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PRODUCTIVITY AND EMPLOYMENT DYNAMICS: NEW EVIDENCE FROM ITALIAN REGIONS

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WORKING PAPERS

2015/05

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Title: PRODUCTIVITY AND EMPLOYMENT DYNAMICS: NEW EVIDENCE FROM ITALIAN REGIONS

ISBN: 978 88 8467 926 0

First Edition: May 2015

Productivity and employment dynamics: new evidence from Italian regions

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Abstract

When productivity growth accelerates job destruction and job creation occurs simultaneously. However the results for the whole economy depend on which effect eventually dominates.
We investigate what occurs in Italy during the time span 1977-2003, when some waves of labor market reforms have been introduced towards more flexibility. We also investigate if there are any systematic regional differences in the employment/productivity dynamics and whether these dynamics experience any sort of spatial externalities.
Findings suggest that overall in Italy job destruction effect prevails and that the labor market reforms have a negative impact on employment.

Jel classification: J01; J20; O30; R11; R23.

1. Introduction

Economic growth and labor market theories have been developed independently until the 1990s. During this decade (1990s), the work of Pissarides (1990; 2000) breaks the dichotomy by developing a model in which the rate of technical progress directly affects the labor market tightness as measured by the ratio of vacant jobs to the unemployment rate. According to this theory, high productivity growth increases the expected profits and provides incentives to open new jobs. This outcome has been termed the "capitalization effect" of growth on employment. Some years later, Aghion and Howitt (1998) find that faster productivity growth, embodied in industrial innovations, generates job destruction rather than job creation, thereby reducing the value of posting vacancies. This outcome has been named the "creative destruction effect". Thereafter, Mortensen and Pissarides (1998) show that the two effects (i.e., the "capitalization effect" à la Pissarides and the "creative destruction effect" à la Aghion and Howitt) depend on the type of technology such that if the technology is disembodied, as in the Solow growth model, even old jobs can take advantage of technological change. In this case, the capitalization effect is expected to prevail; however, if the technology is embodied, only new jobs can take advantage of technological progress and old jobs will be destroyed. In the latter case, the creative destruction effect prevails over the capitalization effect. More recently, Prat (2007) investigates the relationship between unemployment and disembodied technological change using a search-matching model where firms operate in a stochastic environment. He finds that the effect of technological change on unemployment depends on the degree of uncertainty as unemployment can increase or decrease with the pace of innovation. Pissarides and Vallanti (2007) model employment by deriving steady state rules for job creation and job destruction for the representative firm. As in Mortensen and Pissarides (1998), the impact of growth of Total Factor Productivity (TFP), which is used to measure economic growth, depends on whether the technology is embodied or disembodied.

Despite the importance of the above-mentioned theoretical contributions, the empirical applications of the relationship between growth and employment are not many, and they do not produce straightforward results (Bean and Pissarides, 1993; Caballero, 1993). Blanchard and Wolfers (2000), analyzing the rise of unemployment for a panel of 20 OECD countries over 5-year intervals from 1960 to 2000 conclude that the interaction between shocks and institutions are crucial to explain trends in unemployment rates in heterogeneous countries. Staiger et al. (2001), using quarterly data for a panel of US states, identify a positive relationship between growth and employment. Pissarides and Vallanti (2007), investigating the relationship between TFP growth and employment for a panel of 15 industrial countries, conclude that TFP growth has a negative impact on employment in the short run and a positive impact in the long run.

The majority of empirical applications focus on the relationship between growth and employment at a cross-country or a country level. However, those types of analyses neglect the role of regional disparities within countries. Empirical literature shows that regional disparities are larger when compared to cross-countries differences. For the case of the European Union, for instance, economic disparities are persistent despite the acceleration of the European Integration of the last decades (Ladu, 2010). Thus far, only Ladu (2012) offers a regional analysis based on a panel of 83 regions in 10 European countries between 1976 and 2000. The author finds that when this relationship is investigated at a more disaggregated level (NUTS 2 European regions), the finding of Pissarides and Vallanti (2007) provides a rather different picture of this relationship in the long run for the case of European regions. More precisely, the effect of TFP on employment is not found to be positive, as it is in their study.

Those outcomes suggest that the final results are actually country-specific; therefore, it is crucial to investigate this relationship at a more disaggregated level to determine its implications for regional growth and related policies. Regional and sub-regional analysis needs to account also for spatial dynamics in the form of spatial spillovers/externalities due to agglomeration and territorial proximity. Hence, the purpose of this work is to examine the dynamic of regional employment and productivity growth (measured by the TFP), productivity spillovers, specialization and diversity externalities in the Italian regions for the period 1977 to 2003. Specifically, the model of Pissarides and Vallanti (2007) is extended including spatial spillovers in the forms of specialization and diversity indexes. Furthermore, the spatial link in regional productivity is investigated by using a spatial lagged explanatory variable model (SLX) suggested by LeSage and Pace (2009), LeSage (2014), Elhorst (2010) and Vega and Elhorst (2013).

The effect of the labor market reforms on the employment /productivity dynamics is also investigated.

The analysis follows two main steps. In a first step the TFP for the country as a whole is estimated; in a second step the TFP growth rate and the lag of TFP growth rate are included in the employment equation as well as the other explanatory variables. The paper is organized as follows. Section 2 presents the theoretical background. Section 3 shows some national and regional trends on productivity and employment and some descriptive statistics on the variables under investigation. Section 4 is divided into two sub-sections: the first one (4.1) presents the estimation procedure of the TFP, while the second one (4.2) illustrates the empirical model to estimate the impact of TFP on employment. Section 5 discusses the results of the basic model à la Pissarides and Vallanti (2007), while Section 6 extends the basic model including specialization, diversity externalities and productivity spatial spillovers. Section 7 concludes with the main findings and further developments of the present work.

2. Theoretical background

To derive the effect of productivity growth (measured by TFP) on employment, we follow the approach of Pissarides and Vallanti (2007). As in Mortensen and Pissarides (1998), Pissarides and Vallanti (2007) derive a model in which the impact of TFP on job creation and job destruction depends on the type of technology, i.e., whether the new technology is disembodied, as in the Solow growth model, or embodied in new jobs (Schumpeterian type). Pissarides and Vallanti introduce a Cobb-Douglas production function with the two types of technology. One, denoted by A_1, can be applied in existing jobs as well as in new jobs, thus allowing existing jobs to take full advantage of new technological improvements. In the other production function, denoted by A_2, can only be applied in new jobs. This is the "Schumpeterian" assumption of embodied technology. In the production function, the output per worker is denoted by f(., .). The first argument denotes the creation time of the job, while the second denotes the valuation time. At time τ, the output per worker in a new job is:

$$f(\tau,\tau) = A_1\,(\tau)^{1-\alpha}\,A_2\,(\tau)^{1-\alpha}\,k(\tau,\tau)^{\alpha} \qquad (1)$$

where k(τ,τ) is the capital-labor ratio in new jobs at τ. However, in jobs of vintage τ, output per worker at time t>τ is:

$$f(\tau,t) = A_1\,(t)^{1-\alpha}\,A_2\,(\tau)^{1-\alpha}\,k(\tau,t)^{\alpha} \qquad (2)$$

where, in general, k(τ,t) is different from k(τ,τ).

The value of a job created at time 0 and lasting until T satisfies the following Bellman equation for t ϵ [0, T]:

$$r\big(V(0,T) + k(0,T)\big) = f(0,T) - \delta k(0,t) - w(0,T) - sV(0,T) + \dot{V}(0,T) \quad (3)$$

$$V(0,T) = 0$$

In the above equation, the value of a job consists of two parts: the value of its capital stock and a value V(.,.)≥0, which is due to the frictions and the quasi-rents that characterize employment. The job can be destroyed either by an exogenous process, which occurs at rate s, or because of obsolescence, which occurs T periods after creation. Capital depreciates at rate δ, and there is a perfect market for capital in which the firm can re-sell its capital stock when the job is destroyed. One of main the assumptions of the model is that rental capital market is perfect and there are no capital adjustment costs, r is the exogenous rental rate of capital and w(0, t) is the wage rate at t in a job of vintage 0. The interpretation of the Bellman equation derives from search theory, that is, firms hire capital stock k(0, t) and realize profit V(0, t) as a result. The firm controls at time 0 whether or not to create a job. Once the decision to create a is made, the next decision is when to terminate it, and the path of k(0, T) for t ϵ [0, T]. Pissarides and Vallanti assume that the firm and the worker jointly determine the wage rate after bargaining. Maximizing the Bellman equation (3) with respect to k(0,t) we obtain:

$$k(0,t) = A_1\ (t)A_2\,(0)(\alpha/(r+\delta)^{\frac{1}{1-\alpha}} \qquad t\,\epsilon\,[0,T] \qquad (4)$$

Wages play a key role in the transmission of the effects of growth on employment, showing that due to the competition of new jobs, workers' reservation wages grow faster than the marginal product of labor in existing jobs. Accordingly, jobs eventually become unprofitable. The wage equation is derived using a Nash bargaining solution:

$$w(\tau,t) = (1-\beta)b(t) + \beta m(\theta)V(t,t) + \beta\Phi(\tau,t) \qquad (5)$$

where b(t) is the unemployment income, $\theta \geq 0$ is a measure of market tightness, m(θ) is the rate at which new jobs are offered to unemployed workers and β ϵ [0,1) is the share of labor. There is no search regarding the job. In existing jobs, technology and capital stock grow at a lower rate than they do in new jobs, while wages grow at a rate that is close to new jobs due to their dependence on reservation wages. The differential rates of growth of labor's marginal product and reservation wages drive the results of employment. A job is destroyed when the reservation wage becomes equal to the worker's marginal product. Wages then become equal to reservation wages as well and the job is then unprofitable as reservation wages continue to grow faster than the marginal product of labor. Employment in the representative firm evolves, on average, according to the difference between job creation and job destruction:

$$\dot{L}(t) = x(t) - e^{-sT}\, x(t-T) - sL(t) \qquad (6)$$

where x(t) is job creation and exp(- sT) is the fraction of jobs of vintage t - T that survive to T and accordingly, it becomes obsolete.

3. Productivity and labor: national and regional trends 1977-2003

At the end of the seventies and in the first half of the eighties the TFP in Italy grows almost continuously; starting from the beginning of the nineties it follows a fluctuating up and down path around a general declining trend (Graph 1). This productivity slowdown in Italy has been found also in previous research (see among others Fachin and Gavosto, 2010; Addessi, 2014; Hassan and Ottaviano, 2013; Lasinio and Vallanti, 2013). The employment rate increases in the first two years of the eighties and decreases afterwards; a discontinuous path characterizes the subsequent years, while a slight recover occurs in the second half of the nineties. Furthermore, the evolution of the growth rate of unemployment has stronger fluctuations and higher volatility respect to the other two economic indicators (Graph 1).

[GRAPH 1 HERE]

It is worth noting that over the past three decades many important reforms modify the Italian labor market towards a higher degree of flexibility (for a deep analysis see Lasinio and Vallanti, 2013). The first ones, adopted in the eighties (1983-1984 and 1986), introduce the temporary apprenticeship contracts and reduce the wage indexation; the second ones, realized in the nineties (1991-1993, 1994-1995, 1997-1998), decrease the level of employment protection encouraging the use of temporary contracts of employment; the third ones, started in the two thousands years (2001, 2003), extend the application of temporary contract to regular employees. According to recent studies (Lasinio and Vallanti, 2013; Manasse and Manfredi, 2014) labor market deregulation reduces productivity in all sectors encouraging investments in sectors characterized by higher labor flexibility, lower skills and lower productivity.

It is interesting at this point to compare the evolution of TFP growth and, respectively, employment and unemployment rate (Graph 2.1 and 2.2). Two patterns seem to emerge: an inverse relationship between TFP and employment; and a direct connection between TFP and unemployment. It is very likely that this flexibility introduced by the labor market deregulation encouraged firms to hire low skill workers that are also less able to adapt to technological change.

[GRAPH 2.1-2.2 HERE]

Those descriptive results give some first hints on the possibility that creative destruction prevails over the capitalization effect. Indeed, when the capitalization effect prevails, the TFP and employment should follow the same trend, namely they should grow together, while unemployment goes in the opposite direction (negative relationship with TFP growth). The analysis of the same indicators at a regional level confirms those relationships for all the three macro areas (North, Centre and South of Italy), even tough they are particularly evident for the Northern regions of the country where the majority of manufacturing firms are traditionally located (Graphs 3.1-3.3; 4.1-4.3).

[GRAPHS 3.1-3.3HERE]
[GRAPHS 4.1-4.3 HERE]

Finally, it is interesting to check the relationship between TFP growth and real wages. If wages follow productivity, a positive linkage is expected. However in the case of Italy only at the first beginning of the eighties this is confirmed, after this period of time appears evident that wages do not substantially reflect productivity both, at national and macro areas level (Graphs 5; 5.1-5.3). This pattern has been found also in previous research (Manasse and Manfredi, 2014).

[GRAPHS 5; 5.1-5.3 HERE]

4. Estimation of the TFP and the empirical model

The final purpose of the present work is to investigate the connection between employment and productivity growth for the 20 Italian regions over the period 1977 to 2003. Following Pissarides and Vallanti (2007) and Easterly and Levine (2001), productivity growth is measured by means of TFP growth. The latter note that much of the empirical evidence indicates that factor accumulation in the form of GDP growth explains only a portion of the observed cross-country growth. De la Fuente and Doménech (2000) also highlight that TFP dynamics are crucial for the productivity dynamic.

Methodologically, the analysis follows two main steps. In a first step, TFP for the country as a whole is estimated. As in Marrocu et al. (2012), to avoid any potential bias due to endogeneity, the national TFP is obtained using two-stage least squares estimation method (2SLS) and an IV procedure. The estimated coefficients of α and β are then used to compute the TFP for each region and year of the sample under analysis.

In a second step, the TFP growth rate and the lag of the TFP growth rate are included as explanatory variables in the employment (equation 8). Furthermore, since the descriptive analyses unveils possibilities of structural breaks due to labor market reforms, the model is re-estimated considering four time periods (see Section 3): 1978-1983 (no reform); 1984-1989; 1990-1995; 1996-2001.

We check also for the presence of any systematic difference of TFP growth impact on employment with respect to regional contexts by including two interaction dummies (i.e., TFP in the Northern, central and Southern regions).

4.1 The first step: the estimation of TFP

The estimation of the TFP for a panel of Italian regions is not new: Marrocu et al. (2001) measure the TFP for 17 sectors over the period 1970-1994; Ascari and Di Cosmo (2004) calculate it over the period 1985-2000, while Byrne et al. (2009) for 1970-2001. One of the most used approaches to calculate the TFP is the growth accounting methodology that has been suggested by Solow in a seminal paper of the 1957. This method allows measuring the so-called Solow residual that is interpreted as technical change and innovation. As Byrne et al. (2009, 66) well explain, one of the main limitations of this method is 'the assumption of constant return to scale, perfect competition, and constant factor shares and time invariability of the production technology'. Following previous works (Marrocu et al. 2001; Marrocu et al., 2012) to overcome those problems this paper follows the so-called 'quasi-growth accounting approach' that consists in estimating factor endowment elasticities rather than imposing them.

For the estimation of the TFP we use as dependent variable the Value added in constant prices (VA) in millions of Euros for each Italian region (i=20) by the years 1977-2006 (for a description of data see also Table 1A in the Appendix). The data come from the database of the Italian Centre for North South Economic Research (CRENoS). The capital stock (K) is calculated by using the perpetual inventory method assuming a depreciation rate, δ, as constant. The initial capital stock is calculated as $K_0 = I_0/(g+\delta)$, where g is the average annual growth of investment expenditure and I_0 is investment expenditure in the first year for which data on investment expenditures are available. Pissarides and Vallanti (2007) apply a depreciation rate of 8%, however, their work is based on national data – a panel of OECD countries- while the present work is applied to regional data. Therefore, we decide to follow the recent work of Marrocu et al. (2012) on EU regions that use a depreciation rate of 10%. Data on investment expenditures in million of Euros are derived from the database of the Italian National Institute of Statistics (ISTAT). The units of labor in thousands (L) come from the Labor Force Survey of ISTAT.

In this study, TFP is computed by the estimation of the following Cobb-Douglas production function:

$$\ln(VA_{it}) = a_i + \alpha \ln(K_{it}) + \beta \ln(L_{it}) + \delta_t + u_{it} \qquad (7)$$

where i = 1, …20; t = 1977, …2003 (27 years); VA is value added, K is capital stock, L are units of labor, δ_t are time dummies and u_{it} is the error term. On average, the estimated coefficient for K and L are, respectively, 0.38 and 0.61. Those values are consistent with recent findings on Italy using the pure growth accounting approach (see for instance Byrne et al., 2009). Furthermore, the sum of the coefficients close to the unity implies constant return to scale.

At this point, we test the properties of value added, capital stock and labor by applying panel unit root tests in order to avoid spurious correlation problems. Specifically, we test non-stationarity of our variables by using three types of panel unit root tests: Levin-Lin-Chu (LLC, 2002) that tests the null hypothesis of the presence of unit roots in homogenous panel and assumes that all series are stationary under the alternative; Im-Pesaran-Shin (IPS; 2003) that tests the hypothesis of presence of unit roots in heterogeneous panel and it allows for individual effect, time trends, and common time effect (unlike LLC, IPS is consistent under the alternative that only a fraction of the series is stationary[1]); and finally Fisher test that performs a unit-root test on each panel series separately, next it combines the p-values to get an overall test of whether the panel series contains a unit root (Baltagi, 2013)[2]. As it can be seen from column 1, 2 and 3 of Table 2A in the Appendix, in the majority of cases the series are non-stationary in the levels but stationary in the first difference. Following the results of the tests, the next step is to check whether there is a statistically acceptable cointegration relationship between the variables of interest. In order to do that, the test developed by Pedroni (1999) is applied. The test performs seven statistics, four are within-dimension statistics (panel v-stat; panel rho-stat; panel pp-stat; panel adf-stat) and three are between-dimension statistics (group rho-stat; group pp-stat; group adf-stat). The four within–dimension statistics are based on pooling the autoregressive coefficients across the different regions for the unit root tests on the estimated residuals, while the three between-dimension statistics are based on estimators that simply average the individual estimated coefficients for each region. The null hypothesis of all seven tests is no cointegration. The application of the tests to equation 7 above indicates that five out of seven statistics are in favor of cointegration (see Table 3A).

4.2 *The second step: the impact of TFP on employment*

The structural employment basic equation is represented by equation 6 (see Section 2). Because of the impossibility to have a long time series for job creation and job destruction, we estimate a single equation for employment, as in Pissarides and Vallanti (2007). As a consequence, job creation and job destruction depend on the same variables, which are the level of marginal product (proxied by the level of TFP and the level of the capital-labor ratio), the wage rate level and the expected rates of growth of both the marginal product and the wage rate (both proxied by the rate of TFP growth). Since the Wooldridge test (2002) indicates the presence of serial correlation we include the lag of the dependent variable among the regressors.[3] The estimated basic dynamic model is as follows:

$$\ln(EMP)_{it} = a + \alpha_1 \ln(EMP)_{it-1} + \alpha_2 ln(EMP)_{it-2} + \alpha_3 lnk^*_{it} + \alpha_4 \, ln\, w^*_{it} + \alpha_5 lnTFP_{it} + \alpha_6 \, dlnTFP_{it} + \alpha_7 dlnTFP_{it-1} + \eta_i + \delta_t + u_{it} \qquad (8)$$

All variables are expressed in logarithm terms. EMP_{it} is the ratio of total employment to working age population (L/P) for region i at time t; EMP_{it-1} and EMP_{it-2} are the lags of the dependent variable; lnk_{it}^* is the ratio of capital stock to working age population; lnw_{it}^* is the real cost of labor; $lnTFP_{it}$ is the level of TFP; $dlnTFP_{it}$ is the TFP growth rate; $dlnTFP_{it-1}$ is the lag of the TFP growth rate; η_i and δ_t are, respectively, region and time fixed effects that are included to remove common employment trends and cycles and u_{it} is the error term.

[1] See help of Stata version 12.
[2] See also Stata command xtunitroot.
[3] Wooldridge test for autocorrelation in panel data.
H0: no first-order autocorrelation
F(1, 19) = 225.022
Prob > F = 0.0000

A further technical step implies to check whether employment rate is stationary (α>1) or if it has a unit roots (α=1). The presence of unit roots would indicate that possible shocks to the employment rate are permanent; in this case, using OLS would provide efficient estimates. Conversely, if the process is stationary, the use of OLS would give biased results. Since the tests indicate no stationarity (see last column of Table 2.A) we can use an OLS estimator.

It is important to clarify that in the original model of Pissarides and Vallanti (2007) three simultaneous equations are estimated by using a three stages least square estimator (TSLS), in the first equation the employment rate is the endogenous while in the other two the endogenous are, respectively, wages and capital. In the present paper, the required data for the equation related to wages -such as union coverage, benefit replacement ratio, benefit duration and tax wedge- do not exist or are not available at regional level; the same occurs for data needed for the capital equation (interest rate). To overcome this problem we decide to perform IV two stage least squares (IV2SLS) instrumenting both wages and capital stock by using one-year lag of the same variables. It is worth noting that this method has been already used in the literature (see Marrocu and Paci, 2012).

For the estimation of the effect of the TFP on employment rate, as in Pissarides and Vallanti (2007), the dependent variable is the log of employment rate (*ln*(*EMP*)) calculated as the ratio of employment (L) to working age population (P). The units of labor in thousands (L) come from the Labor Force Survey of the Italian National Institute of Statistics (ISTAT), whereas data on working population in thousands (P) comes from the dataset of the Cambridge Ecometrics (Table 1A in the Appendix). The other variables are: W, Real labor cost (nominal wage/GDP deflator) that come, respectively from Cambridge Econometrics EUROSTAT; TFP that come from the computation in the previous step (Table 1A in the Appendix).

5. Results

Results of the estimation are reported in Tables 1, 2, 3 and 4. Time dummies are introduced in all of the models to remove the common trends and cycles in the regions of the sample, thus avoiding spurious correlations due to these co-movements. As explained in section 4.2, the dependent variable is the log of employment rate (*lnEMP*) calculated as the ratio of employment to working age population. The independent variables are: one and two years lag of the dependent variable ($lnEMP_{t-1}$ and $lnEMP_{t-2}$); the level of TFP (*lnTFP*); the rate of growth of TFP ($dlnTFP$ $dlnTFP_{-1}$); the level of the capital-labor ratio (*lnk*) and the real cost of labor (*lnw)*, which have been both instrumented by using one year lag.

Table 1 in the first column shows the results for the whole sample. The overall model indicates that the impact of TFP growth (*dlnTFP*) on employment is negative in the short run. This result is in line with Pissarides and Vallanti (2007), even though we find a stronger effect (-0.21) respect to that found by the authors for EU countries including US and Japan (-0.084). [4] Unlike Pissarides and Vallanti, however, we do not find any significant effect in the long run.

[4] Excluding Greece and Spain.

[TABLE 1 HERE]

Since the descriptive analysis unveils possibilities of structural breaks due to labor market reforms, the model is then re-estimated considering four time periods (columns 2-5 of Table 1): 1978-1983 (period of no reform); 1984-1989 (reforms in 1983, 1984; 1986); 1990-1995 (reforms in 1991, 1993, 1994); 1996-2001 (reforms in 1995, 1997, 1998).[5] As evidenced from the second model of Table 1, in the first sub-period (1978-1983), TFP growth has a positive effect on employment both, in the short and long run (to determine what happens in the long run, we sum the coefficient of *dlnTFP* with the coefficient of $dlnTFP_{-1}$). Those results indicate that during the first sub-period, capitalization effect prevails. It seems that job destruction starts in the subsequent periods, specifically in 1984-1989 and in 1990-1995 (columns 3 and 4 of Table 1).

Tables 2-4 show the results of the same models of Table 1 performed including interactions dummies of TFP, respectively for the North ($lnTFP_{North}$, $dlnTFP_{North}$, $dlnTFP_{North-1}$, Table 2), for the Center ($lnTFP_{Center}$, $dlnTFP_{Center}$, $dlnTFP_{Center-1}$, Table 3) and for the South ($lnTFP_{South}$, $dlnTFP_{South}$, $dlnTFP_{South-1}$, Table 4). Table 2 confirms that the job destruction in the short run does not seem typical of the Northern regions (column 1). Furthermore, looking at the different sub-periods (columns 2-5) emerges that job destruction in the country as a whole strongly appears in the third period (1990-1995) in which even the long run impact of the TFP growth on employment is negative and significant, indeed summing *dlnTFP* and $dlnTFP_{-1}$ in column 4 the long run impact is -1.07. Furthermore, comparing the same period in Table 4 (column 4), the overall effect in 1990-1995 seems to be driven by the South (see $dlnTFP_{South}$ and $dlnTFP_{South-1}$) since the North shows a positive short run effect of TFP growth on employment (see $dlnTFP_{North}$ in Table 2 and column 4). According to Lasinio and Vallanti (2013) this positive impact on employment is a direct effect of labor market reforms adopted in this period, which boost labor productivity especially in manufacturing and high skilled sectors mostly located in the North.

On average in the region located in the center no effect is found. Moreover, in the last sub-period (1996-2001) something change, the Northern regions where the most manufacturing industries locate show strong signal of crisis, indeed the TFP growth has a negative impact in the long run (-0.33, column 5 in Table 2). This effect could be the result of the crisis of the industrial districts located in the North that reinforced in the second half of the nineties (Banca d'Italia, 2011). Conversely, in the Southern regions the long run impact turns to be positive (+0.43, column 5 in Table 4) and it is probably due to the positive dynamic of exportations of some industrial district located in the South (for instance textile and apparel sector increases by 7.9%, furniture and related products increase by 12%; Banca d'Italia, 2011).

[TABLE 2-4 HERE]

[5] Unfortunately, we cannot investigate the relevance of those breaks by means of a panel cointegration on the TFP-employment relationship because it requires that the two variables are integrated of the same order, which is not our case.

The results obtained so far show a short-run negative effect of productivity growth on employment. It means that in Italy during the time span 1977-2003 job destruction effect prevails in the short run, on the contrary long run effect is not significant. Furthermore, analyzing more in depth the time span considering the labor market legislation changes**,** we find that in the first sub-period (1979-1983) the relationship is positive and capitalization effect prevails both in the short and in the long run. However, starting from the second half of the eighties the relationship turns to be negative and job destruction effect prevails in the short run.

Controlling also for the productivity for macro areas, findings suggest that in the first half of the nineties (1990-1995) in the North prevails job creation and in the South job destruction, both in the long run; while in the second half of the nineties (1996-2001) occurs the opposite, in the South prevails job creation while in the North job destruction.

6. Specialization and diversity index and spatial spillovers

In this section we extend the analysis to take into account the effect of various forms of spatial spillovers on employment such as specialization and diversity externalities and productivity spatial spillover.

According to Glaeser et al. (1992), local employment dynamics may depend on various type of spillovers generated by the agglomeration of firms in the city/region. Precisely, they refer to three types of spillovers: specialization spillovers (Marshall-Arrow-Romer externalities or MAR; respectively 1890; 1962; 1986); competition spillovers (Porter externalities; 1990); and diversity spillovers (Jacobian externalities; 1969).

MAR spillovers arise from knowledge sharing of firms of the same sector (intra-industry agglomeration). The main argument is that spillovers such as the possibility of sharing ideas, information, infrastructures, services and suitable labor force (local labor pool argument) boost innovation and generate increasing returns to scale. On the same line of MAR, Porter considers intra-industry local competition as a strong incentive for firm innovation. Unlike MAR and Porter, Jacobs advocates the agglomeration of different sectors (inter-industry agglomeration) as the way to boost imitation, innovation, transmission of ideas and therefore local growth.

In empirical studies, three types of indexes are used to measures such type of spillovers: specialization index, diversity index and competition index. For unavailability of data over the time span under analysis, this work can introduce only the first two. The specialization index we used is the location quotient, which is the common measure of specialization externalities. Specifically, we calculate the quota of industry employment in a region relative to the national share such as:

$$Spec_{ijt} = \frac{L_{ijt} / \sum_{jt}^{3} L_{ijt}}{\sum_{it}^{20} L_{ijt} / \sum_{it}^{20} \sum_{jt}^{3} L_{ij}} \tag{9}$$

where L represents the number of employees, i the specific region (out of the total 20 regions in Italy), j the sectors (the three macro sectors such as industry, agriculture and services), and t the time span (1977-2003).

The diversity index is calculated using the classical Herfindal concentration index (HCI) modified according to Combes (2000) and Marrocu et al. (2012). Precisely, as suggested by (Combes, 2000) the index is calculated as sum of squares of the ratio of employment in all sectors excluding the industry in a given region and the difference between the total employment in that region (all the sectors together) and the total employment in the industry for the same region. As in Marrocu et al. (2012) we use the inversed index in order to simplify the interpretation of the results. The index is as follows:

$$Div_{ijt} = \frac{1}{\sum_{j't=1;j'\neq j}^{3} \left(\frac{L_{ij't}}{L_{it}-L_{ijt}}\right)^2} \quad (10)$$

Besides, another type of spatial spillover controls whether productivity/technology (TFP) of one region affects the employment of neighboring regions. This type of spatial spillover is detected by using a spatial lagged explanatory variable model (SLX) suggested by LeSage and Pace (2009), LeSAge (2014), Elhorst (2010) and Vega and Elhorst (2013). All other "classical" spatial models such as spatial lag model (SAR), spatial error model (SEM), spatially lagged dependent variable plus spatially autocorrelated error term model (SAC), spatial Durbin lagged model (SDM), are all criticized (LeSAge and Pace, 2011; 2014; Elhorst 2010; Vega and Elhorst, 2013; Gibbons and Overman, 2012) on the line of that they measure global spatial spillover rather than local. Besides, the use of some models, such as for instance, the SDM is discussed for identification problems since endogenous and exogenous interaction effects cannot be distinguished from each other (Gibbons and Overman, 2012). As a consequence, SLX model is considered the simplest way to account only for specific local spillover such as in the present work. Besides, another advantage is the possibility to use standard estimation techniques rather than specific spatial estimators (LeSage, 2014, Vega and Elhorst, 2013).

Therefore, the basic model (column 1 of Table 1) is then re-estimated considering also externalities and spatial effects. The model is as follows:

$$\ln(EMP)_{it} = a + \alpha_1 \ln(EMP)_{it-1} + \alpha_2 ln(EMP)_{it-2} + \alpha_3 lnk^*_{it} + \alpha_4\, ln\, w^*_{it} + \alpha_5 lnTFP_{it} + \alpha_6\, dlnTFP_{it} + \alpha_7 dlnTFP_{it-1} + \alpha_8 spec_{i,t} + \alpha_9 div_{i,t} + \alpha_{10} WTFP_{i,t} + \eta_i + \delta_t + u_{it} \quad (11)$$

where the new terms are: $spec_{i,t}$ that is the specialization index for region i at time t; $div_{i,t}$ that is the diversity index for region i at time t; and $WTFP_{i,t}$ that is the spatial weight matrix (the square of the inverse distance matrix) of the TFP.

Results in Table 5 confirm the stability of the coefficient and the sign of TFP growth, the persistency of employment and the positive role on employment rate in Italy of specialization and diversity externalities (column 2 and 3 of Table 5). Albeit our study is not directly comparable with other studies on the role of agglomeration externalities on employment growth or TFP growth since we are interested in analyzing the effect of economic growth (measured by the TFP) on employment rate, we find that the sign of specialization externality is in line with Cingano and Schivardi (2004) and Cainelli et al. (2014) for the case of Italy, and Marrocu et al. (2012) for European regions. However, unlike Cingano and Schivardi (2004) and Marrocu et al. (2012) but in line with Cainelli et al. (2014), we find that also diversity externalities have a positive and robust impact even though much lower than specialization externalities. This might due to the predominance of mature capital-goods industries over high tech industries in Italy as found by Henderson et al. (1995) for US.

Another form of spatial externality has been controlled by means of the spatial weight matrix of the TFP. As far as we know this is the first time that this type of spatial externalities has been used in such way. The negative coefficient of the variable WTFP (column 3 of Table 5) indicates that an increase of TFP in one region will reduce employment in neighboring regions and pull new labor force into the region experiencing the increase. As robust check on the last model we apply a set of tests for presence of spatial correlation of the residuals. Specifically, we perform Moran I test pooling the data together and also more recent tests proposed by Baltagi, Song, Jung and Koh (BSJK, 2007) for panel data regression models with spatial and serial error correlation. All tests confirm the absence of spatial correlation and that the fixed effect estimation is the best model.

[TABLE 5 HERE]

7. Conclusions

Equilibrium models of employment imply that the effects of faster growth can be either positive or negative and that they depend on the extent to which new technology is embodied in new jobs. This paper investigates what occurs in Italy during the time span 1977-2003 when some waves of labor market reforms have been introduced towards more flexibility. We also study whether there are any systematic regional differences in the employment /productivity dynamics and if those dynamics are affected by any sort of spatial externalities. To do that, we extend the Pissarides and Vallanti model (2007) by including various types of spillovers such as specialization and diversity externalities. Spatial spillovers of productivity are then investigated by means of spatial lagged explanatory variable model (SLX).

The obtained results shed lights on the impact of labor market regulation in the country as a whole and on the dynamic/reactions/competitions of the macro areas in Italy (North, Centre and South). Specifically, for the whole country and over the whole period under analysis the impact of the TFP on employment in Italy is negative in the short run. Unlike previous works based on different countries, we do not find any impact in the long run. However, when the time period is divided according to labor market reforms, the picture becomes more interesting: in the first sub-period (1979-1983) -where no reform is adopted -job creation prevails both in the short and in the long run; but when the deregulation of the labor market starts and reinforces –in 1984-1989 and in 1990-1995- job destruction prevails and long run effects completely disappear. Those results confirm very recent studies according to which labor market deregulation in Italy -incentivizing temporary jobs-decreases labor productivity in all sectors with a higher effect on those sectors using low skilled workers (Lasinio and Vallanti, 2013). It is like to say that those reforms in some way have interfered with the allocation of employment towards less productive firms/sectors (Manasse and Manfredi, 2014).

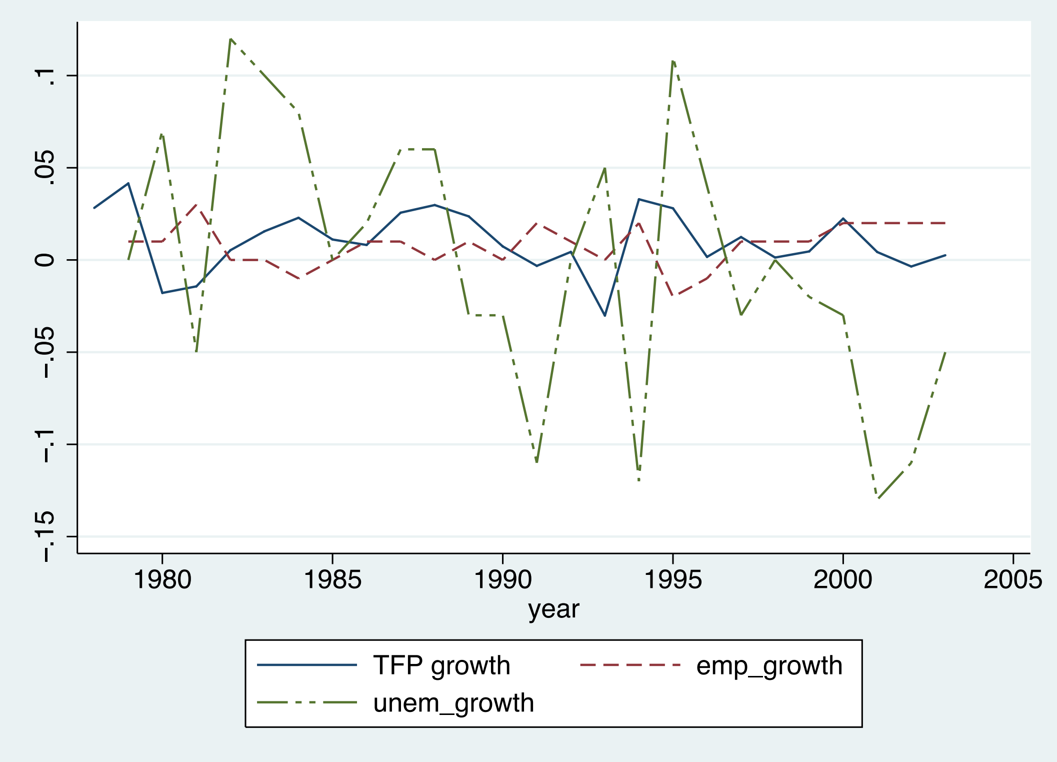
When considering the difference between macro areas, findings suggest that until the end of eighties there is no specific regional effect. Since the beginning of the nineties, in the Northern regions prevails job creation while in the Southern job destruction – both are short run effects. In the last sub-period (1996-2001) the situation reverses: in the North prevails job destruction while in the South prevails job creation. While the negative performances of the Northern regions reflect the crisis of industrial districts, the positive outcomes of the South can be explained by positive dynamics of exportations of some manufacturing sectors such as textile, apparel, furniture and so on (Banca d'Italia, 2011).

When controlling for spatial spillovers, we find that specialization and diversity externalities have both a positive effect on employment with stronger intensity of specialization, as typical of economies in which mature capital-goods industries prevails over high-tech industries.

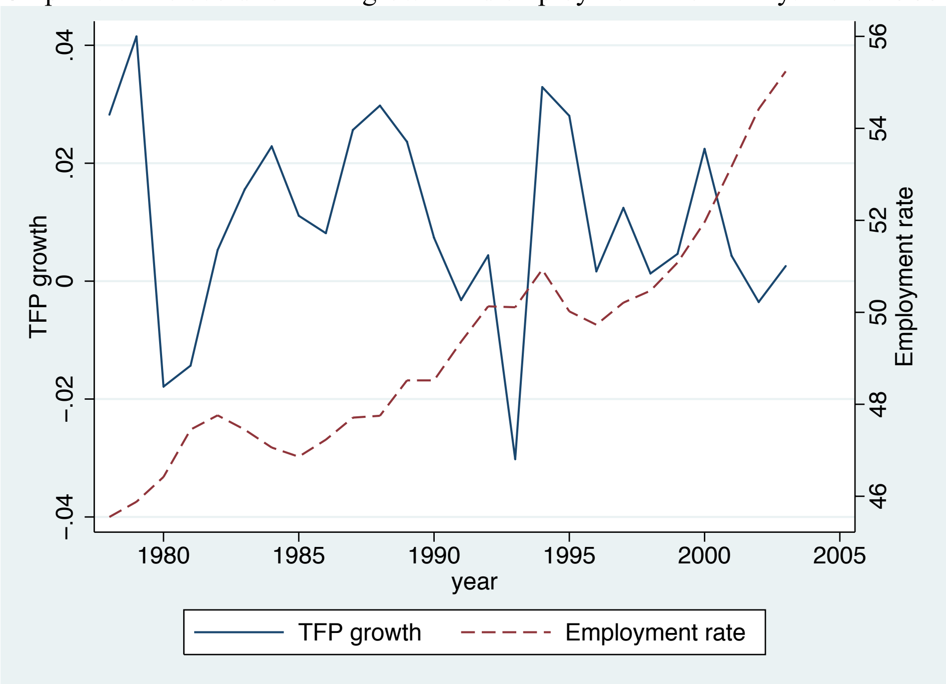
Finally, the spatial relationship of regional productivity has a negative impact on employment suggesting the presence of regional competition - *i.e.* when the productivity of one region grows the employment of neighboring regions decreases.

The results obtained for Italy confirm the importance to analyze this topic at regional level to better understand the employment/productivity dynamics that emerge in different contexts. Further extensions, beyond the scope of this paper, could go towards analyzing whether the impact of productivity on employment changes by worker skills and sectors to see whether and to what extent the labor market flexibility adopted in Italy encourages firms to hire low skill workers that are also less able to adapt to technological change.

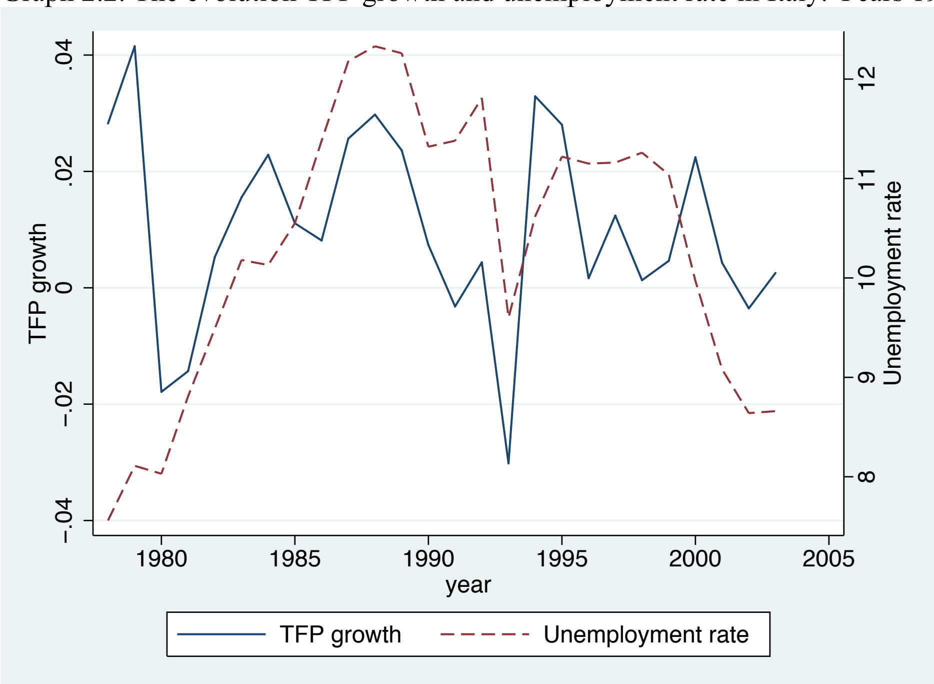
Graph 1. The evolution TFP, employment and unemployment growth in Italy. Years 1977-2003.



Graph 2.1. The evolution TFP growth and employment rate in Italy. Years 1977-2003.

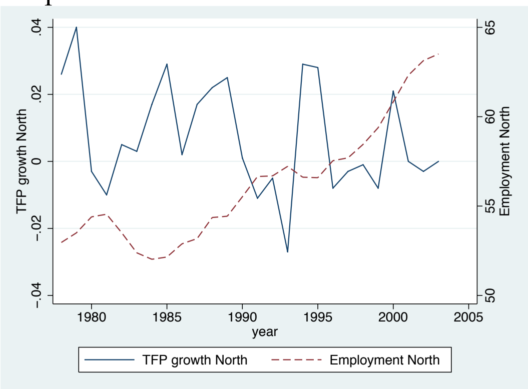


Graph 2.2. The evolution TFP growth and unemployment rate in Italy. Years 1977-2003.

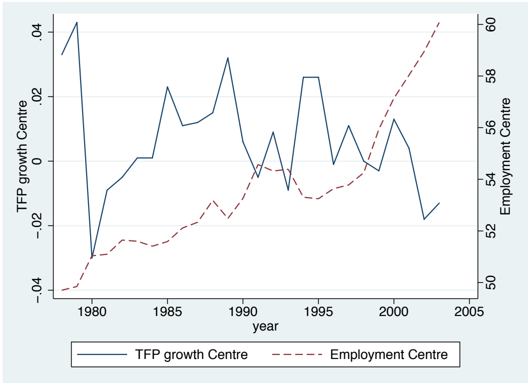


The evolution TFP growth and employment rate in the macro areas of Italy. Years 1977-2003.

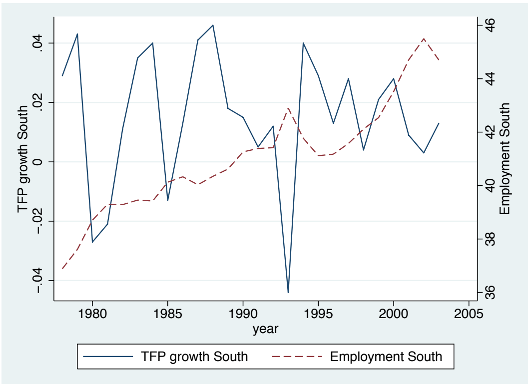
Graph 3.1 North



Graph 3.2 Centre

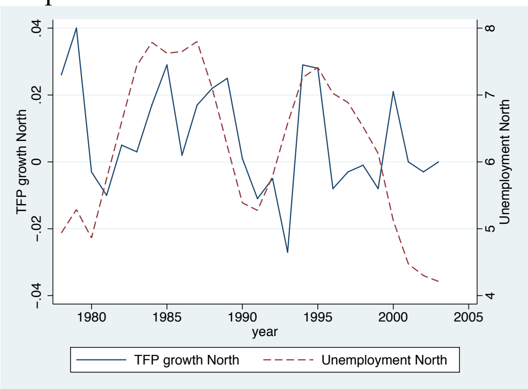


Graph 3.3. South

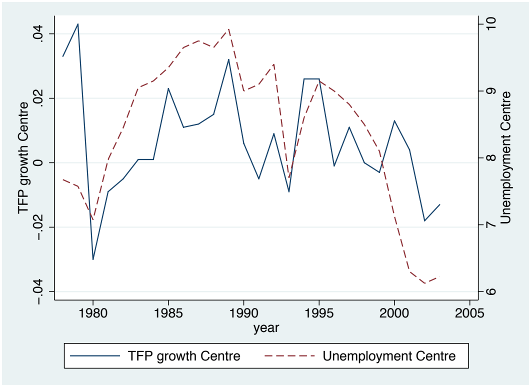


The evolution TFP growth and unemployment rate in the macro areas of Italy. Years 1977-2003.

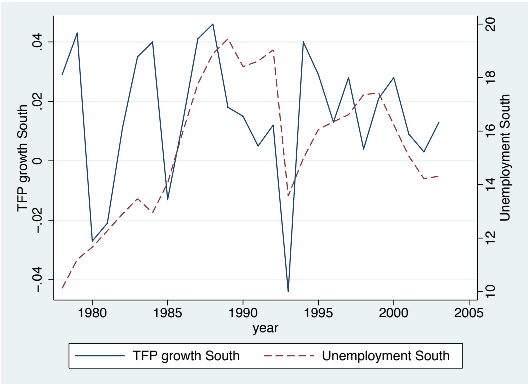
Graph 4.1 North



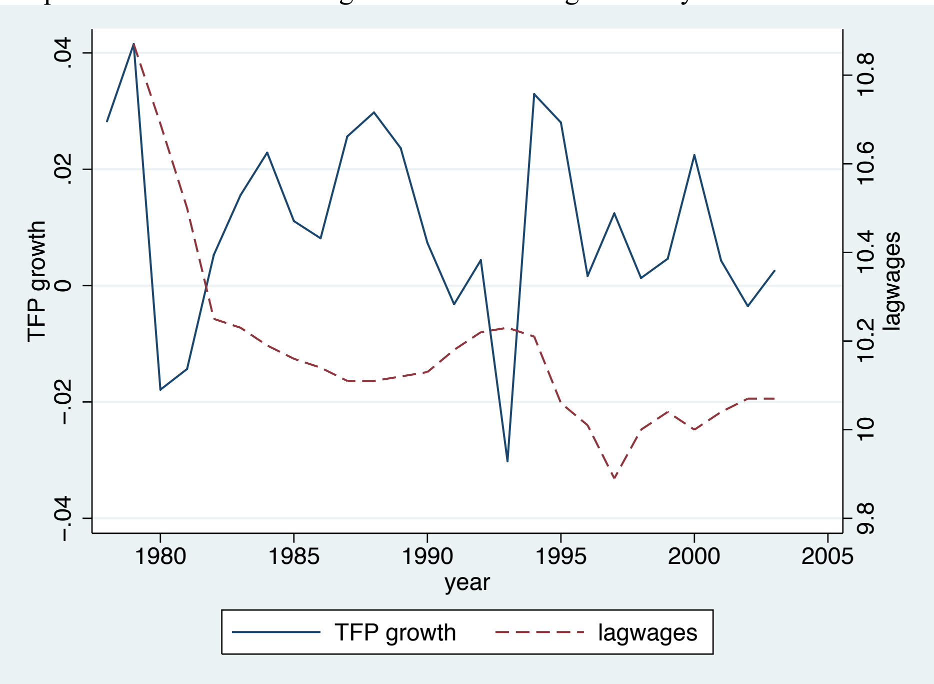
Graph 4.2 Centre



Graph 4.3 South

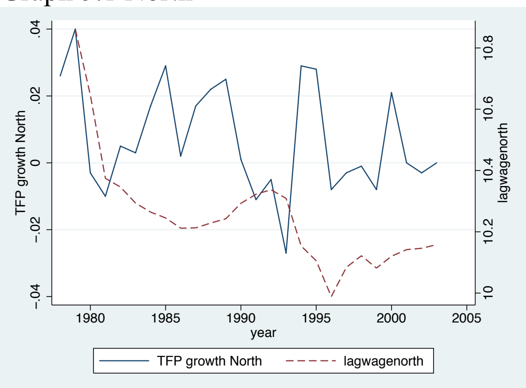


Graph 5. The evolution TFP growth and real wages in Italy. Years 1977-2003.

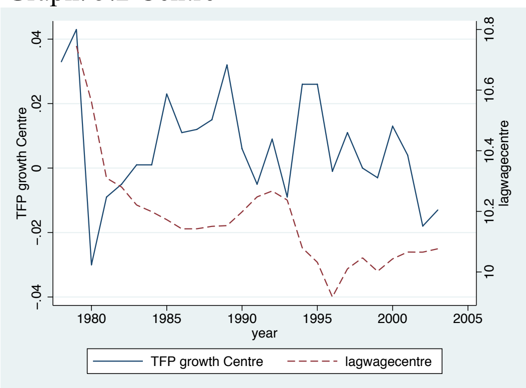


The evolution TFP growth and real wages in the macro areas of Italy. Years 1977-2003.

Graph 5.1 North



Graph. 5.2 Centre



Graph 5.3. South

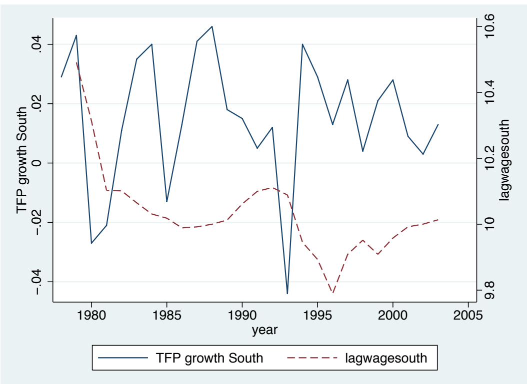


Table 1. 2SLS Estimation. The effect of TFP on employment. Dependent variable: Employment rate (lnEMP)

VARIABLES	(1) 1977-2003	(2) 1979-1983	(3) 1984-1989	(4) 1990-1995	(5) 1996-2001
lnwages#	-0.021	0.46***	0.023	-0.42	-0.19
	(0.041)	(0.17)	(0.17)	(0.39)	(0.19)
lnk#	-0.012	-0.020	-0.10**	-0.11	-0.11*
	(0.0090)	(0.056)	(0.043)	(0.088)	(0.064)
$lnEMP_{-1}$	0.86***	0.55***	0.43***	0.69***	0.30***
	(0.048)	(0.11)	(0.095)	(0.10)	(0.11)
$lnEMP_{-2}$	-0.078*	-0.41***	-0.16*	-0.054	-0.10
	(0.047)	(0.14)	(0.085)	(0.12)	(0.099)
lnTFP	-0.014	-0.18**	-0.15	0.15	-0.16**
	(0.019)	(0.079)	(0.097)	(0.098)	(0.077)
dlnTFP	-0.21***	0.16**	-0.17*	-0.47***	-0.073
	(0.035)	(0.080)	(0.089)	(0.12)	(0.066)
$dlnTFP_{-1}$	0.018	0.18**	0.078	-0.096	0.013
	(0.036)	(0.075)	(0.078)	(0.11)	(0.068)
year dummies	yes	yes	yes	yes	yes
Constant	1.30***	-0.034	4.60**	5.78	7.30**
	(0.49)	(2.13)	(2.03)	(4.34)	(2.95)
Observations	500	120	120	120	120
Number of code	20	20	20	20	20

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
# instrumented variables (the instruments used are all the exogenous variables in the regression and lags of the endogenous

Table 2. 2SLS Estimation. The effect of TFP on employment adding interaction terms (North).
Dependent variable: Employment rate (lnEMP)

VARIABLES	(1) 1977-2003	(2) 1979-1983	(3) 1984-1989	(4) 1990-1995	(5) 1996-2001
lnwages#	0.0084	0.42**	-0.064	-0.82**	-0.050
	(0.042)	(0.17)	(0.18)	(0.41)	(0.19)
lnk#	-0.025***	-0.014	-0.17***	-0.22**	-0.18***
	(0.0097)	(0.059)	(0.048)	(0.095)	(0.069)
$lnEMP_{-1}$	0.84***	0.55***	0.37***	0.62***	0.30***
	(0.048)	(0.11)	(0.098)	(0.11)	(0.11)
$lnEMP_{-2}$	-0.059	-0.42***	-0.16*	0.13	-0.13
	(0.047)	(0.13)	(0.083)	(0.13)	(0.100)
lnTFP	-0.053**	-0.12	-0.26***	0.23**	-0.33***
	(0.021)	(0.099)	(0.10)	(0.12)	(0.11)
dlnTFP	-0.19***	0.20**	-0.10	-0.75***	-0.074
	(0.041)	(0.090)	(0.10)	(0.15)	(0.093)
$dlnTFP_{-1}$	0.0078	0.13	0.089	-0.32**	0.20**
	(0.041)	(0.082)	(0.084)	(0.13)	(0.097)
$lnTFP_{North}$	0.097***	-0.16	0.30***	0.053	0.42**
	(0.027)	(0.13)	(0.10)	(0.16)	(0.19)
$dlnTFP_{North}$	---------------	-0.17	-0.13	0.42***	-0.044
	(0.062)	(0.14)	(0.15)	(0.16)	(0.16)
$dlnTFP_{North-1}$	0.049	0.14	-0.027	0.18	-0.33**
	(0.061)	(0.14)	(0.15)	(0.17)	(0.15)
year dummies	yes	yes	yes	yes	yes
	(0.020)	(0.065)			
Constant	1.16**	0.42	6.38***	9.94**	6.72**
	(0.49)	(2.08)	(2.12)	(4.49)	(2.84)
Observations	500	120	120	120	120
Number of code	20	20	20	20	20

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
# instrumented variables (the instruments used are all the exogenous variables in the regression and lags of the endogenous variables)

Table 3. 2SLS Estimation. The effect of TFP on employment adding interaction terms (Center).
Dependent variable: Employment rate (lnEMP)

VARIABLES	(1) 1977-2003	(2) 1979-1983	(3) 1984-1989	(4) 1990-1995	(5) 1996-2001
lnwages#	-0.018	0.49***	0.016	-0.40	-0.22
	(0.041)	(0.17)	(0.17)	(0.42)	(0.19)
lnk#	-0.013	-0.018	-0.10**	-0.11	-0.11*
	(0.0092)	(0.057)	(0.045)	(0.088)	(0.064)
$lnEMP_{-1}$	0.86***	0.55***	0.42***	0.69***	0.29**
	(0.048)	(0.11)	(0.096)	(0.10)	(0.12)
$lnEMP_{-2}$	-0.076	-0.42***	-0.15*	-0.058	-0.073
	(0.047)	(0.14)	(0.085)	(0.12)	(0.10)
lnTFP	-0.016	-0.16*	-0.16*	0.14	-0.16**
	(0.019)	(0.081)	(0.098)	(0.11)	(0.079)
dlnTFP	-0.21***	0.16*	-0.19**	-0.46***	-0.093
	(0.036)	(0.082)	(0.092)	(0.13)	(0.069)
$dlnTFP_{-1}$	0.028	0.18**	0.090	-0.092	0.032
	(0.037)	(0.078)	(0.084)	(0.11)	(0.072)
$lnTFP_{Center}$	0.014	-0.37	-0.10	-0.023	-0.018
	(0.032)	(0.25)	(0.15)	(0.29)	(0.26)
$dlnTFP_{Center}$	-0.016	0.090	0.26	0.090	0.15
	(0.090)	(0.19)	(0.24)	(0.37)	(0.24)
$dlnTFP_{Center-1}$	-0.093	-0.087	0.021	0.043	-0.17
	(0.088)	(0.18)	(0.22)	(0.33)	(0.22)
year dummies	yes	yes	yes	yes	yes
Constant	1.26***	-0.020	4.86**	5.63	7.58**
	(0.49)	(2.15)	(2.07)	(4.65)	(3.00)
Observations	500	120	120	120	120
Number of code	20	20	20	20	20

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
# instrumented variables (the instruments used are all the exogenous variables in the regression and lags of the endogenous variables)

Table 4. 2SLS Estimation. The effect of TFP on employment adding interaction terms (South).
Dependent variable: Employment rate (lnEMP)

VARIABLES	(1) 1977-2003	(2) 1979-1983	(3) 1984-1989	(4) 1990-1995	(5) 1996-2001
$lnwages^{\#}$	0.045	0.43***	0.027	-0.64*	-0.067
	(0.045)	(0.17)	(0.18)	(0.38)	(0.20)
$lnk^{\#}$	-0.037***	-0.0056	-0.19***	-0.22***	-0.18***
	(0.011)	(0.057)	(0.054)	(0.080)	(0.066)
$lnEMP_{-1}$	0.83***	0.54***	0.35***	0.62***	0.26**
	(0.048)	(0.11)	(0.10)	(0.10)	(0.11)
$lnEMP_{-2}$	-0.059	-0.42***	-0.16*	0.13	-0.074
	(0.047)	(0.13)	(0.085)	(0.12)	(0.10)
lnTFP	0.045**	-0.30***	0.022	0.21*	0.040
	(0.023)	(0.097)	(0.12)	(0.11)	(0.14)
dlnTFP	-0.23***	0.081	-0.19	-0.26**	-0.092
	(0.047)	(0.11)	(0.12)	(0.12)	(0.11)
$dlnTFP_{-1}$	0.020	0.21*	0.032	-0.063	-0.14
	(0.048)	(0.11)	(0.12)	(0.15)	(0.087)
$lnTFP_{South}$	-0.13***	0.22*	-0.29**	-0.045	-0.40**
	(0.030)	(0.13)	(0.11)	(0.16)	(0.20)
$dlnTFP_{South}$	0.070	0.12	0.038	-0.46***	-0.069
	(0.061)	(0.13)	(0.15)	(0.16)	(0.17)
$dlnTFP_{South-1}$	0.018	-0.080	0.065	-0.25*	0.43***
	(0.059)	(0.13)	(0.15)	(0.15)	(0.14)
year dummies	yes	yes	yes	yes	yes
	(0.022)	(0.064)			
Constant	0.89*	0.38	5.38**	8.55**	6.60**
	(0.50)	(2.06)	(2.11)	(3.97)	(2.74)
Observations	500	120	120	120	120
Number of code	20	20	20	20	20

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
# instrumented variables (the instruments used are all the exogenous variables in the regression and lags of the endogenous variables)

Table 5. 2SLS The effect of TFP on employment: agglomeration externalities. Dependent variable: Employment rate. Years 1977-2003.

VARIABLES	(1) basic model	(2) basic model with indexes	(3) basic model with indexes and spatial TFP
Lnwages#	-0.021	-0.0061	-0.0059
	(0.041)	(0.042)	(0.041)
lnk#	-0.012	-0.014	-0.013
	(0.0090)	(0.0090)	(0.0090)
$lnEMP_{-1}$	0.86***	0.86***	0.85***
	(0.048)	(0.048)	(0.048)
$lnEMP_{-2}$	-0.078*	-0.074	-0.071
	(0.047)	(0.046)	(0.046)
lnTFP	-0.014	-0.0094	0.0013
	(0.019)	(0.019)	(0.019)
dlnTFP	-0.21***	-0.21***	-0.21***
	(0.035)	(0.035)	(0.035)
$dlnTFP_{-1}$	0.018	0.024	0.023
	(0.036)	(0.036)	(0.035)
Spec_index		4.18*	4.27**
		(2.16)	(2.16)
Diver_ index		0.042**	0.040**
		(0.020)	(0.020)
WTFP			-0.035**
			(0.018)
year dummies	yes	yes	yes
Constant	1.30***	3.62***	3.79***
	(0.49)	(1.35)	(1.35)
Observations	500	500	500
Number of code	20	20	20
Moran I test on residuals (pool data)			*0.50*
P-value			*0.31*
BSJK conditional test1 (panel data)			*0.04*
P-value			*0.83*
BSJK conditional test2 (panel data)			*0.90*

P-value	*0.34*
BSJK conditional joint test (panel data)	*0.04*
P-value	*0.79*

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
# instrumented variables (the instruments used are all the exogenous variables in the regression and lags of the endogenous variables)

Appendix

Table 1.A. Data sources and definitions

Variable	Short name	Source	Definition	Description
Value added	VA	National Institute of Statistics (ISTAT)	Million of euros	At constant price
Capital stock	K	Own calculation derived from investment expenditure by ISTAT	Million of euros	Perpetual inventory method, the depreciation rate, δ, is assumed constant and equal to 10%. Initial capital stock is calculated as $K_0=I_0/(g+\delta)$
Units of labor	L	Labour Force Survey by ISTAT	Thousands	
Total Factor Productivity	TFP	Own estimation		
Wage	W	real wage: nominal wage Cambridge Econometrics, GDP deflator EUROSTAT.	Thousands of euros	
Working age population	P	Cambridge Econometrics	Thousands	

Table 2A. Unit root tests. Value added (VA), Capital (K), Labor (L) and Employment rate (EMP)

	VA	K	L	EMP
LLC				
Level	0.58	0.76	0.16	1.83
Diff	-7.68***	-4.09***	-4.56***	-9.41***
IPS				
Level	5.61	2.25	2.23	-0.47
Diff	-9.52***	-3.30***	-7.64***	-4.29***.
Fisher-DF				
Level	7.55	50.68	25.69	29.20
Diff	-222.37***	-79.16***	-148.85***	227***
Fisher_PP				
Level	22.19	372.42***	33.43	20.58
Diff	-334.29***	-59.40***	-387.24***	326***

Notes: *, ** and *** denotes the 1 %, 5% and 10 % significance level respectively. All variables are in logs. LLC
H0 in all tests: the series are not stationary.

Table 3.A Pedroni and panel cointegration test (VA, K, L)

Statistics	Value
panel v-stat	1.937**
panel rho-stat	-1.271
panel pp-stat	-2.732***
panel adf-stat	-2.720***
group rho-stat	0.106
group pp-stat	-2.402***
group adf-stat	-2.718***

Notes: *, ** and *** denotes the 1 %, 5% and 10 % significance level respectively. Critical values at 1%, 5% and 10% are -2.328,-1.645 and -1.282 respectively.
Nsecs = 20 , Tperiods = 27 , no. regressors = 2
All reported values are distributed N(0,1)
Ho in all tests: no cointegration.
Panel stats are weighted by long run variances.

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Finito di stampare nel mese di Giugno 2015
Presso Centro Stampa dell'Università degli Studi di Cagliari
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