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Structural Instability and Unemployment:
Evidence from Italian Regions

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Abstract

This paper comes from research conducted for the I.D.E.E. project. Taking data from Italian regions, the dynamics of a multisector economy is studied by the use of the Framework Space, an analytical tool proposed by Böhm and Punzo (1998). Quantitative analysis of the dynamics is carried out by considering elements of Markov Chains theory. Dualism in Italian regions appears also in terms of different sectoral dynamics; then, it is shown that the latter can explain part of the differences in unemployment levels between North-Centre and South regions.

JEL Classification: O41, R00, J64.

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1 Introduction

This paper applies the approach to structural economic dynamics proposed by Böhm and Punzo (1998), and central to the I.D.E.E. research project[1], to the study of recent development of Italian regions. Its aim is to provide a characterization of the differences in regional dynamics, and to investigate if and how much the latter is linked to the employment performance. Then, this exercise is relevant to the debates on regional dualism in Italy (see for instance Mauro and Podrecca, 1994 and Paci and Saba, 1998), and to the more general discussion on the determinants of unemployment, one of the major concerns for European policy makers.

The paper is organized as follows: Section 2 introduces the Framework Space, the theoretical background for this article and its relations with existing theories of growth; then, it presents the exercise to be performed here; Section 3 provides some graphical analysis of the Italian regional dynamics; the latter is given a first quantitative evaluation in Section 4, by the estimation of transition matrices; in Section 5, some indices of structural instability, based on the estimated transition matrices, are defined; then, the relation between structural instability and unemployment is evaluated and discussed; Section 6 concludes.

2 The Framework Space

Böhm and Punzo (1998) (BP from now on) introduce the *Framework Space* (FS), as an analytical device to study the structural dynamics of an economic system, where focus is on the relation between capital accumulation and productivity. FS is a two-dimensional space where observations of economic units (sectors, regions, countries) are expressed as a couple of growth rates: the growth rate of investment per worker, g_i, and the growth rate of value added per worker, g_v. The FS is equipped with a partition generating a set of 6 *regimes*, where every regime is characterized by a different relation between g_i and g_v.

Figure 1 shows the FS:

[1]I.D.E.E. stands for *Industrial Dynamics and Employment in Europe*, a EU financed project carried out by the network: IDEFI, Valbonne, France; Dipartimento di Economia Politica, University of Siena, Italy; Institute of Econometrics, Operations Research and Systems Theory, Wien, Austria. Results of the research, still in preliminary form, are contained in VV.AA. (1999).

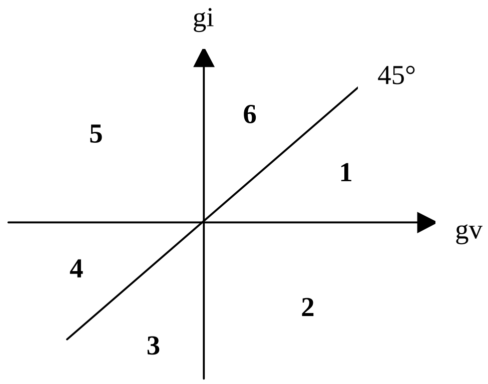


Figure 1: The Framework Space

BP motivate the choice of this tool with the following argument: in many standard theories of growth: "factors [are] measured by their physical quantities and capital [including human capital] appears as the stock variable at a given date...stocks are *functionally* related to the flows they are assumed to generate, and the posited production functions relate, at each point of time, productivity, factors endowments and technology. Growth reflects their properties" (BP, p.2, italics in the text).

This approach, in particular the use of production functions, is criticized along two lines: first, since production functions establish a stable, well-specified relation between outputs and stocks of inputs, like labor and capital, BP claim that "the notion of capital becomes rather shaky when [it comes] to make it operational, as it is an estimate whose value depends crucially on a number of assumptions"; moreover, their interest is in "shorter run sectoral dynamics [that] exhibits time variability that is hardly compatible with the stability of some underlying technical or production relations" (BP, p.2); second, in a multisectoral approach, as this, it is likely that sector-specific production functions exist, and their consideration, not to mention their estimation, "would amplify statistical and conceptual problems" (BP, p.2).

In contrast, it is proposed an approach where rates of growth matter more than levels, as in Kaldorian models, where the rate of investment positively influences the rate of growth of productivity, and as in models in the Schumpeterian tradition, where "the dynamics of productivity is explained by the pace of innovations, ..., which increases the gap between material input costs and sals prices (i.e. value added)"[2] (BP, p.3).

Then, an observation in the FS represents a growth path in two dimensions, and a time series of observations is interpreted as a sequence of steps

[2]It can be added that, recently, the time evolution of GDP growth rates, and their irregular behavior, has attracted some attention. See Pritchett (1998).

among *different models of growth*. The latter is the way to interpret each regime: every regime is a family of growth paths, corresponding to a *local model of growth*: Regime 1 is defined as the *innovation regime*, i.e. a regime where $g_v > g_i > 0$; Regime 2 is defined as the *restructuring regime*, i.e. a regime where $g_v > 0 > g_i$; Regime 6, where $g_i > g_v > 0$, is the *accumulation regime*, and can be considered the normal focus of many investment-based growth theories. "Traditionally, theory sees only regimes 1 and 6 (and their polar cases 3 and 4 respectively). The introduction of regimes 2 and 5 presents us with the possibility of analyzing oscillations that fall outside standard economic dynamics" (BP, p.11)[3].

Once introduced the FS, there remains the difficult task of evaluating a dynamics described in terms of it. The simplest starting point is to consider a system like the following:

$$\mathbf{g}_{j,t+1} = \Phi(\mathbf{g}_{j,t}) \tag{1}$$

where $\mathbf{g}_j = [g_{v,j}, g_{i,j}]$, t indexes time, and j is the economic unit under observation.

The first kind of questions relates to the dynamics of the economic unit, taken in isolation from all the others belonging to the same system (like a sector in a multisector economy, a region in a country, etc.); the second, and more demanding, is related to the way different dynamics of the units belonging to a system interact. BP do not provide a complete model, but give hints for its elaboration (BP, pp.7-8). As such the FS can be considered a tool for qualitative representations of the dynamics of a multisector economy.

In the present paper the following exercise will be carried out: the economic unit of relevance will be a sector belonging to one of the 20 Italian regions[4]; then, the dynamics of every region will be studied as the joint dynamics of the sectors belonging to it. From the formulation of the system of equations 1) we will retain its character of fist-order autoregressive model, since we will study the dynamics as a Markov Chain. That is, we will be interested in evaluating the transition probability for a sector from one regime to another; then, the overall sectoral dynamics of a region will be summarized by a transition matrix, whose entries are the transition probabilities, and some of its properties will be discussed.

[3]Recently, Matsuyama (1999) has proposed a model where growth can proceed by alternating between two regimes: the Solow regime, where perfect competition prevails and the rate of capital aaccumulation is higher than the rate of innovation; the Romer regime, where the environment is monopolistically competitive and the rate of capital aaccumulation is lower than the rate of innovation.

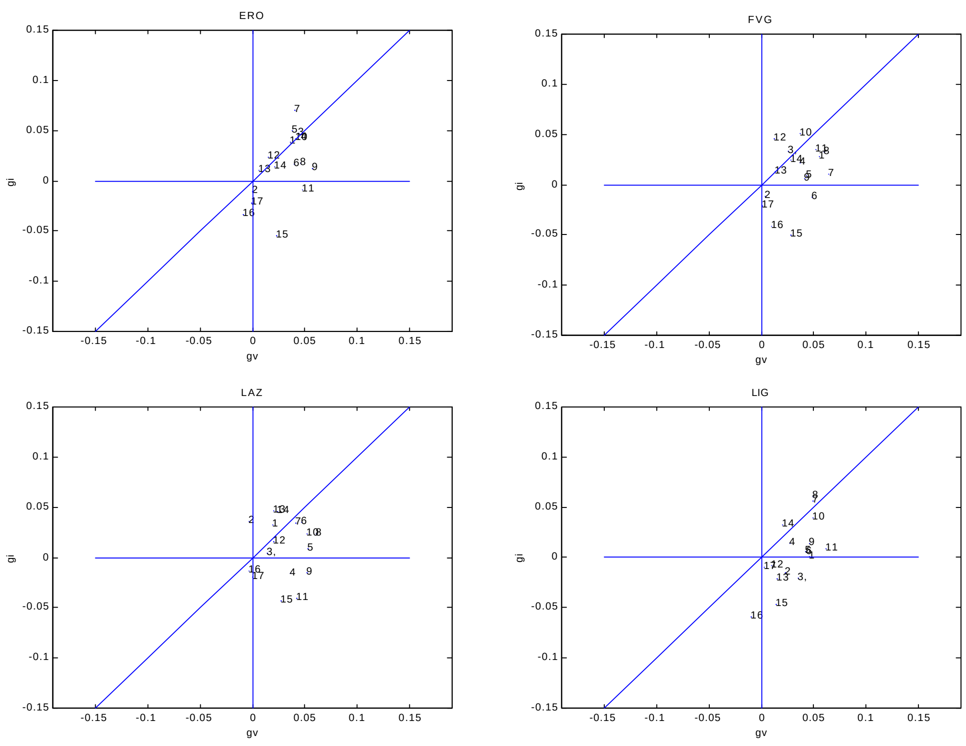
[4]Appendix 1 contains information on the data used in this paper, the list of regions and of sectors (17).

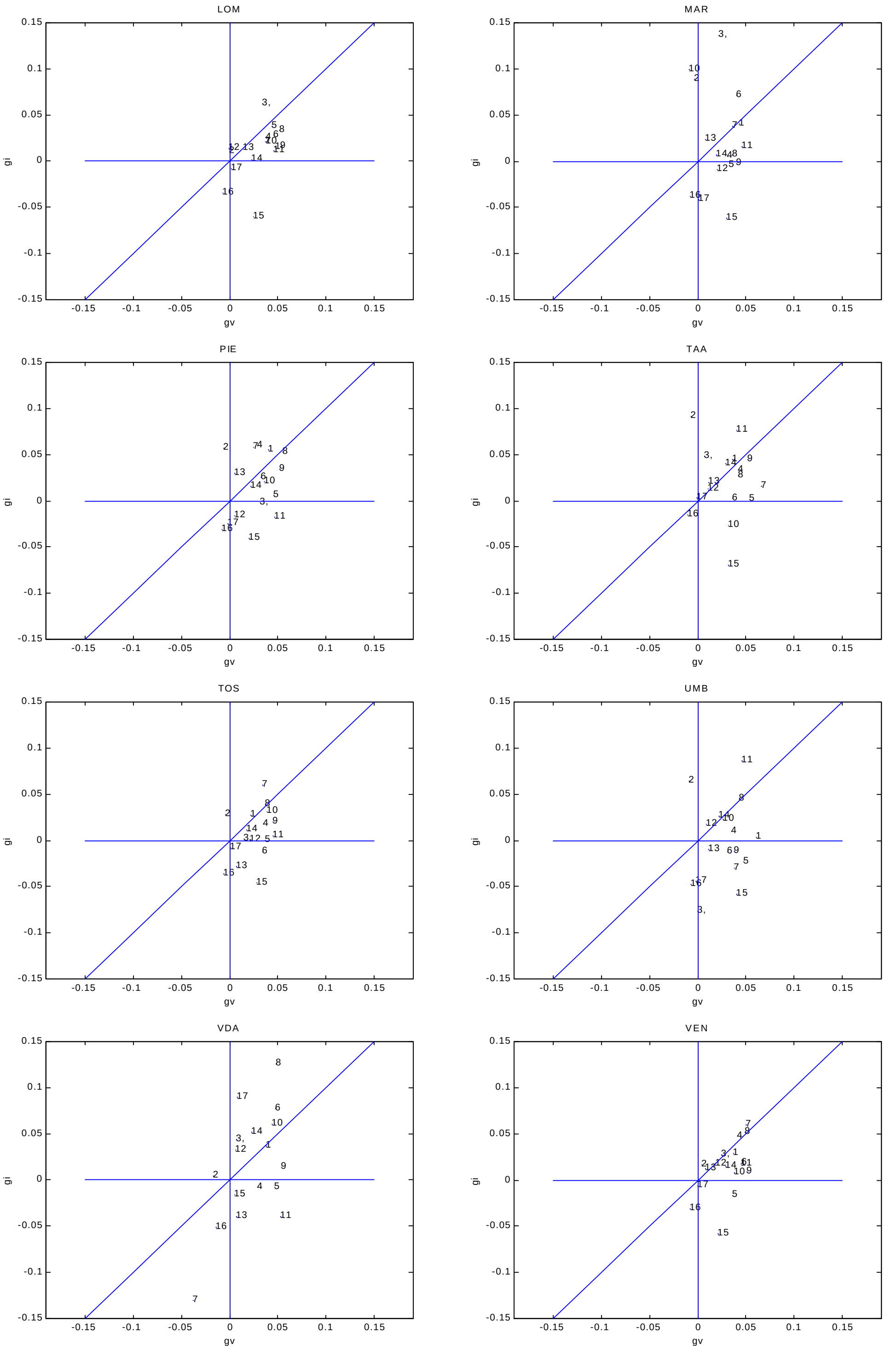
As one question relevant to BP is how to define and quantify the level of structural instability of an economy, in this case a region, we will propose to consider some synthetic indexes of structural instability, calculated from the transition matrices. This indexes will successively be put in relation to regional levels of unemployment, in order to check if and how much the interplay of different sectoral dynamics is linked to the capacity of the system to absorb unemployment.

3 Graphical Analysis

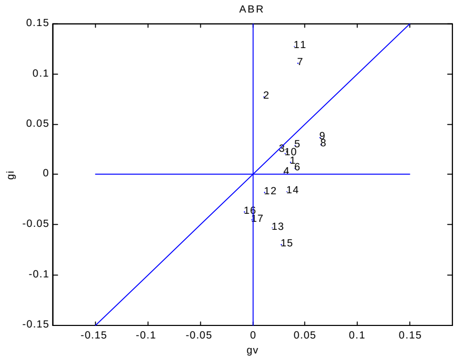
In this Section, the dynamics of every region is represented graphically as a set of 17 (i.e. the number of sectors) observations in the FS. Each observation is based on the couple of sectoral growth rates, $\overline{g_v}$ and $\overline{g_i}$, representing averages over the whole period considered: 1970-1993. To stick to the traditional classification, we keep the distinction between North-Centre and South (Mezzogiorno) Regions, reported in Appendix 1.

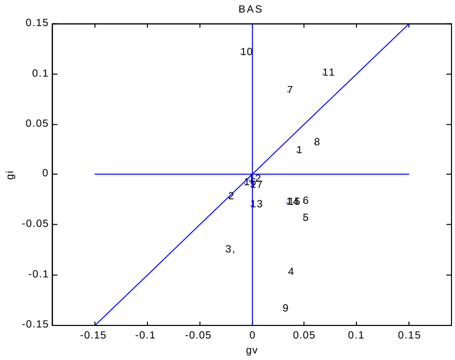
North-Centre Regions

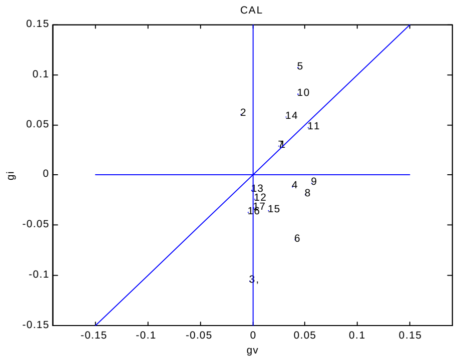


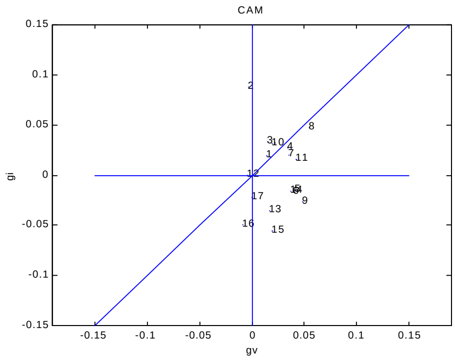

LOM
MAR
PIE
TAA
TOS
UMB
VDA
VEN
gv
gi

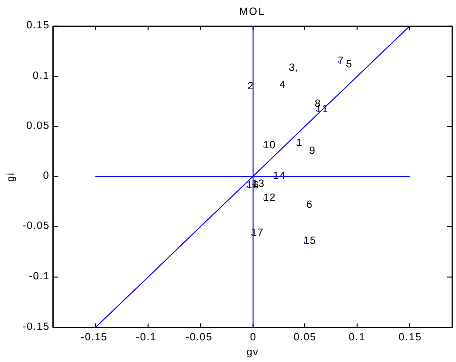
South Regions

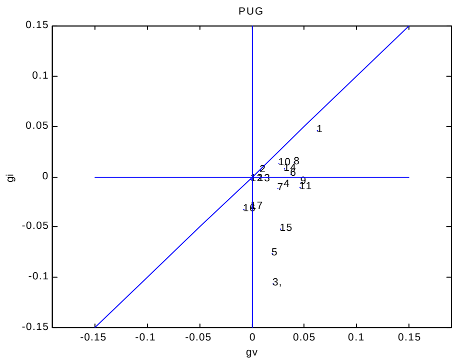


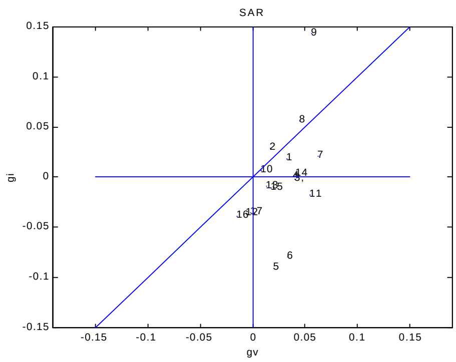


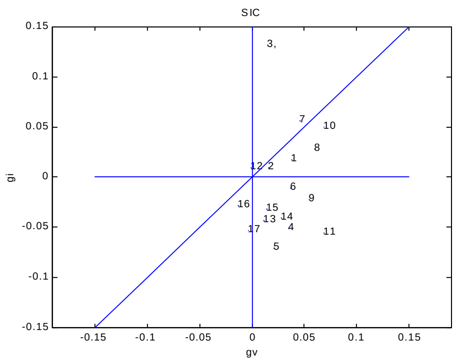












These "snapshots" reveal some differences among the two geographical areas: it seems that the "clouds" of points in North-Centre regions is often more concentrated than the one in South regions. In almost all North-Centre regions, observations are contained in a "box" given approximately by: $0 \leq g_v \leq 0.05$ and $-0.05 \leq g_i \leq 0.05$ (partial exceptions are MAR and VDA in North-Centre, CAM and PUG in South). This first type of evidence can be interpreted in terms of different capacities for the set of sectors to move in a coordinated fashion, with sectors in North Centre regions generally showing a higher tendency to experiencing similar growth performances, and with smaller oscillations in the FS.

Another question is the evolution of these clouds of dots in the time period considered here. In other words, an analysis could be conducted region by region by representing a series of graphs, each referred to a time interval. The choice of these intervals can be for instance dictated by business cycles or by the occurrence of shocks (like the oil shocks in the seventies). For reasons of space we omit this kind of graphical analysis, and move directly to a quantitative analysis of the evolution of these clouds, where yearly intervals are considered.

4 Sectoral Regime Dynamics as a Markov Chain

We describe the economic dynamics of every region by the *distribution dynamics of its sectors.* That is, assuming that time is discrete and indexed by t, we represent the distribution of sectors in the set of regimes $S = \{1, ..., 6\}$ in period t, by a vector:

$$\mathbf{x}_t = [x_1, ..., x_6] \text{ where } 0 \leq x_i \leq 1 \text{ and } \sum\nolimits_{i \in S} x_i = 1. \tag{2}$$

In every period, a given distribution is mapped into the distribution of the following period by a *transition matrix* $\mathbf{P}$ (to be estimated), i.e. the process follows an evolution process given by:

$$\mathbf{x}_{t+1} = \mathbf{x}_t \mathbf{P} \tag{3}$$

where every element of $\mathbf{P}$, p_{ij}, satisfies the following conditions:

$$0 \leq p_{ij} \leq 1 \; for \; i, j \in S$$

$$\sum\nolimits_{j \in S} p_{ij} = 1 \; for \; every \; i,$$

and represents the probability for a sector in regime i in period t to be in regime j in period $t+1$.

Then, we can exploit the theory of Markov Chains to describe the dynamics[5] since, a Markov Chain is a stochastic process $[X_t;\ t = 0, 1, 2, ...]$, which takes values in a *state space*, say S (in our case finite) and, for $i, j, z, w \in S$, satisfies the *Markov property*:

$$p_{ij} = \Pr[X_{t+1} = j \mid X_t = i] = \Pr[X_{t+1} = j \mid X_t = i, X_{t-1} = z, ..., X_0 = w]$$

stating that, to know the transition probability in the present period from i to j, it is sufficient to know the state of the system in the last period. In addition, we will assume that the process is *stationary*, i.e. the probabilities of transiting from one regime to another are the same, no matter when the transition takes place[6]. So, for a stationary Markov Chain, the probability distribution in period t is mapped in the probability distribution of period $t + 1$, according to an equation like (3).

The assumption of stationarity permits us to estimate *one* transition matrix starting from data for the specified period: 1970-1993. It is well known that over this time span some important facts occurred, besides cyclical fluctuations: from the oil shocks in the seventies to the collapse of the Italian exchange system in 1992. By assuming the stationarity of the process it is our aim to abstract from this aspects in order to estimate an average *path*, something useful to shed light on the deep characteristics of the regional dynamics.

The tables presented below represent the transition matrices for every Italian region. We estimated transition probabilities by:

$$\underset{\sim}{p}_{ij} = \frac{N_{ij}}{N_i}$$

where N_i is the number of observations in regime i, and N_{ij} is the number of transitions from regime i to regime j. Norris (1997) shows that these estimates are the maximum likelihood estimates of the true transition probabilities and are consistent, i.e. they converge with probability one to their true values as $N_i \to \infty$.

Notice that, in the estimation of transition probabilities, we do not distinguish among the transitions realized by different sectors belonging to the same region. For our analysis this is not important, since we are interested in

[5]A reference here is to the recent work on convergence in terms of distribution dynamics. See for instance Quah (1993) and (1996), and Durlauf and Quah (1998).

[6]This is implicit in the formulation of the Markov property just given, since transition probabilities do not depend on t. If the process is not stationary, then the notation for a transition probability in period t would be $p_{ij}^{(t)}$.

characterizing the dynamics of a particular geographic area (a region) and in obtaining something to be contrasted with its labor market performance[7],[8].

North Centre Regions

0,1471	0,3235	0,0588	0,0000	0,1471	0,3235
0,1075	0,1935	0,0968	0,0323	0,1935	0,3763
0,1061	0,2273	0,1970	0,0455	0,1667	0,2576
0,0000	0,3750	0,2500	0,0000	0,0000	0,3750
0,0577	0,2115	0,2308	0,0000	0,1346	0,3654
0,0826	0,2810	0,2231	0,0248	0,0992	0,2893

ERO

0,0357	0,2857	0,1786	0,0714	0,1786	0,2500
0,1277	0,1277	0,2447	0,0213	0,1277	0,3511
0,0247	0,2593	0,1852	0,0123	0,0864	0,4321
0,0909	0,4545	0,2727	0,0000	0,0000	0,1818
0,0714	0,3810	0,1667	0,0238	0,1190	0,2381
0,0847	0,3136	0,2034	0,0424	0,1102	0,2458

FVG

0,0333	0,2667	0,1667	0,0667	0,1333	0,3333
0,0818	0,2545	0,1273	0,0273	0,1545	0,3545
0,1071	0,2321	0,1786	0,0357	0,0893	0,3571
0,0000	0,3333	0,0000	0,0833	0,3333	0,2500
0,0980	0,2549	0,2549	0,0196	0,1373	0,2353
0,0783	0,4174	0,1304	0,0174	0,1217	0,2348

LAZ

0,1250	0,3750	0,2500	0,0000	0,2083	0,0417
0,0531	0,2035	0,1062	0,0531	0,2743	0,3097
0,0345	0,2759	0,2241	0,0172	0,1207	0,3276
0,2000	0,1000	0,3000	0,0000	0,1000	0,3000
0,0959	0,4247	0,1233	0,0137	0,1370	0,2055
0,0625	0,3542	0,1875	0,0208	0,1771	0,1979

LIG

0,0889	0,2889	0,0667	0,0444	0,0889	0,4222
0,1000	0,2900	0,1500	0,0200	0,1700	0,2700
0,1404	0,2632	0,1579	0,0702	0,0877	0,2807
0,3000	0,1000	0,3000	0,0000	0,0000	0,3000
0,0400	0,3000	0,2000	0,0200	0,2000	0,2400
0,1607	0,2768	0,1607	0,0089	0,1071	0,2857

LOM

0,0968	0,2903	0,1290	0,0645	0,1613	0,2581
0,0928	0,2371	0,1340	0,0206	0,2165	0,2990
0,0580	0,2029	0,2029	0,0000	0,2029	0,3333
0,2000	0,2000	0,2000	0,1000	0,0000	0,3000
0,0645	0,3065	0,2581	0,0161	0,0968	0,2581
0,0952	0,2667	0,2286	0,0286	0,1429	0,2381

MAR

0,1034	0,4138	0,1034	0,0345	0,1034	0,2414
0,0490	0,2549	0,1275	0,0196	0,1961	0,3529
0,0820	0,2459	0,2131	0,0656	0,1148	0,2787
0,0769	0,3846	0,1538	0,0769	0,2308	0,0769
0,0909	0,3455	0,1455	0,0182	0,1636	0,2364
0,0877	0,2807	0,1667	0,0263	0,0965	0,3421

PIE

0,1563	0,0625	0,1563	0,0938	0,1563	0,3750
0,0500	0,2100	0,1000	0,0100	0,2400	0,3900
0,1579	0,2105	0,1579	0,0000	0,1930	0,2807
0,1176	0,4706	0,1765	0,0000	0,1176	0,1176
0,0492	0,3607	0,1639	0,0656	0,1148	0,2459
0,0748	0,3178	0,1682	0,0841	0,1308	0,2243

TAA

[7] More research can be conducted by focusing on the dynamics of the same sector observed in different regions. Perhaps, this can add something to the known story on sectoral evolutions: increasing importance of the service sectors and decreasing weight of agricultural and industrial sectors.

[8] Transition matrices were estimated from *symbolic matrices*, i.e. (23 x 17) matrices where each column is referred to a sector, and contains a string of 23 symbols. Every symbol is the regime visited by the sector in a year. These matrices are currently being studied in I.D.E.E. through the lens of *symbolic dynamics*.

0,0968	0,2581	0,0645	0,0645	0,1935	0,3226
0,0700	0,2600	0,1300	0,0200	0,1800	0,3400
0,0746	0,3134	0,1791	0,0149	0,1343	0,2836
0,0000	0,1429	0,1429	0,0000	0,2857	0,4286
0,1053	0,2456	0,2632	0,0000	0,1404	0,2456
0,0804	0,2589	0,2321	0,0179	0,1429	0,2679

TOS

0,0667	0,3333	0,2000	0,0000	0,2000	0,2000
0,0476	0,2667	0,1429	0,0000	0,2000	0,3429
0,0253	0,2278	0,1519	0,0633	0,1772	0,3544
0,0000	0,0909	0,4545	0,0000	0,0000	0,4545
0,0517	0,3621	0,2241	0,0345	0,0690	0,2586
0,0377	0,3019	0,2925	0,0377	0,1604	0,1698

UMB

0,0526	0,2105	0,1579	0,2105	0,1579	0,2105
0,0381	0,2476	0,1238	0,0381	0,2286	0,3238
0,0882	0,2647	0,1765	0,0588	0,1912	0,2206
0,0714	0,2500	0,1071	0,2143	0,0714	0,2857
0,0484	0,3387	0,2419	0,0968	0,1290	0,1452
0,0435	0,3043	0,2500	0,0652	0,1087	0,2283

VDA

0,1176	0,3529	0,0588	0,0882	0,0882	0,2941
0,0660	0,2736	0,1792	0,0377	0,1321	0,3113
0,0820	0,2295	0,1803	0,0492	0,1311	0,3279
0,1333	0,2667	0,4000	0,0000	0,0667	0,1333
0,0769	0,4103	0,1795	0,0256	0,0513	0,2564
0,1092	0,2773	0,1176	0,0336	0,1008	0,3613

VEN

South Regions

0,1071	0,1786	0,1786	0,0714	0,2857	0,1786
0,0381	0,3429	0,1238	0,0286	0,1905	0,2762
0,0685	0,2055	0,2603	0,0274	0,1370	0,3014
0,0000	0,1818	0,2727	0,0000	0,1818	0,3636
0,0984	0,3607	0,2295	0,0164	0,1311	0,1639
0,0938	0,2917	0,2083	0,0313	0,1458	0,2292

ABR

0,0714	0,2500	0,1786	0,0357	0,3929	0,0714
0,0804	0,2054	0,1964	0,0357	0,2500	0,2321
0,1304	0,3043	0,1594	0,0145	0,1884	0,2029
0,0769	0,3077	0,2308	0,0000	0,1538	0,2308
0,0519	0,3636	0,2078	0,0390	0,1429	0,1948
0,0533	0,3867	0,1867	0,0533	0,1867	0,1333

BAS

0,0476	0,3333	0,1905	0,0476	0,1905	0,1905
0,0328	0,2459	0,1721	0,0164	0,3197	0,2131
0,0492	0,3607	0,1148	0,0656	0,1475	0,2623
0,0667	0,2667	0,3333	0,0000	0,0667	0,2667
0,0800	0,4400	0,1733	0,0667	0,0667	0,1733
0,0750	0,3375	0,1625	0,0375	0,2250	0,1625

CAL

0,0000	0,3333	0,1667	0,0417	0,1667	0,2917
0,0804	0,3304	0,1339	0,0179	0,1964	0,2411
0,0704	0,3380	0,1690	0,0423	0,0845	0,2958
0,0000	0,1111	0,1111	0,0000	0,3333	0,4444
0,0492	0,2951	0,2623	0,0328	0,0984	0,2623
0,0722	0,2887	0,2680	0,0000	0,1649	0,2062

CAM

0,0741	0,2593	0,1111	0,0370	0,2222	0,2963
0,0707	0,1818	0,1515	0,0606	0,2828	0,2525
0,1129	0,2258	0,1290	0,0645	0,1935	0,2742
0,0000	0,2778	0,0556	0,0000	0,2778	0,3889
0,0526	0,4079	0,1579	0,0658	0,1053	0,2105
0,0652	0,2500	0,2717	0,0217	0,2065	0,1848

MOL

0,0303	0,2424	0,1818	0,0303	0,3030	0,2121
0,1165	0,2136	0,1359	0,0485	0,2039	0,2816
0,0820	0,3115	0,1803	0,0656	0,2131	0,1475
0,0556	0,4444	0,2222	0,1667	0,0000	0,1111
0,0656	0,4262	0,1803	0,0164	0,0820	0,2295
0,0918	0,2857	0,1531	0,0510	0,1020	0,3163

PUG

0,0323	0,2258	0,2581	0,0323	0,2581	0,1935
0,1058	0,2500	0,1538	0,0673	0,1827	0,2404
0,0435	0,2319	0,1739	0,0870	0,1594	0,3043
0,2222	0,1852	0,1111	0,0741	0,0741	0,3333
0,1228	0,3158	0,1930	0,1228	0,0877	0,1579
0,0465	0,3721	0,2326	0,0465	0,1279	0,1744

SAR

0,0714	0,1071	0,2500	0,0357	0,2857	0,2500
0,0769	0,1538	0,1346	0,0096	0,2212	0,4038
0,1094	0,2969	0,1563	0,0156	0,2344	0,1875
0,0000	0,3000	0,3000	0,1000	0,1000	0,2000
0,0556	0,3611	0,2083	0,0417	0,1250	0,2083
0,0521	0,3750	0,2083	0,0104	0,1875	0,1667

SIC

Some facts can be noticed: the number of zeros is very small, meaning that almost any "story" is possible: basically, a sector in a regime has a positive probability of transiting to any other. Moreover, the elements on the diagonal are generally quite low, ranging from 0 to about 0,35; this fact has already been termed as the *volatility of growth regimes* (see VV.AA., 1999, p.45), and is here confirmed: once a sector enters a regime, it is quite unlikely that it stays there in the following period (besides the fact that can jump in any other regime).

Regimes 2 and 6 seem to have the highest capacity to "attract" a sector: in 15 out of 20 cases p_{22} and p_{66} have the highest values among the principal diagonal elements; in addition, p_{i2} and p_{i6} ($i \in S$) are generally relatively high (see the second and sixth columns of every transition matrix). This is reflected in the shape of the long run distributions[9] (not reported here), which generally show a bimodality, with higher fractions of sectors concentrated in Regimes 2 and 6.

5 Structural Instability and Unemployment

From the estimation of a transition matrix it is possible to obtain a first quantitative evaluation of the law of motion governing the transitions among the set of Regimes. One of the original motivations of the I.D.E.E. research project is to investigate the possible relation existing among sectoral dynamics and unemployment.

In particular, after a preliminary observation of the different dynamics in the FS characterizing the United States and some European countries, the following conjecture was formulated: "structural instability may account for such a poor employment performance in European Countries"[10].

The reason why this hypothesis was formulated can be found in the following argument: a change in regime, as noted, can be interpreted as a change in the model of growth followed by a sector, that can be associated with changes in the technology. In this case a problem of "viability"[11] can

[9]If a stationary Markov Chain satisfies certain properties, (irreducibility, positive persistency and aperiodicity), it is defined *ergodic* (see for instance Isaacson and Madsen, 1976, pp. 277 and 293). In this case, its probability distribution tends to a unique *long run distribution* (or invariant distribution). In our case, the above mentioned properties are satisfied in all cases, so every transition matrix can be associated with an invariant distribution, which represents the long run tendency for the distribution of sectors in the set of 6 Regimes.

[10]VV. AA. (1999), p.54.

[11]See Amendola et al. (1999) for a concise description of the Neo Austrian approach to production dynamics. In this framework the issue of intertemporal complementarity of

exist, if for instance different levels of employment and skill structures are associated with different regimes. For example, a change in regime can be associated with a decrease in employment if, following a different technological choice, a sort of Ricardian unemployment is created as the skill level and/or composition requested changes.

Technological changes can be associated with the adoption of labor-saving techniques or with different requirements of skills: in both cases problems of mismatch can arise if it is assumed that the workforce do not adapt instantaneously to the changing requirements of the productive system.

Then, if a multisector economy is characterized by a high level of structural instability, i.e. by too frequent changes of regimes, one can conjecture that there are frequent changes in growth models followed by the sectors, frequent changes in technology and consequently the labor force may result underutilized (some phenomena of hysteresis are for instance likely to appear). In a Neo Austrian framework: "unemployment [may] appear as the result of the breaking of the intertemporal complementarity of productions"[12]

A first question is how to measure the level of structural instability present in a multisector economy. Having adopted the tool of Markov Chains to analyze the structural dynamics, we can resort to some indexes, originally developed in the literature on mobility, which can be directly calculated from a transition matrix (see Bartholomew,1982, pp.24-30, and Shorrocks, 1978, for discussions).

Mobility indexes can basically reveal two types of information: 1) the *degree of generation dependence*, i.e. a measure of the dependence of the status of "sons" from the status of "fathers"; 2) *the amount of movement*, i.e a measure of the proportion of "individuals" that change status[13].

In what follows, we propose the adoption of a mobility index as our indicator of structural instability. In particular, we use two mobility indexes

production phases is crucial, as problems of "viability" can arise if the process does not follow some intertemporal equilibrium conditions.

[12]Amendola et al., 1999, p.280

[13]Following Bartholomew, 1982, p.24, it is possible to clarify this distinction with one example: consider the three matrices:

$$a)\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}, \qquad b)\begin{bmatrix} p & 1-p \\ p & 1-p \end{bmatrix}, \qquad c)\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$$

according to both criteria, matrix a) represents an *immobility* situation, every "son" has the same status of the "father"; matrix b) is at the opposite of the spectrum according to criterium b), since the "son" status is independent from the "father" status; finally, matrix c) is at the opposite of the spectrum according to criteria c), in every period every "son" changes its status.

proposed in Bartholomew (1982), one based on type 1) information and the other based type 2) information. The first one, *Ind1*, is based on the elements of the principal diagonal, and it is given by:

$$Ind1 = \frac{trace(P) - 1}{n - 1}$$

where P is a transition matrix of dimension n. The index represents the average of the eigenvalues different from 1[14]; in this case, where $n = 6$, the range of possible values for *Ind1* is $[-0.2, 1]$. We interpret *Ind1* in the following way: it is a measure of the joint capacity of regimes to be attractors, i.e. to be such that, once a sectors enters one of them, it is likely that it stays there in the following period. In this case, the higher the value of the diagonal elements, the more stable the system should be, i.e. the smaller the jumps made by the clouds representing the aggregate situation.

We noticed that, in general, the diagonal elements are never very high, but the evaluation of the index *Ind1* reveals some interesting differences. In particular, it is generally higher for North-Centre regions. The following figure represents the scatterplot of the average unemployment rate for the period 1970-1993[15] against the stability indicator *Ind1*.

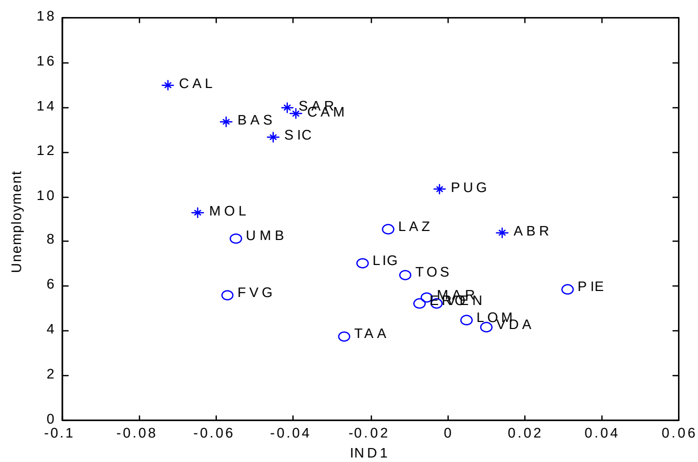


Figure 2

We can see that a negative relation appears (remember that a higher value of *Ind1* means a higher level of stability), and that there seems to be a substantial difference between the behavior of North-Centre and Mezzogiorno

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[14]Remember that the trace of a matrix equals the sum of its eigenvalues and that every transition matrix has 1 as maximal eigenvalue.

[15]Data on unemployment are from ISTAT publications.

regions. A partial exception is represented by PUG, ABR and MOL, with observations closer to those of North Centre regions. In particular, PUG and ABR show levels of stability comparable to the majority of North Centre regions. This is in line with recent arguments in favor of a classification between South-East regions, like PUG, ABR and MOL, considered more dynamic, and the rest of Mezzogiorno (see for instance Paci and Saba, 1998).

This relation can be estimated quantitatively by running a simple OLS regression of average unemployment rates (U), against the instability index (IND1), a dummy variable for Mezzogiorno regions (SUD), and a constant term (C). The estimated equation is the following (standard errors in parenthesis):

$$U = \underset{(0.53)}{5.42} - \underset{(14.74)}{34.71}\ IND1 + \underset{(0.86)}{5.34}\ SUD \qquad (4)$$
$$\overline{R}^2 = 0.78$$

We see that the *Ind1* coefficient is negative and significantly different from zero. The dummy variable SUD is also highly significant and positive (this was predictable from a look at Figure 1)

Let us consider another index based on criterium 2), i.e. on the amount of movement:

$$Ind2 = \sum_{i=1}^{6} p_i \left(\sum_{i \neq j} p_{ij} \right) = 1 - \sum_{i=1}^{6} p_i p_{ii}.$$

where p_i is the *i-th* element of the invariant distribution[16]. We have *Ind2* $\in [0,1]$, but now a higher level corresponds to higher mobility/instability. It represents a measure of the proportion of sectors that change regime in every period. Note the slight difference between the indexes: *Ind1* is based on the elements of the principal diagonal, giving an information on the capacity of every regime to be an attractor; *Ind2* takes explicitly into account the distribution of the population of sectors in every regime, through the consideration of the invariant distribution. In the latter case we have a quantitative picture of the movements of members of a population, and not just a characterization of how the regimes influence the dynamics.

The following figure contains the new scatterplot:

[16]By the use of the invariant distributions (not reported here) it is possible to extract all information from the transition matrix since, as noted, invariant distributions are directly implied by them.

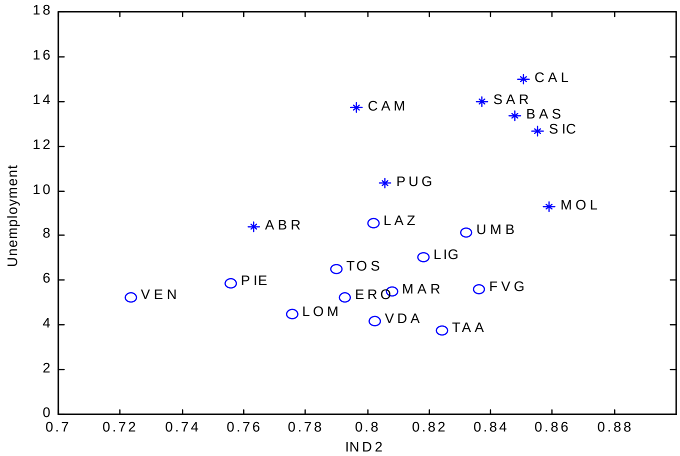

Figure 3

The new estimated equation is:

$$\begin{aligned} U &= \underset{(10.41)}{-9.06} + \underset{(13.06)}{18.76 \; IND2} + \underset{(0.93)}{5.65 \; SUD} \\ \overline{R}^2 &= 0.74 \end{aligned} \qquad (5)$$

OLS results are less satisfying than before, but the index *IND2* has the expected sign, though the level of significance is quite low. Again the dummy for South regions is highly significant; note also that the intercept term is not statistically different from zero.

6 Concluding Remarks

This paper made a step in the direction of using a new tool for the analysis of the dynamics of a multisector economy, the Framework Space, as a part of the I.D.E.E. research project. The analysis was carried out with respect to the 20 Italian regions, whose story of dualism is well known.

We represented the dynamics in the FS as a distribution dynamics of the sectors belonging to a region. Assuming the stationarity of the process and the irrelevance of the past in governing the transitions, we estimated the one-step transition matrices for every region. A first look at the graphical analysis and to the structural instability indexes calculated from the transition matrices, suggest that there is some evidence of another type of dualism, i.e. *dualism in sectoral dynamics*, with South regions generally characterized by higher levels of structural instability, as we defined it.

Then, it was shown that part of the difference in the employment performances can also be related to the different sectoral dynamics. This evidence can be considered as a promising direction for further research, in order to check the robustness of the results obtained. For instance, different synthetic indexes of structural instability, based on alternative representations of the dynamics, can be constructed; a different econometric strategy can be pursued. In particular note that, in a sense, the previous analysis is completely static, since it is just referred to numbers representing an average behavior over the period considered; it is suggested that some moving index of stability should be built, in order to examine its evolution in relation to the evolution of unemployment rates.

References

[1] Amendola, M., Gaffard, J.L. and Punzo, L.F. (1999): "Neo Austrian Processes", The Indian Journal of Applied Economics, 8, 277-293.

[2] Bartholomew, D.J. (1982): *Stochastic Models for Social Processes*, 3rd Ed., John Wiley and Sons.

[3] Böhm, B. and Punzo, L.F. (1998): "Productivity-Investment Fluctuations and Structural Change", mimeo, University of Siena.

[4] Durlauf, S. and Quah, D. (1998): "The New Empirics of Economic Growth", NBER Working Papers Series, Nr.6422.

[5] Isaacson, D.L. and Madsen, R.W. (1976): *Markov Chains: Theory and Applications*, John Wiley and Sons.

[6] Matsuyama, K. (1999): "Growing Through Cycles", *Econometrica*, 67, 335-347.

[7] Mauro, L. and Podrecca, E. (1994): "The Case of Italian Regions: Convergence or Dualism?", *Economic Notes*, 24, 447-472.

[8] Norris, J.R. (1997): *Markov Chains*, Cambridge University Press.

[9] Paci R. and Saba (1998): "The Empirics of Regional Economic Growth in Italy: 1951-1993", *Rivista Internazionale di Scienze Economiche e Commerciali*, 3, 515-542.

[10] Pritchett, L. (1998): "Patterns of Economic Growth: Hills, Plateaus, Mountains and Plains", Policy Research Working Paper nr. 1947, The World Bank.

[11] Quah, D. (1993): "Empirical Cross-section Dynamics in Economic Growth", *European Economic Review*, 37, 426-434.

[12] Quah, D. (1996): "Empirics for Economic Growth and Convergence", *European Economic Review*, 40, 1353-1375.

[13] Shorrocks, A.F. (1978): "The Measurement of Mobility", *Econometrica*, 46, 1013-1024.

[14] VV.AA. (1999): *Industrial Dynamics and Employment in Europe*, mimeo.

Appendix 1

The data on Value Added, Investment and Employment are from the CRENoS (Centre for North South Economic Research, University of Cagliari) database, available on-line at: http://www.crenos.unica.it/databanks/italian.html. They cover the period 1970-1993 and are expressed in 1985 constant prices.

The regions are:

Abruzzo (ABR)
Basilicata (BAS)
Calabria, (CAL)
Campania (CAM)
Emilia Romagna (ERO)
Friuli Venezia Giulia (FVG)
Lazio (LAZ)
Liguria (LIG)
Lombardia (LOM)
Marche (MAR)
Molise (MOL)
Piemonte (PIE)
Puglia (PUG)
Sardegna (SAR)
Sicilia (SIC)
Trentino Alto Adige (TAA)
Toscana (TOS)
Umbria (UMB)
Valle D'Aosta (VDA)
Veneto (VEN).

The macroregion of Mezzogiorno is composed by: ABR, BAS, CAL, CAM, MOL, PUG, SAR, SIC.

The sectors considered are:

1) Agricolture;
2) Fuel and power products;
3) Ferrous and non-ferrous mineral and metals;
4) Minerals and non-metallic mineral products;
5) Chemical products;
6) Metal products and machinery;
7) Transport equipment;
8) Food, beverages, tobacco;
9) Textiles and clothing, leather and footwear;
10) Paper, and printing products;
11) Wood, rubber and other industrial products;
12) Building and construction;

13) Trade, hotels and public establishment;
14) Transport and communication services;
15) Credit and insurance institutions;
16) Other market services;
17) Non-market services.