The Relationship between Aggregate Unemployment and the Labor Force Participation Rate: New Evidence on Divorced Women And the Discouraged Worker Effect

by

Dale Bremmer
Rose-Hulman Institute of Technology

and

Randall Kesselring
Arkansas State University

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I. Introduction

The Great Recession and the high unemployment rates that have accompanied it have brought increased attention to the discouraged worker effect. In the United States, to be counted as unemployed and included in the labor force, the person who does not have a job must have actively looked for employment in the prior four weeks. Persons without a job that have not actively looked for work during that period, are not counted as unemployed nor are they included in the labor force.

A discouraged worker is one who has looked for work; but; when the marginal cost of additional job search began to exceed the marginal benefit of getting a job, they stopped looking for work. Hence, they are not considered to be unemployed and they are not included in the labor force. An increase in the number of discouraged workers will simultaneously decrease the unemployment rate, the size of the labor force and the labor force participation rate.

The presence of the discouraged-worker effect may lead to an inverse relationship between the unemployment rate and the labor force participation rate. As the unemployment rate increases and more people are competing for fewer jobs, over time more of the unemployed workers become discouraged, decreasing the labor force and the labor force participation rate. However, like most of the employment statistics collected by the Bureau of Labor Statistics, these numbers differ across ages, races, gender and marital status.

This paper uses vector autoregressions (VAR) and impulse functions to analyze the relationship between the overall unemployment rate and the labor force participation rate for adult males and females. In particular it focuses on the following categories of both sexes:

single, never married; married; and divorced, separated or widowed. Analysis of the impulse functions reveal that the overall unemployment rate is inversely related to the labor force participation rates for single men and women, and for married men. A positive innovation to the overall unemployment rate will at first decrease then increase the labor force participation rate of divorced, separated and widowed males.

If there is an added-worker effect, an increase in the overall unemployment rate leads to an increased incidence of spouses of job losers entering the labor market to offset the loss of household labor income. Impulse functions generated by the VAR model reported in this paper show a short-run direct relationship between the overall unemployment rate and the labor force participation rate of married women. A similar, but weaker direct relationship is observed between the overall unemployment rate and the labor force participation rate of divorced, separated and widowed females.

The discouraged-worker effect reduces the size of the labor force while the added-worker effect does what its name suggests and increases the size of the labor force. In analyzing these opposing effects, this paper is organized as follows. A brief literature review in the second section of the paper follows these introductory comments. Data definitions and sources are discussed in the third section along with discussion of the unit root and Granger causality tests. Estimation results and statistical inferences are covered in the paper's fourth section. A summary and plans for future research are provided in the concluding section of the paper.

II. Literature Review

Borjas (2008, p. 76) notes there is "overwhelming evidence that the correlation between the labor force participation rates of many groups and the aggregate unemployment rate is negative." Mincer (1966) reports that a one percentage point increase in the overall

unemployment rate causes the labor force participation rate of white, teenage males and females to fall by 2 percentage points. However, the same increase in the overall unemployment rate reduces the labor force participation rate of teenage blacks by 5 percentage points.

Mincer also found an inverse, but weaker, relationship between the overall unemployment rate and the labor force participation rate of older workers. In this case, if the overall unemployment rate increased by one percentage point, the fall in the labor force participation rate of older men and women was less than 0.5 percentage points. Therefore in Mincer's well-cited, but dated, study, the inverse relationship between the overall unemployment rate and the labor force participation rate indicates that the discouraged-worker effect dominates the added-worker effect for the subsets of the population that he studied.

In a study published almost twenty years after the publication of Mincer's study, Lundberg (1985) found that the added-worker effect swamps the discouraged worker effect for white, married women. Her simulations show that if 100 husbands become unemployed, at the most, three white wives that were previously not in the labor force will enter the labor market with two of them finding a job. The simulation results did differ across races.

Lundberg's model also indicated that as more black husbands become unemployed, both the employment and the labor force participation rate of black females would decline. Lundberg also provided evidence that the added-worker effect dominates the discouraged worker effect for Hispanic wives. Her explanation of this behavior is that wives and husbands with similar labor-leisure tastes and similar labor market opportunities tend to marry. She based this conclusion on her simulation finding that black and Hispanic females married to employed husbands were more likely to find employment than minority females married to unemployed husbands.

Wasmer (2009) examined the short-run and medium-run links between female labor supply and unemployment, comparing the countries in Europe to the United States using VAR models. This study was unique in that it examined whether the causal link between unemployment and labor force participation was reversed from the conventional direction assumed by previous investigators. Wasmer found that increases in total labor force participation, in general, and female labor force participation, in particular, would increase the unemployment rate during a 5 to 8 year period. However, Wasmer did find that the causal link was bilateral.

Variance decomposition showed that labor force participation in Europe had a greater reaction to unemployment while labor force participation in the U.S. had a greater reaction to labor supply shocks such as changes in demographics and immigration. Wasmer also found that fluctuations in the U.S. unemployment rate were driven more by demand shocks and technological change than the equivalent European rate.

III. Data, Unit Root Tests and Granger Causality Tests

Given that past studies show a causal link between the overall unemployment rate and the labor force participation rate, this paper explores the relationship between these two variables and how the relationship may be affected by differences in gender or marital status. This section of the paper introduces the seven time series used in the study, their unit root tests and the pairwise Granger casualty tests.

The data

Seven monthly time series were used to examine the relationship between unemployment and labor force participation. This data was extracted from the Current Population Survey databases of the Bureau of Labor Statistics.[1]

The data consists of observations on: (1) the overall unemployment rate (U_t), (2) the labor force participation rate of single females (SF_t), (3) the labor force participation rate for married females (MF_t), (4) the labor force participation rate for divorced, separated and widowed females (DF_t), (5) the labor force participation rates for single males (SM_t), (6) the labor force participation rate for married males (MM_t) and (7) the labor force participation rate for divorced, separated and widowed males (DM_t). The longest data series for all seven variables begins in June 1976 and ends with the last observation in February 2011.

Unit root tests

The augmented Dickey-Fuller (1979) tests for each of the seven series are reported in Table 1. The tests indicate whether each data series is stationary. A stationary series does not exhibit a unit root while a nonstationary series does. Statistical inferences made from nonstationary data are problematic because spurious results are likely. In this case, no true long-run relationships between the variables exist even though the estimation results might include high R^2s and statistically significant coefficients.

Table 1 reveals an interesting difference between male and female labor force participation rates. In the case of level data, the Dickey-Fuller tests rejects the null hypothesis of a unit root for every one of the female time series - - single, married or divorced - - indicating that these time series are stationary. However, in the case of the level data for the various male time series, there is a failure to reject the null hypothesis of a unit root for every subsample: single, married and divorced males.

[1] See http://www.bls.gov/cps/.

Using a level of significance equal to ten percent, one can reject the null hypothesis that the overall unemployment rate has a unit root for level data. However, if the level of significance is set at five or one percent, one fails to reject the null hypothesis of a unit root and the overall unemployment rate appears to nonstationary in level values.

Referring to the results reported in the lower half of Table 1, all seven of these time series appear to be stationary if the data is in first differences. The null hypothesis of a unit root is rejected at the one-percent level for all seven time series, implying the first-differences of all these series are stationary.

Selection of the appropriate number of lags of the dependent variable to include in each of the unit root tests was accomplished by choosing the number that minimized the Schwarz Information Criterion. If when estimated, either the constant or the slope coefficient on the time trend was statistically significant, it was included in the specification of the underlying regression model used to derive the Dickey-Fuller test statistic.

Granger-causality tests

To explore the causal relationship between the labor force participation rates and the overall unemployment rates, pairwise Granger (1969) causality tests were performed. The key question is whether the overall unemployment rate Granger causes labor force participation rates or does the labor force participation rate of a subsample of the population Granger cause the overall unemployment rate. Granger causality is usually determined through a series of t tests and F tests. Current values of a time series (say variable A) are regressed on lagged values of A and on an equal number of lagged values of another time series (say variable B). If the t test and F test reveal that the estimated slope coefficients associated with the lagged values of B are not all simultaneously equal to zero, B is said to Granger cause A. If the direction of causality goes

only in one direction (from A to B but not from B to A), then there is unidirectional causality from A to B. If causality goes both ways (from A to B and from B to A) then there is bilateral causality or feedback.

The results of the Granger causality tests are reported in Table 2. The number of lagged values included in the underlying model specification was again the number of lags that minimized the Schwartz Information Criterion. The F tests reveal there is pairwise bilateral causality between the overall unemployment rate and the labor force participation rates of single and married females (both F test were statistically significant at the one-percent level). A similar feedback relationship exists between the overall unemployment rate and the labor force participation rates of single males (again, the F test was statistically significant at the one-percent level). There is statistical evidence of bilateral causality between the unemployment rate and the labor force participation rate of married males only at the five-percent level but not at the one-percent level.

There is only evidence of unidirectional causality between the unemployment rate and the labor force participation rate of divorced females and males. Past values of the unemployment rate were found to affect labor force participation rates; but, causality did not flow in the reverse direction. Regarding the case of divorced and other females, the null hypothesis that all the slope coefficients associated with lagged values of the unemployment rate are simultaneously equal to zero was rejected at the one-percent level. The same null hypothesis was rejected for the sample containing divorced males at the five-percent level. Neither of these two regressions had statistically significant evidence that past values of the labor force participation rate affected the unemployment rate.

IV. Estimation Results: VAR Model and Impulse Functions

To further explore the causal relationships between these six measures of labor force participation the overall unemployment rate, a VAR model was specified. The VAR format is intended to be an atheoretical, empirical estimation technique that assumes the current value of an economic variable is a function of past values of this variable and past values of other related economic variables. The goal of the time-series model is to closely describe the time-path of a variable and explain how this path depends on the rest of the variables. Rather than performing a series of statistical tests on a subset of the coefficients of the models, impulse functions are used to show the relationships between the variables. Impulse functions involve simulating the model and obtaining "pseudo" future values of one set of endogenous variables given a shock to another set of endogenous variables.

The VAR model

The VAR model is a symmetric model that assumes the current value of an endogenous variable is a function of the same set of past values of all the model's endogenous variables. The parameters of the estimated seven equations of the VAR model are reported in Table 3. Note that the explanatory variable of each equation consists of five lagged values of all the endogenous variables and an intercept. Thus, each equation has 36 parameters to estimate, one intercept and 35 slope coefficients. In essence, the VAR model is a seven-equation system of seemingly unrelated regressions (SUR). Since each regression has the same set of explanatory variables, the estimates of the SUR model are identical to the ordinary least squares estimates (OLS) obtained by separately estimating each equation. Five lags were selected because that number minimized the Schwarz Information Criterion.

The estimated R-squareds for the seven equations range from 0.88 to 0.99. The F statistic reported in Table 3 indicates that for each of the seven regressions, the null hypothesis that all the slope coefficients are simultaneously equal to zero is rejected at the one-percent level.

Analysis of the impulse response functions

Figures 1 through 6 show a single impulse response function for each of the six different measures of the labor force participation rate. Each figure shows the accumulated response of one of the labor force participation rates to a one standard deviation increase in the overall unemployment rate (often called an innovation by those that frequently estimate VAR's). The unemployment rate innovation used the Cholesky methodology, modified for degrees of freedom. The dashed lines show the confidence intervals associated with the analytical standard error for each time path.

The impulse functions show that the discouraged-worker effect dominates the added worker effect for single women (Figure 1), single men (Figure 4), and eventually for married men (Figure 5). However, there is evidence that the added-worker effect dominates the discouraged-worker effect for married females. As shown in Figure 2, an increase in the overall unemployment rate leads to an increase in the labor force participation rate of married women for at least the first seven months. As the probability that the husband may lose his job increases, married women reduce the risk of income loss by entering the labor market. There is a similar, but weaker, positive response for divorced, separated and widowed women (see Figure 3). An increase in the unemployment rate results in increases in the labor force participation rate of divorced women between three and six months after the shock.

In Figure 6, the response of the labor force participation rate for divorced, separated and widowed males shows an inconsistent response to an increase in the overall unemployment rate.

At first the participation rate for divorced males falls and then it increases. There is no future time period where the confidence interval does not include zero. One may conclude the impact of increased unemployment rates on the labor force participation rate for divorced males is negligible.

V. Concluding Thoughts

Using VAR estimation techniques and analyzing the associated impulse response functions, this paper uses more recent time-series techniques to find that the added-worker effect dominates the discouraged-worker effect for married women. The model estimates that an increase in the overall unemployment rate leads to an increase in the labor force participation rate of married women, at least over the initial seven months after the shock. In addition, the impulse functions show a dominant discouraged-worker effect in the case of single women, single men, and married men.

These are the initial results of an ongoing study. While labor force participation data is not readily available for even smaller subsets of the population, estimates of the labor force can be obtained separately for males and females across different races and marital status. So it will be possible to examine how an increase in the unemployment rate affects the number of white, Hispanic, black and Asian married (or single) women who are in the labor force. Looking across these racial boundaries will be a topic of future research.

In addition, given the possibility that the male data and the unemployment data are nonstationary in level form, cointegration tests and vector error-correction models will have to be considered. The question of whether a long-run relationship between these variables exists still needs answering. Initial attempts with cointegration tests were dissatisfying because, in one instance, Johansen and Juselius tests (1990) indicated the existence of not one, but seven

cointegrating vectors. As lag lengths, and the assumptions about the cointegrating vector and associated VAR model were changed, the large number of cointegrating vectors remained. The notion of several long-run relationships becomes difficult to explain and interpret.

However, this initial pass of studying the behavior of these time series with more modern time-series estimation techniques confirms the dominant discouraged-worker effect for single and married men. While it confirms a dominant added-worker effect for married women, there is statistical evidence that the discouraged-worker effect is the stronger effect for single women and it was the weaker effect for divorced women.

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Table 1
Augmented Dickey-Fuller Unit Root Tests: Sample 1976:6 – 2011:2

Level Data

Variable	Test Statistic	Constant	Trend	Lag
Single Female Labor Force Participation Rate	-71.7820* (0.0001)	Yes	No	25
Married Female Labor Force Participation Rate	-66.3142* (0.0001)	Yes	Yes	0
Divorced, Separated, or Widowed Female Labor Force Participation Rate	-176.0965* (0.0001)	Yes	Yes	14
Single Male Labor Force Participation Rate	-1.2943 (0.8878)	Yes	Yes	13
Married Male Labor Force Participation Rate	-2.5277 (0.3145)	Yes	Yes	4
Divorced, Separated, or Widowed Male Labor Force Participation Rate	-2.9909 (0.1361)	Yes	Yes	12
Overall Unemployment Rate	-2.6313*** (0.0875)	Yes	No	15

First Differences of the Data

Variable	Test Statistic	Constant	Trend	Lag
Single Female Labor Force Participation Rate	-19.8829* (0.0000)	Yes	Yes	0
Married Female Labor Force Participation Rate	-20.5808* (0.0000)	Yes	Yes	0
Divorced, Separated, or Widowed Female Labor Force Participation Rate	-20.6227* (0.0000)	Yes	Yes	0
Single Male Labor Force Participation Rate	-6.2895* (0.0000)	Yes	Yes	12
Married Male Labor Force Participation Rate	-15.4538* (0.0000)	Yes	No	3
Divorced, Separated, or Widowed Male Labor Force Participation Rate	-7.3785* (0.0000)	Yes	Yes	12
Overall Unemployment Rate	-4.9429* (0.0000)	Yes	Yes	11

Table 2
Pairwise Granger-Casualty Tests: The Relationship between Labor Force Participation Rates and the Overall Unemployment Rate

	Null Hypothesis: Sample 1976:6 – 2011:2		
Population Subsample	Labor Force Participation Rate Does Not Granger Cause Overall Unemployment Rate	Overall Unemployment Rate Does Not Granger Cause the Labor Force Participation Rate	Lags in VAR
Single Females	5.141*	3.889*	16
Married Females	2.535*	5.018*	13
Divorced, Separated and Widowed Females	0.960	3.577*	16
Single Males	5.159*	4.291*	16
Married Males	1.750**	5.741*	13
Divorced, Separated and Widowed Males	1.519	2.078**	13

*, and ** indicates the null hypothesis is rejected at the one- or five-percent level, respectively. The lag length in the underlying VAR is the number of lags that minimizes Schwarz's Information Criterion.

Table 3
VAR Estimation Results

Explanatory Variables	Explanatory Variables						
	SF_t	MF_t	DF_t	SM_t	MM_t	DM_t	U_t
SF_{t-1}	0.6909*	-0.0113	0.0795**	0.0810	-0.0284***	-0.0123	-0.0112
SF_{t-2}	-0.2174	0.0530	-0.0127	-0.3789**	0.0003	0.0686	-0.0001
SF_{t-3}	0.1178	0.0559	0.0475	0.1366	-0.0106	-0.0237	0.0137
SF_{t-4}	0.4445*	-0.1355*	-0.0525	0.4674*	0.0050	-0.0312	-0.0514
SF_{t-5}	-0.1837	0.0129	0.0267	-0.3078**	0.0216	-0.0238	0.0072
MF_{t-1}	0.1185	0.7000*	-0.0256	0.3255	0.0124	-0.0651	-0.0106
MF_{t-2}	-0.1910	0.1454**	0.2991*	-0.4347	-0.0511	-0.0349	0.0002
MF_{t-3}	0.4564***	-0.0417	-0.0970	0.5674***	0.0391	0.1088	0.1308***
MF_{t-4}	0.0068	-0.1623**	-0.0728	0.0497	-0.0244	-0.0003	0.0208
MF_{t-5}	-0.0077	0.2254*	-0.0341	-0.0158	0.0055	0.0242	-0.1563*
DF_{t-1}	0.0870	-0.0451	0.7239*	-0.0986	-0.0174	-0.0007	-0.0482
DF_{t-2}	-0.4226**	0.0130	0.0865	-0.2994	0.0150	-0.1880**	0.0752
DF_{t-3}	0.0963	0.0001	0.0813	0.0306	-0.0218	0.1459	0.0392
DF_{t-4}	0.0087	0.1112**	-0.2734*	-0.0516	-0.0087	-0.0023	0.0473
DF_{t-5}	-0.1379	-0.0221	0.1598*	-0.1471	0.0086	0.0046	-0.01676
SM_{t-1}	0.1635	-0.0254	-0.0984*	0.8356*	0.0223	0.0426	-0.0182
SM_{t-2}	-0.1562	0.0161	0.0791**	-0.0921	0.0037	-0.1078***	-0.0343
SM_{t-3}	-0.2445**	0.0624***	-0.0120	-0.3099**	0.0084	0.0491	0.1056*
SM_{t-4}	-0.0791	0.0568	0.0237	-0.1140	0.0087	0.0705	-0.0862*
SM_{t-5}	-0.2242**	0.0386	-0.0746**	-0.1522	-0.0374**	-0.0300	0.0582**
MM_{t-1}	1.3042*	-0.0170	-0.0649	1.3697*	0.7711*	-0.1404	0.1006
MM_{t-2}	-0.3057	-0.1326	0.1101	-0.7056	0.0211	0.2315	-0.1556
MM_{t-3}	0.1637	-0.0462	-0.0440	0.4741	0.0638	-0.1608	0.3504*
MM_{t-4}	-0.1136	-0.0761	-0.0892	0.0102	-0.1785*	0.3321	-0.2189***
MM_{t-5}	-0.5192	-0.0100	0.0658	-0.4927	0.2284*	-0.1792	-0.0250
DM_{t-1}	0.4527*	-0.1045*	0.0013	0.5628*	-0.0023	0.8640*	-0.0273
DM_{t-2}	-0.0317	0.0873**	-0.0148	-0.0612	-0.0094	0.0591	0.0351
DM_{t-3}	-0.0775	-0.0051	0.0223	-0.0458	0.0013	-0.0395	0.0260
DM_{t-4}	0.1081	-0.0179	-0.0145	0.1200	0.0183	-0.1281***	0.0064
DM_{t-5}	0.0926	-0.0625**	0.0005	0.1648	-0.0030	0.1788*	-0.0405
U_{t-1}	-0.2658	0.1074**	0.0408	-0.4060***	-0.0090	-0.0744	0.9625*
U_{t-2}	-1.0420*	0.1219***	0.1581**	-1.1468*	0.0099	0.1305	-0.0538
U_{t-3}	-0.3201	0.0272	-0.2216*	-0.3859	-0.0213	-0.0034	-0.2023*
U_{t-4}	1.1707*	-0.1722*	-0.0344	1.5595*	0.0439	0.2194**	0.2579*
U_{t-5}	0.3503***	-0.1167**	0.03578	0.2468	-0.0643**	-0.2838*	0.0431
Intercept	-32.6879***	25.0163*	8.7943	-40.3253***	9.8596*	-2.3334*	-6.8069
R^2	0.88	0.99	0.98	0.88	0.99	0.91	0.97
Adjusted R^2	0.85	0.99	0.98	0.87	0.99	0.90	0.97
F-statistic	69.38†	2810.94†	531.72†	78.76†	1062.95†	103.83†	368.83†

*, **and *** indicate the null hypothesis that the estimate is equal to zero can be rejected at the 1%, 5%, and 10% level, respectively. † indicates the null hypothesis that all the slope parameters are simultaneously equal zero can be rejected at the 1% level. Data Sample: 1976:6 – 2011:2.

Figure 1

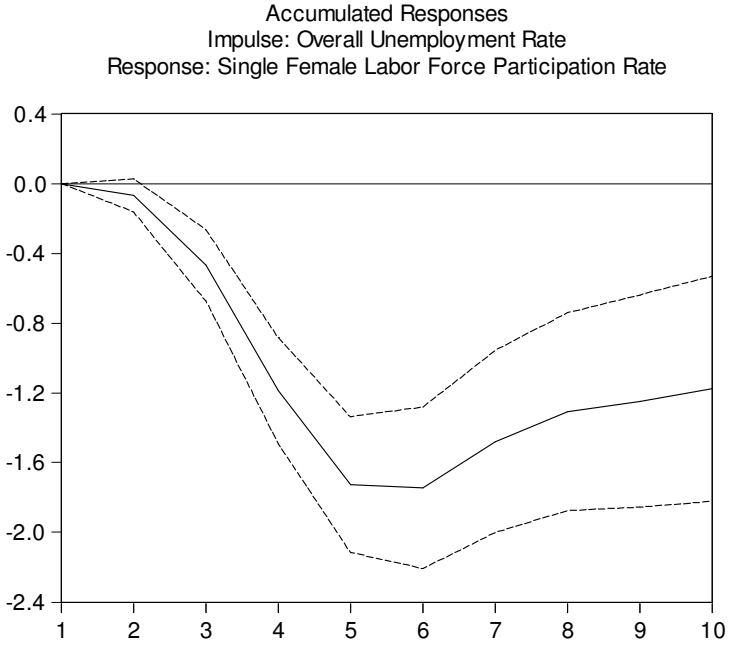

Figure 2

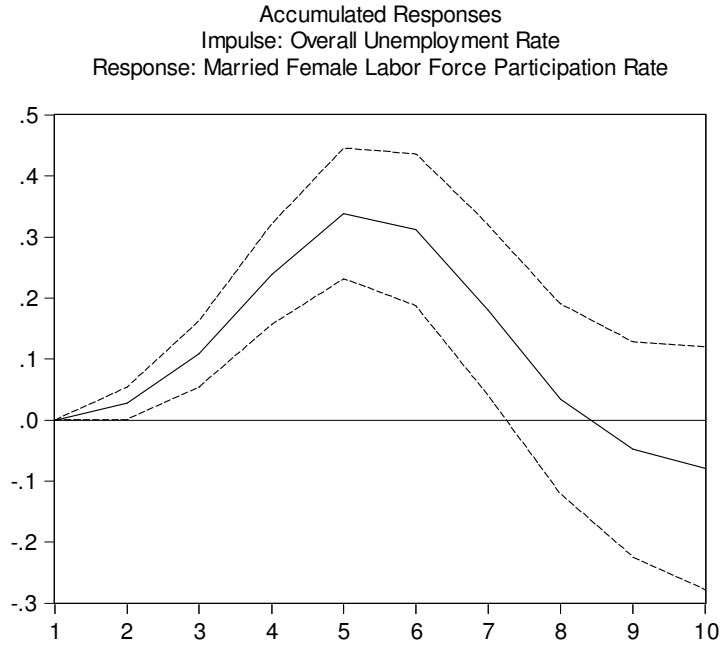

Figure 3

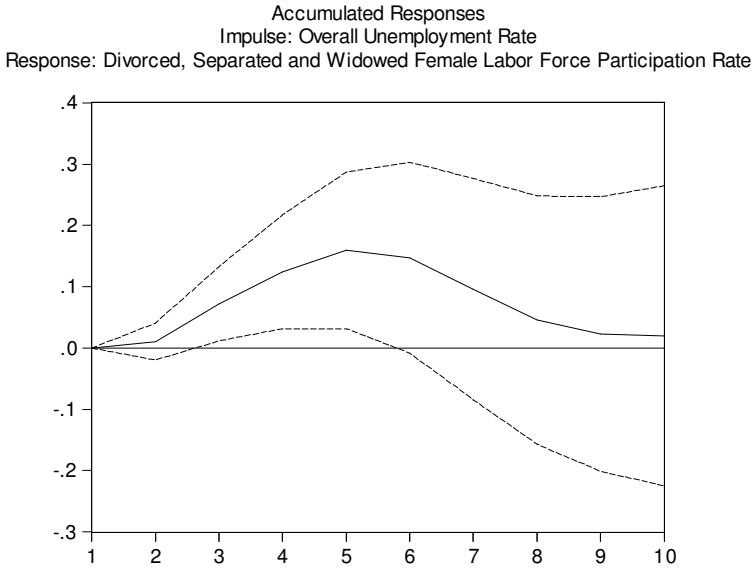

Figure 4

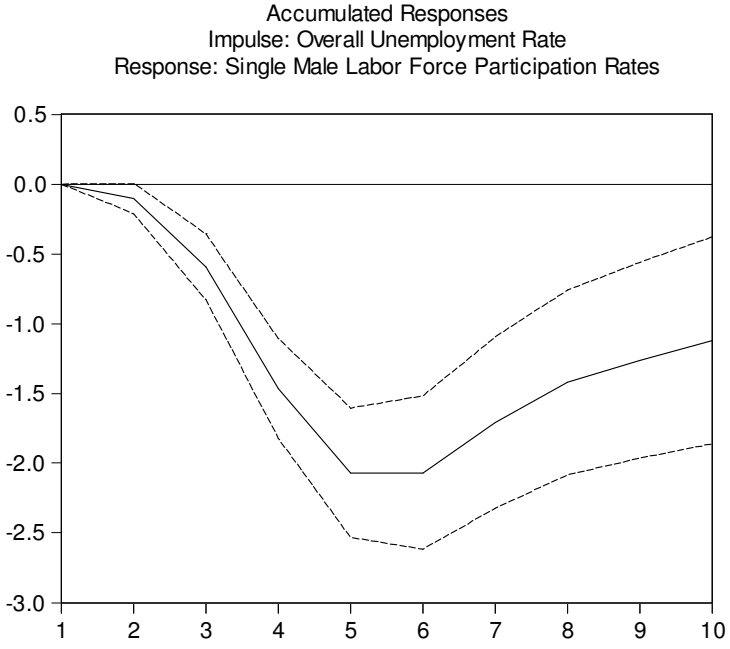

Figure 5

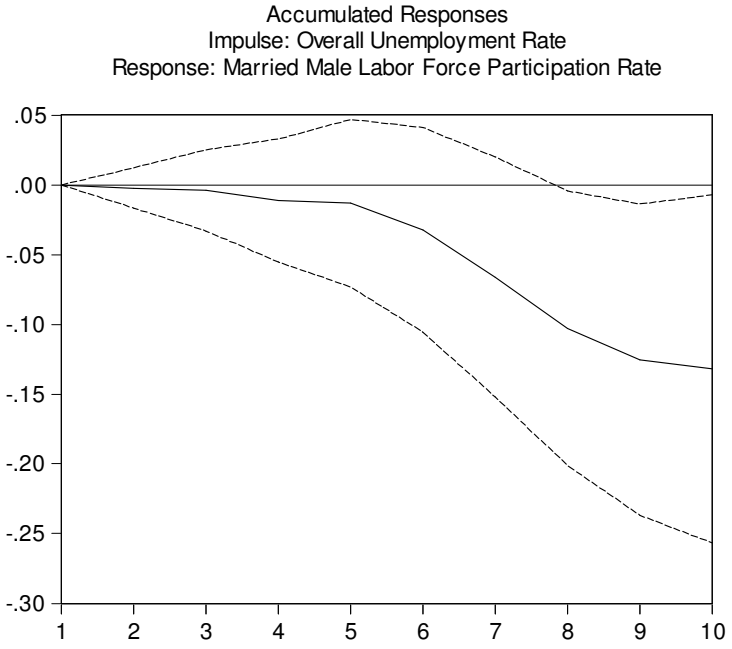

Figure 6