BANK OF ALBANIA

MODELLING THE QUARTERLY GDP - ROLE OF ECONOMIC AND SURVEYS INDICATORS-

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ABSTRACT

The quarterly GDP forecasting models developed in this material aim to estimate the Albanian GDP trends in the short term. . Delays until the publication of the official quarterly GDP data make indispensable the preliminary estimation of this indicator. The modelling strategy of the quarterly GDP consists in building a set of different models for its estimation. They consist on ARIMA models with seasonal components and indicator models, similar to bridge models. This paper presents a first attempt to model the GDP using a multiequations system which accounts for the sectoral interactions. This model can not be used for forecasting purposes because of short time series. The estimates were made for total and for disaggregated sectoral GDP for the period: Q1:2003 – Q1:2009. The models exploit information from economic variables, financial variables and confidence surveys indicators, held by the Bank of Albania. The bridge models estimates show that the past developments of economic and financial variables explain the GDP changes while the survey variables lead them. The above mentioned behaviour of the explanatory variables supports the forecasting process of the quarterly GDP. Thus the policy makers in the Bank of Albania are provided with a timely estimation (nowcast) of the economic activity tendency for the reference quarter and for the coming two quarters. In general, estimations from the developed models are promising. It is suggested that the "best" forecast will be considered the average of the forecasts from all the proposed models. The off-sample forecast performance, "will decide" the model with the best qualities in order to predict the quarterly GDP.

INTRODUCTION

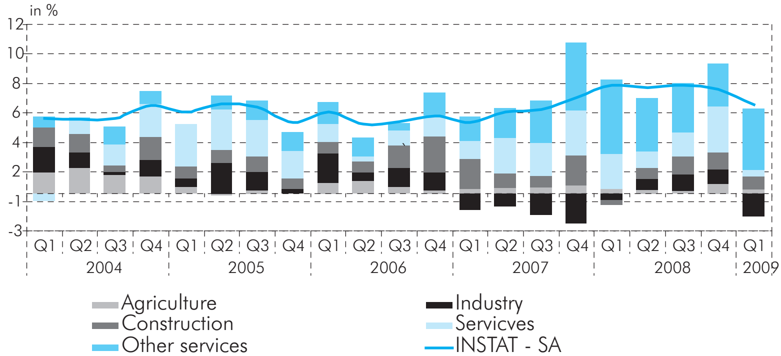
The quarterly GDP data are important for economic analyses, because it gives insight on the general economic activity, on the fluctuations of business cycle and on the economic turning points. The quarterly GDP is published by the national statistics agencies with different time lags after the reporting quarter. The progress of information systems in terms of quarterly GDP measurement process, aims to narrow them. Notwithstanding the developments in this field, the availability of preliminary estimations of GDP, even in short terms is a necessity for the decision-making process. Estimations are accomplished by constructing models which tend to explain quarter-on-quarter GDP changes, with the support of new economic information. The new information might be at monthly or quarterly frequency, might correspond to the current or subsequent period, might be quantitative data published by official statistical agencies or might be qualitative data generated from business and consumer confidence/sentiment surveys. The results obtained from the estimation of the quarterly GDP models, based on the most recent published information, serve as intermediate steps which guide the decision-makers and the market agents regarding the performance of the economic activity for the reference[1] and forthcoming quarter. The decision-making process in various central banks is broadly based on these estimations, notwithstanding the monetary policy regimes followed and the primary targets generated by them.

The path for the achievement and consolidation of short-term forecasting of quarterly GDP goes through the constructing of models that explain the GDP fluctuations as regards the historical tendency. This paper will introduce some models which explain the quarterly GDP tendency with the assistance of economic variables published by INSTAT and the indicators generated by the confidence surveys, held by the Bank of Albania.

I. MAIN TENDENCIES OF QUARTERLY GDP

The quarterly GDP for the Albanian economy during the period, Q1:2003-Q1:2009, is characterised by positive growing rates, which on average annual terms point to 5.8%. These positive growth rates have supported the macroeconomic stability consolidation of the country. For analysis purposes, GDP[2] data are grouped by dividing the economy into five main sectors: "agriculture, hunting and forestry"[3], "industry", "construction", "services" and "other services"[4]. Their respective shares to total GDP, in average, for the 6-year period point to: 20%; 10%; 14%; 31% and 25%. "Construction", "services" and "other services" sectors appear as the main contributors to the positive growth rates of GDP during the last years. The higher growth rates in these sectors provided an important contribution to the total national revenues. While the annual share of "agriculture" has followed a declining trend from year to year.

Chart 1 Annual sectoral share to GDP growth (in percentage points).



Source: INSTAT and authors' estimations

The average growth rates of GDP in annual and quarterly terms, show important differences among the economy sectors. Although the "other services" and "construction" sectors show notably higher average annual growth rates relative to the other sectors, they are accompanied by considerable volatilities for the respective period. "Industry" sector marked an annual average growth of about 4.8 % accompanied by a more emphasised fluctuation relative to the other sectors. On the other hand, "agriculture" has registered a lower annual average growth rate and lower variance expansion relative to the other sectors.

*Table 1 Time series statistics – annual changes (2004Q1-2009Q1)**

	Average	Median	Coefficient of variance[1]	Variance expansion[2]
GDP	5.8	5.2	0.25	5.1
Agriculture	2.9	2.9	0.77	7.3
Industry	4.8	7.1	2.46	40.3
Construction	7.8	6.9	0.53	19.0
Services	5.6	5.1	0.57	11.4
Other services	7.9	5.9	0.73	20.3

Source: Authors' estimations

* GDP – quarterly and sectoral, in annual growth rates.

[1] Ratio of standard deviation to the simple average.

[2] Spread between the maximum and minimum value of the annual growth rate for each sector.

The quarterly changes reflect a more pronounced fluctuation relative to the annual ones. "Other services" sector shows a higher average growth rate relative to the other sectors of the economy and a lower coefficient of variance. "Agriculture" sector shows lower average growth rates and a higher coefficient of variance than the other sectors. The later owes to the high positive values of this indicator during the second quarters, for the studied years.

*Table 2 Time series statistics – quarterly changes (2004Q1-2009Q1)**

	Average	Median	Variance coefficient[1]	Variance expansion[2]
GDP – Quarterly	1.3	-1.2	5.8	26.1
Agriculture	0.7	-1.0	34.8	65.0
Industry	0.4	2.4	23.5	46.5
Construction	1.7	7.0	7.4	45.1
Services	1.0	2.8	6.9	25.4
Other services	2.0	4.2	3.9	28.9

Source: Authors' estimations.

* GDP – quarterly and sectoral, on annual growth rates.

[1] Ratio of standard deviation against the average.

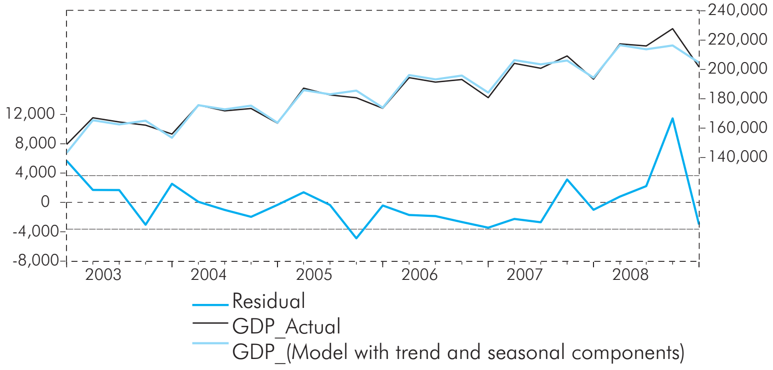
[2] Spread between maximum and minimum value of the annual growth rate for each sector.

The higher fluctuation is mainly explained by the presence of the seasonal factor, which impacts considerably the Albanian economic activity during certain periods of the year. Grasmann and Keereman (2001) suggest that the quarterly changes are more adequate to estimate the short-term developments of the economy. Frequently, depending on the calculation method, annual changes mirror a moving average of the four preceding quarters' changes.

Thus, they mostly reflect the economic conditions of the previous periods rather than the specific economic conditions of the latest quarter.

In the light of these considerations and from the descriptive statistics results, it is carried out a more detailed analysis of GDP time series and disaggregated by sectors. Based on the structure of the time series components, the quarterly GDP series is formed mainly from the trend component (GDP_ trend) and from the seasonal one. The cyclical component is not yet identified, as the length of quarterly GDP series is insufficient to detect the later. The residuals are distributed among the four quarters at an insignificant average rate for each of them.

Chart 2 Time series model results of the quarterly GDP

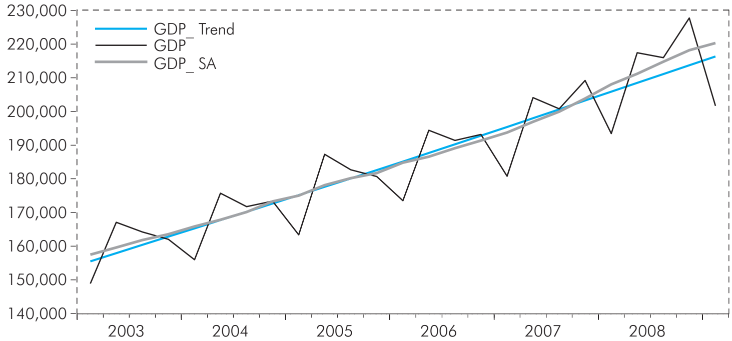


Source: INSTAT and authors' estimations

The most notable deviations[5] at positive and negative values, although at a lower degree, resulted in Q1:2003, Q4:2005 and in Q4:2008.

The GDP series shows a strong seasonal profile. The statistical importance of the seasonal factors, results higher in the first and the second quarters. The economic activity historically slows down and remains under the historical trend during the first quarters. During the second quarters, in general, it remains above the historical

Chart 3 Time series components of quarterly GDP



Source: INSTAT and authors' estimations

trend. The economic agents and annalists expect this seasonal behaviour to be repeated in years. Examining the total quarterly GDP behaviour, the seasonal factor whose value is statistically important lower than 1 belongs to the first quarter, while those higher than 1 belongs to the second quarter.

Table 3. The seasonal factor according to the multiplicative model

Quarters	Value of factor versus the trend
1	0.93
2	1.05
3	1.01
4	1.01
Total of seasonal factors	4.00

Source: Author's estimations.

Seasonal behaviour by sectors tends to identify their individual features. Seasonal factors on total GDP at a certain way result from a weighted average of GDPs by sectors.

The contraction of the economic activity during the first quarters is observed almost in all sectors, excluding "agriculture". Meanwhile, economic activity revitalization over the second quarters occurs only in "agriculture" and "industry", which is reflected on the developments of total GDP. The reason behind this behaviour is the fact that the industry activity is vitalized due to the conclusion of new businesses' contracts, which are usually completed and implemented after the first quarter. The significant increase of value added in "agriculture" during the second quarters is explained by the re-activation of agricultural activity in spring[6]. The economic activity in "services" sector flourishes considerably in the third quarter, owing to tourism season. "Other services" sector is affected by increasing government expenditures which tend to be concentrated during the last quarters in years.

*Tabele 4 Setoral sesonality significane**

Quarters	1	2	3	4
PBB – Total	-	+		
Agriculture		+		
Industry	-	+		
Construction	-			
Services	-		+	
Other services	-			+

Source: Authors' estimates

Note: *) A (+/-) sign shows the presence of the seasonal factor which is important in terms of statistics for each sector. The sign +/- shows the increasing/decreasing impact of seasonal factor on GDP by sectors according to the respective quarter.

The presence of the seasonal factor and the fact that the series do not appear stationary at level, but turn as such in the first differences are taken into account in modelling the quarterly changes of both total and disaggregated GDP by sectors[7].

II. ROLE OF VARIABLES IN MODELLING THE QUARTERLY GDP

Various estimating models of quarterly GDP are developed during the last decade, which aim to explore the factors affecting its trend. Their final goal is to provide forecasts at shorter term horizons than those accomplished through macro models, which have more strict requirements regarding the fulfilment of macroeconomic equilibrium conditions. The short term estimating models employ all the available economic information (monthly and quarterly) deriving from the system of official, economic, financial data and from confidence surveys. Distinguished researchers in the field of estimating the quarterly GDP (Sedillot *et. al*. 2003, Barhoumi *et. al*. 2008), categorise the economic data, which are measured and published as official statistics or "*hard data*". This name relates to the fact that these economic indicators are directly related to underlying components of GDP[8]. *Hard data* indicators are published according to the calendars as set out by the national statistical agencies and might be of monthly or quarterly frequency. These indicators might be subject of regular revisions.

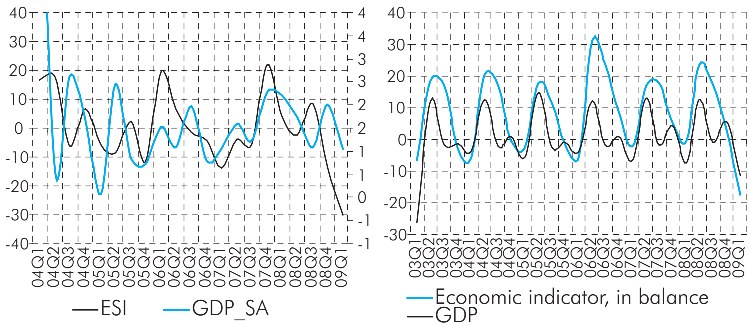
Surveys (confidence, sentiment, economy experts) and financial data are known as *"soft data"*. The survey indicators reflect the assessments of economic agents on the development of the economic activity in general and on specific aspects for the reference period, when no information on the GDP is available for that period. At the same time, the surveys' indicators provide information on the market agent's expectations of the future short-term developments of the economy. Notwithstanding the s*oft-data* indicators *are* not directly related with GDP components, they provide valuable information for explaining its behaviour, similar to the *hard-data* indicators[9].

The surveys' indicators used in this material result from the quantification of qualitative information acquired from business and consumer confidence surveys. Their usage in the explanatory and short-term GDP forecasting models is based on the assumption that the judgements and opinions of businesses shall be reflected on concrete actions with economic consequences. Thus, the ability of surveys' indicators to assess the economic activity depends on the degree that these opinions will be reflected in concrete actions (Santero and Westerlund, 1996).

The advantages of using survey indicators in the short-term GDP forecast models consist on the fact that: (i) they provide preliminary signals that are obtained directly from the economic agents regarding the short-term evolution of their activity; (ii) they are published in advance of the main macroeconomic aggregates or the hard data indicators; (iii) the results are subject only to minor revisions (Darne, 2008). The experience of European developed economies has shown that these indicators are broadly used to forecast short-term GDP owing to the available timely economic information.

Based on this experience and using the variables build from businesses survey results, there are built models explaining the short-term fluctuations of quarterly GDP by combining the use of *hard* with *soft data*[10]. The survey based indicators signal at a relative satisfactory level the fluctuation of certain indicators of the real economy. Thus, the survey based indicators contribute in *nowcasting* and in short-term forecasting of GDP (up to two consecutive quarters).

Chart 4 Quarterly changes of GDP and of surveys indicators*



Source: INSTAT, Bank o Albania and authors' estimates
Note: * ESI - Economic Sentiment Indicator (BoA) and EI -the aggregated balances indicator out of surveys, constructed for the purposes of this study.

Qualitative survey indicators usually explain the developments in the total and sectoral GDP by leading with a quarter. Past values of hard data explain the current GDP developments entering the equation with different lags, contributing thus in the process of GDP forecast.

The estimates of the value added (GDP) quarterly changes are carried out for the economy as a whole and for the five constituent sectors. The disaggregating of GDP by sectors provides more detailed information for the main economic activities developments and their contribution on total GDP for a short-term period. At the end of this process, prior information is obtained on what is occurring in the economy and what is expected to happen. These are frequently known as preliminary estimates about the economic growth.

As explained above, these models can assess current and close future tendencies of the economic activity. The advantages of these models, compared to those constructed based on the historical behaviour of GDP, consists in the economic explanation of the linear combination of the best correlated confidence indicators to real GDP developments, contributing to the short-term forecast.

III. MODELLING STRATEGY

The building process of econometric models for short-term modelling of quarterly GDP in this paper has taken in consideration the theoretical and practical arguments concerning the inclusion of various variables and their role in forecasting[11]. The modelling experience shows that the estimation and forecast process should be based on a set of models rather than on a single one. The constructed models for estimating the quarterly GDP consist in:

- a set of ARIMA models;
- a set of indicator models or "bridge" equations;
- a system of equations estimated through SUR method[12].

The first set of models describes the historical development of total and sectoral GDP via ARIMA processes[13], combined with the seasonal information. The results from ARIMA models are frequently used as a benchmark for the other GDP forecasting models.

This set of models includes:

- a total GDP estimating model by ARIMA process ;
- a GDP estimating model as a sum of sectoral GDPs. The GDP for each sector is modelled by a separate ARIMA process.

The second set of models is closer to the structural models and will be referred as indicator models in the following. According to Sedillot and Pain (2003), these models try to explain the quarterly fluctuations of GDP (total and sectoral) with the support of hard and soft data along with the inertia terms and the seasonal factors. In the case of Albania, it isn't constructed a linear multivariable model that can explain the economic growth with the above mentioned depended variables. The explanatory variables, in general, are available during the quarter when an assessment should be carried out regarding the development of total and sectoral economic activity. They might be at monthly or quarterly frequencies. Some of them, at major part linear combinations of confidence indicators resulting from surveys, contain current and leading information[14]. As such they contain information on both the reference and the consecutive quarters. This quality allows estimating the GDP even for 1-2 subsequent quarters to the reference quarter. In this aspect, these models are similar to bridge models, but not exactly the same. The bridge models[15] "bridge" the lower frequency data with the higher frequency data. These models "imitate" the stages of GDP compilation and revision based on the national accounts methodology, but at an advance up to 2 quarters ahead to the one when the GDP is published.

The second set includes these models:

- Total GDP estimating model, represented by an equation including economic indicators (*hard data*), surveys indicators and financial indicators (*soft data)* as explanatory variables;
- Total GDP estimating model as a sum of sectoral estimates. It is designed an estimating model for each of the sectors. Sectoral GDP are explained by equations containing economic variables (*hard data*), surveys indicators and financial indicators (*soft data*);
- Total seasonally adjusted GDP estimating model. In this case the explanatory equation incorporates information from the historical developments of GDP and from the Economic Sentiment Indicator (ESI). ESI results from the confidence surveys and is seasonally adjusted.

Box:

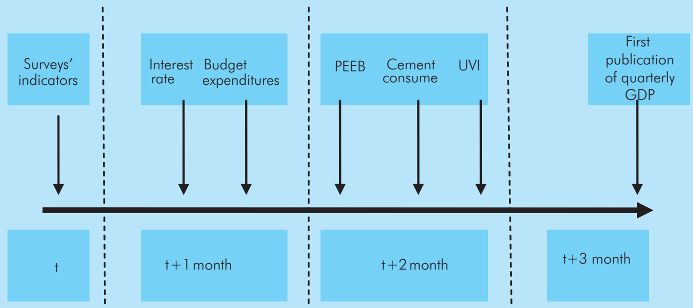
Quarterly GDP forecasting in bridge models depending on the available data

The indicator models developed in this material make use of the short-term signals from monthly variables. They estimate the GDP for the reference quarter and for the succeeding quarter. The reference quarter (t) is the one for which no official GDP data is published from INSTAT. Thus, it does not coincide with the current calendar quarter, but it might be the previous one. The succeeding quarter (t+1) (successive to the reference quarter) might coincide with the current calendar quarter. The purpose of the GDP estimation models in this material is to forecast the GDP for the reference quarter and for the successive one, without making any assumption on the explanatory variables. This process otherwise is known as 'nowcasting'. It doesn't represent a classic forecast, but mostly an estimation regarding the level of indicators in the previous and current quarter.

In the case of a variable being available only during the first or second month of the reference quarter or current quarter, simple extrapolation methods are applied to populate the quarterly series. The literature on bridge equations which are used to nowcast the quarterly GDP suggests the construction of auxiliary equations to lengthen the data series with monthly frequency. Simple extrapolation methods are applied in this material; while in special cases auxiliary equations are build to lengthen the series of explanatory variables up to two forthcoming quarters through ARIMA processes (Golinelli and Parigi, 2004).

The quarterly changes of GDP might be projected for one or two succeeding quarters from the reference one by exploiting the same equations. These estimates are reviewed during the coincident quarter and are updated with the information from the monthly explanatory variables. The models built for estimating the quarterly growth of Albania GDP, are linear regressions which contain quarterly and monthly explanatory variables. The later are aggregated into indicators of quarterly frequency (inters rate of credit denominated in EUR, real effective exchange rate, the produced electric energy, etc). The following figure explains schematically the forecasting horizon depending on data *availability during the months of the reference quarter and that after the reference quarter (t).*

Figure 1 From quarter (t) to the first release of the quarterly GDP



Note :*) The seasonally adjusted GDP data are published at the official website of INSTAT and are available for use 90 days after the reference quarter.

The third model is a multi equations system assessed under the techniques suggested from SUV[16] (Mourougane and Roma, 2002). This approach considers the inter-sectoral relationships and explains the sectoral GDP developments by their respective past fluctuations, by the seasonal effects and by the past developments in the other sectors, which are economically related with the respective sector. Appendix D deals with this model and its estimate results. Short time series still do not allow the inclusion of other exogenous variables to assess the model. Thus, the results of this model are excluded from the comparative analysis of models' results, provided in part V.

Variables at different lags are used for the specification of the models described above. In any case, the lags by which the explanatory variables impact both the quarterly total and sectoral GDP are determined by using the AIC and SC criteria and the findings derived from the tests about variables stability[17].

The final goal of the multiple model construction strategy is to inform the decision-makers on the estimated tendency of the future economic activity in general and by the main sectors. The final outcome is a mixture of all the models' results in use. The outcome might be an interval around an average value or a simple average of GDP growth rates for the reference and expected quarter.

III.1 ESTIMATION HORIZON

The time series of quarterly GDP is available for the period from the first quarter of 2003 to the first quarter of 2009. This fact restricts the assessment period of models, notwithstanding the explanatory variables are available for a longer period of time. Given the fact that the estimations of the presented models in this material include only 25 observations, the short time horizon requires continuous monitoring of the estimated models. Other reason to review the GDP estimated models is that during the 6-years period the economy has manifested an upward stable trend, still failing to identify a full business cycle, but volatilities as mini cycles. As argued in part 2 of this material, GDP series are taken as quarterly changes and seasonal factors are considered.

III.2 DEPENDENT VARIABLE

The dependent variable is the quarterly change of the real total GDP at basic prices – total and by sectors (INSTAT).

III.3 THE SELECTION OF EXPLANATORY VARIABLES

In the selection process of the pool of possible variables to include it was judged on their potential economic correlations with the dependent variable. This process was mainly based on the continuous analysis of the direct and indirect indicators, which provide information about the developments on the supply and demand side in the domestic economy. The models were specified with the general to specific modelling approach. This form occurs frequently in specifying the bridge-indicator equations as well as in cases when a history of the dependent variable modelling does not exist, in this case for the Albanian GDP. A significant number of variables were employed in the selection process and different lags were applied on them. The economic and financial variables which failed to follow the direction of relations according to the economic theory and logic were eliminated, also those variables that resulted statistically unimportant. Such as: remittances, foreign direct investments, imports, exports, share of re-exports, machineries and equipment imports, credit interest rates (denominated in ALL), the key interest rate, T-bills yields by maturities, monetary aggregates, capital budget expenditures, GDP of Euro zone countries, etc.

The selection strategy of variables for building the indicator models aimed the inclusion of the information which is disclosed or made available ahead to the official release of quarterly GDP. Thus, the sales index in economy and the turnover index that are frequently used to estimate GDP and which have showed a strong correlation with the quarterly GDP changes, were not considered in modelling, as they are published after the GDP and have quarterly frequencies. On this way, they do not provide any advantages to the preliminary estimation and to the economic activity forecasting. As explained above, the economic explanatory variables were combined with surveys variables and with financial ones.

The overall selection process of explanatory variables considered the fulfilment of the three preconditions that explanatory variables must meet in the bridge models (Golinelli and Parigi, 2004). According to these authors, the selected indicators firstly should be made available ahead to the publication of the quarterly GDP. Secondly, they must be reliable. This implies that the indicators should not be subject of revisions, at least not at a high degree. Finally, indicators should be correlated to the dependent variable, notwithstanding the later does not necessarily implies the identification of a structural correlation between the indicators and GDP. The relationship between the selected variables with the dependent variable implies either the existence of their direct connection with GDP or with its components, or the presence of an indirect economic impact that indicators might have on GDP (for example, the impact of financial indicators on GDP). The variables employed in the quarterly GDP forecast model in general respect the above stated preconditions[18].

Economic variables

- Government expenditures (Ministry of Finance).
- Construction permissions for residential and business purposes, in value (INSTAT).
- Cement consumption (INSTAT).
- Electrical power production, in MWh (KESH).
- Unit value index, for total imports (INSTAT).

Variables from surveys

Variables from surveys are based on indicators constructed from qualitative surveys developed by the Bank of Albania with businesses and consumers.

ESI, the Economic Sentiment Indicator aggregates in a single indicator the opinions of the main market agents[19]. They are collected from the confidence surveys for the industry, construction and services sector and for the consumers. ESI is constructed on 13 seasonally adjusted balances[20].

EI, II, CI, SI, represent indicators constructed for the purposes of this modelling process[21]. They symbolise respectively: the survey indicator for the economy, the survey indicator for industry sector, the survey indicator for construction sector; the survey indicator for services sector. The size of correlation coefficient among them and the quarterly changes of total and sectoral GDP was the selective criteria of individual balances (not seasonality adjusted), as suggested at Çeliku and Shtylla, 2007. The original balances with correlation coefficient higher than 0.45 were selected out of this process. EI, II, CI, SI were calculated as a simple arithmetic average of these original balances. Individual balances selected as provided above for the studied years have resulted with an average of internal consistency coefficient in line with Cronbauchut test *(Alpha)*, from 0.53 – 0.68. Values stimulate the avoidance of multicolinearity phenomenon among them by establishing a sole indicator (Litwin, 1995). If individual balances would be included simultaneously into indicator models, multicolinearity would have been present at a significant level and thus deforming the information on their real explanatory level.

Although some of these balances are not included in the confidence indicators construction, they resulted valuable in improving the forecasting availability of the new built indicators by meeting one of the essential conditions of variables selective process in models.

Concretely:

- EI, summarises some balances from surveys in industry, construction and services sector in a sole indicator. EI results from a simple arithmetic average of 13 balances out the three main economy sectors (industry, construction and services). Out of which, 5 represent balances of answers to questions which assesses aspects of current quarter in which the survey takes place and 8 balances represent business expectations from the survey of previous quarter which explain the current quarter developments.
- II, resulted from the simple arithmetic average of 4 balances of expectations from the industry survey. As regards to its construction, it identifies more quickly the future tendency of industrial activity.
- CI, resulted from the simple arithmetic average of 7 balances from construction sector survey. This indicator combines confidence indicators for the current quarter and the expected one and thus provides an indicator that can lead with a quarter.
- SI: resulted from the simple arithmetic average of 3 balances on expectations from the services sector survey. As such, it is adequate to estimate the short –term tendency in services activity.
- CCI: confidence indicator from consumer survey which characterises the consumers' tendency to carry out large purchases or goods of long-term use, in the future. This variable competes in explaining the volatility of the economic activity in

the services sector. It represents an indirect indicator to judge on the trading activity, which accounts for a considerable share in services sector. It confirms simultaneously the future performance of a part of (consuming) demand in economy.

Financial variables

- Interest rate on loans denominated in EURO[22] (Bank of Albania);

Other variables

- AR and MA terms of different ranks;
- Seasonal factors;
- Trend component.

Variables are not seasonally adjusted, excluding the economic sentiment indicator, which is seasonally adjusted and used to explain the quarterly seasonally adjusted GDP changes[23].

III.4. PRELIMINARY TESTS

Variables are tested for stationarity (ADF–test) and the direction of causality in time (*Granger Causality Test)*[24]. After the first step of modelling it came out that survey indicator improve the explanatory abilities of the models.

IV. RESULTS OF MODELS' ESTIMATION

This section will present the basic results of the estimated models and some explanations of their economic characteristics. Appendix C provides the most detailed statistics of assessing each model and the results of some basic tests on models quality.

IV.1. ARIMA MODELS

ARIMA – Total GDP

The estimated equation of the quarterly changes of real GDP by

ARIMA process and the seasonal factors is as following:

$$DLog(GDP_t) = 0.013 - 0.72*AR(2) - 0.97*[MA=e_{t-1}] - 0.10 * Seas(1) + 0.11*Seas(2) \quad (1)$$

The combination of the autoregressive processes and the moving average processes with seasonal factors provides a relatively sufficient explanation of the quarterly GDP volatilities.

ARIMA – GDP by sectors

In the following there are presented the estimated equations of real GDP quarterly changes of 5 sectors, by ARIMA processes combined with seasonal factors:

a. $DLog(GDP\_Agriculture_t) = -0.06 - 0.98*AR(2) + 0.87*[MA=e_{t-2}] + 0.28*Seas(2)$ (2.a)

b. $DLog(GDP\_Industry_t) = -0.002+0.49*AR(1)-0.88*[MA=e_{t-4}]–0.12*Seas(1)+ 0.08*Seas(2)$ (2.b)

c. $DLog(GDP\_Construction_t) =0.11+0.57*AR(4)-0.96*[MA=e_{t-1}]-0.35*Seas(1)$ (2.c)

d. $DLog(GDP\_Services_t)=0.03-0.60*AR(2)-0.93*[(MA=e_{t-1})]- 0.13*Seas(1)+0.07*Seas(3)$ (2.d)

e. $DLog(GDP\_Other\ services_t)=0.04+0.71*[(MA=e_{t-4})]- 0.13*Seas(1)+0.07*Seas(4)$ (2.e)

The historical behaviour of quarterly GDP fluctuations by sectors is set out almost by the autoregressive factors, moving average (MA) and the seasonal factors. The assessment by sectors individualises the influence direction of the seasonal factors and their quantitative impact on the quarterly change of GDP for each sector.

IV.2 INDICATOR MODELS

Total GDP

The constructed equation for estimating the total GDP combines the information from the chosen economic indicators that resulted important for the short-term forecast, with the historical behaviour of GDP. The model of total quarterly GDP, assessed through the *OLS*[25] method results as the following:

$$DLog(GDP_t)=0.02+0.002*(EI_t)+0.07*DLog(PEV_{t-2})–0.29*DLog(UVI_{t-3})–0.72*DLog(GDP_{t-1})-0.05*Seas(1) \quad (3)$$

All indicators of the estimated equation meet the preconditions for the explanatory variables in an indicator-bridge equation. They are published ahead to the quarterly GDP, are not revised after the publication and are related to the dependent variable in economic terms. These characteristics make possible to nowcast the quarterly GDP for the reference quarter (t) and for the succeeding one (t+1). The surveys' variable is available for the reference quarter (t) and for the succeeding one (t+1). The produced energy variable (PEV) is fully available only for the quarter t and for the first month of the subsequent quarter. The Unit Value Index for imports (UVI) is available only for quarter t, but, because of the three quarters lags through which this variable explains GDP, it makes possible to forecast without the need of making any assumption.

PEV precedes by two quarters the developments in the quarterly GDP and EI is connected with GDP simultaneously. The increase of electric power production by 1% and the improvement of the surveys variable by 1 percentage point have a positive impact on quarterly GDP by 0.07% (after two quarters) and by 0.002 %, respectively. The increase of UVI in quarter 't' by 1% would affect the further rise of raw materials costs for businesses, being reflected into a tightening and fall of production rates at about 0.29%, after three quarters.

Sectoral GDP

The sectoral GDP modelling is based on ARIMA models enriched with economic and surveys variables. The ARIMA form is preserved only for the "agriculture" sector owing to the lack of economic data which might explain the developments in this sector. Even in those cases when these data are available, their frequency is annual, thus being worthless for the estimation process and for the short-term forecast of this sector GDP.

The models which explain the short-term developments of the quarterly sectoral GDP by including also in the assessing process economic and surveys variables are as follows:

a. $DLog(GDP\_Agriculture_{t}) = -0.06 - 0.98*AR(2) + 0.87*[MA=e_{t-2}] + 0.28*Seas(2)$ – ARIMA (4.a)

b. $DLog(PGDP\_Industry_{t}) = -0.03-0.51*DLog(GDP\_Industry_{t-4})+0.11*Seas(4) - 0.004*Trend + 0.01*(TI_{t-1}) - 0.68*DLog(IR\_KREDI\_EU_{t-2})$. (4.b)

c. $DLog(GDP\_Construction_{t})=-0.06+0.13*Seas(4)+0.008*(TN_{t-1})+0.08*DLog(Cons\_cement_{t-2})+ +0.04*DLog(Permission\_construction_{t-4})$ (4.c)

d. $DLog(GDP\_Services_{t})=0.15-0.12*Seas(1)+0.86*[MA=e_{t-4}]+0.003*(TBM_{t-1})+0.002*(SI_{t-1})$ (4.d)

f. $DLog(GDP\_Other services) = -0.02 + 0.71*[(MA=et-4)] - 0.12*Seas(1) + 0.15*Seas(2) + 0.04*Seas(4) + 0.14*DLog(Gov\_Expend_{t-4})$. (4.e)

The estimate’s outcomes of indicator models for each sector show that economic indicators, part of *hard* and *soft data,* improve the explanatory power of the models. The indicator models perform better than the ARIMA models. The previous quarters volatilities of some *hard* variables, are reflected in the subsequent developments of GDPs, while *soft variables* have a ’signalling’ nature.

The increase of the cement consumption and the construction permissions by 1% in a given quarter, would impact the increase of construction value added by 0.08% after 2 quarters and 0.04 % after 4 quarters, respectively. The rise by 1% of budget expenditures might impose the same impact on the GDP rates of other services sector. The later would increase averagely by 0.14% after 4 quarters.

The advantage of survey data, combined for individual sectors, which consist on the signalling of short-term sectoral GDP developments for the reference quarter and the successive one, is supported also by the results of the estimations. The positive signs of parameters show that signals operate in the same direction with GDPs future fluctuations. The upsurges by 1 percentage point of indicators combined in equations (4.b, 4.c and 4.d), shall be reflected on a growth of the respective GDPs in the succeeding quarter by 0.011%, 0.008% and 0.002% respectively, and by sectors described by these equations. The survey indicator of consumer confidence (CCI), on gross purchases (for goods of long-term use) is an original balance, which assists the explanation of GDP fluctuations of the services sector thus contributing in the forecast of a part of the demand in the economy. An increase by 1 percentage point of this indicator is expected to cause an increase in the respective GDP on average by 0.003% in the subsequent quarter. This coefficient along with the one close to SI, lead to the total value yielding from surveys' indicators in explaining GDP fluctuation occurring in "service" sector points to about 0.005%, comparative to the indicators rates in the other indicator equations by sectors.

The financial indicator, which resulted as a good explanatory variable of "industry" GDP, is the average interest rate of loans denominated in EURO. An increase of this indicator by 1%, would affect the average fall of the industry sector's economic activity by 0.68% after 2 quarters, owing to the increase of financial intermediation costs denominated in EURO.

After the overall estimation of indicator models, , the coefficients of the new constructed confidence indicators have rather low values. This phenomenon is particularly frequent and well explained in the respective literature, because of the way the confidence indicators are constructed from the respective balances[26]. The value added of these indicators is the preliminary signalling of the turning points on total and sectoral GDP in short-terms.

Total seasonally adjusted GDP

The following model explains the quarterly changes of seasonality adjusted GDP by exploiting the information derived from the economic sentiment indicator (ESI). ESI is obtained more quickly than the quarterly GDP and it is found to be useful to asses the economic activity[27]. As Mourouganne (2002) states, ESI is likely to be a broader measure of economic activity, compared to the other confidence indicators, therefore it is more closely linked to the dynamics of GDP and its mini-cycles. Correlation analysis and causality tests reveal that ESI might be used to explain short-term volatilities of seasonally adjusted GDP.

The equation explains the quarterly seasonally adjusted GDP through its historically quarterly changes, and by the changes of two delayed quarters of ESI. The features of this model[28] are comparable to those of model (3). Equation 5 may be used to *nowcast* the GDP for the quarter on which no prior publication has taken place yet, without the need of making assumptions regarding the explanatory variable (ESI). The seasonally adjusted quarterly GDP model is specified as a linear equation, as the following:

$$DLog\ (GDP\_SA)_t = 0.02 + 0.03*Dlog(ESI_t) - 0.39Dlog(GDP\_SA_{t-1}) \quad (5)$$

where GDP_SA – shows the seasonally adjusted GDP series

V. OVERVIEW OF THE RESULTS

The estimation results and the main diagnostic tests outcomes of the models (Appendix C) indicate that they are in general well specified. Given that, they are available to explain short-term fluctuations of total and sectoral GDP in terms of quarterly changes.

In indicator models (3 and 4), it is noted that the variables from surveys are characterized by regression coefficients at relatively low values, compared to those of other explanatory variables. The way the survey indicators are measured[29], is one of the main reasons which explains the low values of the coefficients. Researchers of this field have analysed this phenomenon, which in addition to the above stated reason, identify also the presence at some degree of the collinearity among the quantitative variables and those of confidence surveys. In particular, Golinelli and Parigi (2004), explain that multy-collinearity is frequently unavoidable in indicator models, as the information from surveys indicators is similar to that expressed by the other quantitative variables. Notwithstanding this issue, the researchers have chosen to include the surveys variables in the bridge models, owing to their advantages in terms of time-availability and economic meaning. In the case of indicator models developed in this material, the multicolinearity rate does not appear significant, mainly due to the low number of explanatory variables.

'RMSE'[30] and "Direction identification" are the indicators which provide additional information to asses ahead the forecasting abilities of the models. These indicators are calculated in-sample, owing to the lack of longer time series. Their results are provided in the following table:

Table 6. RMSE and the percentage of finding the right direction of GDP quarterly changes.

Models	RMSE	Direction identification (in %)
1	0.019	91
2	0.036	93
3	0.015	95
4	0.035	95
5	0.005	91

Source: Authors' estimates

RMSEs values suggest that the seasonally adjusted GDP model (model 5) is the one with the smallest forecast error (model 5). But it succeeds in capturing correctly only 91% of the direction of change in GDP quarterly rates. The estimations models of sectoral GDP (2 and 4) result with the highest indicator of finding the direction.

The results of tests about models qualities (Appendix C) and those of the forecasting abilities within the period (in-sample) are mixed. This makes difficult the selection of the most appropriate model for the forecasting purpose. Currently all models are considered as promising for the forecast of the quarterly GDP. The literature suggests that "the best" forecast is the one which combines the information of all forecasts into an average value. The extension of time series will test for the forecasting abilities of models out of the sample and their stability in time. The analysis of their forecasting performance in time will make possible to select the model with the best qualities.

Current results emphasize the fact that the models constructed in the form of bridge-indicator equations are constructive if used for short-term time horizons, from one to two quarters.

CONCLUSIONS

Estimating the economic activity for short-term periods is necessary, as the publication of official statistics for the quarterly and annual GDP is accomplished at different lags. The development in the collection and elaboration process of information aim to narrow the time span not covered with data regarding the economic activity. The intensive efforts in this field are encouraged by the increasing demand of agents, decisionmakers and policymakers to get timely information regarding the developments occurring in the economy. The construction of quarterly GDP models for estimation and short-term forecasting purposes has been a successful experience by directly assisting the decision-making process of central banks as well.

The literature suggests forecasting models from the simple one to the more complex. The academic debate on selecting among them remains open depending on the economic condition and statistics development of a country. Models aim to identify in time the GDP volatilities and the turning points of the economic cycle, by using a considerable number of explanatory variables. The indicators from the consumer and business confidence surveys share a particular value in this view. Their distinguished features to signal the performance of the economic activity at a close future and the quicker availability in time relative to official statistics, augments the value of their exploitation in the short-term forecast models of GDP.

This material presents 6 models, estimated through General to Specific method for the period 2003:Q1 – 2009:Q1. Models vary from ARIMA models with seasonal components, to the bridge-indicator ones. A system of linear simultaneous equations, tend to explain total GDP developments through the development of each constituent sector and their correlations.

Two basic approaches are followed in the assessment: by total and by sectoral GDP. The first provides information about the short-run tendency of the economic activity; the second approach provides a preliminary estimation of the expected contribution of sectors on the overall economic activity or on the total GDP. The quarterly total and sectoral GDP is modelled based on the seasonality unadjusted series in 5 models, and the total seasonally adjusted GDP series is estimated in one of them.

The estimation results show that models have good statistical qualities. The estimation of the best model or models remains a debatable issue. Two are the main reasons behind this judgement: firstly, the estimates have been conducted for a relatively short period; secondly, the forecast examinations are focused on the approaching degree of real values to the theoretical ones within the period (in-sample). Studying the forecast performance out of the sample period in the future would assist to identify the model or models with higher forecasting power.

The forecasting qualities within the sample reveal that while some models perform better in terms of explanatory power, based on the RMSE results and the coefficient of determination, others are better at finding the direction (increase/decrease) of change of the quarterly rates.

At the conclusion it would be suggested the following:

- Maintain and develop all models with the aim of further improvement;
- Consider the average of forecasts from various models as the "best" forecast. The forecasting performance out of sample would be the one playing a weighting role in selecting the best models in the average forecasting calculation;
- Bridge indicator models to be used in the short-term forecasting.

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APPENDIX A

Variable	Description	Frequency	Source
GDP	Gross Domestic Product	Quarterly	INSTAT
Budg - expenses	Governmental expenditures	Monthly	Ministry of Finance
Permss_constrc	Construction permission for housing and business purposes, at value	Quarterly	INSTAT
Cons_cement	Cement Consumption	Quarterly	INSTAT
PEV	Electrical Power Production	Quarterly	KESH
ESI	Economic Sentiment Indicator	Quarterly	Bank of Albania
EI[1)]	Survey indicator for the economy	Quarterly	Bank of Albania
II[2)]	Survey indicator for industry sector	Quarterly	Bank of Albania
CI[3)]	Survey indicator for construction sector	Quarterly	Bank of Albania
SI[4)]	Survey indicator for services sector	Quarterly	Bank of Albania
CCI	Consumer survey indicator, huge purchases	Quarterly	Bank of Albania
IR_CREDIT_EUR	Credit interest rate denominated in EUR	Monthly	Bank of Albania
UVI	Aggregated index of the value per unit, for imports in total	Quarterly	Bank of Albania

Explanatory notes:

1) EI is the simple arithmetic average of these balances: the assessment and expectations for the business situation in industry, the assessment and expectations for the domestic demand in industry, expectations for exports in industry and expectations for the industrial production; expectations for the situation of business in construction, expectations for the demand in construction and the expectations for production in constructions; assessment and expectations for the business situation in services, assessment of the demand and the situation of services employment.
2) II is the simple arithmetic average of 4 surveys balances of industry sector: expectations for the demand; expectations for the performance of company business; expectations for the industrial exports; expectations for the production.
3) CI results as a simple arithmetic average of 7 surveys balance of construction sector: current demand, current performance of company; current production; expectations for the demand; expectations on the company development; expectations for the demand; expectations on the company performance; production expectations; company financial position.
4) SI is the simple arithmetic average of 3 surveys balances of services sector: expectations for the demand; expectations on the company performance; expectations on the employment in the sector.

APPENDIX B

Null Hypothesis: "GDP" has a unit root			
Exogenous: Constant			
Lag Length: 3 (Automatic based on SIC, MAXLAG=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		2.969276	1.0000
Test critical values:	1% level	-3.78803	
	5% level	-3.01236	
	10% level	-2.64612	
*MacKinnon (1996) one-sided p-values.			
Null Hypothesis: D("GDP") has a unit root			
Exogenous: Constant			
Lag Length: 2 (Automatic based on SIC, MAXLAG=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-22.2608	0.0000
Test critical values:	1% level	-3.78803	
	5% level	-3.01236	
	10% level	-2.64612	
*MacKinnon (1996) one-sided p-values.			
Null Hypothesis: D("GDP",2) has a unit root			
Exogenous: Constant			
Lag Length: 4 (Automatic based on SIC, MAXLAG=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.80046	0.0015
Test critical values:	1% level	-3.85739	
	5% level	-3.04039	
	10% level	-2.66055	
*MacKinnon (1996) one-sided p-values.			
Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 18			

Null Hypothesis: "Agriculture" has a unit root			
Exogenous: Constant			
Lag Length: 4 (Automatic based on SIC, MAXLAG=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.09618	0.6961
Test critical values:	1% level	-3.80855	
	5% level	-3.02069	
	10% level	-2.65041	
*MacKinnon (1996) one-sided p-values.			
Null Hypothesis: D("Agriculture") has a unit root			
Exogenous: Constant			
Lag Length: 2 (Automatic based on SIC, MAXLAG=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-58.5642	0.00000
Test critical values:	1% level	-3.78803	
	5% level	-3.01236	
	10% level	-2.64612	
*MacKinnon (1996) one-sided p-values.			

Null Hypothesis: “Industry” has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic based on SIC, MAXLAG=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.71128	0.0868
Test critical values:	1% level	-3.73785	
	5% level	-2.99188	
	10% level	-2.63554	
*MacKinnon (1996) one-sided p-values.			
Null Hypothesis: D(“Industry”) has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic based on SIC, MAXLAG=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.39869	0.0023
Test critical values:	1% level	-3.75295	
	5% level	-2.99806	
	10% level	-2.63875	
*MacKinnon (1996) one-sided p-values.			

Null Hypothesis: “Construction” has a unit root			
Exogenous: Constant			
Lag Length: 3 (Automatic based on SIC, MAXLAG=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.329545	0.9741
Test critical values:	1% level	-3.78803	
	5% level	-3.01236	
	10% level	-2.64612	
*MacKinnon (1996) one-sided p-values.			
Null Hypothesis: D(“Construction”) has a unit root			
Exogenous: Constant			
Lag Length: 2 (Automatic based on SIC, MAXLAG=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-19.3245	0.00000
Test critical values:	1% level	-3.78803	
	5% level	-3.01236	
	10% level	-2.64612	
*MacKinnon (1996) one-sided p-values.			

Null Hypothesis: “Services” has a unit root			
Exogenous: Constant			
Lag Length: 4 (Automatic based on SIC, MAXLAG=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.35349	0.8998
Test critical values:	1% level	-3.80855	
	5% level	-3.02069	
	10% level	-2.65041	
*MacKinnon (1996) one-sided p-values.			
Null Hypothesis: D(“Services”) has a unit root			
Exogenous: Constant			
Lag Length: 3 (Automatic based on SIC, MAXLAG=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.02467	0.0496
Test critical values:	1% level	-3.80855	
	5% level	-3.02069	
	10% level	-2.65041	
*MacKinnon (1996) one-sided p-values.			

Null Hypothesis: "Other services" has a unit root			
Exogenous: Constant			
Lag Length: 4 (Automatic based on SIC, MAXLAG=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.143638	0.9964
Test critical values:	1% level	-3.80855	
	5% level	-3.02069	
	10% level	-2.65041	
*MacKinnon (1996) one-sided p-values.			
Null Hypothesis: D("Other services") has a unit root			
Exogenous: Constant			
Lag Length: 3 (Automatic based on SIC, MAXLAG=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.72593	0.00000
Test critical values:	1% level	-3.80855	
	5% level	-3.02069	
	10% level	-2.65041	
*MacKinnon (1996) one-sided p-values.			

APPENDIX C

MODEL 1

ARIMA structure of total GDP model with the involvement of seasonal components

Model for the quarterly GDP

Subordinated variable	Dlog(GDP_Total)	
Explanatory variables	Regression coefficient	t-stat
@SEAS(1)	-0.105554	-2.271918
@SEAS(2)	0.109128	2.363936
AR(2)	-0.715776	-2.924305
MA(1)	-0.969926	-19.28728
C	0.013080	0.572780

R^2 corrected = 0.95 Normality (Jarque-Bera) = 3.8 (0.15)

S.E. = 0.015 Serial Correlacion (LM(3)) = 5.5 (0.14)

DW=2.0 RMSE = 0.019

MODEL 2

ARIMA structure of GDP models by each sector with the involvement of seasonal components.

2.a Quarterly GDP model in "agriculture"

Dependent variable	Dlog(GDP_Agriculture)	
Explanatory variables	Regression coefficient	t-stat
@SEAS(2)	0.28	24.51
AR(2)	-0.98	-154.63
MA(2)	0.87	11.52
C	-0.06	-15.71

R^2 corrected = 0.99 Normality (Jarque-Bera) = 0.63 (0.73)

S.E. = 0.014 Serial correlation (LM(2)) = 0.34 (0.51)

DW=2.3 RMSE = 0.012

2.b. Quarterly GDP model in "industry"

Dependent variable	Dlog(GDP_Industry)	
Explanatory variables	Regression Coefficient	t-stat
@SEAS(1)	-0.112299	-8.740426
@SEAS(2)	0.080798	4.951615
AR(1)	0.488730	1.896137
MA(4)	-0.877759	-8.281459
C	-0.001888	0.9120

R^2 corrected = 0.67 Normality (Jarque-Bera) = 0.71 (0.70)

S.E. = 0.06 Serial Correlation (LM(5)) = 2.63 (0.75)

DW=1.96 RMSE = 0.07

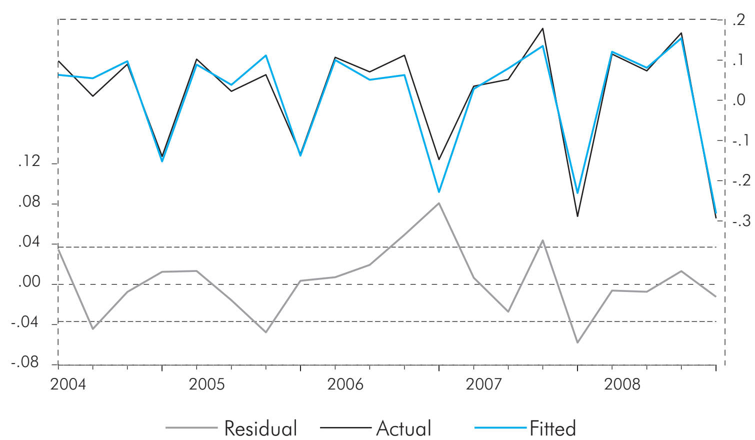
2. c. Quarterly GDP model in "construction"

Dependent variable	Dlog(GDP_Construction)	
Explanatory variables	Regression coefficient	t-stat
@SEAS(1)	-0.347658	-3.534899
AR(4)	0.570562	2.254968
MA(1)	-0.964575	-16.03706
C	0.105084	4.220157

R^2 corrected = 0.93 Normality (Jarque-Bera) = 0.20 (0.90)

S.E. = 0.04 Serial correlation (LM(4)) = 0.77 (0.94)

DW=1.83 RMSE = 0.05



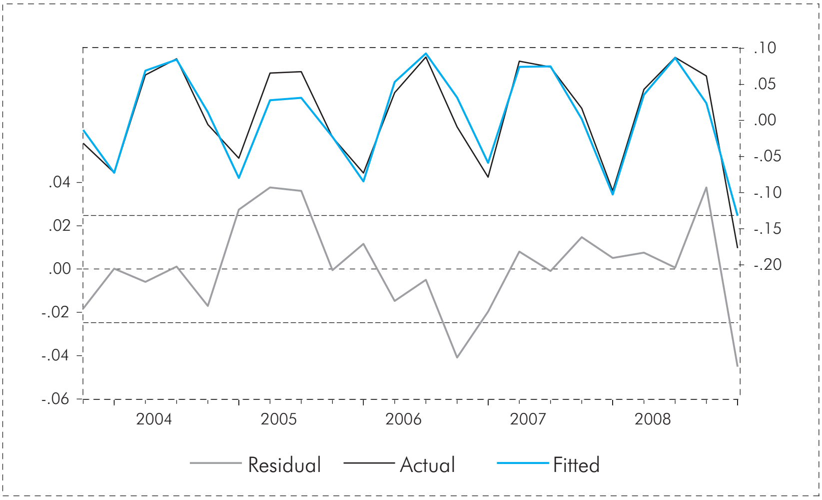
2.d. Quarterly GDP model in services

Dependent variable	Dlog(GDP_Services)	
Explanatory variables	Regression coefficient	t-stat
@SEAS(1)	-0.133838	-4.506494
@SEAS(3)	0.065111	1.975398
AR(2)	-0.598000	-2.592164
MA(1)	-0.934926	-33.09692
C	0.031480	4.795303

R^2 corrected = 0.89 Normality (Jarque-Bera) = 0.096 (0.95)

S.E. = 0.02 Serial correlation (LM(2)) = 2.29 (0.32)

DW=1.63 RMSE = 0.03



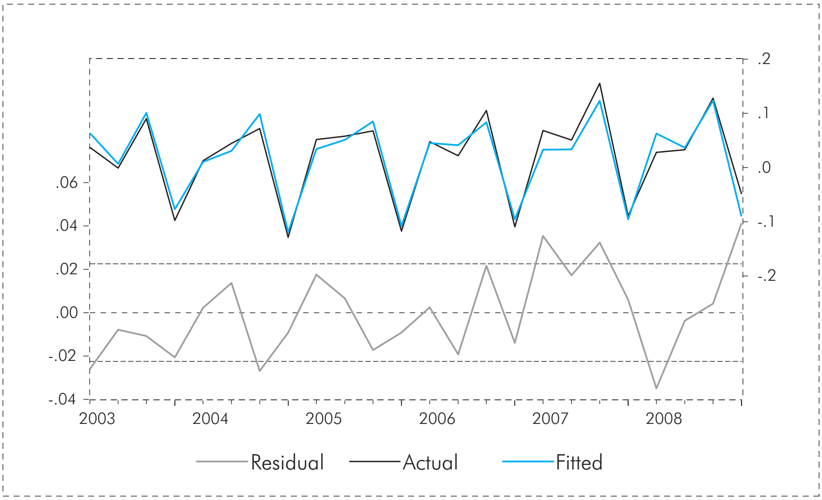
2. e. *Quarterly GDP model in "other services"*

Dependent variable	Dlog(GDP_Other services)	
Explanatory variables	Regression coefficient	t-stat
@SEAS(4)	0.066356	3.583717
@SEAS(1)	-0.131547	-7.089569
MA(4)	0.712422	6.194268
C	0.035621	2.995954

R^2 corrected = 0.92 | Normality (Jarque-Bera) = 0.92 (0.63)

S.E. = 0.02 | Serial correlation (LM(2)) = 0.13 (0.94)

DW=1.64 | RMSE = 0.02



MODEL 3

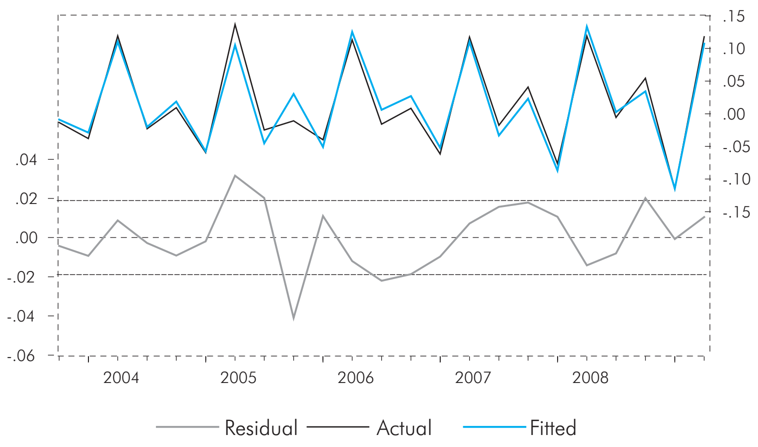
Quarterly GDP indicator model as a total

Explanatory model	Coefficient	t-stat
EI(t)	0.002	3.6
dlog(PEV) (t-2)	0.07	2.5
dlog(UVI) (t-3)	-0.29	-1.96
dlog(GDP) (t-1)	-0.72	-11.7
Seas(1)	-0.05	-3.6
C	0.02	2.11

R^2 corrected = 0.93 Normality (Jarque-Bera) = 0.57 (0.74)

S.E. = 0.019 Serieal correlation (LM(2)) = 1.4 (0.49)

DW = 1.90 RMSE = 0.015



MODEL 4

4.a. Quarterly GDP model in "agriculture".

Dependent variable	Dlog(GDP_agriculture)	
Explanatory variables	Regression coefficient	t-stat
@SEAS(2)	0.28	24.51
AR(2)	-0.98	-154.63
MA(2)	0.87	11.52
C	-0.06	-15.71

R^2 corrected = 0.99 Normality (Jarque-Bera) = 0.63 (0.73)

S.E. = 0.014 Serial correlation (LM(2)) = 0.34 (0.51)

DW=2.34 RMSE = 0.012

4.b. Quarterly GDP model in "industry".

Dependent variable	Dlog(GDP_industry)	
Explanatory variables	Regression coefficient	t-stat
DLog(GDP_Industry(-4))	-0.511703	-2.574617
@SEAS(4)	0.106072	3.362369
@TREND	-0.00429	-1.867128
TI(-1)	0.010901	7.093260
DLog(IR_KREDI_EU(-2))	-0.683080	-3.548549
C	-0.030000	-0.351669

R^2 corrected = 0.76 | Normality (Jarque-Bera) = 3.64 (0.16)

S.E. = 0.05 | Series correlation (LM(2)) = 2.20 (0.33)

DW=2.05 | RMSE = 0.05

4.c. Quarterly GDP model in "construction"

Dependant variable	Dlog(GDP_construction)	
Explanatory variables	Regression coefficient	t-stat
@SEAS(4)	0.130	5.329586
TN(-1)	0.008	8.435975
DLog(Cons_cement(-2))	0.077	2.237334
DLog(Permmsion_construct (-4))	0.042	4.029388
C	-0.059	-4.835733

R^2 corrected = 0.89 Normality (Jarque-Bera) = 1.67 (0.43)

S.E. = 0.04 Series correlation (LM(2)) = 3.29 (0.20)

DW=1.95 RMSE = 0.04

4.d. Quarterly GDP in "services"

Dependent variable	Dlog(GDP_services)	
Explanatory variables	Regression coefficient	t-stat
@SEAS(1)	-0.124999	-4.808439
MA(4)	0.864083	16.13473
CCI(-1)	0.002550	1.876948
SI(-1)	0.001848	2.869693
C	0.146588	2.323265

R^2 corrected = 0.87 Normality (Jarque-Bera) = 0.81 (0.66)

S.E. = 0.03 Reries correlation (LM(2)) = 1.71 (0.43)

DW=2.3 RMSE = 0.03

4.e. GDP quarterly model in "other services"

Dependent variable	Dlog(GDP_other services)	
Explanatory variables	Regression coefficient	t-stat
@SEAS(1)	-0.119247	-4.670991
@SEAS(2)	0.153319	17.18029
@SEAS(4)	0.039210	3.487883
MA(4)	0.712422	6.194268
DLOG(Expendityres_Budget-4))	0.138976	-14.46980
C	-0.015821	-2.630743

R^2 corrected = 0.97 Normality (Jarque-Bera) = 0.95 (0.61)

S.E. = 0.02 Series correlation (LM(2)) = 3.2 (0.20)

DW=2.2 RMSE = 0.02

MODEL 5

Quarterly GDP model seasonally adjusted

Explanatory variables	Coefficient	t-stat
dlog(ESI), (t-2)	0.03	2.5
dlog(PBB), (t-1)	-0.38	-2.4
c	0.01	7.5

R^2 corrected = 0.4   RMSE = 0.006

S.E. = 0.006   Normality (Jarque-Bera) = 0.16 (0.791)

DW = 1.6   Series (LM(2)) = 2.6 (0.26)

APPENDIX D

A SIMPLE VERSION OF SECTORAL INTERACTION MODEL

The estimation of sectoral interaction is done by implementing SUR method[31], an estimation method applied in the multidimensional regressions under the presence of the heteroscedasticity and the correlation among the errors of the equation's system. The SUR method minimises the errors generated by both problems mentioned above on the GDP forecast. This approach implemented by Stučka (2002), and Çeliku *et. al.* (2006), in case of CPI forecast by categories, has shown that models that take into account the interactions among the categories give more accurate results than ones based on aggregated data series. In this respect *SUR* approach is more appropriate than *OLS* one.

The system consists of five equations. Each of them tries to explain the quarterly sectoral GDP behaviour based on inertia variables and on the quarterly developments of the GDP in the other sectors. Initially, the general form of the model included variables with high lags. Excluding variables by lags from the general model is achieved based on the Wald[32] test results. In the final specification form, the sectoral GDP quarterly changes are explained by the most significant lags in statistical and economical point of view. The theoretical specification of models is as follows:

$$DLog(PBB^i_t) = \alpha_0 + \delta_i * @seas_f + \sum_{j=1}^{k} \alpha_j * DLog(PBB^i_{t-j}) + \sum_{j=1}^{k} \sum_{i \neq i}^{5} \beta_{j,m} * DLog(PBB_{t-j})$$

where i=1,...,5 indicates each sector and k its lags

Equation 'i' shows the GDP quarterly change of the 'i' sector in the 't' quarter. In each of 5 equations of the system, under the first sign of sum there are summarised the inertia terms and under the doubled sign of the sum, the previous developments in other sectors of the economy. In each of the equations, the first term is the constant vector and second one represents the seasonal factor/factors ($@\ seas_f$), where f=1,...4.

To provide with a more clear idea on the sectoral interaction, inertia and seasonal factors as identified through the equations system estimation with *SUR* method, below are provided its 5 equations:

a. $DLog(GDP\_Agriculture_{t})=C(1)+C(2)*@Seas(2)+C(3)*DLog(GDP\_Agriculture_{t-2})+ C(4)*DLog(GDP\_Construction_{t-2})$

b. $DLog(GDP\_ Industry_{y})=C(5)+ C(6)*@Seas(4)+C(7)*DLog(GDP\_Agriculture_{-1})+C(8)*DLog (GDP\_Construction_{2})$

c. $DLog(GDP\_Construction)=C(9)+C(10)*@Seas(2)+C(11)*@Seas(4)+C(12)*DLog(GDP\_Construction_{t-2})$

d. $DLog(GDP\_Services_{t})=C(13)+C(14)*@Seas(3)+C(15)*DLog(GDP\_Construction_{-4})+C(16)*DLog(GDP\_Agriculture_{-2})$

e. $DLog(GDP\_Other\_services_{t})=C(17)+C(18)*@Seas(1)+C(19)*Seas(4)+C(20)*DLog (GDP\_Construction_{-5})$.

where C(m), for m=1,..., 20, are the parameters resulting after the estimation of the model, including constants and the seasonal factors.

Some of the most interesting inter-correlations among sectors are:

- The agriculture GDP developments are positively correlated to past developments of the GDP in the construction sector. Investments in the construction of green houses, in animal farming and in fishing branches, support the future developments of the agriculture sector;

- An increase of the value added in the agriculture production is reflected a quarter ahead in the positive growth rates of the value added of the industrial sector. The economic activity in the agro-industry is an important part of the industrial production.

- An increase of value added in “industry” sector depends on the extension of investments in industrial structures two quarters before. This is reflected in the increase of the value added in the construction sector. The later one depends mainly on its previous developments, in the mini-cycle forms;

- The future developments in the GDP of the service sector are positively correlated with the developments in the past four quarters in the value added in constructions sector. Constructions in tourism branch (hotel, restaurants, bars, etc) and in those supporting the trade activity (trade centres of different sizes), are preconditions for the future developments in services sector. At the same time, the development of value added in services depends also on the developments of the two previews quarters in agriculture, whose products may support the business of bars, restaurants and trade activities;

- Investments, mainly in the public sector, are part of the value added in construction sector. The performance of the later one in the 5 previous quarters is estimated to affect positively the future developments of "other services" sector;

The aggregation of sectoral results provides the estimation for the short-term forecast of total GDP, a process which is described from the following expression:

$$GDP\_total_{t+h} = GDP\_Agriculture_{t+h} + GDP\_Industry_{t+h} + GDP\_Construction_{t+h} + GDP\_Services_{t+h} + GDP\_Other\ services_{t+h}, \quad (7)$$

where h- the number of the forecasted quarters.

Concluding this estimation method, it comes out that the quarterly GDP developments of the construction sector contribute to explain the GDP developments in all the other sectors of the economy. This conclusion confirms the view that construction sector has been the driving force for the positive growth rates in Albanian economy during the observed period. The enrichment of this system with other exogenous variables is an impossible process from econometrical point of view, due to the short-term series. For this reason this model will be further developed, in order to be implemented in the forecasting process of the quarterly GDP, in the near future.

The model of quarterly GDP estimated by Seemingly Unrelated Regression (SUR) method

System: GDP _ SYSTEM				
Estimation Method: Seemingly Unrelated Regression				
Date: 01/27/10 Time: 13:01				
Sample: 2003Q4 2009Q1				
Included observations: 22				
Total system (unbalanced) observations 110				
Linear estimation after one-step weighting matrix				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.053866	0.008696	-6.194534	0.0000
C(2)	0.210543	0.019199	10.96663	0.0000
C(3)	-0.579103	0.032937	-17.58204	0.0000
C(4)	0.633493	0.070074	9.040361	0.0000
C(5)	-0.037880	0.018949	-1.999039	0.0486
C(6)	0.106528	0.043757	2.434522	0.0169
C(7)	0.455515	0.097018	4.695135	0.0000
C(8)	0.664723	0.154963	4.289558	0.0000
C(9)	-0.123315	0.019533	-6.313117	0.0000
C(10)	0.308812	0.037760	8.178310	0.0000
C(11)	0.314082	0.036742	8.548298	0.0000
C(12)	-0.845924	0.145713	-5.805421	0.0000
C(13)	-0.017510	0.003978	-4.402075	0.0000
C(14)	0.082127	0.008365	9.817818	0.0000
C(15)	0.596770	0.034405	17.34567	0.0000
C(16)	-0.090355	0.017770	-5.084666	0.0000
C(17)	0.045460	0.008206	5.539738	0.0000
C(18)	-0.157983	0.015299	-10.32623	0.0000
C(19)	0.056024	0.014374	3.897507	0.0002
C(20)	0.105878	0.053669	1.972772	0.0516
Determinant residual covariance		1.68E-15		
Equation: DLOG(Agriculture) = C(1)+C(2)*@SEAS(2)+C(3)*DLOG(Agriculture(-2)) +C(4) *DLOG(Construction(-2))				
Observations: 23				
R-squared	0.977838	Mean dependent var		0.018280
Adjusted R-squared	0.974339	S.D. dependent var		0.239939
S.E. of regression	0.038436	Sum squared resid		0.028069
Durbin-Watson stat	2.474827			
Equation: DLOG(Industry) = C(5) +C(6)*@SEAS(4)+C(7)*DLOG(Agriculture(-1)) +C(8) *DLOG(CONST(-2))				
Observations: 23				
R-squared	0.457374	Mean dependent var		0.007907
Adjusted R-squared	0.371696	S.D. dependent var		0.099029
S.E. of regression	0.078496	Sum squared resid		0.117071
Durbin-Watson stat	2.005850			
Equation: DLOG(Construction) = C(9)+C(10)*@SEAS(2)+C(11)*@SEAS(4) + C(12)*DLOG(Construction (-2))				
Observations: 23				
R-squared	0.774978	Mean dependent var		0.014674
Adjusted R-squared	0.739449	S.D. dependent var		0.133598
S.E. of regression	0.068194	Sum squared resid		0.088358
Durbin-Watson stat	3.233542			
Equation: DLOG(Services) = C(13)+C(14)*@SEAS(3)+C(15)*DLOG(Construction (-4))+C(16)*DLOG(Agriculture(-2))				
Observations: 21				
R-squared	0.953839	Mean dependent var		0.014872
Adjusted R-squared	0.945692	S.D. dependent var		0.073885
S.E. of regression	0.017218	Sum squared resid		0.005040

Durbin-Watson stat	2.710240			
Equation: DLOG(Other services) = C(17) +C(18)*@SEAS(1)+C(19)*@SEAS(4) +C(20)*DLOG(Construction (-5))				
Observations: 20				
R-squared	0.893474	Mean dependent var		0.020319
Adjusted R-squared	0.873501	S.D. dependent var		0.081553
S.E. of regression	0.029006	Sum squared resid		0.013461
Durbin-Watson stat	2.004702			

ENDNOTES

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The views expressed in this paper are those of the authors only and do not necessarily express those of the Bank of Albania.
[1] The quarter for which an official data of quarterly GDP is not yet released, but economic data are available.
[2] INSTAT publishes data on quarterly GDP which are seasonally adjusted. Unadjusted seasonally data (INSTAT), are available for further analysis and research purposes. In this paper both series shall be employed; quarterly seasonally adjusted and the no seasonally adjusted GDP. Both these series are subject of regular reviews.
[3] It will be refereed shortly as "agriculture" hereinafter this paper.
[4] In this sector there are included financial services, education, health, public administration, obligatory defence and social insurances, etc.
[5] Deviation = [GDP_Facts (INSTAT) – GDP_Theoritical (Model)]
[6] Estimates of authors based on the regular analysis of the Albanian economy performance.
[7] Appendix B shows the ADGF results on total and GDP stagnancy.
[8] These components are measured by official statistics and are involved in GDP calculation according to one of distinguished calculating method.
[9] See: Banbura, M dhe Runstler, G. (2007); Barhoumi, K. et. al. (2007); Hansson, J. (2003); Claveria, O. (2005); Sedillot, F. dhe Pain, N. (2003); Golinelli and Parigi (2004).
[10] The important role of confidence in real sector analyses of Albanian economy (for reference, current and expected periods) is analyzed and verified in working papers: Çeliku and Shtylla (2007); Lama and Istrefi (2007).
[11] See the most distinguished references of the field, as identified in unit II of this study.
[12] The estimations' results are presented in the appendix D, of this material. This model is not yet considered in the process of GDP forecasting, because of very short quarterly GDP time series.
[13] Acronym of terms: Auto Regressive Integrated Moving Average.

[14] In particular in Brunet (2000) and in Banbura & Runstler (2007), is verified that the aggregated indicators (combination of individual balances), resulting from the confidence surveys, contain a more complete, timely and representative information on economic activity , compared with the singe balances or with the inclusion of different balances simultaneously in indicator models. The later, considering the short-term time series of quarterly GDP, would infringe the credibility of models by lowering the degree of freedom.

[15] The "bridge" models were firstly developed by Klein and Sojo (1989).

[16] Acronym of econometric concept of Auto- Regressive Vectors

[17] Acronyms of Akaike Information Criteria and Schvarc Criteria

[18] Appendix A provides detailed information on variables, periodicity, their source and the used symbols as well as details of calculating some of them.

[19] For methodological details see http://www.bankofalbania.org/web/pub/metodologjia_vbb_vbk_shqip_2301_1.pdf.

[20] Balance is the quantification method of the qualitative answers, in the form of opinions provided from businesses. The questions addressed to these businesses impose an answer as qualitative of type "is increased", "equal", "is decreased", relative to the previous quarter. As a result, balances are simplified forms of quarterly changes about an average in time. They are stationary and in equation are included in level.

[21] See the explanatory notes in the table of Appendix A for more details.

[22] Loans in EURO dominate the banks' total credit portfolio.

[23] In the end of the forecasting process, from the other models which explain the seasonally unadjusted changes of GDP, the estimated series of GDP is seasonally adjusted with the purpose of comparing the actual changes (INSTAT) and the forecasted ones, presented in this material. INSTAT publishes the quarterly and annual changes with respective seasonally adjusted and unadjusted series.

[24] The causality tests results may be available upon specific request to the authors.

[25] Acronym of Ordinary Least Squares Method.

[26] Golinelli and Parigi (2004) – support the inclusion of survey variables by explaining in theory and practice their importance (page 7), notwithstanding the low values of respective coefficients in their estimation equations (page 12).

[27] This indicator is used at the Bank of Albania for analysing the economic activity as additional information to assist the decision-making.

[28] In terms of normality tests' results, outcomes and the explanatory variables stability (Appendix C)

[29] These indicators are expressed as net balances in percentage points. Thus, the respective coefficient, of regression show the percentage the quarterly GDP shall change in average, if the confidence variable shall be increased by 1 percentage point, as the model with variables from surveys are of the log-lin form.

[30] Acronym of the indicator name: Root Mean Square Errors (RMSE).

[31] Acronym of terms "Seemingly Unrelated Regression".
[32] Results become available upon the submission of specific requests at authors.

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