The Italian GDP at T+30 days
Model estimation, real time analysis and performance evaluation

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Abstract
The paper discusses the exercise recently carried out at ISTAT concerning the quarterly estimate of Italian GDP by 30 days after the end of the reference quarter, T+30. Main results are presented together with a coherent set of real time revision errors with respect to those produced at T+60 when the full set of data is available. The modeling setup is built on main components of GDP from both the production and the demand side, respectively 11 and 6 components. For each component a suitable set of autoregressive distributed lag models are fitted and estimations are carried out by generalized least squares within the Kalman filter methodology. Monthly indicators, for which last month of the quarter to estimate is not yet available, are preliminarily nowcasted by means of ARIMA models. GDP is obtained aggregating production components and changes of inventories are derived as residual, therefore including also statistical discrepancies. The proposal is novel with respect to applied research on Italian data for detail of GDP components, as well as the broad number of related indicators used in the exercise. Moreover an extensive real time analysis is conducted for both model selection and accuracy evaluation of estimates at T+30. Real time analysis provides the revision errors for GDP and its components, relative gains with respect to pure autoregressive models adopted as benchmark and relative losses with respect to the official flash estimate of GDP published at T+45 days.

Background information

The European statistical system is strongly involved in the development of a wide spectrum of economic indicators and there is a continuous demand of timely and reliable data from users, stakeholders and the community of researchers. GDP is probably the most relevant indicator and its quarterly publication is coordinated by Eurostat according to a release calendar at 45, 60 and 90 days after the end of the reference quarter. In recent years the need of anticipating the first release, so called 'GDP flash estimate', at T+30 resulted in a decision by Eurostat to settle down a dedicated task force in 2013 involving a wide number of member states.

Since the majority of member states is involved in a flash estimate at T+45 days (only Spain, the United Kingdom, Belgium and Lithuania are already publishing quarterly GDP at T+30), the task force has investigated the feasibility to shorten this delay, involving each member state in the production of GDP at 30 by the end of reference quarter. Eurostat adopts an indirect strategy of compilation for European aggregates (as sum of member states data), recognizing therefore the importance that each member state provide its contribution in order to ensure high quality standards even at shorter delay of dissemination. The interest is limited to GDP in volumes and in particular to growth rates of seasonally and calendar adjusted data.

ISTAT has given its contribution to the task force mainly implementing a new nowcasting exercise to estimate the Italian GDP at T+30. The main challenge of this exercise is the lack of short term statistics in the last quarter which determines larger revisions with respect to both estimations carried out at T+45 and T+60 when relevant data become available.
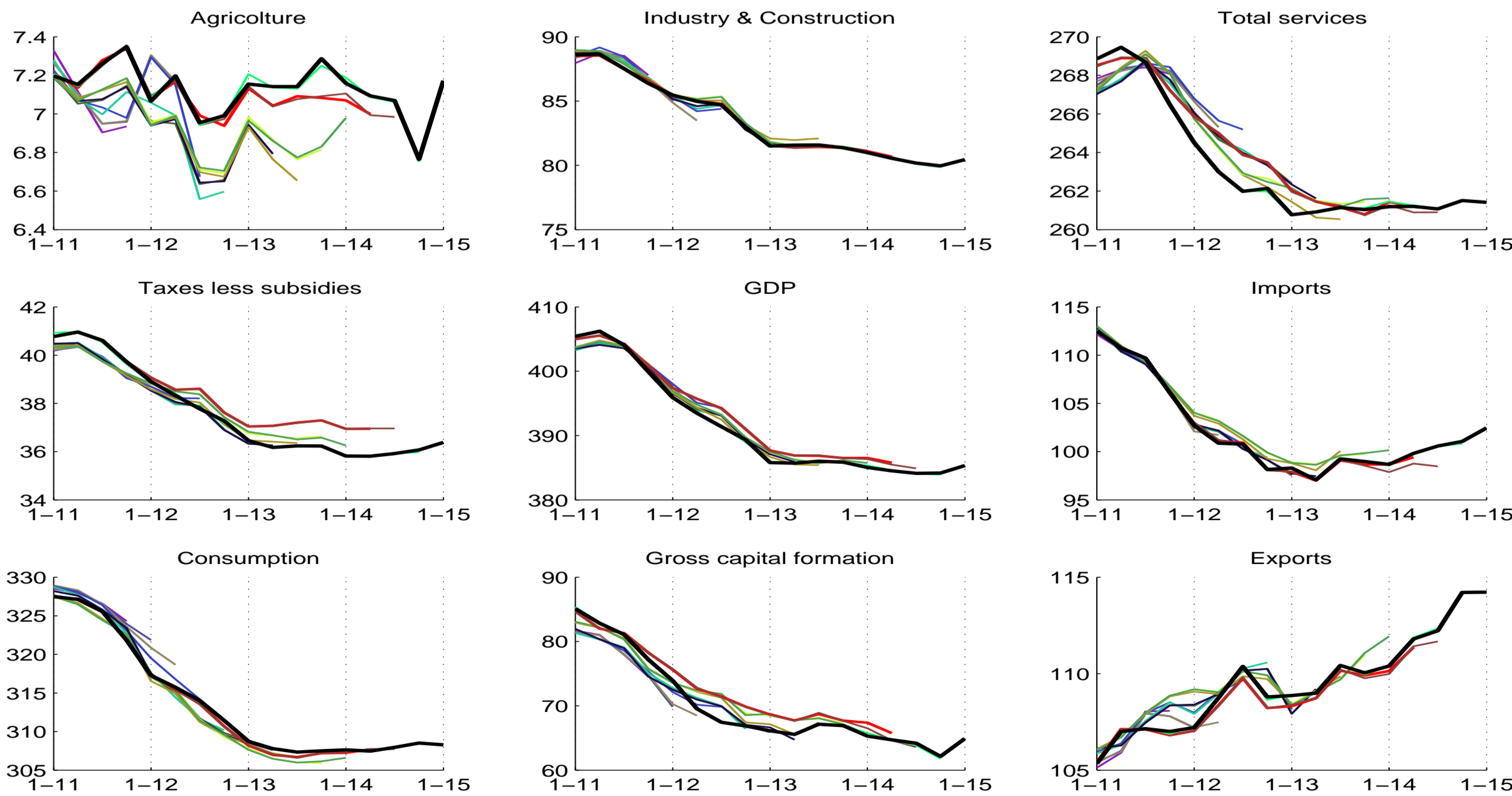
Main characteristics of the exercise

1. The nowcasting one-step-ahead exercise is conducted over seasonally and calendar adjusted chain-linked volumes of Italian quarterly accounts with reference year 2010. Data span the sample 1995q1-2015q1.
2. It takes place over 11 components of GDP from the production side and 6 from the demand side.
3. In the current production of quarterly national accounts (both at T+45 and T+60 days), the set of official estimates involves also current price evaluations as well as unadjusted and calendar adjusted data. In terms of components GDP is split respectively into 44 and 49 items from the production and demand sides.
4. GDP nowcasts are derived aggregating production components.
5. Aggregation is carried out by means of a 3-step procedure: de-chaining of components to derive data at previous year prices, their sum to derive GDP and final chain-linking.
6. The exercise involves a broad number of quarterly and monthly short term statistics, as well as business and consumer surveys.
7. Seasonal and calendar adjustment as well as nowcasting of missing data are all coherent with standard practices of quarterly national accounts.
8. The model strategy adopts the class of ADL(1,1) models.

$$\Delta^l y_t = \rho \Delta^l y_{t-1} + m + gt + \beta'_0 \Delta^l x_t + \beta'_1 \Delta^l x_{t-1} + \varepsilon_t, \qquad \varepsilon_t \sim NID\left(0, \sigma^2\right)$$

9. Statistical treatment of ADL models is carried out by GLS within the Kalman filter methodology.
10. Models are selected among at most 72 model specifications. 48 of them distinguish the following elements: order of the model, ADL(1,0) or ADL(1,1); presence of the constant and/or trend; data transformation, levels or logarithms; order of regular or seasonal differentiation, 0 or 1. Remaining 24 specifications concern AR(1) models, therefore without related data, including or not the constant and trend.
11. A real time exercise is implemented for both model selection and performance evaluation using 14 vintages of time series released over the quarters 2011q4-2015q1.
12. The selection criteria is the mean absolute errors (MAE) with respect to official data released at T+60.
13. For each component nowcasts resulting from the most performing models are averaged together to obtain the final estimate. Equal weights are used in the average.

GDP and its components. Vintages over the sample 2011q4-2015q1

The set of short term indicators

When not specified, data are seasonally and calendar adjusted, cover the quarters 1995q1-2015q1, are provided by ISTAT and are of public domain. Aggregated indexes adopt the rules of chain-linking. A summary description concerning the most recent vintage is provided below.

- Quarterly volume indicator of production of harvesting and fishery products (elaborations on detailed productions not disseminated to the general public).

- Industrial production index of 16 sectors belonging to the NACE sections B, C and D, base 2010=100 from January 1995 to March 2015. The index for section E is composed as a weighted average of available indexes whose weights are the intermediate consumptions by branch extracted from the use table. The index of total industry is a weighted average of the 17 sectors using value added as relative weight. Calendar adjustment is carried out over the monthly frequency, whereas seasonal adjustment over quarterly data.
- Index of production in construction base 2010=100. Seasonal and calendar adjustment follows the same strategy as the industrial production index.
- Index of trade and transport margins. This indicator is obtained as a weighted average of the 20 production indexes listed in 1), 2) and 3) with weights extracted by the column of the supply table relative to trade and transport margins.
- Index of taxes less subsidies. Similarly to trade and transport margins it is composed by the 20 elementary indexes with weights consistent with values of taxes less subsidies from the supply table.
- Quarterly confidence climate of service business activities (NACE from L to N) base 2010=100 over the sample 2003q1-2015q1.
- Quarterly indicator of deflated financial intermediation services indirectly measured. Source Bank of Italy, not disseminated to the general public.
- Quarterly data of hours worked in public administration (NACE O) obtained from temporal disaggregation of the corresponding annual aggregate (for the last year programmed evolution of public sector employment is used). Sample 2003q1-2015q1, source Ministry of Treasury, data not disseminated to the general public.
- Quarterly composite indicator obtained as weighed average of the Italian consumer confidence indicator and production indexes for consumer goods. Elementary data of production are those listed in 1), 2) and 3); weights are extracted from the use table for final consumption expenditure of households and non-profit institutions serving households. For homogeneity between consumer-confidence and the consumer-production the latter indicator is transformed in annual growth rates and standardized; weights are respectively 0.65 and 0.35 reflecting the relative importance of goods on services.
- Quarterly indicator of production indexes for investment goods obtained as weighted average of indicators listed in 1), 2) and 3). As before weights are extracted from the use table column for gross fixed capital formation.
- Quarterly seasonally adjusted production index of manufacture of jewelery and related articles (NACE 321). This indicator is leaded of 2 quarters.
- Quarterly deflated imports and exports of goods. These totals are split by the 2 areas of countries of the European Union and the rest of the world. Deflators are the producer price indexes for imports and exports also split by area.

Results of real time analysis

The table below contains a summary view of the performance of the nowcasting exercise at T+30 for GDP and its components. Nowcast errors are computed over official T+60 estimates. Mean nowcast errors (ME) and mean absolute nowcast errors (MAE) are used to assess model performances. Same approach is used for T+45 estimates and the pure extrapolation exercise based on AR models. This allows to evaluate: relative losses of the T+30 exercise from the T+45 one; relative gains of same T+30 exercise from AR extrapolations. Relative losses/gains are computed as difference between MAEs.

Mean error statistics of T+30 estimates over the quarters 2011q4-2015q1, relative losses over the T+45 exercise and gains over AR(1) benchmark models

Component	levels			quarterly growths				annual growths		
	ME	MAE	loss	ME	MAE	loss	gain	ME	MAE	loss
Agriculture,forestry,fishing	16	128	(-70)	.375	1.609	(-1.036)	(+.131)	.129	2.042	(-1.439)
Industry	43	462	(-263)	-.109	.347	(-.284)	(+.433)	-.141	.536	(-.322)
Construction	-72	147	(-49)	-.093	.615	(-.130)	(+.136)	-.233	.768	(-.373)
Trade,transports,accomm.,food	-167	252	(-81)	-.030	.179	(-.014)	(+.128)	-.181	.371	(-.090)
Information and communication	132	262	(+22)	-.455	.500	(+.242)	(.000)	.141	1.171	(+.349)
Financial and insurance	103	276	(-24)	-.323	.701	(-.278)	(+.137)	.208	1.116	(-.111)
Real estate	-33	238	(-61)	-.007	.186	(-.076)	(.000)	.080	.444	(-.094)
Professional,support services	-164	259	(-44)	-.106	.484	(-.108)	(+.130)	-.057	.883	(-.257)
Public adm. education, health	4	229	(-60)	.011	.182	(-.088)	(+.019)	.007	.240	(-.082)
Other services	12	98	(-24)	.410	.701	(-.143)	(.000)	.203	.668	(+.194)
Taxes less subsidies	-96	339	(-92)	-.004	.515	(-.384)	(+.240)	-.114	.647	(-.354)
GDP	-256	723	(-350)	-.050	.151	(-.106)	(+.144)	-.055	.174	(-.095)
Imports of goods and services	71	738	(-270)	-.011	.550	(-.254)	(+.524)	-.144	.763	(-.289)
Household consumptions	-352	875	(-366)	-.142	.222	(-.089)	(+.068)	-.272	.384	(-.136)
Gen.government consumption	-428	558	(-300)	-.063	.246	(-.088)	(+.000)	-.375	.510	(-.254)
Gross fixed capital formation	-249	857	(-466)	-.091	1.001	(-.760)	(+.079)	-.023	1.219	(-.841)
Valuables (acquis.-disposals)	5	9	(+4)	-.382	4.948	(-4.308)	(+.000)	1.335	3.069	(-1.108)
Exports of goods and services	-110	608	(-151)	-.129	.410	(-.228)	(+.169)	-.112	.622	(-.409)

Legend: ME=mean error; MAE=mean absolute error; loss=MAE at T+45 - MAE at T+30; gain=MAE at T+30 - MAE for AR(1) extrapolations; all errors are revision computed over the official T+60 estimates

Main evidences from the analysis of error statistics of the table above are:

- MEs of both levels and growths are prevalently negative. Their significance is difficult to assess since the experiment is based only on 14 observations.
- MAEs in growths provide information on how challenging is the nowcasting exercise based on available related indicators. Apart from small components (agriculture and acquisition less disposals of valuables), the most unpredictable components are: gross fixed capital formation, value added of construction, information and communication, financial activities and other services. As expected GDP has the lowest MAE equal to 0.151% points.
- Concerning GDP over the period 2011q4-2015q1, both quarterly and annual nowcast growths of the T+30 exercise loss around 1 decimal in terms of MAE compared with T+45 releases, while gain over 1 decimal when compared to the set of benchmark AR(1) models. This latter result is a measure of the explicative power of used short term indicators.
- As far as GDP components are concerned, loss of information affects mainly gross fixed capital formation and the production components of taxes less subsidies, industry and financial intermediation, while larger gains concern imports, industry and taxes less subsidies.