

# Eventuality of Rotation Group Bias on the Estimates of the Italian LFS<sup>(1)</sup>

*Sulla Presenza Di Distorsione Da Gruppo Di Rotazione Nelle Stime Della Rilevazione Trimestrale Sulle Forze Di Lavoro*

Riccardo Gatto

Istat, via Ravà 150, 00142 Roma, e-mail: rigatto@istat.it

Luca Ciccarella

Università di Roma “La Sapienza”, e-mail: conte.77@libero.it

**Riassunto:** Viene indagata la presenza di effetti distorsivi, sui dati della Rilevazione Trimestrale sulle Forze di Lavoro, causati dalla struttura di rotazione del campione. L’analisi viene condotta grazie a un test di indipendenza tra la variabile appartenenza a un particolare gruppo di rotazione e la condizione professionale, condotto a diversi livelli di aggregazione e sia nella dimensione trasversale sia in quella longitudinale. Il test utilizzato e’ il test di indipendenza di Pearson corretto per tener conto della complessità del disegno campionario.

**Keywords :** Rotation sample, Rotation group bias, Corrected Pearson Test.

## 1. The sample design of the Italian Labour Force Survey

In the Italian Labour Force Survey (LFS) the households are the statistical units. The sample design is a 2 – 2 – 2 rotation design, which means that each household, once entered in the sample, is interviewed for two quarters consecutively, is not contacted for the following two quarters and is interviewed again for the last two quarters. The whole sample is divided into four sections, each, approximately, with the same dimension in term of households and in terms of individuals. Every quarter a new section is entered into the sample and the section that has already been interviewed four times exits.

This rotation design allows half a sample to be unchanged after one quarter and after one year. Longitudinal data can be created thanks to the rotation design described and the increased stability in the estimates makes robust rate of change estimates.

Similar experiences in other countries show that repeated interviews can result in biased data (Bailar, 1975; Shack-Marquez, 1985) due to a sort of conditioning that can arise in people who are submitted to several interviews, or due to different tools used in the different interviews. In the literature this effect is called “rotation group bias”.

The question investigated in this work is whether there is rotation group bias in the Italian Labour Force Survey’s results. Since in this survey all the interviews are run on a face to face – paper assisted basis, the bias can arise from the tendency to answer in a different way to the same question when people are asked several times.

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<sup>(1)</sup> The present paper is part of a stage program born thanks to the collaboration between the ISTAT and the First University of Rome “La Sapienza”.

## 2. The Test

A test can be run in order to determine the presence of the rotation group bias in the estimates of the principal aggregates of the labour market. Since here the interests are focused not on behaviours but on accuracy of macro data, the chosen approach is to directly test the result of the survey data on main indicators of the labour market in order to test if any dependences from the section of rotation can be detected.

A similar work (Allewa, 1991) has shown evidence of no bias. However, the survey had a major change in 1992 and no inquires have been run since then in order to test the new procedures.

In this work data from the current survey are tested with a  $\chi^2$  test of independence, it is applied to a double entries table with two variables. The first variable is the professional condition, classified in three items: Employed, Unemployed, Non-Active; the second variable being the group of rotation of the individuals (four items). The sum of the cells is the whole population 15 years old and older.

Several studies (Skinner, Holt, Smith, 1989) show that the standard  $\chi^2$  test does not fit when the sample design is complex. The one of the Italian LFS is a two-stage sample according which first the geographical areas are sampled (with different probability of inclusion between large and small towns) and then the households are sampled in the chosen areas. Indeed this is a complex design. A correction is introduced in the Pearson test in order to adjust it according to the sample design.

Standard Pearson's  $\chi^2$  test has the general form:

$$c_p^2 = n_{00} \sum_{i=1}^I \sum_{j=1}^J (\hat{\mu}_{ij} - \hat{\mu}_{i0} \hat{\mu}_{0j})^2 / (\hat{\mu}_{i0} \hat{\mu}_{0j})$$

where  $n_{00}$  is the total number of the statistical units;  $\hat{m}_{ij}$  is the estimated relative frequencies of the  $(i,j)$  cell;  $\hat{m}_{i0} = \sum_j \hat{m}_{ij}$  and  $\hat{m}_{0j} = \sum_i \hat{m}_{ij}$  are respectively the marginal

estimated relative frequencies per row and per column and  $i$  and  $j$  are the numbers of items of the row-variable and of the column-variable. The correction is then introduced in the form (Rao e Scott, 1987):

$$c_p^2(\hat{d}) = \frac{c_p^2}{\hat{d}}$$

the *generalized average effect*,  $\hat{d}$ , is obtained solving the equation:

$$(I-1)(J-1)\hat{d} = \sum_{i=1}^I \sum_{j=1}^J \frac{\hat{\mu}_{ij}}{\hat{\mu}_{i0}\hat{\mu}_{0j}} (1-\hat{\mu}_{ij})\hat{D}_{ij} - \sum_i (1-\hat{\mu}_{i0})\hat{D}_i(1) - \sum_j (1-\hat{\mu}_{0j})\hat{D}_j(2)$$

where  $\hat{D}_{ij}$  is the estimate of the design effect related with  $\hat{m}_{ij}$  while  $\hat{D}_i(1)$  and  $\hat{D}_j(2)$  are the estimate of the design effect related with the marginal distributions. Given the null hypothesis of independence the  $c_p^2(\hat{d})$  has a  $\chi^2$  distribution with  $(I-1)(J-1)$  degrees of

freedom. The value of the test applied to the 4x3 tables of the LFS should be then confronted (at a significance level of 5%) with the value 12,592.

Two kinds of analysis can be conducted from the quarterly data of the LSF: one is cross-sectional the second is longitudinal. The former refers to one quarter, testing the data coming from contemporaneous answers of people belonging to different rotation groups. Are their answers on the key questions not dependent on the group? This sort of analysis has the advantage to test exactly the published data, the ones the users are interested in being unbiased, but has the disadvantage to be run on different people. It cannot answer the real question: do people change their way to answer, after being interviewed several times? Differences can arise, not because each group is interviewed a different number of times but because the groups were different since the beginning.

The longitudinal analysis follows one group along the fifteen months of permanence in the sample to test if their ways to answer change over the time. In this case the focus is on the right question, but the data on which the analysis is run are not actual LFS data. Following the same people there is also high permanence in the same professional condition pushing the test through independency.

### 3. The Results

A cross-sectional analysis has been run on the data regarding three years: 1995, 1998 and 2002, both to cover the period since the major change in the survey occurred and to test the data in different moments of the labour market cycle. The 1995 being the year of minimum of the employment and the maximum of the unemployment, the 1998 the year of highest growth for the employment and the 2002 a year of moderate growth, most probably near a maximum of the cycle of the employment.

For these years every quarter has been tested, the analysis has been run per geographical area (the twenty administrative regions) and gender, up to a total of 160 aggregates per year. The results are summarized in table 1.

**Table 1:** *Number of refuse of the null hypothesis (evidence of dependence) per year (over 160 tests run), and total (over 480 tests run); absolute values and percentage.*

| <i>Year</i>  | <i>Number of refuse</i> | <i>Percentage over total</i> |
|--------------|-------------------------|------------------------------|
| <i>1995</i>  | 16                      | 10.0 %                       |
| <i>1998</i>  | 9                       | 5.6 %                        |
| <i>2002</i>  | 9                       | 5.6 %                        |
| <i>Total</i> | 34                      | 7.1 %                        |

In general numbers are small, only in 7.1 % of the cases there is a refuse of the null hypothesis, and they seems to suggest that the rotation group bias has a limited effect on the LFS data. Anyway, in order to be considered negligible the effect should not arise in particular items of the variables under analysis. Even if a bigger number is registered for the year 1995 in the three analyzed years numbers are not far from the average, equal to 11.3. With respect to the variables Quarter, Gender and Region again the number of tests that non-refuse the dependence are uniformly distributed among the items.

The longitudinal analysis has been run including all the groups that were present in January 2002. The four groups entered in the sample in four different quarters, they

were in the sample for the periods: group 1 since Jan. 2002 to Apr. 2003, group 2 since Oct. 2001 to Jan. 2003, group 3 since Jan. 2001 to Apr. 2002 and group 3 since Oct.2000 to Jan. 2002. The covered period is then since October 2000 to April 2003. Each group has been tested separately in order to check their consistency along time in answering the same questions.

Again the analysis has been run per geographical area and gender. All the 160 tests accept the null hypothesis of absence of dependence.

## Conclusions

A test procedure has been run in order to verify the eventuality of rotation group bias on the estimates of the Italian LFS. The test used is a corrected version of the  $\chi^2$  test of Pearson. Results from a cross-sectional analysis show that, in few cases (7.1% of the total cases), dependence between the professional condition and the rotation group, emerges, but it is not related with any other variables in the analysis. Results from the longitudinal data show no dependence at all. The results found in the transversal analysis then probably arise because of the difference among the groups since their first interview and not because of a rotation group bias. The analysis set up can reveal some utilities in the future, to test the forthcoming change in the LSF, since one of the changes will regard the different tools of collecting data through the following interviews.

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