GIORNATE DELLA RICERCA IN ISTAT | 10-11 NOVEMBRE 2014

SESSIONE V
ANALISI DELLE SERIE STORICHE

Approccio diretto e indiretto alla destagionalizzazione di serie storiche: un confronto per gli indici del commercio all'ingrosso

Barbara Guardabascio, Barbara Iaconelli e Roberto Iannaccone

Istat

Indirect and direct seasonal adjustment: an application to the wholesale trade time series

Barbara Guardabascio, Barbara Iaconelli, Roberto Iannaccone

Istat- Short Term Statistics Department

guardabascio@istat.it iaconell@istat.it iannacco@istat.it

Sommario

In questo articolo verranno studiate le differenze tra l'approccio indiretto e diretto per la destagionalizzazione delle serie trimestrali del fatturato del commercio all'ingrosso. La decisione se sia più opportuno utilizzare un approccio diretto o indiretto per la destagionalizzazione è ancora un problema aperto, come sottolineato negli orientamenti suggeriti dalle linee guida di Eurostat. Lo scopo di questo lavoro è quello di analizzare le differenze soprattutto in presenza di valori anomali o di break stagionali che caratterizzno in modo particolare le serie di fatturato del commercio all'ingrosso. In questa analisi prenderemo in considerazione un set di statistiche descrittive sulla qualità dell'approccio indiretto e diretto insieme ad alcune misure basate sul triangolo delle revisioni e atte a controllare la dimensione delle revisioni che si ottengono utilizzando in ciascuno dei due approcci.

Parole chiave: destagionalizzazione con approccio diretto/indiretto, break stagionale, triangolo delle revisioni

Abstract

In this paper the differences between the indirect and direct approach for seasonal adjustment will be investigated for the quarterly series of turnover in the whole trade services. The decision whether it is more appropriate to use a direct or an indirect seasonal adjustment is still an open issue as underlined in Eurostat Guidelines on Seasonal Adjustment. The aim of this work is to analyse the differences especially in the presence of seasonal level shift outliers that characterizes the series of turnover in the whole trade services. In this analysis we will consider the usual descriptive statistics on the quality of the indirect and direct seasonally adjusted series together with some measures to control the size of the revisions using the approach implemented in the revision triangle.

Key words: seasonal adjustment indirect/direct approach, seasonal break, revision triangle

1. Introduction

Seasonally adjusted data for time series (aggregates) which are sum of other time series (components) can be estimated in two different ways: either directly by applying the seasonal adjustment procedure directly to the aggregate data, or indirectly by summing the seasonally adjusted component series to get an indirect adjustment for the aggregate series. Under most circumstances, the direct and indirect adjustments for an aggregate series are relevant in different cases. Whether it is more appropriate to use a direct or an indirect seasonal adjustment is still an open issue (Eurostat Guidelines on Seasonal Adjustment, 2009). This paper discusses these aspects for the series of turnover in wholesale trade. The series

is the result of the aggregation of eight component time series. Moreover, in the most recent estimation of the model two seasonal outliers have been introduced to take into account the presence of a seasonal break. Our attention therefore has been focused to a more in-depth analysis of the component time series to investigate the characteristic of the seasonal break for them looking at the differences in the seasonal adjustment using a direct or indirect strategy (Ladiray and Mazzi, 2003). In general the direct approach is preferred for transparency and accuracy and especially when component series show similar seasonal patterns. On the other hand the indirect approach is preferred when the component series that make up the aggregate series have quite distinct seasonal patterns. For a choice between the two approaches different statistics have been proposed (Hood and Findley, 2003 Otranto and Triacca, 2002). In this paper we consider the usual descriptive statistics on the quality of the indirect and direct seasonally adjusted estimates as the smoothness of the component time series and residual seasonality tests. Together with these we implemented also some measures to control the size of revisions using the approach in the revision triangle (Di Fonzo, 2005).
In the following section we provide a description of the model estimation for the aggregate time series and its components together with the criteria and diagnostics used to assess the seasonal adjustment quality. The results for the comparison between the seasonal adjustment obtained with the two alternative approaches are shown in section 3 and section 4 reports the conclusion.

2. Methodology

The components of the wholesale trade turnover index include a set of economic activities, ranging from *wholesale on fee or contact basis* to *non-specialized wholesale trade* and are aggregated with a set of weights coming from the turnover in Structural Business Statistics for the base year (2010). More in details the three series that give an higher contribution to the overall index are: *G467. Other specialized wholesale (0.344), G464. Wholesale of household goods (0.225), G463. Wholesale of food, beverages and tobacco (0.204).*
In order to assess empirically the quality of the different approaches (indirect and direct seasonal adjustment) first of all we search for the best model for each component as well as for the aggregate index. In particular for each series we check the presence of calendar effects or outliers and then, through the autocorrelation analysis and taking into account the Tramo-Seats and X12 diagnostics produced by Demetra +, we select the best Arima model.
One of the aims of this analysis is to study in the depth the seasonal break present in the aggregate index using the components time series. In the following table 1 we report the model chosen for each series (the series G46 is the aggregate time series).
The models selected require the introduction of a ramp regressor from the III quarter 2008 to the III quarter 2009 for a large number of series, a seasonal level shift in 2006 (SLS, Kayser and Maravall, 2001) for three of the eight component series (among them two are with greater weights in the overall index) but not always in the same quarters and the calendar effects are significative only for two of the eight series components. Instead for the aggregate index the regressors for the calendar effects and the ramp are introduced together with two seasonal level shift outliers whose effects are related to the II and IV quarter 2006. The airline model is the best model in the direct approach and also for two of the eight series components. The constant is never significant but for the G463. In the following section we will show in details both some quality measures and concordance analysis of growth rates (Ladiray and Mazzi, 2003) and then the statistics for the choice between the indirect and direct approach.

Table 1 – Main Future of the Seasonal adjustment for the wholesale trade series

Group \ Division	Weight	Log	Model	Regressors	SLS Outlier
G46 – Total Wholesale trade	1.000	No	(0,1,1)(0,1,1)	TD ; I.V: IV 2008 - I 2009	Q2_06 Q4_06
G461 - Wholesale on a fee or contact basis	0.048	No	(1,0,0)(0,1,0)	I.V: III 2008 - III 2009	
G462 - Wholesale of agricultural raw materials and live animals	0.031	No	(0,1,1)(0,1,1)	I.V.: I 2008 - III 2009	Q1_06 Q3_06
G463 - Wholesale of food, beverages and tobacco	0.204	No	(1,0,0)(0,1,0)		Q1_06 Q2_06
G464 - Wholesale of household goods	0.225	Yes	(0,1,0)(0,1,1)	TD	Q4_06
G465 - Wholesale of information and communication	0.047	Yes	(1,0,0)(0,1,1)		
G466 - Wholesale of other machinery	0.062	Yes	(1,0,0)(0,1,0)	I.V: III 2008 - III 2009	
G467 - Other specialized wholesale	0.344	Yes	(0,1,0)(0,1,1)	I.V: III 2008 - III 2009	
G469 - Non Specialized wholesale trade	0.039	Yes	(0,1,1)(0,1,1)	TD ; I.V.:III 2008 - III 2009	

* TD: Trading Days Variable; I.V. : Intervention Variable

2.1 Quality Measures and concordance analysis of growth rates

We compute some measures for analysing the size of the differences both in the levels and in the growth rates of the two seasonal adjusted (SA) series with the aim to check if the direct and indirect approaches give similar results.

Table 2 – Absolute percentage deviation indicators

Indicator	Value
Mean APD (SA)	0.487
Max APD (SA)	1.748
Mean APD (SA), Last 3 years	0.069
Max APD (SA), Last 3 years	0.688

The indicator calculated in table 2, the percentage difference between the two SA series, shows that the difference is lower if we consider the last three years, both in terms of mean and of maximum value, compared to the values calculated for the full period. In particular the mean reduces from 0.487 to 0.069. This is due to the fact the main differences between the two approaches are in the way the level shift outliers and the ramp regressors are treated, respectively, in the year 2006 and 2009.
Moreover we compute the mean, the variance, the maximum and minimum value and the variation range of the differences between the growth rates. From the results in table 3 it is clear as there are not big differences between the two approaches.

Table 3 – Difference in growth rates (SA) between the two approaches

Indicator	Direct	Indirect
Mean	0,24	0,24
Minimum	-6,00	-5,60
Maximum	2,90	3,10
Variance	2,63	2,91
Range	8,90	8,70

One of the aim of our analysis is to check for the effects on the SA series due to the different way in which the seasonal break is treated introducing seasonal level shift outliers in two approaches. In the analysis of the differences between the growth rates we tried to identify the most significant ones. From table 4 it results that these are concentrated in the period from 2006 to 2009. The results are in line with the models estimated for the component series and the aggregate index already shown in table 1. In particular both the models and the regressors introduced are different if we consider the aggregate index and the two series with bigger weights in the overall index (G464 and G467).

Table 4 – Significant differences in growth rates (absolute value)

Date	Direct
2005Q4	1,23
2006Q1	1,22
2007Q1	2,53
2007Q3	1,71
2008Q1	1,03
2008Q3	1,37
2009Q1	1,07
2009Q3	1,81
2009Q4	1,42

From the growth rates analysis in table 5 it is quite evident as the main differences are induced by the different pattern in the series for G467 that has effects on the growth rate calculated for the SA series with the indirect approach.

Table 5 – Significant Differences in growth rates for some quarters

Date	Direct	Indirect	G463	G464	G467
2005Q4	0,8	2,1	-1,0	1,2	**4,7**
2006Q1	2,2	1,0	0,6	1,8	0,6
2007Q1	0,6	3,1	1,9	0,2	**6,2**
2007Q3	1,0	-0,8	1,4	-0,5	**-2,9**
2008Q1	1,5	2,5	0,5	-0,7	**6,4**
2008Q3	-0,9	-2,3	0,7	-1,4	**-4,1**
2009Q1	-5,7	-4,7	0,6	-1,8	**-9,3**
2009Q3	0,0	-1,8	-1,2	-0,9	-1,6
2009Q4	1,3	2,7	0,1	1,0	**6,0**

Another quality measure on the two SA series can be carried out looking at the difference in the growth rate calculated on the annual averages for the raw, the indirect and direct SA series. From Table 6 we can see that the difference between the growth rate on the raw and the SA series are bigger for direct approach.

Table 6 – Annual growth rates

Date	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Raw	4,3	1,2	1,1	3,1	1,1	5,2	3,9	0,7	-11,1	5,7	3,4	-4,5	-2,6
Direct	3,7	1,3	1,5	2,3	1,8	6,5	2,4	0,7	-11,4	5,5	3,9	-4,4	-2,5
Indirect	4	1,3	1,3	3,1	1,5	5,7	3,4	0,5	-11,5	5,8	3,6	-4,5	-2,4

Another key point to be considered in the seasonal adjustment for the short-term analysis is to control if there is any big discordance in signs of the growth rate calculated on SA series with the direct and indirect approach. As shown in Table 7 the two approaches lead to different signs only for three quarters and the biggest one is in the III quarter 2007 (+0.96 direct approach vs -0.76 for the indirect).
This result is confirmed also looking at the overall concordance rate that is quite high (94.64%).

Table 7 – Inconsistencies in growth rates

Date	Direct	Indirect
2003Q4	-0,11	0,43
2006Q3	0,29	-0,58
2007Q3	0,96	-0,76

Table 8 – Concordance rates in (%)

Indicators	Rates
Direct and Indirect	94,64
Indirect vs G463	60,71
Indirect vs G464	78,57
Indirect vs G467	89,29
Direct vs G463	57,14
Direct vs G464	62,50
Direct vs G467	73,21

The analysis has been carried out also for the concordance rate between the indirect SA series and the SA series components and between the direct SA series and the SA series components. The highest concordance rate is recorded for the group G467 that is one with the biggest weight in the calculation of the general index G46.

3. Direct vs Indirect seasonal adjustment

3.1 Idempotency

We check for idempotency by running the TRAMO-SEATS procedure on the two SA series, testing that seasonal adjustment does not leave a significant residual seasonality or calendar effects. Before applying the automatic Arima selection procedure for the Final Seasonal Adjusted Series (Direct approach) we test for the significance of the regressors. The results suggest that the ones with a seasonal effect (Trading days and SLS) are not significant differently from the others (Ramp). In the following table we present the results of the automatic Arima selection operated by Demetra+.

Table 9 – Idempotency results

Group \ Division	Regressors	Model Selected
G46 – Final Seasonal Adjusted (Direct approach)	I.V: IV 2008 - I 2009	(1,1,0)(0,0,1)
G46 – Stochastic Seasonal Adjusted (Direct approach)		(1,1,0)(1,0,0)
G46 – Final Seasonal Adjusted (Indirect approach)		(1,1,0)(0,0,0)

For the indirect approach the autocorrelation analysis on the fourth lag is inside the band of significance, as consequence the idempotency test applied on the indirect seasonal adjusted series is hold immediately. For the direct approach we can state that both the final and the stochastic series present a significant autocorrelation on the fourth lag. For, the same test applied to the direct seasonal adjusted provides more complex results to read. Indeed, if we run it on both the stochastic and final series we obtain an Arima model with a seasonal parameter. However, the two model selected are not admissible for SEATS who cannot decompose it and find a different model without the seasonal component.

3.2 Revisions Analysis

We compute a set of measure of quality coming from the revisions analysis for three different horizons (h = 1, 2, 4).
The revision analysis measures calculated using the triangle approach and presented in table 10 goes in favor of the indirect approach looking at most of the indicators. Indeed, although the t-test computed to evaluate the significance of the mean revision to early estimates accept the null that the mean revision is zero for both the approaches, the indirect approach shows a lower positive average error (SD-HAC) for the horizons considered. Moreover, the mean absolute revision (MAR) the relative ones (RMAR) and mean square revision (MSR) are lower in the indirect approach compared to the direct one.

Table 10 – Main Future of the Seasonal adjustment for the wholesale trade series

Revision Index	Direct Approach			Indirect Approach		
	H = 1	H = 2	H = 4	H = 1	H = 2	H=4
N. Obs.	15	14	12	15	14	12
MAR	0.76	0.60	0.75	0.41	0.32	0.36
RMAR	0.63	0.48	0.52	0.34	0.26	0.25
MR	-0.02	-0.12	-0.08	-0.07	-0.08	-0.06
SD-HAC	0.15	0.14	0.18	0.10	0.11	0.13
T-statistic	-0.11	-0.85	-0.46	-0.69	-0.71	-0.51
$t_{(1-o,o5/2,\ n-1)}$	2.14	2.16	2.20	2.14	2.16	2.20
MSR	0.82	0.50	0.76	0.25	0.18	0.22
RANGE	3.3	2.2	2.6	1.9	1.6	1.7

In the following figures we show the seasonal adjusted series obtained through the application of the two approaches and the relative change on the previous quarter.
The main differences between the two SA series and the growth rates, as stressed in the previous section, can be observed in the period 2005-2006 in connection with the change of the seasonal pattern in the raw series (G46).

Fig. 1 G46: raw and seasonal adjusted series

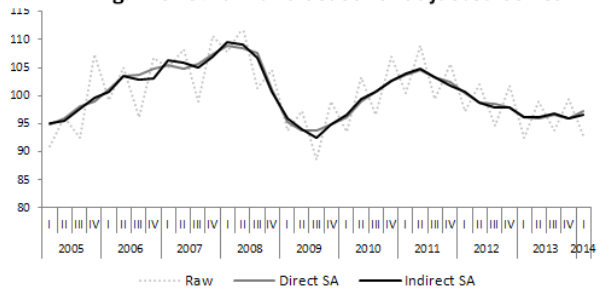
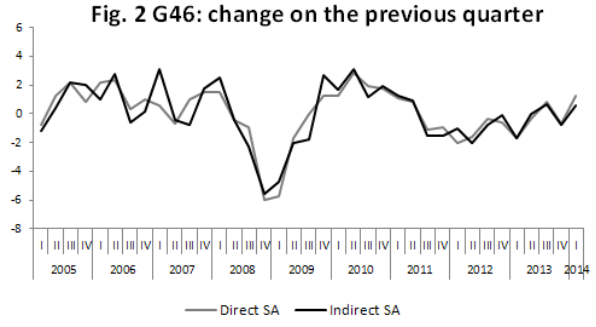


Fig. 2 G46: change on the previous quarter



4. Conclusions

In this paper we tested the direct and indirect seasonal adjustment for the wholesale trade turnover index. More in detail after checking the best Arima model for each component series as well as for the wholesale indicator we computed the idempotency test and we have estimated some measures coming from the revision analysis. Our results, in line with the Eurostat Guidelines, go in favor of the indirect approach, probably due to the greater accuracy through which the component time series are decomposed that gave us the opportunity to treat better the presence of the seasonal break introduced in the series in the most recent period.

Bibliography

Di Fonzo, T. *The OECD Project on Revisions Analysis: First Elements for Discussion*, OECD short-term economic statistics expert group (STSEG), meeting June 2005.

Eurostat. *Eurostat Guideline on Seasonal Adjustment*, Luxembourg, 2009.

Hood C., Findley. D. *Comparing Direct and Indirect Seasonal Adjustments of Aggregate Series*, in *Seasonal Adjustment* (eds. Michele Manna and Romana Peronaci), 9-22. Frankfurt: European Central Bank, 2003.

Kaiser R., Maravall, A. *Seasonal outliers in time series*, Banco de Espana, Working Papers 9915, Banco de Espana, 2001.

Ladiray, D., Mazzi, G. *Seasonal Adjustment of European Aggregates: Direct versus Indirect* in M. Manna and R. Peronaci (eds.) Seasonal Adjustment, Frankfurt am Main, Germany: European Central Bank, pp. 37-65, 2003.

Maravall; A. *An application of the TRAMO-SEATS automatic procedure; direct versus indirect adjustment*, Computational Statistics & Data Analysis 50 2167 – 2190, 2006.

Otranto, E., Triacca, U. *Measures to Evaluate the Discrepancy between Direct and Indirect Model-Based Seasonal Adjustment*, Journal of Official Statistics, 18, 2002.