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# *Labour-Market Reforms and the Beveridge Curve. Some Macro Evidence for Italy*

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**Abstract**

A matching theory approach is utilised to assess the impact on the Italian labour market of the 1997 *legge Treu*, which considerably eased the regulation of temporary work and favoured its growth in Italy. We re-parameterise the matching function as a Beveridge Curve and estimate it as a production frontier, finding huge differences in matching efficiency between the South and the rest of the country. The *legge Treu* appears to have improved matching efficiency in the North of the country, particularly for skilled workers, but also to have strengthened competition among skilled and unskilled workers, especially in the South.

**JEL Classification**: J64, J69, C24

**Keywords**: temporary contracts, matching efficiency, regional disparities

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# Contents

## 1. Introduction

During the last two decades European countries have enacted a liberalisation of employment protection regulations in order to combat their high rates of unemployment. Italy is no exception to this. According to the OECD (1994, 2000), Italy used to be, together with Spain, one of the countries with higher labour market rigidity within the OECD. Quite recently, the situation underwent some change: labour legislation was modified, and non-standard work regulation converged to the levels of other European countries (see Table 1). As a result, the share of temporary over total employment in Italy has changed from 5.4% in 1983 to 7.8% in 1997 to 10% in 2000 (OECD, 2000).

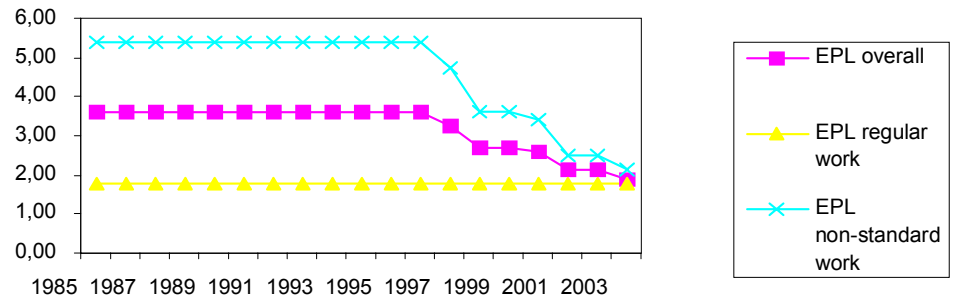
**Table 1** - Overall strictness of regulation on non-standard employment

| | 1990 | 1998 | 2003 |
|---|---|---|---|
| Austria | 1.5 | 1.5 | 1.5 |
| Belgium | 4.6 | 2.6 | 2.6 |
| Denmark | 3.1 | 1.4 | 1.4 |
| Finland | 1.9 | 1.9 | 1.9 |
| France | 3.1 | 3.6 | 3.6 |
| Germany | 3.8 | 2.3 | 1.8 |
| Ireland | 0.3 | 0.3 | 0.6 |
| Italy | 5.4 | 3.6 | 2.1 |
| Netherlands | 2.4 | 1.2 | 1.2 |
| Portugal | 3.4 | 3.0 | 2.8 |
| Spain | 3.8 | 3.3 | 3.5 |
| Sweden | 4.1 | 1.6 | 1.6 |
| U.K. | 0.3 | 0.3 | 0.4 |

*Source:* OECD Employment Outlook 2004.

More in detail, we observe from Figure 1 a very important drop in the strictness of regulation right after 1997, from a value of 5.4 to 2.1 in 2003 (OECD Employment Outlook, 2004).

**Figure 1** - EPL in Italy: source OECD Employment outlook 2004




It can be safely surmised that this drop in the strictness of regulation is to be mainly ascribed to the so-called Treu Act (*legge Treu*, a law which considerably liberalised the temporary work agency employment from 1997 and favoured its growth in Italy). As is well known, the literature includes claims both to the effect that higher labour market flexibility can help job creation (Bertola et al., 1999), and that job security is helpful in containing job destruction and obtaining smooth consumption (Pissarides, 2001; Bertola, 2004). In the last two decades, a very rich literature (both theoretical and empirical) developed from the matching theory proposed in Pissarides (1990, 2000). In this literature, labour market transactions are supposed to be characterised by high costs and co-ordination problems, originating difficulties in the matching between jobs and workers and bringing about the existence in the same labour market of unemployment and vacancies. Hence the interest of the framework for the Italian labour market, well known for being characterised by serious regional and skill mismatch (Sestito, 1991a; Brunello et al., 2001).

This paper aims to investigate to what extent the Treu Act has affected the unemployment-vacancy relationship across regional and skill labour markets. Indeed, with higher flexibility, both hirings and firings could be easier for the firm, with an ambiguous final effect on labour market tightness. As job turnover increases, labour market tightness may fall or rise depending on different heterogeneities across jobs, regions and workers: shifts in the Beveridge Curve may subsequently be indeterminate. Although the Treu Act elicited considerable

interest in the press and among labour market participants, there has not been so far extensive scientific work on its effects (we provide, in Section 2, a concise review of this literature).

Our work is also of some interest since the unemployment-vacancy relationship has been very seldom analysed in the Italian literature, mainly because of the lack of official vacancy data, and no estimates of the Beveridge Curve basically exist after 1990. We adopt a fairly recent empirical approach. The matching function, re-parameterised as a Beveridge Curve, is modelled and estimated as a production frontier. In empirical labour economics the efficiency of labour markets has often been analysed through matching functions. Furthermore, the interpretation of the matching function as a production function is quite common, and some research has been devoted to unveiling the micro foundations of this ”black box” (Petrongolo and Pissarides, 2001). However, only recently the matching function has been used for analysing matching efficiency with the tools of production frontier analysis (after the seminal contribution of Warren, 1991, see Fahr and Sunde, 2002, 2005, for Germany; Ilmakunnas and Pesola, 2003, for Finland; Ibourk *et al*., 2004, for France).

Here we apply this relatively novel technique on Italian data, with the effects of the Treu Act as a main focus of interest. We concentrate on quarterly data the 1992-2001 period, adopting two different measures for vacancies, the ISFOL-CSA help-wanted ads collected from some important daily newspapers and the ISAE labour scarcity indicator. The paper has the following structure. Section 2 provides a fairly brief account of the main features of the Treu Act, as well as of the existing literature relating to it. Section 3 considers the relationships between matching functions and production frontiers, while the Italian empirical literature on the Beveridge Curve is surveyed in Section 4. The empirical specification and the data are presented in Section 5. The results are commented in Section 6. Section 7 contains some concluding remarks.

## 2. The Treu Act: Main Features and Implications

One of the major recent structural changes that affected OECD economies is the advent of some previously uncommon forms of job relationships (part-time, temporary employment, fixed-term contracts, ...).[1] The label of non-standard employment has often been used to cover all these "new" types of employment, which share the characteristic of differing from what was usually defined standard employment: a job with a full-time, open-ended and secure contract. In Italy the growth of non-standard employment has become important only very recently. It is widely believed that the Italian labour legislation evolving during the 1960s and the 1970s produced a system characterised by important hiring and firing costs (Bertola and Ichino, 1995). The most decisive legislative step in favour of non-standard employment has been the Law 196/1997, the so-called Treu Act (*legge Treu*, by the name of the then minister of Labour and Welfare, Tiziano Treu). In particular,[2] the Treu Act made temporary work agencies legal (Law 196/1997, articles 1-11). The Act, whose actual implementation took place in the second half of 1998, brought about a decisive growth in the number of temporary workers: they were already 250,000 in 1999 and 470,000 in 2000 (Confinterim, 2000). Temporary, fixed-term, employment quickly expanded, particularly in manufacturing and in the more developed Northern regions of Italy. The impact of the Treu Act on the diffusion of non-standard employment naturally calls for an evaluation of the economic and social effects of this new institution.

There is a spreading literature which analyses the implications of short-term contracts for unemployment (Saint-Paul, 1996; Adam and Canziani, 1998; Wasmer, 1999). An important intuition relates to the screening device role of fixed-term contracts (Jovanovic, 1979, 1984). They should allow employers to observe the productivity of the job-worker pair during a maximum probation period, improving matching efficiency. An obvious question, which has already been analysed in a few Italian studies (Centra *et al*., 2001; Ministero del Lavoro e della Previdenza Sociale, 2001, pp. 123-125; Nannicini, 2004a, 2004b; Ichino *et*

[1] See on this Felstead and Jewson (1999).
[2] The Treu Act also contained some items on the regulation of on-the-job training for workers aged between 16 and 32 (Law 196/1997, articles 15-16), extending previous changes in this field.

*al*., 2005) is whether temporary work leads to some kind of permanent job relationship. Nannicini finds that industries that have used temporary employment more intensively experienced an after-liberalisation drop of their share of permanent employment. Ichino *et al*. rely on data from temporary work agencies and evaluate the determinants of the transition from temporary to permanent employment in two Italian regions, Tuscany and Sicily. They find a higher probability of transition for Tuscany. Closer to our focus is the study of Centra *et al*., analysing temporary work through regional and skill labour markets. They find that temporary work has a higher probability to become permanent in regions where the rate of unemployment is lower.[3]

The above works mostly focus on the following question: which is the stronger among the greater flexibility implied by temporary work (increasing the chance for unemployed to find jobs) and the higher probability of a subsequent job separation? More generally, it can be asked whether temporary work brings in the formal labour market workers previously excluded from it, or if it urges firms that previously would have not posted a vacancy to post one. Finally, temporary work could intensify competition among skilled and unskilled workers. The evaluation of the latter phenomena calls for a macroeconometric assessment of the Treu Act, in the sense of Calmfors (1994) and Calmfors and Skedinger (1995). A relatively novel and interesting approach to this kind of assessment involves the modelling and estimation of matching functions. Such is the goal of our paper, which starkly differs in this sense from the works reviewed in this section.

## 3. Matching Functions and Production Frontiers

According to the matching function approach, firms (jobs) and workers can match each other only with some delay (this account is largely based on Pissarides, 1990, 2000). New matches between workers and jobs produce new hirings, a process which can be described by the following function:

[3] Other Italian studies focusing on the nature of the relationships between temporary work agencies, employers and workers are Anastasia et al. (2001), Iacus and Porro (2002), Montanino and Sestito (2003).

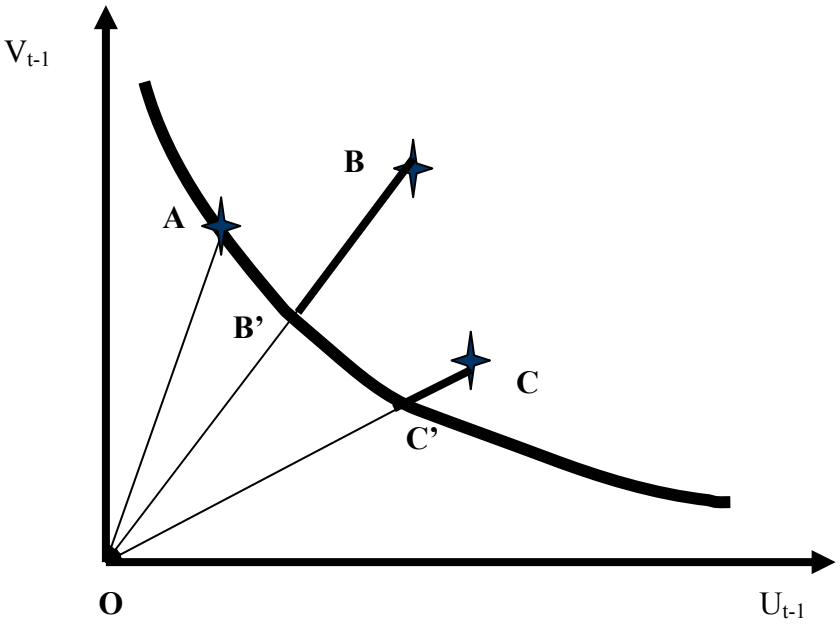
(1) $H_{it} = h\,(U_{it-1}, V_{it-1})\, e_{it}$

where *i* are the units defining the labour market (areas, industries, occupations, …), *t* is the time period, H are hirings, U the number of job-seekers (here proxied by the unemployed) and V the number of vacancies. Higher levels of $e_{it}$, usually defined in the literature as the efficiency term, bring about higher $H_{it}$ levels, for given $U_{it-1}$ and $V_{it-1}$ stocks. This term is influenced by the search intensity of firms and workers, by the effectiveness of search channels, by the labour mismatch across micro markets defined over areas, industries or skills. Obviously, it is extremely important to ascertain whether $e_{it}$ varies across time and categories.

Some interesting contributions have been appearing in the empirical analysis of the matching function, which exploit the deep conceptual and analytical resemblance between this function and the commonly adopted production function. Consider again equation (1). If the estimation of this function concentrates upon the term $e_{it}$, its evolution and its determinants, then the analysis can profit of the methodologies developed in the field of the stochastic production frontiers (see in particular Kumbhakar and Lovell, 2000).

Stochastic production frontiers are based on the assumption that the technical efficiency of a productive unit is measured by the distance between the input and output mixes observed for the unit itself and the input and output mixes on the point of the production frontier relevant for the observed unit. In the case of the matching function, consider Figure 2, where various mixes of $U_{t-1}$ and $V_{t-1}$, all of them capable of producing the output $H_t$ ($H_{0t}$), are considered along an isoquant.

**Figure 2 –** The Matching Function as an Isoquant




Obviously, the $U_{t-1}$ and $V_{t-1}$ combinations on the isoquant are efficient points. For each value of $U_{t-1}$ on the isoquant they single out the minimum $V_{t-1}$ value consistent with obtaining $H_{0t}$, and conversely for each $U_{t-1}$ value. It will always be possible to obtain $H_{0t}$ for $U_{t-1}$ and $V_{t-1}$ values higher than those on the isoquant, but this will not be technically efficient. Then, both points B and C are inefficient, while A is technically efficient. Adopting the measure of technical efficiency proposed in Farrell (1957), that is the largest radial input contraction consistent with obtaining a given output (in this case $H_{0t}$), the technical efficiency of C is OC'/OC, that of B is OB'/OB and that of A is OA/OA. The latter, being fully efficient, has an efficiency score equal to one. On the other hand, the technical efficiency of C is higher than that of B, which is situated further away from the isoquant.

The literature treating matching functions within the frontier approach is still rather recent. The seminal contribution is Warren (1991). Three much more recent studies have been carried out for European countries. All these studies share the assumption of a Cobb-Douglas functional form for the matching function. They fundamentally differ for the data-sets utilised and the variables considered in the explanation of inefficiency.

Ibourk *et al*. (2004) consider monthly data for the 22 French regions from March 1990 to February 1995, including in the estimates (beside a linear trend), a considerable number of potential determinants for inefficiency. They find wide regional differences in efficiency and a decline in efficiency over the time period considered. The hypothesis of constant returns to scale for the matching function is not rejected. The potential efficiency determinants considered in Ibourk et al. (2004) explain about 30% of the variability in efficiency (across both time and space). Interestingly, the decline occurring in open-end contracts over the time period considered has apparently little impact on hirings.

Ilmakunnas and Pesola (2003) consider annual data for the 14 Finnish regions from 1988 to 1997. They too include in the estimates a linear trend and allow for some potential determinants of inefficiency. Among the latter of particular interest are the average unemployment and vacancy rates of the neighbouring regions. The authors believe that in this way allowance can be made for the spillover effects highlighted by Burda and Profit (1996), Burgess and Profit (2001). Indeed, the average unemployment and vacancy rates of the neighbouring regions enter significantly and with the expected signs in the estimates (the average unemployment rate of the neighbouring regions has a negative impact on efficiency, while the average vacancy rate has a positive impact).

The analysis by Fahr and Sunde (2002) is based upon two different sets of German annual data, relating to the occupational as well as to the territorial dimension of matching. In the first case 117 local labour markets are considered from 1980 to 1997. In the second case data are taken from 1980 to 1995 for 82 occupational groups. The results suggest that, both across areas and occupations, wide efficiency differentials exist. Furthermore, like in the two studies surveyed above, average efficiency seems to decrease over time. Fahr and Sunde (2005) carry out a more detailed analysis of the efficiency of the matching process in Western Germany using the same data, shedding new light on potential determinants of search frictions and on the consequences of German reunification for the matching process.

## 4. Vacancies and Unemployment in Italy. The Empirical Literature

In Italy there are no official data on vacancies. However, there are two ongoing surveys allowing the empirical appraisal of the relationship between vacancies and unemployment, also over a regional dimension. The CSA (Centro di Studi Aziendali, Florence) and the ISFOL, Rome, carry out a survey on the help-wanted ads published in some important daily newspapers. Another data source relates to the quarterly business survey undertaken by ISAE (formerly ISCO) in manufacturing. Among other things, firms are asked whether the scarcity of labour prevents them from expanding their activity. Furthermore, until 1999 it was also possible to utilise another (administrative) source: the data from the Ministry of Labour (*Ministero del Lavoro e della Previdenza Sociale*) relating to the vacancy notices posted by firms (usually firms only posted these notices when they already had actually decided upon the hiring).

Perhaps because of the absence of official data on vacancies, not many studies have examined in Italy the nature and evolution of the Beveridge Curve. Sestito (1988) and Bragato (1990) utilise the ISFOL-CSA data on vacancies, and find a significant relationship between unemployment and vacancies only in the presence of a growing linear trend. Bragato (1990) also finds a significant Beveridge Curve for the North and the Centre, but not for the South. A significant difference between the Southern labour market and the rest of the country also shows up in Sestito (1991b), where vacancies are measured using the data from the ISAE survey. In this case, however, no linear trend has to be included in the estimates to find a significant relationship between unemployment and vacancies. The analysis in Di Monte (1992) is based on a similar econometric specification, but utilises the Ministry of Labour data on vacancies. The main difference in the results obtained by Di Monte relative to previous evidence is that a significant Beveridge Curve also shows up for the South. More recent evidence is provided by Mocavini and Paliotta (2000), who examine Beveridge Curve plots based on the ISFOL-CSA data, and by Destefanis and Fonseca (2004). Only in the latter study a direct comparison of the three vacancy indicators is carried out, obtaining,

at least as far as the 1990s are concerned, substantially consistent results. The recent evidence is largely similar to the previous one. A Beveridge Curve shows up also in the 1990s, with some outer shift over this period.

## 5. The Econometric Analysis: Empirical Specification and Data

### *5.1 The Model*

The simple dynamic specification of (1) contrasts with the sometimes complex dynamic structure of the relationship between vacancies and unemployment (see for instance the Beveridge Curves reviewed in Section 4). In order to facilitate the empirical search for an appropriate dynamic specification, we re-parameterise the matching function as a Beveridge Curve. This also has the advantage of making our estimates easier to compare with previous Italian evidence. In order to re-parameterise the matching function as a Beveridge Curve we must assume constant returns to scale for the matching function and the existence of a steady state with constant average rate of unemployment. It is commonly believed that these assumptions are not particularly restrictive. Under the hypothesis of constant returns to scale, equation (1) becomes:

(2) $H_{it} / U_{it-1} = h\,(V_{it-1} / U_{it-1})\, e_{it}$

In its turn, this function can be rewritten as:

(3) $(H_{it} / N_{it-1})\,[\,(L_{it-1} / U_{it-1}) - 1\,] = h\,[\,(V_{it-1} / L_{it-1}) / (U_{it-1} / L_{it-1})\,]\, e_{it}$

In a steady state with constant rate of unemployment, the hiring rate $(H_{it} / N_{it-1})$ is equal to $s + g$, where $s$ is the separation rate and $g$ is the rate of growth in the labour force, $L$. Hence (3) becomes an inverse relationship between the unemployment and the vacancy rates, the Beveridge Curve, whose position depends on $s$, $g$, and $e_{it}$. The interpretation of the last term does not change vis-à-

vis (1); however empirical measures of efficiency will reflect the evolution not only of $e_{it}$, but also of *s* and *g*. Below, we keep this in mind when interpreting our results, and provide some evidence on the evolution of *s* and *g* in our sample (we cannot include these variables in our estimates as we do not have quarterly measures for the separation rate).

In order to understand better the structure of our empirical analysis, consider now, for simplicity, the following Cobb-Douglas specification:

$$(4)\quad u_{it} = \beta_1 u_{it-1} + \beta_2 v_{it} + \beta_3 v_{it-1} + \mathbf{z}_{it}\boldsymbol{\gamma} + \delta_{i1} + \delta_{i2}\, t + \delta_{i3}\, t^2 + \delta_{i4}\, t^3 + \tau_i\, TREU_t + \varepsilon_{it}$$

where $i = 1, \ldots N$, stands for the territorial area, and $t = 1, \ldots T$, for the time period (quarter). We posit a simple fixed-effects Auto Regressive-Distributed Lags (1, 1) specification; $u_{it}$ is the natural log of the unemployment rate, $v_{it}$ the natural log of the vacancy rate; *t* a time trend; $\mathbf{z}_{it}$ a vector of variables potentially determining the technical efficiency of observation *i* at time *t*; $TREU_t$ a term standing for the impact of the Treu Act (whose nature shall be clarified in the following section); $\varepsilon_{it}$ a stochastic variable assumed to be *iid. N (0,* $\sigma_\varepsilon^2$*)*; $\boldsymbol{\beta}$, $\boldsymbol{\gamma}$and $\boldsymbol{\delta}$ are parameter vectors. We assume, developing upon the approaches proposed in Cornwell *et al*. (1990) and Papke (1994), that the technical efficiency of observation *i* follows an idiosyncratic function of time, and may also depend on some variables $\mathbf{z}_{it}$.[4] In order to choose the latter, we mostly rely on the suggestions made in previous papers (Fahr and Sunde, 2002, 2005; Ilmakunnas and Pesola, 2003; Ibourk *et al*., 2004).

There are various econometric issues involved in the estimation of (4). First of all, it could be asked whether the hypothesis of common $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ coefficients made in (4) is actually borne out by the data. Another issue relates to the structure of the disturbances. In pooled cross-section time-series datasets, it is likely that different units exhibit idiosyncratic residual variances (a phenomenon known as

[4] We are aware that the role of the **z** variables is usually modelled through the maximum likelihood approach suggested in Kumbhakar et al. (1991), Battese and Coelli (1995). However, that approach cannot accommodate the presence of a lagged dependent variable, as its assumption of no correlation between error terms and regressors fails in this case.

groupwise heteroskedasticity). It is also likely that residuals are contemporaneously correlated across units, a phenomenon initially highlighted within the Seemingly Unrelated Regressions models. In order to rely on the proper standard errors for inference, the existence of these two phenomena must be put to test and eventually taken into account. Finally, there is the issue of dynamic specification. The dynamic structure of (4) is arguably too simple for quarterly data. A proper dynamic specification search should be carried out to take care of this feature, something which can be properly done within the general-to-specific approach promoted by Davidson *et al*. (1978). There may be concern in this ambit for the presence of small-sample biases in the autoregressive coefficients. However, the time-period considered should be long enough (35 quarters) to make this problem unlikely.[5]

In order to deal with all these issues, we take as starting point of the empirical analysis the following general specification:

$$(5)\quad u_{it} = \beta_{i1}u_{it-1} + \ldots + \beta_{i4}u_{it-4} + \beta_{i5}v_{it} + \ldots + \beta_{i9}v_{it-4} + \mathbf{z}_{it-1}\boldsymbol{\gamma}_i + \\ + \delta_{i1} + \delta_{i2}\,t + \delta_{i3}\,t^2 + \delta_{i4}\,t^3 + \tau_i\,TREU_t + \varepsilon_{it}$$

In (5) there are four lags for both unemployment and vacancy rates (a specification usually believed to be sufficiently rich for quarterly data; our sample size does not permit an equally high lag-order for the $z_{it}$ variables, which enter the equation with a one-quarter lag), and slope coefficients can freely vary across regions.

Taking (5) as a benchmark, we can easily test for equal slopes across regions for the $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$ coefficients, a restriction which yields the following specification:

$$(5')\quad u_{it} = \beta_{1}u_{it-1} + \ldots + \beta_{4}u_{it-4} + \beta_{5}v_{it} + \ldots + \beta_{9}v_{it-4} + \mathbf{z}_{it-1}\boldsymbol{\gamma} + \\ + \delta_{i1} + \delta_{i2}\,t + \delta_{i3}\,t^2 + \delta_{i4}\,t^3 + \tau_i\,TREU_t + \varepsilon_{it}$$

[5] In any case, the usual GMM-based approaches to this issue are barred by the smallness of *N* in our case (as we explain below, our level of territorial disaggregation is constrained by the vacancy measures).

Besides positing equal slopes across regions for the $\beta$ and $\gamma$ coefficients, we can also put to test a more parsimonious dynamic structure, yielding for instance the specifications in Tables A.3-A.5, to which we shall subsequently refer as (5''). Bearing in mind the above considerations, (5), as well as its restricted versions, should be estimated through a fixed-effects feasible GLS procedure that can allow for groupwise-heteroskedastic and contemporaneously correlated residuals.

Finally, following common practice, technical efficiency for observation *i* at time *t* can be calculated through:[6]

$$(6)\quad TE_{it} = \exp\{\max_{i}(\mathbf{z}_{it-1}\hat{\gamma} + \hat{\delta}_{i1} + \hat{\delta}_{i2}\,t + \hat{\delta}_{i3}\,t^2 + \hat{\delta}_{i4}\,t^3 + \hat{\tau}_{i}\,TREU_t) - (\mathbf{z}_{it-1}\hat{\gamma} + \hat{\delta}_{i1} + \hat{\delta}_{i2}\,t + \hat{\delta}_{i3}\,t^2 + \hat{\delta}_{i4}\,t^3 + \hat{\tau}_{i}\,TREU_t)\}$$

*5.2 The Data*

The main data source used is the quarterly Labour Force Survey from ISTAT (*Indagine trimestrale sulle forze di lavoro*). This survey involves every quarter about 200,000 persons in 1,400 municipalities from all over the country. In particular, individual data from 1992:4 to 2001:2 are utilised to measure stocks of unemployed and labour force for the three main areas of Italy (North, Centre, South).

With a view to getting as much information as possible from the data, we also focus on their skill dimension. We retain two skill categories: skilled and unskilled. These categories are defined as in the Labour Force Survey. We consider as skilled the labour force with university or (non-vocational) high-school diploma and as unskilled the rest of the labour force.[7] Relying on this segmentation of the labour force we calculate unemployment rates relating not only to the whole labour force, but also to the skilled and the unskilled labour

[6] For the sake of simplicity, in (6) we posit equal slopes across regions for the $\gamma$ coefficients.

[7] More in detail, skilled workers have post-degree, degree or pre-superior studies (*Dottorato di ricerca o Specializzazione post-laurea*, *Laurea*, *Diploma universitario o Laurea breve*, *Diploma di maturità*), while unskilled workers have professional, secondary, primary or no studies (*Diploma di qualifica professionale - corso di 2-3 anni che non permette l'accesso all'università*, *Licenza media inferiore*, *Licenza elementare*, *Nessun titolo*).

force (e.g. the skilled rate of unemployment is given by the ratio between the skilled unemployed and the skilled labour force).

We utilise data only from 1992:4 onwards because individual data are not previously available. These data are very important not only for the information they give on unemployment, but also for the construction of a series of potential determinants of matching efficiency. Following the works surveyed in Section 3, we considered variables controlling for search intensity, for discrimination or ranking effects, for firm or industry effects, and for other factors. All these potential determinants of efficiency are listed in Table 2.

**Table 2** – The potential efficiency determinants from the *Indagine trimestrale sulle forze di lavoro*, ISTAT

| *Factors* | *Variables* |
|---|---|
| | |
| **Search Intensity**<br>**Discrimination Effects**<br><br>**Ranking Effects** | share of unemployed less than 25 years of age<br>share of unemployed less than 35 years of age<br>share of unemployed more than 55 years of age<br>share of female unemployed<br>share of long-term unemployed |
| **Firm Effects**<br><br>**Industry Effects** | share of labour force in agriculture<br>share of labour force in industry<br>share of labour force in services<br>share of labour force in public administration |
| **Spillover Effects** | rates of unemployment of the other areas<br>rates of vacancy of the other areas |
| **Other Factors** | share of part-time employment<br>share of permanent contract employment |

As already said, we include in the estimates *TREU*, a term standing for the impact of the Treu Act. It is an indicator constructed using the information from Confinterim (various years). Knowing for the whole of Italy the number of temporary work contracts, it was possible to construct a variable equal to zero until 1998:2, and taking values of 0.2 for 1998:3 and 1998:4, of 0.4 for the year 1999, and of 1.0 from 2000:1 onwards (these values are roughly proportional to the actual numbers of temporary work contracts). No allowance was made for regional differences in the numbers of temporary work contracts, as they are more

or less stable through time.[8]

Focusing on the impact of the Treu Act means that it is highly desirable to extend as much as possible the sample after the second half of 1998. This implies relinquishing the Ministry of Labour vacancy indicator. We rely instead on the ISFOL help-wanted ads - divided by labour force[9] - and the ISAE indicator of labour scarcity. As regards the latter, we utilised in the estimates both its raw value and its transformation suggested in Sestito (1991b):

$$(7) \qquad G(ISAE) = \pi \times \Phi^{-1}(\pi) + f[\,\Phi^{-1}(\pi)\,]$$

where $\pi$ is the percentage of firms reporting that the scarcity of labour *does not* prevent them from expanding their activity, $\Phi^{-1}(\,.\,)$ is the inverse of a standardised normal distribution function and $f[\,.\,]$ is a standardised normal density function.

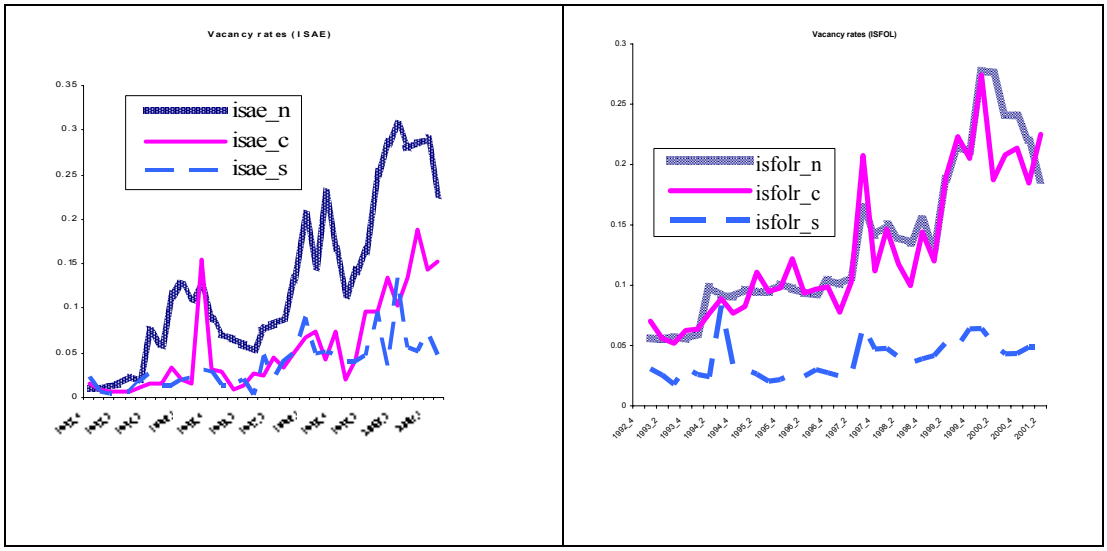
It should be kept in mind that both our vacancy indicators have some problems. Help-wanted ads mostly refer to skilled labour, while the ISAE survey relates to manufacturing only. Moreover the help-wanted ads are not currently available at a very fine level of territorial disaggregation (indicators are only produced for the three main areas: North, Centre and South). As we want to compare estimates obtained with both indicators, this effectively constrains the level of territorial disaggregation of our analysis.

It is instructive to consider in Figure 3 the evolution of the vacancy rate indicators.

[8] We also adopted the simpler approach of modelling the Treu Act through a binary variable equal to one from 1998:3 onwards. Furthermore, we allowed for the possibility that the Act could also affect the slopes of the vacancy terms. The data amply favoured the approach reported in the text. Results concerning the other specifications are not reported for the sake of brevity and are available upon request.

[9] When analysing the skilled and unskilled unemployment rates, we proceeded to divide correspondingly the help-wanted ads by the skilled and unskilled labour force.

**Figure 3 –** The Evolution of the Vacancy Rates in the Three Areas (annual means)




From 1998 onwards, vacancies increased markedly. This rise is especially strong in the North, less marked in the South (vis-à-vis the previous years), and is not likely to be explained by cyclical factors alone: the Italian labour market had already been picking up for some years (see ISTAT 2003, 2004). However, firm evidence on the impact of the Treu Act on vacancy supply requires a considerably more complex model than the one specified and estimated here (perhaps along the lines of Wasmer, 1999). In the Centre, the two vacancy indicators - while showing fairly different levels - have a similar evolution.

## 6. The Estimates

The basic econometric approach was to proceed to the estimation of models (5), (5') and (5'') through a fixed-effects feasible GLS procedure, testing the linear restrictions implied by the latter specifications and carrying out the appropriate diagnostic tests. When both tests for heteroskedasticity and contemporaneous correlation across areas turned out to be significant, we adopted an iterated GLS procedure (which yields ML estimates as long as the residuals are normal).

Before turning now to the evidence about the Treu Act, we provide some

general remarks about our results, which are presented in the Appendix. These results relate to a semi-log specification, which gave a better fit than the Cobb-Douglas (whose results were in any case broadly similar). We find for all vacancy indicators evidence largely favourable to the existence of a Beveridge Curve in the 1990s across the main territorial areas. There is however a ranking in the sense that estimates for unskilled and total rates of unemployment have higher fit than estimates for the skilled rate of unemployment.

The hypothesis of common $\beta$ and $\gamma$ coefficients across regions can never be rejected: see Table A.2, where we report both a traditional Chow test and a Wald test allowing for non-spherical residuals. Disturbances are always strongly groupwise heteroskedastic (while their variance does not seem to vary across time). Only when modelling the skilled rate of unemployment we find contemporaneously correlated residual across areas. As shown in Tables A.3-A.5, the other diagnostics (for serial correlation, normality, and omitted variables) are very comforting.

As far as the significance of the $z_{it}$ variables is concerned, only the share of labour force in industry (positive sign, especially significant for the unskilled), and the share of unemployed less than 25 years of age (negative sign, for the unskilled) reach some degree of significance (all the control variables listed in Table 2 were included one at the time, to provide a more powerful test). The signs indicate that efficiency is negatively related to the share of labour force in industry and the share of unemployed less than 25 years of age. The fact that other controls are not significant does not mean *per se* that these factors are not relevant. An obvious alternative interpretation of this result is that territorial disparities in these factors are sufficiently well caught by the regional fixed effects and trends. It is also noteworthy that our main results do not depend at all on the control variables, whose inclusion simply affects the fit of the equations.

Focusing now more closely on the impact of the Treu Act, let us first consider the evidence in Tables A.1 and A.2. We do not present in full the (rather cumbersome) specifications (5) and (5'), but single out the estimates for the $\tau_i$'s, the *TREU* coefficients. They show the basic message of our paper: the $\tau_i$'s are

negative in the North for skilled labour, but positive in the South for unskilled labour. Throughout the estimates (see tables A.3-A.5) we find much the same results, whose implication is clear. The Treu Act generally increases the efficiency of the northern labour market (through its impact on skilled labour), and decreases the efficiency of the southern labour market (through its impact on unskilled labour).

This is not the only difference showing up across areas. The Southern labour market turns out to be much less efficient than that of the other two areas. In Figures 4a-4b we depict for the 1993:4-2001:2 estimation period the technical efficiency scores for skilled, unskilled and total labour force. We represent only the scores obtained with the transformed ISAE and the ISFOL indicators, and exclude from the figures the scores for the North, which turn out to be always equal to one.

**Figure 4a - The Evolution of the Efficiency Scores (ISAE indicator)**

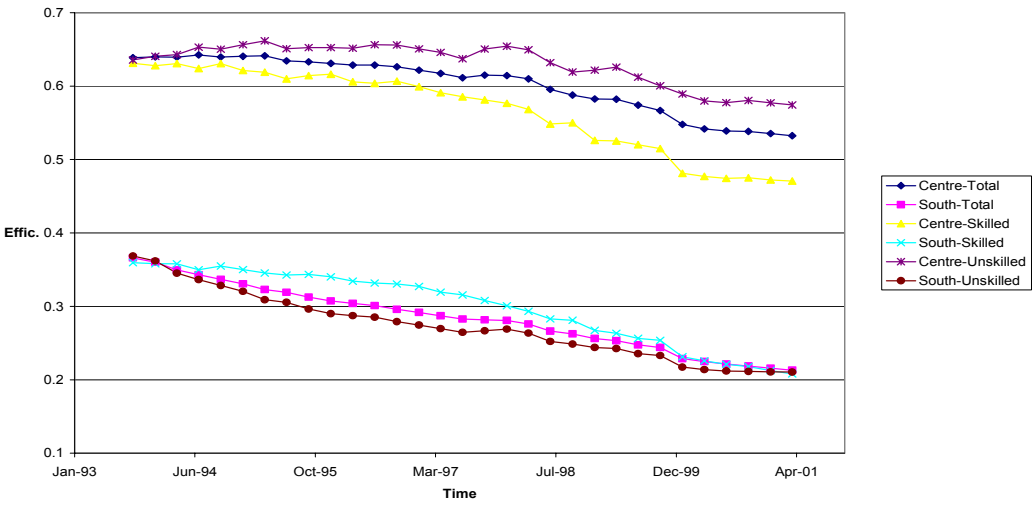
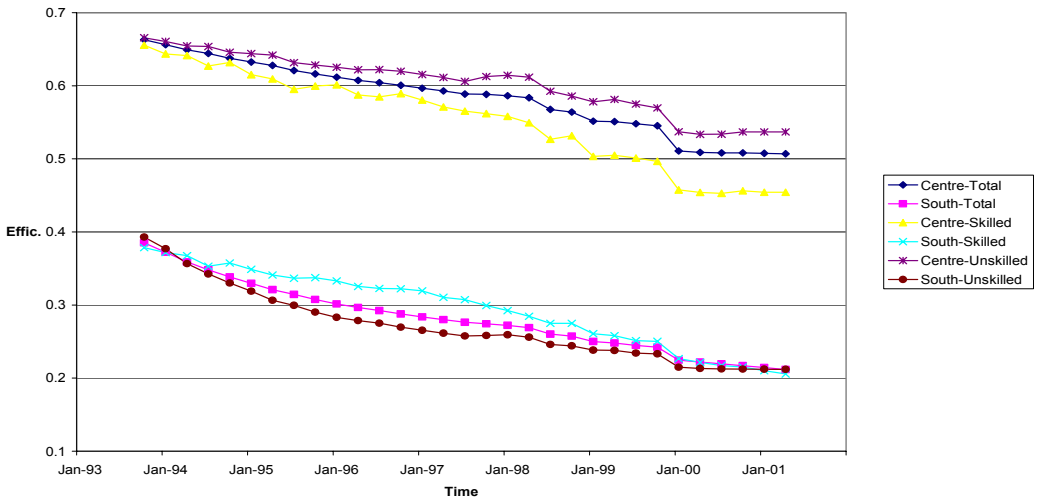


**Figure 4b - The Evolution of the Efficiency Scores (ISFOL indicator)**




Roughly speaking, technical efficiency for the total labour force varies from 60 to 50% in the Centre and from 35 to 20% in the South. Also technical efficiencies for the skilled and unskilled labour force experience similar reductions over the sample period. By construction, the technical efficiency of the central and southern labour markets is adversely affected by the increase of labour-market efficiency in the North following the Treu Act.

In order to gain further understanding of these results, consider Tables 4 and 5. In Table 4 we provide data for the annual rates of growth of the labour force throughout the whole sample, and for two periods immediately before and after the implementation of the Treu Act (1996-1998, 1998-2001). Naturally we consider separately the three areas (North, Centre, South) and the two skill levels.

**Table 4 –** Rates of Growth for Labour Force in the North, Centre, South

| | **Skilled LF** | | | | **Unskilled LF** | | | | **Total LF** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **N** | **C** | **S** | | **N** | **C** | **S** | | **N** | **C** | **S** |
| ***April 1993-April 2001*** | **0.057** | **0.042** | **0.045** | | **-0.017** | **-0.016** | **-0.011** | | **0.006** | **0.007** | **0.008** |
| ***April 1996-April 1998*** | **0.050** | **0.028** | **0.032** | | **-0.019** | **-0.018** | **-0.007** | | **0.005** | **0.002** | **0.007** |
| ***April 1998-April 2001*** | **0.044** | **0.043** | **0.045** | | **-0.007** | **-0.011** | **-0.014** | | **0.013** | **0.014** | **0.009** |
| | | | | | | | | | | | |
| | Source: our elaborations on ISTAT data | | | | | | | | | | |

It turns out that differences across areas are not large, especially if the total labour force is considered. Also, while the growth of the skilled labour forces before and after the Treu Act may explain at least some of the evolution in the relative labour-market efficiencies, the same is not true for unskilled and total labour force.

Consider now Table 5, where we provide, again across areas, some annual values for the separation rate taken from the work of Centra et al. (2001).

**Table 5 –** Separation Rates in the North, Centre, South

| | **N** | **C** | **S** |
|---|---|---|---|
| ***1994*** | **0.029** | **0.027** | **0.031** |
| ***1995*** | **0.028** | **0.027** | **0.030** |
| ***1996*** | **0.024** | **0.023** | **0.027** |
| ***1997*** | **0.026** | **0.023** | **0.023** |
| ***1998*** | **0.024** | **0.022** | **0.023** |
| ***1999*** | **0.021** | **0.024** | **0.026** |
| ***2000*** | **0.024** | **0.019** | **0.022** |
| ***2001*** | **n.a.** | **n.a.** | **n.a.** |
| | | | |
| | Source: Centra et al. (2001) | | |

There appears to be a decreasing trend for the separation rates across all areas. Differences across areas are even smaller than in Table 4, and comparing the rates before and after the Treu Act does not lead one to believe that the explanation for the positive sign on *TREU* in the South lies there.

As we do not find large regional differences in *s* and *g*, we feel entitled to interpret our results in terms of matching efficiency. Then, they suggest that the Treu Act brought about an improvement of matching efficiency in the North, especially for skilled labour, but had no favourable overall effect on the matching efficiency of the labour markets. For the South of Italy and for unskilled labour in particular, there is indeed some evidence of a reduction of matching efficiency. A possible interpretation of this result is that the Treu Act, while increasing the chance for unemployed to find jobs, intensified the job competition between skilled and unskilled unemployed in the South, through a strengthened ladder effect (Collard et al., 2003; Dolado et al., 2002). This explanation requires that

after the Treu Act, a higher proportion of Southern skilled workers found work in low-skill jobs. In Table 6 there is some evidence which is, at least, consistent with such a state of affairs.

**Table 6 –** Ladder Effects in the North, Centre, South

| | **Ladder Effect** | | |
|---|---|---|---|
| | N | C | S |
| | | | |
| **April 1998** | **0.117** | **0.168** | **0.116** |
| **April 2002** | **0.137** | **0.202** | **0.155** |
| | | | |
| **% Changes** | **0.17** | **0.20** | **0.34** |
| | | | |
| Source: our elaborations on ISTAT data | | | |

The ladder effect indicator is [ $L^s_\lambda$ / ($L^s_\lambda$ + $L^u_\lambda$) ], where L is employment, superscripts s and u denote the education status (skilled, s, and unskilled, u), subscript $\lambda$ indicates low-skilled occupation (ISTAT definition: *Operaio e assimilati*). Hence the indicator is the proportion of highly-educated (skilled) employees in low-skilled occupation. Table 6 indicates that the proportion of skilled workers that found work in low-skill jobs increased concomitantly with the Treu Act in all the three areas, but nowhere as strongly as in the South.

Comparing the percentage variations of the ladder effect across areas, one finds differences roughly comparable to the gaps in the coefficients on *TREU*, at least for the unskilled and the total labour force. According to this interpretation, the sizes of those coefficients (and their negative sign in the North) would still imply that the Treu Act had a positive impact on the probability to find a job. Further research is naturally needed in order to corroborate these results, finding perhaps some validation for one or the other of the explanations available in the literature for the ladder effect. The latter could in principle occur because of overeducation or because of structural factors, possibly linked to biased technological change (Katz and Krueger, 1999).

## 7. Concluding Remarks

In this paper we utilised a matching theory approach to assess the impact on the Italian labour market of the so-called 1997 Treu Act (*legge Treu*). Although the Treu Act elicited considerable interest in the press and among labour market participants, there has not been so far extensive scientific work on its effects. Our work is also of some interest since the relationship between unemployment and vacancies has been very seldom analysed in the Italian literature, mainly because of the lack of official vacancy data. We adopt a fairly recent empirical approach. The matching function, re-parameterised as a Beveridge Curve, is modelled and estimated as a production frontier.

We find largely favourable evidence to the existence of a Beveridge Curve in the 1990s across the main territorial areas. Huge efficiency differences show up between the South and the rest of the country. The matching efficiency of observations from the Southern labour market varies between one third and one fifth. Our results also show that the Treu Act did improve matching efficiency in the North (mainly for skilled labour), but had a detrimental impact on the matching efficiency of unskilled labour in the South. A possible interpretation of this result is in terms of a ladder effect, which emphasises the need to focus on the skill mismatch in the Southern labour market both from the demand- and the supply-side.

In future work, we plan to get more robust evidence on these matters by relying on the ISAE indicators and pursuing our analysis at a finer level of territorial disaggregation. It could also be interesting to get firmer evidence on the impact of labour-market reforms on vacancy supply, by setting up and estimating a more complex model.

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**Table A.1 – General specifications (5)**

| **Measure of vacancies: ISAE Indicator of Labour Scarcity** | | | | | |
|---|---|---|---|---|---|
| **Total u** | | **Skilled u** | | **Unskilled u** | |
| Adj. R2 | 0.7459 | Adj. R2 | 0.6604 | Adj. R2 | 0.8061 |
| TREU N | -0.095 | TREU N | -0.288 | TREU N | -0.06 |
| t-stat. | -1.19 | t-stat. | -2.40 | t-stat. | -0.89 |
| TREU C | -0.067 | TREU C | 0.025 | TREU C | -0.098 |
| t-stat. | -1.02 | t-stat. | 0.26 | t-stat. | -1.26 |
| TREU S | 0.068 | TREU S | 0.029 | TREU S | 0.088 |
| t-stat. | 2.76 | t-stat. | 0.56 | t-stat. | 4.15 |
| | | | | | |
| **Measure of vacancies: G (ISAE) Indicator of Labour Scarcity** | | | | | |
| **Total u** | | **Skilled u** | | **Unskilled u** | |
| Adj. R2 | 0.7425 | Adj. R2 | 0.6564 | Adj. R2 | 0.8066 |
| TREU N | -0.086 | TREU N | -0.272 | TREU N | -0.056 |
| t-stat. | -1.13 | t-stat. | -2.32 | t-stat. | -0.82 |
| TREU C | -0.043 | TREU C | 0.057 | TREU C | -0.086 |
| t-stat. | -0.62 | t-stat. | 0.54 | t-stat. | -1.25 |
| TREU S | 0.058 | TREU S | 0.057 | TREU S | 0.08 |
| t-stat. | 3.04 | t-stat. | 1.17 | t-stat. | 3.50 |
| | | | | | |
| **Measure of vacancies: ISFOL Help-Wanted Ads** | | | | | |
| **Total u** | | **Skilled u** | | **Unskilled u** | |
| Adj. R2 | 0.6911 | Adj. R2 | 0.6328 | Adj. R2 | 0.7734 |
| TREU N | -0.019 | TREU N | -0.112 | TREU N | -0.041 |
| t-stat. | -0.22 | t-stat. | -0.77 | t-stat. | -0.54 |
| TREU C | 0.064 | TREU C | 0.147 | TREU C | 0.04 |
| t-stat. | 0.89 | t-stat. | 1.39 | t-stat. | 0.44 |
| TREU S | 0.053 | TREU S | 0.055 | TREU S | 0.076 |
| t-stat. | 2.21 | t-stat. | 1.16 | t-stat. | 2.34 |

**Table A.2 –Specifications (5'): common $\beta$ and $\gamma$ coefficients across regions**

| **Measure of vacancies: ISAE Indicator of Labour Scarcity** | | | | | |
|---|---|---|---|---|---|
| **Total u** | | **Skilled u** | | **Unskilled u** | |
| Adj. R2 | 0.7782 | Adj. R2 | 0.6813 | Adj. R2 | 0.8202 |
| F(26,39) | 0.85 | F(26,36) | 0.67 | F(26,39) | 0.70 |
| $\chi^2(26)$ | 0.83 | $\chi^2(26)$ | 0.76 | $\chi^2(26)$ | 0.18 |
| TREU N | -0.089 | TREU N | -0.203 | TREU N | -0.063 |
| t-stat. | -1.72 | t-stat. | -2.47 | t-stat. | -1.25 |
| TREU C | -0.018 | TREU C | 0.025 | TREU C | -0.04 |
| t-stat. | -0.36 | t-stat. | 0.40 | t-stat. | -0.71 |
| TREU S | 0.061 | TREU S | 0.021 | TREU S | 0.093 |
| t-stat. | 2.50 | t-stat. | 0.45 | t-stat. | 3.09 |
| | | | | | |
| **Measure of vacancies: G (ISAE) Indicator of Labour Scarcity** | | | | | |
| **Total u** | | **Skilled u** | | **Unskilled u** | |
| Adj. R2 | 0.7751 | Adj. R2 | 0.6916 | Adj. R2 | 0.8000 |
| F(26,39) | 0.85 | F(26,36) | 0.78 | F(26,39) | 0.40 |
| $\chi^2(26)$ | 0.66 | $\chi^2(26)$ | 0.87 | $\chi^2(26)$ | 0.13 |
| TREU N | -0.063 | TREU N | -0.198 | TREU N | -0.043 |
| t-stat. | -1.30 | t-stat. | -2.64 | t-stat. | -0.81 |
| TREU C | -0.014 | TREU C | 0.029 | TREU C | -0.026 |
| t-stat. | -0.28 | t-stat. | 0.45 | t-stat. | -0.47 |
| TREU S | 0.066 | TREU S | 0.023 | TREU S | 0.092 |
| t-stat. | 2.58 | t-stat. | 0.54 | t-stat. | 2.86 |
| | | | | | |
| **Measure of vacancies: ISFOL Help-Wanted Ads** | | | | | |
| **Total u** | | **Skilled u** | | **Unskilled u** | |
| Adj. R2 | 0.7395 | Adj. R2 | 0.6271 | Adj. R2 | 0.7851 |
| F(26,39) | 0.89 | F(26,36) | 0.45 | F(26,39) | 0.63 |
| $\chi^2(26)$ | 0.80 | $\chi^2(26)$ | 0.41 | $\chi^2(26)$ | 0.57 |
| TREU N | -0.067 | TREU N | -0.155 | TREU N | -0.068 |
| t-stat. | -1.17 | t-stat. | -1.76 | t-stat. | -1.15 |
| TREU C | 0.061 | TREU C | 0.102 | TREU C | 0.046 |
| t-stat. | 1.19 | t-stat. | 1.41 | t-stat. | 0.73 |
| TREU S | 0.065 | TREU S | 0.029 | TREU S | 0.085 |
| t-stat. | 2.60 | t-stat. | 0.62 | t-stat. | 3.03 |

## TABLE A.3

**Measure of vacancies: ISAE Indicator of Labour Scarcity** – *Specification (5'')*

| | **Total Labour Force** | | **Skilled Labour Force** | | **Unskilled Labour Force** | |
|---|---|---|---|---|---|---|
| | *Coeff.* | *T-stat.* | *Coeff.* | *T-stat.* | *Coeff.* | *T-stat.* |
| **$\Delta.u_{it-1}$** | 0.535796 | 5.74 | 0.568751 | 5.76 | 0.272192 | 2.78 |
| **$u_{it-1}$** | -1.46873 | -11.75 | -1.53573 | -11.13 | -1.08227 | -9.01 |
| **MA (4) $v_{it-1}$** | -0.73185 | -3.95 | -0.45239 | -1.67 | -0.82736 | -4.27 |
| **Ind. share$_{it-1}$** | 0.997347 | 1.64 | | | 1.888194 | 2.77 |
| **Yng25 share$_{it-1}$** | | | 0.956587 | 2.63 | | |
| **North** | -4.26661 | -10.65 | -4.73839 | -9.85 | -3.47241 | -8.34 |
| **Centre** | -3.4974 | -11.11 | -4.02114 | -9.73 | -2.75557 | -8.56 |
| **South** | -2.65004 | -11.34 | -3.16023 | -9.23 | -2.06756 | -8.67 |
| **tr N** | 0.042768 | 3.59 | 0.073697 | 4.16 | 0.028014 | 2.35 |
| **tr C** | 0.039637 | 4.42 | 0.077783 | 5.79 | 0.014473 | 1.41 |
| **tr S** | 0.081619 | 10.00 | 0.088369 | 7.32 | 0.06358 | 7.08 |
| **$tr^2$ N** | -0.00221 | -3.46 | -0.00363 | -3.85 | -0.00155 | -2.38 |
| **$tr^2$ C** | -0.00159 | -3.33 | -0.003 | -4.50 | -0.00064 | -1.14 |
| **$tr^2$ S** | -0.00317 | -9.10 | -0.00355 | -6.36 | -0.00243 | -6.15 |
| **$tr^3$ N** | 2.21E-05 | 2.07 | 4.15E-05 | 2.71 | 1.99E-05 | 1.77 |
| **$tr^3$ C** | 1.04E-05 | 1.29 | 2.53E-05 | 2.38 | 4.68E-06 | 0.48 |
| **$tr^3$ S** | 3.46E-05 | 7.27 | 4.34E-05 | 5.05 | 2.52E-05 | 4.48 |
| **TREU N** | -0.07847 | -1.98 | -0.197000 | -3.21 | -0.05162 | -1.27 |
| **TREU C** | -0.0013 | -0.03 | 0.005852 | 0.11 | -0.02947 | -0.65 |
| **TREU S** | 0.070243 | 3.82 | 0.013986 | 0.39 | 0.090347 | 3.67 |
| | | | | | | |
| **adj. $R^2$** | 0.7884 | | 0.6805 | | 0.8158 | |
| **$\chi^2$ (32)** | 0.82 | | 0.78 | | 0.19 | |
| **AB (1)** | 0.81 | | 0.59 | | 0.19 | |
| **AB (4)** | 0.24 | | 0.27 | | 0.78 | |
| **Reset** | 0.09 | | 0.23 | | 0.81 | |
| **J-B** | 0.43 | | 0.35 | | 0.40 | |
| **BP-CW** | 0.66 | | 0.77 | | 0.17 | |
| **Greene** | 0.00 | | 0.00 | | 0.00 | |
| **BP** | 0.14 | | 0.05 | | 0.34 | |

# TABLE A.4

**Measure of vacancies: G (ISAE) Indicator of Labour Scarcity** – *Specification (5'')*

| | **Total Labour Force** | | **Skilled Labour Force** | | **Unskilled Labour Force** | |
|---|---|---|---|---|---|---|
| | *Coeff.* | *T-stat.* | *Coeff.* | *T-stat.* | *Coeff.* | *T-stat.* |
| **$\Delta.u_{it-1}$** | 0.53399 | 5.75 | 0.588607 | 6.08 | 0.27829 | 2.73 |
| **$u_{it-1}$** | -1.46349 | -11.80 | -1.56125 | -11.53 | -1.06514 | -8.37 |
| **MA (4) $v_{it-1}$** | 0.096095 | 4.28 | 0.092642 | 3.16 | 0.090106 | 3.46 |
| **Ind. share$_{it-1}$** | 1.270181 | 1.93 | | | 1.969943 | 2.57 |
| **Yng25 share$_{it-1}$** | | | 0.783991 | 2.17 | | |
| **North** | -4.57718 | -10.37 | -4.98251 | -10.24 | -3.65686 | -7.67 |
| **Centre** | -3.78423 | -10.88 | -4.23275 | -10.10 | -2.9574 | -8.01 |
| **South** | -2.90435 | -11.15 | -3.34119 | -9.65 | -2.26318 | -8.19 |
| **tr N** | 0.047633 | 3.83 | 0.086525 | 5.11 | 0.027108 | 1.99 |
| **tr C** | 0.043714 | 4.71 | 0.082755 | 6.09 | 0.016823 | 1.60 |
| **tr S** | 0.082555 | 9.95 | 0.088451 | 7.59 | 0.063481 | 6.69 |
| **$tr^2$ N** | -0.00228 | -3.58 | -0.00418 | -4.81 | -0.00132 | -1.87 |
| **$tr^2$ C** | -0.00173 | -3.54 | -0.00322 | -4.79 | -0.00068 | -1.18 |
| **$tr^2$ S** | -0.00314 | -8.85 | -0.00346 | -6.47 | -0.00236 | -5.72 |
| **$tr^3$ N** | 1.96E-05 | 1.93 | 4.69E-05 | 3.52 | 1.24E-05 | 1.07 |
| **$tr^3$ C** | 1.21E-05 | 1.48 | 2.84E-05 | 2.67 | 4.38E-06 | 0.44 |
| **$tr^3$ S** | 3.34E-05 | 6.88 | 4.15E-05 | 5.03 | 2.37E-05 | 4.07 |
| **TREU N** | -0.0682 | -1.70 | -0.181000 | -3.06 | -0.04845 | -1.08 |
| **TREU C** | 0.004115 | 0.11 | 0.007411 | 0.14 | -0.01875 | -0.42 |
| **TREU S** | 0.069724 | 3.62 | 0.015415 | 0.45 | 0.087091 | 3.44 |
| | | | | | | |
| **adj. $R^2$** | 0.787 | | 0.695 | | 0.8034 | |
| **$\chi^2$ (32)** | 0.49 | | 0.88 | | 0.07 | |
| **AB (1)** | 0.59 | | 0.63 | | 0.15 | |
| **AB (4)** | 0.44 | | 0.29 | | 0.99 | |
| **Reset** | 0.09 | | 0.25 | | 0.35 | |
| **J-B** | 0.47 | | 0.65 | | 0.57 | |
| **BP-CW** | 0.61 | | 0.58 | | 0.39 | |
| **Greene** | 0.00 | | 0.00 | | 0.00 | |
| **BP** | 0.38 | | 0.02 | | 0.40 | |

# TABLE A.5

**Measure of vacancies: ISFOL Help-Wanted Ads –** *Specification (5'')*

| | **Total Labour Force** | | **Skilled Labour Force** | | **Unskilled Labour Force** | |
|---|---|---|---|---|---|---|
| | *Coeff.* | *T-stat.* | *Coeff.* | *T-stat.* | *Coeff.* | *T-stat.* |
| $\Delta.u_{it-1}$ | 0.539641 | 5.57 | 0.557522 | 5.66 | 0.302271 | 2.87 |
| $u_{it-1}$ | -1.41047 | -11.06 | -1.50217 | -11.28 | -1.07687 | -8.18 |
| $v_{it-3}$ | -0.38301 | -3.59 | -0.10146 | -1.64 | -0.22999 | -2.97 |
| **Ind. share$_{it-1}$** | 0.420461 | 0.69 | | | 1.158115 | 1.66 |
| **Yng25 share$_{it-1}$** | | | 1.036461 | 2.83 | | |
| **North** | -3.83463 | -9.87 | -4.62712 | -9.85 | -3.12106 | -7.12 |
| **Centre** | -3.22582 | -10.32 | -3.97008 | -9.69 | -2.56964 | -7.44 |
| **South** | -2.46423 | -10.51 | -3.13081 | -9.14 | -1.95686 | -7.58 |
| **tr N** | 0.020718 | 2.10 | 0.06132 | 4.24 | 0.002603 | 0.26 |
| **tr C** | 0.036123 | 4.27 | 0.076452 | 5.84 | 0.01145 | 1.10 |
| **tr S** | 0.076889 | 9.05 | 0.087134 | 7.13 | 0.061634 | 6.54 |
| **tr$^2$ N** | -0.00101 | -1.90 | -0.00294 | -3.87 | -0.00015 | -0.26 |
| **tr$^2$ C** | -0.0013 | -2.94 | -0.00286 | -4.46 | -0.00034 | -0.60 |
| **tr$^2$ S** | -0.00298 | -8.07 | -0.00351 | -6.16 | -0.00235 | -5.79 |
| **tr$^3$ N** | 2.18E-06 | 0.24 | 2.99E-05 | 2.45 | -4.24E-06 | -0.44 |
| **tr$^3$ C** | 3.63E-06 | 0.49 | 2.21E-05 | 2.18 | -3.10E-06 | -0.32 |
| **tr$^3$ S** | 3.18E-05 | 6.18 | 4.27E-05 | 4.83 | 2.36E-05 | 4.22 |
| **TREU N** | -0.08992 | -2.14 | -0.19861 | -3.22 | -0.068 | -1.55 |
| **TREU C** | 0.059287 | 1.65 | 0.038215 | 0.72 | 0.04005 | 0.85 |
| **TREU S** | 0.070143 | 3.36 | 0.016073 | 0.42 | 0.089129 | 3.77 |
| | | | | | | |
| **adj. $R^2$** | 0.7762 | | 0.6778 | | 0.8017 | |
| **$\chi^2$ (32)** | 0.89 | | 0.45 | | 0.70 | |
| **AB (1)** | 0.75 | | 0.54 | | 0.26 | |
| **AB (4)** | 0.82 | | 0.62 | | 0.87 | |
| **Reset** | 0.40 | | 0.23 | | 0.43 | |
| **J-B** | 0.97 | | 0.13 | | 0.79 | |
| **BP-CW** | 0.32 | | 0.64 | | 0.31 | |
| **Greene** | 0.00 | | 0.00 | | 0.00 | |
| **BP** | 0.21 | | 0.05 | | 0.25 | |

**LEGEND OF TABLES AND FIGURES:**

The sample relates to the 1993:4 - 2001:2 period, for a sum total of 31×3 = 93 observations (for the ISFOL indicators, 1994:1 - 2001:2, and 30×3 = 90 observations).
The dependent variable is always $\Delta u_{it}$, the log difference of the rate of unemployment, where $i = 1, 2, 3$, stands for North, Centre and South, and $t$ is a given quarter. Accordingly, $u_{it}$ is the natural log of the unemployment rate, while the vacancy rates, $v_{it}$, *are not logged*. MA (4) $v_{it-1}$ is the (one-period lagged) moving average of the vacancy rate.

Variables are not deseasonalised. Seasonal dummies (not shown in the interest of parsimony) are always significant.
T-stat.'s are obtained from variance-covariance matrices corrected through a feasible GLS procedure. We usually take groupwise-heteroskedastic disturbances only; for the skilled labour force equations, disturbances are also assumed to be contemporaneously correlated across areas.

Ind. $share_{it-1}$ and Yng25 $share_{it-1}$ are respectively the (one-period lagged) share of labour force in industry and the share of unemployed less than 25 years of age.
North, Centre, South are the territorial fixed effects; while tr N, tr C, tr S; $tr^2$ N, $tr^2$ C, $tr^2$ S; $tr^3$ N, $tr^3$ C, $tr^3$ S are the (territorial) linear, quadratic and cubic time trends. TREU N, TREU C, TREU S are the territorial indicators for the Treu Act described in the text.

Adj. $R^2$ is the coefficient of determination corrected for degrees of freedom.
F (m,n-k) are F-tests of linear restrictions which, in Table A.2, test specification (5') vs. specification (5). In Table A.2 they are accompanied by a Wald test, allowing for non-spherical residuals, for the same linear restrictions. In Tables A.3-A.5, only the Wald test ((5'') vs. (5)) is reported.
AB(1) and AB (4) are the Arellano-Bond test for first- and fourth-order serial correlation (distributed as a normal). Reset is Ramsey's specification test carried out by including the square, the cube and the quadric of the fitted values (F(3,n-k-3)). J-B is the Jarque-Bera test for residual normality ($\chi^2(2)$). BP-CW is the Breusch-Pagan / Cook-Weisberg test for residual heteroskedasticity ($\chi^2(1)$). Greene is Greene's test for groupwise residual heteroscedasticity ($\chi^2(2)$). BP is Breusch-Pagan test of residual contemporaneous correlation independence ($\chi^2(3)$). We report only the p-value of all these tests.

The efficiency scores in Figure 4 were calculated from expression (6) in the text (coefficients are taken from equations (5'')).