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Note on Lilien and Modified Lilien Index

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ABSTRACT

Note on Lilien and Modified Lilien Index

This note is a companion to the Lilien (lilien) and Modified Lilien (mlilien) commands for computing the relative indices in STATA. The note illustrates the main features of the commands with an application to the structural determinants of regional unemployment.

JEL Classification: C46, C87, J63, L16, R23

Keywords: econometric software, Stata commands, Lilien and Modified Lilien index, structural change, regional unemployment

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1 Lilien index

The Lilien index is an important measure of structural change in a number of fields of economic research. One field on which we especially focus here is the common use of the Lilien index as a measure of structural change in the composition of employment in the research literature on the determinants of structural unemployment. Indirectly, it measures the degree to which labor demand is affected by sectoral shifts in the composition of output. Lilien (1982) developed an index that measures the standard deviation of the sectoral growth rates of employment from period $t-1$ to period t. For each region (or geographical area) of the country, the Lilien index measures the structural change in the demand for variance in industry employment growth.

Most of the literature on structural unemployment dealt with the relationship between worker turnover[1] and unemployment. The literature on this issue is neither clear nor unambiguous. Different signs of the relations mentioned have indeed been introduced theoretically. There might be a positive relationship (Aghion and Blanchard, 1994), a negative relationship (Krugman, 1994), or absence of relationship.

Many empirical works have added evidence on the nature of the relationship. For Italy Basile et al. (2012) and Mussida and Pastore (2012) find a positive relationship between worker turnover and unemployment rates. In other words, larger turnover (high rates of layoff and hiring) is found in the higher unemployment regions of the South of Italy.

In addition, the Lilien hypothesis suggests that industrial restructuring causing sectoral shifts might explain the high level of turnover of high unemployment regions. The Lilien index therefore is a useful tool to explore this theoretical hypothesis at a very detailed (regional) geographical level.

The Lilien module that this note aims to introduce constructs the Lilien index (LI), originally proposed in Lilien (1982), to measure structural change in the demand for sectoral and total employment. The module calculates the index for two time periods (t and $t-1$) and allows users to export output in table format.

The data to be used to compute the Lilien index must be in long format (see help long). In addition an id representing the number of sectors (of employment) in each region is required. Data to be used might be either regional or individual level date.

The index is computed on the sum of employment in each sector, region, and time period (e.g., year). One of the main advantages of the index is that it allows for geographically detailed investigations. The index, indeed, can be computed also at very detailed geographical levels. In this note we refer to the regional or NUTS2 level of disaggregation.[2]

[1] Worker turnover (WT) at time t is the number of accessions to employment from unemployment and inactivity plus the number of separations from employment to unemployment and inactivity, respectively. WT rates are computed by dividing WT by the average employment level (between $t-1$ and t).

[2] This is the acronym of "Nomenclature of Units for Territorial Statistics". More precisely, we refer to the second level of disaggregation, NUTS2, corresponding to regions.

basic syntax:
lilien x, i(sec) j(time)
computes the Lilien index on variable x by sector and time. This is the default setting. The module considers only one region if the user does not specify by(reg).
options:
lilien x, i(sec) j(time) by(varlist) [outfile, replace]
computes the Lilien index on variable x by sector, time and varlist (e.g., region). The output is exported in a csv table. (outfile replace).

2 Module on Lilien index

Lilien generates the Lilien index variable for two time periods (t and $t-1$). The Lilien index measures relative standard deviation of sector employment growth relative to overall growth in the region. There are two restrictions on the kind of data to be used for a correct computation of the index. First, data cannot be negative. This does not limit the use of the module, since employment data - most frequently used for Lilien index computation - cannot be negative. Second, there is a balanced panel requirement (e.g. the number of sectors of employment must be the same across regions and time). Data to be used might be either regional or individual level date.

For each region (or geographical area) of the country, the Lilien index measures the structural change in the demand for variance in industry employment growth as follows:

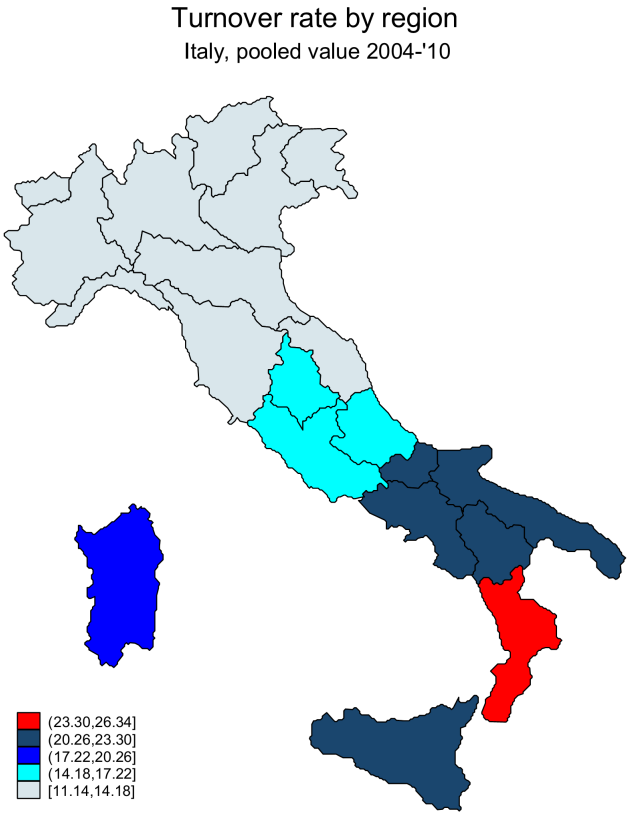
LI= $SQRT\{Summation(w_{it}) * [ln(x_{irt}/x_{irt-1}) - ln(X_{rt}/X_{rt-1})]^2\}$
where,
w_{it}: sector i share in total regional employment in period t.
x_{irt}: employment in sector i in region r.
X_{rt}: employment in the entire region.
$ln(x_{irt}/x_{irt-1})$:employment growth in sector i in period t.
$ln(X_{rt}/X_{rt-1})$: employment growth in the entire region in period t.
Options
by(varlist): allows groups defined by 'varlist' e.g. (region)
outfile: export output in .csv table format
Examples:
Lilien index computed on the variable x by sector i and time j:
lilien x, i(sectors) j(time)
Lilien index computed on the variable x by sector i, time j, and region:
lilien x, i(sectors) j(time) by(region)
Lilien index computed on the variable x by sector i, time j, and region saved in csv format table (option outfile replace):
lilien x, i(sectors) j(time) by(region) outfile replace

The option outfile replace, indeed, permits to export the dataset in csv format. In the example, a csv table with three columns (year, region and Lilien index) is produced and saved in the csv file $Lilien\_Index.csv$.

3 Example

As explained above, data for Italy suggest the presence of a positive relationship between worker turnover and the unemployment rate. Figure 1 displays, indeed, that the worker turnover rate is higher in regions with higher unemployment rates (South of Italy).

Figure 1: Turnover Rate by Region



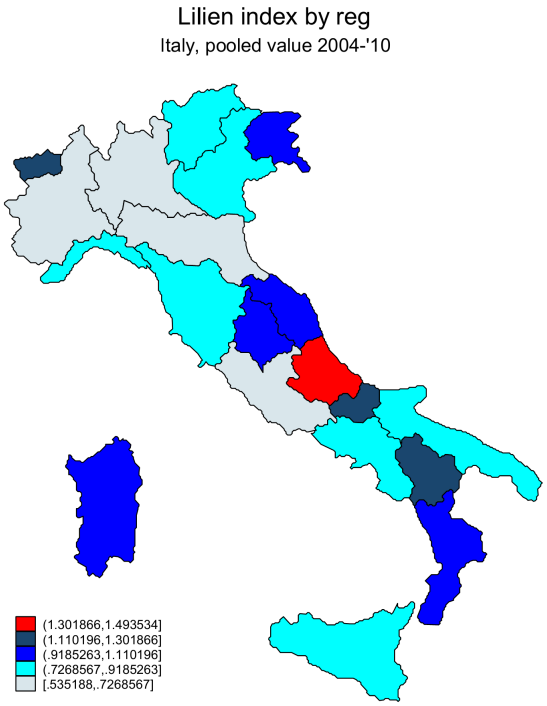
The map in Figure 1 is obtained by using the Stata package *spmap*. More in detail, by using a regional dataset on Italy that provides information on worker turnover we plot the worker turnover by region.

One of the reasons explaining the high level of turnover of high unemployment regions is a higher degree of industrial change. In fact, the Lilien hypothesis suggests exactly that

industrial restructuring causing sectoral shifts might explain the high level of turnover of high unemployment regions. To test the Lilien hypothesis we first computed the Lilien index by region and year by using the module described above. More in detail, we obtained the csv table showing the Lilien index by year and region.

Then, by exploiting the available Stata commands and options (see spmap) we plot the regional Lilien index to get a visual inspection of the distribution of the indicator across the Italian regions. Figure 2 displays the Lilien index by region in Italy over the period 2004-2010.

Figure 2: Lilien Index by Region



Our data therefore seem to confirm the Lilien hypothesis: the Lilien index is higher in the regions where also unemployment is higher.

The Lilien index might also be used as a regressor for the worker turnover as a proxy of the relevance of the impact of structural change on worker turnover.[3]

4 Modified Lilien index

The need for additional indicators of structural change is well documented in the literature (Stamer, 1998, 1999). For instance, Stamer (1999) shows any indicator of structural change might ideally fulfill five "required" conditions:

1. The index should take the value zero if there are no structural changes within one period;
2. Structural change between two periods should be independent of the time sequence;
3. Structural change in one period should be smaller or equal to structural change between two sub-periods;
4. The index should be a dispersion measure;
5. The index should consider the weight (size) of the sectors.

Stamer (1999) demonstrates that the Lilien index violates conditions 2 and 3. He shows that a little change is sufficient to solve this flaw and to obtain an index, the Modified Lilien index, which fulfills all the required conditions.

The Lilien index is modified by augmenting it with the weighting by the shares of the sectors in both periods. Hence, the influence/relevance of sector i is growing in proportion to its size and also with respect to the value of its relative growth.[4]

The availability of two measures of structural change (Lilien and Modified Lilien index) leads to several advantages. First, the user has the opportunity to choose the index which best fit the aim of her/his analysis. Second, it can be obviated that the choice of the indicator of structural change (either Lilien or Modified Lilien index) is the only reason of the observed relationships. Finally, the choice of these indices allows for comparison of the results to other works done for Italy, Germany as well as the UK.

Nonetheless, the similarities in the computation of the Lilien and Modified Lilien index imply a strong correlation between the two indicators of structural change.

5 Module on Modified Lilien index

MLilien constructs modified Lilien index(MLI) also known as a measure of structural change in the demand for sectoral and total employment. The module calculates the index for two

[3] Empirical evidence on Lilien index is available in Basile et al. (2012) and Mussida and Pastore (2012).

[4] For additional details on the Modified Lilien index, see Stamer (1999).

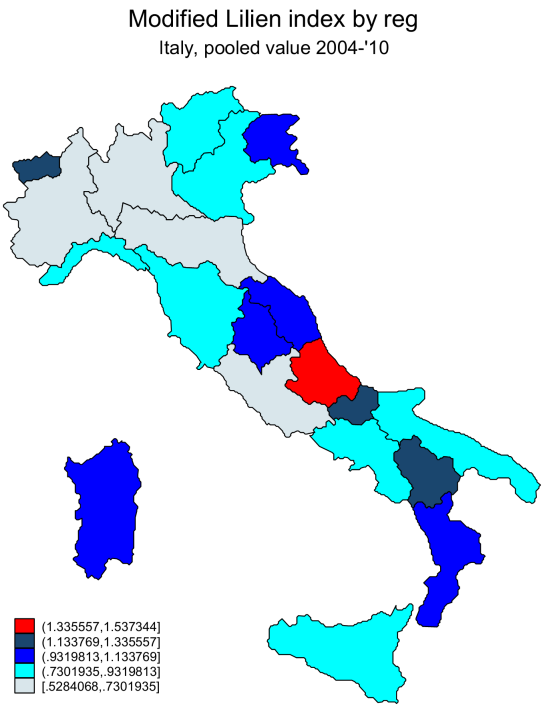
time periods (t and $t-1$) and allows users to export the output in table format. It is called modified Lilien since it is computed on the average of the employment shares in time t and t-1 and not on the current (or shares at time t) shares as for the Lilien index.

basic syntax: mlilien x, i(sec) j(time)
computes the Modified Lilien index on variable x by sector and time. This is the default setting. The module considers only one region if the user does not specify by(reg).
options:
mlilien x, i(sec) j(time) by(varlist) [outfile, replace]
computes the Modified Lilien index on variable x by sector, time and varlist (e.g., region). The output is exported in a csv table (outfile).
Description:
MLilien generates a Lilien index variable for two time periods (t and $t-1$). The modified Lilien index measures the relative standard deviation of sector employment growth relative to overall growth in the region. The restrictions on the kind of data to be used are the same as for the Lilien index, namely data cannot be negative and there is a balanced panel requirement (e.g. the number if sectors of employment must be the same across regions and time).
Modified Lilien Index:
MLI= $SQRT\{Summation(W_t) * [ln(x_{irt}/x_{irt-1}) - ln(X_{rt}/X_{rt-1})]^2\}$
where,
W_t: average share of sector i in total regional employment for time periods t and $t-1$.
x_{irt}: employment in sector i in region r.
X_{rt}: employment in the entire region.
$ln(x_{irt}/x_{irt-1})$: employment growth in sector i in period t.
$ln(X_{rt}/X_{rt-1})$: employment growth in the entire region in period t.
Options
by(varlist): allows groups defined by 'varlist' e.g. (region)
outfile: export output in .csv table format
Examples:
Modified Lilien index computed on the variable x by sector i and time j:
mlilien x, i(sectors) j(time)
Modified Lilien index computed on the variable x by sector i, time j, and region:
mlilien x, i(sectors) j(time) by(region)
Modified Lilien index computed on the variable x by sector i, time j, and region saved in csv format table (option outfile):
mlilien x, i(sectors) j(time) by(region) outfile replace.
The option outfile replace, indeed, permits to export the dataset in csv format. In the example, a csv table with three columns (year, region and Lilien index) is produced and saved in the csv file Lilien_Index.csv.

6 Example

Then, by exploiting the available Stata commands and options (see spmap) we plot the regional Modified Lilien index to get a visual inspection of the distribution of the indicator across the Italian regions. Figure 3 displays the Modified Lilien index by region in Italy over the period 2004-2010.

Figure 3: Lilien Index by Region



The Modified Lilien index is higher in the regions where also unemployment is higher. This is in line with expectations. The two indices for structural changes are indeed highly correlated.

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