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Is the Discouraged Worker Effect Time-Varying?

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Indice

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Abstract

This study investigates the relationship between the female labour force participation and the female employment rate in Italy by adopting non-linear econometric modelling. In our specification we are unable to reject a non-linear relationship. This implies that the discouraged worker effect is time-varying.

Keywords: Discouraged Workers, Non-linearity
JEL Classification: J23, C32

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1. Introduction

Recent years have been characterised by some improvements in labour market performances. A variety of stylised facts characterised European labour market. First, European unemployment rate covers deep cross-country asymmetries. Second, it particularly affects specific population segments (males, females, adults and youngest) and for rather long time periods.

In principle, there are several ways the labour market can react to a negative shock. When a recession occurs, workers who lose their jobs can react in three different ways. First, they can keep looking for a job in the area, thus remaining unemployed; second, they can migrate to another area; or third they can stop looking for a job, thereby exiting the labour force (and becoming “discouraged workers”). The discouraged worker hypothesis (Long, 1953) assumes that since searching for a job is a very expensive activity, a persistent period of unemployment reduce the probability of finding a job and may induce groups of secondary workers not to enter in the labour market waiting, instead, for better opportunities.

A large number of empirical studies exist for different countries reporting evidence consistent with the discouraged worker hypothesis (Benati, 2001; Darby, Hart and Vecchi, 2001; Blundell, Ham and Meghir, 1998; Clark and Summers, 1982). None of the previous studies, however, use non-linear techniques in order to ascertain the existence of time-dependence in the discouraged worker effect. What will be the aim of the present paper.

2. The Econometric Methodology

Before employing non-linear econometric methodology we estimate a linear VECM with the maximum likelihood technique and test for possible non-linearity in the residuals. The data used in the empirical analysis are quarterly observations drawn from the Labour Force Survey (LFS) produced by ISTAT. The sample period goes from 1959:1 to 2004:4. The benchmark linear model we used to characterize the long-run dynamic adjustments is a finite-order VECM of the following form:

$$[1] \quad \begin{bmatrix} \Delta e_t \\ \Delta p_t \end{bmatrix} = \Gamma(L) \begin{bmatrix} \Delta e_{t-1} \\ \Delta p_{t-1} \end{bmatrix} + \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \end{bmatrix} \left(e_{t-1} - p_{t-1} - \gamma t \right) + \begin{bmatrix} u_t^e \\ u_t^p \end{bmatrix}$$

Where $[\Delta e_t, \Delta p_t]'$ is a vector of stationary variables containing the female employment rate (e_t) and the female participation rate (p_t); Δ is the first difference operator; α_{11} and α_{21} indicate the speed of adjustment of each variable back to its long-run value. The estimation results are reported in table 1.

The two adjustment coefficients (α_{11} and α_{21}) are significantly different from zero, meaning that both the female participation rate and female employment rate adjust to restore the long-run equilibrium. The absolute value of α gives information about the number of quarters needed to restore the long-term equilibrium. In our case, after almost four years, 50 percent of the disequilibrium gap created by the shock has been closed by the adjustment in the female participation rate[1]. This time pattern suggests that, in the long-run, the employment rate is increasingly driven by the participation rate.

Table 1: Linear VECM Estimates

	Δe_t		Δp_t	
	Coeff.	St. Error	Coeff.	St. Error
c	0.495	[0.12]	0.605	[0.21]
Δp_{t-1}	0.546	[0.15]	0.506	[0.17]
Δp_{t-2}	0.611	[0.25]	0.488	[0.15]
Δe_{t-1}	-0.740	[0.28]	-0.684	[0.38]
Δe_{t-2}	-0.833	[0.63]	-0.657	[0.77]
α	-0.033	[0.015]	0.036	[0.018]
σ^2	0.38		0.47	

It is now possible to check the non-linearity of the residuals by using three widely used tests. We apply the BDS, the Reset and Tsay test to the residuals of each equation in the VECM system. The null hypothesis for

1 In order to obtain the number of quarters (τ) required to dissipate x% of a shock we use the following formula: $(1-\alpha)^{\tau} = (1-x\%)$, where α is the absolute value of the estimated speed adjustment parameter.

these tests is that the residual generating process is linear. Table 2 and table 3 show the results.

Table 2: BDS Test statistics

Residuals from Employment Rate Equation

Dimension	BDS Statistic	Std. Error	Z-Statistic	Asymptotic	Bootstrap
2	0.03	0.01	3.44	2.5E-02	6.3E-02
3	0.08	0.02	5.18	0.0E+00	8.0E-04
4	0.24	0.02	5.28	0.0E+00	0.0E+00
5	0.18	0.03	8.26	0.0E+00	0.0E+00
6	0.31	0.03	7.98	0.0E+00	0.0E+00

Residuals from Participation Rate Equation

Dimension	BDS Statistic	Std. Error	Z-Statistic	Asymptotic	Bootstrap
2	6.88E-04	4.17E-04	6.13	3.32E-02	3.59E-02
3	3.26E-04	2.04E-04	5.17	3.04E-02	4.70E-02
4	-2.05E-04	2.96E-05	-7.35	0.00E+00	4.66E-02
5	-2.04E-05	3.52E-06	-4.24	1.20E-03	8.27E-02
6	-8.80E-07	5.90E-07	-5.00	4.55E-02	9.56E-02

Table 3: Tsay and Reset Test statistics

		Employment rate		Participation rate	
	Distribution	Statistic	P-value	Statistic	P-value
Tsay	F(1 , 98)	27.15	*2E-06*	34.34	*3E-08*
Reset	F(3,96)	2.963	*0.04619*	24.093	*9E-11*

The tables report, for each equation from the VECM, the p-values under the null hypothesis that the corresponding residual is a serially *i.i.d.* process. Table 2 also reports the bootstrapped p-values for the BDS test statistic. All tests reject the null hypothesis of a linear generating mechanism for the residuals of the selected variables. The analysis altogether suggests the presence of non-linearity in the residuals. This evidence corroborates the decision of estimating the model in non-linear form.

We account for non-linearity by estimating a multivariate Markov-switching model. The asymmetry of the effects is captured by allowing for state-dependent parameters where the latent state variable follows a Markov-switching process. The idea behind this class of models is that the parameters underlying the data generating process of the observed time series vector depend upon the unobservable regime variable s_t, which represents the probability of being in a different state of the world.

This variable s_t is governed by a discrete state of a Markov stochastic process, which is defined by the following transition probabilities:

$$p_{ij} = \Pr\left(s_{t+1} = j \middle| s_t = i\right) \qquad P = \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1m} \\ p_{21} & p_{22} & \cdots & p_{2m} \\ \vdots & \vdots & \ddots & \cdots \\ p_{m1} & p_{m2} & \cdots & p_{mm} \end{bmatrix}$$

where p_{ij} is the probability that state *i* is followed by state *j* and *P* is the corresponding transition matrix. The idea is that the relation between the employment and participation rate is time-varying but constant conditional on the stochastic and unobservable regime variable. We then proceed to estimate a Markov-switching vector equilibrium correction model (MS-VECM) of the form[2]:

$$\begin{bmatrix} \Gamma_{11}(L) & \Gamma_{12}(L) \\ \Gamma_{21}(L) & \Gamma_{22}(L) \end{bmatrix} \begin{bmatrix} \Delta e_t - \mu(s_t) \\ \Delta p_t - \mu(s_t) \end{bmatrix} = \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \end{bmatrix} \left(e_{t-1} - p_{t-1} - \delta(s_t) - \gamma t\right) + \begin{bmatrix} u_t^e \\ u_t^p \end{bmatrix}$$

where residuals are conditionally Gaussian, $u_t \middle| s_t \sim NID\left(0, \Sigma\left(s_t\right)\right)$; $\delta(s_t) = E\left[e_{t-1} - p_{t-1} - \gamma t\right]$ represents the state-dependent deviation from the trend in employment and captures the correction to the long-term equilibrium; $\mu(s_t)$ describes the regime-dependent mean.

Following the two-stage procedure suggested by Krolzig (1997) the results obtained in the linear VECM concerning the cointegration analysis are used in this stage of the analysis. The maximum likelihood estimates of the model are reported in table 2. Standard bottom-up procedure hints three as the number of regimes.

The estimated quarterly growth of the employment rate is -0.29% in regime 1, 0.32% in regime 2 and 0.31% in regime 3. Table 4 also reports the quarterly growth of the labour force participation associated with regime 1 (-0.3%) regime 2 (0.38%) and regime 3 (0.18%).

[2] We also estimated the model allowing for a shift in the intercept of the variables. The results we obtained from the two specifications are very similar with respect to the regime classification as well as to the parameter values.

Table 4: ML estimates of the MSMH (3)-VECM (2)

	Δe_t		Δp_t	
	Coeff.	St. Error	Coeff.	St. Error
μ_1	-0.292	[0.09]	-0.298	[0.09]
μ_2	0.322	[0.06]	0.377	[0.06]
μ_3	0.314	[0.08]	0.176	[0.05]
Δp_{t-1}	-0.552	[0.15]	-0.255	[0.12]
Δp_{t-2}	0.007	[0.15]	0.062	[0.12]
Δe_{t-1}	0.457	[0.16]	0.138	[0.14]
Δe_{t-2}	-0.624	[0.15]	-0.710	[0.13]
α	-0.101	[0.04]	0.104	[0.03]
σ^2 *(Reg.1)*	0.853		0.897	
σ^2 *(Reg.2)*	0.385		0.320	
σ^2 *(Reg.3)*	0.664		0.562	
log-likelihood	-161.75	vs. linear	-225.76	
AIC criterion	2.18	vs. linear	2.72	
HQ criterion	2.40	vs. linear	2.83	
SC criterion	2.73	vs. linear	2.99	
LR linearity test:	128.0179 Chi(10) =[0.0000] **			
	Chi(36)=[0.0000] ** DAVIES=[0.0000] **			

The speed of the adjustment coefficient is higher than the one estimated by using the linear VECM: approximately 10% of the adjustment takes place each period. The participation rate restores 50% of the pre-shock long-run equilibrium level after almost 6 quarters. Moreover, the pace at which the employment rate moves to restore the long-run equilibrium is very similar.

Once we have estimated the model, the transition matrix may be computed to analyse the probability of moving from one state to another. As the estimated process follows a 3-state Markov chain it is then possible to collect the transition probabilities in a 3×3 transition matrix (table 5 -left):

Table 5: Matrix of transition probabilities and Regime Properties

	Regime 1	Regime 2	Regime 3
Regime 1	0.970	0.000	0.030
Regime 2	0.020	0.980	0.000
Regime 3	0.000	0.035	0.965

	N. Obs	Prob.	Duration
Regime 1	65.8	0.2955	33.04
Regime 2	53.9	0.4509	50.42
Regime 3	57.3	0.2537	28.36

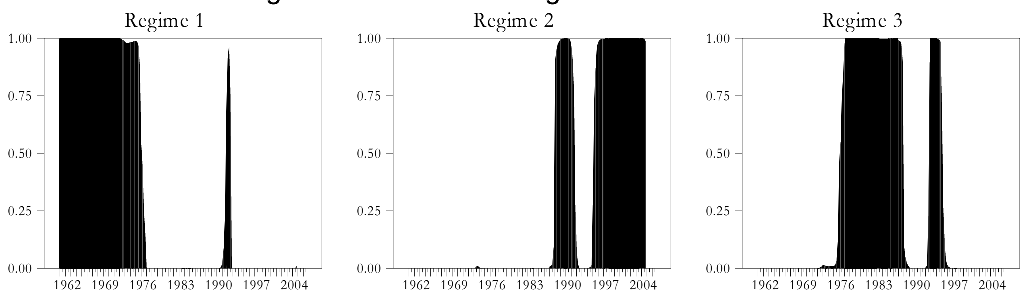
The regimes are estimated to be quite persistent. The least persistent regime is the last one. The expected duration[3] and the ergodic probabilities

[3] The expected duration can be easily calculated from the estimated transition probabilities. The expected duration of regime 1, for example, can be derived as follows: $\sum_{z=1}^{\infty} z p_{11}^{z-1}\left(1-p_{11}\right)=\left(1-p_{11}\right)^{-1}$.

are also shown in table 5 (right). The above table shows respectively the expected duration for regime 1 (33 quarters), regime 2 (50 quarters) and regime 3 (28 quarters).

The further step consists of characterizing the timing of the regimes. The resulting smoothed probabilities are given in Figure 1.

Figure 1: Smoothed Regime Probabilities



Regime 1 coincides with the decrease in the employment rate and participation rate from the 1960s to the first half of the 1970s. Regime 2 and 3 are characterized by a positive growth in both employment and participation rate.

We now turn to the impulse response analysis. Following Krolzig and Toro (1998) we compute the effects of a regime-wide shock on the employment and participation rate (Figure 2). This methodology allows us to investigate the dynamic responses of the employment and participation rate in transition across regimes. We first analyse the response of all variables in the system to a shock that induces a movement from the ergodic[4] distribution to a specific regime. A 40-quarter horizon is considered.

Figure 2 shows the response of the female employment (dashed lines) and participation rate (solid lines) when they move from steady-state probabilities to the three estimated regimes. Here, we observe the different dynamics governing the two selected variables during high- and low-employment periods. The upmost left graph (shift to regime 1), for example, represents the reaction of the employment and participation rate to the

[4] Note that as the Markov chain is stationary, the conditional distribution of the different states converges to the ergodic distribution.

information that $s_t = 1$. Then, the time profile of the reactions illustrates the pattern of employment reduction and the subsequent labour force movements when the system moves to regime 1. The middle graph of the second column, reports the response of the variables when moving from equilibrium to regime 2. Finally, the lowest right graph reports the response of the variables when the system moves from steady-state to the third regime.

As it clearly emerges, there are asymmetries in the reaction of the selected variables when employment falls (shift to regime 1) with respect to when the employment rate moves to regime 3 (shift to regime 3). In particular, the occurrence of regime 1 produces a larger deviation from the long-term equilibrium if compared with a shift to regime 3. In other words, a shock that leads to employment reduction has a bigger impact on the long-run equilibrium than a shock that induces an increase in the employment rate.

Figure 2: Responses to Regime Shifts: Employment (dashed) - Participation (solid)

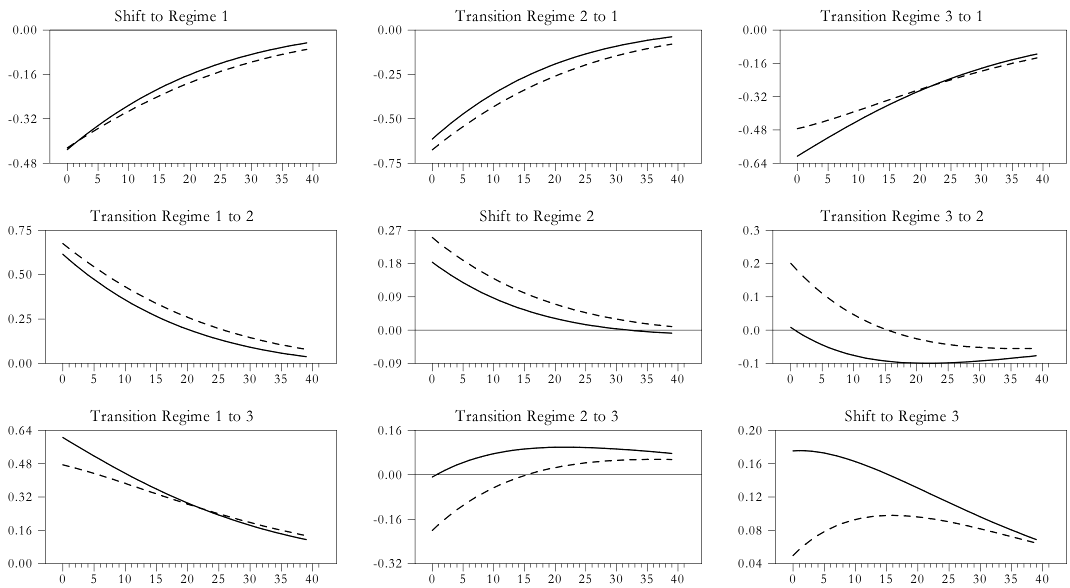


Figure 2 also suggests a different time pattern of the selected variables to a regime shift. During regime 1 and 3 the employment rate reacts more than the participation rate. In contrast, during regime 2, the simulated response of the employment rate is smaller than the one observed for the participation rate.

The main implication arising from impulse response analysis is that a shock producing a shift from the steady state probabilities to the estimated regimes will have a greater effect when it leads to a decrease in the employment rate than when the shock produces an increase in both employment and participation rate. Finally, when the employment rate increases, the dynamic responses of the two variables might generate either an increase in the unemployment (when the change in the participation rate is larger than the employment rate response – regime 3) or a decrease in the unemployment rate (i.e. when the labour force participation react less than the employment rate – regime 2).

3. Conclusions

The estimated model characterizes the employment adjustment process toward its long-run equilibrium. The main implication arising from the analysis suggests the presence of nonlinear mean reversion. As a consequence the relative strength of the participation rate to act as driving force for employment long-term equilibrium is consistently time-varying.

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