UNIVERSITÀ DEGLI STUDI DI NAPOLI
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ISTITUTO DI STUDI ECONOMICI

ON THE NON-LINEAR DYNAMICS BETWEEN EMPLOYMENT AND LABOUR FORCE PARTICIPATION

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Carlo ALTAVILLA[*] Antonio GAROFALO[**] Concetto Paolo VINCI[***]

Abstract
This paper investigates the relationship between the labour force participation and the employment rate. First, we apply linear vector error correction methodology and check the non-linearity of the residuals. Second, we account for non-linearity in the labour force participation rate by adopting a Markov-switching vector error correction model (MS-VECM); in particular, we employ a regime-dependent impulse response analysis in order to analyse the asymmetric behaviour of the employment and participation rate in transition across different regimes. The results suggest the presence of non-linear mean reversion in the employment rate process. The main implication arising from the analysis suggests that an equilibrium-distorting shock will have a greater effect when it leads to a reduction in the employment rate than when the shock produces an increase in both employment and participation rate. Most interestingly, when the employment rate increases, the dynamic responses of the two variables might generate either an increase or a decrease in the unemployment rate.

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

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Indice

1. Introduction

Unemployment was one of the major problems afflicting European countries at least until the mid 1990s. A striking fact about unemployment records is that while the US in the early 1960s had the highest rate and most of the European countries performed rather well, nowadays the situation has dramatically reversed.

Some stylised facts have, however, characterised European labour market performances. First, high and persistent unemployment has not been a European peculiarity. Indeed, in the early 1960s, unemployment was so low as to talk of a "European unemployment miracle" (Blanchard, 2004). Unfortunately the phenomenon came to an end in the 1970s, with unemployment rising till the 1980s. Since the mid 1990s, however, trends have reversed, although to date European unemployment rate is still rather high, averaging at around 8 percent. Second, the average European unemployment rate has, over time, experienced profound cross-country differences. Third, though mitigated in terms of levels, it still remains a cause for concern given that it particularly affects specific population segments (males, females, adults and the young) and for rather long time periods. Bearing this in mind, most European countries aim to raise employment and participation rates.

This paper aims to investigate the relationship between the labour force participation and employment rate with particular reference to the Italian labour market. The paper will be organized as follows: Section 2 will examine some trends in the Italian labour market, Section 3 will review the literature on the relation between employment and the labour force participation with particular reference to the Italian debate. In Section 4 the econometric methodology will be presented while Section 5 will account for non-linearity. Section 6 concludes.

2. Labour market trends

Most economists agree that Italy's poor labour market performance is mainly due to a series of factors, comprising growth slowdown (which according to some economists was the natural consequence of the considerable growth paths of the 1950s and 1960s, although others argue that this was one of the first signals of adopting misguided, inappropriate economic policies), industrialisation and subsequent de-industrialisation, the growing role of the trade unions and, finally, the supply side oil shocks of the 1970s.

Since structural factors prove crucial in analysing labour market matters, it is worth emphasising that an interesting feature concerning the Italian labour market, and indeed Western economies as a whole, has been the path followed by labour force distribution by sector during the past century. Together with a massive reduction in the labour force hired in Agriculture there has been a robust increase both in the Service and the Public Administration sectors.

Italian labour market performances/fallacies may be partly explained by means of the main trends in labour market indicators. After the downtrends of the participation rate characterising the decades before the first oil shock (1973-1974) there has been a resurgence which has, however, not been able to recover the previous fall, the latter circumstance being more clearly explained by gender-based analysis: as far as men are concerned, a continuous decline in the participation rate ending in the mid 1990s, follows a trend reversion. The female participation rate has experienced a continuous increase since the mid 1970s, although in terms of levels those of men remain higher. The growing share of women flowing into the labour force has been one of the most significant labour market trends, especially in the 1980s. The reasons behind such an occurrence relate mainly to domestic labour market organisation in Italy: women are those who look after children and the home. However the need to achieve economic independence and the labour force reallocation (from Agriculture to Services) has helped women obtain an increasingly high employment share in the Services

sector, to the extent that the ILO (2004) reports that the male employment share in Services is lower than that of women. Finally, a certain role in the decline of labour force participation has been played by the withdrawal of resources from the labour market of older male employment (early retirement).

Shifting attention to the employment to population ratio, which in some way captures the ability of economies to generate employment opportunities, we observe that this indicator turns out on average higher for men than for women. In particular, a declining trend for men is observed, at least till the mid 1990s, when the trend reverses, while for women, after a decreasing trend till the mid 1970s this ratio has on average progressively increased. The employment to population ratio mainly reflects the result of the shift mentioned above between the main economic sectors: the first period experienced a progressive reduction in the agricultural sector alongside an expanding industrial sector; subsequently the latter too declined (de-industrialisation process) while Services and Public Administrations progressively increased.

Finally the unemployment rate. After a period known as the "unemployment miracle" (1959-1973) with satisfactory employment performance, from the oil crisis shock (1973-1974) the unemployment rate rose, continuing to do so until the 1990s when a turn-around occurred. A characterising feature of such a social burden was that it mainly regarded women (with unemployment rates no less than twice their male counterpart) and young workers. Indeed, as regards the latter, the 1980s recorded worryingly high unemployment: in Italy unemployment in the 15-24 age class amounted to 42.2 per cent (female) and 28.8 per cent (male) (1985Q1) although since 2000 youth unemployment trends seem to have reversed. Nonetheless, it remains high (irrespective of gender, the 15-24 age class has a rate of almost 24 per cent).

3. Employment and Labour force participation relation: Literature Review

An interesting feature concerning the labour market is the possible relation, if any, between labour demand (expressed in terms of employment) and labour supply (expressed in terms of participation rate). Indeed, in many works on the labour market it has been hypothesised that labour supply is not independent of labour demand. It has been stressed that once there occur reductions in labour demand from firms there may be different responses from the labour supply side. Either some components of the family may react by varying their willingness to work in the opposite direction as the labour demand (added worker effect) or, conversely, they may vary their willingness to work in the same direction with regard to labour demand (discouraged worker effect).

A huge body of literature has been written on this subject, some of which is reported in Table 1. In Italy this topic has been hotly debated among economists since the 1970s.

Table 1: Selected Studies on Labour Force Participation

Author(s)	Country	Methodology	Sample Period
Altavilla C., Garofalo A. and Vinci C.P. (2005)	Italy	MS-VECM	1959 - 2004
Giannelli G. and Monfardini C. (2003)	Italy	Multinomial Probit	1995
Benati L. (2001)	US	Band-pass Filters	1976 - 93
Darby J., Hart R. and Vecchi M. (2001)	FR - J - SV - US	Filters	1970 - 95
Blundell R., Ham J. And Meghir C. (1998)	UK	Panel	1981 - 84
Clark K. And Summers L. (1982)	US	VAR - CS	1966 - 74
De Meo G. (1969)	Italy	OLS	1951 - 68
La Malfa U. and Vinci S. (1970)	Italy	OLS-ML	1959 - 68
Long C. (1953)	US - UK - CAN	Corr.	1940 - 52

The Italian controversy regarding the two hypotheses mentioned above took off with De Meo (1969) and La Malfa and S. Vinci (1970). De Meo argued that

changes in labour force participation rates may depend on both demographic[1] and socio-economic factors[2]. At odds with the above hypothesis is that postulated by La Malfa and S. Vinci (1970), who stated that the higher the labour demand the higher the number of potential workers searching for jobs. At the same time, an increasingly small number of vacancies will yield a declining labour supply. The simplest motivation behind this statement lies in the fact that searching for a job is, in line with Long (1958), a very expensive activity, entailing costs which job-seekers are likely to be willing to bear only if there is a good chance of success. The higher (lower) the employment rate, the stronger (weaker) the workers' job-seeking effort. When the opportunity of getting a job is scarce there will be many discouraged workers (mainly young), who decided not to enter the labour force, improving say their education, in the hope of better future job opportunities.

The controversy continued into the 1970s (Meldolesi, 1972; De Cecco, 1972). In his paper on the dynamics of the Italian labour force Jannaccone Pazzi, on re-examining the antithetical hypotheses of La Malfa, S. Vinci and De Meo, reached the following conclusions: De Meo in his analysis did not consider the wage rates of the different worker categories, the price changes and the aggregate demand variations, and these aspects were necessary for medium–long period labour

[1] They concern migration factors such as age and labour force gender structure.

[2] These are: increased educational rates among young workers; improved pension benefits that had reduced the labour force participation rates for both young and old persons; industrialization of the Italian economy during those decades when the role played by the agricultural sector dramatically decreased. He used the latter two arguments to explain the employment crisis at the time: whilst there appeared to be a decline in the number of employed persons, it was in fact related to the number of women who only sporadically help their husbands at work. In short, the De Meo position may be summarized as follows: the declining trend in the labour force participation rate from 1951 to 1968 may roughly be attributed to the improved condition of the economy.

force analysis. Nonetheless, he considered La Malfa and S. Vinci's results quite unsatisfactory since use was made of the E/P ratio instead of E/L ; in his opinion the first ratio is not a good indicator for short-period labour market conditions.

Meldolesi (1972) strongly criticised the significance of the unemployment rate used by De Meo since the presence of a massive stock of unemployed workers was not considered because they were not searching for a job. Meldolesi maintained that the labour force participation rate decline derived from the negative trend in output demand, thus appearing more likely to agree with La Malfa and S. Vinci's findings[3]. Nevertheless, he considered their analysis somewhat incomplete due to the inability to shift the discouraged and the added worker effects in the econometric evidence.

De Cecco (1972) also found fault with De Meo: phenomena like early retirement and the increase in education among young workers may explain most of the decline in labour force participation rates, in the sense that many young workers decide to continue their studies in the hope of obtaining a job, while a lower demand for workers will induce older unemployed workers to retire early.

More recently, as well detailed in MacDonald (2002), in a cross-national comparison, Sorrentino (1993), by using 1989 data, highlighted a wide variation of the share of discouraged workers among different countries, with very high values for Italy and Japan. In the case of Italy, she stated that discouraged workers are chiefly those who are not job-seeking since they are awaiting a response from previous job applications.

As regards the 1990s Giannelli and Monfardini (2001) in studying the Italian labour market (Bank of Italy data) argued that Italy has an increasing number of young workers who delay their exit from their parental home, which may be due to the very high youth unemployment rates. *"[A]ccording to a multipurpose*

[3] For more details see S. Vinci (1977).

survey conducted by the Italian National Statistical Institute, 52% of Italians aged 18-34 lived with their parents in 1990 and the percentage increased to 59% in 1998. Young adults in their thirties tend to leave their parental home later: in 1990, 18% of males aged 30-34 coresided with their parents, while in 1998 this percentage increased to 29%. The corresponding percentage for females is 10% and 15% respectively" (p. 3 Giannelli and Monfardini 2001).

An interesting paper aiming to disentangle the complicated question at stake is the one by Benati (2001) based on US data. Although, as argued by Benati (2001), the existence of a discouraged worker effect for some periods appears largely plausible, econometric evidence does not seem to give a clear verdict. In reviewing various studies he concludes that only five of them support the hypothesis of a discouraged worker effect (Tella, 1964, 1965; Mincer 1966; Perry, 1977; Clark and Summers, 1981). His results, which are based on the behaviour of the "not in labour force series" and its segments "going to school" and "keeping house" (ages and gender), confirm the existence of a discouraged worker effect, particularly for those groups of "secondary workers", to follow business cycles (in the labour force during boom and out during recessions).

Blundell, Ham and Meghir (1998), in a noteworthy work on UK family expenditure, develop a model of female participation, labour supply and employment which allows for discouraged workers. Their conclusion is that fixed costs roughly account for 15 per cent of the discouraged from participating while 10 per cent is imputable to search costs.

Interestingly, in estimating the effects of labour market programmes on labour force participation (Sweden, 1986-1998, panel data) Johansson (2002) concludes that such programmes have a "relatively large and positive effects on labour force participation"; in particular they counteract business-cycle variation in the participation rate due to the discouraged worker effect, hence preventing labour force outflow. Tansel (2001) too in studying female labour force participation in Turkey concludes that female labour force participation is

negatively influenced by unemployment, with a rather strong discouraging effect on female participation rates coming from male and female unemployment rates.

Darby, Hart and Vecchi (2001) in performing a study on France, Japan, Sweden and the US (Labour Force Statistics, 1970-1995, age groups and gender) and using country-specific business cycles (Harvey and Jaeger, 1993) conclude with the following results: discouraged worker effects are predominant, this being particularly true for females (aged 45-54) and during cycle slumps.

4. Econometric Methodology

Before employing non-linear econometric methodology we estimate a linear VECM with the maximum likelihood technique. Then we check whether the impulse-response functions implied by the linear structure are stable over different sample periods. 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 is a finite-order VAR of the following form:

[1] $$y_t = c + \sum_{i=1}^{k} A_i y_{t-i} + \varepsilon_t$$

In the above model, $y_t = [\, e_t, p_t \,]'$ is a vector of non-stationary variables containing the employment rate (e_t) and the participation rate (p_t). All variables involved in the analysis are found to be non-stationary. As a consequence, the likely misinterpretation of the long-run relationship among the variables, resulting from forcing these variables to be stationary by differencing them, can be avoided by taking into account the cointegration properties of the integrated variables. The original definition of cointegration requires that all the variables involved in the analysis have the same order of integration. The univariate unit root analysis, implemented by means of the Augmented Dickey-Fuller, suggests that all the series are I (1).

In order to characterize the long-run dynamic adjustments, we can rewrite the equilibrium VAR model as a vector error correction model (VECM). Specifically, the VAR*(k)* model described above can be rewritten in its VECM representation by subtracting y_{t-1} from the left and right sides:

[2] $$\Delta y_t = c + \sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-i} + \Pi y_{t-k} + \varepsilon_t$$

where $\Gamma_i = -\left(I_n - \sum_{j=1}^{i} A_j \right)$, $i = 1, ..., p-1$ and $\Pi = I_n - \sum_{j=1}^{k} A_j$.

The residuals from the cointegrating vector, lagged once, act as an error correction term. This term captures the disequilibrium adjustment of each variable towards its long-run value. The parameter on the error correction terms in each individual equation indicates the speed of adjustment of this variable back to its long-run value. A significant error correction term implies long-run causality from the explanatory variables to the dependent variables.

The matrix Π is usually decomposed as:

[3] $$\Pi = \alpha \beta'$$

where α and β are $n \times r$ matrices, *n* is the number of variables and *r* is the number of cointegrating relationships, containing the adjustment coefficient and the cointegrating vector, respectively; Δ is the first difference operator. In this form all terms are stationary, that is integrated of order zero, denoted I(0).

The system can be written as:

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

where α_{11} and α_{21} indicate the speed of adjustment of each variable back to its long-run value. We estimated this model by using the maximum likelihood procedure developed by Johansen (1988, 1991). The estimation results are reported in table 1 and 2.

Table 1: Linear VECM Estimates – Females

	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	

Table 2: Linear VECM Estimates – Males

	Δe_t		Δp_t	
	Coeff.	St. Error	Coeff.	St. Error
c	-0.085	[0.07]	-0.161	[0.07]
Δp_{t-1}	-0.243	[0.12]	-0.676	[0.17]
Δp_{t-2}	0.109	[0.16]	-0.039	[0.16]
Δe_{t-1}	0.117	[0.04]	0.563	[0.14]
Δe_{t-2}	-0.602	[0.14]	-0.280	[0.14]
α	-0.186	[0.09]	0.166	[0.13]
σ^2	0.91		0.89	

For the participation rate equation the adjustment coefficients (α_{11}) are significantly different from zero, both in Table 1 and 2, meaning that the participation rate adjusts to restore the long-run equilibrium. By contrast, in the participation rate equation the error-correction term is not significant for the male specification (table 2). As α_{21} is not statistically different from zero, the male employment rate is said to be long-run weakly exogenous with respect to the long-run equilibrium.

The absolute value of α gives information about the number of quarters needed to restore the long-term equilibrium. Specifically, for values of α close to unity, adjustment is very fast, with the disequilibrium being totally eliminated within one quarter. For $0 < \alpha < 1$ the dynamic adjustment path will be monotonically convergent.

Table 3 reports the speed of adjustment coefficients for the two estimated models.

Table 3: Estimated Speeds of Adjustment

	Females		Males	
	50%	90%	50%	90%
Employment rate	20.66	68.62	3.18	10.55
Participation rate	18.91	62.8	3.82	12.68

The table shows that, 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[4]. The speed of adjustment of the male participation rate is much higher: it takes less than one year for the participation rate to close the gap created by an equilibrium-distorting shock.

Having estimated the model, it is then possible to apply the impulse response analysis. The aim of this quantitative analysis is to document empirically the likely response of the employment and participation rate to a positive employment shock.

The estimated responses to a one percent increase in the employment rate are reported in Figure 1 and 2, which separately analyse four sub-periods that we select to account for the changes in the ISTAT LFS. To be exact, the characteristics of the LFS sample and the definition of labour market variables changed in 1977, 1983, 1992, 1996, and 2004. We will then analyse the model according to this timing.

The first period goes from 1959:4 to 1977:4. After an initial increase, both the employment and participation rate decrease. Consistent with the historical records the unemployment rate is also found to decrease. The pattern of the unemployment reaction is due to the larger response observed for the participation rate with respect to the employment rate reaction. As the difference between employment and participation rate is constantly negative, this results in a decreasing unemployment rate.

[4] 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.

Figure 1: Impulse Response Functions – Females

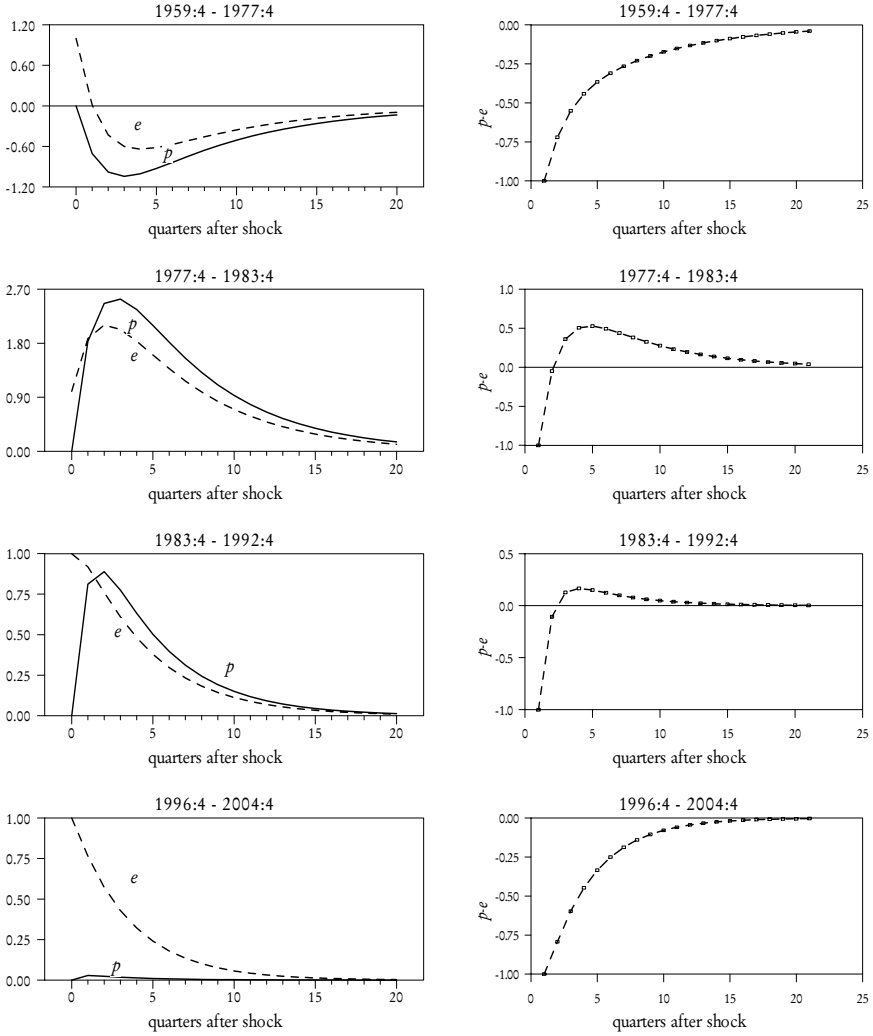
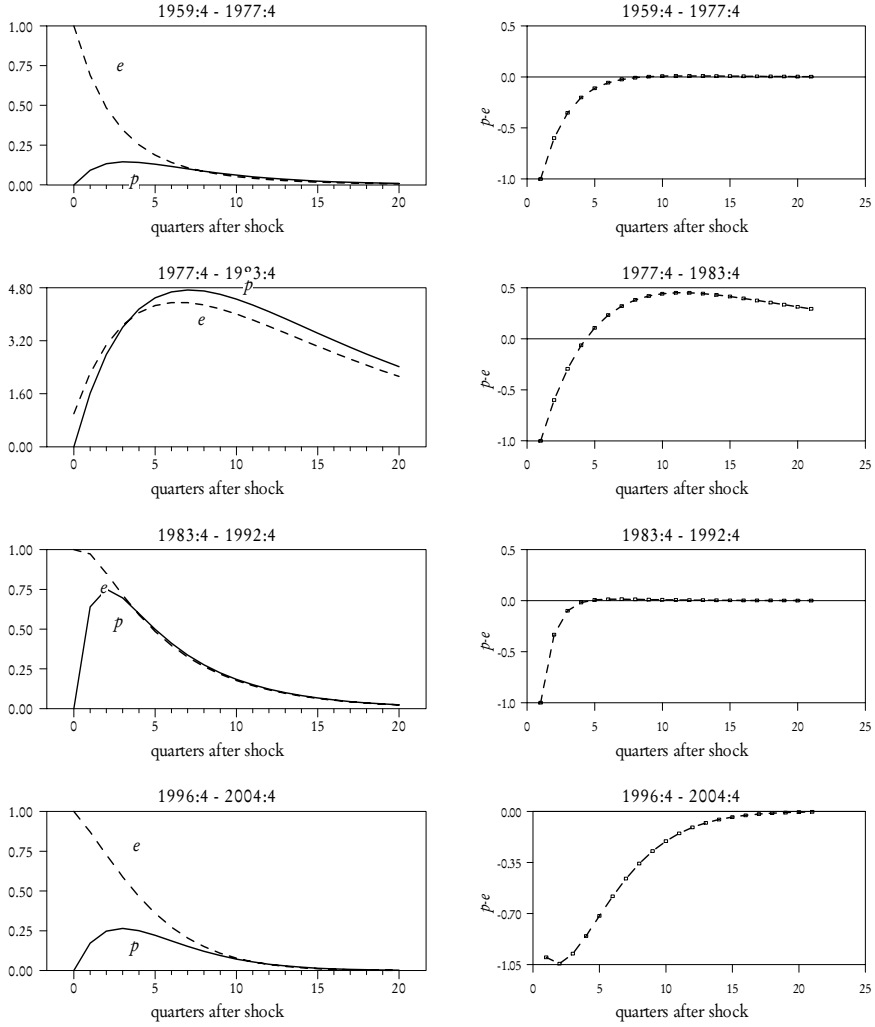


Figure 2: Impulse Response Functions - Males



In the second period, 1977:4-1983:4, an increase in the employment rate produces a rise in the participation rate. As the reaction of the participation is larger than the employment response, the positive shock leads to an increase in the unemployment rate.

The third period (1983:4-1992:4) is also characterized by an increasing unemployment rate. However, as the responses of the employment and participation rate are much closer, the resulting movement in the unemployment rate is lower than that observed in the second sub-sample.

Finally, for 1996:4-2004:4, the participation rate reaction is rather small. As the employment response is larger than the reaction of the participation rate, a 1% positive shock to employment rate leads to a decrease in the unemployment rate.

Results suggest that the reactions mostly depend on the sample periods selected for simulation. This seems to indicate that the relationship between employment and participation rate is time-dependent. As a consequence, the response of the unemployment rate[5] (obtained as the difference between employment and participation reaction functions) is also time-varying.

5. Modelling Non-linearity

We then 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:

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

[5] Note that the variables obtained by subtracting the employment rate from the participation rate is the unemployment rate defined as the ratio between job seekers and population aged 14-65.

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[6]:

$$[5] \quad \begin{bmatrix} \Gamma_{11}(L) & \Gamma_{12}(L) \\ \Gamma_{21}(L) & \Gamma_{22}(L) \end{bmatrix} \begin{bmatrix} \Delta e_t - \mu(s_t) \\ \Delta p_t - \mu(s_t) \end{bmatrix} = \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \end{bmatrix} (e_{t-1} - p_{t-1} - \delta(s_t) - \gamma t) + \begin{bmatrix} u_t^e \\ u_t^p \end{bmatrix}$$

where residuals are conditionally Gaussian, $u_t | s_t \sim NID(0, \Sigma(s_t))$; $\delta(s_t) = E[e_{t-1} - p_{t-1} - \gamma t]$ 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 4 and 5. Standard bottom-up procedure suggests three as the number of regimes for the female model, and two for the number of regimes selected for the male model.

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[6] 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 the parameter values. As we expected, the differences between the two models mainly consist of the different pattern of the dynamic propagation of a permanent shift in regime. More precisely, in the MSIAH model, the expected growth of the variables responds to a transition from one state to another in a smoother way. See Krolzig (1997) on the peculiarity of the two models.

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

	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] **			

In these tables, μ_1 refers to the average growth rate of quarterly employment and participation rate series in state 1 whereas μ_2 and μ_3 are the average growth rate of the dependent variables in state 2 and state 3, respectively.

These estimates are used to characterize the periods of high and low employment growth. The estimated quarterly growth of the female 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%).

The coefficients reported in table 5 indicate that the first regime is associated with a decrease in both employment and participation rate, with an average reduction of 25% and 19%, respectively. This means that in the first regime there is a positive relationship between the two observed variables. The second regime is characterized by a close-to-zero movement in the variables. The estimated quarterly growths are -1.3% and -0.6% for employment and participation rate, respectively. The evidence emerging from the table is consistent with the relative stability of these variables over the time periods associated with the second regime.

Table 5: ML estimates of the MSMH(2)-VECM(2) – Males

	Δe_t		Δp_t	
	Coeff.	St. Error	Coeff.	St. Error
μ_1	-0.255	[0.10]	-0.191	[0.07]
μ_2	-0.013	[0.03]	-0.006	[0.04]
Δp_{t-1}	-0.095	[0.12]	-0.389	[0.11]
Δp_{t-2}	-0.172	[0.11]	-0.170	[0.10]
Δe_{t-1}	-0.008	[0.09]	0.267	[0.08]
Δe_{t-2}	-0.412	[0.09]	-0.273	[0.08]
α	0.048	[0.03]	-0.082	[0.03]
σ^2 *(Reg.1)*	0.942		0.838	
σ^2 *(Reg.2)*	0.579		0.597	
log-likelihood	-238.2	vs. linear	-286.4	
AIC criterion	2.9	vs. linear	3.4	
HQ criterion	3.1	vs. linear	3.5	
SC criterion	3.3	vs. linear	3.7	
LR linearity test:	96.4485	Chi(5) =[0.0000] **		
	Chi(7) =[0.0000] **	DAVIES =[0.0000] **		

The speed of the adjustment coefficient is higher than that 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.

Table 6 also suggests that the adjustment coefficients for the male model are higher than that obtained for the female model. In particular, the employment rate restores 90% of the long-run equilibrium after almost 6 years. This evidence indicates that when considering the female variables, the relationship between employment and participation rate is consistently stronger than that observed for the male variables.

Table 6: Adjustment coefficients

	Females		Males	
	50%	90%	50%	90%
Employment rate	6.51	21.63	14.09	46.81
Participation rate	6.31	20.97	8.1	26.91

Once we have estimated the model, the transition matrix may be computed to analyse the probability of moving from one state to another. Our hypothesis

is that the estimated process follows a 3-state Markov chain. It is then possible to collect the transition probabilities in 3×3 and 2×2 transition matrices (table 7):

Table 7: Matrix of transition probabilities

Females

	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

Males

	Regime 1	Regime 2
Regime 1	0.899	0.101
Regime 2	0.031	0.970

The regimes are estimated to be quite persistent. For the female model, the least persistent regime is the last, while for the male model, the second regime is the most persistent.

The expected duration[7] and the ergodic probabilities are shown in table 8. The table shows that for the female model the expected duration for regime 1 (33 quarters), regime 2 (50 quarters) and regime 3 (28 quarters).

The right-hand table also indicates the expected probabilities for the male model. Regimes 1 and 2 are expected to last for 9.9 and 32.7 quarters, respectively.

Table 8: Regime Properties

Females

	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

Males

	N. Obs	Prob.	Duration
Regime 1	46.4	0.2	9.9
Regime 2	130.6	0.8	32.7

[7] 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: $\sum_{z=1}^{\infty} z p_{11}^{z-1}(1-p_{11}) = (1-p_{11})^{-1}$.

The further step consists in characterizing the timing of the regimes. The resulting smoothed probabilities are given in Figures 3 and 4.

Figure 3: Smoothed Regime Probabilities – Females

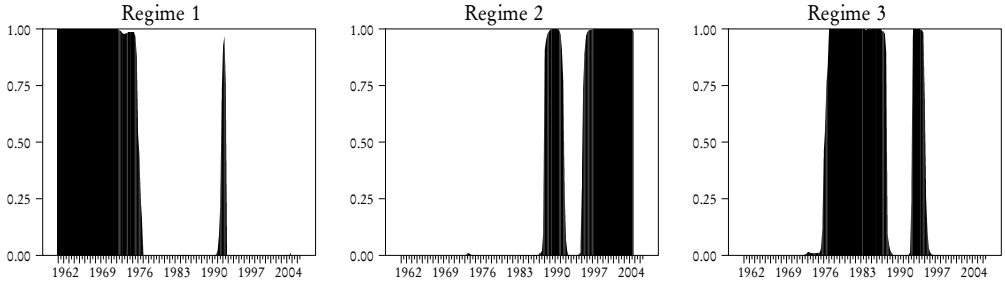
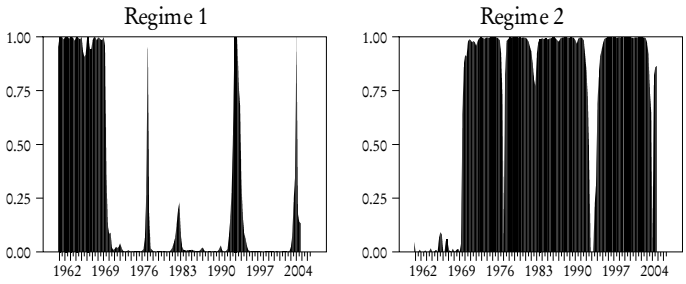


Figure 4: Smoothed Regime Probabilities – Males



The estimated smoothing probabilities point out the behaviour of the variables within the selected regimes.

Figure 3 depicts the female regimes. Regime 1 coincides with the decrease in the employment rate and participation rate from the 1960s to the first half of the 1970s. The changing composition of the labour force from agriculture towards non-agricultural activities might be the reason for the declining participation rates. In fact, both female and male participation rates are higher in rural than in urban areas. In agricultural-based areas, men are typically self-employed, while women are mainly voluntary family workers. When women migrate into industrial-based areas they drop out of the labour force and concern themselves with household work.

Regime 3 summarizes the recovery of the employment rate following industrialization. At higher income levels when agriculture is not the dominant form of economic activity women participate in the labour force in small numbers. This evidence is in line with a U-shaped female labour force participation rate. This particular relation alludes to a non-linear long-term relationship between female labour force participation rate and economic development.

Finally, Regime 2 is characterized by a positive growth in both employment and participation rate. However, the years 1988-91, and 1995-2004, as reported in table 9, are identified as periods of time when the growing process observed in the previous years decelerates.

Figure 3 and table 9 describe two estimated regimes related to the male variables. Regime 1 coincides with decreasing employment and participation rate of the 1960s and 1970s. Regime 2 is instead characterized by a close-to-zero growth in both employment and participation rate. During these periods the two variables stabilized.

Table 9: Regime Classification

Regime 1	Regime 2	Regime 3
	Females	
1960:4 - 1976:1 [0.9873]	1988:1 - 1991:3 [0.9634]	1976:2 - 1987:4 [0.9787]
1991:4 - 1992:3 [0.8387]	1995:2 - 2004:4 [0.9882]	1992:4 - 1995:1 [0.9659]
	Males	
1960:4 - 1969:2 [0.9835]	1969:3 - 1976:4 [0.9582]	
1977:1 - 1977:1 [0.9868]	1977:2 - 1992:2 [0.9699]	
1992:3 - 1993:4 [0.8388]	1994:1 - 2003:4 [0.9639]	
2004:1 - 2004:1 [1.0000]	2004:2 - 2004:4 [0.8480]	

We now turn to impulse response analysis. Following Krolzig and Toro (1998) we compute the effects of a regime-wide shock on the employment and participation rate (Figure 5 and 6). 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[8] distribution to a specific regime. A 40-quarter horizon is considered.

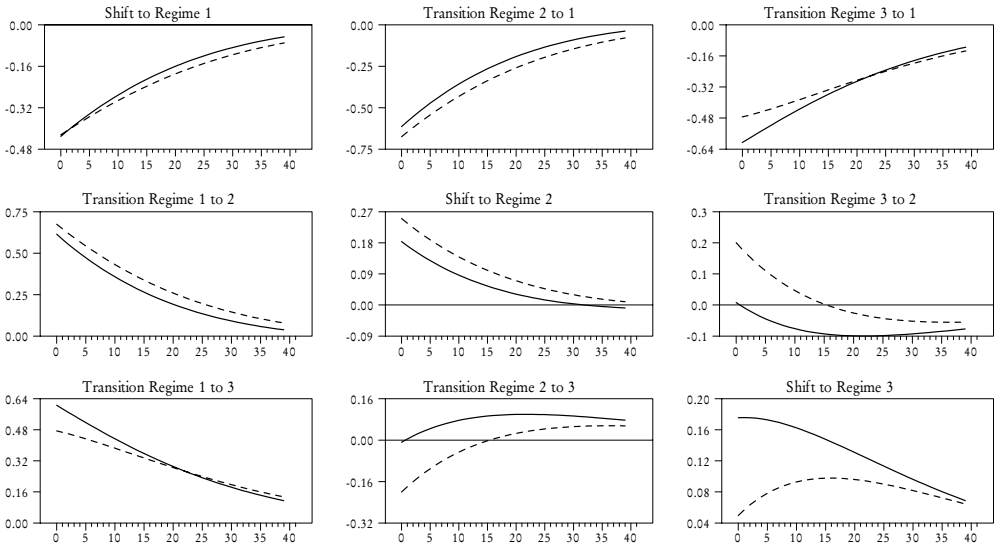
Figure 5 shows the response of the female employment (dashed lines) and participation rate (solid lines) when they move from steady-state probabilities to the three estimated regimes. Here, we observe the different dynamics governing the two selected variables during high- and low-employment periods. The upmost left graph (shift to regime 1), for example, represents the reaction of the employment and participation rate to the information that $s_t = 1$. 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 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 5 also suggests a different time pattern of the selected variables to a regime shift. During regimes 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 that observed for the participation rate.

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

Figure 5: Responses to Regime Shifts - Female: Employment (dashed) - Participation (solid)



These asymmetries can also be detected by looking at male employment and participation when there is a change in the existing regime.

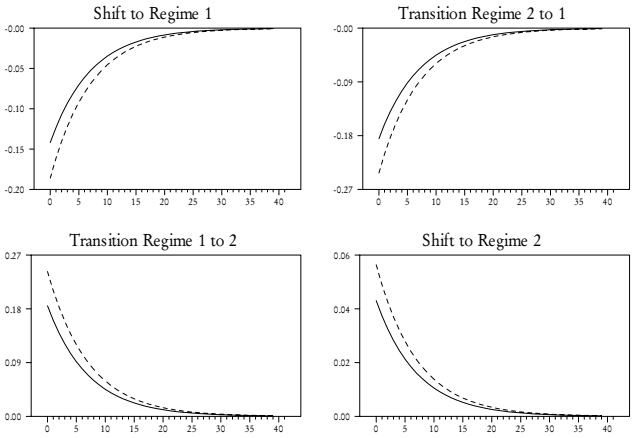
Figure 6 depicts the dynamics of male employment and participation when they move from regime 1 to regime 2. The time profile of the estimated responses suggests that when the system moves from steady-state probabilities to regime 1 the speed and magnitude of the employment and participation reduction that follows is lower with respect to the increase in the observed variables that leads from the shift to regime 2.

The figure suggests that the discouraged worker effect is greater than the encouraged worker effect: the latter appears to be approximately one-half the size of the former effect.

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 rate (when the

change in the participation rate exceeds the employment rate response – regime 3) or a decrease in the unemployment rate (i.e. when the labour force participation reacts less than the employment rate – regime 2).

Figure 6: Responses to Regime Shifts – Male: Employment (dashed) - Participation (solid)



6. Conclusions

This paper investigated the relationship between the labour force participation and the employment rate in a gender-based perspective in Italy. We stressed that Italian labour market performances/fallacies may be explained by means of some key labour market variables and their underlying driving factors. Then we reviewed the econometric literature concerning the exact nature of the relationship between employment and labour force participation and conclude that the econometric evidence does not seem to give an unambiguous picture.

The contribution of the present paper was twofold. First, we model the relationship between employment and labour force participation by means of non-linear econometric techniques. Second, we characterise the dynamic interaction between the two selected variables by computing regime-dependent impulse-response functions. In particular, the estimated models describe the

employment adjustment process towards its long-run equilibrium for both males and females.

Although the number of stable regimes identified over the sample period is gender-dependent, some analogies emerge. Precisely, the main implication arising from the analysis suggests the presence of non-linear mean reversion. However, the female counterpart shows larger asymmetries over the estimated regimes when compared with males.

The results also suggest that an equilibrium-distorting shock will have a greater effect on employment during periods when the deviation between the employment rate and participation rate is large. As a consequence, when the employment rate is close to its equilibrium value it tends to be less sensitive to any shock in the participation rate. Hence the relative strength of the participation rate to act as a driving force for employment long-term equilibrium is consistently time-varying.

Appendix

The time series used in the empirical analysis are shown in figure A.1, A.2 and A.3.

Figure A.1: Labour Market Trends – Females

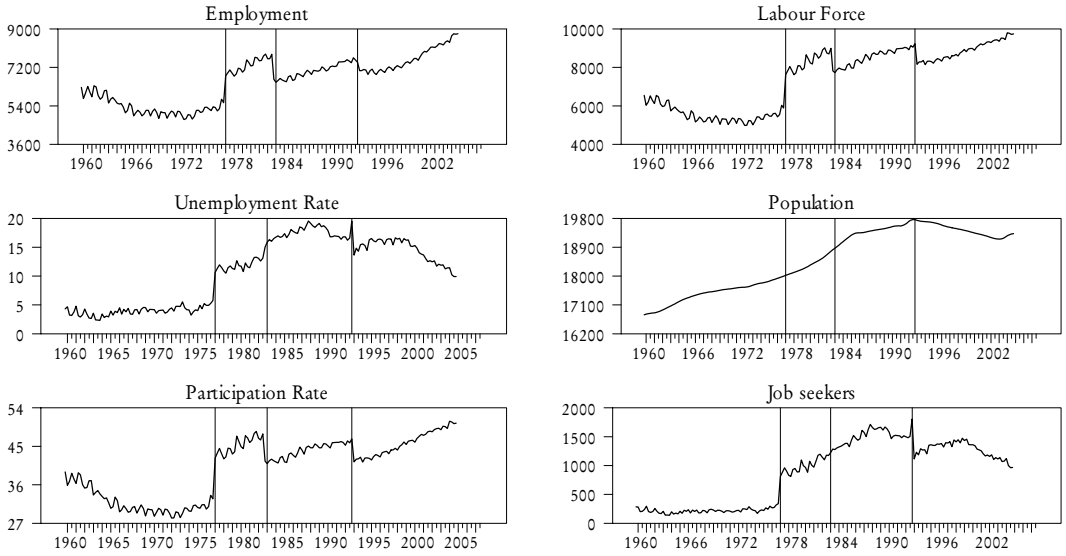


Figure A.2: Labour Market Trends – Males

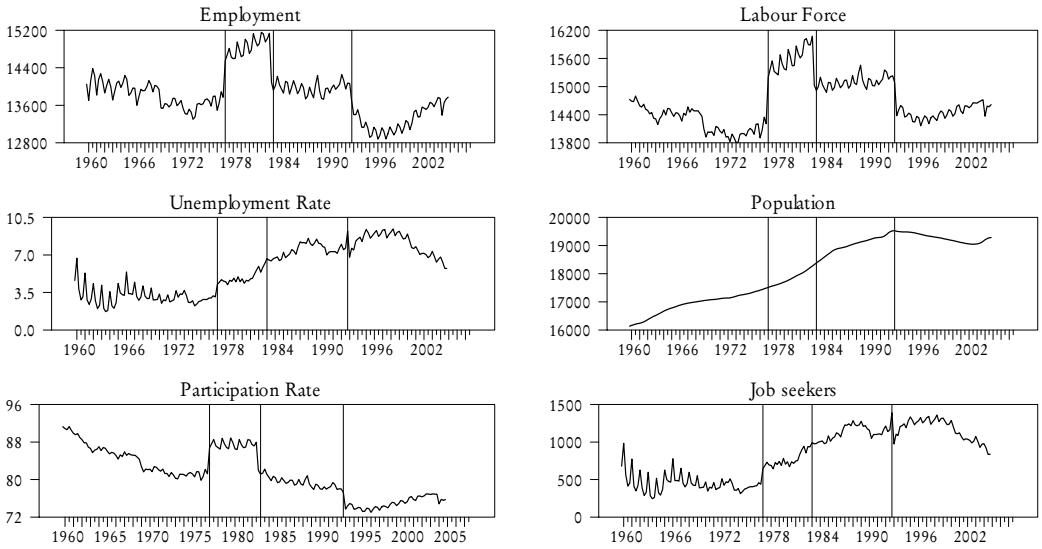
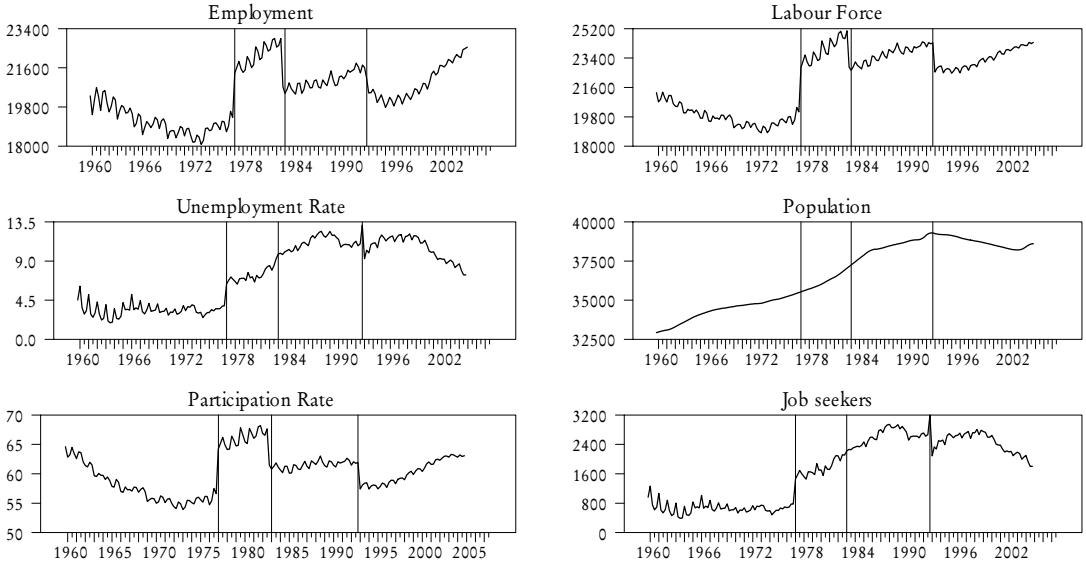


Figure A.3: Labour Market Trends – Total



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