LABOUR MARKET FLOWS
AND UNEMPLOYMENT DYNAMICS BY SEX
IN GREECE DURING THE CRISIS

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Although, during the current Greek crisis, male employment retreated much more than female employment, the gender unemployment gap remained remarkably stable. To explain this outcome we have analysed labour market flows by sex using descriptive statistics and counterfactual techniques. Empirical findings suggest that while men experienced more dramatically the labour demand shock of the crisis because its impact was harder on male-dominated sectors, their falling participation rate mitigated the rise in the male unemployment rate. Women were affected less than men by the labour demand shock, but inactive women joined the labour force in increasing numbers that boosted the female unemployment rate. We interpret supply-side responses in terms of the discouraged worker and added worker effects.

Keywords: Gender unemployment gap, Labour market flows, Greece, Crisis.

Greece is currently undergoing the deepest structural crisis in its recent history, triggered by a sovereign debt crisis which erupted in late 2009. In May 2010 the country received financial aid from its Eurozone partners and the IMF. This was made conditional on the implementation of an Economic Adjustment Programme (EAP) promoting fiscal consolidation through austerity, and internal devaluation through the reduction of labour costs.

The austerity cure produced a huge fall of the GDP in the first three years of the EAP's implementation (2010-12), on top of that

in 2008-9 caused by the global financial crisis. Since the beginning of the crisis, GDP has declined by 20.1% and employment by 17.5%. The number of unemployed has increased by 3.3 times, while the unemployment rate climbed from 8.1% to 26.3% between the last quarter of 2008 and the last quarter of 2012. By the latter date, the male unemployment rate had reached 23.3%, while the female rate was 29.7%; the largest unemployment gender gap among the EU27 Member States.

In fact, Greece already had the largest gender gap in unemployment in EU27 before the crisis, mainly due to very high female unemployment compared to European rates. In spite of the rapid growth of female employment in the 1980s, 1990s and 2000s, demand for female labour had been constantly outstripped by supply, leading to very high female unemployment throughout this very long period (Karamessini 2012). Moreover, with the advent of the crisis, the gender gaps in activity and employment rates were among the highest in the EU27. Finally, in 2008, female activity and employment rates were increasing but still low (55.1% and 48.7% respectively), while the female unemployment rate was decreasing but still high (11.4 per cent).

Although employment of both sexes has collapsed due to the deep and prolonged recession, the gender gap in unemployment remained stable between 2008 and 2012, at 6.4 percentage points. To explain this stability, we have used labour market flow analysis to identify and measure the contribution of distinctive flows in the dynamics of unemployment by sex. The starting point of this kind of analysis and modeling is that aggregate labour market indicators, such as employment, unemployment and inactivity rates, and their changes over a given period are determined by the inflow and outflow of workers between the main labour market statuses.

The analysis of labour market flows by sex enriches and complements existing literature on the gendered effects of the crisis and their determinants. As regards the explanation of gender differences in the employment effects of the crisis, this literature emphasizes the role of sex segregation of employment by occupation, sector and type of work/contract (Milkman 1976, Bettio 1988, Humphries 1988, Rubery 1988, Bettio *et al.* 2012, Karamessini and Rubery 2014). Concerning the crisis effects on the labour supply behaviour of men and women, the economic literature has

concentrated its attention on women and tested the added/discouraged worker hypotheses (Mincer 1962, 1966; Lundberg 1985). For its part, the feminist literature is interested, more broadly, in the coping strategies of households that vary by gender (Sabarwal *et al.* 2010), and the changes these bring to the family (work) model (Bettio *et al.* 2012).

There is also a longstanding literature on the determinants of gender inequalities in unemployment, dating from the crisis of the 1970s. Within this literature, DeBoer and Seeborg (1989) were among the first to explain the change in the gender unemployment gap in the United States, using transition rates between labour market statuses. They found that half of the change was explained by transitions into and out of the labour force, while the other half was linked to transitions between employment and unemployment. In a more recent paper, Azmat, Güell and Manning (2006) have studied the gender labour market dynamics in OECD countries and established that the gender unemployment gap is mainly the outcome of gender differences in flows inside the labour market, rather than gender differences in flows into or out of the labour force. Women face higher transition rates from employment into unemployment and lower transition rates from unemployment into employment.

Our paper follows the tradition of the above literature and tries to understand the evolution of the gender gap in unemployment during the crisis,through an analysis of gender differences in labour market flows. Its main finding is that the observed stability of the gender gap in unemployment during the crisis is the net outcome of two countervailing developments. On the demand side, the decline in employment has been proportionally higher among men, leading to a narrowing of the gap. On the supply side, female labour force participation has been increasing while male participation has been falling, leading to a widening of the gap. These opposing effects have canceled each other out. While the greater decline of male employment can be explained by sector segregation of employment by sex, the increase in the female labour force participation can be attributed to the pre-existing large pools of inactive women.

The structure of the paper is as follows. In Section 1 we briefly set out the gendered labour market effects of the crisis, by looking

at the evolution of basic labour market indicators. Section 2 describes the labour supply behaviour of men and women during the crisis, analyzing the flows between labour force and inactivity. We then measure the effect of changes in the labour force participation rates of men and women on the dynamics of unemployment by sex. Section 3 turns to flows between employment and unemployment, and we estimate their contributions to the variations of the unemployment rate. The final section summarizes and concludes.

1. The gendered impact of the crisis and trends in basic labour market indicators

The labour market effects of the economic crisis differ considerably by sex as can be demonstrated by the changes in basic labour market indicators, such as labour force participation, employment and unemployment, since the beginning of the crisis (Table 1).

Table 1. Labour market developments during the crisis

In %

	Men	Women	Men	Women
	2008 q4 - 2010 q4 change		2010 q4 – 2012 q4 change	
Labour force	-0.5	3.9	-1.8	1.0
Employment	-7.0	-3.4	-14.9	-13.5
Unemployment	114.6	59.4	98.2	67.5
	2008 q4	2012 q4	change in p.p.	
Activity rate				
Men	78.9	77.5	-1.4	
Women	55.3	58.7	3.4	
Employment rate				
Men	74.6	59.2	-15.4	
Women	48.8	41.1	-7.7	
Unemployment rate				
Men	5.3	23.3	18	
Women	11.7	29.7	18	

Source: ELSTAT, Labour Force Survey.

Although both male and female employment collapsed during the crisis, net job destruction between 2008 and 2012 (last quar-

ters) was more sizeable in the case of men than in the case of women (-20.5% and -16.3% respectively). This was mainly due to the sector segregation of employment by sex (Karamessini 2014, Table 9.3, p. 174): male-dominated sectors contributed to 54% of the overall contraction of employment between 2008 Q4 and 2012 Q4, mixed-sex sectors to 42% and female-dominated ones to 4.2%. At the same time, female employment was proportionally less hit in male-dominated sectors and more hit in the mixed-sex and female-dominated ones. Sector segregation also explains why male employment retreated much more than female employment during the initial phase of the crisis (2008-9), while the decline of female employment almost equalized the male decline during the phase of fiscal consolidation: i.e., since 2010 (Table 1). Public sector employment has suffered from fiscal consolidation and women have taken a heavy toll, because at the onset of the crisis they were over-represented in this sector, relative to their share in total employment. Since 2010, female public sector employment has incurred heavier losses than male employment (Karamessini 2014, Table 9.4, p. 177).

In spite of the steep contraction in employment, the female activity rate increased by 3.8 percentage points and the female labour force by 5.3% between 2008 and 2012 (last quarters). Opposite changes took place for men: i.e. there was a decrease in the male activity rate and labour force. The rise in the migrant women's activity rate was more spectacular than that of Greek women, contributing more than the latter to the increase in the overall female activity rate (Karamessini 2014, Figure 9.1, p. 172).

The outcome of the above changes is that the number of unemployed men increased 3.25 times and that of women 1.67 times, while the unemployment rate of both sexes rose. In the 2012 Q4, the female unemployment rate had reached the vertiginous height of 29.7%. As for the male rate, it stood at the historically high level of 23.3%. Both rates were still rising in June 2013.

Male and female unemployment rates rose in parallel during the crisis (Figure 1) keeping the gender gap stable in terms of its percentage point difference. Given the greater relative contraction of male employment, this can be accounted for only by the important mobilization of inactive women during the crisis.

Figure 1. Unemployment rates by sex
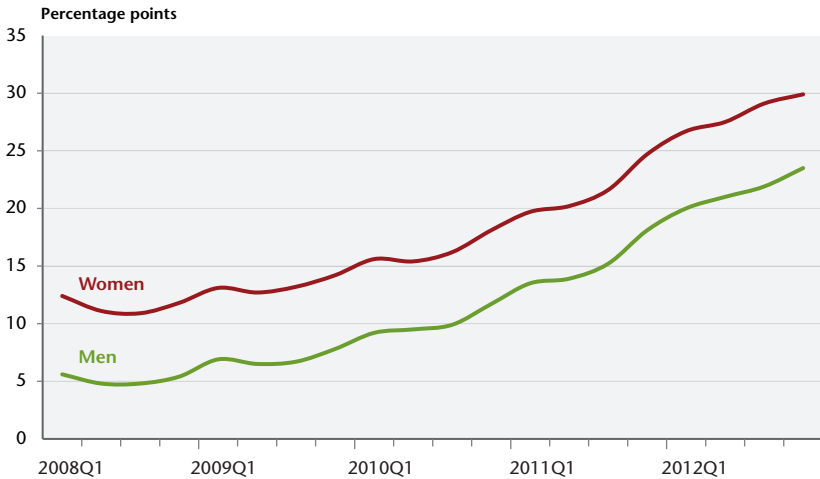
Source: Quarterly Labour Force Surveys of The Hellenic Statistical Authority (EL.STAT.).

2. The labour supply behaviour of men and women: flows in and out of the labour force and unemployment dynamics gender

In this section we study differences in the labour supply behaviour of men and women during the crisis, as well as their impact on unemployment dynamics by sex and the evolution of the gender gap in unemployment rates. The impact of the crisis on the male and female labour supply behaviour has been analysed in the literature through the "discouraged" vs. "additional" worker effects.

Lundberg (1985, p. 12) has maintained that *"A widespread deterioration in employment opportunities results in discouraged workers, who drop out of the labor force or refrain from entering it in anticipation of reduced wages or more costly job search. Additional labor force participants, however, may appear in families whose employed members have experienced layoffs or restrictions in work hours"*. The latter phenmenon corresponds to the added worker effect and concerns "secondary workers" such as married women and teenagers. Ehrenberg and Smith (1997, p. 232) argue that the effect tends to be small for the following reason: *"The added-worker effect is confined to the relatively few families whose sole breadwinner loses a job… and as more and more women become regularly employed for pay, the added-worker effect will tend to both decline and become increasingly confined to teenagers"*. This assumption does not however hold for all countries and time periods.

From the above we deduce that: (a) discouragement will be higher among the sex that experiences the greatest deterioration in employment opportunities; (b) the higher the share of male-bread-winner families in society, the greater the added-worker effect will be among female spouses/partners and the larger the rise in the female labour force participation rate will be. In 2008 Q2, 40.1% of all couples aged 20-55 years in Greece lived in male-breadwinner households. This means that there was a large scope for a robust added-worker effect among women when the recession broke out. Moreover, in the first four years of the crisis, net job destruction was higher for men than for women, making a greater rise in discouragement among men more likely.

The following sub-section describes the trends in the flows in and out of the labour force by sex, and discusses these trends in the light of the theoretical forecasts mentioned above. The second sub-section measures the impact of gender differences in labour force participation behaviour on the evolution of the male and female unemployment rates, by estimating a counterfactual unemployment rate if both the male and female activity rates had remained constant through the crisis.

2.1. Trends in flow rates in and out of the labour force

To analyse gender differences in labour supply behaviour during the crisis and its relationship to the growth of unemployment in depth, we have calculated the transition rates between labour market statuses by sex, using Labour Force Survey (LFS) data of respondents' labour market status, one year before the survey. The latter has been compared to the labour market status at the moment of the survey, in order to produce quarterly data on annual flows from which we have calculated the respective rates. The same method has recently been used by Kanellopoulos (2011, 2012) to calculate and analyse worker flows before and during the current crisis in Greece.

Ideally, analysis of flows in and out of the labour force during the crisis should also take into account the effect of migration flows on the observed outcomes. However, Eurostat data are available only for 2010 and 2011. They demonstrate net emigration flows in both years, as well as a decline in immigration and a rise in emigration flows between 2010 and 2011. Net emigration experienced a U-turn brought about by the crisis, since Greece had become a net

host country in the beginning of the 1990s, and remained so until 2008. The crisis has caused not only the departure of established migrants, who lost their jobs mainly in construction and manufacturing (males) and services to house-holds (females). It has also pushed young and highly-educated Greeks, unable to find decent jobs, to look for employment and careers abroad.

Although of great relevance, studying the impact of net migration on labour market flows falls outside the scope of empirical analysis here, and would require complete time series and detailed data sets. We can only guess that, in the absence of net emigration, the male and female unemployment rate would be much higher, although we are unable to predict if the gap between men and women would have been greater or smaller than that observed. That said, we analyse the flows of men and women in and out of the labour force during the crisis, describing trend flow rates.

Figure 2 shows similar trends in the male and female flow rates **from inactivity to activity** during the crisis: an increase until the end of 2009, a decline in 2010 and 2011, followed by an upswing during the latest phase. Increases though were steeper and the decline period was shorter in the case of female rates. As a result, in the last quarter of 2012, the male inactivity-to-activity flow rate was roughly the same as four years earlier, while the respective female rate was much higher than that in the last quarter of 2008. This indicates the predominance of the added-worker over the discouraged-worker effect among inactive women, for the whole period of study. In the case of inactive men, the discouraged and added-worker effects cancelled themselves out during the same period.

Given the trends in flows from inactivity to activity, let us now turn to the outcome of job search of inactive men and women joining the labour force over the first four years of crisis. Figure 3 shows that a constantly growing rate of inactive men and women was becoming unemployed in this period. This is due to increasing difficulties in finding a job, illustrated by the decreasing rate of inactive men and women moving from inactivity to employment (Figure 4). The growth in the male flow rate from inactivity to unemployment across the whole period has been slightly more important than that of the female rate, in accordance with the steeper decline in the flow rate of men from inactivity to employment, between the 2009 Q4 and 2011 Q1.
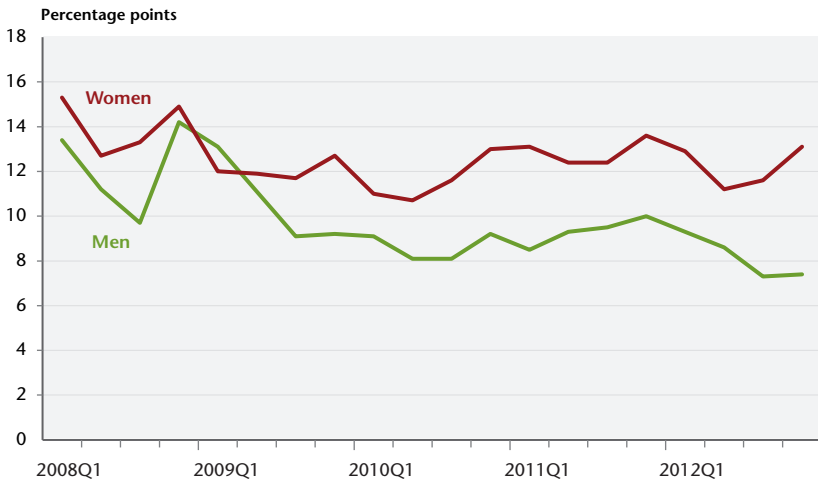
Figures. 2,3 and 4. Flow rates from inactivity...

... to Activity

... to Unemployment
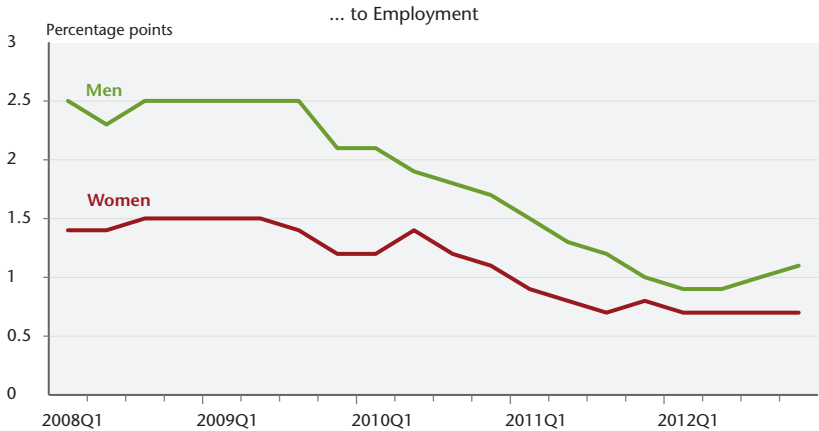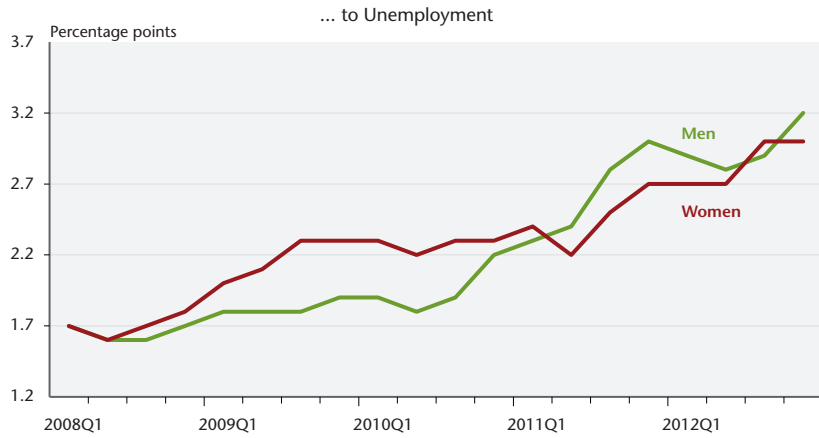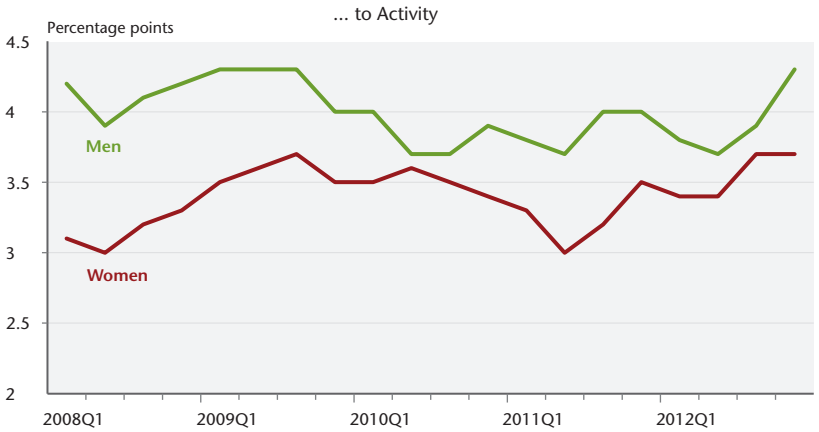
... to Employment

Source: Quarterly Labour Force Surveys of The Hellenic Statistical Authority (EL.STAT.).

Another important flow affecting the volume and rate of unemployment concerns **exits from unemployment to inactivity**, measuring the discouragement effect of job scarcity on unemployed people. This is supposed to increase during recessions. In order to test the validity of this hypothesis, we have calculated the exit rates from unemployment to inactivity, using quarterly LFS data. Figure 5 below shows that discouragement of the unemployed of both sexes to engage in job search decreased during the first two years of the crisis, hence their exit rate from the labour force has been falling until mid-2010, and more in the case of men. After mid-2010, the trend was reversed in the case of women, most probably due to the steep fall in female employment. As for the male exit rate, it continued its fall after a temporary rise. The end result of the above trends (over the first four years of the crisis examined here) is that the discouragement effect of job scarcity on the unemployed was reduced by half in the case of men, and slightly less in the case of women.

**Figure 5. Flow rates from unemployment to inactivity**

Source: Quarterly Labour Force Surveys of The Hellenic Statistical Authority (EL.STAT.).

Finally, **exits from employment to inactivity** reduce the labour force and boost the unemployment rate, if the volume of unemployment remains constant. Figure 6 shows increasing flow rates from employment to inactivity, from the end of 2009 until the end of 2011 in the case of men, and to mid-2012 in the case of women. These trends mainly capture the effects on the retirement

decisions of both sexes of radical pension reforms to basic and supplementary pensions, which took place in 2010 and 2011 respectively. These reforms aimed to reduce significantly state-budget allocations to social security funds to meet deficits caused by the skyrocketing of unemployment during the crisis. But the reforms also projected longer-term deficits due to a falling contributor-to-pensioner ratio. Such reforms have significantly raised the legal retirement age of men and women, as well as the qualifying periods for full pension entitlements. At the same time, they have reduced early retirement options and pension benefits. In so doing, the reforms have produced mass exits to retirement of public and private sector employees entitled to early retirement under the old system and willing to benefit from incentives granted by the reforms during transition periods to the new system. Increasing flow rates from employment to inactivity may also capture a discouraged-worker effect among all persons who became unemployed but were not entitled to benefits. However, qualifying conditions for claiming benefits are relatively loose in Greece (only 5 months of contributions).

Figure 6. Flow rates from employment to inactivity
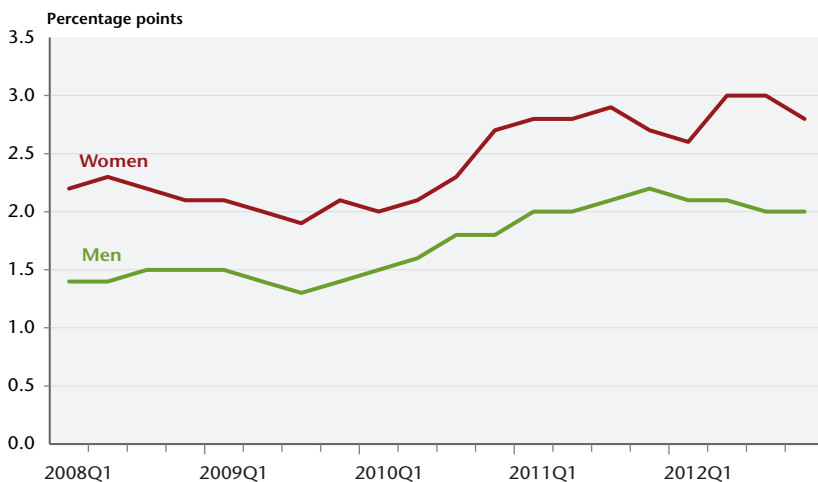
Source: Quarterly Labour Force Surveys of The Hellenic Statistical Authority (EL.STAT.).

We can draw the following conclusions from the above analysis. First, the increase in the rate of inactive women joining the labour force has boosted female unemployment, given job scarcity. It points to the prevalence of the added-worker effect

among inactive women during the crisis. The respective rate of inactive men remained constant across the period, indicating that the added-worker and the discouraged-worker effects have cancelled each other out. Second, discouragement of the unemployed of both sexes has weakened during the initial phase of the crisis. The effect was stronger in the case of men and has thus increased male more than female unemployment. Since mid-2010, discouragement has been growing among unemployed women but has kept falling among unemployed men. Last but not least, pension reforms in 2010 and 2011 have increased male and female flow rates from employment to inactivity, indirectly boosting male and female unemployment rates.

2.2. The constant participation unemployment rate

In this sub-section we consider all the trends in flows in and out of the labour force which were presented in the previous sub-section, in order to examine the impact of changes in the labour force participation rates of men and women on the evolution of the gender gap in unemployment. In particular, we construct separately a counterfactual unemployment rate for men and women, which we would observe if participation decisions of men and women had not been affected by labour market conditions and institutional changes, such as pension reforms. We call this the **'constant participation unemployment rate'** and derive it in the following way.

The unemployment rate is given by

$$u = \frac{L - E}{L} \tag{2.1}$$

where L is the labour force and E employment.

Log-differentiation of (2.1) (see the Appendix) obtains the change in the unemployment rate, as a function of logarithmic changes of employment and the labour force.

$$du = (1 - u)(d \log L - d \log E) \tag{2.2}$$

Since the labour force equals the participation rate a times the working age population P i.e.

$$L = aP,$$

it holds that:

$$d \log L = d \log a + d \log P$$

and the unemployment change is given by:

$$du = (1-u)(d \log a + d \log P - d \log E) \cdot$$

In discrete time this can be written as:

$$u_t - u_{t-1} = (1 - u_{t-1})(\Delta \log a_t + \Delta \log P_t - \Delta \log E_t) \qquad (2.3)$$

Setting $d \log a = 0$, and summing up the changes to the initial unemployment rate $u_0 = u_0^{CP}$, we find that the constant participation unemployment rate at any period t is given by:

$$u_t^{CP} = u_0 + \sum_{i=1}^{i=t}\left[(1 - u_{i-1})(d \log P_i - d \log E_i)\right] \qquad (2.4)$$

Equation (2.4) is applied to calculate the constant participation unemployment rates in Figures 7 and 8 below.

This also allows the decomposition of changes in the unemployment rate in any period $\{t, t+n\}$ into changes of employment and changes of participation:

$$u_{t+n} - u_t = (u_{t+n} - u_{t+n}^{CP}) + (u_{t+n}^{CP} - u_t)$$

The first term on the right-hand side captures the **participation effect**, and the second term the **employment effect.**
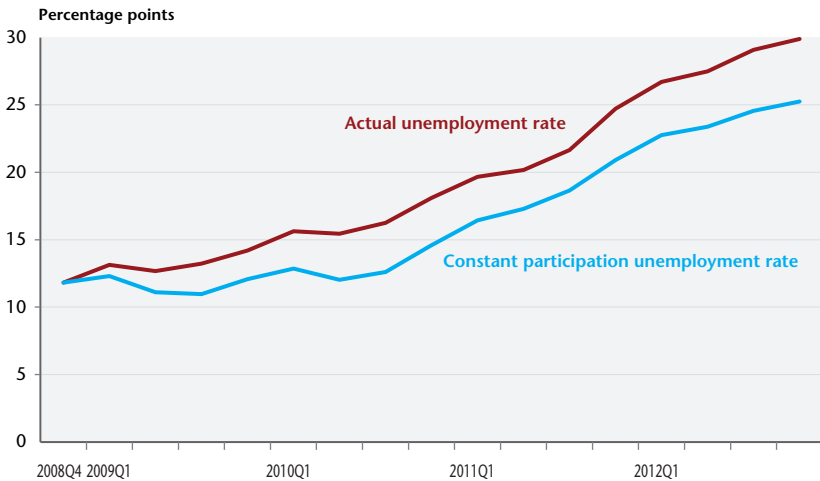
The actual male unemployment rate in 2008 Q4 was 5.4%. By 2012 Q4 this had climbed to 23.5%, whereas the constant participation unemployment rate stood at 25.3%. This implies that the actual unemployment rate is 1.8 percentage points lower than the would-be unemployment rate, because of the large decline in the male activity rate during the crisis. This is entirely accounted for by the rise in the male flow rate from employment to inactivity – mainly due to the 2010 and 2011 pension reforms – since discouragement remained constant among inactive men and declined among those unemployed between 2008 and 2012, as discussed above. The decline in the male activity rate has lessened the increase in the male unemployment rate by about 10%. It should be noted that decline followed a period of stability in the male activity rate between 2004 and 2008.

Figure 7. Actual and constant participation unemployment rates-men

Percentage points

Constant participation unemployment rate

Actual unemployment rate
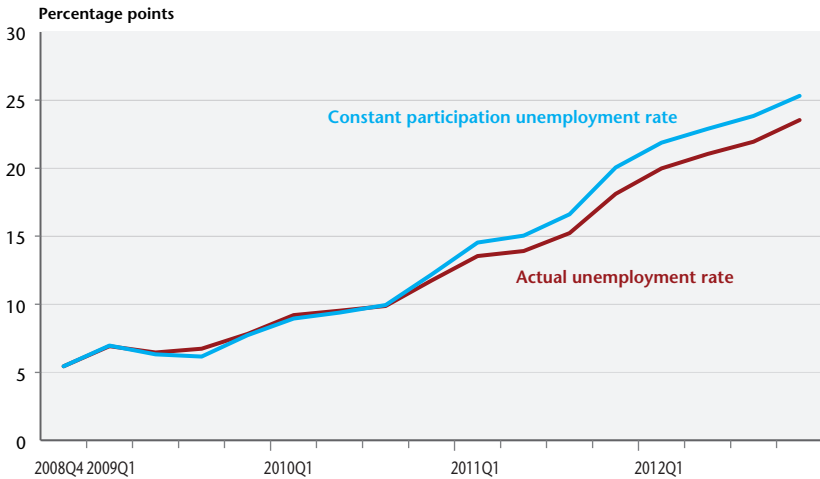
Source: Quarterly Labour Force Surveys of The Hellenic Statistical Authority (EL.STAT.).

Figure 8. Actual and constant participation unemployment rates-women

Percentage points

Actual unemployment rate

Constant participation unemployment rate

Source: Quarterly Labour Force Surveys of The Hellenic Statistical Authority (EL.STAT.).

The actual female unemployment rate in 2008 Q4 was 11.8%. In 2012 Q4 it had climbed to 29.8% whereas the constant participation unemployment rate was only 25.2%. This means that the actual unemployment rate was 4.6 percentage points higher than the would-be unemployment rate, because of increasing participation. Also, 25.5% of the percentage-point change of the female unemployment rate between the 2008 Q4 and 2012 Q4 is ex-

plained by the increase in the female activity rate of 3.4 percentage points. It is noteworthy that this rate had risen from 50% to 55% between 2000 and 2008, indicating acceleration during 2008-2012, and pointing to the prevalence of the added-worker effect over the discouraged-worker effect, during the crisis discussed above.

In sum, the actual male unemployment rate is lower than the constant participation unemployment rate, whereas the actual female unemployment rate is higher than the constant participation one. It follows that if the participation rates of both genders remained constant, we would observe a smaller gender unemployment gap than is actually the case.

3. Unemployment dynamics and flows Inside the labour force: gender differences and gaps

After an examination of the effects of gender differences in the participation behaviour on unemployment dynamics by sex, we now turn to the impact on the latter of flows inside the labour force: i.e., the transitions between employment and unemployment, holding the labour force constant.

3.1. Job finding and separation rates

The methodology we employ calculates the flow rates from LFS data. The core methodology draws on Shimer (2007), extended and modified by Elsby, Michaels and Solon (2009) and Fujita and Ramey (2009). The method is built on basic stock-flow relationships. Assuming that the labour force is constant (i.e., all unemployment variations derive from transitions between two states, namely employment and unemployment), the unemployment stock U (i.e., the number of unemployed persons) evolves according to:

$$\frac{dU}{dt} = sE - fU \; .$$

Where E is the employment stock, s is the flow rate from employment to unemployment (i.e., the separation rate), and f is the flow rate from unemployment to employment (i.e. the job finding rate). We assume that s, f are Poisson arrival rates (see the Appendix).

Denoting the constant labour force by L, and substituting $E = L - U$ we find that:

$$\frac{dU}{dt} + (s+f)U = sL \qquad (3.1)$$

If we take U_t as the initial condition, the solution (see Appendix) of differential equation (3.1) is:

$$U_{t+1} = \frac{s_t}{s_t + f_t} L_t [1 - e^{-(s_t + f_t)}] + U_t e^{-(s_t + f_t)} \qquad (3.2)$$

This is a relationship between current and previous unemployment levels and the flow rates that we shall use later.

Following Shimer (2007), we shall obtain the flow rates from labour force survey data. Let us consider the discrete change in the number of unemployed workers within a quarter: it must necessarily be equal to the inflows during the quarter, given by the short-term (less than three months) number of unemployed workers, U_t^S, minus the outflows, given by the previously unemployed who found a job during the quarter: i.e., the previous unemployment stock times the probability of finding a job $F_t U_{t-1}$.

Thus,

$$U_t - U_{t-1} = U_t^S - F_t U_{t-1} \qquad (3.3)$$

Solving equation (3.3) for F we find that the job finding probability is:

$$F_t = 1 - \frac{U_t - U_t^S}{U_{t-1}} \qquad (3.4)$$

Having thus determined the job finding probability we can calculate the associated Poisson rate using the formula (see Appendix):

$$f_t = -\ln(1 - F_t) \qquad (3.5)$$

The calculation of the separation rate is a little more complicated. Had we used the expression $U_t - U_{t-1} = S_t E_{t-1} - F_t U_{t-1}$ (which can be rewritten as $S_t = \frac{U_t^S}{E_{t-1}}$), we would be underestimating the job separation probability, since we would fail to take

account of all those workers who lost a job and found another one during the same quarter: this is what Shimer (2007) calls *time aggregation bias*. To avoid this problem, we substitute the current and previous number of unemployed workers, the current labour force and the current job finding rate (as calculated above) into equation (3.2), and calculate the implied s_t .

The figures below illustrate the evolution of the calculated flow rates for the period 2000 Q1 to 2012 Q4, as 4-quarter moving averages.
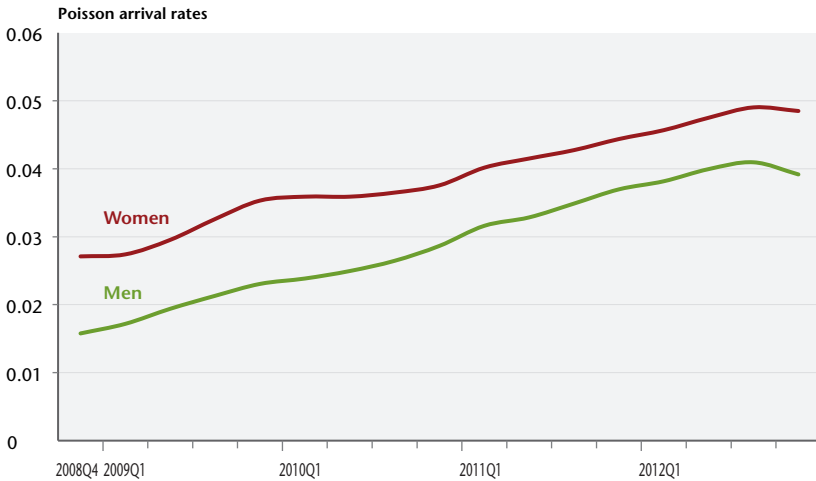
Figure 9. Job finding rates (4 quarters moving average)
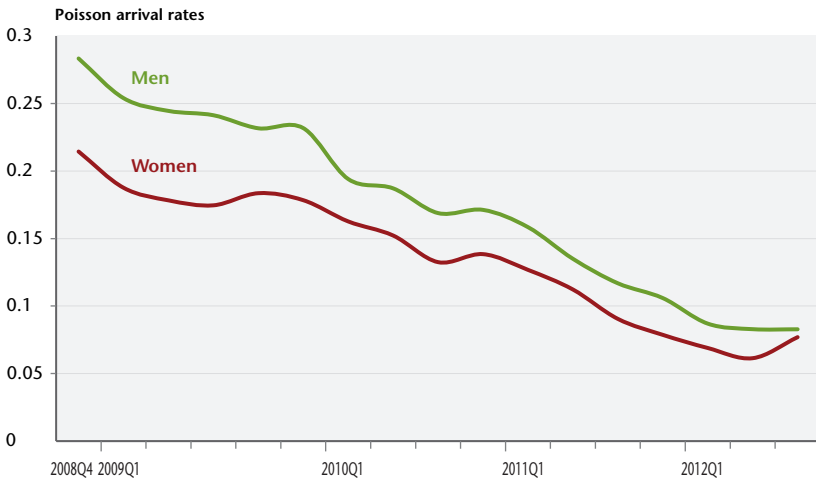
Source: Quarterly Labour Force Surveys of The Hellenic Statistical Authority (EL.STAT.).

For both sexes, the job finding rates have been falling whereas the separation rates have been increasing, a typical feature of recessions. Nevertheless, this deterioration of employment opportunities has not been identical for both sexes. It is evident from Figures 9 and 10 that the job finding rate has been falling much more rapidly for men than for women, while the separation rate has been rising slightly more rapidly for men than for women. We should associate these gender differences to the fact that the crisis hit male-dominated industries more than female-dominated ones (see Section 1 above). Hence, the employment situation for men has deteriorated more than for women, and this has exerted a narrowing effect on the gender unemployment gap.

Figure 10. Separation rates (4 quarters moving average)

Poisson arrival rates

Source: Quarterly Labour Force Surveys of The Hellenic Statistical Authority (EL.STAT.).

However, as we have already seen above, this asymmetric deterioration of labour market conditions has triggered different labour supply responses from men and women which have, in turn, exerted a widening effect on the gender unemployment gap.

3.2. Flows inside the labour force and unemployment dynamics

Assuming that flows into and out of the labour force are constant, unemployment may rise due to falls in the job finding rate, or to increases in the separation rate. Since, as shown above, such changes occurred simultaneously during the recession, it is interesting to estimate their respective contribution to the fluctuations of the unemployment rate by gender. Hereafter we do this by using the "steady state of unemployment" decomposition technique. Steady state unemployment is the rate at which unemployment would eventually stabilise in each time period, if the current flow rates remained constant and there had not been any transitions into or out of the labour force.

Note that given the flow rates, the implied steady state unemployment rate is found by setting $dU/dt = 0$ in equation (3.1) and noting that $u_t \equiv U_t/L_t$. We thus reach the standard expression:

$$u_t^{s.s.} = \frac{s_t}{s_t + f_t} \tag{3.6}$$

Now we decompose unemployment fluctuations to those attributed to changes in the job finding rate and those attributed to changes in the separation rate, and quantify their relative contributions. Following Elsby, Michaels and Solon (2009), we log-differentiate (see Appendix) the steady state unemployment rate in equation (3.6) above to obtain:

$$du_t^{ss} = u_{t-1}^{ss}(1 - u_{t-1}^{ss})(d \log s_t - d \log f_t) \tag{3.7}$$

Equation (3.7) decomposes the change of the (steady state) unemployment rate into the respective logarithmic changes of the flow rates, with an equal weight.

Let us denote by $du_t^f = -u_{t-1}^{ss}(1 - u_{t-1}^{ss})d \log f_t$ and the $du_t^s = u_{t-1}^{ss}(1 - u_{t-1}^{ss})d \log s_t$ respective contributions of the job finding rate and the separation rate to the variation of the unemployment rate, i.e. $du_t^{ss} = du_t^s + du_t^f$.

To quantify the contributions of each flow rate, we follow Fujita and Ramey (2009) who calculate the proportion of the variance of du_t^{ss} that is explained by its covariance with du_t^f and du_t^s:

$$\beta^f = \frac{Cov(du_t^{ss}, du_t^f)}{Var(du_t^{ss})} \tag{3.8a}$$

$$\beta^s = \frac{Cov(du_t^{ss}, du_t^s)}{Var(du_t^{ss})} \tag{3.8b}$$

In the above expressions, β^f is the proportion of unemployment fluctuations deriving from fluctuations in the job finding rate, and β^s is the proportion deriving from fluctuations in the separation rate.[1] The sum $\beta^f + \beta^s$ should equal to unity: this holds approximately in our results. The ratio β^f / β^s measures the relative weight of job finding in the determination of the unemployment rate.

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1. These are in fact the OLS regression coefficients of the percent changes of the job finding and separation rates, as explanatory variables for the changes of the steady state unemployment rate.

Table 2 below reports the results for the whole period 2000 Q1-2012 Q4, as well as the period of the crisis, i.e. 2008 Q1-2012 Q4. Note that the latter period includes only 20 observations rendering the results tentative.

Table 2. Contribution of the flow rates to the fluctuations of the unemployment rate

	2000-2012		2008-2012	
	Men	**Women**	**Men**	**Women**
Job finding β^f	0.81	0.85	0.77	0.78
Separation β^s	0.25	0.12	0.15	0.14
Ratio β^f / β^s	3.29	6.94	5.24	5.64

This table tells us that for the whole period about 0.8 of every percentage point of increase in the male unemployment rate is explained by the deterioration in the job finding rate, while about 0.2 is due to an increase in the separation rate. For women, the respective contributions are 0.85 and 0.15. This means that job finding difficulties are a more important determinant of unemployment dynamics than job separations. This holds for both sexes, but the effect on female unemployment is more powerful. Job finding difficulties are mainly related to the volume of job openings in the economy, relative to the stock of the unemployed, and less to the employability of the unemployed.

During the period 2008 Q1-2012 Q4, job finding difficulties kept their primacy in determining the dynamics of male and female unemployment over job separations. However their contribution increased in the case of male unemployment and decreased for female unemployment. Job finding difficulties do not only concern young people, but the whole unemployed population, regardless of age, given that persons aged 15-24 represented 13.9% of all unemployed in 2012 Q4, compared to 20.4% in 2008 Q4. Across-age job finding difficulties also explain the rise in the share of long-term unemployed from 47% to 65.3% of all unemployed, for the same four-year period.

4. Conclusions

The ongoing Greek crisis has had dramatic effects on employment. While this generally holds for both sexes, male employment declined more than female employment, mainly due to the major impact of the crisis on male-dominated sectors, and its limited effect on the female-dominated ones. The greater deterioration in male than female employment is the outcome of both a bigger fall in male job finding rates and a steeper rise in male job separation rates.

These developments implied a narrowing of the gender unemployment gap through a faster increase in male than female unemployment. Nevertheless, although the actual gender unemployment gap narrowed in ratio terms, it remained constant in its percentage-point difference. In this article, we have attributed the latter phenomenon to the different labour supply responses of men and women to job scarcity. The male participation rate has been falling, while the female participation rate has been increasing throughout the crisis. The former has contained the rise of the male unemployment rate, while the latter has reinforced the rise in the female unemployment rate. Specifically, between 2008 Q4 and 2012 Q4, the fall in the male participation rate lessened the increase in the male unemployment rate by about 10%, while the increase in the female participation rate contributed to the actual increase in the female unemployment rate by 25.5%.

Changes in labour supply behaviour have affected the dynamics of male and female unemployment to a far lesser extent than transitions inside the labour force between employment and unemployment, during the current crisis. Furthermore, it is the decrease in the job finding rate rather than the increase in the job separation rate that played the dominant role in boosting unemployment. This implies that firms reduced hiring proportionally more than they increased labour shedding. Finally, during the current crisis, job finding difficulties became more important in determining male unemployment, relative to the pre-crisis period. The opposite holds for female unemployment, as job separations became more significant for women. However, for women too, the decrease in the job finding rate was the major factor in the rise of unemployment during the crisis.

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Log-differentiation of (2.1)

$$d\log u = d\log(\frac{L-E}{L}) \rightarrow d\log u = d\log(L-E) - d\log L \rightarrow \frac{du}{u} = \frac{d(L-E)}{L-E} - \frac{dL}{L} \rightarrow$$

$$\frac{du}{u} = \frac{dL\cdot L - dE\cdot L - dL\cdot L + dL\cdot E}{L(L-E)} \rightarrow \frac{du}{u} = \frac{dL\cdot E - dE\cdot L}{L(L-E)} \rightarrow \frac{du}{u} = \frac{E}{L-E}(\frac{dL}{L} - \frac{dE}{E}) \rightarrow$$

$$\frac{du}{u} = (\frac{L}{L-E} - \frac{L-E}{L-E})(\frac{dL}{L} - \frac{dE}{E}) \rightarrow \frac{du}{u} = \frac{1-u}{u}(\frac{dL}{L} - \frac{dE}{E}) \rightarrow du = (1-u)(d\log L - d\log E)$$

Solution of differential equation (3.1)

Equation (3.1) is a first order differential equation of the form $ax + dx/dt = b$ with the standard solution $x_t = (1-e^{-at})b/a + x_0 e^{-at}$. Hence the value of a variable in the current period given its (initial) value in the previous period is given by $x_{t+1} = (1-e^{-a})b/a + x_t e^{-a}$ We substitute $x = U$, $a = s + f$, $b = sL$ to obtain (3.2).

Flow rates

In a Poisson distribution the probability that a variable X takes the value x is given by

$$P(X = x) = \frac{e^{-\lambda}\lambda^x}{x!}$$

The probabilities F, S we measure are equivalent to $P(X > 0)$: i.e., the probabilities of finding (leaving) a positive amount of jobs. Hence

$$P(X > 0) = 1 - P(X = 0) = 1 - \frac{e^{-\lambda}\lambda^0}{0!} \to 1 - P(0) = 1 - e^{-\lambda}$$

$$\to P(0) = e^{-\lambda} \to 1 - P(X > 0) = e^{-\lambda} \to \lambda = -\log(1 - P(X > 0))$$

The flow rates f, s are the parameter λ in the Poisson distribution, measuring the average (or expected) number of jobs found (left) in the period.

Log-differentiation of (3.6)

$$d\log u = d\log(\frac{s}{s+f}) \to d\log u = d\log s - d\log(s+f) \to \frac{du}{u} = \frac{ds}{s} - \frac{d(s+f)}{s+f} \to$$

$$\frac{du}{u} = \frac{ds \cdot s + ds \cdot f - ds \cdot s - df \cdot s}{s(s+f)} \to \frac{du}{u} = \frac{ds \cdot f - df \cdot s}{s(s+f)} \to \frac{du}{u} = \frac{f}{s+f}(\frac{ds}{s} - \frac{df}{f}) \to$$

$$du = u(1-u)(d\log s - d\log f)$$