The seasonal adjustment of quarterly service turnover indices[1]

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Abstract

In the last years Istat has increased information in the short-term statistics domain for the service sector. Until 2010 quarterly service turnover indices were published only in unadjusted form. The time span available made the estimation of seasonally adjusted indicators feasible. However the change in the economic classification, that was relevant especially in the service sector, has raised significant methodological issues in the determination of the seasonal component, as for example the presence of seasonal level shift. Although Istat' strategy for seasonal adjustment is based on TRAMO-SEATS procedure, in this work different diagnostics useful to provide empirical evidences on seasonal outliers detection are exploited. In more detail, the TRAMO-SEATS framework was integrated with X12-ARIMA diagnostic on seasonal outliers by applying the Demetra+ procedure that combines TRAMO-SEATS and X12-ARIMA procedures in a unique framework.

Keywords: Seasonal adjustment, Demetra+, Service Turnover, Seasonal Break. JEL: C22, C43, L80

1. Introduction

In the last years, Istat improved statistic information on service sector. Concerning the quarterly service turnover indices the strategy has been developed along three lines. Firstly, the coverage of the indicators has increased by the release of more indices completing the wholesale and retail trade and repair of motor vehicles and motorcycles, land transport, warehousing and support activities for transportation, accommodation and food and beverages service activities (Bacchini et al. 2014). Secondly, in 2013 new surveys for professional, scientific and technical activities and for administrative and support service activities have been launched completing the set of indices required by the European short-term statistics regulation. The indices for these sectors were released in June 2014 together with the total index for services (Istat, 2014). Finally, for an easy interpretation of the economic performance of the service sector, the seasonal adjusted figures were elaborated for the following economic sectors: maintenance and repair of motor vehicles (G452), wholesale trade (G46), water transport (H50), air transport (H51), postal and courier activities (H53) and information and communication services (J), for which the time span available is more than 10 years.

In this work the unadjusted series are the ones released in the base year 2010=100. The TRAMO-SEATS seasonal adjustment method (Gomez and Maravall, 1996) which represents

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the standard approach in Istat (see for example Anitori et. al, 2000 and Piccolo, 2000) is applied.

The aim of this work is to illustrate the empirical analysis behind the release of seasonal adjusted indicators. Particular attention is paid to the detection of seasonal outliers. The hypothesis is that the introduction of the economic activities Nace 2 (Eurostat, 2008), associated with the change of the base year (2005=100), might have involved significant changes in the seasonal pattern. To investigate this issue, it is important to use the diagnostic of X12-ARIMA (Findley et al., 1998) together with TRAMO-SEATS method. The combination of the use of TRAMO-SEATS and X12-ARIMA is one of the novelties of our work together with a deeply investigation of the problem of seasonal outliers.

For the empirical application has been used the software Demetra+, that is the result of a project developed by Eurostat (2013) in an open source environment. Demetra+ represents the standard tool introduced by the European national statistic institutes. The latest version of Demetra+ includes some new analysis for TRAMO-SEATS as seasonality test or residual seasonality test, the revision history and the sliding spans analysis.

The remainder of this paper is organized as follows. Section 2 briefly recaps the characteristics of TRAMO-SEATS procedure, section 3 introduces the deterministic effects with a focus on the seasonal pattern features. Section 4 presents the results of the identification and estimation of the seasonal component for each sector of economic activity while conclusive remarks are reported in section 5.

2. Time series seasonal adjustment with TRAMO-SEATS

All the seasonal adjustment methods are founded on the assumption that each time series Y_t can be decomposed in three different unobserved components:

- **trend-cycle** (TC): represents the long-run movement of the series (like those associated to the business cycles). It is generally associated to structural conditions like the institutional situation, the technological and demographic trends or patterns of civil and social organization.
- **Irregular component** (I): represents the short term fluctuations that are not systematic and in some instances not predictable, e.g. uncharacteristic weather patterns. In a highly irregular series, these fluctuations might be relevant obscuring the trend and seasonality. The irregular component, in some cases, may include extreme values or outliers, due for example to abrupt climate change, natural disasters, strikes or faults.
- **Seasonal component** (S): represents the intra-year (monthly, quarterly) fluctuations that are more or less stable year after year with respect to timing, direction and magnitude. The seasonal component recur every year to the same extent, e.g. weather fluctuations that are representative of the season, tax deadline, expectations, institutional arrangements, social, religious or cultural events.The seasonal component may also include calendar related systematic effects that are not regular in their annual timing or are caused by variations in the calendar from year to year (like the Easter). Moreover, some phenomena might exhibit an evolution of the seasonal characteristics along the time. According to the causes, seasonality may vary slowly or quickly, in a deterministic or stochastic way.

Althogh the series may be decomposed in different way, generally we refer to the following models:

- additive model: $Y_t = TC_t + S_t + I_t$
- multiplicative model: $Y_t = TC_t \times S_t \times I_t$

- log-additive model: $\log(Y_t) = log(TC_t) + log(S_t) + log(I_t)$

where the additive model assumes that the components are mutually orthogonal and the multiplicative one considers the components as mutually dependent. TRAMO-SEATS adopts only the additive and log additive model. Once estimated the components, the seasonally adjusted series is obtained by removing the seasonal component from the raw series as follows:

- additive model: $Y_t - S_t = TC_t + I_t$
- motiplicative model: $\frac{Y_t}{S_t} = TC_t \times I_t$.

According to theoretical results coming from modern analysis of time series, for which the series Y_t can be interpreted as the result of both deterministic and stochastic effects, TRAMO-SEATS performs the estimation of a model RegARIMA as follows:

$$Y_t = w_t + z_t = \sum \beta_i x_{it} + z_t \tag{1}$$

where Y_t describes the value of the time series at time t, $w_t = \sum \beta_i x_{it}$ represents the deterministic component relating to k non-stochastic variables identified by the set of regressors x_{it} and z_t identifies the stochastic component without deterministic effects (linearized series) which is supposed to follow an ARIMA process.

The procedure applied by TRAMO-SEATS takes place in two phases:

- the first performed by TRAMO whose aim is to identify and to estimate the deterministic effects (βx_{it}) contained in raw data using a linear regression model, providing as output the stochastic or linearized series. TRAMO performs the identification and the estimation of the seasonal ARIMA model (SARIMA) for Y_t;
- the second performed by SEATS which aims to decompose Y_t by estimating some ARIMA models able to represent the unobservable components: trend, seasonality and irregular component.[1]

3. The deterministic effects

The seasonal adjustment procedures through ARIMA models is based on the assumption that the target series is stochastic. Therefore, it should be done a preliminary treatment of data in order to remove from the series any deterministic effect. These effects refer to:

- calendar effects, as the different number of working days in the periods observed (months, quarters), the presence of leap year or changing holidays like the Easter;
- outliers, such as extreme values, due to different causes, like disasters or strikes;
- level shifts occurred when the long-term trend of the series undergoes an increase or decrease;
- seasonal outliers, reflecting changes in the level of the series in specific months/quarters.

To estimate the deterministic effects specific regressors (x_i) of the RegArima model (1) are used.

[1] While SEATS estimates the final model, it proceeds also with a reallocation of the different components as the deterministic effects already estimated by TRAMO. For example, calendar effects are assigned to the seasonal component, while those arising from anomalous values can be assigned to the trend component or to the irregular one. For further details, see paragraph 3.

The calendar effects and those resulting from the change in the seasonal pattern are assigned to the seasonal component, while the outliers that produce changes in the level of the series (level shift, ramp) are assigned to the trend-cycle component, finally those resulting from occasional outliers to the irregular component.

3.1 Calendar effects

The observations of a series can differ from one period to another due to different frequency of working days as well as to effects of moving holidays, like Easter changing year by year.

For example, by considering $X_{1t}, X_{2t} \dots X_{7t}$ as the number of *Mondays, Tuesdays, ..., Sundays* for each month/quarter it is possible to estimate the calendar effects through two different parametrisation:

- when it is important to underline the number of specific days per week, 6 regressors (trading days) are used:

$$\begin{aligned} r_{1t} &= X_{1t} - X_{7t} \\ r_{2t} &= X_{2t} - X_{7t} \\ &\dots \\ r_{6t} &= X_{6t} - X_{7t} \end{aligned}$$

- when it is important to distinguish between working days (Monday-Friday) and not (Saturday and Sunday) only one regressor is used (single regressor), defined as:

$$r_t = (X_{1t} + X_{2t} + X_{3t} + X_{4t} + X_{5t}) - \frac{5}{2}(X_{6t} + X_{7t})$$

  where $\frac{5}{2}$ represents the constraint that the sum of the effects is null each week.

A unified approach for the modelisation of the working days effect has been investigated by the Istat task-force (Istat, 2005). The task-force provided evidences also on the introduction of the correction of the national holidays and the leap year. The conclusions were in favour of the introduction of a single regressor that accounts for all the calendar effects (working day, national holidays and leap year).

For service turnover time series the calendar effect has been tested by the inclusion in the model of an *ad hoc* variable that takes into account also the national holidays, while the Easter effect has been checked using the standard regressor provided by the Demetra software.

The “Calendar Effects” appeared to be not significant for any series but for the wholesale trade while the Easter effect was not significant for all the sectors.

3.2 The outliers detection

The presence of outliers can lead a model missspecification. Outliers are atypical data that appear to be inconsistent with the remainder of the observed sample. They may depend on: new legislation governing/affecting economic activity, new taxes, natural disasters, strikes or even errors of measurement. TRAMO has an automatic search algorithm of outliers able to identify:

- additive outliers (AO), when a single observation presents an extreme value with respect to the normal trend of the series (error, strike, etc);
- transitional outlier or temporary change (TC), when at the time t_0 occurs an increase/decrease in the series level that needs a certain number of periods for being nullified;
- level shift (LS), whereas starting from a certain period time series shows a permanent change in the level.

In order to take into account the effect produced by an additive outlier (AO), it is sufficient to introduce a dummy variable which takes values 0 everywhere but for the observation in which the outlier occurs where it takes value 1.

$$AO_t^{(t_0)} = \begin{cases} 1 & \textit{if } t = t_0 \\ 0 & \textit{if } t \neq t_0 \end{cases}$$

The variable used to capture the effect of a temporary change in t_0 is:

$$TC_t^{(t_0)} = \begin{cases} 0 & \textit{if } t < t_0 \\ \delta^{(t-t_0)} & \textit{if } t \geq t_0, \quad 0 < \delta < 1 \end{cases}$$

Unlike the two previous cases, if a shock appears to be permament and the series changes its level, the relative effect is integrated in the trend component. To treat it two hypothesis can be considered:

- In case level change occurs in a single instant of time the following regressor can be adopted:

$$LS_t^{(t_0)} = \begin{cases} -1 & \textit{if } t < t_0 \\ 0 & \textit{if } t \geq t_0 \end{cases}$$

  with all values equal to -1 until time t_0 and 0 in the remaining part of the series.[2]

- In case the series increases/decreases over more periods (from t_0 to t_1 following a linear trend) the most suitable variable to capture the effect of the change is the ramp:[3]

$$RP(t_0)_t = \begin{cases} -1 & \textit{if } t \leq t_0 \\ \frac{t-t_1}{t_1-t_0} & \textit{if } t_0 < t < t_1 \\ 0 & \textit{if } t \geq t_1 \end{cases}$$

[2] In this case the effect is to adapt the first part of the series to the second.

[3] Generally, the ramp is used when the series shows a set of consecutive AO followed by a LS in the same interval in which is manifested the increase/decrease of the series. In this case the regressor used try to adapt the first part of the series to the second. However, it is possible to adapt the second part of the series to the first by using a quite similar regressor like the following:

$$RP_t^{(t_0)} = \begin{cases} 0 & \textit{if } t \leq t_0 \\ \frac{t-t_1}{t_1-t_0} & \textit{if } t_0 < t < t_1 \\ 1 & \textit{if } t \geq t_1 \end{cases}$$

In specific case of short-term economic indicators the ramp has been used to take into account the effects of the crisis occurred between end of 2008 and 2009.

For quarterly service turnover indices, the ramp has been included in the seasonal adjustment model of the wholesale trade sector, while the decline in the air transport occurred at the end of 2008 has been modelled with a LS at the fourth quarter of 2008.

3.3 The changes in the seasonal pattern

The seasonal pattern of a time series might evolve over time, for reasons related to the economic operators behavior, consequences related to the introduction of a new legislation[4], or for statistical reason, such as the introduction of new classifications of economic activities or methodology changes in the surveys.

In presence of changes in the seasonal pattern it is more difficult to apply the seasonal adjustment methods. Indeed, both in the case of the parametric approach (TRAMO-SEATS) than in the non-parametric (X-12-ARIMA), these effects can influence several characteristics of the seasonal adjustment procedure. In particular, they affect the identification of the calendar components as well as the outliers (Kaiser and Maravall, 2001, Monsell, 2007). Moreover, they can produce biased estimation of the seasonal component, in term of optimal allocation between seasonal and irregular component.

The result is an high volatility of the seasonally adjusted series with the risk of significant revisions. The current version of TRAMO-SEATS does not include a procedure for the automatic identification of seasonal level-shift (although it should be available in future releases), therefore the identification is left to the researchers looking at the following items:

- the “moving seasonality” statistic test that, if significant, identifies the presence of changes in the seasonal pattern[5]
- a significant and not temporary change of the monthly/quarterly SI ratios[6] usually accompanied by an high outliers concentration or a sudden change in the dynamic of the series in that specific month/quarter.[7]

The software X-12-ARIMA, through a specific module, provides statistical tests able to assess the differences between the seasonal pattern of two subperiods.[8]

Following Kaiser and Maravall (2001), the presence of a seasonal break has been trated by the introduction of a “seasonal level shift outlier” whose effect captures, from a certain year onwards, increments (or decrements) in the permanent level of the series for one or more months/quarters.

In the present analysis the regressor is related to the definition of the seasonal outlier effect introduced by Monsell (2007), which is “identical (or equivalent) to the seasonal level shift outlier found in Kaiser and Maravall”.[9]

[4] We can think for example to the law that discipline the number of opening days of the commercial exercises per week.

[5] The test is based on an F-statistic that considers the ratio between the residual sum of squares of the seasonal component among the years and the residual sum of squares computed through the model (ONS, 2005 Chapter 27).

[6] The SI ratios represent the seasonal and irregular components jointly considered. They are plotted for each quarter/month separately to analyse the seasonal dynamic.

[7] See ONS, 2005 Chapter 17.

[8] The test computes, by adding specific quarterly (monthly) regressors, a t-statistic for each quarter (month) and a χ^2 statistic for the total set of regressors.

[9] The formulation proposed by Monsell is defined differently than the one found in Kaiser and Maravall (2001) because of the regressor is constructed so that the seasonal pattern of the data before the date of the seasonal level shift is changed, conform with the seasonal pattern of the present (Monsell).

According to Monsell, a seasonal outlier effect beginning at time t_0 is defined as:

$$SO_t^{(t_0)} = \begin{cases} 0 & \textit{if } t \geq t_0 \\ 1 & \textit{if } t < t_0, \text{ t same quarter as } t_0 \\ -\frac{1}{(s-1)} & \text{otherwise} \end{cases}$$

where s is the period of the time series being modelled (i.e. for quarterly series we have $s = 4$).

This regressor aims to redistribute uniformly increase (decrease) of a month/quarter (t_0), in the other periods of the year without changing the level of the series. Furthermore this regressor has the advantage of adapting the seasonal pattern of the series to the latest data rather than altering the seasonal pattern of the present to conform with that of the past. [10]. Indeed, the introduction of this regressor produces slight variations in the adjusted level of the series.

As an example, suppose that for quarterly time series starting at time $t = 1$ a seasonal outlier break occurs at time $t = 9$, the regressor will correspond to:

$$SO_t^{(t_0)} = \begin{cases} 0 & \textit{if } t \geq 9 \\ 1 & \textit{if } t = 1, 5 \\ -\frac{1}{3} & \text{otherwise} \end{cases}$$

In order to evaluate the presence of possible changes in the seasonal pattern, a deep analysis on the characteristics of the raw indices and on the evolution of the quarterly profile in different years has been elaborated. Moreover, the SI ratios has been checked by looking at the results of some specific tests. The results are reported in the following section.

In some cases, the service turnover series show a significant movement in the seasonal pattern around the 2005. This result is in line with the hypothesis that it has been not easy to reshape the annual data collected for the enterprises entered in the sample according to the introduction of the economic classification Nace 2. The modification in the evolution of the market for the sector of the postal services and air transport in those years could reinforce the hypothesis.

4. The empirical analysis and the model selection

In this section, after a short presentation of the Demetra+ package, the results of the empirical analysis on the seasonal dynamics and the choice of seasonal adjustment models for the service turnover index series (base year 2010 = 100) are presented. Moreover looking to the diagnostics provided by TRAMO-SEATS and X12-ARIMA the presence of break in the seasonal pattern is checked. The introduction of the new classification of the economic activities as well the difficulties in the collection of the microdata for 2005[11] and the introduction of some degree of liberalisation for some sectors could support the change in the seasonal behaviour around the 2005.

The data analyzed refer mostly to the period 2000-2012, but from 2001 for the maintenance and repair of auto vehicles and for the postal and courier activities sector, and from 2002 for the air transport sector.

[10] Also, there can be a slight change in the level of the adjusted series when this outlier is used; it would be better to avoid changes in level to the most recent data. See Monsell, 2007 page 3.

[11] The late availability of the Business register information with the code of economic activity (Nace 2) has implied some difficulties recording the quarterly data for the base year.

4.1 On the use of Demetra+ for the model selection

During the last few years, greater importance has been given by Eurostat to the seasonal adjustment procedures. The GSPBM (Generic Statistical Business Process Model) diagram (Unece, 2009), a recent tool to describe the different phases of the statistical data production process, includes in the Analysis phase (phase 6) “the production of additional measurements such as indices, trends or seasonally adjusted series".

Therefore, Eurostat focused its activities to compare different methods of seasonal adjustment and to prepare guidelines to be used in the production phase of seasonally adjusted data.

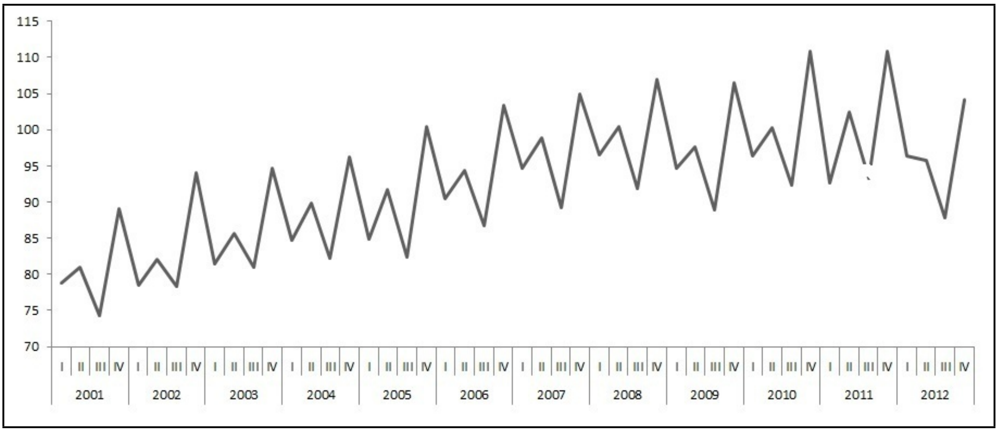
More in detail, the studies led to the selection of two seasonal adjustment methods, as X-12-ARIMA and TRAMO-SEATS. The second step was the release of a standard interface that make easier to perform seasonal adjustment. The result was the development of Demetra+.

In our analysis Demetra+ was important especially for the assessment on the seasonal outliers detection. Moreover it provided a common presentation/analysis tools for both TRAMO-SEATS and X12-ARIMA.

4.2 The maintenance and repair of auto vehicles sector (G452)

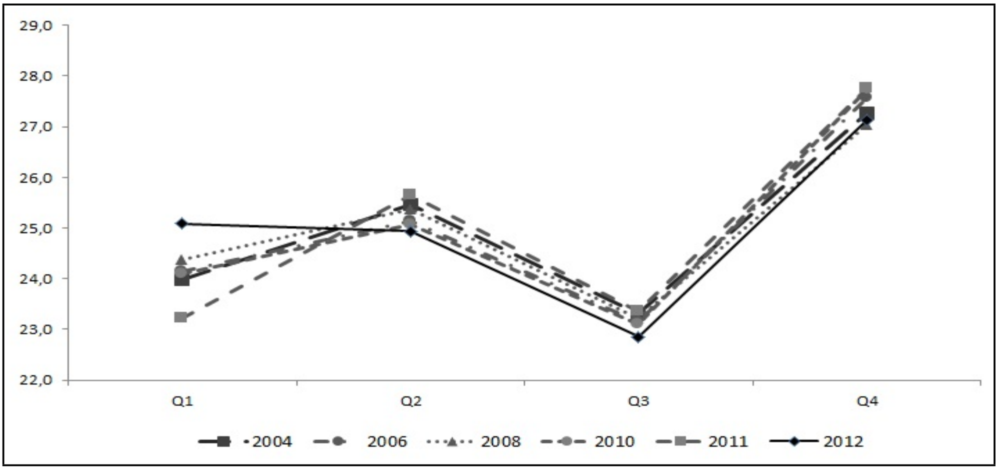
The quarterly turnover index for maintenance and repair of auto vehicles presents a stable movement around a growing trend until the end of 2008. Starting from 2009 the series follows a more static and less regular path, with a decreasing trend until 2012 (Figure 1).

Figure 1 - Quarterly index of maintenance of auto vehicles (G452) - 2001-2012 unadjusted series



The quarterly profile shows a decrease during the summer followed by a peak in the fourth quarter. The series shows a regular seasonality but for the value of the first quarter of 2011, that TRAMO-SEATS identified as an additive outlier (AO), and the second quarter of 2012, which could define a possible change in the level of the series. However it is most likely connected to the economic crisis (Figure 2).

Figure 2 - Quarterly share of the annual index - 2004-2012 (G452)



Indeed, the graphical analysis of the SI ratios does not show any presence of significant changes in seasonal dynamics. The model chosen for the series is an ARIMA [(0,1,0);(0,1,1)] with logarithmic transformation of data and the pre-specification of an additive outlier (AO) at the first quarter of 2011. The treatment of the AO allows to recover good results in terms of normality of the residuals. Moreover, this model as well as presenting a good residuals diagnostic, guarantees compared to other tested models ARIMA [(0,1,0);(1,1,1)] a greater stability of the parameters and a greater efficiency.

Table 1 - G452: ARIMA model [(0,1,0);(0,1,1)]

Parameter	Value	T-Stat	P-Value
BTh(1)	-0.5006	-3.79	0.0005

Outliers

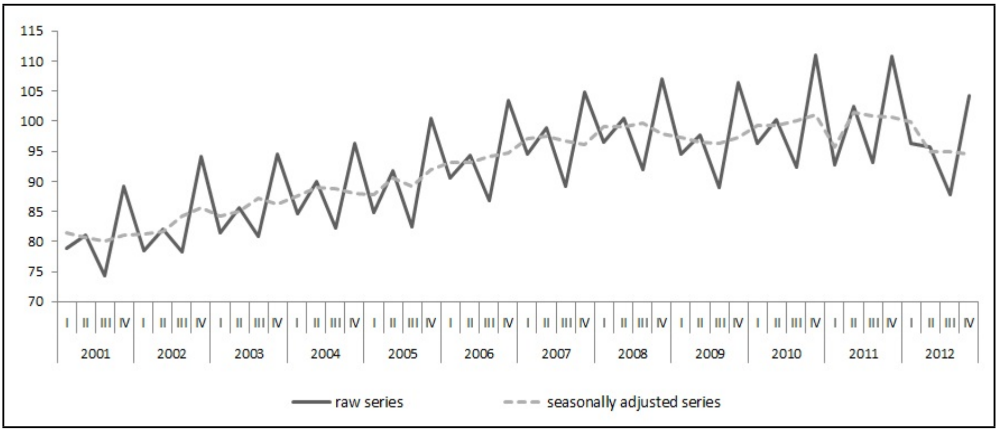
Parameter	Value	T-Stat	P-Value
AO[I-2011]	-0.0699	-5.71	0.0000

Residuals

Normality test	0.2052		0.9025
Ljung-Box	13.785		0.5419
Ljung-Box^2	15.2742		0.4318
Box Pierce on seasonality	1.0855		0.5811

Figure 3 shows the unadjusted series together with the seasonally adjusted one.

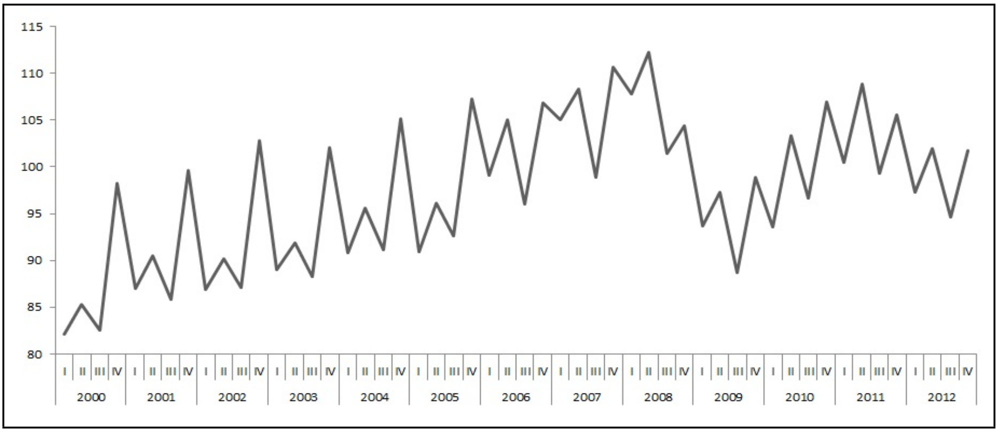
Figure 3 - Quarterly index of maintenance of auto vehicles (G452) - 2001-2012 unadjusted and seasonally adjusted series



4.3 The wholesale trade sector (G46)

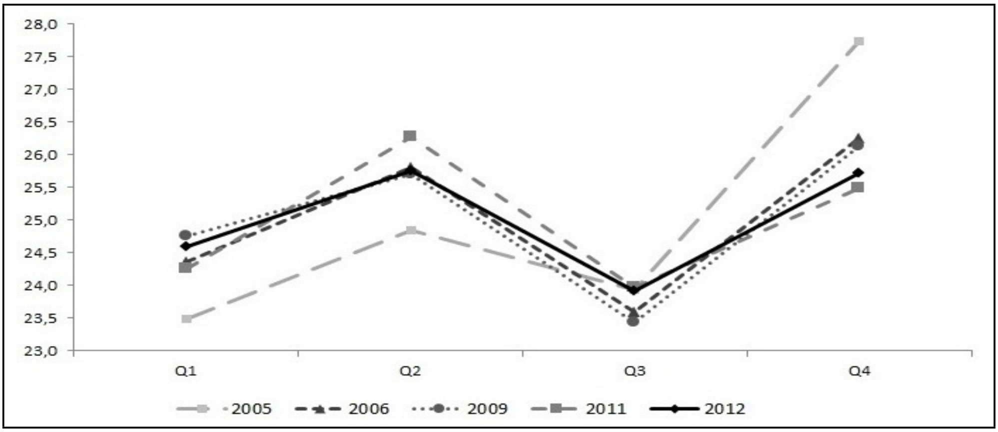
The wholesale trade quarterly turnover index shows a moderate upward trend until the third quarter of 2008 when, following the strong financial crisis, undergoes a drastic decline, measuring a contraction of the year to year growth rate of -13.3% during the second quarter of 2009. In the following period the indicator starts growing until the second quarter 2011, when takes place a new contraction that is still in place (Figure 4).

Figure 4 - Quarterly index of wholesale trade (G46) - 2000-2012 - unadjusted series



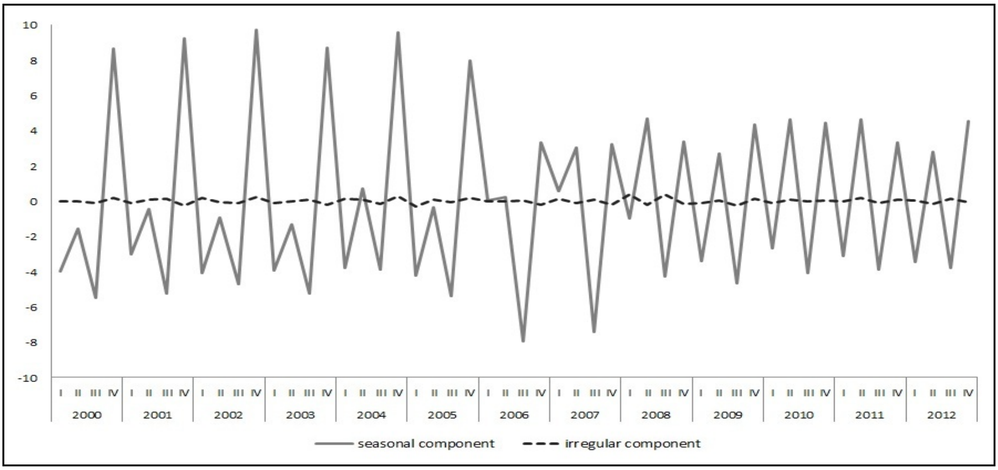
The unadjusted series presents an irregular seasonality with different paths before and after the 2006. Indeed, looking at the contribution of each quarter to the annual variation of the index, can be stated that between 2000 and 2005, the largest contribution to growth is the one related to the fourth quarter, whose value is between 27.5% and 28.2% of annual turnover while the contribution amounts to 23.7% for the first quarter, to 24.8% for the second and to 23.8% for the third one. Between 2006 and 2012 the relative variation of the fourth quarter declines to 25.7%, while the one of the other quarters increases. Indeed, during the same period, the importance of the second quarter grows by reaching a relative share value of 26.3% in 2011, at a lesser degree increases also the variation of the first quarter, while the third quarter remains stable (Figure 5).

Figure 5 - Quarterly share of the annual index - 2004-2012 (G46)



The estimation of the seasonal factor obtained through TRAMO-SEATS (with or without the inclusion of the calendar regressor) allows to distinguish clearly two different seasonal profiles, before and after 2006 (Figure 6).

Figure 6 - Quarterly index of wholesale trade (G46) - 2000-2012 seasonal component



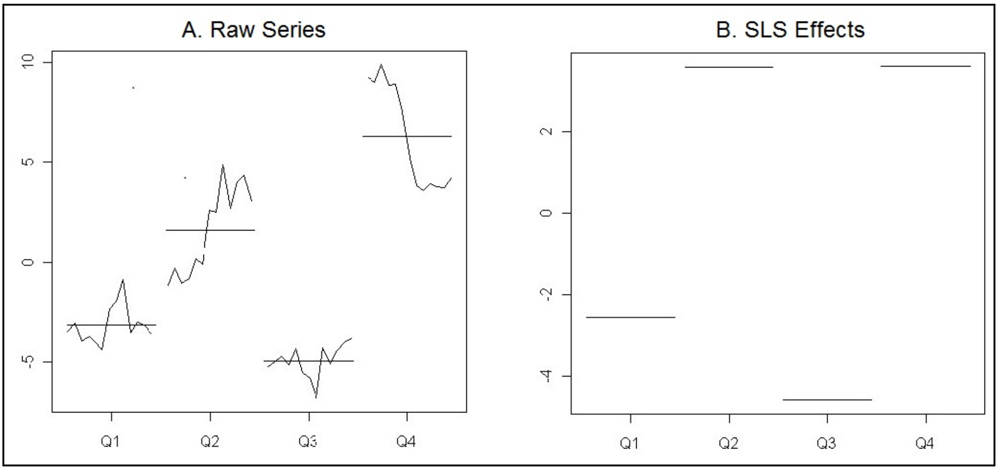
In particular, analysis of the SI ratios shows an opposite path for the second and the fourth quarter (figure 7.A).

To confirm the empirical findings, the presence of a seasonal break has been tested by means of the X-12-ARIMA procedure. The t-test shows that the seasonal regressors of the I, II and IV quarter are significant $(t - value > |2|)$ as well as the Chi-square, used to test the set of regressors, confirm a change in the seasonal pattern of the series from 2006.

To treat the change of seasonality occurred in the series two seasonal level shift (SLS) have been introduced with effect respectively on the second and fourth quarter. The choice was made by iterating the process to obtain the most parsimonious configuration (less interventions), able to ensure an appropriate estimate of both the irregular and the seasonal component.

The effect of the two regressors is to standardize the seasonal pattern of the series prior to 2006 to the next. In figure 7.B, looking at the SI ratios path, the level of the second quarter is higher and equal to that of the fourth one.

Figure 7 - Quarterly index of wholesale trade (G46) - 2000-2012 SI ratios



The final model chosen is an ARIMA [(0,1,1);(0,1,1)] with the calendar regressor, two SLS regressors and a ramp for the period [IV:2008 I:2009] to outline the effects of the crisis in 2008-2009.

A comparison has been made with an Airline model with one SLS on the fourth quarter, however it shows a tendency to amplify the cyclical fluctuations for the period 2000-2005 and produce major revisions in 2008-2009 (given a less continuity with the models already used).

Figure 8 shows the unadjusted series together with the seasonally adjusted one.

Table 2 - G46: ARIMA model [(0,1,1);(0,1,1)]

Parameter	Value	T-Stat	P-Value
Th(1)	0.5996	4.78	0.0000
BTh(1)	-0.4184	-2.66	0.0110

Calendar Effects

Parameter	Value	T-Stat	P-Value
Cal	0.1868	5.12	0.0000

Ramp

Parameter	Value	T-Stat	P-Value
Ramp	-5.5113	-4.22	0.0001

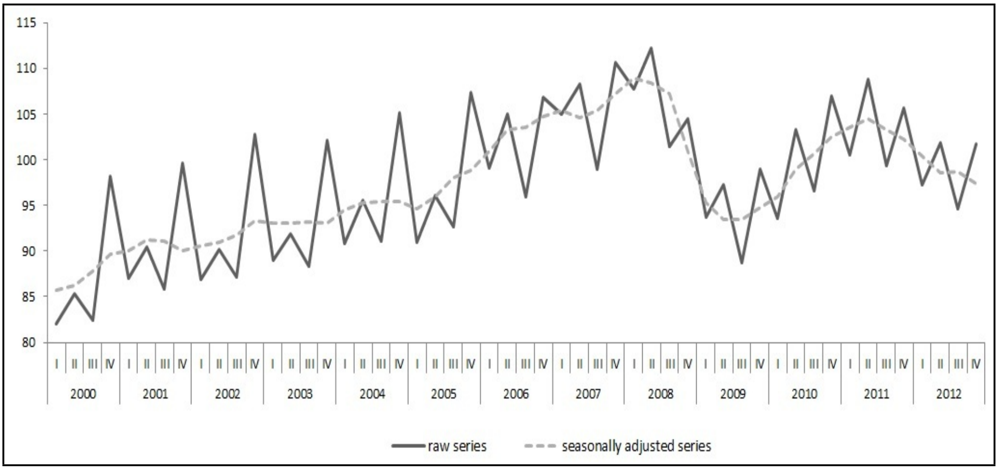
Seasonal Outliers

Parameter	Value	T-Stat	P-Value
SLS[II-2006]	-2.6733	-3.56	0.0010
SLS[IV-2006]	5.0711	7.11	0.0000

Residuals

Normality test	3.251		0.1968
Ljung-Box	18.0827		0.203
Ljung-Box^2	7.371		0.9195
Box Pierce on seasonality	1.8133		0.4039

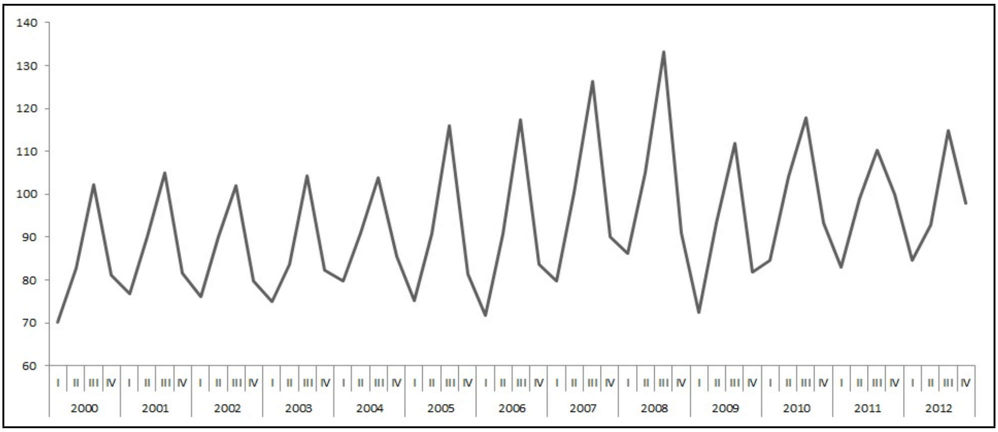
Figure 8 - Quarterly index of wholesale trade (G46) - 2000-2012 unadjusted and seasonally adjusted series



4.4 The water transport sector (H50)

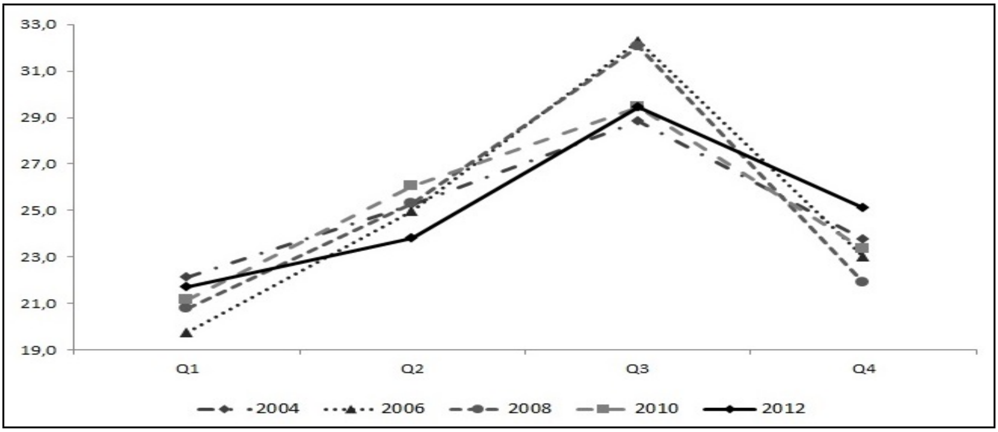
The water transport quarterly turnover index shows an increasing tendency, especially in the period 2005-2008. This trend has a break by the first quarter of 2009 according to the evolution of the economic crisis (Figure 9).

Figure 9 - Quarterly index of water transport (H50) - 2000-2012 unadjusted series



The seasonal pattern evolves along a stable dynamic. On average, the largest contribution to annual growth of the sector occurs in the third quarter with a relative share of 30% and in the second quarter with a share of 25%. While the average contribution values of the fourth and the first quarter result equal to 23% and 21% (Figure 10).

Figure 10 - Quarterly share of the annual index - 2004-2012 (H50)



The analysis of the SI ratios and statistical tests support the hypothesis of the absence of changes in the seasonal pattern.

The selected model corresponds to ARIMA [(0,1,1);(0,1,0)] with logarithmic transformation of the data and the inclusion of a TC (temporary change) outlier at the first quarter of 2009.

The choice optimizes all the diagnostics, particularly those related to the normality of the residuals, the sliding spans and the estimate of the irregular component. Furthermore, the insertion of the TC in place of the ramp is considered more appropriate to explain the economic evolution in the crisis.

Table 3 - H50: ARIMA model [(0,1,1);(0,1,0)]

Parameter	Value	T-Stat	P-Value
Th(1)	-0.6554	-5.95	0.0000

Outliers

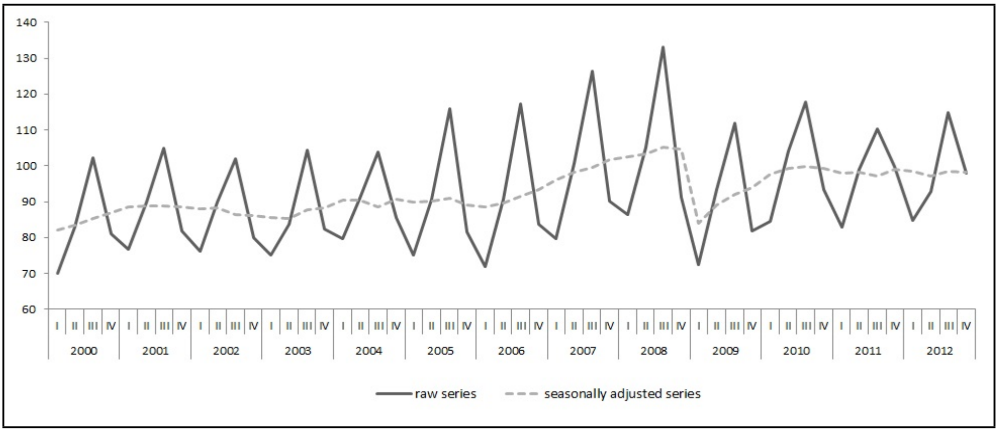
Parameter	Value	T-Stat	P-Value
TC[I-2009]	-0.2202	-6.95	0.0000

Residuals

Normality test	2.1573		0.3401
Ljung-Box	14.5657		0.4831
Ljung-Box^2	17.7256		0.2774
Box Pierce on seasonality	1.7535		0.4161

Figure 11 shows the unadjusted series together with the seasonally adjusted one.

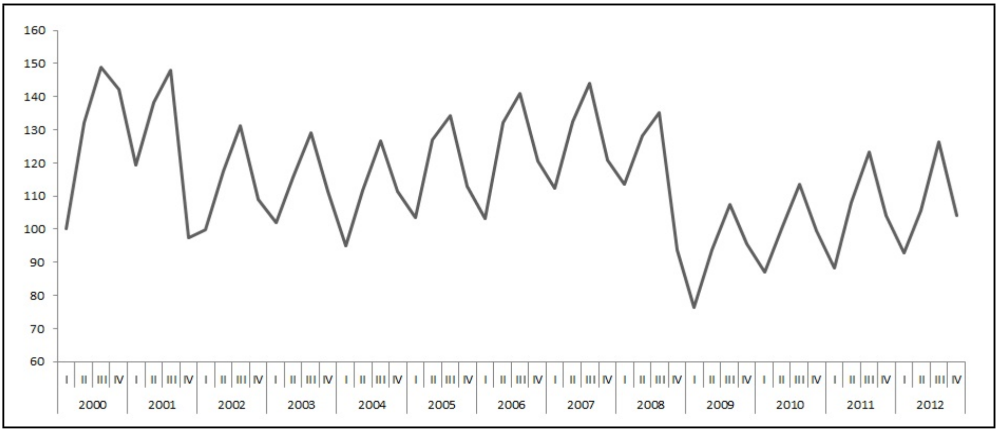
Figure 11 - Quarterly index of water transport (H50) - 2000-2012 unadjusted and seasonally adjusted series



4.5 The air transport sector (H51)

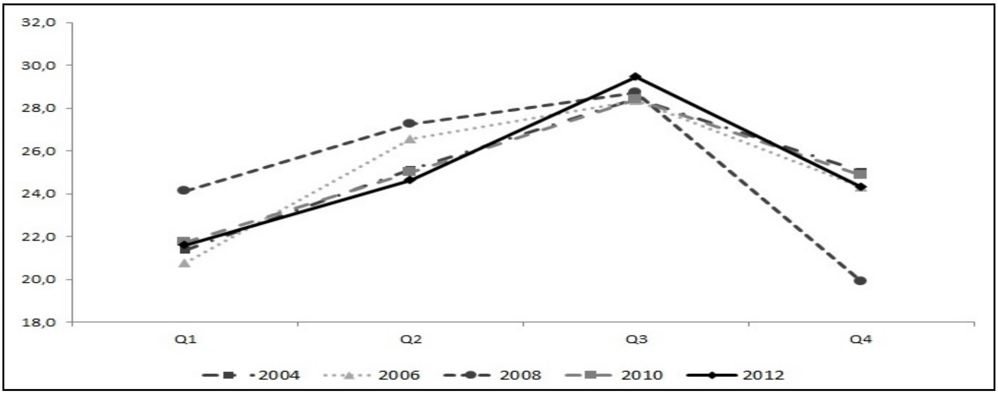
The air transport quarterly turnover index[12] is characterized by a significant change of level occurred from the fourth quarter of 2008. In particular, it increases slowly from the first quarter 2002 until the third quarter 2008, when it recorded a trend decline of 23%. The recovery has been slow and its level is still lower than 2008 (Figure 12).

Figure 12 - Quarterly index of air transport (H51) - 2000-2012 unadjusted series



The series presents a regular seasonality over the period but for 2008. More in detail, the quarterly profile of the indices shows that the greatest contribution is developed by the third quarter ($28-29\%$ of the variation), followed respectively by the second quarter (with a relative share of 25.7%), the fourth quarter (with a relative share of 24%) and finally the first quarter (with a residual relative share of 21.8%). See Figure 13.

Figure 13 - Quarterly share of the annual index - 2004-2012 (H51)



[12] Although the data of the air transport are available from 2000, the model for computing the seasonally adjusted series is identified from 2002.

Although the statistic test on the moving seasonality is significant even when the level change in the trend is treated with a LS regressor, the SI ratios show a trend very regular and no other statistical test shows the presence of changes in the seasonal pattern.

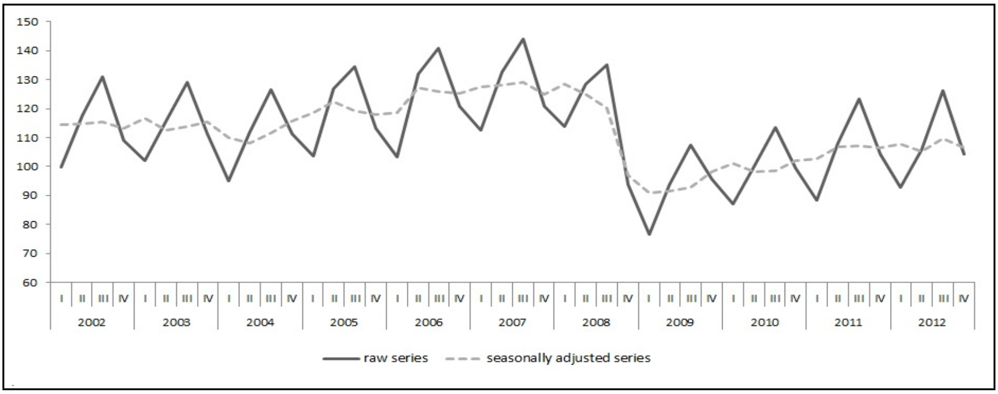
The principal feature of the series is a change of level in the fourth quarter of 2008. Moreover, neither the calendar regressor, nor the Easter effect are significant. The model selected by TRAMO-SEATS is an ARIMA [(0,1,1);(0,1,1)] with a LS in correspondence of the fourth quarter 2008. Due to the value of the test on the residuals and the value and the significance of the Bth parameters, the performance of this model has been compared with an ARIMA [(1,0,0);(0,1,1)] with a LS in the fourth quarter of 2008. This model shows a smoother estimate of the irregular component and a better performance in terms of the statistics on residuals.

Table 4 - H51: ARIMA model [(1,0,0);(0,1,1)]

Parameter	Value	T-Stat	P-Value
Phi	-0.7668	-6.66	0.00
Th(1)	-0.5856	-3.46	0.0014
Outliers			
Parameter	Value	T-Stat	P-Value
LS[IV-2008]	-23.4906	-6.14	0.0000
Residuals			
Normality test	0.389		0.8232
Ljung-Box	13.0223		0.5248
Ljung-Box^2	16.2542		0.2981
Box Pierce on seasonality	2.4547		0.2923

Figure 14 reports the unadjusted series together with the seasonally adjusted one.

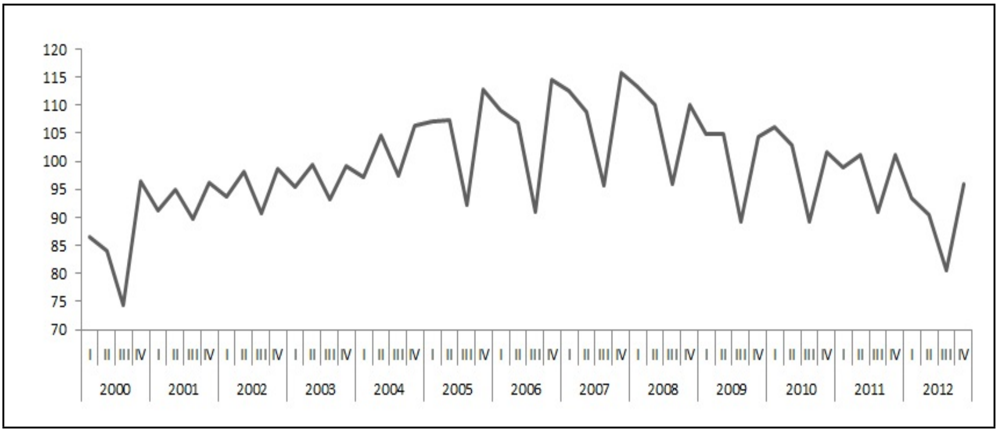
Figure 14 - Quarterly index of air transport (H51) - 2002-2012 unadjusted and seasonally adjusted series



4.6 The postal and courier activities sector (H53)

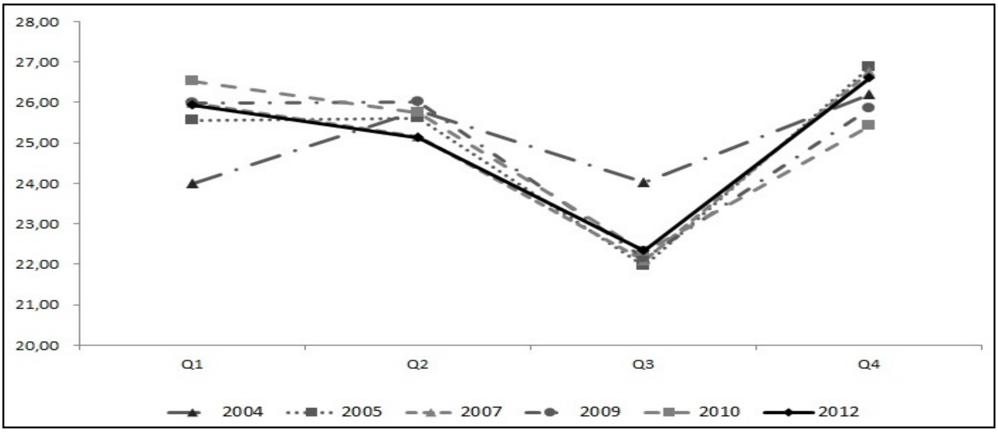
The postal service turnover index shows a positive trend until 2009 when a moderate and constant decline appears (Figure 15).

Figure 15 - Quarterly index of postal sector (H53) - 2000-2012 unadjusted series



The series exhibits a change in the seasonal pattern from 2005 and an ongoing instability in the seasonal dynamic since 2009. In particular, the quarterly profile from 2005 shows a switching between the third quarter, whose relative share declines, and the first quarter, whose relative share grows. Moreover the quarterly share increases also for the fourth quarter (Figure 16).

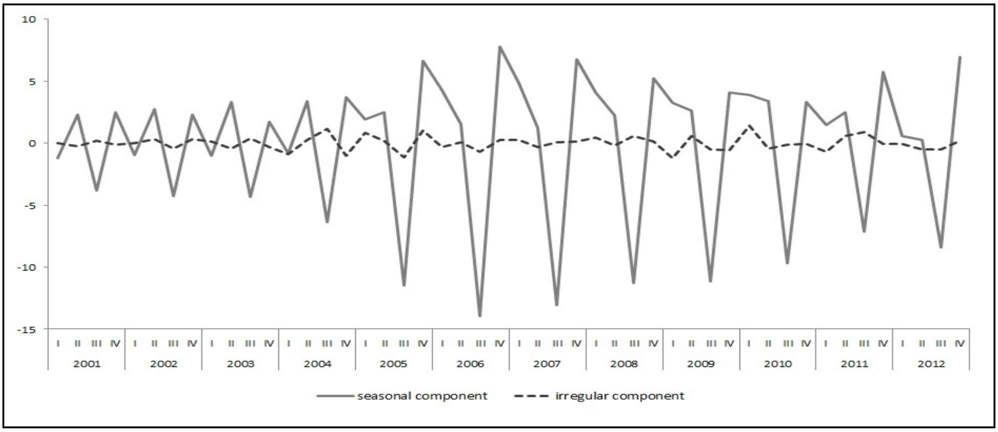
Figure 16 - Quarterly share of the annual index - 2004-2012 (H53)



These results appear more clear between 2005 and 2010, while in recent years the seasonal path shows some irregular value probably related to the changes induced by the crisis. The

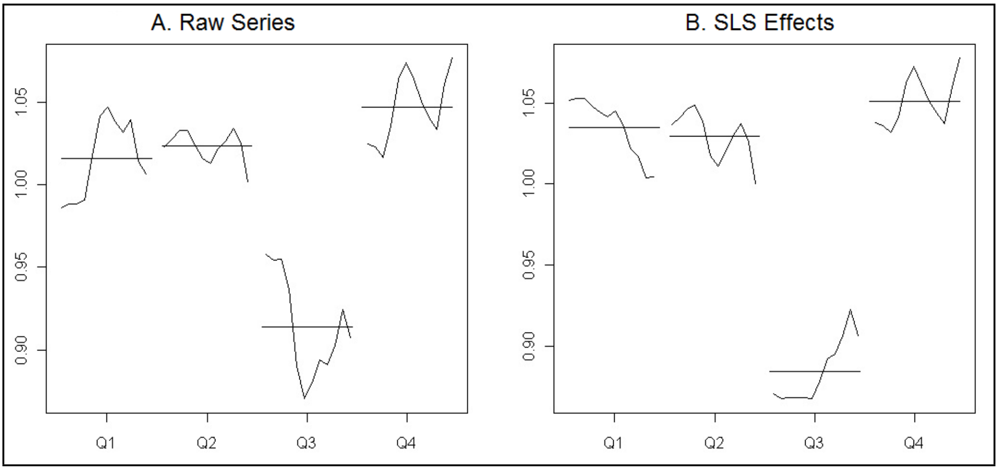
SI ratios analysis and the estimate of the seasonal factor supports the picture of the quarterly share (Figure 17).

Figure 17 - Quarterly index of postal sector (H53) - 2000-2012 seasonal component



The test performed with X-12-ARIMA confirms the discontinuity in the seasonal dynamic since 2005. The t-test on seasonal regressors are significant for the I, III and IV quarter ($t - value > |2|$) as well as the Chi-square test for the set of regressors ($p - value < 0.05$). As the wholesale trade sector, to take into account the seasonal changes occurred in the series, two SLS in the model are included. The choice was made by iterating the process to obtain the most parsimonious configuration (less interventions)with the aim to ensure an appropriate estimate of both the irregular and the seasonal component. The SLS regressors have been introduced on the first and the third quarter. In the Figure 18.B the SI ratios after the treatment are reported:

Figure 18 - Quarterly index of postal sector (H53) - 2000-2012 SI ratios



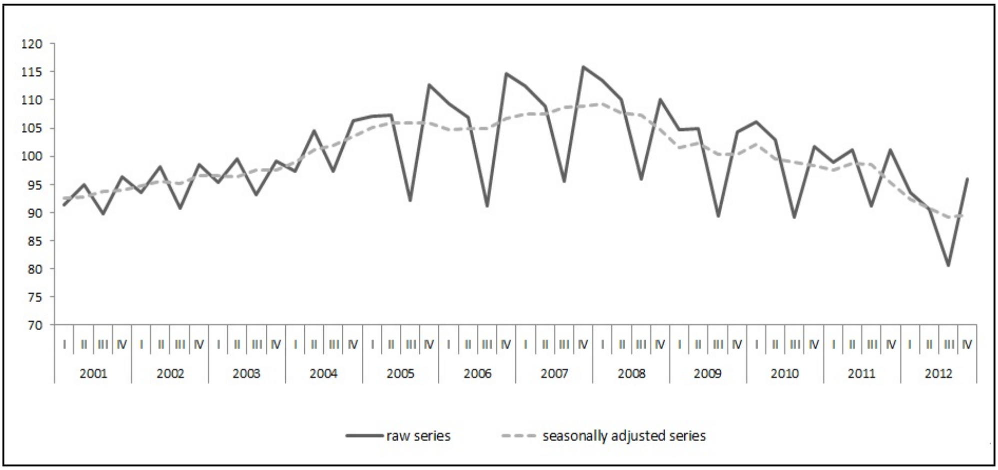
The model selected for the postal and courier activities sector is an ARIMA [(1,0,0);(0,1,0)] with logarithm transformation and the two seasonal level shift (SLS) described above on the first and third quarter. The following table presents the parameters of the model.

Table 5 - H53: ARIMA model [(1,0,0);(0,1,0)]

Parameter	Value	Std error	T-Stat	P-Value
Phi(1)	-0.7591	0.0981	-7.73	0.0000
Seasonal Outliers				
Parameter	Value	Std error	T-Stat	P-Value
SLS[I-2005]	-0.0378	0.0197	-1.92	0.0618
SLS[III-2005]	0.0809	0.0197	4.11	0.0002
Residuals				
Normality test	2.2132			0.3307
Ljung-Box	14.8641			0.4612
Ljung-Box^2	24.9542			0.0506
Box Pierce on seasonality	2.9055			0.2339

Figure 19 illustrates the unadjusted series together with the seasonally adjusted one.

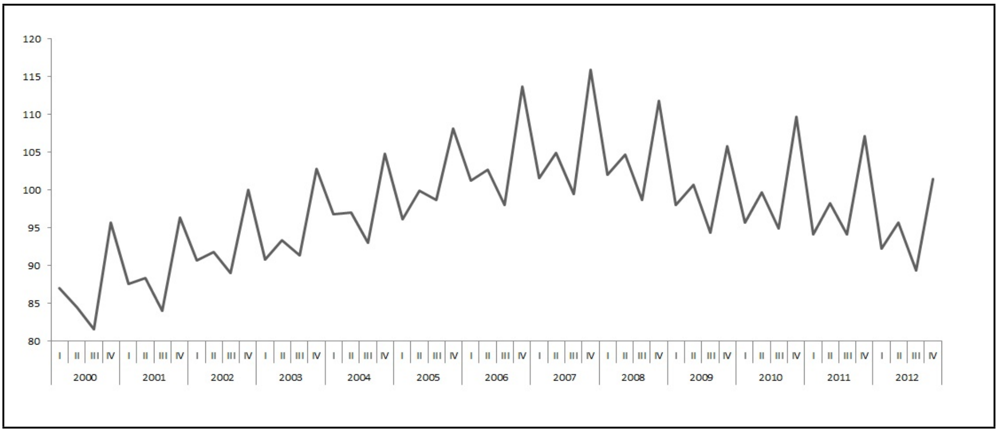
Figure 19 - Quarterly index of postal sector (H53) - 2000-2012 unadjusted and seasonally adjusted series (H53)



4.7 The information and communication services sector (J)

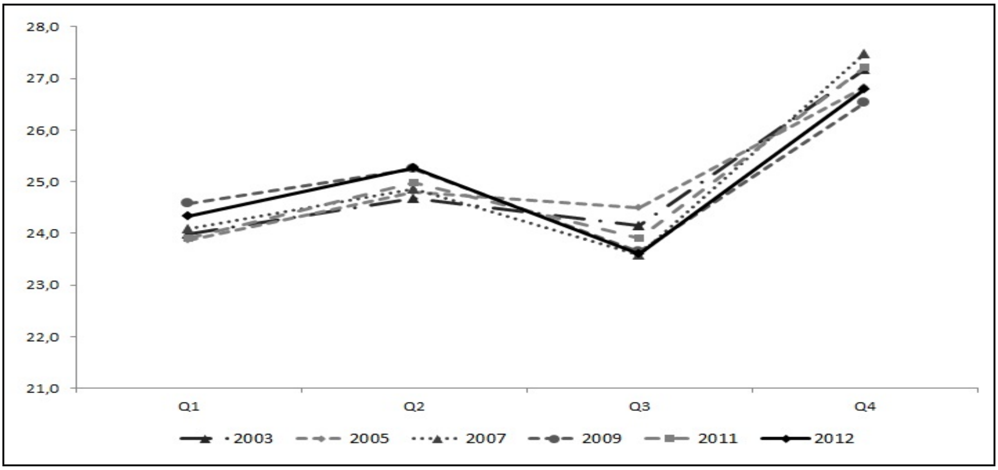
The information and communication quarterly turnover index presents two different regimes, an increasing trend until the middle of 2008 followed by a decreasing behaviour (Figure 20).

Figure 20 - Quarterly index of information and communication (J) - 2000-2012 unadjusted series



The seasonal pattern appears to be quite regular even if during the period analysed there are some mild switchings between the quarters. The value of the quarterly share is higher in the fourth quarter, whose average contribution is between 26.5% and 27.5%. Moreover, while the second quarter grows slightly from 24.2% to 25.3%, the first quarter decreases in the second part of the series by reaching a market share of 24.3% on average. Finally, the third quarter remains quite stable with a relative share of 23.8% per annum (Figure 21).

Figure 21 - Quarterly share of the annual index - 2004-2012 (J)



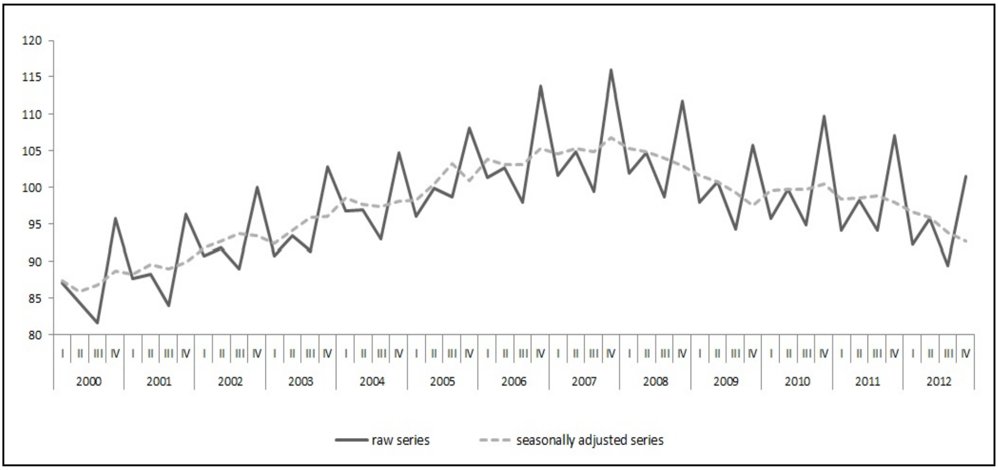
The SI ratios and the tests implemented do not detect any significant changes in the seasonal pattern. The model selected for this sector is an AIRLINE model with logarithmic transformation.

Table 6 - J: ARIMA model [(0,1,1);(0,1,1)]

Parameter	Value	Std error	T-Stat	P-Value
Th(1)	-0.3621	0.1399	-2.59	0.0129
BTh(1)	-0.4861	0.1432	-3.39	0.0014
Residuals				
Normality test	7.3271			0.0256
Ljung-Box	7.2545			0.9245
Ljung-Box^2	14.3995			0.4204
Box Pierce on seasonality	0.3846			0.825

Figure 22 describes the unadjusted series together with the seasonally adjusted one.

Figure 22 - Quarterly index of information and communication (J) - 2000-2012 unadjusted and seasonally adjusted series



4.8 Summary of the results

The previous section illustrated the analysis performed to assess both the identification and estimation of the model providing seasonal adjusted data for the quarterly service turnover indices. The estimated models exhibit an overall good diagnostics of the residuals with a lower performance for the air transport sector that could be related to the shortest time span available.

The tests provided by X12-ARIMA to detect for seasonal level shift confirmed the presence of effects for the wholesale trade sector (G46) and for postal sector (H53). Table 7 summarizes the results for all sectors.

Table 7 - The sectors results for the Seasonal level shift test

Sector	Seasonal Level Shift	Time
G452	No	
G46	Yes	[II-2006][IV-2006]
H50	No	
H51	No	
H53	Yes	[I-2005][III-2005]
J	No	

Two reasons could explain the findings. Both sectors have been characterized by a relevant rotation of the enterprises selected in the sample. However the selection of the sample associated with the change of the economic classification made the business register available with some delay compared to the normal timetable.

Therefore the quarterly data collection needed for the base year was quite difficult requiring an estimation of the quarterly picture.

Moreover the postal sector has been characterized by a rapid evolution of the market conditions towards a more competitive position with new firms entering in the market.

5. Conclusive remarks

During last years particular attention in Istat has been paid to the short-term statistics domain for the service sector in order to meet users needs. The analysis presented are part of this effort reporting the analysis that undergone for the release of the seasonally adjusted data for the main sectors. The index features of these sectors were mainly linked to changes in classification economic activity introduced with the switch to the base year 2005=100. Indeed these changes raised several methodological issues in the estimation of the best model for the seasonal adjustment.

To check for the evidence of seasonal level shift, TRAMO-SEATS approach, currently used in Istat, has been integrated with the X12-ARIMA statistics. The analysis carried out by the software Demetra+ gave helpful features for the assessment on the seasonal outliers detection. Moreover it provided a common presentation/analysis tools for both TRAMO-SEATS and X12-ARIMA.

The results reported the presence of seasonal level shift both for the wholesale trade and the the postal service.

These results go in favour of the development of Demetra + as an useful tool to reinforce the seasonal adjustment activities performed by the national statistical institute by means of an integrated approach of TRAMO-SEATS and X12-ARIMA.

This approach will be followed by the Institute for the next release of the seasonal adjusted series of the whole quarterly service turnover index.

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