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Data Envelopment Analysis (DEA) assessment of composite indicators of infrastructure endowment

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Abstract

In Data Envelopment Analysis the distance from the best practice frontier can be interpreted as the economic performance of sample units. In the present paper this distance is used as an efficiency measure to correct the weighted average of non-substitutable sub-indicators of infrastructure endowment.

Keywords: benefit-of-the-doubt indicators, composite indicators, Data Envelopment Analysis, infrastructure endowment. JEL classification: C18; R50; H54.

1. Introduction

Data envelopment analysis (DEA),first introduced by Farrell (1957) and successively developed by Charnes, Cooper e Rhodes (1978), is a linear programming technique; it defines the *best practice frontier* that serves as a benchmark and computes the relative distance between each unit and the frontier. This distance can be interpreted as the economic performance of the units in the sample. Within the context of composite indicators this interpretation has been used to reassess indicators, see for example Mahlberg and Obersteiner (2001); Despotis (2005), and their reassessment of the Human Development Index; also see Somarriba and Pena (2009), and Sharpe and Andrews (2010) for applications within the context of quality of life and economic well being respectively.

In this paper, however, we make use of the distance from the best practice frontier as an efficiency measure to *correct* a composite indicator of endowment. In fact whenever it is reasonable to assume non-substitutability among the sub-indicators, their weighted average should also take into account the combination (or relative proportion) between the sub indicators used in the aggregation function. We therefore suggest the use of DEA to measure the efficiency of the combination of inputs whose weighted aggregation defines the composite indicator of infrastructure endowment; and to correct the composite indicator by taking into account the efficiency of the combination of sub-indicators.

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2. Data envelopment analysis

DEA measures the relative efficiency of decision making units on the basis of multiple inputs and outputs. The efficiency of a unit is defined as the weighted sum of its outputs divided by a weighted sum of its inputs. "The weights for inputs and outputs are estimated by a linear programme so as to maximize the relative efficiency of each unit" (Despotis, 2005).

Farrel (1957) introduced the concept of *best practice frontier* which delineates the technological limits of what a country can achieve with a given level of resources. The distance from the frontier can be used as a performance indicator.

The techniques used to measure the efficiency of a set of firms can be adapted and used also in the context in which a synthetic objective overall index is to be built.

We use an input-oriented DEA, which is a mathematical programming method that could achieve the task (Coelli , 1996)

The computation of the envelope and the performance indicator can be reduced to a linear programme for each individual unit.

The model assumes N inputs and M outputs for each of the I units (for us regions). For the i-th unit the inputs are represented by an array $\underline{x}_i$ and the outputs are represented by an array $\underline{q}_i$. A first problem's formulation is the following: for each unit i the ratio of all the outputs over all the inputs is defined as

$$f(\underline{u},\underline{v}) = \frac{\underline{u}'\underline{q}_i}{\underline{v}'\underline{x}_i}$$

where $\underline{u}$ is an array of output weights and where $\underline{v}$ is an array of input weights . The model seeks to maximize f , which represents the efficiency of the unit i, subject to the constraints that all the efficiency measures must be less than or equal to one. Moreover the weights must be positive. This linear programme is solved for each unit assigning to it the most favourable weights. A problem with this formulation is that it has infinite solutions of the form ($\delta\underline{u}$, $\delta\underline{v}$) for $\delta > 0$. To avoid it, the following constraint is introduced

$$\underline{v}'\underline{x}_i = 1$$

Thus the problem can be written as

$$\begin{cases} \max\limits_{\underline{u},\underline{v}} \underline{u}'\underline{q}_i \\ \underline{v}'\underline{x}_i = 1 \\ \underline{u}'\underline{q}_1 - \underline{v}'\underline{x}_1 \le 0 \\ \vdots \\ \underline{u}'\underline{q}_I - \underline{v}'\underline{x}_I \le 0 \\ \underline{u},\underline{v} \ge 0 \end{cases}$$

Lastly we call the model DEA with no input if for the array $\underline{x}_i$ we have $\underline{x}_i=(1,...,1)'$.

The model computes the weights so that the unit under investigation is valued as best as possible. The weights can differ from unit to unit; and range between 0 and 1.

A particular weakness of DEA must be underlined. Any unit supporting the frontier is credited as equally well performing even if it is superior with respect to one indicator but performs poorly with respect to all the others. For such a unit DEA computes a high weight

for the indicator on which the unit is superior and a low weight for all the others. In fact as Cherchye et al. (2007) affirm: "*the core idea is that a good relative performance of a country in one particular sub indicator dimension indicates that this country considers the policy dimension concerned as relatively important*". Such a data oriented weighting method is justifiable in the typical composite indicator context of uncertainty about and consensus on an appropriate weighting scheme, and opens the way to the "benefit of the doubt" indicators(Cherchye et al., 2007, 2008).

3. DEA as a measure of the efficiency of a combination of indicators

3.1 DEA with no inputs

Assume we have an infrastructure endowment composite indicator obtained as a weighted average of different sub-indicators. For the sake of simplicity assume equal weighs of the different (possibly normalized) sub-indicators. This means that a situation in which subindicator 1 assumes value 100 and sub indicator 2 assumes value 50 is equivalent to a situation in which sub indicator 1 assumes value 50 and sub indicator 2 100 : the value for the composite infrastructure endowment indicator remains the same. The question is: do we agree that the sub-indicators are substitutable? Can we define and measure the efficiency of their combination and define on this basis an equivalence between different values (and different combinations) of sub-indicators?

DEA provides a useful insight.

Let us take as an example, 8 health care infrastructure endowment indicators for 20 italian regions:

1. public health care expenditure per 10.000 residents
2. National health care staffx 1.000 residents
3. medical specialist x 10.000 residents
4. Primary Care Trusts Number x 1.000.000 residents
5. physicians 10.000 residents
6. emergency medical service x 1.000.000 residents
7. n. inpatient beds x 10.000 residents
8. rehabilitation centres/long-term care centre/nursing x 1.000.000 residents

These indicators are necessary and not substitutable: how could health care be provided without physicians or impatient beds or without a sensible combination of these or any of the other indicators?

First of all we perform an unconstrained DEA without input to obtain the so called Benefit of the Doubt (BoD) composite indicator. These and the next results shed a light on how *doubtful* some composite indicators can be.

As a result of DEA without input we have (in table 1a) that more than 50% of the regions are classified as efficient and thus would obtain the highest value for the composite BOD indicator of infrastructure endowment. It is the precise aim of DEA to value each unit as best as possible allowing for different combinations of inputs.

Table 1a - Efficiency for DEA with no input (scenario A.1)

REGIONS	Efficiency	REGIONS	Efficiency
Piemonte	95,86%	Marche	93,76%
Valle d'Aosta	100,00%	Lazio	100,00%
Lombardia	91,32%	Abruzzo	100,00%
Trentino Alto Adige	100,00%	Molise	100,00%
Veneto	88,97%	Campania	84,84%
Friuli Venezia Giulia	100,00%	Puglia	93,51%
Liguria	100,00%	Basilicata	100,00%
Emilia Romagna	100,00%	Calabria	100,00%
Toscana	100,00%	Sicilia	97,03%
Umbria	100,00%	Sardegna	100,00%

As for the weights, they are reported in table 1b.

Table 1b - Weights for DEA with no input (scenario A.1)

	Piemonte	**Valle d'Aosta**	**Lombardia**	**Trentino Alto Adige**	**Veneto**	**Friuli Venezia Giulia**	**Liguria**
u_1	0,00%	1,45%	0,00%	1,66%	0,00%	1,10%	2,40%
u_2	37,85%	7,90%	0,00%	77,19%	9,55%	34,80%	42,73%
u_3	5,16%	5,23%	50,19%	1,54%	0,00%	5,72%	32,52%
u_4	0,00%	68,85%	0,00%	0,63%	17,86%	7,28%	7,23%
u_5	44,49%	14,53%	0,00%	4,97%	70,48%	50,06%	13,83%
u_6	0,00%	0,03%	0,00%	0,10%	0,00%	0,05%	0,08%
u_7	12,51%	0,35%	49,81%	10,34%	2,11%	0,47%	0,85%
u_8	0,00%	1,65%	0,00%	3,57%	0,00%	0,54%	0,35%
v_1	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
	Emilia Romagna	**Toscana**	**Umbria**	**Marche**	**Lazio**	**Abruzzo**	**Molise**
u_1	0,59%	2,81%	0,48%	0,00%	2,77%	0,29%	0,00%
u_2	41,21%	67,27%	2,60%	15,10%	2,22%	1,13%	8,22%
u_3	30,44%	6,66%	5,51%	0,00%	77,10%	5,69%	12,85%
u_4	1,98%	0,22%	19,44%	0,00%	7,23%	2,23%	24,29%
u_5	1,66%	17,45%	71,75%	83,11%	8,15%	89,55%	17,28%
u_6	0,04%	0,07%	0,01%	0,00%	0,18%	0,02%	9,89%
u_7	24,02%	0,89%	0,15%	1,79%	1,71%	0,40%	22,14%
u_8	0,06%	4,63%	0,06%	0,00%	0,64%	0,70%	5,33%
v_1	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%

Table 1b continued **- Weights for DEA with no input (scenario A.1)**

	Campania	Puglia	Basilicata	Calabria	Sicilia	Sardegna
u_1	56,16%	0,00%	2,79%	1,43%	0,00%	2,06%
u_2	0,00%	0,00%	12,79%	6,63%	0,00%	11,50%
u_3	11,57%	0,00%	8,72%	71,81%	6,79%	9,84%
u_4	0,00%	0,00%	34,65%	3,48%	0,00%	35,30%
u_5	31,37%	98,06%	29,60%	5,39%	92,46%	26,05%
u_6	0,00%	0,00%	9,30%	10,27%	0,21%	0,05%
u_7	0,00%	1,79%	0,91%	0,85%	0,00%	0,59%
u_8	0,90%	0,15%	1,23%	0,15%	0,54%	14,62%
v_1	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%

It should be noticed that many weights are null, and this, for necessary sub-indicators does not make much sense. We thus performed a DEA with weights constrained to be positive. The number of efficient regions(see table 2a) decreased sensibly.

Table 2a - Efficiency for DEA with no input and non negative constraints (scenario B.1)

REGIONS	Efficiency	REGIONS	Efficiency
Piemonte	87,31%	Marche	86,40%
Valle d'Aosta	100,00%	Lazio	88,92%
Lombardia	77,37%	Abruzzo	93,10%
Trentino Alto Adige	96,97%	Molise	100,00%
Veneto	79,88%	Campania	75,39%
Friuli Venezia Giulia	97,67%	Puglia	84,80%
Liguria	95,50%	Basilicata	100,00%
Emilia Romagna	91,15%	Calabria	98,68%
Toscana	97,66%	Sicilia	89,59%
Umbria	87,77%	Sardegna	100,00%

Looking at the weights (table 2b) it is easy to see that there is very great variability among them. Moreover in some cases a not-too-bad overall performance is due almost exclusively to one single sub indicator; for example Toscana an Lazio (high weights respectively on u_2 - national health care staff- and u_3 number of specialists) but nearly in the same situation also Sicilia, Puglia, Abruzzo and Campania with non negligeable weights only on u_5 - n. of physicians - and u_3 medical specialists (respectively around 83% and 8% in all three regions).

Table 2b - Weights for DEA with no input and non negative constraints (scenario B.1)

	Piemonte	Valle d'Aosta	Lombardia	Trentino Alto Adige	Veneto	Friuli Venezia Giulia	Liguria
u_1	1,39%	2,28%	2,70%	1,82%	1,36%	1,39%	1,55%
u_2	59,42%	8,46%	2,70%	78,59%	60,55%	59,42%	70,00%
u_3	8,62%	5,08%	51,22%	1,82%	1,36%	8,62%	20,69%
u_4	1,39%	67,81%	2,70%	1,82%	1,36%	1,39%	1,55%
u_5	25,04%	13,04%	2,70%	1,82%	31,32%	25,04%	1,55%
u_6	1,39%	1,02%	2,70%	1,82%	1,36%	1,39%	1,55%
u_7	1,39%	1,30%	32,61%	10,49%	1,36%	1,39%	1,55%
u_8	1,39%	0,99%	2,70%	1,82%	1,36%	1,39%	1,55%
v_1	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
	Emilia Romagna	**Toscana**	**Umbria**	**Marche**	**Lazio**	**Abruzzo**	**Molise**
u_1	1,69%	1,58%	1,23%	1,36%	1,95%	1,15%	6,21%
u_2	68,82%	84,36%	44,40%	60,55%	1,95%	1,15%	14,31%
u_3	16,01%	4,14%	3,45%	1,36%	86,38%	8,40%	8,13%
u_4	1,69%	1,58%	11,88%	1,36%	1,95%	1,15%	17,97%
u_5	1,69%	1,58%	35,36%	31,32%	1,95%	84,71%	28,88%
u_6	1,69%	1,58%	1,23%	1,36%	1,95%	1,15%	8,24%
u_7	6,74%	1,58%	1,23%	1,36%	1,95%	1,15%	8,99%
u_8	1,69%	3,62%	1,23%	1,36%	1,95%	1,15%	7,27%
v_1	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%
	Campania	**Puglia**	**Basilicata**	**Calabria**	**Sicilia**	**Sardegna**	
u_1	2,16%	1,15%	4,87%	3,09%	1,15%	3,86%	
u_2	1,16%	1,15%	13,45%	3,09%	1,15%	12,20%	
u_3	8,14%	8,25%	9,51%	70,17%	8,40%	10,91%	
u_4	1,16%	1,15%	29,92%	3,09%	1,15%	33,50%	
u_5	83,90%	84,66%	27,32%	3,09%	84,71%	25,11%	
u_6	1,16%	1,15%	8,91%	11,30%	1,15%	1,93%	
u_7	1,16%	1,33%	3,27%	3,09%	1,15%	2,43%	
u_8	1,16%	1,15%	2,76%	3,09%	1,15%	10,05%	
v_1	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	

The next question is: what happens if we compute average weights and thus a (possibly) unique best performing unit?

Computing the averages of the constrained weights we obtain:

Table 3a - Mean Weights for DEA with no input and non negative constraints

u_1	u_2	u_3	u_4	u_5	u_6	u_7	u_8	v_1
1,95%	32,35%	13,40%	9,98%	34,92%	2,08%	3,21%	2,12%	100,00%

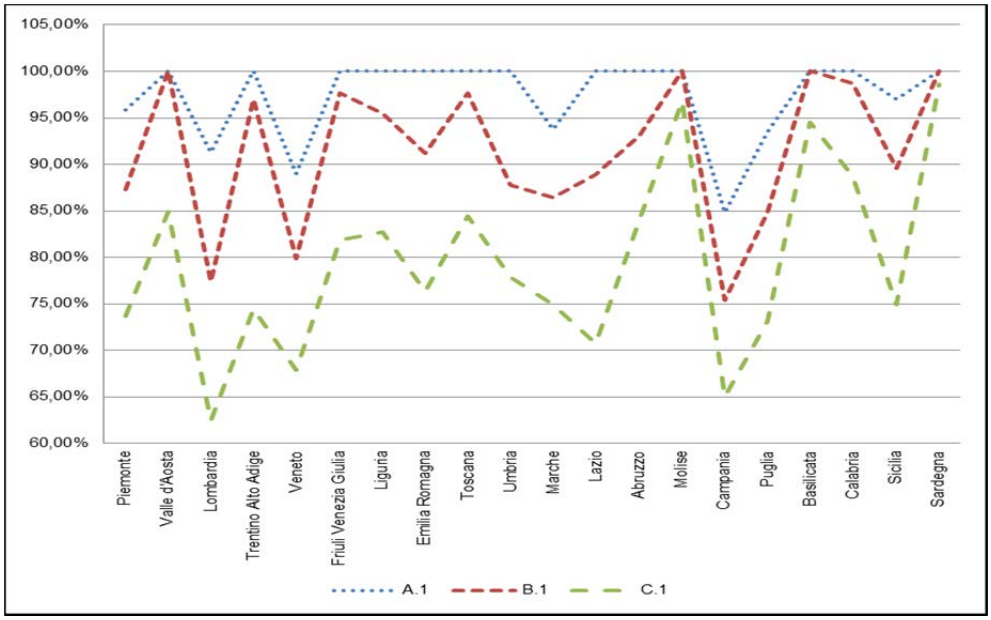
Considering that some of the units of measure of the indicators are per 1.000, others per 10.000, the weights obtained for the different indicators seem not too far from what we could expect.As for efficiency none of the regions appear to be efficient (see table 3b).

Table 3b - Efficiency for DEA with no input and non negative constrained mean weights (scenario C.1)

REGIONS	Efficiency	REGIONS	Efficiency
Piemonte	73,66%	Marche	74,97%
Valle d'Aosta	84,93%	Lazio	70,72%
Lombardia	62,49%	Abruzzo	84,04%
Trentino Alto Adige	74,43%	Molise	96,85%
Veneto	67,92%	Campania	65,03%
Friuli Venezia Giulia	81,85%	Puglia	73,10%
Liguria	82,76%	Basilicata	94,49%
Emilia Romagna	76,39%	Calabria	88,77%
Toscana	84,44%	Sicilia	74,91%
Umbria	77,91%	Sardegna	98,66%

To compare the efficiencies of three scenarios we have figure 1:

Figure 1 - DEA with no input (scenario 1) Efficiency comparison A.1, B.1. C.1



The efficiency rankings appear to be a lot different between the three models and different from the health care infrastructure endowment rankings we would have if we defined the composite indicator as the average of the standardized indicators (thus resorting to so called equal weighting) . This result stands against the use of DEA to construct BoD composite indicators; in fact DEA is an efficiency measure, whereas composite indicators relate to the endowment. This consideration leads us to our original suggestion: the use of DEA to correct a composite endowment indicator taking into account the efficiency of the sub-indicators combination. If we were to choose among the three different scenarios for DEA without input, we would certainly choose to compute our measure of performance by means of average constrained to be positive weights (i.e.Scenario C.1). In fact, as Despotis (2005) comments on the use of DEA without input to compute a Human Development Indicator: "*The DEA approach is meaningful in identifying the 'inefficient' countries. The DEA scores, however, cannot be used to rank the countries in terms of human development, given that the scores are not based on common weights".*

Now, given we need common weights in order to compare the performance of the different regions, the next choice to be made is whether to base our efficiency measure on a production function i.e. DEA with input.

3.2 DEA with different combinations of inputs and outputs

Our next step is to define costs as input indicators, the others as outputs.

First of all we define scenario 2: DEA with one input and choose 1. public health care expenditure per 10.000 residents as an input indicator and all the others as output sub indicators.

Then we add a second input variable (Primary Care Trusts Number x 1.000.000 residents) to define scenario 3.

For both scenarios the other indicators are outputs and the weights are average constrained to be strictly positive weights. First of all let us compare – for these new scenarios – the average constrained to be positive weights. In table 5 we have the different sets of weights for the three scenarios defined so far:

Table 5 - Average weights for the three scenarios C.1,2,3.

	C.1		C.2		C.3
u_1	1,95%	u_1	28,63%	u_1	36,17%
u_2	32,35%	u_2	14,01%	u_2	23,08%
u_3	13,40%	u_3	21,96%	u_3	18,09%
u_4	9,98%	u_4	22,32%	u_4	3,51%
u_5	34,92%	u_5	2,03%	u_5	9,19%
u_6	2,08%	u_6	8,37%	u_6	9,96%
u_7	3,21%	u_7	2,68%	v_2	21,17%
u_8	2,12%	v_1	100,00%	v_1	78,83%
v_1	100,00%				

While in table 6 we compare efficiencies by means of ranks.

Table 6 - DEA Efficiency comparison by means of ranks of all scenarios

REGIONS	Ranks A.1	Ranks B.1	Ranks C.1	Ranks C.2	Ranks C.3
Piemonte	15	15	15	13	18
Valle d'Aosta	1	1	5	4	10
Lombardia	18	19	20	19	19
Trentino Alto Adige	1	8	14	12	14
Veneto	19	18	18	18	20
Friuli Venezia Giulia	1	6	9	9	12
Liguria	1	9	8	8	7
Emilia Romagna	1	11	11	10	13
Toscana	1	7	6	7	6
Umbria	1	14	10	11	15
Marche	16	16	12	14	11
Lazio	1	13	17	17	16
Abruzzo	1	10	7	6	4
Molise	1	1	2	2	2
Campania	20	20	19	20	17
Puglia	17	17	16	16	8
Basilicata	1	1	3	3	3
Calabria	1	5	4	5	5
Sicilia	14	12	13	15	9
Sardegna	1	1	1	1	1

For some regions the efficiency evaluation is stable, for others it changes sensibly.

Unfortunately the weights change significantly and so does the efficiency of the input combination.

As already underlined it is difficult to accept the suggestion (see Cherchye et al., 2007, Despotis 2005, Mahlberg and Obersteiner , 2001) to resort to DEA or to benefit-of-doubt indicators as an alternative to traditional composite indicators. The main reason is that we would use an efficiency measure to compute endowment. A second reason is that even when computing common weights for all regions there is no clear indication on which scenario to prefer.

Our suggestion is to use efficiency to correct an equally weighted composite indicator. Which scenario? What general indication? To use as output variables for an efficiency measure , the same variables the composite indicator is based on. In fact we believe the efficiency measure used to correct the endowment composite indicator must be based on exactly the same sub-indicators, so that in view of non-substitutability their inefficient combination can be accounted for. We will thus take into account DEA without input.

4. Comparison with the Method of Penalties by coefficient of variation

Other suggestions have been introduced in literature to account for non-substitutability of the sub-indicators of infrastructure endowment. For example (Brunini Paradisi Terzi, 2004, and similarly Mazziotta Pareto, 2007) suggest a correction of a composite indicator of infrastructure endowment based on an inverse function of the horizontal variability of the sub-indicators. Under the hypothesis of non-substitutability, equilibrium condition between the different dimensions of the phenomenon implies equality between the sub-indicators. Thus a penalty is attached to the variability among sub-indicators referring to the same unit. The underlying assumption is the availability of a benchmark unit (or region) whose normalized sub-indicators all assume the same value. (In other words the infrastructure endowment for the benchmark region is assumed to be the objective equilibrium endowment; all sub-indicators are normalized with respect to these values).

In particular, according to Mazziotta-Pareto's Method of Penalties by Coefficient of Variation the composite indicator of infrastructure endowment of each region *i* (Mz_i) can be corrected by taking into account disequilibrium as measured by the square of the coefficient of variation $cv_i = S_{Z_i}/M_{Z_i}$. The corrected indicator (denominated MPI) is defined as

$$MPI = Mz_i(1 - cv_i^2)$$

where Mz_i, is the average of standardized [3] sub-indicators. This means that if for some regions all the sub-indicators have the same value, there is no correction.

Our suggestion is similar in spirit. In fact, to account for non-substitutability we suggest a correction of the composite indicator based on the distance from the efficient frontier, in other words the DEA_{cl} :

$$DEA_{C.l} = Mz_i(efficiency_i)$$

Table 7 shows our weights:

Table 7 - Penalty case: Mean Weights for DEA with no input and non negative constraints

u_1	u_2	u_3	u_4	u_5	u_6	u_7	u_8	v_1
10,98%	17,69%	11,11%	10,94%	14,07%	12,09%	11,80%	11,31%	100,00%

They are obtained exactly as in scenario 1, however now the variables are standardized to have mean 100 and std 10.

What are the differences between the two suggestions? For MPI the frontier is defined as equally weighted standardized sub-indicators; this is equivalent to saying that for the best performing unit all sub-indicators must have the same weight equal to 12,5% . For DEA instead the weights for the best performing unit are the values for u1, u2,...,u8 shown in table 7.

For an overall comparison we have reported in table 8 the values of the composite

[3] standardized to have mean 100 and std 10.

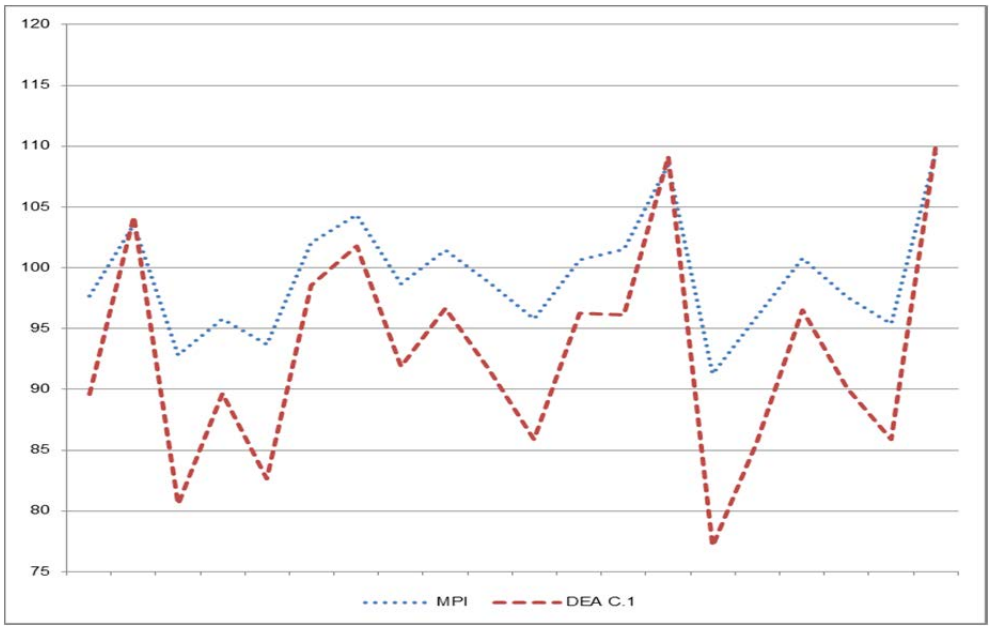
equally weighted indicator Mz_i; its penalties for the different regions, the efficiencies and the corrected indicators MPI and DEA_{C1} as well as their ranks.:

Table 8 - Penalty case: Composite indicator, penalties, efficiencies, corrected indicators

REGIONS	Mzi	$(1\text{-}cv^2)$	EFF	MPI	DEAcl	RankMzi	Rank MPI	RankDEAcl
Piemonte	97,9944	0,9968	0,9144	97,6808	89,6061	13	12	14
Valle	105,526	0,9812	0,9876	103,5421	104,2175	3	4	3
Lombardia	93,3124	0,9949	0,863	92,8365	80,5286	19	19	19
Bolzano	97,3887	0,9833	0,9209	95,7623	89,6853	14	16	13
Veneto	94,1838	0,9948	0,8777	93,694	82,6651	18	18	18
Friuli V. Giulia	102,5557	0,995	0,9611	102,0429	98,5663	5	5	5
Liguria	104,7887	0,996	0,9716	104,3695	101,8127	4	3	4
Emilia Romagna	99,2701	0,9943	0,9255	98,7043	91,8745	11	11	10
Toscana	101,8757	0,9957	0,9488	101,4376	96,6597	9	7	6
Umbria	99,3891	0,9937	0,921	98,7629	91,5374	10	10	11
Marche	96,1131	0,9969	0,8934	95,8151	85,8674	17	15	16
Lazio	101,9784	0,9871	0,9437	100,6629	96,237	6	9	8
Abruzzo	101,9456	0,9957	0,9432	101,5072	96,1551	7	6	9
Molise	109,1713	0,9933	1	108,4399	109,1713	2	2	2
Campania	91,7584	0,9951	0,8401	91,3088	77,0862	20	20	20
Puglia	96,3457	0,9964	0,8895	95,9989	85,6995	15	14	17
Basilicata	101,9352	0,9884	0,947	100,7528	96,5326	8	8	7
Calabria	98,4235	0,9921	0,9156	97,646	90,1166	12	13	12
Sicilia	96,1521	0,9918	0,8932	95,3637	85,8831	16	17	15
Sardegna	109,8921	0,9955	1	109,3976	109,8921	1	1	1

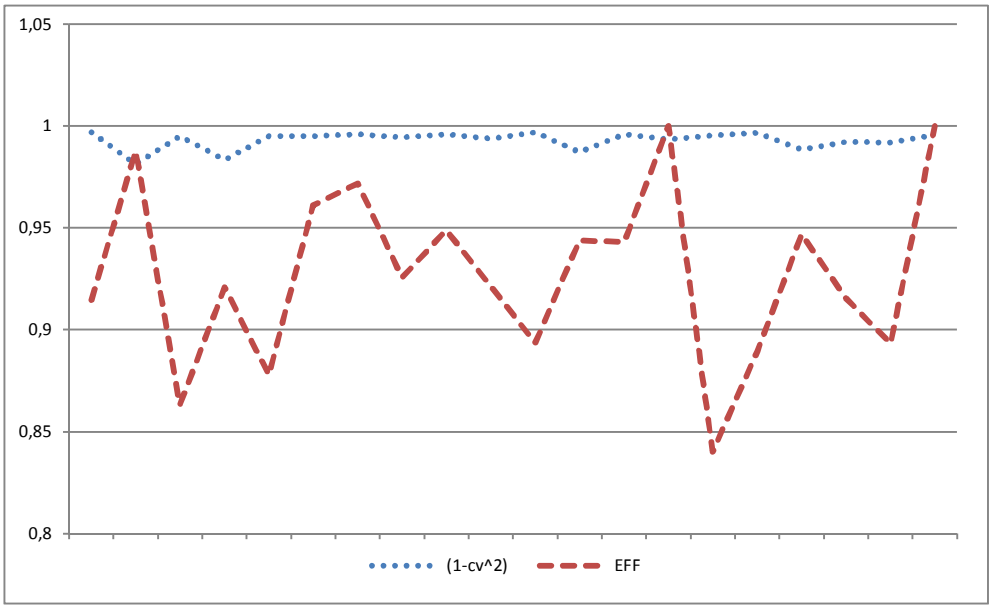
For a comparison between the two corrected indicators we have figure 2

Figure 2 - A comparison between the two indexes DEA_{cl} and MPI



Where as to compare the two different corrections we have figure 3

Figure 3 - Comparison between the two corrections DEA and coefficient of variation



As expected the two corrections give rise to different values of the composite corrected indicator. In particular efficiency shows greater variability among regions and is lower than the MPI correction; thus DEA_{c1} indicator is almost uniformly lower than MPI, whereas comparison among the rankings is not so straightforward.

5. Concluding remarks

The suggestion to correct composite indicators to account for non-substitutability is not new in literature; in particular it is not new within infrastructure endowment indicators. An interesting suggestion that we have taken as a reference guideline is provided by Mazziotta-Pareto's Method of Penalties by Coefficient of Variation. A possible interpretation of their method is that sub-indicators are considered in equilibrium (or optimally combined) whenever for one unit they assume identical values. Moving along this same direction we argue that the tool to measure the efficiency of a combination of indicators is provided by Data Envelopment Analysis. Different DEA models provide different results. In fact DEA is not as objective as it claims to be since it depends on the variable/sub-indicators choice. We believe that further research along this path will lead to more definite suggestions and hope that Istat or individual readers will take up the challenge. The conclusions that can be drawn from our study is that comparing the results of the different scenarios there are differences in the values and in the rankings of the indicators, but these differences are not too strong. With respect to the uncorrected indicator Mz_i for both alternative rankings we have a maximum difference between ranks of corresponding units (maxdiff) equal to 3. Considering its range between 0 and 19 the differences are not huge.

References

Brunini C., Paradisi F., Terzi S. , (2004) Banca dati delle infrastrutture, una proposta di metodo per la sintesi di indicatori, ISTAT *Progetto interdipartimentale "Informazione statistica territoriale e settoriale per le politiche strutturali 2001-2008"* Roma: mimeo

Charnes A., Cooper W. W., Rhodes E., (1978), Measuring the efficiency of decision making units, *European Journal of Operational Research* n.2, 429-444

Cherchye L., Moesen W., Rogge N., Puyenbroeck T. V., (2007), An Introduction to Benefit of Doubt Composite Indicators, *Social Indicators Research* n. 82,111–145

Cherchye L., Moesen W., Rogge N., Puyenbroeck T. V., (2008), Benefit of the doubt composite indicators, KEI-project, *European Commission's Sixth Framework Programme*

Coelli T., (1996), A Guide to DEAP, CEPA Working Paper

Cooper W., Seiford L. M., Zhu J., (2011), Handbook on Data Envelopment

Despotis DK, (2005) , A reassessment of the human development index via data envelopment analysis, Journal of the Operational Research Society , n.56, 969–980

Farrell M.J. , (1957) "The measurement of productive efficiency" *Journal of the Royal Statistical Society*

ISTAT La dotazione di infrastrutture e servizi nella sanità - Anni 2004-2005.

Mahlberg B., Obersteiner M., (2001), Remeasuring the HDI by Data Envelopement Analysis, *International Institute for Applied Systems Analysis Interim Report* 01-069, Laxenburg, Austria

Mazziotta C., Mazziotta M., Pareto A., Vidoli F., (2010) La sintesi di indicatori territoriali di dotazione infrastrutturale: metodi di costruzione e procedure di ponderazione a confronto *Rivista di Economia e Statistica del territorio* v.1, pp 7-33.

Mazziotta M., Pareto A,. (2007) "Un indicatore sintetico di dotazione infrastrutturale: il metodo delle penalità per coefficiente di variazione", in: *Lo sviluppo regionale nell'Unione Europea – Obiettivi. Strategie, politiche. Atti della XXVIII Conferenza Italiana di Sciene Regionali*, AISRe, Bolzano.

Sharpe A., Andrews B., (2010), An Assessment of Weighting Methodologies for Composite Indicators: The Case of The Index of Economic Well-Being, *CSLS Research Report* No. 10.

Somarriba N., Pena B., (2009) , Synthetic Indicators of Quality of Life in Europe, *Soc Indic Res* n.94,115–133.

Preface

The preliminary approach to identify the position of the productive system along the business cycle were based on diffusion indices and compared the trend of statistical time series with positive evolution with respect to stationary or negative ones. The underlying assumption was simple: in the presence of many time series on different productive sectors, the business cycle could be measured by the share of series showing similar trends. If the number of time series with positive trend observed in the short term (monthly or quarterly) amounted to over 50% of the whole set of series observed, then it could be inferred that the economy was expanding. The higher the share of time series with positive trends, the stronger the expansion phase of the economy. Conversely, by decreasing series with positive trends the economic evolution showed a deceleration: when the share of series with positive trends was lower than 50% the economy went toward the turning point marking a recession phase.

This simple rule of evaluation of the economic cycle has been used for a long time and is still quite popular. The basic idea is simple: if a very large number of monthly or quarterly time series related to various economic trends is available, the weight of each series is necessarily quite limited (virtually when the number of series tends to infinity the relative weight tends to zero) and there is no need to distinguish among them according to a system of weights. As a consequence the described analyses was well suited to sketch economic fluctuations. An essential condition was that the considered set of series were satisfactorily representative of the whole economy. This is why very disaggregated series by sector, price and products that in the past were the core of the economic system were usually taken into account. For many years the analysis of the business cycle only concerned the industrial sector- The official statistics favoured this orientation, paying great attention to it and producing a huge amount of surveys that are currently able to generate a great number of disaggregated time series representing its fluctuations.

Nowadays the industrial sector does no longer represent the core of economic activities in advanced countries: Industry represents roughly one fifth of the GDP and the share of the tertiary sector has tremendously grown. However, statistical institutions did not track perfectly this evolution. Although there is a great deal of monthly and very detailed information on industrial production or external trade of goods, information on the tertiary sector is often available only for a few macro-sectors (such as transports, finance, commerce, etc…) while higher detail is not available at all.

The recent analyses on quarterly turnover in the service sectors presented in this publication try to fill this relevant gap by providing new evidences. The indicators proposed shed new lights on the Italian business cycle fluctuations and aim to reinforce the debate on the coherence of the existing framework adopted to measure industrial short-term movements.

The measurement of the service sector cannot go along the same route adopted for the industrial sector. The paradigmatic concept of a quantity measure (for example number of shoes, etc…) is not tailored to capture the complexity of the service production. This is why suitable price indices are needed in order to deflate turnover index series and deduce quantities. Turnover indicators together with price indicators both for the domestic and non-domestic market exist for industry too, but they are usually overwhelmed by industrial production indices.

The approach related to the production measure has a different characterisation compared to the analysis based on turnover. The former supports the supply side focusing on commodity characteristics. The latter privileges the demand side looking at consumer needs rather than commodity features. The turnover concept implies information on goods and services which are not directly observed by the supply-side approach. In this way there could be some homogeneity problems comparing turnover over time but this approach provides a more comprehensive coverage of the economic activities developed by enterprises.

The actual evolution of the economy is rather going toward a more integrated output than toward a single product to be sold. Even manufacturing enterprises are more oriented to offer a set of services together with a product (for example the customer service related to the purchase of a boiler) in a way that the final product could evolve according to customer desiderata. Thus the concept of "prevailing production" vanishes along this evolution.

Moreover, the fast changes in the quality of goods makes the use of a fixed basket of commodities to be observed along the years less appealing. More in general, advanced economies are characterised by a progressive shift towards higher quality commodities and services involving a constant challenge to fit the appropriate measure to monitor this evolution. This is true looking both at individual behaviours and at the collective level. The growing implementation of the hedonic approach in the current practices of National Statistics Institutes, especially in the price domain, is a clear evidence in this direction.

In advanced countries consumer behaviours are no longer characterised by higher expenditure on food or clothing but by consumption of higher quality commodities. This picture holds for the majority of the population, although a share of households fall below the poverty line. However, macroeconomic growth is driven by total factor productivity gains reflecting an improvement in the quality of goods and services. Along this framework, turnover measures seem more suitable than those based on a product fixed basket that are not appropriate to monitor the evolution on quality.

The surveys and indices on turnover presented in this publication are relevant both because they fill the important gap in the knowledge of short-term indicators on services in Italy and because they shift the attention on the demand-side approach looking at turnover. This should imply a more precise measure for the business cycle interpretation of Italian economy. In a complex world where enterprises try to identify customer desiderata by providing tailored products and services and the production of commodities is not related to a single plant but is performed by assembling different components supplied by different enterprises, it becomes crucial for National Statistics Institutes to follow this trend by shifting attention toward the demand-side approach instead of focussing on the traditional single product view. The surveys on service turnover carried out by Istat represent a significant step in this direction.

Innocenzo Cipolletta

Recent developments for quarterly service turnover indices [1]

Fabio Bacchini, Giuseppe Busanello, Diego Chianella, Rosmarie D. Cinelli, Roberto Iannaccone, Valeria Quondamstefano

Abstract

The European Statistical System has put more attention on activities to improve quality, frequency and coverage of short term indicators for the service sector The aim is to implement a set of indicators similar to those already available for the manufacturing sector. Within this framework, Istat has put forth an intensive effort to complete the set of indices required by European regulations, both for Service Production Prices and for quarterly Turnover Indices. Concerning Turnover, in 2011 a new survey was launched to obtain indices for Wholesale and retail trade and repair of motor vehicles and motorcycle (NACE G45), Land transport and transport via pipelines (NACE H49), Warehousing and support activities for transportation (NACE H52), Accommodation (NACE I55) and Food and beverage service activities (NACE I56). The aim of this paper is to describe the operational and methodological choices carried out for the release of the indices according to the Generic Statistical Business Process Model (GSBPM), together with the economic findings associated with the new indicators

Keywords: Short-term statistics indicators, Turnover, Services Sector. JEL: C43, C81, L80

1. Introduction

In 2011 in Italy services sector enterprises were almost 3.3 million, employing 10.6 million workers. According to the census data, in the period 2001-2011, the number of enterprises in services sector increased by 13.1% while in the manufacturing sector decreased by 23.6%. The number of employees increased by 17.6% and decreased by 17.5% in manufacturing (Istat, 2013). According to Structural Business Statistics in 2010 the service sector represented 76.0% of enterprises, 63.3% of employees and 56.9% of the value added (Istat, 2012b). The growing importance of the service sector in the Italian economy has been similar to that of other European countries.

This phenomenon has corresponded to an increase in the analysis of the sector's performances both at an international (for example Giovannini and Caves, 2005, *Voorburg group on services statistics*) and national level (for example Cipolletta, 2013), together with the analysis of the interaction between services and industry (for example, Evangelista et al, 2013). This process has been associated with a constant improvement of the measuring instruments.

[1] F. Bacchini, Econometric Studies and Economic Forecasting Division, G. Busanello, National Accounts and Economic Statistics Department, D. Chianella, R. D. Cinelli, R. Iannaccone and V. Quondamstefano Short-term Economic Statistics Directorate. Although the document is the result of a joint effort of the authors, F. Bacchini realized sections 1, 2, 4.3, 6, 7, 8, 9, G. Busanello section 5, D. Chianella sections 3.1, 3.2.1, 3.3, 4.1.1, 4.2, 6, 7, R. D. Cinelli sections 3.1, 3.2.2, 3.2.3, 3.3, 4.1.2, 4.1.3, 4.2, 6, 7, R. Iannaccone sections 1, 4.3, 6, 8, 9, V. Quondamstefano sections 2, 3.1, 3.2.4, 3.3, 4.1.4, 4.2, 6, 7. We are grateful for comments and suggestion to Laura Leoni and two anonymous referees. We would like to remember Maurizio Perez for his expertise and enthusiasm that inspired him. The views expressed in this article are those of the authors and do not necessarily represent the views of Istat.

In 2011, Eurostat launched a survey within the European Statistic Offices requesting information regarding the activities planned to further available information on short term statistics for quarterly turnover indices and for Services Production Prices indices. The results have been presented on December 2011 during the meeting held by the Working Group on Short-Term Economic Statistics. The main idea was to analyse the activities scheduled and the modalities necessary to reduce the gap between statistics in the services and manufacturing sector. The working group approved also the creation of an apposite task-force to explore the methodology necessary for realising an index of production on services, that is already released by the United Kingdom and Sweden.

In coherence with this description, Istat's strategic aim for the period 2010-2013 has been to complete the set of indices for the services sector as required by European Regulation (Regulation No 1158/05 of the European Parliament and of the Council, annex D). For the quarterly turnover indices, this implied the realisation of new surveys to increase the coverage of the indices already produced for other economic activities.

The planning and launch of the new surveys made possible, in March 2012, the release of the indices for: the Divisions [1]45 (Wholesale and retail trade and repair of motor vehicles and motorcycles), completing the G Section (equal to 8.9% of the turnover[2]), 49 (Land transport and transport via pipelines) and 52 (Warehousing and support activities for transportation) completing the H Section (equal to 10.1% of the turnover), 55 (Accommodation) and 56 (Food and beverage service activities) that compose the I Section (equal to 6.0% of the turnover).

With the launch of the implemented surveys the coverage has reached 84.9% of the total turnover allowing the compilation of the aggregate index for the services. Moreover, during 2013, saw the launch of new surveys for the economic sectors referred to the M and N Sections (Professional, scientific, technical, administration and support service activities) have been launched and the sample size for the quarterly survey on turnover for services sector has increased to 19,400 units. The indices of these sectors have been released in June 2014 during the revision process of the current article. We have accounted for these new results in the dissemination paragraph where the total index for turnover in the services is presented.

The statistical process phases concerning the new surveys have been done implementing, where necessary, the general framework already in use in the survey for the quarterly turnover for which a review took place in 2010 (Bacchini et al., 2012). The development has been carried out using as reference the *Generic Statistical Business Process Model* (GSBPM hereafter, UNECE 2009). The GSBPM turned out to be a flexible tool able to highlight the single phases of the productive process considered as an innovation object. To our knowledge this is the first Istat survey documented by means of the GSBPM conceptual framework.

Within the survey plan definition, particular attention has been paid to the point of view of the relevant users (Trade Associations). Their collaboration has been important for the introduction of innovations regarding data collection, estimation method and release of new indices. In particular, the methodological analysis of indices calculation resulted in the introduction of an estimator for expansion instead of the one already used for the indices previously implemented.

The aim of this work is twofold. Firstly, it serves to provide a description of the operative and methodological choices implemented to launch the new surveys and to produce estimates of the respective indices are described. Secondly, the economic characteristics of the quarterly index for the total turnover in the services and the new division are explored looking at the

[1] Since January 2008 Istat has adopted the new ATECO 2007 classification of economic activities (Istat, 2009). This classification is the national version of the European nomenclature, Nace Rev. 2 (hereafter NACE) and is organised in Sections, Divisions, Groups and Classes.

[2] According to the structure of the weights of the base 2010 = 100.

comparison with the main European countries. A comparison between the business cycle characteristics for manufacturing and services is also provided for the period 2010-2014 (first quarter).

In particular, the second paragraph specifically describes the GSBPM model. Subsequent paragraphs are focused on the activities that have characterised the GSBPM's single phases (described in Section 2): information needs (Section 3), design phase (Section 4), the system for data collection (Section 5) and the sample selection (Section 6) for the turnover service survey. After describing the enterprises collaboration (Section 7), the new indices profiles, together with European comparison, are presented (section 8). Conclusive remarks will follow (Section 9).

2. The GSBPM model

The quarterly turnover services survey has been subjected, during the 2010-2011, to profound reorganisation. These changes have brought about the realisation of a new procedure for data collection and recall procedures, the analysis of the coherence of the turnover's definition, a new website for data collection using the Indata platform, a reorganization of the database and of the procedure used for survey management (Bacchini et al,2012). Concurrently, in June 2010, the release of seasonally adjusted data began (Iaconelli et al, 2014).

The Generic Statistical Business Process Model has been chosen to give a general framework of these activities and of those done for the new surveys (Unece 2009).

The version of the current model (4.0 version) has been approved by the Directive Group on the metadata founded by UNECE, EUROSTAT and OECD and issued to the public on April 2009.

The GSBPM's original intention was to give the statistic institutes a common framework on standard terminology and to aid their discussion about the systems development of statistic metadata and processes. The GSBPM represents a flexible tool to describe and define the different phases necessary for the production of official statistics. The model represents a development of the one used by Statistics New Zealand. Istat started a discussion on the potentialities of this model at the beginning of 2012 within the innovation committee.

In GSBPM terms (Figure 8 in the Appendix), the measures adopted towards changes in survey organisation for the services turnover implemented in 2010, were aimed mainly to define the framework (phase 2), the construction (phase 3), the data collection (phase 4), the process (phase 5), the analysis (phase 6) and the diffusion (phase 7).

Starting from the innovations and following the GSBPM scheme, the activities for the launch of the new surveys have concerned the information needs (phase 1), contextually for the necessary operations to define the framework (phases 2 and 4) and the collection phase's implementations (phase 3). Particular attention has been paid towards both the analysis of the estimator used to the indices calculation (phase 6) and the release phase (phase 7). This has made possible the release of an aggregate index for the services sector for the first time.

In Figure 9 (Appendix) are highlighted the phases and steps developed for the launch of the new surveys. In the following sections we describe the implementation of these steps.

3. The identification of the needs for information

Regarding the launch of the new surveys particular attention was paid to the point of view of the main users. Together with the mandatory requirements expressed by European Regulation on Short-term Statistics, the needs of the associations of the new economic sectors were considered.

3.1 European Regulation on short term statistics

Quarterly indices of services turnover fall within the Group of Principal European Economic Indicators (PEEIs), for which a specific European regulation (Regulation (EC) No 1165/98, amended by Regulation (EC) no 1158/2005) establishes the characteristics of coverage, frequency and timeliness. The PEEIs, which include among others the monthly indices of industrial production and retail sales, are used for monitoring European economic situation.

Until March 2012, Istat elaborated only one part of turnover indicators required by the European Regulation. These indicators represented a share in turnover equal to 59.9% of the total.

To complete the set of indices, Istat developed a two-phase strategy. The first started in 2010 and led to the launch of new surveys and to the dissemination of the related indicators for divisions 45 (Wholesale and retail trade and repair of motor vehicles and motorcycles), 49 (Land transport and transport via pipelines), 52 (Warehousing and support activities for transportation), 55 (Accommodation) and 56 (Food and beverage service activities). In such a way the coverage of the sector reached 84.9% (Table 1).

The second referred to a portion of economic activities included in Sections M (Professional, scientific and technical activities) and N (Administrative and support service activities) and was initiated in 2013 with the launch of new surveys. The coverage for these sectors is 15.1% of the total turnover. The indices for these sectors were released in June 2014[3].

Table 1 - The weights in 2010 for quartely turnover indicators of services

Nace (Rev. 2)	Economic Activities	Weights 2010
G45	**Wholesale and retail trade and repair of motor vehicles and motorcycles**	10.200
G46	Wholesale trade, except of motor vehicles and motorcycles	46.046
H49	**Land transport and transport via pipelines**	5.827
H50	Water transport	1.085
H51	Air transport	0.726
H52	**Warehousing and support activities for transportation**	4.272
H53	Postal and courier activities	0.625
I 55	**Accommodation**	1.732
I 56	**Food and beverage service activities**	4.267
J	Information and communication	10.153
	Total published before June 2014	**84.933**
M69	Legal and accounting activities	3.064
M70.2	Management consultancy activities	1.361
M71	Architectural and engineering activities; technical testing and analysis	2.227
M73	Advertising and market research	1.257
M74	Other professional, scientific and technical activities	1.280
N78	Employment activities	0.555
N79	Travel agency, tour operator reservation service and related activities	1.123
N80	Security and investigation activities	0.318
N81.2	Cleaning activities	1.224
N82	Office administrative, office support and other business support activities	2.658
	Total released in June 2014	**15.067**
	Total	**100.000**

[3] A detailed analysis of the GSBPM characteristics for these sectors will be completed in the next months.

Concerning the new sector described in this article Eurostat regulation requires the indices reported in Table 2.

Table 2 - Indices of turnover required by STS regulation

Sections	Divisions	Indexes required by STS Regulation
G	45	45; 45.2; (45 - 45.2)
H	49	49
H	52	52
I	55	(55 + 56)
I	56	

3.2 Collaboration with trade associations

The economic characteristics of the new sectors were discussed with the representatives of industry associations. The criteria used in participants selection were of an inclusive type trying to reach the maximum number of representative users for these sectors. The meetings highlighted significant attention to the issue of new economic indicators on services, highlighting the gap compared to information available for other European countries. These meetings, started in November 2010, were opportunities for:

- integrating Istat information sources on enterprises with those available from trade associations;
- sharing the joint dissemination plan for each sector;
- encouraging enterprises to cooperate in the survey.

3.2.1 Wholesale and retail trade and repair of motor vehicles and motorcycles

The **Division 45** (Wholesale and retail trade and repair of motor vehicles and motorcycles) associations with which Istat was able to discuss are related to *Confcommercio* and they were:

- *FEDERAUTO* (Federazione italiana concessionari auto, Italian Association of car dealers), comprising the associations of undertakings dealerships for distribution and after-sales services for vehicles;
- *FEDERMOTORIZZAZIONE* (Federazione nazionale dei commercianti della motorizzazione, Italian Association of vehicles Traders), which represents the entrepreneurial category of dealers of motor vehicles, motorcycles and mopeds, spare parts, accessories and lubricants for motor vehicles, motorcycles and mopeds and of tyre dealers;
- *UNRAE* (Unione Nazionale Rappresentanti Autoveicoli Esteri, Association of foreign car makers operating in Italy), which represents foreign companies operating in the Italian market of passenger cars, commercial and industrial vehicles, buses, caravans and motor homes.

These meetings made possible to identify the minimum level, in terms of disaggregation NACE, at which indicators are required. Consistent with the objectives of each association, the request was of specific indicators of turnover at the Group level (45.1, 45.3 and 45.4). It is important to stress that the quarterly index for Group 45.2 has been already published by Istat since 2000.

With respect to information integration, it was possible to analyse in depth the features of the Statistical Register of Active Enterprises available in Istat (ASIA) using microdata from UNRAE source registrations referred to the year 2010. Through a record linkage of these enterprises with the ones in the ASIA database, referring to the year 2008 and using the VAT number, it has resulted a high level of overlap (91.5% representative units, the 96.7% of registrations). The enterprises, for which a link was not found, were the subject of further analysis. The predominant reason for not linking is connected to corporate transformations that occurred between 2008 (reference year of ASIA) and 2010 (base year of registrations). Taking into account this aspect, the overlap has covered 98.9% in terms of number of enterprises, and 99.8% in terms of vehicles registered.

3.2.2 Land transport and transport via pipelines

The **Division 49** (Land transport and transport via pipelines) is quite heterogeneous in terms of type of activities. This evidence supported the need for a contact with different categories of associations. In particular we developed a collaboration with:

- Confederations:
  - the infrastructure manager of *CONFINDUSTRIA* (Confederazione generale dell'industria italiana, the main Italian Association representing manufacturing and service companies);
  - *CONFETRA* (Confederazione generale italiana dei trasporti e della logistica, Italian Confederation of Transport and Logistics), which operates for companies in the sectors of transport, shipping, logistics and storage of goods;

- Industry associations:
  - *FEDERTRASPORTO*, which accommodates operators' associations and operators of transport infrastructure, logistics and tourism adhering to Confindustria;
  - *ASSTRA* (Associazione Trasporti, Italian Association of local public transport companies), acting on behalf of local public transport companies, both owned by local private bodies;

- Trade associations:
  - *ANITA* (Associazione Nazionale Imprese Trasporti Automobilistici, Italian Association of Automobile Transport Companies), which brings together associations of transport and logistics of *Confindustria* and has the coordination of freight transport. Anita is the Trade Association of road haulage by *Confindustria* and a constituent organisations of Member of *Federtrasporto*.

In meetings that were held between January and February 2011 these organisations illustrated the opportunity to have an index for: Passenger rail transport and interurban (49.1), Freight rail transport (49.2), Urban and suburban passenger land transport (49.31), Freight transport by road (49.41) underlining in this last case the need for deeper information on the dynamics of turnover according to the type of transport (car transporter, combined, containers, refrigerated, not refrigerated food, oversize load, hydraulic binders, dangerous goods, garbage, other).

As auxiliary sources of information on firms the register of enterprises with license and active in the rail sector (source Ministry of infrastructure and transport) and the one used for the railway transport survey in Istat were considered, while for Urban and suburban passenger land transport (NACE 49.31) the associated list of *Asstra* was used.

3.2.3 Warehousing and support activities for transportation

The economic activities represented by division 49 are related with those of **Division 52** (Warehousing and support activities for transportation). The common characteristic of the enterprises for this division is their role in a complex logistical task not immediately linked to a single item of the NACE. Besides *Confetra*, member of *Confindustria* and *Anita*, in the meetings was also involved *ASSOLOGISTICA* (Associazione Italiana Imprese di logistica, magazzini generali e frigoriferi, Italian Association of Logistics, general stores and refrigerators), directly connected to *Confetra* and member of *Federtrasporto*, *Confindustria*.

The collaboration led to the participation in the annual Confetra conference (Rome, February 1, 2011) and, following the invitation of Italian manufacturers' Association and member of Confindustria, in a meeting of the General Council for the road haulage and logistics at the Ministry of Infrastructure and Transport (Rome, February 8, 2011).

Analysis of logistics

Particularly attention was paid to the concept of logistics. Although the term is currently used in the business world and identifies the prevailing activity of the most important players, the word logistics was introduced only at the national level and it appears only in the Category 52.29.2 of the ATECO 2007 classification[4].

Following the request made by the associations of an index for the logistics sector, a text search in the company name was carried out for enterprises in ASIA database [5] using the key words *logistica*, *logistic* and *logistics*. The results obtained showed significant values, measured in terms of number of enterprises, employees and turnover for the following classes of economic activity:

- 49.41 (Freight transport by road);
- 52.10 (Warehousing and storage);
- 52.24 (Cargo handling);
- 52.29 (Other transportation support activities).

The selection identified overall 1,833 companies with activities definitely in the logistic sector. Of these, 1,593 (86.8%) belong to 4 specific economic activity classes. In Table 3 it is showed the prevalence of enterprises in the Class 49.41 (42.8%). Instead the highest percentage of employees is in the Class 52.24 (25.8%) and the one of turnover in Class 52.29 (35.5%).

Moreover, data reported in the Table 4 show the percentage of number of enterprises with word of logistic, number of employees and turnover on the totals for the 4 classes of economic activities. In particular, for Class 49.41 they represent the 0.9% of enterprises employing the 2.6% of workers and with turnover equal to the 3.7% of the total; for Class 52.10 these percentages are respectively 11.2%, 28.2% and 29.5%; in Class 52.24 5.3% for enterprises (6.5% for employees and 7.2% for turnover) and at last for Class 52.29 the 7.1% of enterprises (11.6% of employees and 10.8% of the turnover).

[4] The first four digits of the code, which is the first four levels of the classification system, are the same in all European countries. The fifth digit (categories) might vary from country to country and further digits are sometimes placed by suppliers of databases.

[5] Archive available at the time of designing was referred to the year 2008. Record linkage has been performed also with most recent version of ASIA and it did not emerge any significant change in the distribution.

Table 3 - Number and percentage composition of the enterprises that contain keywords in the class compared to the total enterprises that contain the keyword in the register Asia 2008

	49.41		52.10		52.24		52.29		Other	
	N. log	%	N. log	%	N. log	%	N. log	%	N. log	%
Enterprises	785	42.8	197	10.7	195	10.6	416	22.7	240	13.1
Employees	8,912	24.9	6,537	18.2	9,245	25.8	7,848	21.9	3,320	9.3
Turnover*	1,641	26.7	1,093	17.8	444	7.2	2,184	35.5	786	12.8

∗ Mln of Euro

Table 4 - Number and percentage composition of the enterprises that contain keywords in the class compared to the total class enterprises

	49.41			52.10			52.24			52.29		
	N. log	N. tot	%	N. log	N. tot	%	N. log	N. tot	%	N. log	N. tot	%
Enterprises	785	87,295	0.9	197	1,762	11.2	195	3,680	5.3	416	5,890	7.1
Employees	8,912	341,882	2.6	6,537	23,186	28.2	9,245	141,278	6.5	7,848	67,831	11.6
Turnover*	1,641	43,798	3.7	1,093	3,701	29.5	444	6,199	7.2	2,184	20,306	10.8

∗ Mln of Euro

Analysis of freight transport by road

For the road freight transport sector in Istat there is already a survey which provides information on transport flows and on the type and quantity of the goods transported. This survey is based on a sample of the registered vehicles, namely the single lorry registered in Italy whose activity of good transport is observed for one week.

The quarterly turnover survey, on the other hand, as unit of analysis uses the enterprises classified in the inland transport sector according to the prevailing economic activity. The register used for the extraction of the sample unit is ASIA.

As a first assessment of the differences between the criteria of eligibility of two surveys, a record-linkage has been made between the universe of vehicles (Ministry of Transport source) used to transport cargo and ASIA database[6]. The link was made using VAT number/tax code.

The Table 5 summarizes the results of the link.

For the class 49.41, where freight transport is on behalf of third parties, we have about $29,000$ enterprises with a total fleet of about $78,000$ units and $193,000$ employees. The high number of vehicles for Section K is due to the presence of enterprises in Financial service activities (K64) as for example Leasing activities (K64.91). The presence of vehicles in other sectors of economic activity is justified by own-account transport.

[6] The register used is the one for year 2008.

Table 5 - Result record linkage universe vehicle fleet - Asia 2008

Economic Activities	N. Vehicles	Employees	Enterprises
B - Mining and quarrying	2,242	24,655	698
C - Manufacturing	19,779	595,478	11,233
D - Electricity, gas, steam and air conditioning supply	743	42,497	68
E - Water supply; sewerage, waste management and remediation activities	8,969	113,471	2,190
F - Construction	33,785	305,313	22,215
G - Wholesale and retail trade; repair of motor vehicles and motorcycles	33,652	263,799	15,994
H - Transportation and storage*	2,843	54,529	959
– H49.41 - Freight transport by road	**77,629**	**192,942**	**29,094**
– H49.42 - Removal services	212	1,003	163
I; J - Accommodation & food service activities; Information and communication	264	43,058	161
K - Financial and insurance activities	80,547	108,032	172
Other activities	4,556	85,116	2,418
	265,221	1,829,893	85,365

∗ Calculated without the Classes 49.41 and 49.42

3.2.4 Accommodation and food service activities

For **Section I** (Accommodation and food service activities) the collaboration with trade associations led to meetings with:

- *Associazione Italiana Confindustria Alberghi, Italian Association of Hotels* and *FEDERALBERGHI* (Federazione delle associazioni italiane alberghi e turismo, Italian Federation of Associations hotels and tourism) for the Division 55;
- *FIPE* (Federazione Italiana Pubblici Esercizi, Italian Association of restaurants, bars and catering businesses) for the Division 56.

Accommodation services associations focused their attention on the possible release of 3 indicators: one for the Division 55, one for the single Group 55.1 and one for the total excluding the Group 55.1. The associations highlighted also the need to assess the evolution of the turnover of the hospitality industry (55.1) separately for the accommodation service and for food & beverages service. For this reason a special section in the questionnaire was introduced to collect data on turnover separately for the two distinct services. In addition, to take into account of the seasonal characteristic, it was decided to ask for the number of days of openings in the quarter in addition to the number of rooms.

Through the meetings with trade associations it was also possible to promote the survey between the associated enterprises. Istat attended the meeting of the heads of the regional associations of hotel owners (Trento, February 12, 2011) to illustrate the content, the aims and the modalities of implementation of the new survey.

Regarding the food and beverage service sector the need for four indicators was expressed: one for the Division, one for each of the three Groups: *Restaurants and mobile food service activities*, *Event catering and other food service activities* and *Beverage serving activities*. With the aim to update the list of companies providing food and beverage services, a link between the list of companies associated with Fipe and enterprises in the ASIA database was performed. In order to raise awareness of restaurant operators to participate in the survey, Fipe published an article on Mixer magazine (Fipe, 2011) to announce the launch of the new survey.

The quarterly survey on turnover of Accommodation and Food Service Activities was also presented on 29 April 2011 at *Valorizzazione e responsabilità sociale della statistica pubblica*, organized in Rome by the Italian Statistical Society and 23 May 2011 at the University of Sassari.

Analysis of hotel groups

For the accomodation sector we analysed the characteristics of hotel groups. The *Associazione Italiana Confindustria Alberghi* placed emphasis on the need to appropriately consider the groups at the time of sample extraction. According to the statistical definition a hotel is a receptive public exercise, which provides accommodation, meals and any other ancillary services, rooms in one or more buildings or parts of buildings.

Although the single hotel associated with a single enterprise is one of the characteristics of the Italian economy, many hotels are part of a wider reference group, in *a soft way*, for example in the case of a joint promotion agreement, or in *a hard way*, when a property is owned by a chain. A hotel may depend on a group through franchising contracts, consortia or various types of agreements (purchase of goods or services, making strategies, online management, ...). In the case of franchising, a hotel is associated with a group as long as certain parameters of membership hard franchise or soft franchise are met. A special case is provided by large international hotel groups, i.e. those that own and/or manage more extra wide national groups (examples include Accor and Marriot groups).

Bearing in mind these differences, it was decided to carry out a thorough analysis of the 50 major hotel companies (in terms of number of rooms) in Italy in 2009 according to the Italian Annual report on Tourism (Mercury, 2010) and the ones in the ASIA 2008 archive. This record-linkage showed that 47 enterprises on 50 are registered in ASIA 2008[7]. Missing companies were listed in the commercial register in the first half of 2010 and originate from mergers and incorporations of other undertakings present in ASIA 2008. As shown in Table 6 of the 47 firms in ASIA 2008, 32 are classified in Division 55. Of the 29 companies included in Group 55.1 (Hotels and similar accommodations) 18 (62.1%) have more than 100 employees, while 100.0% of companies belonging to the Group 55.2 (Holiday and other short-stay accommodation) has more than 100 employees.

Table 6 - Summary of hotel chain according to Asia 2008

	Employees				
NACE (Rev. 2)	2 - 5	5 - 20	20 - 100	$\geq$ 100	Tot
47.71				1	1
55.10	2	2	7	18	29
55.20				3	3
70.10		1			1
70.22		1	1		2
73.11	1	1			2
73.20	1		1		2
79.12			1		1
79.90				1	1
82.99	1	2	2		5
Total	**5**	**7**	**12**	**23**	**47**

It needs to be stressed that 3 companies were classified in Division 70 (Activities of head offices; management consultancy activities), 4 in Division 73 (Advertising and market research), 2 in Division 79 (Travel agency, tour operator and other reservation service and related activities) and 5 in Division 82 (Office administrative, office support and other business support activities).

[7] Archive available at the time of designing was referred to the year 2008.

3.3 The summary of information needs

During the meetings with trade associations it emerged the demand of economic information on turnover with more details compared to the requirements of the European regulation. Regarding the economic activity data were required at least at the level of Groups of economic activity (3 digit). Moreover, for some sectors it was considered of relevant importance to obtain information on the dynamics of turnover for macro geographical area or for specific aspects of economic activity. A summary of the indicators of turnover of Sections, Divisions, Groups and Classes required by the regulation and by the associations surveyed is shown in Table 7.

Table 7 - Indices of turnover: survey of needs information

Sections	Divisions	Indexes required by Regulation	Indexes required by stakeholders
G	45	45; 45.2; (45 - 45.2)	45.1; 45.3; 45.4
H	49	49	49.1; 49.2; 49.31; 49.41
H	52	52	52.1; 52.2; 52.29
I	55	(55 + 56)	55.1; (55 - 55.1)
I	56		56.1; 56.2; 56.3

Informational needs were carefully evaluated during the phase of the sample design looking for the best compromise between the costs, the statistical burden and the demand for detailed information.

4. The design phase: sector analysis, variable description and the estimation methodology

The sampling design demanded an accurate analysis of the structural characteristics of economic sectors subject to investigation. In order to evaluate the composition of each division by number of companies and employees information contained in the database of the active enterprises in ASIA for year 2010 and annual statistical surveys on economic performance of industrial and services companies have been used. In particular the average size of enterprise, measured as ratio between number of employees and enterprises (**size**), and the percentage of employees for enterprises with more than 100 employees (**Conc**) have been calculated.

4.1 Structural characteristics of the sectors

4.1.1 Wholesale and retail trade and repair of motor vehicles and motorcycles - Division 45

The STS Regulation requires 3 indicators for Division 45: the total of the division, the total of Group 45.2 and net Division of 45.2 Group. Until fourth quarter of 2010 only the indicator for the Group 45.2 was produced.

A detailed description of the number of enterprises, employees and turnover for economic activity for the division is shown in Table 8. The division includes 4 Groups of economic activity, the first 3 refer to vehicles and the fourth includes all activities on motorcycles. The largest enterprises in terms of employees for enterprise (5.4) and percentage of employees for the biggest enterprises (13.9) belong to the Group 45.1, which at its core consists of 21,514 enterprises (17.8% of the total). The Group 45.2 employs the 50.7% of workers of the Division 45. The residual number of employees is referred respectively to the Groups 45.3 (14.8% of total employees) and 45.4 (4.6% of total employees).

Table 8 - Detailed structure of division 45 - NACE, Asia 2010

NACE	Economic Activities	Enterprises	Ent. %	Employees	Empl. %	Size	Conc
45.1	**Sale of motor vehicles**	**21,514**	**17.8**	**116,604**	**30.0**	**5.4**	**13.9**
45.11	Sale of cars and light motor vehicles	20,751	17.2	108,811	24.4	5.2	13.4
45.19	Sale of other motor vehicles	763	0.6	7,793	1.7	10.2	20.8
45.2*	**Maintenance and repair of motor vehicles**	**77,015**	**63.9**	**197,083**	**50.7**	**2.6**	**0.6**
45.3	**Sale of motor vehicle parts and accessories**	**15,295**	**12.7**	**57,546**	**14.8**	**3.8**	**5.5**
45.31	Wholesale trade of motor vehicle parts and accessories	7,831	6.5	37,544	8.4	4.8	7.0
45.32	Retail trade of motor vehicle parts and accessories	7,464	6.2	20,002	4.5	2.7	2.7
45.4	**Sale, maintenance and repair of motorcycles related parts and accessories**	**6,758**	**5.6**	**17,794**	**4.6**	**2.6**	**1.1**
45	**Wholesale and retail trade and repair of motor vehicles and motorcycles**	**120,582**	**100.0**	**389,028**	**100.0**	**3.7**	**4.7**

∗ Already published

4.1.2 Land transport and transport via pipelines - Division 49

The STS Regulation requires the turnover index for the total of the Division 49. The sector consists of 5 Groups of economic activity (Table 9).

In this division the Class 49.41 is the relevant one. In particular it represents the 57.7% of employees for about 78,000 enterprises (on 110,000 for the total division). Although the Group 49.4 is the one with the lower values for size and Conc compared to the other Groups.

For three Groups of economic activity (49.1, 49.2, 49.5) because of the low number of active enterprises in the reference population but of big dimension, in the sample all the enterprises are selected.

Table 9 - Detailed structure of division 49 - NACE (Rev.2), Asia 2010

NACE	Economic Activities	Enterprises	Ent. %	Employees	Empl. %	Size	Conc
49.1	**Passenger rail transport, interurban**	**11**	**0.0**	**46,699**	**8.4**	**4,245.4**	**99.6**
49.2	**Freight rail transport**	**14**	**0.0**	**1,090**	**0.2**	**77.9**	**62.6**
49.3	**Other passenger land transport**	**29,289**	**26.6**	**174,952**	**31.6**	**6.0**	**61.2**
49.31	Urban and suburban passenger land transport	1,635	1.5	99,274	17.9	60.7	86.2
49.32	Taxi operation	24,025	21.8	34,860	6.3	1.5	11.0
49.39	Other passenger land transport n.e.c.	3,629	3.3	40,818	7.4	11.2	43.3
49.4	**Freight transport by road and removal services**	**80,777**	**73.4**	**327,943**	**59.3**	**4.1**	**12.1**
49.41	Freight transport by road	77,663	70.5	318,996	57.7	4.1	12.4
49.42	Removal services	3,114	2.8	8,948	1.6	2.9	1.2
49.5	**Transport via pipeline**	**14**	**0.0**	**2,606**	**0.5**	**186.1**	**91.4**
49	**Land transport and transport via pipelines**	**110,105**	**100.0**	**553,290**	**100.0**	**5.0**	**35.5**

4.1.3 Warehousing and support activities for transportation - Division 52

The STS Regulation requires the turnover index for the total of the Division 52. The Division is characterised by two main Groups even if contains strongly differentiated economic realities. A detailed description of the economic activities is then given at 5-digit level (Table 10). According to ASIA in 2010 were approximately 22,000 enterprises operating in the sector of warehousing and logistics. Of these about 8,000 were of service activities incidental

to land transportation (52.21) and about 7,000 other transportation support activities (52.29). The enterprises belonging to Service activities incidental to air transportation (52.23) are the biggest (70.1 employees for enterprises) and the 89.5% of employees works for enterprises with more than 100 employees.

Table 10 - Detailed structure of division 52 - NACE (Rev.2), Asia 2010

NACE	Economic Activities	Enterprises	Ent. %	Employees	Empl. %	Size	Conc
52.1	**Warehousing and storage**	**1,737**	**7.7**	**18,890**	**5.5**	**10.9**	**29.4**
52.2	**Support activities for transportation**	**20,914**	**92.3**	**321,900**	**94.5**	**15.4**	**55.5**
52.21	Service activities incidental to land transportation	8,381	37.0	83,701	24.6	10.0	62.0
52.22	Service activities incidental to water transportation	1,835	8.1	12,884 3.8	7.0	16.7	
52.23	Service activities incidental to air transportation	370	1.6	25,934	7.6	70.1	89.5
52.24	Cargo handling	3,548	15.7	125,815	36.9	35.5	59.9
52.29	Other transportation support activities	6,780	29.9	73,565	21.6	10.9	35.6
52	**Warehousing and support activities for transportation**	**22,651**	**100.0**	**340,790**	**100.0**	**15.0**	**54.1**

4.1.4 Accommodation and Food Service Activities - Section I

The STS Regulation requires an index of turnover for the entire Section I (Activities of accommodation services and restaurants). Given the importance of these activities in the Italian economy, the analysis has been carried out separately for Division 55 (Accomodation activities) and 56 (Food and beverage service activities).

A detailed description of the economic activities for the 55 Division is listed in Table 11. The Division 55 includes 4 Groups of economic activity. The most representative is the Group 55.1 with 55.0% of enterprises and 79.4% of employees. Moreover the size of these enterprises is the biggest (9 employees for enterprise) compare to the other Groups. Instead the 36.9% of employees for other accommodation works for enterprises with more than 100 of employees.

Table 11 - Detailed structure of Division 55 - NACE (Rev.2), Asia 2010

NACE	Economic Activities	Enterprises	Ent. %	Employees	Empl. %	Size	Conc
55.1	**Hotels and similar accommodation**	**24,667**	**55.0**	**221,717**	**79.4**	**9.0**	**15.3**
55.2	**Holiday and other short-stay accommodation**	**18,073**	**40.3**	**46,156**	**16.5**	**2.6**	**8.0**
55.3	**Camping grounds, recreational vehicle parks and trailer parks**	**1,646**	**3.7**	**9,095**	**3.3**	**5.5**	**5.7**
55.9	**Other accommodation**	**430**	**1.0**	**2,265**	**0.8**	**5.3**	**36.9**
55	**Accommodation**	**44,816**	**100.0**	**279,233**	**100.0**	**6.2**	**13.9**

A detailed description of the economic activities of 56 Division is listed in Table 12. The Division is mainly characterized by the two Groups 56.1 and 56.3. The first expresses the 53.1% of employees for about 130,000 enterprises, while the second one the 33.8% of employees with about 123,000 enterprises. The remaining 3,469 enterprises in Group 56.2 (Event catering and other food service activities) are characterised by the biggest size in the Division with the 79.7% of employees working for the enterprises with more than 100 of

employees. For subsequent analysis we will indicate with "traditional food" the aggregation between the Group 56.1 and the Group 56.3 and simply with "catering" Group 56.2.

Table 12 - Detailed structure of Division 56 - NACE (Rev.2), Asia 2010

NACE	Economic Activities	Enterprises	Ent. %	Employees	Empl. %	Size	Conc
56.1	**Restaurants and mobile food service activities**	**129,715**	**50.5**	**507,302**	**53.1**	**3.9**	**4.1**
56.2	**Event catering and other food service activities**	**3,469**	**1.4**	**124,445**	**13.0**	**35.9**	**79.7**
56.21	Event catering activities	1,872	0.7	11,224	1.2	6.0	13.9
56.29	Other food service activities	1,597	0.6	113,220	11.9	70.9	86.2
56.3	**Beverage serving activities**	**123,485**	**48.1**	**322,834**	**33.8**	**2.6**	**4.1**
56	**Food and beverage service activities**	**256,669**	**100.0**	**954,580**	**100.0**	**3.7**	**13.9**

4.2 Characteristics of the variables

For all economic sectors covered by the survey, the quarterly survey on turnover of services sector asks for two types of information: the total turnover and the average number of employees in the quarter.

During the recent reorganization of the survey (Bacchini et al. 2012) the definition of the two aggregates has been harmonised with the definitions used for other surveys in the Institute and the ones adopted in the STS regulation.

In coherence with the results from the meetings with the associations of categories, it was decided to extend the set of variables for 55.1 Group and to include the transport mode between the characteristics of enterprises in Class 49.41.

Concerning Group 55.1, the turnover for the services of accommodation and food & beverages are defined as:

The **turnover for accommodation services** includes *the turnover of services only overnight stay excluding breakfast. The value of the breakfast, which is not shown on the invoice as a separate item, can be determined in a conventional way, whereas a fixed fee amount for each overnight stay or a percentage of the price of the same*;

The **turnover for food & beverages** includes *turnover to the administration of food and beverages including breakfast (whose value is to be calculated in the manner described above), the minibar, room service, bar, restaurant, wine cellar, banquets, etc., even if related to customers seated.*

Concerning the transport modes has been classified according to 10 possible items: car transporter, combined, containers, refrigerated, not refrigerated food, oversize load, hydraulic binders, dangerous goods, garbage, other.

4.3 The estimation methodology

The launch of the new survey has led to the analysis of which estimator should be used for the calculation of the indices.

For the sector already disseminated, the index number is compiled using the quarterly year to year growth rate of the observed turnover calculated on respondents that coexist in the current quarter and the same period of the previous year (estimator for variation). This

methodology is characterized by its operational simplicity but, at the same time presents some limits.

Particularly, the treatment of non-response does not occur within a traditional correction of the expansion factor. Moreover it is not possible to derive an estimation for the total turnover for each quarter.

The introduction of the new surveys supported a supplement investigation on the estimation's characteristic. By means of a simulation experiment we studied the performance of the traditional estimator for expansion (Horwitz-Thompson estimator, Cochran 1977) and of the estimator for variation.

Both estimators perform in an optimal way when the units are all respondent and there is a low degree of persistence of the indices along the time. When the number of nonrespondents increases and we are in presence of a period of growth, the estimator for variation exhibits a biased behaviour.

For these reasons the estimates of the turnover indices for the new sectors are developed using the traditional Horwitz-Thompson estimator. Inside this framework, on the occasion of the change of base year [8] a calibration estimator has been introduced correcting the initial sample weights using an auxiliary variable to account for non-response (Bacchini et al. 2014).

5. The data collection tools

The needs from stakeholders have been taken into account in both the questionnaire design and in the implementation for new capabilities of the information system used for data collection.

5.1 The questionnaire

The questionnaire for the services turnover survey is organised in four different sections regarding the information about the enterprise; the economic activity; data for the current period and data for the previous periods. Moreover to take into account the needs from the stakeholders some additional information are required for the enterprises classified as land transport of goods (NACE 49.41) and accommodation (NACE 55.1). For the former data are gathered for the main transportation while for the latter the number of rooms, the number of opening days in the quarter and the split of turnover between accomodation and food and beverages services.

5.2 The information system updating

In order to manage the additional information requested by trade associations for the class land transport of goods (class 49.41 of NACE) and accommodation (Group 55.1 of NACE), it was necessary to update the information system (for more details see Bacchini et al., 2012). The update affected the website, the tables and the management procedures used for dealing with information on the enterprise and on quarterly data on turnover.

5.2.1 The website

As consequence of both the re-engineering process of service sector survey and of new data collection as required by associations for land transport of goods (NACE 49.41) and

[8] The indices in base 2010=100 have been released on 5th June 2013

accommodation (NACE 55.1), at February 2011 a new website *(https://indata.istat.it/fas)* was put online for data collection[9]. Moreover were upgraded the real-time acquisition procedure of data collected via web and the procedure for entering data received by fax .

5.2.2 The database

The operation for the management of the additional enterprises demographic information has been realized in two phases. In the first one new attributes were added at tables on external database server:

- *TRASP_PRINC* to save the information about the main transportation;
- *VAR_TRASP_PRINC* to allow the communication of a new value of main transportation;
- *NUM_CAMERE* to save the information about the number of rooms;
- *VAR_NUM_CAMERE* to allow the communication of a new value of number of rooms.

In second phase internal database and communication procedures between external and internal database server were updated. In this case, instead of changing the structure of demographic table a new one was created in the internal database scheme. In addition, the management software was modified to allow viewing, modification and deletion of new fields (in the Appendix, Figure 10 e Figure 11).

For the Group 55.1 it was decided to leave unchanged the existing data table used to collect information on total turnover and employees and create a new table *dati_alberghi* to gather the information, for each quarter, related to part of turnover attributable to accommodation services and food & beverage services. Therefore, it was created a procedure *(aggiorna_dati_alberghi_da_web)* to transfer the data obtained via the web to internal database. Correspondingly, the management software was modified for handling quarterly data relating to turnover for accommodation and food & beverage (in the Appendix, Figure 12).

6. The sample selection

Following the meetings with trade associations, it was decided to consider as estimation domains the Groups of economic activity (3 digits of NACE Rev 2 classification). Only for some sectors the 4 digits were used for economic activities and in particular for the Classes 49.31, 49.41, 52.21 and 52.29.

For 55 and 56 Divisions was also taken into consideration the geographical distribution (Northwest, Northeast, Middle, South and Islands).

The stratification variables are the economic activity together with classes of employees. In particular, the enterprises with more 100 employees (according to ASIA database) are a self-representative stratum and 3 classes of employees (2-4, 5-19, 20-99) are considered. For Division 52 and Groups 45.1, 52.1, 49.1, 49.2 the threshold is equal to 5 employees.

Taking into account the hypothesis about domains of estimation and stratifications, optimal allocation of the sample was created using both information on the enterprises in the ASIA database and structural business statistics referred to year 2010. It has been used the algorithm Bethel at a level of 3.0%[10], implemented in Mauss version developed in R (Di Giuseppe et al., 2010). The sample size obtained are shown in Table 13.

[9] We would like to thank Franco Garritano for the improvements of the previous release

[10] In the presence of the domain for geographical breakdown the error was set at 5.0%

Table 13 - Sample size for new surveys

Domain	Economic Activities	Sample size
45.1	Sale of motor vehicles	348
45.3	Sale of motor vehicle parts and accessories	485
45.4	Sale, maintenance and repair of motorcycles related parts and accessories	476
Total Division 45	**Wholesale and retail trade and repair of motorcycles**	**1,309**
49.1	Passenger rail transport, interurban	8
49.2	Freight rail transport	9
49.31	Urban and suburban passenger land transport	129
49.41	Freight transport by road	738
49.5	Transport via pipeline	4
49a = (49.32 + 49.39 + 49.42)	Other	242
Total Division 49	**Land transport and transport via pipelines**	**1,130**
52.1	Warehousing and storage	236
52.21	Service activities incidental to land transportation	199
52.29	Other transportation support activities	291
52a = (52.22 + 52.23 + 52.24)	Other	648
Total Division 52	**Warehousing and support activities for transportation**	**1,374**
55.1	Hotels and similar accommodation	561
55a = (55.2 + 55.3 + 55.9)	Other	531
Total Division 55	**Accommodation**	**1,092**
56.1	Restaurants and mobile food service activities	570
56.2	Event catering and other food service activities	259
56.3	Beverage serving activities	471
Total Division 56	**Food and beverage service activities**	**1,300**
Total Section I	**Accommodation and food service activities**	**2,392**
Total		**6,205**

The determination of domains for 55 Division has highlighted the importance of the Hotels compared to other accommodations: for geographical distribution were regarded domains 55.1 (Hotels and similar accommodation) and 55a (55.2, Holiday and other short-stay accommodation, 55.3, Camping grounds, recreational vehicle parks and trailer parks, and 55.9, Other accommodation).

In the restaurant industry, the choice of the domains has been done according to the economic differences between the *traditional restaurants* (56.1 and 56.3) and the *Event catering* (56.2). Only for the traditional restaurants the geographical variable has contributed to the domain definition.

The 1,309 companies sampled for the 45 Division represent a share of turnover of 43.3% of the national total of the sector; the 1,130 enterprises sampled in 49 Division accounted for 44.5% of turnover; the 738 companies sampled in 49.41 Class represent the 25.6% of the total turnover in the Class and the 16.9% of the Division; the 1,374 companies sampled in Division 52 represent 62.7% of total national revenues by Division; the coverage for the 1,092 enterprises sampled for the Division 55, is equal to 25.9%; the 561 sampled enterprises on Group 55.1 account for 20.1% of total sector national; the 1,300 enterprises sampled 56 Division accounted for 21.1% of the national total.

Table 14 - Sample size by geografic areas for accomodation and food and beverage service activities

Domain by geografic areas	Economic Activities	Sample size
55.1 North-West	Hotels and similar accommodation	122
55.1 North-East	Hotels and similar accommodation	139
55.1 Middle	Hotels and similar accommodation	142
55.1 South and Islands	Hotels and similar accommodation	158
55a North-West	Other	68
55a North-East	Other	150
55a Middle	Other	140
55a South and Islands	Other	173
Total Division 55	**Accommodation**	**1,092**
56.1 North-West	Restaurants and mobile food service activities	132
56.1 North-East	Restaurants and mobile food service activities	125
56.1 Middle	Restaurants and mobile food service activities	145
56.1 South and Islands	Restaurants and mobile food service activities	168
56.2 Italy	Event catering and other food service activities	259
56.3 North-West	Beverage serving activities	74
56.3 North-East	Beverage serving activities	119
56.3 Middle	Beverage serving activities	129
56.3 South and Islands	Beverage serving activities	149
Total Division 56	**Food and beverage service activities**	**1,300**
Total Section I	**Accommodation and food service activities**	**2,392**

7. The data collection phase

The surveys for these economic sectors were launched in March 2011 by sending by mail the cover letter, the questionnaire and the instructions to the 6,205 enterprises in the sample.

The personal information for enterprises, necessary for the postal sending, were created using the ones contained in the ASIA register. For a limited number of enterprises, the mailing failed because of cessation of activities (for bankruptcy or liquidation, merger, lease or transfer of all or of business interested in detection) or list errors (incorrect address). For these enterprises, a further control on the activity state has been carried out through administrative sources (in particular by *Telemaco*[11]) or searching via web.

The final size of the first sample retrieved also takes into account the changes in NACE activities and transformations (mergers, incorporations, new born) that companies have made. In the Table 15 we report the number and characteristics of non-contact.

The percentage of sampled firms lists was among the 91.6% of the survey on the warehousing and support activities for transportation (NACE Division 52), and 93.5% of the survey on land transport and transport via pipelines (NACE Division 49). The negative peak regarding Groups is recorded for warehousing and storage (NACE Group 52.1) with 88.1% coverage.

[11] The database provided by Unioncamere (Unione italiana delle Camere di commercio, industria, artigianato e agricoltura, Italian Union of Chambers of Commerce, Industry, Handicraft and Agricolture), the public body that unites and represents istitutionally the Italian chambers

Table 15 - Number of enterprises for new surveys and characteristics of non-contact

NACE (Rev. 2)	Theoretical num.	Cease	Undeliverable mail	Final num.	%
45.1	348	6	8	334	96.0
45.3	485	14	11	443	91.3
45.4	476	16	18	443	93.1
Total Division 45	**1,309**	**36**	**37**	**1,220**	**93.2**
49.1	8	0	0	8	100.0
49.2	9	0	0	9	100.0
49.31	129	4	3	118	91.5
49.41	738	18	26	689	93.4
49.5	4	0	0	4	100.0
49a	242	6	3	229	94.7
Total Division 49	**1,130**	**28**	**32**	**1,057**	**93.5**
52.1	236	13	9	208	88.1
52.21	199	10	7	181	91.0
52.29	291	12	5	278	95.5
52a	648	29	16	591	91.2
Total Division 52	**1,374**	**64**	**37**	**1,258**	**91.6**
55.1	561	25	5	534	95.2
55a	531	26	17	486	91.5
Total Division 55	**1,092**	**51**	**22**	**1,020**	**93.4**
56.1	570	16	23	535	93.9
56.2	259	7	10	240	92.7
56.3	471	19	21	430	91.3
Total Division 56	**1,300**	**42**	**54**	**1,205**	**92.7**
Total I	**2,392**	**93**	**76**	**2,225**	**93.0**

7.1 System of data capturing

The quarterly survey on turnover of services includes two ways of data return by companies:

- via fax, using dedicated fax server;
- via web, through the indata website.

The launch of the new surveys was associated with the release of the new website for data capturing. It was then possible to measure the impact of the new site by observing the responses of both enterprises belonging to the sample before 2011 (sectors already monitored) and the new ones (for the new economic sectors together with the enterprises that are annually rotated after the refreshment operation).

For the economic activities already monitored (Table 16) an increase is registered in web responses by 4.5 percentage points between the 2nd and the 3rd quarter 2010 (start time of the reminder procedure for businesses through fax communication) and 9.9 percentage points between the fourth quarter of 2010 and the 1st quarter 2011 (launch of the new site). If we consider the average of the responses arrived via web of 2010 and 2011, the increase is even 18.2 points. In 2012 the increasing trend of the response via web has continued to grow.

Table 16 - Type of data capturing used by enterprises extracted before 2011 (services sectors already published)

Type	Send to quarter %												Average per year %		
	2010				2011				2012						
	I	II	III	IV	I	II	III	IV	I	II	III	IV	2010	2011	2012
Fax	61.5	61.4	56.1	51.6	41.7	39.7	38.8	37.3	37.0	36.3	35.2	34.3	57.7	39.4	35.7
Web	38.5	38.6	43.9	48.4	58.3	60.3	61.2	62.7	63.0	63.7	64.8	65.7	42.3	60.6	64.3

The new enterprises, those one selected in the sample for the first time in 2011, choose web as the main tools to provide data (Table 17). Also for this subgroup the web percentage ratio increased in the last years.

Table 17 - Type of data capturing used by enterprises extracted in 2011 (all services sectors)

Type	Send to quarter %												Average per year %		
	2010				2011				2012						
	I	II	III	IV	I	II	III	IV	I	II	III	IV	2010	2011	2012
Fax	46.6	45.9	45.6	45.3	46.5	42.3	39.7	37.3	38.8	38.5	37.7	37.0	45.8	41.5	38.0
Web	53.4	54.1	54.4	54.7	53.5	57.7	60.3	62.7	61.2	61.5	62.3	63.0	54.2	58.5	62.0

Overall, the introduction of the new web portal for data capturing has significantly increased the percentage of firms responding mode via web.

7.2 Response rate and respondents

If you look at the 2010-2012 period, the average enterprises collaboration has increased, whether measured in terms of turnover (source Istat structural data archives and Asia) or measured in terms of number of enterprises (Table 18).

Table 18 - Response rate and coverage of turnover - average per year

NACE (Rev. 2)	Response rate			Coverage of turnover		
	Average 2010	Average 2011	Average 2012	Average 2010	Average 2011	Average 2012
45	60.6	75.8	77.1	87.6	92.5	91.7
49	34.7	51.8	57.0	75.2	82.4	86.7
52	44.9	60.4	63.3	74.4	86.9	86.6
I	34.4	53.8	55.8	70.4	85.0	85.0
55	36.8	50.8	59.0	61.7	77.8	76.7
56	32.3	57.1	53.0	74.4	88.5	88.8

With regard to the variables inserted specifically for some economic activities, 245 of 442 respondents belonging to the sample enterprises of companies selected for the road freight transport have compiled the prevailing transport section (see Table 19) and in 197 cases a prevailing mode of transportation has not been indicated.

Table 19 - Respondents by type of transport prevailing

Transport prevailing	Number of enterprises
Transportation not indicated	197
Car transporter	7
Combined	17
Container	11
Refrigerated	35
Food not refrigerated	10
Oversize load	4
Hydraulic binders	2
Dangerous goods	20
Garbage	10
Other	129
Total	**442**

Regarding accomodation services, 151 of 203 enterprises respondents in the sample for the hotel sector have provided the required turnover data split, 86 the number of rooms (worth about 25,100 units) and 127 the number of opening days. If we look at the breakdown by geographical area (Table 20), the lowest response rates is observed for firms in the South and Islands.

Table 20 - Percentages of the collaborations of the hotel enterprises by geographical areas

Geografic areas	Coverage of turnover		
	2010	2011	2012
North-West	53.3	64.5	64.0
North-East	47.4	66.3	66.1
Middle	39.3	57.1	56.1
South and Islands	34.3	54.5	53.1

8. Dissemination and analysis of the new indicators

The data collection for the new surveys started with reference to the first quarter in 2010. The new indicators have been released for the first time on the 27th of March 2012 (Istat, *Nuovi indicatori del fatturato dei servizi*, Il Sole 24ore) with reference of the Groups of Division 45 (Wholesale and retail trade and repair of motor vehicles and motorcycles) never surveyed before (Groups 45.1, 45.3 e 45.4) and the Divisions 49 (Land transport and transport via pipelines), 52 (Warehousing and support activities for transportation), 55 (Accomodation) and 56 (Food and beverage service activities). After that, the quarterly indices for turnover for these sectors have been regularly published, for each quarter, at approximately 60 days from the reference period, as required by the STS regulation. For the period I.2010 - I.2014 the year to year growth rate are reported for the Division 45 (Figure 1), the Division 49 (Figure 2), the Division 52 (Figure 3), the Division 55 (Figure 4) and the Division 56 (Figure 5) for Germany, France, Italy and Spain.

The international comparison illustrates the main characteristics of these sectors during the most recent economic crisis for which Italy is still not out. All of them exhibits a clearly decreasing pattern with a throat around the end of 2012. However the intensity of the re-

cession depends from the countries and sectors. The mainly amplitude of the recession has been registered for the sector of *Wholesale and retail trade and repair of motor vehicles and motorcycles* according to the well known contraction of the motor vehicles market. Italy and Spain recorded the lowest rate during the 2012 (respectively -17% and -20%) but the value for the I quarter of 2014 is positive for all the countries.

The intensity of the recession has been less intensive in the other sectors. The indices related to the *Land transport and transport via pipelines* Division show the peculiarity of the contraction for Spain while the indices for the *Warehousing and support activities for transportation* Division illustrated the comovements between the countries with a slight improvements in the growth rate starting from the first quarter of 2013.

The indices for the *Accommodation and Food Service Activities* share a similar behaviour with the trough in the first quarter of 2013 for all countries. Data in the first quarter of 2014 are positive for all countries but not for France.

With the release of data for these new sectors the coverage of the turnover indices has increased to the 84.9% in terms of Structural Business Statistics weights. In such way an index of turnover for the service sector has been released. However, as stressed before, in the last months Istat has completed the compilation of the indices for all the sectors required by the STS regulation. The total indices for services has been released in June 2014.

Figure 1 - Quarterly Index of Services Turnover: Wholesale and retail trade and repair of motor vehicles and motorcycles (Germany, France, Italy and Spain, 2011-2014 (IQ), Changes on the same quarter of the previous year)

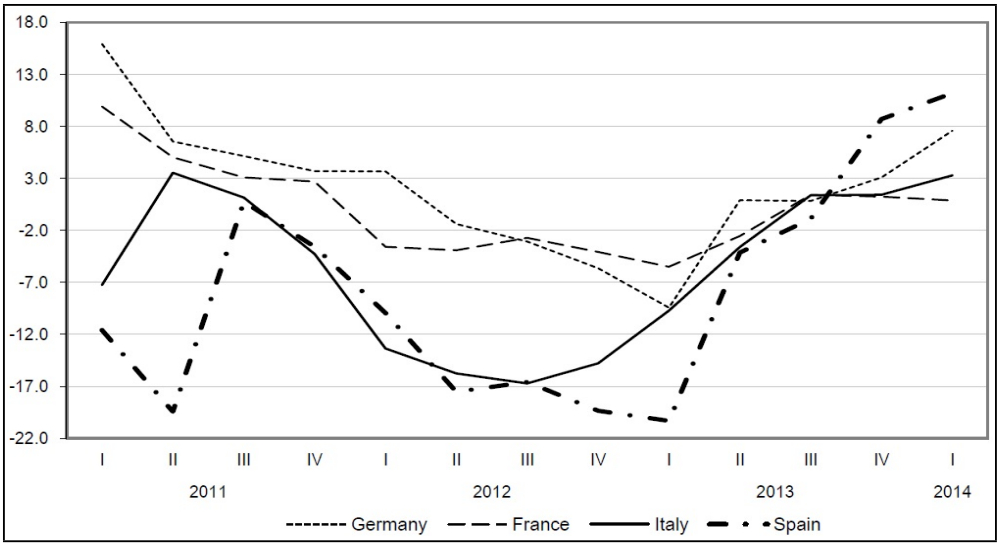


Figure 2 - Quarterly Index of Services Turnover: Land transport and transport via pipelines (Germany, France, Italy and Spain, 2011-2014 (IQ), Changes on the same quarter of the previous year)

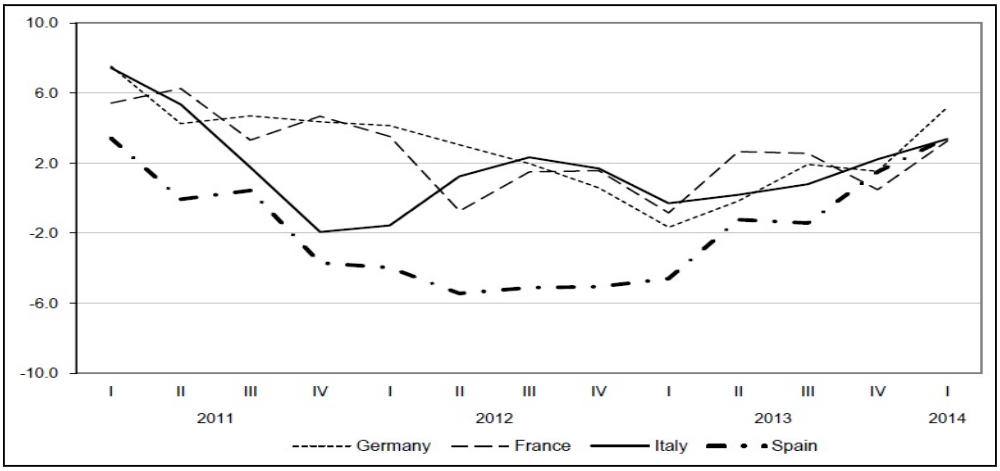


Figure 3 - Quarterly Index of Services Turnover: Warehousing and support activities for transportation (Germany, France, Italy and Spain, 2011-2014 (IQ), Changes on the same quarter of the previous year)

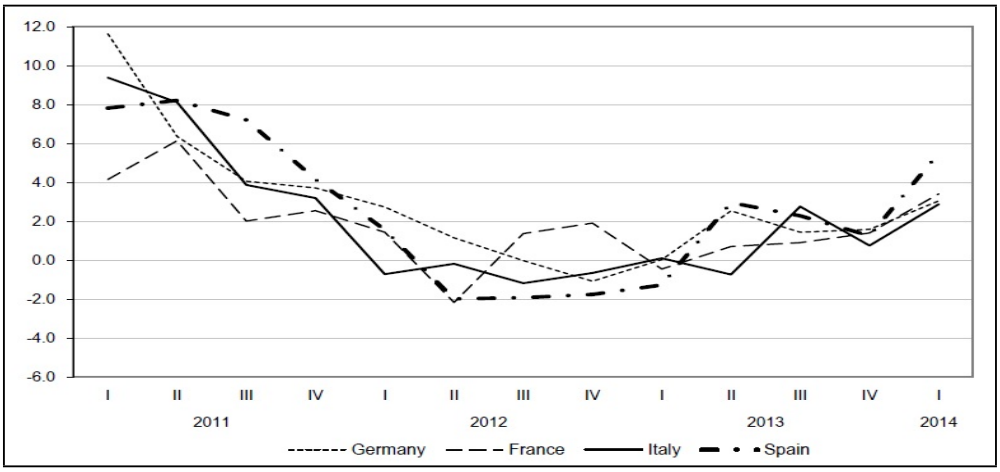


Figure 4 - Quarterly Index of Services Turnover: Accommodation (Germany, France, Italy and Spain, 2011-2014 (IQ), Changes on the same quarter of the previous year)

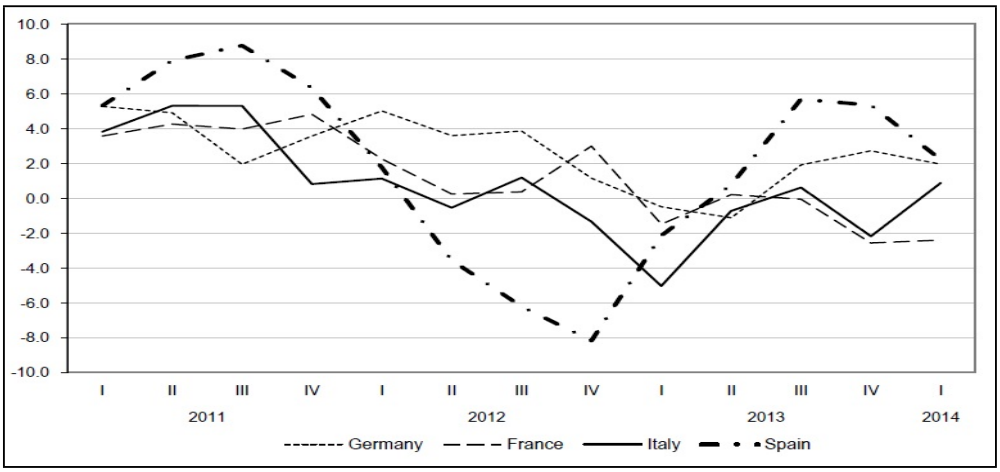
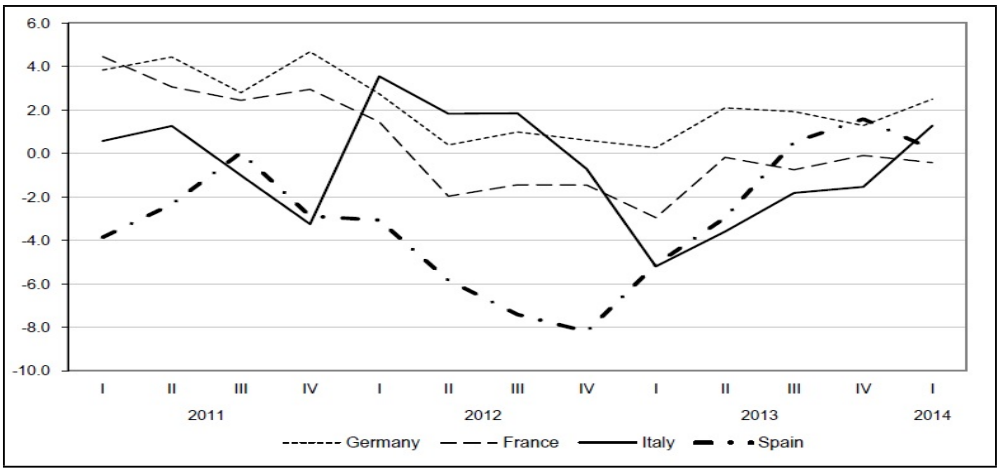


Figure 5 - Quarterly Index of Services Turnover: Food and beverage service activities (Germany, France, Italy and Spain, 2011-2014 (IQ), Changes on the same quarter of the previous year)



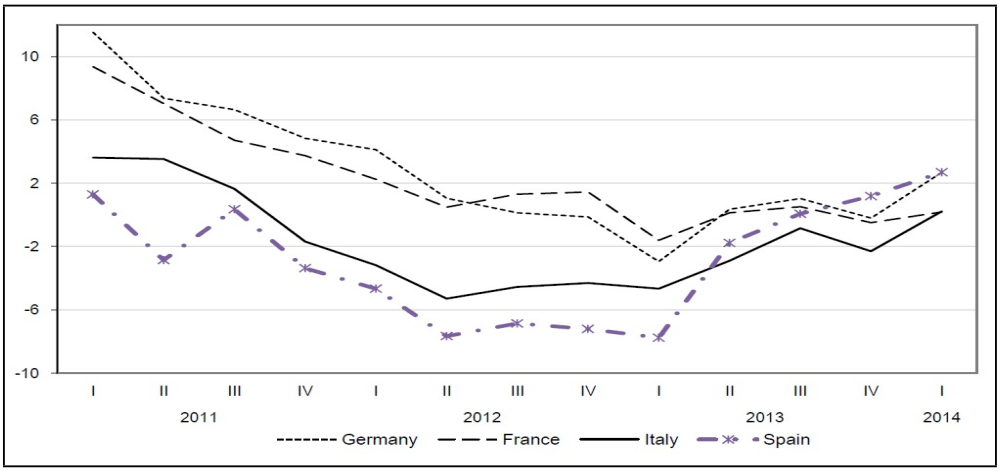
The pictures of the quarterly total index of Services Turnover (Figure 6) support the differences in the business cycle between the central European countries (France and Germany) and the Mediterranean countries (Italy and Spain) that exhibit a deeper contraction.

For all countries the minimum has been reached at the beginning of 2013. Particularly the last data (I quarter 2014) are positive for all countries.

To look at the synchronization of the behaviour of the indexes in the period 2010-2014 (IQ) we have considered the correlation between the year to year growth rate for the four countries. After calculating the average of the correlation between one country with the other three, the highest value of the correlation is reported for Italy (0.79) followed by Germany (0.76) and France (0.68). The minimum is recorded for Spain (0.49).

Moreover, the synchronization for the index of the Service turnover is lower compared to that one for the industrial turnover. In the same period the average of the correlation for the four countries spans from 0.90 (France) to 0.94 (Germany) while Italy and Spain shares the same level (0.93).

Figure 6 - Quarterly Index of Services Turnover: Total activities (Germany, France, Italy and Spain, 2011-2014 (IQ), Changes on the same quarter of the previous year)



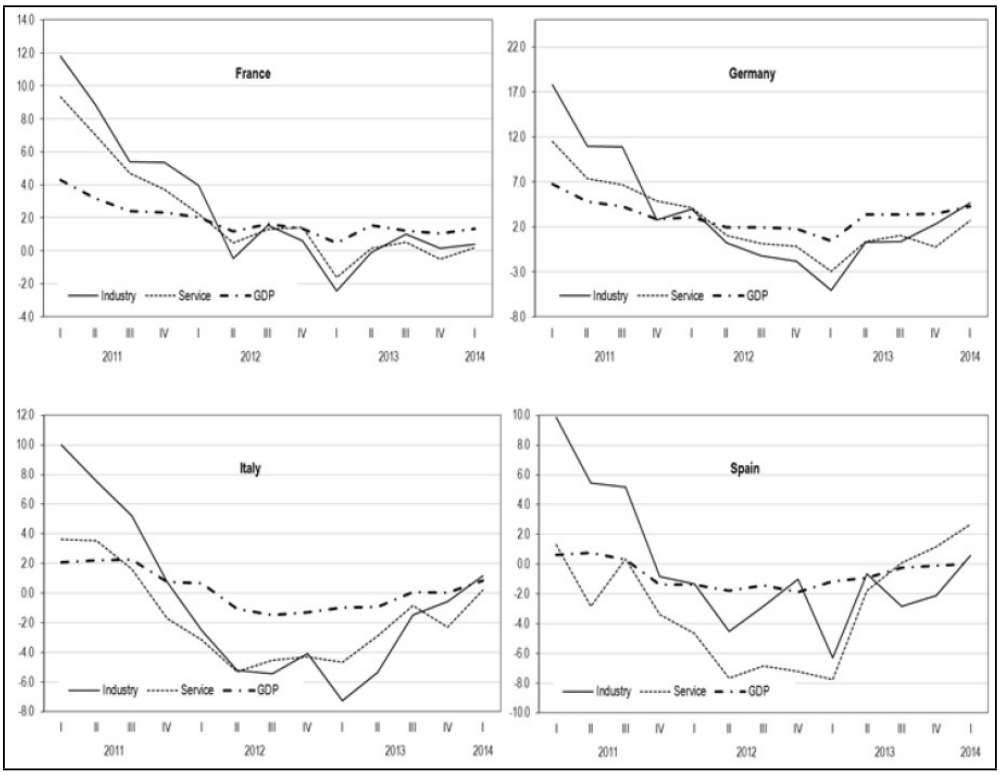
This evidence is supported by the comparison (Figure 7). For each country, of the year to year growth rate of the quarterly index of Service turnover, industrial turnover and nominal GDP over the period 2010-2014 (IQ).

Spain is the only country with a moderate similitude between the index of Service and Industrial turnover. Three main findings emerges from the comparison

- for all countries the year to year growth rate of the turnover indices fluctuate much more than that one of the nominal GDP. Particularly the volatile of the service sector is in line with the industrial' one. However during the crisis the distance from the indices of turnover and nominal GDP is higher for Italy and Spain.
- all indices show a clear business cycle behaviour with a trough in the first quarter of 2013

- data for the indices of turnover for France are not significative positive in the first quarter of 2014 compared to the other countries

Figure 7 - Quarterly Index of Services Turnover, quarterly Index of industrial turnover, GDP at nominal value (Germany, France, Italy and Spain, 2011-2014 (IQ), Changes on the same quarter of the previous year)



9. Conclusive remarks

The release of the new index for the entire service sector represents a big step forward in the coverage of short term indicators. Starting from the press release of June 2014 the number of indices and coverage are fully compliant with STS regulation. The total index for Service turnover as well as the indices for all Divisions will be published currently each quarter at 60 days from the reference quarter.

More importantly, these results have been reached by means of a standardisation framework in the production process. This has been the case, for example, for the determination of the sample size with the generalized software Mauss-R.

However, many issues must be followed up over the next few months. Firstly, a back-calculation of the series from 2000 is required, at least for the total index. In this way it will

become more feasible to provide also seasonally adjusted data to detect the movements of the index with the previous quarter.

Secondly, economic analysis for the new sectors and its relation with the industrial sector and GDP should be investigated in order to improve the measure of the services direct contribution to economic growth (Kox, H. and L. Rubalcaba (2007)).

Thirdly, a measure of a production index should be derived to complete the set of Services Short-term indicators. Eurostat has built up a task-force on this topic.

Finally, we conclude that in the near future these indices will be useful in investigating also the indirect contribution of the services to growth (Evangelista et al., 2013) and in exploring their interrelation with the manufacturing industry. A more integrated analysis of the economic system behind the traditional separation between the economic sectors will be a challenge for the future.

References

Bacchini, F., G. Busanello, G. Capacci, S. Coppola, F. Garritano, B. Iaconelli, M. G. Ippoliti, L. Massimiani, A. Stanco and F. Vaccaro (2012), *Indagine trimestrale del fatturato dei servizi: le innovazioni nel processo produttivo, nella piattaforma di acquisizione dei dati e nel sistema informativo*. Working Paper Istat, n. 5.

Bacchini, F., C. Ceccarelli, D. Chianella and R. Iannaccone (2014), *An application of calibration estimators for the quarterly turnover in service sector*. RIEDS - Rivista Italiana di Economia, Demografia e Statistica - Italian Review of Economics, Demography and Statistics, pages 15-22.

Bethel, J. (1989),*Sample Allocation in Multivariate Survey", Survey Metodology*.

Cipolletta, I. (2013),*Più industria o più servizi? Un falso dilemma*. Economia Italiana n.2.

Cochran, W. (1977), *Sampling techniques*. Wiley, New York.

Di Giuseppe, R., P. Giaquinto and D. Pagliuca (2010),*MAUSS (Multivariate Allocation of Units in Sampling Surveys): un software generalizzato per risolvere il problema dell'allocazione campionaria nelle indagini Istat*. November.

Eurostat (2005), *STS regulation n. 1158/05*.

Eurostat (2008), *NACE Rev. 2. Statistical classification of economic activites in the European Community*. Methodologies and Working papers.

Evangelista, R., P. Guerrieri, M. Lucchese and V. Meliciani (2013),*Utilizzo dei servizi alle imprese e competitività internazionale in Europa: un'analisi a livello settoriale*. Economia Italiana n.2.

Fipe (2011), Confcommercio, *Mixer*. May.

Giovannini, E. and W. Caves (2005), *The statistical measurement of services recent achievements and remaining challenges*. 20th meeting of the Voorburg group.

Guardabascio, B., F. Bacchini and M. Pepe (2012), *La classe LaTex per i working paper Istat*. Working Paper Istat, n. 11.

Iaconelli, B., F. Bacchini, M. G. Ippoliti, B. Guardabascio and R. Iannaccone (2014), *The seasonal adjustment of the quarterly services turnover indices* . Rivista di Statistica Ufficiale n. 1/2015

Istat (2009), *Classificazione delle attività economiche Ateco 2007 derivata dalla Nace Rev. 2*. Metodi e Norme n. 40.

Istat (2010), *Struttura e dimensione delle imprese, Archivio statistico delle imprese attive (ASIA) - anno 2008*.

Istat (2012a), *Nuovi indicatori di fatturato dei servizi (I trimestre 2010 - IV trimestre 2011)*. Press release, March

Istat (2012b), *Struttura e competitività delle imprese - anno 2010*.

Istat (2013), *La struttura del sistema produttivo italiano al 2011 e i cambiamenti rispetto al 2001*.

Istat (2014), *Fatturato dei servizi - I trimestre 2014*. Press release, 5 June.

Kox, H. and L. Rubalcaba (2007). *Analysing the contribution of business services to European economic growth*. MPRA Paper n. 2003.

Mercury (2010), *XVII Rapporto sul Turismo Italiano*. Edizione XVII.

Il Sole 24 ore (2012), *L'indicatore del giorno*. 28 March.

Unece (2009), *Generic Statistical Business Process Model*.

APPENDIX

Figure 8 - GSBPM: phases and sub-phases updated for the re-engineering of service turnover survey

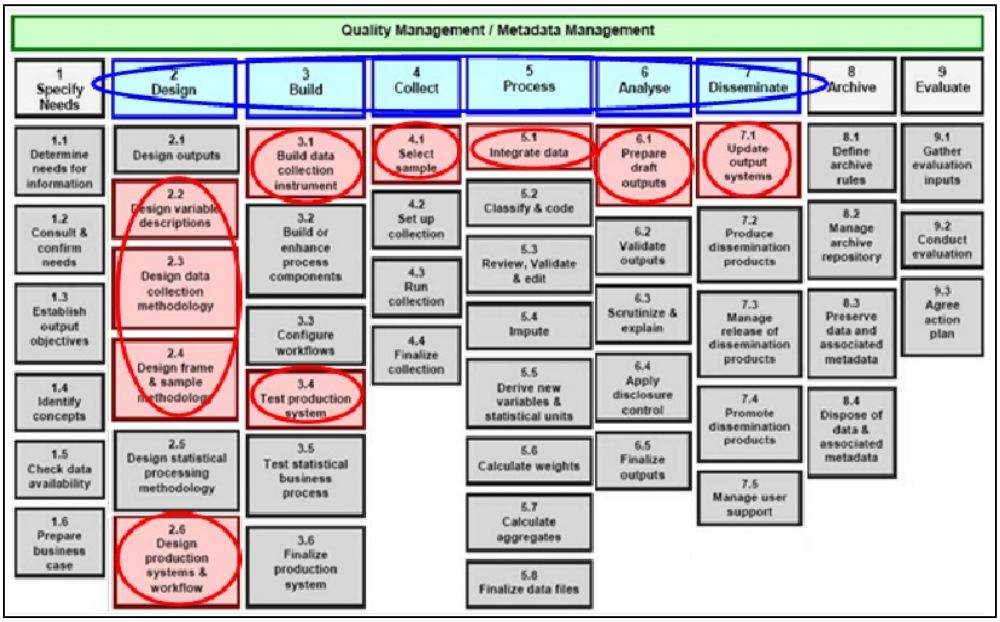


Figure 9 - GSBPM: phases and sub-phases updated for launch of service turnover survey for the new surveys

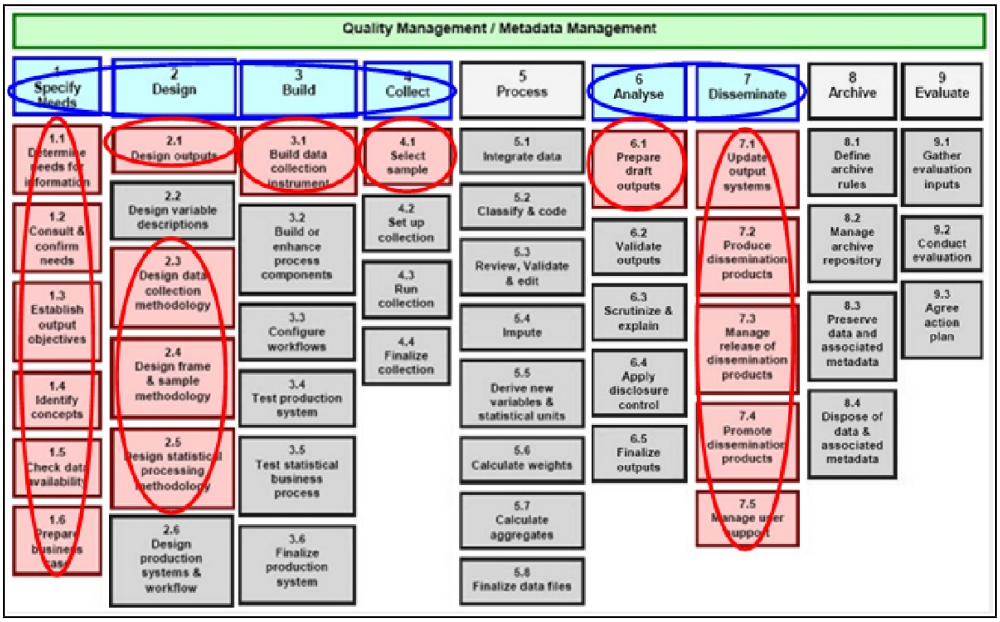


Figure 10 - Demographic data input frame for Freight Transport by road(49.41)

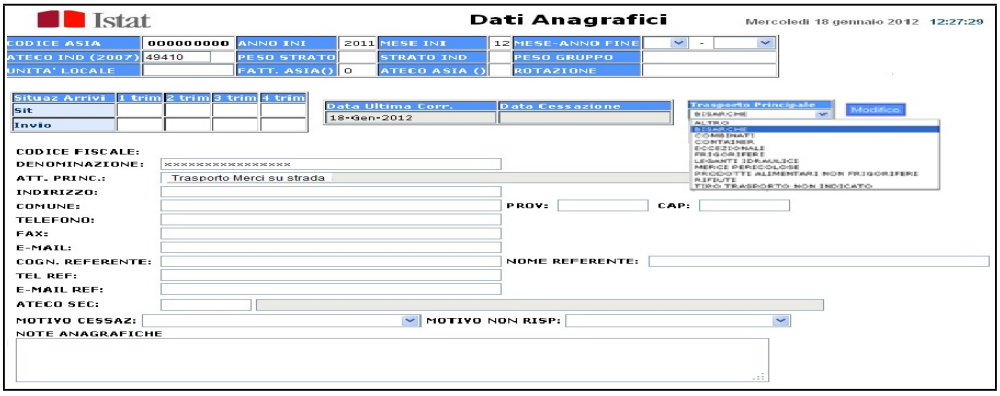


Figure 11 - Demographic data input frame for Hotels (55.1)

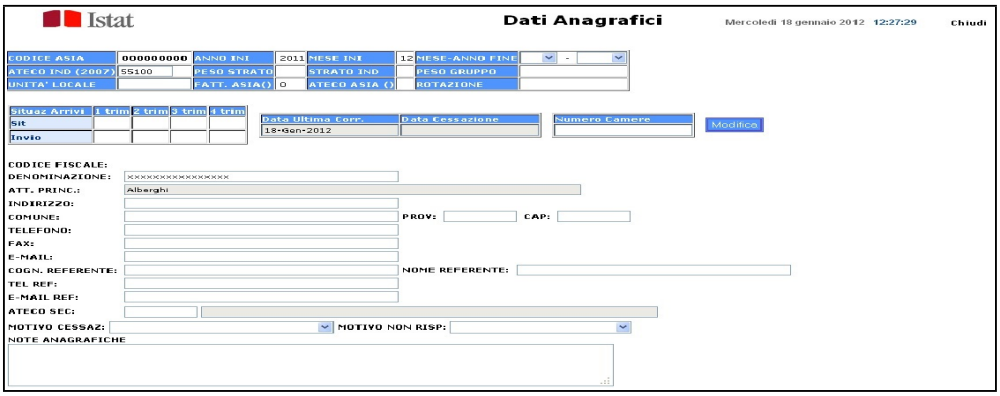
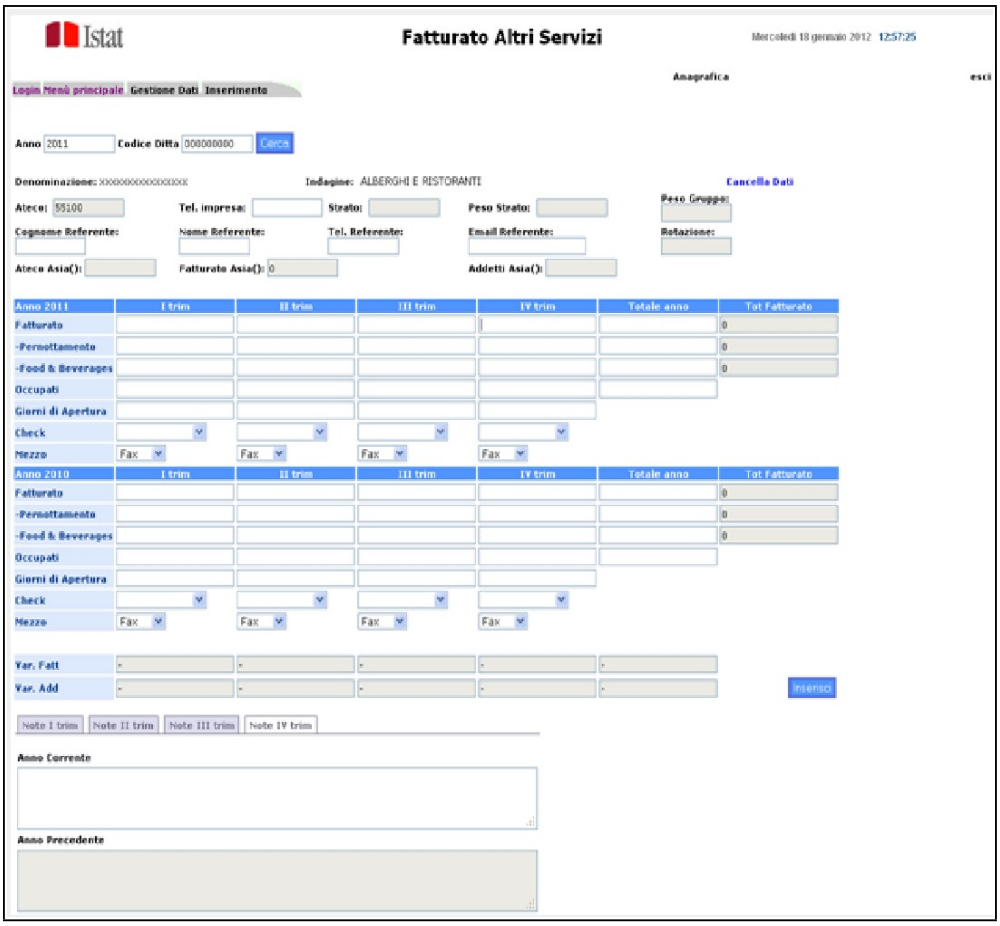


Figure 12 - Data input frame for Hotels (55.1)



The seasonal adjustment of quarterly service turnover indices[1]

Barbara Iaconelli, Fabio Bacchini, Maria Giulia Ippoliti,
Barbara Guardabascio, Roberto Iannaccone

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

[1] F. Bacchini, Econometric Studies and Economic Forecasting Division, B. Guardabascio, B. Iaconelli, R. Iannaccone and M. G. Ippoliti, Short-term Economic Statistics Directorate. Although the document is the result of a joint effort of the authors, Barbara Iaconelli realized sections 2, 3 and 4, Fabio Bacchini 1, 3, 4 and 5, Maria Giulia Ippoliti 1 and 4, Barbara Guardabascio 2 and 3, Roberto Iannaccone 1, 2 and 5. We are grateful for comments and suggestion to Laura Leoni and two anonymous referees. The views expressed in this article are those of the author and do not necessarily represent the views of Istat.

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:

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

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:

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

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.

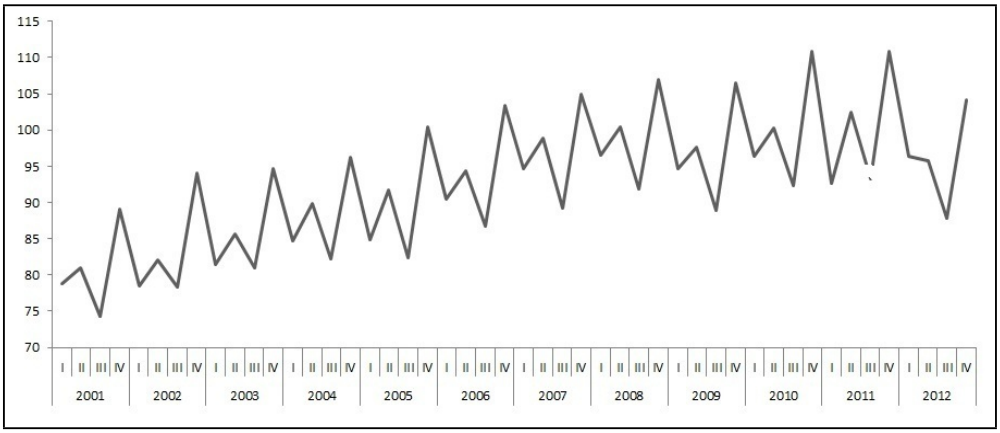
More in detail, the studies led to the selection of two seasonal adjustment methods, as X-12-ARIMA and TRAMO-SEATS. The second step was the release of a standard interface that make easier to perform seasonal adjustment. The result was the development of Demetra+.

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)

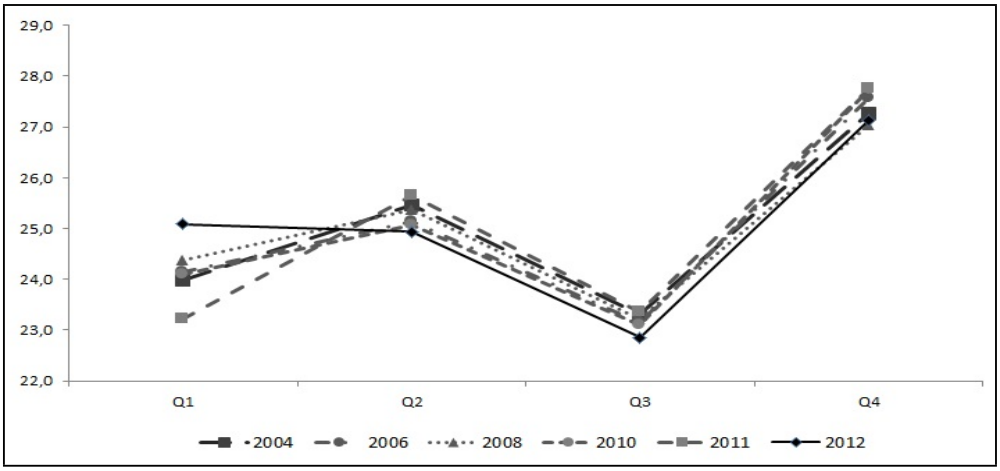
The quarterly turnover index for maintenance and repair of auto vehicles presents a stable movement around a growing trend until the end of 2008. Starting from 2009 the series follows a more static and less regular path, with a decreasing trend until 2012 (Figure 1).

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)



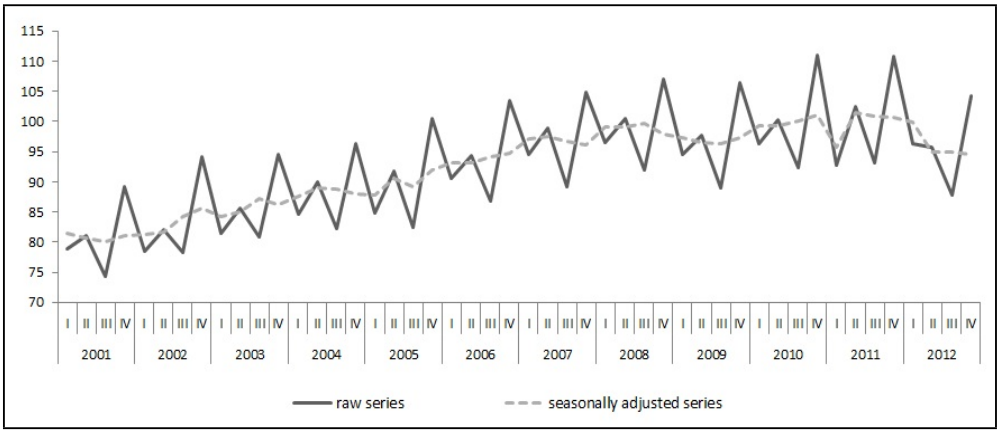
Indeed, the graphical analysis of the SI ratios does not show any presence of significant changes in seasonal dynamics. The model chosen for the series is an ARIMA [(0,1,0);(0,1,1)] with logarithmic transformation of data and the pre-specification of an additive outlier (AO) at the first quarter of 2011. 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.

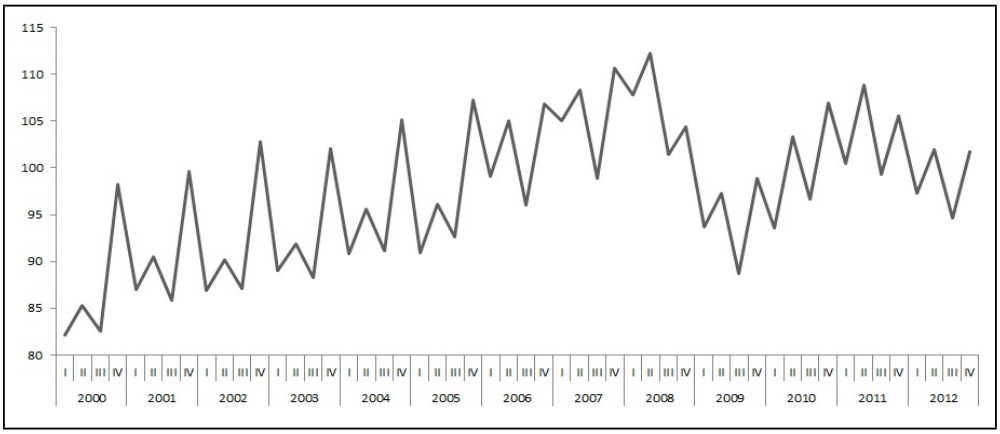
Figure 3 - Quarterly index of maintenance of auto vehicles (G452) - 2001-2012 unadjusted and seasonally adjusted series



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).

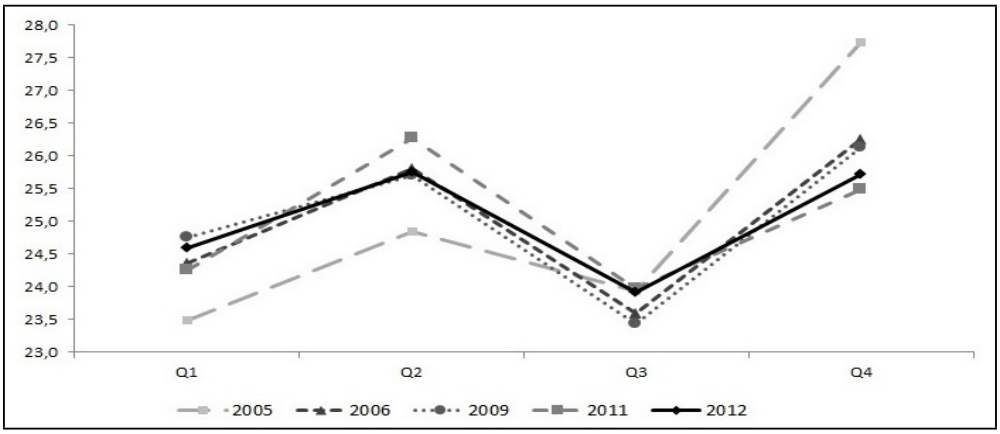
Figure 4 - Quarterly index of wholesale trade (G46) - 2000-2012 - unadjusted series



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

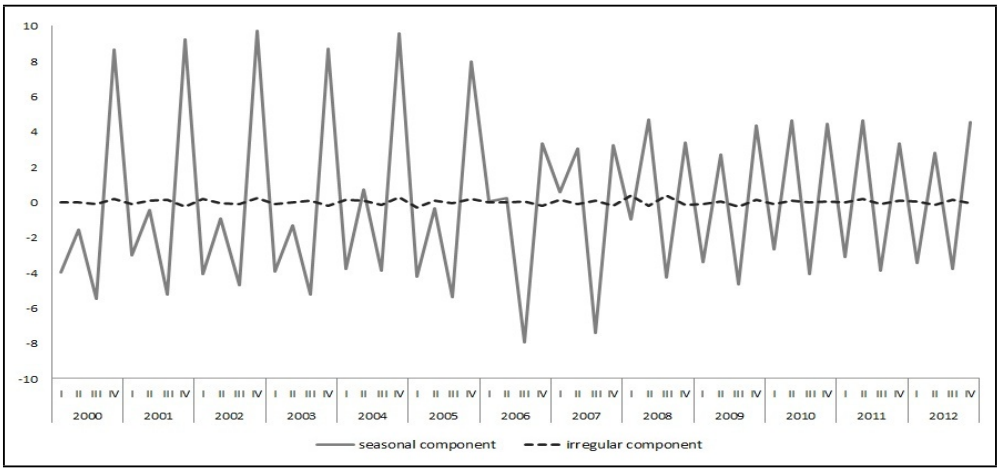
turnover while the contribution amounts to 23.7% for the first quarter, to 24.8% for the second and to 23.8% for the third one. Between 2006 and 2012 the relative variation of the fourth quarter declines to 25.7%, while the one of the other quarters increases. Indeed, during the same period, the importance 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



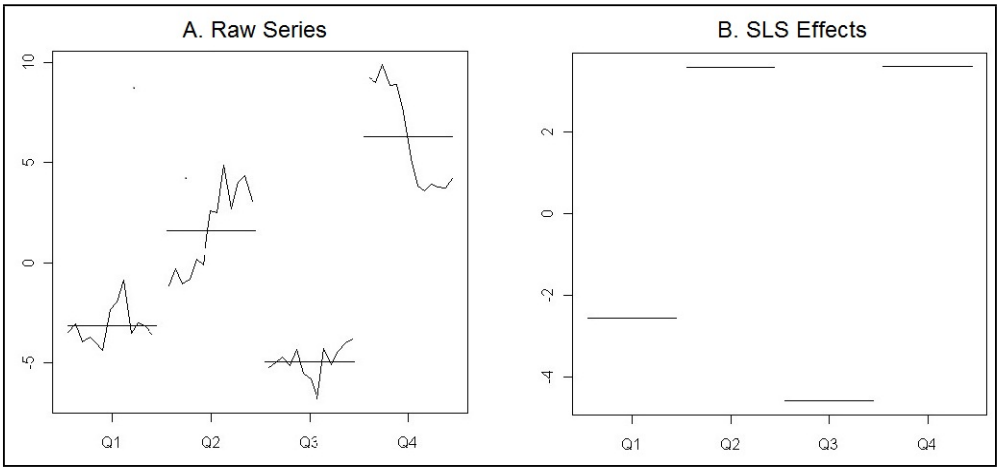
In particular, analysis of the SI ratios shows an opposite path for the second and the fourth quarter (figure 7.A).

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.

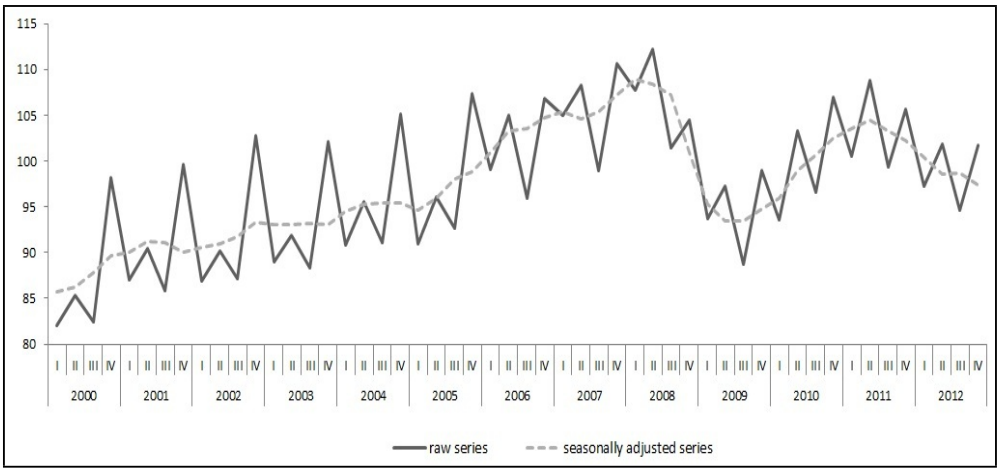
A comparison has been made with an Airline model with one SLS on the fourth quarter, however it shows a tendency to amplify the cyclical fluctuations for the period 2000-2005 and produce major revisions in 2008-2009 (given a less continuity with the models already used).

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

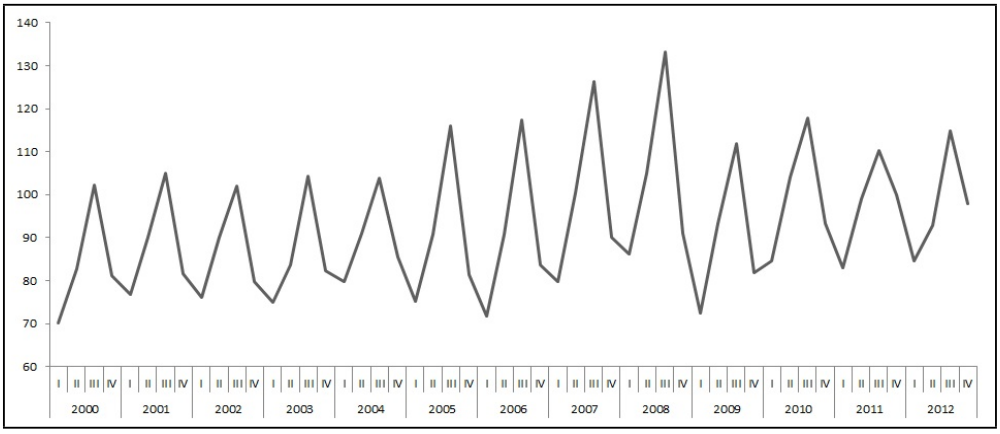
Figure 8 - Quarterly index of wholesale trade (G46) - 2000-2012 unadjusted and seasonally adjusted series



4.4 The water transport sector (H50)

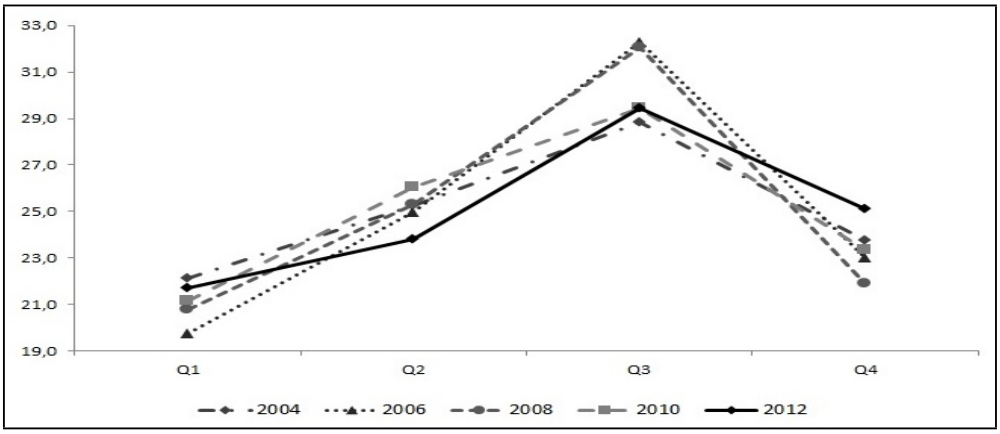
The water transport quarterly turnover index shows an increasing tendency, especially in the period 2005-2008. This trend has a break by the first quarter of 2009 according to the evolution of the economic crisis (Figure 9).

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.

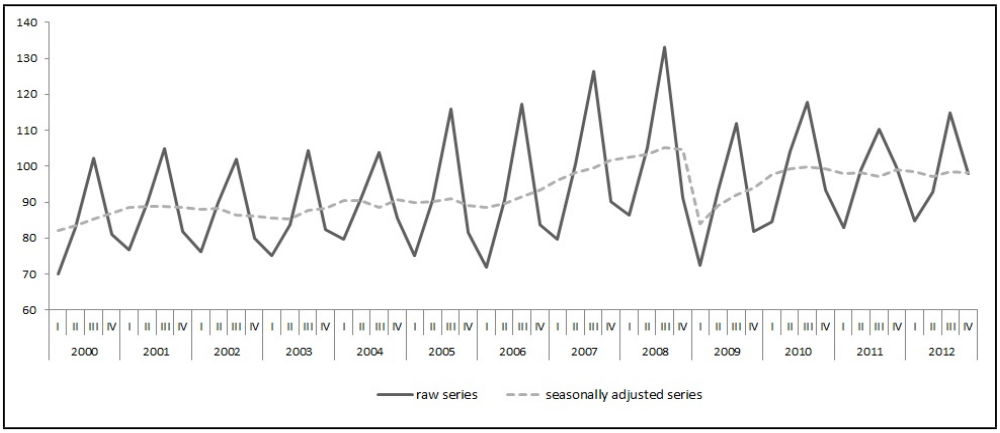
The choice optimizes all the diagnostics, particularly those related to the normality of the residuals, the sliding spans and the estimate of the irregular component. Furthermore, the insertion of the TC in place of the ramp is considered more appropriate to explain the economic evolution in the crisis.

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.

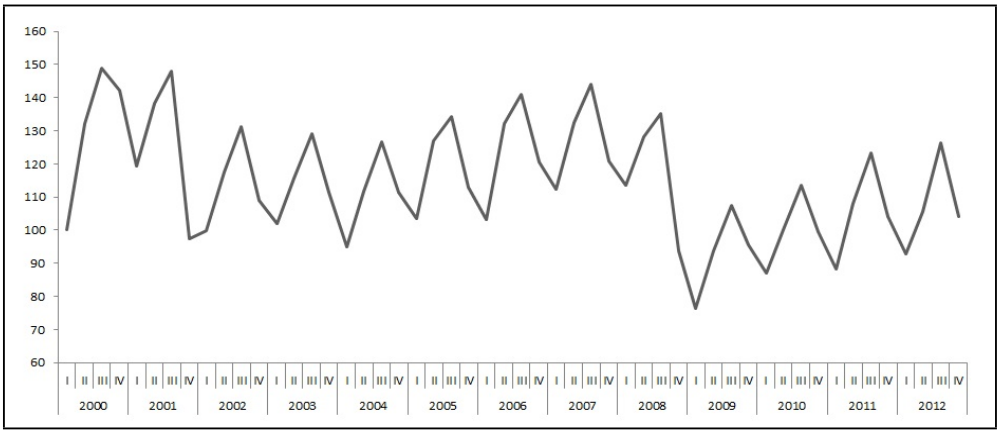
Figure 11 - Quarterly index of water transport (H50) - 2000-2012 unadjusted and seasonally adjusted series



4.5 The air transport sector (H51)

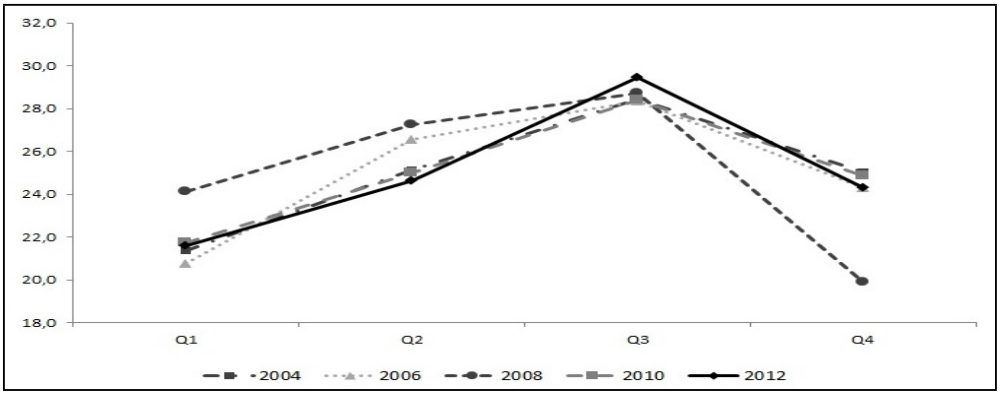
The air transport quarterly turnover index[12] is characterized by a significant change of level occurred from the fourth quarter of 2008. In particular, it increases slowly from the first quarter 2002 until the third quarter 2008, when it recorded a trend decline of 23%. The recovery has been slow and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

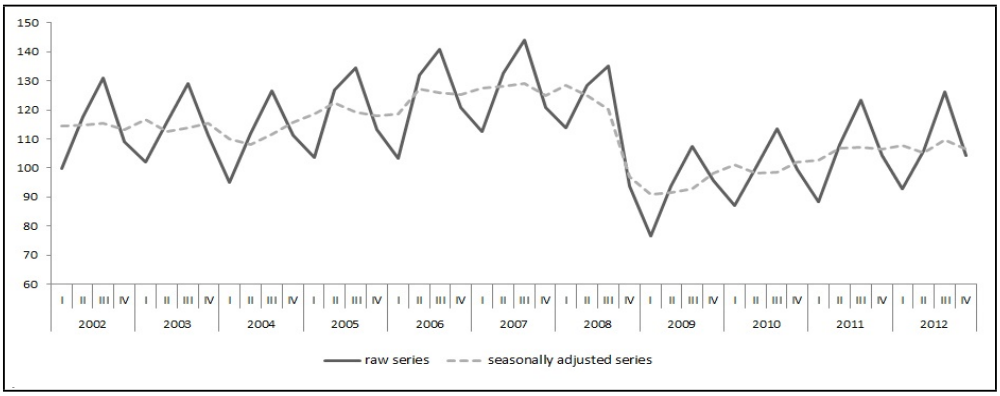
The principal feature of the series is a change of level in the fourth quarter of 2008. Moreover, neither the calendar regressor, nor the Easter effect are significant. The model selected by TRAMO-SEATS is an ARIMA [(0,1,1);(0,1,1)] with a LS in correspondence of the fourth quarter 2008. Due to the value 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.

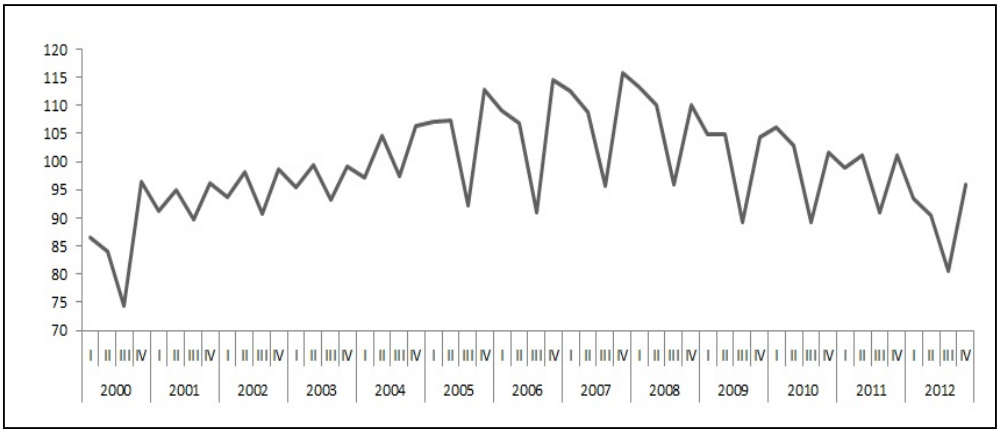
Figure 14 - Quarterly index of air transport (H51) - 2002-2012 unadjusted and seasonally adjusted series



4.6 The postal and courier activities sector (H53)

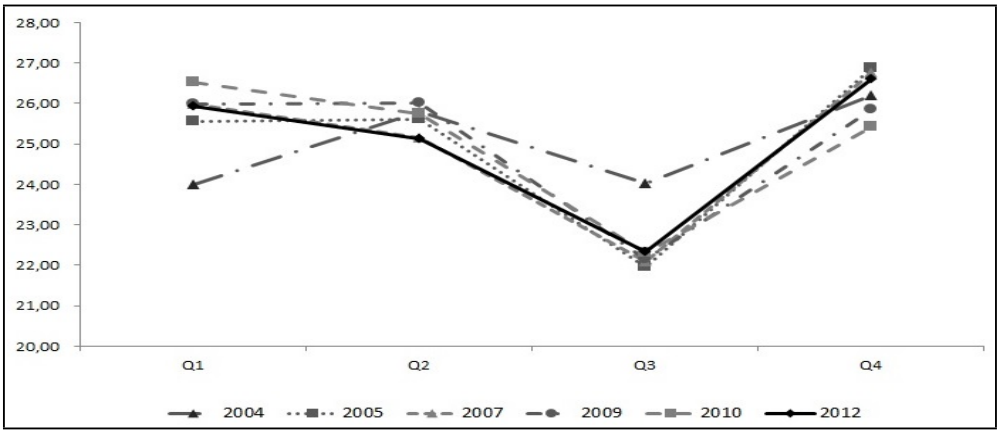
The postal service turnover index shows a positive trend until 2009 when a moderate and constant decline appears (Figure 15).

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).

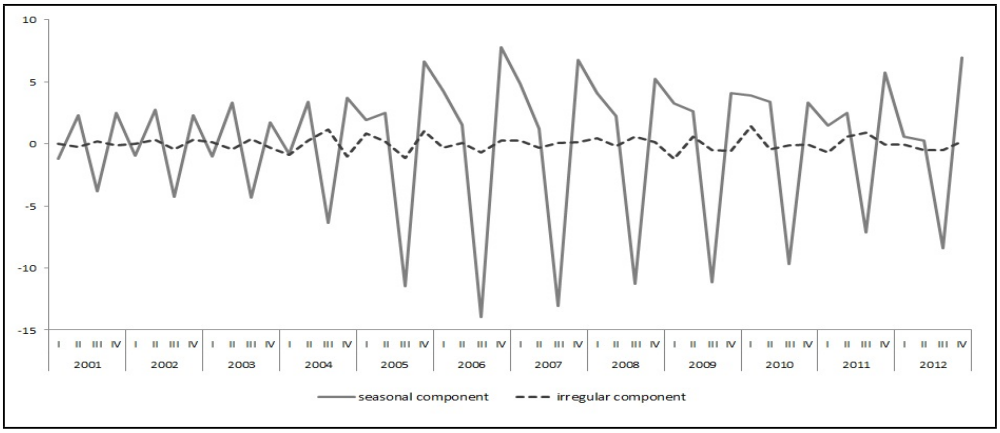
Figure 16 - Quarterly share of the annual index - 2004-2012 (H53)



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

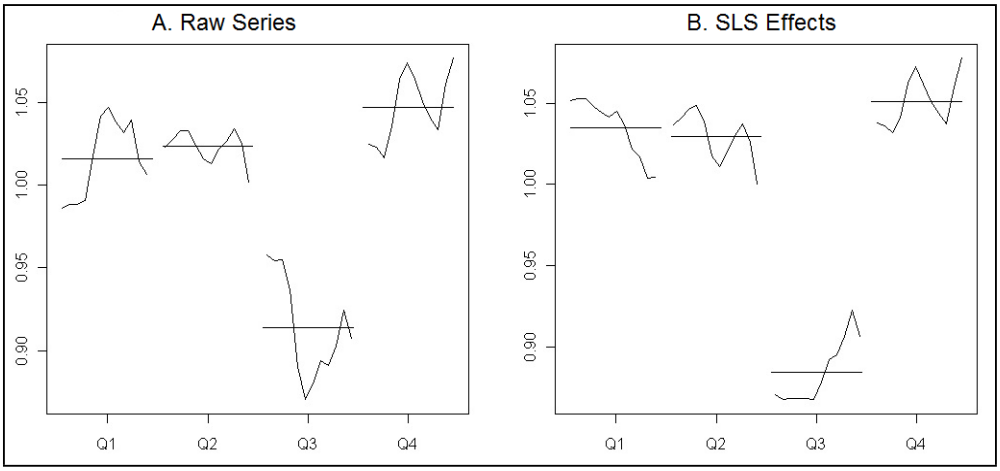
SI ratios analysis and the estimate of the seasonal factor supports the picture of the quarterly share (Figure 17).

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



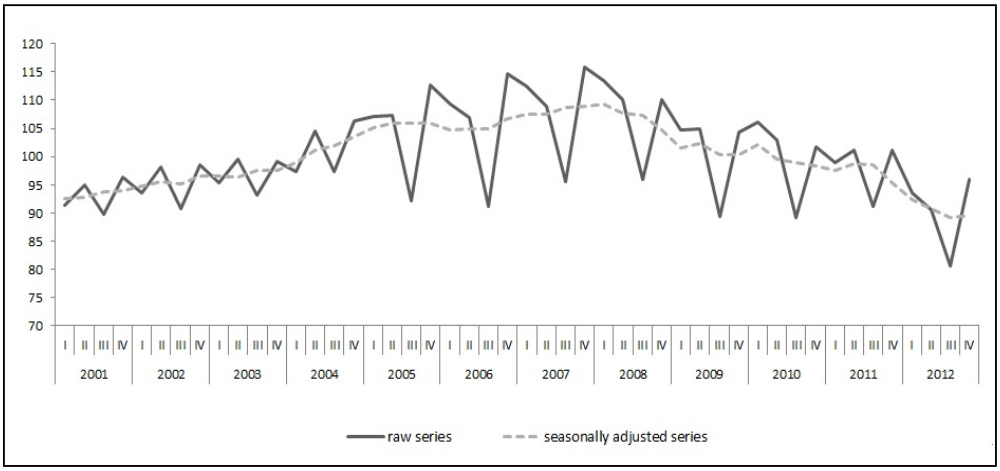
The model selected for the postal and courier activities sector is an ARIMA [(1,0,0);(0,1,0)] with logarithm transformation and the two seasonal level shift (SLS) described above on the first and third quarter. The following table presents the parameters of the model.

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.

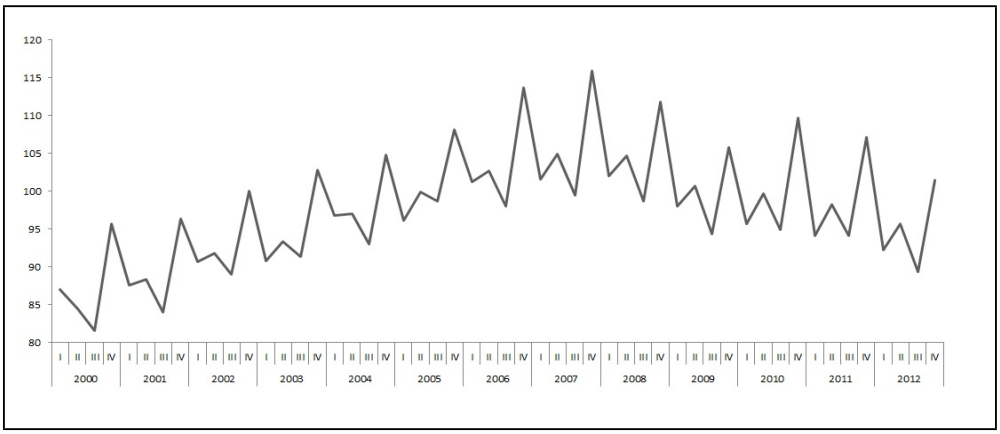
Figure 19 - Quarterly index of postal sector (H53) - 2000-2012 unadjusted and seasonally adjusted series (H53)



4.7 The information and communication services sector (J)

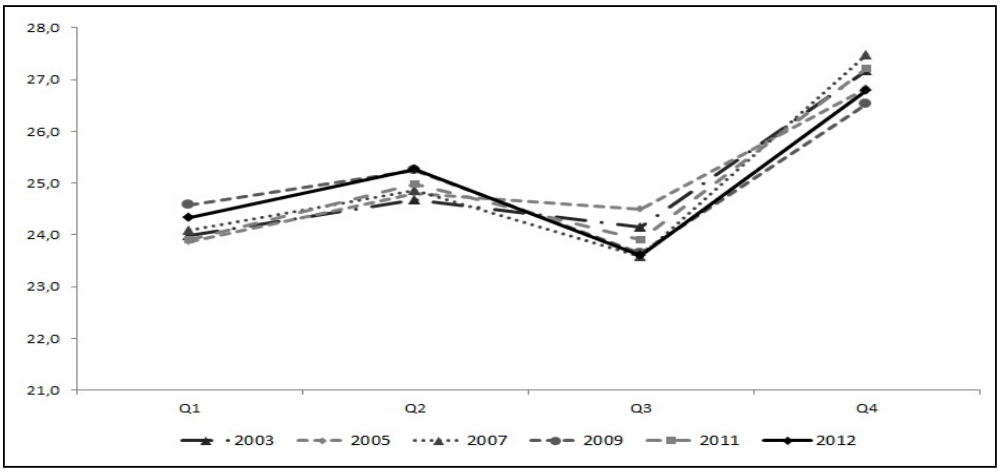
The information and communication quarterly turnover index presents two different regimes, an increasing trend until the middle of 2008 followed by a decreasing behaviour (Figure 20).

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)



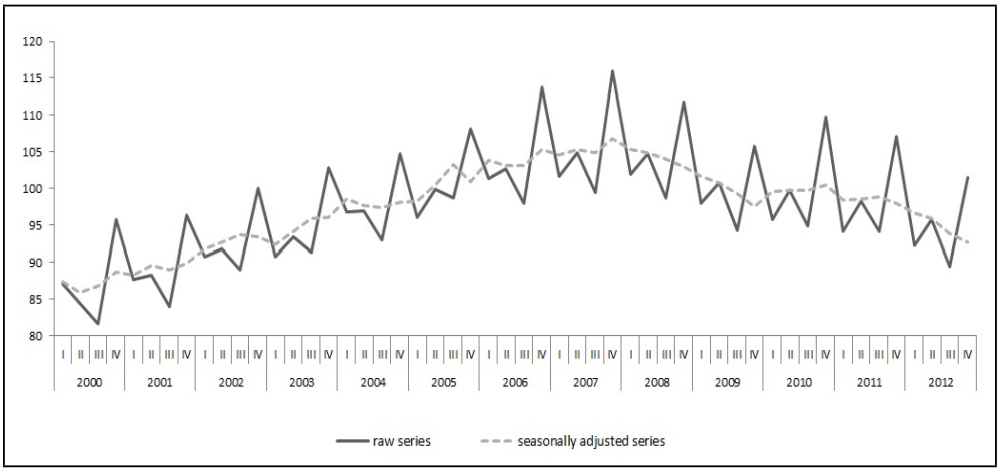
The SI ratios and the tests implemented do not detect any significant changes in the seasonal pattern. The model selected for this sector is an AIRLINE model with logarithmic transformation.

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.

Bibliography

Anitori P., F. Bacchini, C. Baldi, G. Bruno, V. De Vita, F. Di Iorio, R. Gatto, A. Pallara, F. Polidoro, M. Politi, U. Triacca (2000) *Guida all'utilizzo di TRAMO - SEATS per la destagionalizzazione delle serie storiche*, Documenti ISTAT n.4.

Bacchini F., G. Busanello, D. Chianella, R. D. Cinelli, R. Iannaccone and V. Quondamstefano (2015), The recent developments for the quarterly service turnover indices, *Rivista di statistica ufficiale* 1.

Bell W. R., S.C. Hillmer (1983), Modelling time series with calendar variation, *Journal of the American Statistical Association* 78,526-534.

Eurostat (2008), *NACE Rev. 2. Statistical classification of economic activites in the European Community*. Methodologies and Working papers.

Eurostat, *Demetra + 1.02. User Manual*, October 2013. $http://www.cros-portal.eu/content/demetra-user-manual$

Findley D. F., B. C. Monsell, W. R. Bell, M. C. Otto, & B. C. Chen (1998). *New capabilities and methods of the X-12-ARIMA seasonal-adjustment program.* Journal of Business & Economic Statistics 16.2: 127-152.

Gómez V., A. Maravall (1996), *Programs TRAMO and SEATS: Instructions for the user*, Banco de Espana, Servicio de Estudios, DT 9628, Banco de Espana.

Guardabascio B., F. Bacchini, M. Pepe (2012) *La classe LaTex per i working paper Istat*, Istat Working Paper n. 11.

Istat (2005), *Commissione di studio sul trattamento dei dati ai fini dell'analisi congiunturale Incaricata di formulare proposte relative alle strategie da utilizzare per la disaggregazione temporale nei conti economici trimestrali*, Final report.

Istat (2014), *Fatturato dei servizi - I trimestre 2014*. Press release, 5 June.

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

Monsell B.C. (2007), *The X-13 A-S Seasonal Adjustment Program*, US Census Bureau.

ONS, *Methodology and Statistical Development. Guide to seasonal adjustment with X-12-ARIMA*, TSAB December 2005.

Piccolo D. (2012), *Progetto SARA (SEASONAL ADJUSTMENT RESEARCH APPRAISAL), Final Statistical Recomendation of the Scientific Committee*. Annali di Statistica: Seasonal Adjustment Procedures. Experiences and Perspectives, 129, X, 20.

Unece, *Generic Statistical Business Process Model*, 2009.

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