Abstract: The principal scope of this exercise is to check whether the Labour Market statuses are time-homogeneous Markov chains. If they are then forecasting the transitions probabilities from one labour state to the other becomes robust and straight forward.
Using the newly introduced from Eurostat definitions: unemployment halos, are produced transition matrices with six labour statuses. The newly introduced statuses to the classical ones are *involuntary part-time, want to work* and the *jobseekers* . They have smaller marginals as labour status classes, however they are necessary for a better understanding of the dynamics of the labour market. In these current times, more information is requested and there is more need for understanding and answering the why's of the phenomena. Investigating the stochastic processes characteristic's of the labour statuses transition matrices helps in understanding better the labour force market dynamics.
The data used are the longitudinal data of the Italian Labour Force Survey (LFS, from 2004 until 2010 for the age class 15-74).

Keywords: Markov process, Convergence, Chi-square tests, Italian labour force survey, transition matrices, eigenvalues, data generating process, longitudinal data.

1. Introduction

For introducing the subject is important to recall the maybe most well know study of the Labour Market transitions, regarding the American labour industrial mobility by Blumen, Kogan and Mc Carthyin. Back in 1955, they developed the so-called *mover-stayer* model. Holding data of employment in each industry, they divided them into S different classes. For explaining the data, the authors proposed that the population of workers be divided into 2 classes: the movers and the stayers. A stayer remains in the same industrial category throughout his life. A mover changes work and industry category at the end of each period (t) that is $t-1$ he's in the category J and then at t will be in the category k with probability P_{jk} where:
$P_{j1} + P_{j2} + ... + P_{js} = 1$
As far as the movers are concerned, the process of an individual's movement among the S industrial classes is a Markov chain. For a mover in $t-1$ period being in class k, it can be calculated the probability at the end of the period t will be in the class category m and the probability that will be in class J at the end $t+n$ periods.
The realism of the assumption that the movers change category at the end of any given period depends only upon where he was at the end of one earlier period and not on more than one earlier period. In this model, the states of the systems are industrial classes $S = 1, ., 6$ and X_n denotes the class of a randomly selected mover at the end of n. Each individual movers history is a realization of the process. From the statistical point of view, the problem is to estimate from the data the quantities P_jk and the proportion of movers in each category and then to test that they would see of the model. For further details see the original study and also Goodman 1961.
After the above seminal study all the following studies are directly or indirectly 'mover- stayers models'. Frydman (1984) implicitly shown that for identifying the proportion of movers and stayers is requested at least a three years panel. Economists have emphasized the importance of gross labor-market flows and transitions between labor-markets states since at least the 1960s (see, for example, Mincer, 1966; Marston, 1976; Clark and Summers, 1979; Abowd and Zellner, 1985; Blanchard and Diamond, 1990, 1992). The power of the Markov chain approach was occasionally taken into consideration as most of the academic works avoid speaking about Markov properties (exceptions are Marini (1999) and Bulli (2001)). Academics often assumes time-homogeneity for simplicity as *inter alia*, Blumen et al (1955), Cook et al (2002), and Nielsen and Young (1973). Taking the Markov property and time-homogeniety as assumptions are restrictive in one hand but on the other hand makes the forecasting straightforward (Mussida- Fabrizzi, 2009).
Blanchard ed al (2001) explains the importance of transition probabilities of the labour market for a worker and the risk becoming unemployed and

vice versa how easily an unemployed can find work before the end of the period of reference. The explanation and the demonstration that there in no time stationarity is done through graphics and using the French Labour market data from 1983 until 2001. Fouger and Komionka (Oct. 2003) use the same data but for years 1986-2000 for a Bayesian approach of the topic.
Similer to the present exercise is the paper by Mussida and Fabrizzi (2009) using the Italian LFS data from 1993-2003 where they analyze the determinants of the transition probabilities between the three labour market states: employed unemployed and inactive population. Even though they do not probe on the test used for the Markov property and the time stationarity the results refuse the hypothesis.

In this exercise us used the results from the Looking as pictures the six years' histograms the Italian Labour Force Market transition matrices, I have the feeling that are Markov chains. The reason is that for every transition year the picture is very similar. As known, Markov chains have restrictive assumptions regarding the data generating process, and that is why make the transition matrices take a particular aspect. It was exactly for this reason that I felt as that the transition matrices in hand, were Markov chains. The decision to proceed with this exercise was empowered by the fact that any result, whether the LFS transition matrices are Markov or not, would be significant for the forecasting of the Italian Labour Force market. Following the indications from the Cox and Miller book about stochastic processes and the seminal work of F. Bickenbach and E. Bode about Markov chains on income convergence, I tried to replicate this exercise but to use the Italian LFS transition matrices. [1].

This work is divided in three main paragraphs. In the first paragraph, is an introduction to the subject. The second and main paragraph is recalls the theory about Markov chains, the elaboration of the data and the main outcomes. The empirical part has 3 main topics : [1] investigation of the eigenvalues of the LFS transition matrices from 2004 until 2010, for figuring out if the matrices come from the same data generating mechanism, [2] demonstration that the transition matrices are time-homogeneous and [3] a Steady State cannot be found and thus a stable matrix that has all the rows equal is not found. This last result indicates that the Italian LFS matices are not memoryless and that the past history and decisions of a persons change the probabilities of the future.

2. Theory

2.1. Introduction to the Italian Labour Force transition matrices and their state classes.

Works estimating the labour transition matrices by the means of longitudinal data are very few as the availability of the data is very limited and rather new (cit ISTAT) resulting that the time horizon is relatively short, as in our case. Some works that focus on establishing the persistence of both unemployment incidence and duration using longitudinal data are from Boeri and Garibaldi (2009), Petrongolo and Pissarides (2008) and Brandolini et al (2006).

In 2011 Eurostat proposed the supplementary to unemployment indicators as a tempt for better measuring the labour market slacks. The supplementary to unemployment indicators are also called unemployment halos. [2]

2.1.1. ILO and Eurostat definitions

The ILO traditional labour statuses (employed, unemployed and inactive) are still the main official reference indicators of the labour market. However as the labour market complexities increase, the need for a better comprehension also increase and thus to sharpen the labour market statuses. For this reason Eurostat, following the ILO indications (18th ICLS), decided to step ahead and refine the employed and inactive statuses of Labour Force. Thus the new Labour Force status became six, defined as follows: [3]

Employed: *In the context of the LFS, an employed person is a person aged 15 and over (or 16 and over in Iceland and Norway) who during the reference week performed work - even if just for one hour a week - for pay, profit or family gain. Alternatively, the person was not at work, but had a job or business from which he or she was temporarily absent due to illness, holiday, industrial dispute or education and training. This definition follows guidelines of the International Labour Organization (ILO).*

The above definition is valid for all the employed but Eurostat decided to further divide this aggregate in two subsets: Under-employed part time workers and Other employed where the latter should represent the ”standard” employed while the first represent a ”not fully satisfactory working situation”. These concepts are formally defined as follow: Underemployed part time working, Other: employed not in Underemployed part time working.

Under employed part time worker *An underemployed part-time worker is a person aged 15-74 working part-time who would like to work additional*

hours and is available to do so. Part-time work is recorded as self-reported by individuals. This statistical indicator covers persons who, in spite of being employed, do not work full-time and lack a sufficient volume of work, which is somewhat similar to being unemployed. The part-time requirement in the definition is important because the people who work full-time and still want to work more hours have a different profile: in spite of working many hours they have insufficient income; underemployed part-time, on the other hand, highlights situations of insufficient volume of work and underutilized labour among persons already employed. Regarding this definition is important to highlight that are involuntary Under employed part time worker.

Unemployed *An unemployed person is defined by Eurostat, according to the guidelines of the International Labour Organization, as:*

- *someone aged 15 to 74 (in Italy, Spain, the United Kingdom, Iceland, Norway: 16 to 74 years);*
- *without work during the reference week;*
- *available to start work within the next two weeks (or has already found a job to start within the next three months);*
- *actively having sought employment at some time during the last four weeks.*

The unemployment rate is the number of people unemployed as a percentage of the labour force.

Inactive An active person is a person that is not in Employment and not in Unemployment.

Again the new Eurostat definitions are obtained by splitting the existing aggregate of the Inactive in three subsets trying to catch more homogeneous groups with respect the attachment to labour market.

Jobseekers alias *Persons seeking work but not immediately available are the sum of persons aged 15-74 neither employed nor unemployed who:*

- *are actively seeking work during the last 4 weeks but not available for work in the next 2 weeks;*
- *found a job to start in less than three months and are not available for work in the next 2 weeks;*
- *found a job to start in three months or more;*

- *are passively seeking work during the last 4 weeks and are available for work in the next 2 weeks.*

Passive job search is e.g. waiting the results of a job interview. The first of those 4 groups is the biggest by far. The three latter groups are included in this indicator for completeness as they are not ILO unemployed but have many common characteristics with people in the first group. This indicator describes jobless people who do not qualify for recording as unemployed because of their limited availability to start a new job.

Want to work alias *Person available to work but not seeking = Persons available to work but not seeking are persons aged 15-74 neither employed nor unemployed who want to work, are available for work in the next 2 weeks but do not seek work. This indicator covers jobless people who do not qualify for recording as unemployed because they are not actively looking for a job. It includes, among others, discouraged jobseekers and persons prevented from job seeking due to personal or family circumstances. The sum of the two groups persons seeking work but not immediately available and persons available to work but not seeking is called the potential additional labour force (PAF). Persons in the PAF are not part of the standard labour force, which is the sum of employed and unemployment persons. However persons in the PAF have a stronger attachment to the labour market than other economically inactive persons.*

Inactive Hard are all the persons over 15 years old that do not want or seek to be employed. In other words are the persons that are neither Employed nor Unemployed nor Jobseekers nor in Want to Work .

The new Eurostat definitions create, de facto, a 6 labour statuses items taxonomy of the population. Even though Eurostat never directly quote this overall taxonomy I use these taxonomy for defining the **state space** of the Italian Labour Market from 2004 until 2010.

2.2. Markov property and time-homogenety

2.2.1. The Markov property

The Oxford dictionary indicates that a Markov Chain (also Markov model) is a noun, used in statistics and it is defined as A stochastic model describing a sequence of possible events in which the probability of each event depends only on the state attained in the previous event.
From the book 'The Theory of Stochastic Processes' of Cox and Miller, I read: The general definition (i.e. Markov process) can be expressed in terms of the conditional probability distribution function:

$$P(X_{t+1} = j|X_0 = i_0, ..., X_{t-1} = i_{t-1}, X_t = i) = P(X_{t+1} = j|X_(t) = i) \tag{1}$$

Thus for the conditional distribution of X_n, given values assumed by the process at set of times before n, only the value assumed at the latest time in that set is relevant.

Suppose that **P** has distinct eigenvalues (also called characteristic roots) λ_1 and λ_2 etc.(Bellman, 1960, p. 187) then it is legitimate to suppose that if the transition matrices come from the same data generating process may have very similar eigenvalues.

$$\mathbf{P} = \mathbf{Q} \begin{bmatrix} \lambda_1 & 0 & 0 & 0 & 0 & 0 \\ 0 & \lambda_2 & 0 & 0 & 0 & 0 \\ 0 & 0 & \lambda_3 & 0 & 0 & 0 \\ 0 & 0 & 0 & \lambda_4 & 0 & 0 \\ 0 & 0 & 0 & 0 & \lambda_5 & 0 \\ 0 & 0 & 0 & 0 & 0 & \lambda_6 \end{bmatrix} \mathbf{Q}^-1$$

where the columns of **Q** are the solutions so that it holds:
$|\mathbf{P} - \lambda I| = 0$

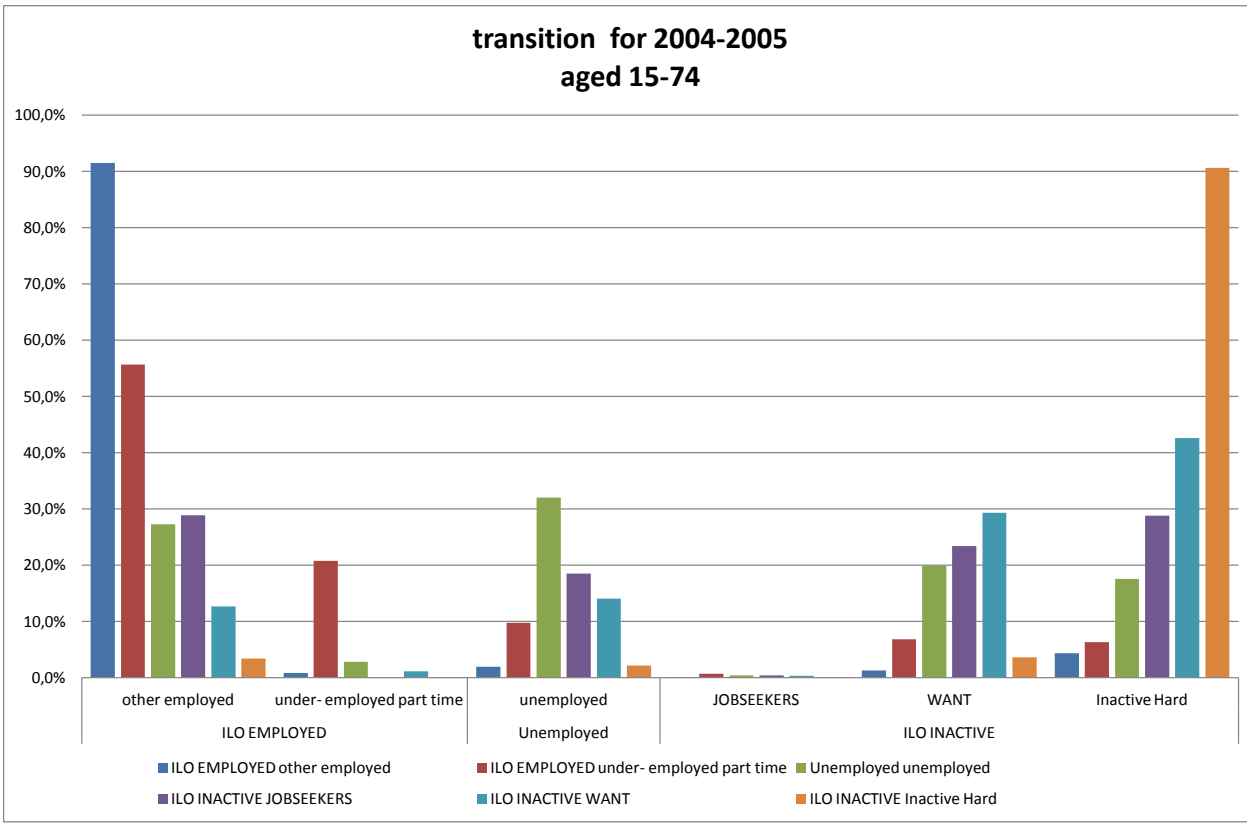
2.2.2. Time-homogeniety

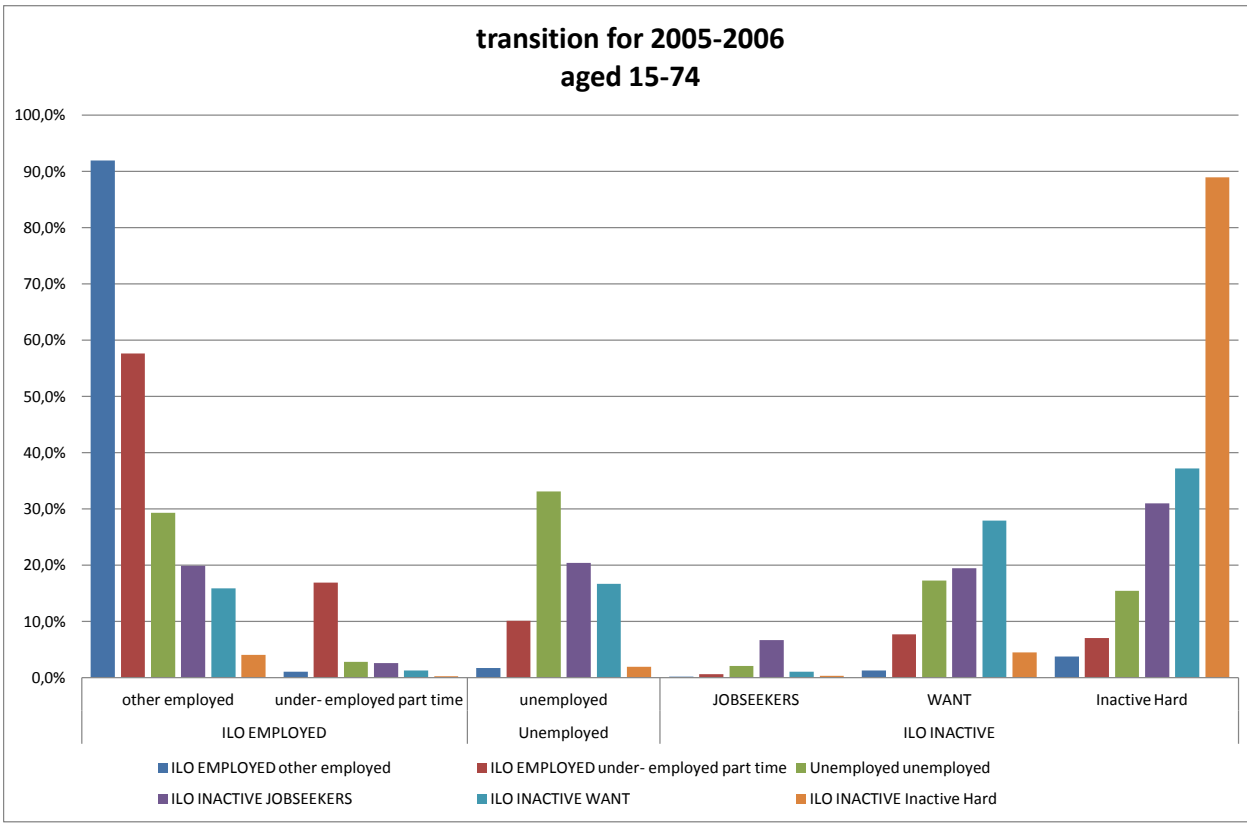
Time-homogeneous Markov chains are processes where :

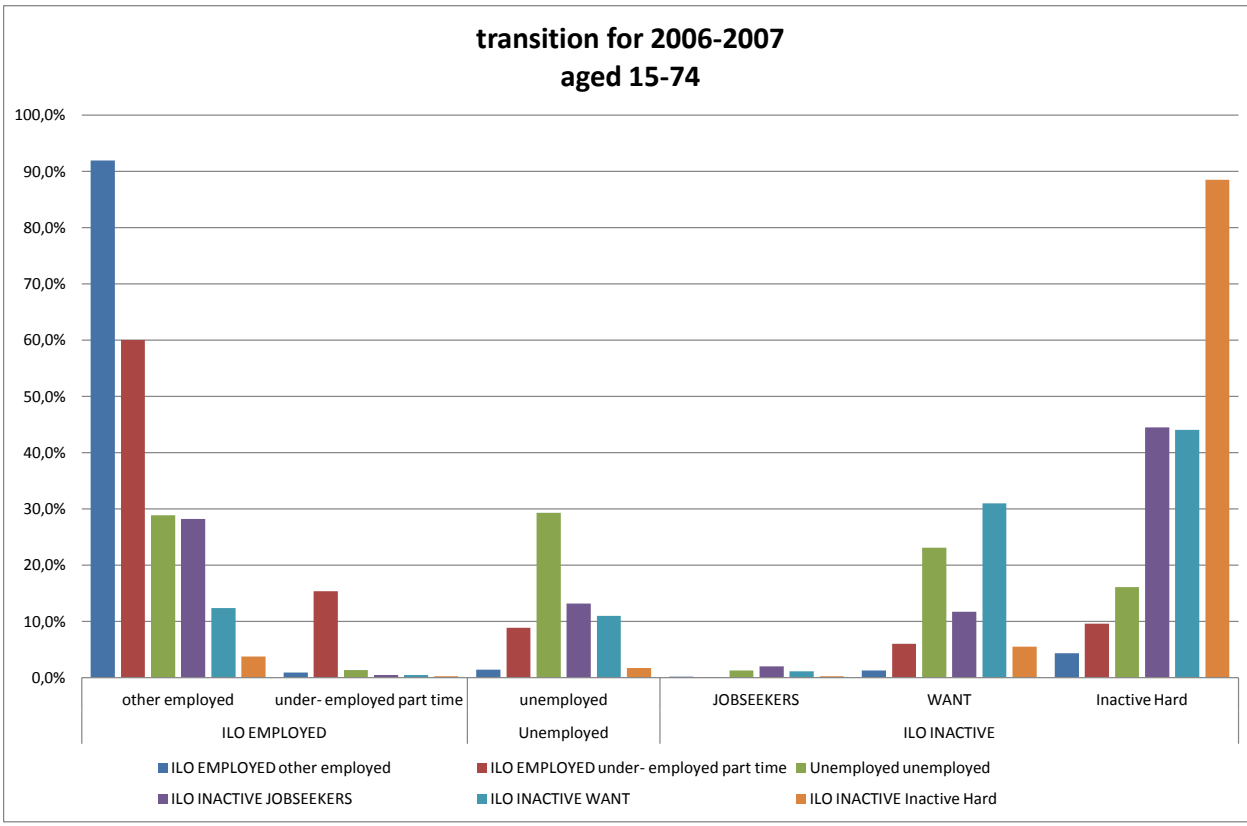
$$P(X_{t+1} = j|X_t = i) = P(X_{t=j}|X_{t-1} = i) = p_{ij} \tag{2}$$

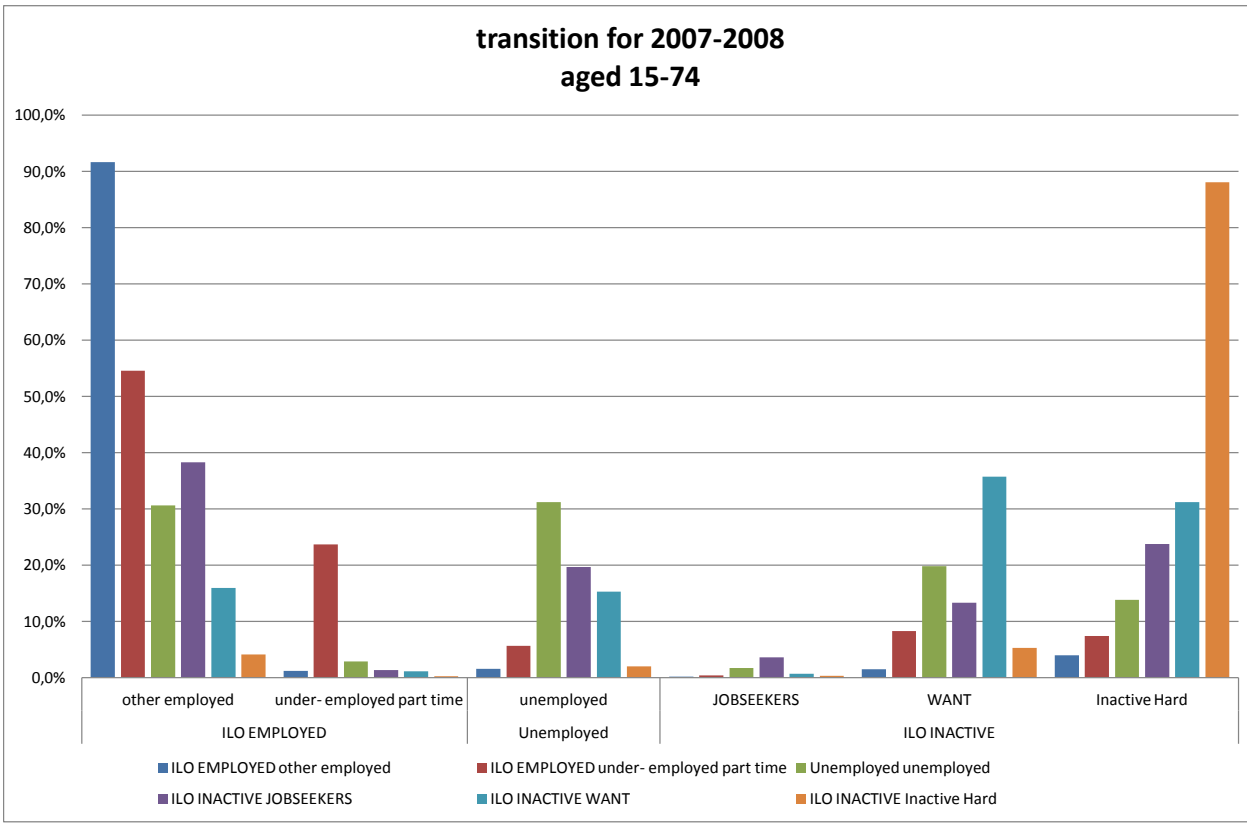
The present exercise is a mover-stayer inspired model but through the labour market classes. With reference to a previous work using the same Italian LFS longitudinal data (Stylianidou 2014) was found that most of the persons living in Italy 15-74 years old are stayers, mainly located in the classes of working satisfied, while some of the persons are movers.

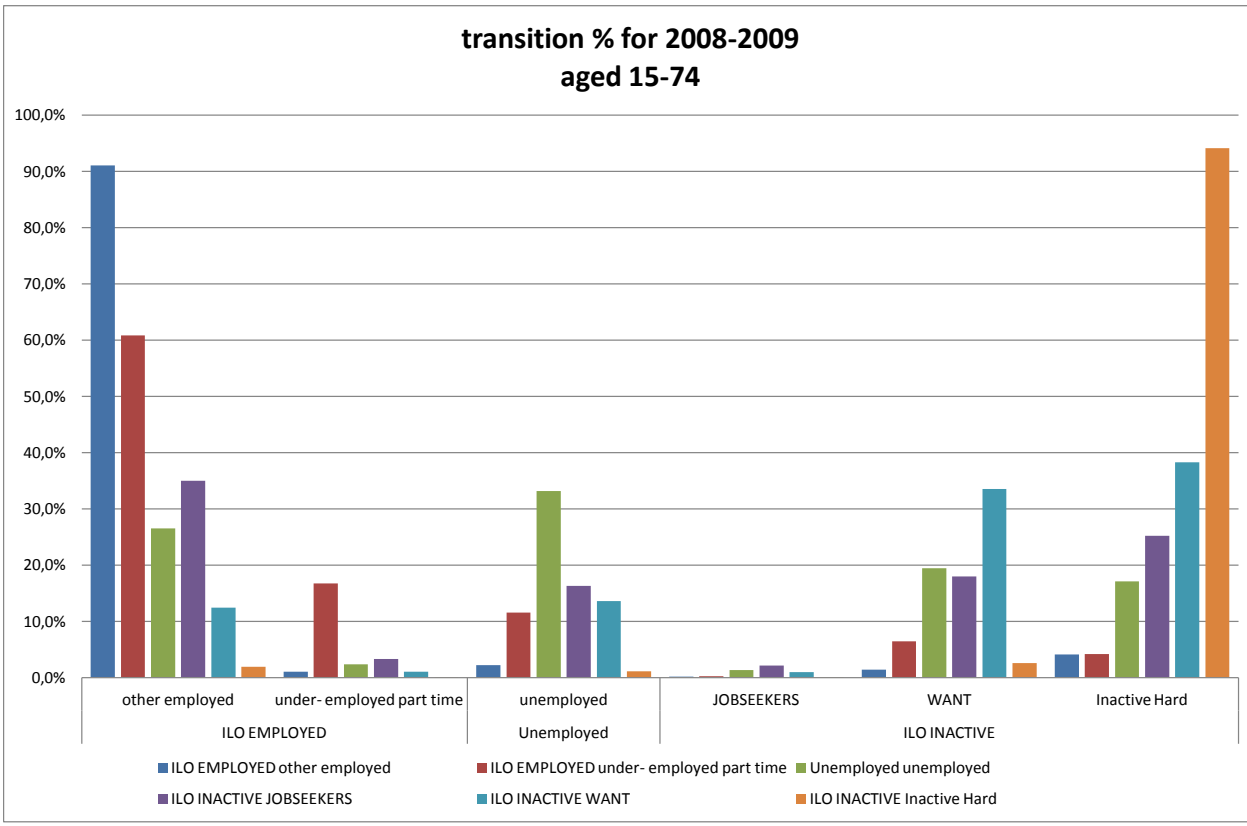
Following are given the histograms of the transition matrices (probabilities):

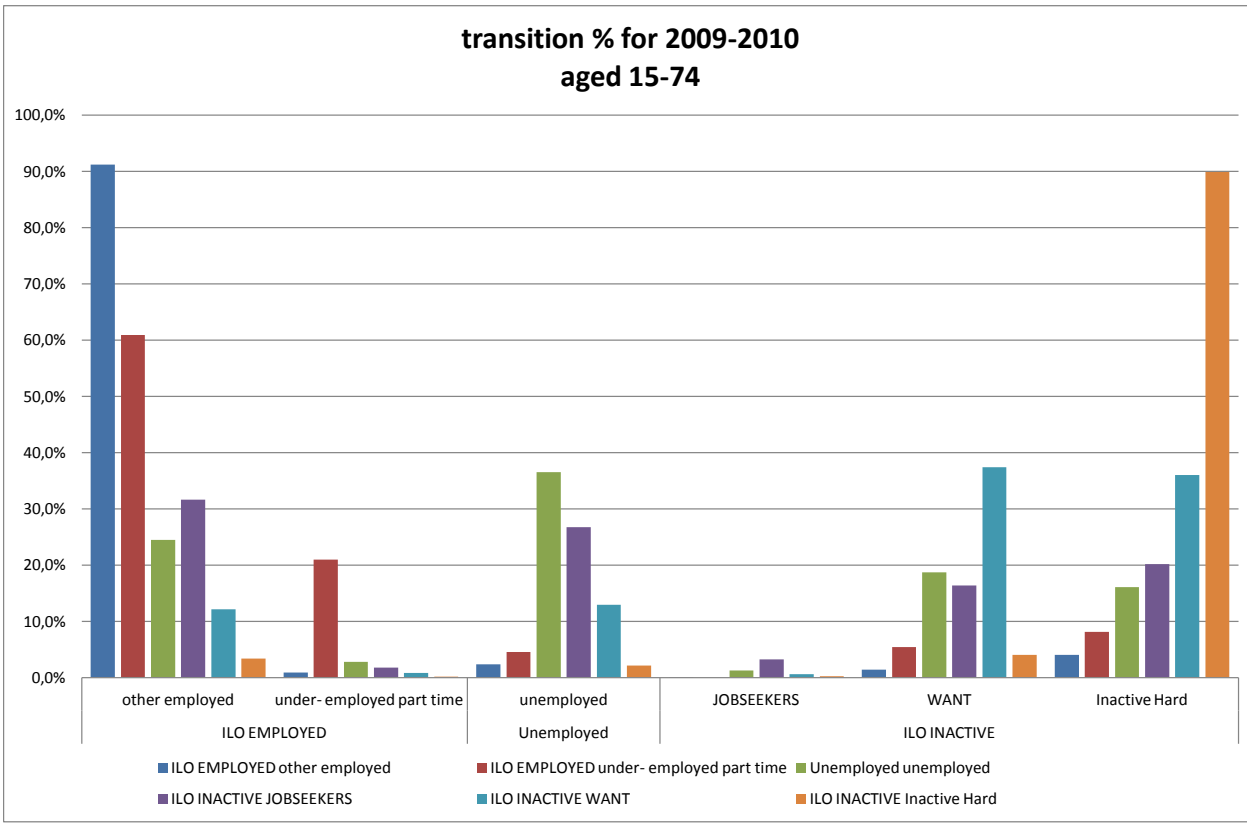

transition for 2004-2005
aged 15-74
100,0%
90,0%
80,0%
70,0%
60,0%
50,0%
40,0%
30,0%
20,0%
10,0%
0,0%
other employed
under- employed part time
unemployed
JOBSEEKERS
WANT
Inactive Hard
ILO EMPLOYED
Unemployed
ILO INACTIVE
ILO EMPLOYED other employed
ILO EMPLOYED under- employed part time
Unemployed unemployed
ILO INACTIVE JOBSEEKERS
ILO INACTIVE WANT
ILO INACTIVE Inactive Hard


transition for 2005-2006
aged 15-74
100,0%
90,0%
80,0%
70,0%
60,0%
50,0%
40,0%
30,0%
20,0%
10,0%
0,0%
other employed
under- employed part time
unemployed
JOBSEEKERS
WANT
Inactive Hard
ILO EMPLOYED
Unemployed
ILO INACTIVE
ILO EMPLOYED other employed
ILO EMPLOYED under- employed part time
Unemployed unemployed
ILO INACTIVE JOBSEEKERS
ILO INACTIVE WANT
ILO INACTIVE Inactive Hard


transition for 2006-2007
aged 15-74
100,0%
90,0%
80,0%
70,0%
60,0%
50,0%
40,0%
30,0%
20,0%
10,0%
0,0%
other employed
under- employed part time
unemployed
JOBSEEKERS
WANT
Inactive Hard
ILO EMPLOYED
Unemployed
ILO INACTIVE
ILO EMPLOYED other employed
ILO EMPLOYED under- employed part time
Unemployed unemployed
ILO INACTIVE JOBSEEKERS
ILO INACTIVE WANT
ILO INACTIVE Inactive Hard


transition for 2007-2008
aged 15-74
100,0%
90,0%
80,0%
70,0%
60,0%
50,0%
40,0%
30,0%
20,0%
10,0%
0,0%
other employed
under- employed part time
unemployed
JOBSEEKERS
WANT
Inactive Hard
ILO EMPLOYED
Unemployed
ILO INACTIVE
ILO EMPLOYED other employed
ILO EMPLOYED under- employed part time
Unemployed unemployed
ILO INACTIVE JOBSEEKERS
ILO INACTIVE WANT
ILO INACTIVE Inactive Hard


transition % for 2008-2009
aged 15-74
100,0%
90,0%
80,0%
70,0%
60,0%
50,0%
40,0%
30,0%
20,0%
10,0%
0,0%
other employed
under- employed part time
unemployed
JOBSEEKERS
WANT
Inactive Hard
ILO EMPLOYED
Unemployed
ILO INACTIVE
ILO EMPLOYED other employed
ILO EMPLOYED under- employed part time
Unemployed unemployed
ILO INACTIVE JOBSEEKERS
ILO INACTIVE WANT
ILO INACTIVE Inactive Hard



For us, the above graphics clearly indicate time-homogeneity as the picture of each transition matrix for every year looks the same.

Below as a first step, I test the matrices for the Markov property and as a second step I test for time homogeneity (chi-square test for independence).

As a third and final step is given the **long term dynamic behaviour** visible with the dynamic transition matrix [4].

Every transition matrix describes the evolution of the Italian labour market form one year to another. The distribution of the population 15-75 years old living, in the Italian territory, after m transition periods, from t to any $t+n$, can be calculated by simply multiplying the transition distribution matrix n times by itself using the population distribution at time t as a starting point $h_{t+n} = h_t * P^n$.

If the Markov chain is regular, the distribution converges towards a states population distribution $h*$ which is independent of the initial population distribution. h so that: $\lim_{n\to\infty} hD^n = h*$.

Each transition matrix was calculated using the Italian Labour Force longitudinal data. The transitions from one state to the other are estimations based on the LFS model of the survey. If the transitions follow a Markov chain this implies :

- that the data generating process is a Markovian (Markov property and time - invariance)
- the transitions have to be based on a sufficient large number of observations.

Two possible dynamic behaviors of the six labour statuses are expected: a long term one and a short term one: The short term (one year horizon) behavior is characterized by inertia. The transition matrices are very year very similar.
For the long term behavior the expectations are different.

3. Experiments

3.1. The data

In this section the exercise will be implemented using the longitudinal data from the Italian LFS ran by ISTAT. The question to be answered is: Do the new labour statuses have different attitude regarding the structural variables as age, behaving in different ways among them? The question has been partially answered by Eurostat with the article published on Statistics in Focus: New measures of labour market attachment; 3 new Eurostat indicators to supplement the unemployment rate. For proving that each profile behaves in a significant different way, there were used quarterly time series data of the European Labour Force Survey. A longitudinal data structure is more indicated for attitudinal analysis gives more robust results to the fact that the different labour profiles are significantly different and the differences persist throughout the years (cit).

3.2. Analysis of the dynamic behavior Italian Labour market

Before passing in the multivariable analysis and individualizing the idiosyncratic differences among the labour statuses, it is given their short and long term dynamic behavior of the Italian labour market.
The **short term dynamic behavior** is observer using the one year transition matrix; in this case can be used the 2009-2010 transition matrix graph placed in the appendix. The histogram that plots the transition matrix indicates that the highest percentage of each labour status it is its own labour status meaning that after one year is most probable, that a person aged 15-74, remain within the initial labour status. In terms of matrix representation means that the principal diagonal is holds the higher percentages of

the labour status transition rates.

Per profile[5]:

Other Employed= [6] On average over 21 million persons belong at the ”other employed” labour status of which the 91.6% of them usually remain after a year in the same status. The overall 6-year average transition probability for an ”unemployed” to become ”other employed” is 34% for men and 27% women.

Under-employed part-time: On average over the 6 years period around 350 - 400 thousands persons belong in this labour status. The probability remaining in this status after one year is approximately 20% .

Unemployed: The unemployed persons are, over the 6 years in average, 1,8 million, while the probability being unemployed and after one year still to be unemployed is 32,6%.

Jobseekers: Around less than 1% (129 thousand) of the reference population belong to this group. The particularity if this group is that has the highest transition probability to become ”other employed” after one year (around 30% - slightly higher than the unemployed which is 27,8%).

Want to Job = Around 11% of the reference population (2,225 thousand) belong to this group. The average transition probability to remain within the economically inactive status after one year is 71.5%.

Hard Inactive = On average 17 million 549 thousand persons belong to this alias 39,75% of the 15-74 Italian residents are inactive hard. The probability to be and to remain after a year in the current status is 94%.

Dealing with Markov chains and relative test statics principally about chi-square and Likelihood-Ratio (LR) tests were Anderson and Goodman (1957); Goodman (1958); Billingsley (1961) and more recently Basawa and Praksa Rao (1980). In the above works the transition probabilities were estimated for the entire sample to those estimated from sub-samples obtained by dividing the entire sample into at least two mutually independent groups of observations. I did the contrary I considered the six transition matrices as sub-samples and for constructing the theoretical matrix I pooled the data. The criteria tests compare multinominal distributions that is the rows of transition matrices rather than Markov processes. A test whether the two sub-samples follow the same Markov process does to take into account whether or not the initial distributions may also be Markov processes. As the paper of Bickenbach and Bode (2001), I only focus on the chi-square test. As already demonstrated by Kullback et al (1962), the LR test is asymptotically equivalent to the chi-square test.

3.3. Testing the Markov property

There are several properties of a Markov process that can be tested for in the context of a dataset pooled across several periods of years. Due to the nature of the data in hand (Mussida, 2008) I cannot directly check that the transition matrices are generic Markov chains and thus to demonstrate that the equation 1 holds. However I have checked that the six matrices have very similar eigenvalues that they are not significantly different per matrix and thus I can infer that they come from the same data generating process.

The results are:

$\lambda_A = (0.999999999, 0.902365591, 0.452429285, 0.193832483, 0.134339444, 0.001372689)$
$\lambda_B = (1.00000000, 0.90075085, 0.46432014, 0.15357185, 0.12744204, 0.05261619)$
$\lambda_C = (1.00000000, 0.89975296, 0.43287568, 0.15287872, 0.12899330, 0.01362168)$
$\lambda_D = (1.00000000, 0.89730592, 0.48583880, 0.21977642, 0.16259435, 0.02387359)$
$\lambda_E = (1.0000000, 0.9026539, 0.4727426, 0.1782109, 0.1421918, 0.0135540)$
$\lambda_F = (1.00000000, 0.90241610, 0.49889160, 0.20610244+0.0057409i, 0.20610244-0.0057409i, 0.02223547)$

3.4. Testing time-homogeneity

First, homogeneity over time (time-stationarity) can be checked by considering the entire sample (all six periods from 2005 until 2010 identified as Theoretical (Theo) as divided in 6 sub-samples. I want to test that each sub-sample significantly differs from the matrix estimated from the entire sample. Each empirical matrix is compared with the theoretical. In addition I compare each empirical matrix with other year's matrices. In fact the aim is to dimostrate that what the pictures tell us that each year I get a very similar picture that is time stationarity.

As the chi-square test in R is a goodness of fit I compare the sub-matrices with the sample matrices.
$H_0 : \forall t : \hat{p}_{ij}(t) = \hat{p}_{ij}$
where $t = (A_{04-05}, B_{05-06}, C_{06-07}, D_{07-08}, E_{08-09}, F_{09-10})$;
$H_1 : \exists t : \hat{p}_{ij}(t) \neq \hat{p}_{ij}$
The data used were the absolute values of the weighted LFS. For solving the issue of zeros cells in the matrices (only in two matrices: A_{04-05}, F_{09-10}) the data were imputed keeping the representativity of the population weight valid (Note the usual weight Italian representativity is one person represents 350 for the elimination of the zero cells was imputed to 150.)

Using the Cox and Miller chi test formula The Chi- square statistic reads:

$$\chi^2 = \sum_{i=1}^{N} \sum_{j=1}^{N} \frac{\hat{p}_{ij}(t) - \hat{p}_{ij}}{\hat{p}_{ij}} \tag{3}$$

where:
$\hat{p}_{ij}(t)$ =the transition probability from the i labour status to the j labour status of the empirical / sub-sample matrices $A_{04-05}, B_{05-06}, C_{06-07}, D_{07-08}, E_{08-09}, F_{09-10}$
$\hat{p}_{ij}$ =the transition probability from the i labour status to the j labour status of the theoretical matrix, pooled across all T (six years) periods.

The degrees of freedom are:
(number of rows -1)*(number of columns -1)=$(N_i - 1) * (N_j - 1) = (6 - 1) * (6 - 1)$ of the empirical sub-matrix.
Our matrices in hand are all full and thus the degrees of freedom for our exercise is 25.

The results showed that for all matrices compared with the theoretical matrix the H_0 is accepted. The same result is obtained also comparing the matrices between them. However since the chi square gave suspicious results (too good to be true...) the individual raws of each transition matrix were compared with the corresponding row of other transition matrix. The results confirmed the positive results. Below is given an example:

c11=C[1,1]
c12=C[1,2]
c13=C[1,3]
c14=C[1,4]
c15=C[1,5]
c16=C[1,6]

b11=B[1,1]

b12=B[1,2]
b13=B[1,3]
b14=B[1,4]
b15=B[1,5]
b16=B[1,6]

primo=matrix(c(c11, c12, c13, c14, c15, c16, b11, b12, b13, b14, b15, b16), 6,2)

$$primo = \begin{bmatrix} 0.918495852 & 0.919013448 \\ 0.008686113 & 0.010221866 \\ 0.013862771 & 0.017374962 \\ 0.044424579 & 0.038649580 \\ 0.001515340 & 0.001878088 \\ 0.013015344 & 0.012862055 \end{bmatrix}$$

chisq.test (primo)
Pearson's Chi-squared test
data: primo X-squared = 0.001, df = 5, p-value = 1

3.5. Looking for the Steady State matrix

According to Quah, the steady state matrix can be obtained by multiplying the transition matrices of t periods. In our case:

SS=(((((A*B)*C)*D)*E)*F)

$$\mathbf{SS} = \begin{bmatrix} 0.6733823 & 0.010289710 & 0.03701384 & 0.2436190 & 0.001669558 & 0.03402562 \\ 0.6002148 & 0.009668768 & 0.03837070 & 0.3118915 & 0.001812047 & 0.03804213 \\ 0.4452331 & 0.008020156 & 0.03891437 & 0.4619507 & 0.002027318 & 0.04385432 \\ 0.1462648 & 0.003751456 & 0.02902437 & 0.7767668 & 0.002030281 & 0.04216227 \\ 0.4028362 & 0.007343632 & 0.03687729 & 0.5080539 & 0.002003975 & 0.04288504 \\ 0.3094123 & 0.006191732 & 0.03552545 & 0.6023866 & 0.002070360 & 0.04441353 \end{bmatrix}$$

The results of the below two results I deduct that $\lim_{n\to\infty} hD^n = h*$ does not hold. This is rather good news. Why? because it means that the working condition of a person at t periods depends from her/his present working condition and that the decisions of today influence the future.

For $n \to 3$ the SS becomes:

$$SS_3 = \begin{bmatrix} 0.305340966 & 1.089455e-06 & 5.070985e-05 & 0.01445884 & 4.653769e-09 & 3.939291e- \\ 0.216232097 & 9.038855e-07 & 5.649358e-05 & 0.03033966 & 5.949882e-09 & 5.505470e- \\ 0.088259703 & 5.158797e-07 & 5.892911e-05 & 0.09857956 & 8.332312e-09 & 8.434066e- \\ 0.003129099 & 5.279583e-08 & 2.445054e-05 & 0.46867527 & 8.368900e-09 & 7.495004e- \\ 0.065371048 & 3.960342e-07 & 5.015069e-05 & 0.13113823 & 8.047800e-09 & 7.887101e- \\ 0.029621892 & 2.373759e-07 & 4.483517e-05 & 0.21858780 & 8.874365e-09 & 8.760845e- \end{bmatrix}$$

For $n \to 20$ the SS becomes:

$$SS_{20} = \begin{bmatrix} 3.674801e-04 & 1.770366e-40 & 2.329604e-29 & 5.422787e-13 & 2.831603e-56 & 4.32 \\ 3.682429e-05 & 5.098269e-41 & 4.786234e-29 & 7.587027e-11 & 1.456763e-55 & 4.02 \\ 9.370219e-08 & 1.212429e-42 & 6.341606e-29 & 1.958450e-07 & 1.375425e-54 & 6.92 \\ 2.008146e-17 & 3.047876e-49 & 1.799933e-31 & 6.394603e-03 & 1.416194e-54 & 3.15 \\ 1.266396e-08 & 2.080740e-43 & 2.163613e-29 & 1.312790e-06 & 1.091058e-54 & 4.42 \\ 6.467731e-11 & 6.858728e-45 & 1.025161e-29 & 3.958277e-05 & 2.093704e-54 & 8.91 \end{bmatrix}$$

4. Conclusions

The present work is a series of investigations and exercises about possible Markov properties of the Italian longitudinal LFS data for the years 2004 until 2010 of the residents aged 15-75. The first finding was that they have the same data generating process as their eigenvalues are so similar. The second finding was that they are t-homogeneous. The second finding was obtained with the use of a chi square test. While the first two results refer more to a short time reference the third and last is about finding the Steady State matrix. The result of 20 years indicated that the matrix does not converge. Thus means that the career path of a person is influenced by its past labour statuses.

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5. ANNEX- Data and Results