAUSALITY TESTS.

Graph 2 Visual Analysis of the Series

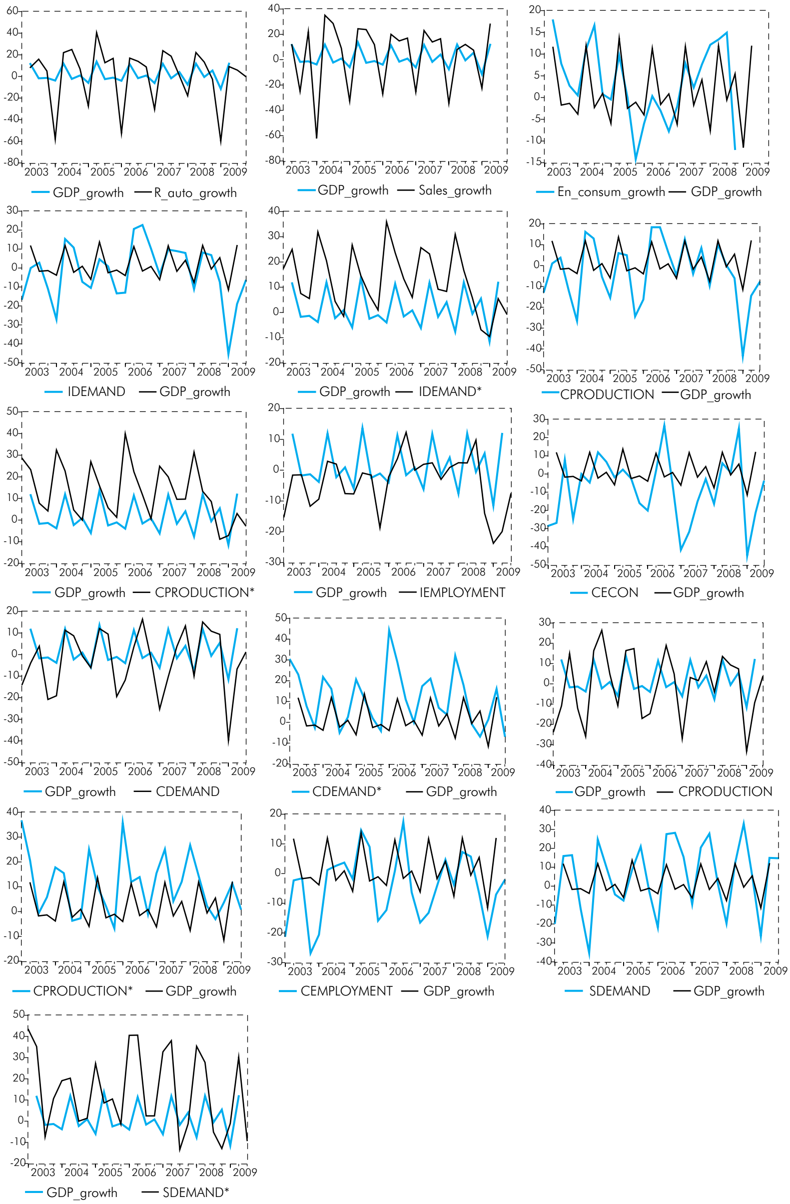


Table 5 ADF Unit Root test

H0	t-stat.	P-value
LGDP has a *unit root* in level.	0.58	0.97
LGDP has a *unit root* in first difference.	-29.55	0.000†
LRsales has a *unit root* in level.	-3.12	0.13
LRsales has a *unit root* in first difference.	-4.82	0.005†
LR_auto has a *unit root* in level.	-2.33	0.400
LR_auto has a *unit root* in first difference.	-2.89	0.066†††
B_3_real has a *unit root* in level.	-7.13	0.000†
B_6_real has a *unit root* in level.	-5.48	0.000†
B_12_real has a *unit root* in level.	-4.84	0.000†
Lreur_lek has a *unit root* in level.	-2.19	0.22
Lreur_lek has a *unit root* in first difference.	-5.18	0.002†
Idemand has a *unit root* in level.	-1.97	0.048
IDemand* has a *unit root* in level.	-7.82	0.000†
IProduction has a *unit root* in level.	-2.27	0.025††
IProduction* has a *unit root* in level.	-2.36	0.021††
IEmployment has a *unit root* in level.	-3.12	0.003†
CEcon has a *unit root* in level.	-4.029	0.000†
CDemand has a *unit root* in level.	-3.78	0.000†
CDemand* has a *unit root* in level.	-5.54	0.000†
CProduction has a *unit root* in level.	-6.29	0.000†
CProduction* has a *unit root* in level.	-5.34	0.000†
SDemand has a *unit root* in level.	-7.64	0.000†
SDemand* has a *unit root* in level.	-8.83	0.000†

† The Null Hypothesis is rejected with 99% confidence (α=1%); †† The Null Hypothesis is rejected with 95% confidence (α=5%);
††† The Null Hypothesis is rejected with 90% confidence (α=10%)

Table 6 Granger Causality Test

	1 lag		2 lags	
Null Hypothesis	F-stat	P-value	F-stat	P-value
LRsales does not Granger cause DLGDP	11.36	0.003†	9.24	0.002†
R_auto do not Granger cause DLGDP	6.97	0.02††	7.82	0.004†
En_ consum does not Granger cause DLGDP	1.20	0.29	6.01	0.011††
B_3_real does not Granger cause DLGDP	0.20	0.66	0.59	0.57
B_6_real does not Granger cause DLGDP	0.28	0.60	0.51	0.61
B_12_real does not Granger cause DLGDP	0.28	0.60	0.41	0.67
Dlreur_lek does not Granger cause DLGDP	0.16	0.69	0.64	0.54
Idemand does not Granger cause DLGDP	0.59	0.45	7.90	0.003†
Idemand* does not Granger cause DLGDP	31.52	0.000†	12.38	0.000†
Iproduction does not Granger cause DLGDP	0.64	0.43	4.86	0.02††
Iproduction* does not Granger cause DLGDP	37.34	0.000†	14.62	0.000†
Iemployment does not Granger cause DLGDP	1.43	0.24	10.43	0.001†
Cecon does not Granger cause DLGDP	0.092	0.76	2.68	0.095†††
Cdemand does not Granger cause DLGDP	1.63	0.22	6.39	0.008†
Cdemand* does not Granger cause DLGDP	31.15	0.000†	12.52	0.000†
Cproduction does not Granger cause DLGDP	3.98	0.06†††	7.40	0.005†
Cproduction* does not Granger cause DLGDP	28.15	0.000†	18.24	0.000†
Cemployment does not Granger cause DLGDP	0.10	0.76	6.93	0.006†
Sdemand does not Granger cause DLGDP	1.32	0.26	15.23	0.000†
Sdemand* does not Granger cause DLGDP	20.71	0.002†	12.87	0.003†

† The Null Hypothesis is rejected with 99% confidence (α=1%); †† The Null Hypothesis is rejected with 95% confidence (α=5%);
††† The Null Hypothesis is rejected with 90% confidence (α=10%)

APPENDIX C NOWCASTING EQUATIONS; DIAGNOSTIC TESTS

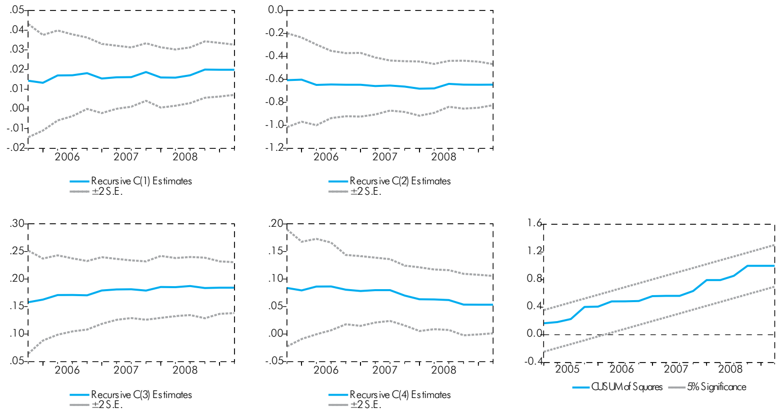
Table 7 Nowcasting Equations and Diagnostic Tests

Nowcasting equations listed according to table 1.	Serial LM correlation F p-value†	White HSK test F p-value†	Normality J-Bera p-value
Quantitative Indicators			
DLGDP= 0.02 - 0.65*DLGDP(-1) + 0.18*DLR_AUTO + 0.053*DLR_AUTO(-3)	0.5 0.62	1.09 0.25	1.08 0.58
DLGDP = 0.02 - 0.85*DLGDP(-1) - 0.41*DLGDP(-2)+ 0.2*DLSALES	0.37 0.70	0.88 0.57	0.45 0.79
Non-household Energy Consumption (en_consum)	1.96 0.15	0.90 0.43	1.89 0.39
Financial Indicators			
Real T-Bills' interest rates			
3-month (b_3)	Statistically insignificant; Low correlation; no Granger causality		
6-month (b_6)			
12-month (b_12)			
Real Euro/ALL exchange rate			
Qualitative Indicators			
DLGDP = 0.023 - 0.5*DLGDP-1) + 0.31*IDEMAND- 0.18*IDEMAND(-1)	0.08 0.92	1.27 0.33	0.06 0.96
DLGDP = -0.025 - 0.7*DLGDP(-1)+ 0.35*IDEMAND*(-1)	0.55 0.59	2.49 0.11	2.89 0.23
DLGDP = 0.025 - 0.48*DLGDP(-1) + 0.3*IPROD - 0.14*IPROD(-1)	0.17 0.85	1.95 0.13	0.67 0.71
DLGDP= -0.026 - 0.66*DLGDP(-1) + 0.36*IPROD*(-1)	0.77 0.48	1.6 0.22	2.95 0.23
DLGDP = 0.043 - 0.86*DLGDP(-1) + 0.32*IEMPL + 0.39*IEMPL(-4)	1.2 0.33	1.03 0.47	4.11 0.12
DLGDP = 0.048 - 0.7*DLGDP(-1) + 0.21*CECONT + 0.16*CECONT(-3)	2.2 0.14	0.73 0.68	1.7 0.4
DLGDP= 0.026- 0.61*DLGDP(-1) + 0.31*CDEMAND - 0.11*CDEMAND(-1)	0.89 0.83	1.66 0.19	0.58 0.75
DLGDP = -0.02 - 0.69*DLGDP(-1) + 0.33*CDEMAND*(-1)	0.36 0.7	0.73 0.61	1.9 0.38
DLGDP = 0.021 - 0.67*DLGDP(-1) + 0.29*CPROD - 0.12*CPROD(-1)	0.42 0.66	2.44 0.09	0.84 0.34
DLGDP = -0.017 - 0.69*DLGDP(-1) + 0.38*CPROD*(-1)	2.23 0.13	1.0 0.45	1.17 0.56
DLGDP = 0.044 - 0.86*DLGDP(-1) + 0.35*CEMPL + 0.25*CEMPL(-4)	1.6 0.23	0.78 0.64	0.9 0.64
DLGDP = 0.009 - 0.77*DLGDP(-1) + 0.27*SDEMAND	0.1 0.9	0.49 0.78	0.03 0.98
DLGDP = -0.007 - 0.75*DLGDP(-1)+ 0.23*SDEMAND*(-1)	2.15 0.14	1.56 0.22	1.18 0.55

† The Null Hypothesis of no serial correlation and no HSK is accepted at all levels of significance.

APPENDIX D COEFFICIENT STABILITY TESTS, ACTUAL FITTED GDP GRAPHS

Graph 3 Coefficient Stability Tests for the R_auto equation



Graph 4 Coefficient Stability Tests for the ACP equation

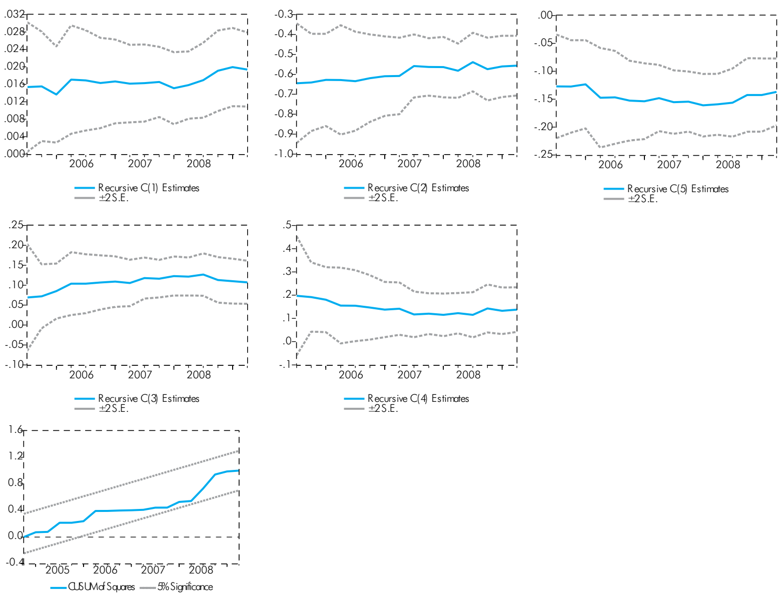
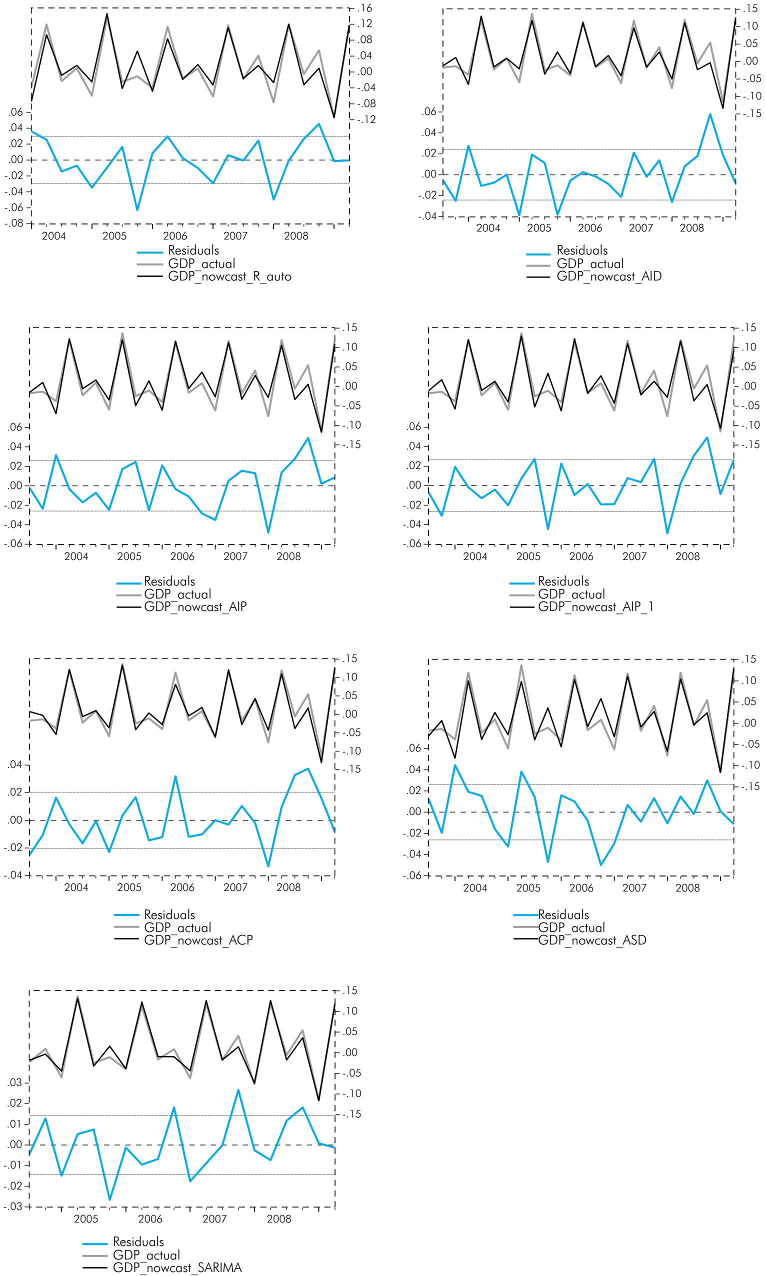


Figure 3 GDP_nowcast, GDP_actual, residuals



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