E C O N O M I C S   B U L L E T I N

Evidence Regarding Persistence in the Gender Unemployment Gap Based on the Ratio of Female to Male Unemployment Rate

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Abstract

We examine the level of persistence in the gender unemployment gap in eight OECD countries: Australia, Canada, Finland, France, Germany, Italy, Japan, and the United States. We use a new measure for the gender unemployment gap, namely, the ratio of the female to male unemployment rate. Our empirical evidence shows that the gender unemployment gap is not persistent given that we reject the unit root null hypothesis for all countries in our sample except Australia.

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1. Introduction

In a recent paper, Queneau and Sen (2007) examine the extent of persistence in the gender unemployment gap across eight OECD countries: Australia, Canada, Finland, France, Germany, Italy, Japan, and the United States. They measure the gender unemployment gap as the difference between the female unemployment rate (u^F) and the male unemployment rate (u^M), denoted by u^D ($= u^F - u^M$). They are unable to reject the unit root null hypothesis for the u^D series for all countries except Finland and Italy. The empirical evidence of Queneau and Sen (2007), therefore, implies that any shock to the gender unemployment gap is relatively persistent in most countries.

The difference between the female and the male unemployment rates has been used to measure the gender unemployment gap in numerous studies, see for example, Niemi (1974), DeBoer and Seeborg (1989), and Azmat, Guell, and Manning (2006). We introduce the ratio of the female unemployment rate to the male unemployment rate, denoted by $u^R = u^F/u^M$, as a new measure of the gender unemployment gap. In the absence of any difference in the female and male unemployment rate, u^R must equal one. However, u^R is more (less) than one if the female unemployment rate is greater (lower) than the male unemployment rate. A time plot of u^R for all eight countries over the period 1965-2002 are shown in Figure 1. In Table 1, we calculate the average u^R for consecutive five-year periods for each country.[1]

We note that u^R captures differences in the gender unemployment gap trends across countries. In France, Germany, and Italy, the female unemployment rate is consistently higher compared to the male unemployment rate ($u^R > 1$), except for Germany over the period 1965-1970, and in each case u^R has a negative trend. In Australia and the United States, u^R is greater than one in the pre-1980 period, but fluctuates around one after 1980. In Finland, however, the female unemployment rate is lower compared to the male unemployment rate ($u^R < 1$) over most of the sample period with a positive trend. Finally, in Japan and to a lesser extent in Canada, the female and male unemployment rates remain very close to each other, and so their u^R fluctuates around one throughout the sample period.

While the two measures of the gender unemployment gap (u^D and u^R) are related,[2] we

[1] To facilitate comparison of our results with those of Queneau and Sen (2007), we use their data set. The unemployment data are obtained from the OECD Quarterly Labour Force Statistics, Volume 2003/4 and cover the period 1965-2002. See Figure 1 and Table 1 in Queneau and Sen (2007) for the time plot and the five year average of u^D for all countries.

[2] The relationship between u^R and u^D can be expressed as: $u^R = (u^D/u^M) + 1$.

argue that they capture the long-term dynamics of the gender unemployment gap differently. In particular, we argue that since u^D is an absolute measure of the gender unemployment gap, it is more suitable for measuring the gender unemployment gap at a given point in time. On the other hand, u^R is a normalized measure for the gender unemployment gap, and so it is more helpful in assessing movements in the gender unemployment gap over time. Consider, for example, the observed time path of the female and male unemployment rates in France. We find that u^D for France was equal to 2.8% in 1970, 5.2% in 1980, and 4.5% in 1992 which suggests that the gap in the female and male unemployment rates for France increases from 1970 to 1980 and remains fairly high until 1992. However, u^R for France steadily falls from 2.87 in 1970, to 2.21 in 1980, and then to 1.55 in 1992 indicating that the gap between u^F and u^M is diminishing throughout the period. That is, the time path of u^R for France implies that the female unemployment rate was 187% greater than the male unemployment rate in 1970, but it was only 55% greater in 1992, and so the u^R measure would suggest that the gap between the female and male unemployment rates in France fell from 1970 to 1992.

As illustrated by the case of France, the two measures, u^D and u^R, can convey different dynamics, and hence, persistence in the gender unemployment gap. Therefore, our objective is to re-examine the extent of persistence in the gender unemployment gap using the u^R series for all countries in our sample. We test for the presence of a unit root in u^R using the ADF test and the mixed model test of Perron (1997), and are able to reject the unit root null hypothesis for all series except Australia. Therefore, our empirical results with the u^R are different compared to the results in Queneau and Sen (2007) regarding the u^D series. We present the empirical results for the u^R series in Section 2, and some concluding remarks appear in Section 3.

2. Empirical Evidence

In this section, we test for the presence of a unit root in the u^R series of all countries in our sample. Specifically, we use the unit root test proposed by Perron (1997) that allows for a break in the trend function at an unknown break-date.[3] The trend-break stationary alternative allows us to model any structural break in the labor market conditions might

[3] Following Sen (2003), we use the mixed model specification of the trend-break alternative that allows for a simultaneous break in the intercept and slope of the trend function.

have occurred during the sample period under consideration. If the Perron (1997) test fails to reject the unit root null hypothesis, we use the ADF statistic to test for the presence of a unit root. Rejection of the unit root null hypothesis implies that any shock to the gender unemployment gap is transitory, so that any shock will dissipate relatively quickly. In this eventuality, examination of the trend-function coefficients will reveal whether the gender unemployment gap is decreasing or increasing. However, failure to reject the unit root null hypothesis implies that any shock to the gender unemployment gap has a permanent effect, that is, the gender unemployment gap is persistent.

The unit root test proposed by Perron (1997) is based on the following regression estimated for each possible break-date $T_b \in \{2, 3, ..., T-2\}$:

$$\begin{aligned} y_t \;&=\; \hat{\mu}_0 + \hat{\mu}_1\, DU_t(T_b) + \hat{\mu}_2\, D_t(T_b) + \hat{\mu}_3\, t + \hat{\mu}_4\, DT_t(T_b) \\ &\quad + \hat{\alpha}\, y_{t-1} + \sum_{j=1}^{k^*} \hat{c}_j\, \Delta\, y_{t-j} + \hat{e}_t \end{aligned} \tag{1}$$

where $DU_t(T_b)$ is the intercept-break dummy that is equal to 0 if $t = T_b$ and 1 if $t > T_b$, $DT_t(T_b)$ is the slope-break dummy that is equal to 0 if $t = T_b$ and $(t - T_b)$ if $t > T_b$, and $D_t(T_b)$ is a dummy variable that takes on the value of one for $t = T_b + 1$ and zero otherwise.[4] Perron's (1997) statistic is defined as $t_{DF}^{min} = Min_{\,T_b \in \{2,3,...,T-2\}}\, t_{DF}(T_b)$, where $t_{DF}(T_b)$ is the t-statistic for $H_0 : \alpha = 1$ in regression (1) with break-date T_b. The implied estimated break-date $\hat{T}_b(t_{DF}^{min})$ is the date at which the sequence $\{t_{DF}(T_b)\}_{T_b=2}^{T-2}$ is minimized.

The empirical results for the u^R are given in Table 2. For each country, we report the unit root statistic, the estimated break-date, and the estimated trend-function coefficients at the estimated break-date. We find that the unit root statistic is significant at the 10% level for France and Italy, and at the 1% significance level for the United States. The estimated break-date for France is 1980, for Italy is 1971, and for the United States is 1980. The estimated trend-function provides insight into whether the gap between the female and male unemployment rates is decreasing.[5] For France, the estimated trend for u^R in both the pre-break and post break samples are negative implying that the gender unemployment gap is

[4] The extra 'k*' regressors $\{\Delta y_{t-j}\}_{j=1}^{k^*}$ are included in the regression to account for additional correlation in the time series $\{y_t\}$. We use Perron and Vogelsang's (1992) k(t-sig) method for selecting the lag-truncation parameter.

[5] The slope of the trend function in the pre-break sample is given by μ_3 and that in the post-break sample is $(\mu_4 - \mu_3)$. For example, for France the slope of the trend function is -0.0605, and the slope of the trend function in the post-break sample is -0.0211.

falling throughout the sample, although at a slower rate in the post-break sample compared to the pre-break sample. For Italy, the gender unemployment gap has a positive trend in the pre-break sample, but a negative slope in the post-break sample. Finally, in the United States, the gender unemployment gap has disappeared in the post-break sample.

Given that Perrons (1997) mixed model test fails to reject the unit root null hypothesis for Australia, Canada, Finland, Germany, and Japan, we calculate the Augmented Dickey Fuller (ADF) test for the u^R series in these countries. We use the ADF test with trend for Australia, Canada, Finland, and Germany, and the ADF test without the trend for Germany and Japan. The ADF tests are based on the following regressions:

$$y_t = \hat{\mu} + \hat{\alpha}\, y_{t-1} + \sum_{j=1}^{k^*} \hat{c}_j\, \Delta\, y_{t-j} + \hat{e}_t \tag{2}$$

$$y_t = \hat{\mu} + \hat{\beta}\, t + \hat{\alpha}\, y_{t-1} + \sum_{j=1}^{k^*} \hat{c}_j\, \Delta\, y_{t-j} + \hat{e}_t \tag{3}$$

The ADF test without trend, denoted by t_μ, is based on regression (2), and the ADF test with trend, denoted by t_τ, is based on regression (3). In Table 3, we report the results pertaining to the ADF test. We reject the unit root null hypothesis for Canada and Finland using the ADF test with trend, and for Japan and Germany using the ADF test without trend.[6] It is interesting to note that the trend slope for Canada is negative and that for Finland is positive, both indicative of a disappearance of the gender unemployment gap, that is, u^R approaching 1. Further, the ratio of female to male unemployment rate in Japan fluctuates around an estimate mean of 0.96, and that in Germany fluctuates around an estimated mean of 1.26.

We examine the extent of persistence using the half life (HL_α) measure implied by the estimated regression used to calculate the unit root test. The half life, calculated as $|log(1/2)/log(\alpha)|$, measures the time required for a shock to decay to half its initial value, see Andrews (1993). Of particular interest are the half life of France, Italy, and the United States based on the mixed model regression (1), the half life for Canada and Finland based on the ADF regression (2), and the half life of Germany and Japan based on the ADF regression (3). The half life ranges between 0.31 years for France and 3.29 years for Germany. It is interesting to note that although we are unable to reject the unit root null hypothesis for Australia, the corresponding half life based on the mixed model

[6] We did not calculate the ADF test without trend for Australia given that its plot of u^R indicates the presence of a trend.

regression is only 0.54 years, and so the extent of persistence in the ratio of female to male unemployment rates in Australia is relatively low.[7] Our empirical results, therefore, imply that there is substantially less evidence of persistence in the gender unemployment gap based on u^R compared to u^D.

3. Concluding Remarks

We examine the level of persistence in the gender unemployment gap for eight OECD countries: Australia, Canada, Finland, France, Germany, Italy, Japan, and the United States. Our measure of the gender unemployment gap is the ratio of the female unemployment rate to the male unemployment rate, denoted by u^R. We reject the unit root null hypothesis for the u^R series in all countries except Australia based on the Perron (1997) and the ADF unit root tests. Further, the estimated trend-function parameters from the u^R regressions show that the gender unemployment gap is disappearing over time in all countries in our sample. An important implication of our findings is that the time series properties of the gender unemployment gap depend on the measure used. Therefore, we suggest that both u^D and u^R be used to evaluate the dynamics of the gender unemployment gap.

[7] Based on the u^R regressions shown in Table 2, we find that the half lives range between 0.20 years and 1.45 years. The half lives corresponding to the u^D measure range between 0.34 years and 2.41 years, see Queneau and Sen (2007). We should also note that the half life corresponding to the mixed model regressions with u^R are less than that with u^D for all countries except Canada.

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Figure 1: Ratio of Female to Male Unemployment Rates

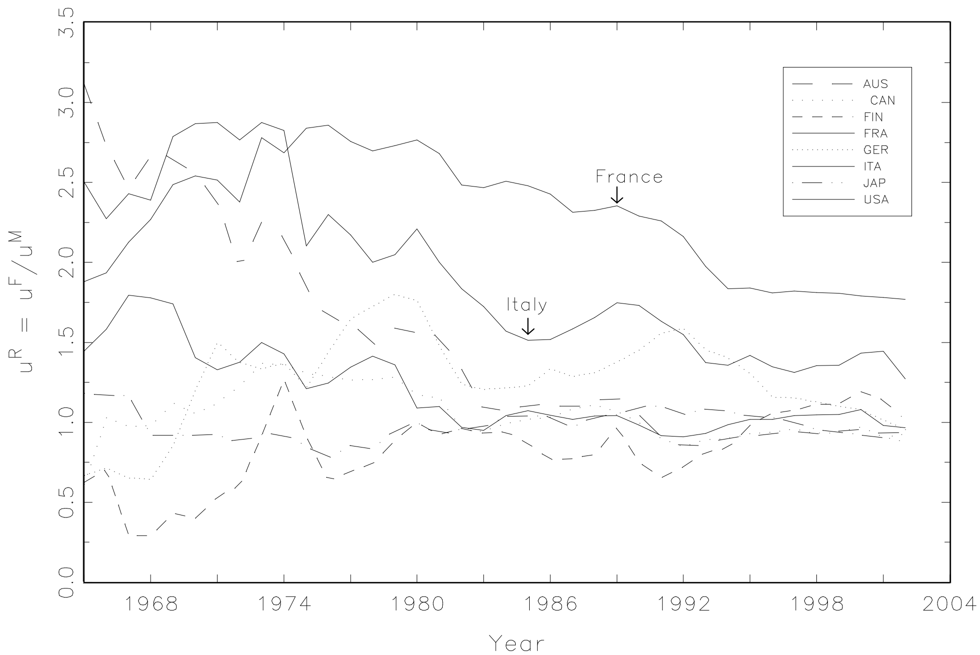

Table 1: Average Gender Unemployment Gap (u^R), 1965-2002

Period	AUS	CAN	FIN	FRA	GER	ITA	JAP	USA
1965-1970	2.70	0.96	0.46	2.54	0.79	2.21	1.04	1.62
1971-1975	2.12	1.28	0.85	2.69	1.36	2.67	0.90	1.37
1976-1980	1.58	1.25	0.79	2.15	1.67	2.76	0.88	1.29
1981-1985	1.23	1.01	0.92	1.73	1.27	2.52	0.98	1.03
1986-1990	1.11	1.06	0.81	1.65	1.35	2.34	1.04	1.02
1991-1995	0.89	0.89	0.80	1.47	1.46	2.01	1.07	0.95
1996-2002	0.94	0.93	1.10	1.36	1.08	1.80	0.95	1.03

Table 2: Mixed Model Unit-Root Tests for the u^R Series, 1965-2002

Series	$\hat{T}_b$	k^*	$\hat{\alpha}$	$\hat{\mu}_0$	$\hat{\mu}_1$	$\hat{\mu}_2$	$\hat{\mu}_3$	$\hat{\mu}_4$	$\hat{\sigma}^2$	HL_α
u^R(AUS)	1980	0	0.28	2.02	-0.20	0.29	-0.0669	0.0582	0.11	0.54
			(-4.80)	(4.37)	(-2.38)	(2.23)	(-3.86)	(3.86)		
u^R(CAN)	1999	0	0.62	0.50	-0.04	0.10	-0.0052	0.0151	0.07	1.45
			(-4.64)	(5.11)	(-0.16)	(0.53)	(-3.77)	(0.15)		
u^R(FIN)	1983	1	0.27	0.27	-0.26	0.19	0.0289	-0.0127	0.13	0.53
			(-4.82)	(3.03)	(-2.60)	(1.14)	(-4.23)	(2.70)		
u^R(FRA)	1980	3	$-\mathbf{0.11^b}$	2.63	-0.28	0.17	-0.0605	0.0394	0.13	**0.31**
			(-5.69)	(5.90)	(-2.50)	(1.14)	(-4.63)	(3.08)		
u^R(GER)	1974	1	0.51	0.28	0.09	-0.31	0.0562	-0.0665	0.09	1.03
			(-5.00)	(3.46)	(1.20)	(-3.13)	(2.98)	(-3.34)		
u^R(ITA)	1971	0	$\mathbf{0.44^d}$	1.13	0.21	-0.40	0.0608	-0.0862	0.07	**0.84**
			(-5.70)	(6.27)	(2.86)	(-4.53)	(2.68)	(-3.39)		
u^R(JAP)	1977	0	0.56	0.45	0.12	-0.11	-0.0080	0.0061	0.05	1.20
			(-3.30)	(2.81)	(2.57)	(-1.89)	(-1.30)	(0.94)		
u^R(USA)	1980	1	$\mathbf{0.03^a}$	1.66	-0.18	0.27	-0.0362	0.0363	0.06	**0.20**
			(-7.10)	(7.06)	(-3.15)	(3.35)	(-5.97)	(5.62)		

Note: The superscripts 'a,' 'b,' 'c,' and 'd' denote respectively significance at the 1%, 2.5%, 5% and 10% significance level. The finite sample critical values (T=35) for t_{DF}^{min} are: -5.58 at the 10% level, -5.99 at the 5% level, -6.35 at the 2.5% level, and -6.75 at the 1% level. (Asymptotic critical values for t_{DF}^{min} can be obtained from Table 1 in Perron (1997). We use simulated finite sample critical values for T=35 to evaluate the significance of the calculated unit root statistics.) The numbers in the parenthesis under the estimated trend-function coefficients are the respective t-statistics for the null hypothesis that the parameter is equal to zero. The number in parenthesis under the estimate coefficient of the first lag is the t-statistic for the null hypothesis that it is equal to one.

Table 3: ADF Tests for the $\mathbf{u^R}$ Series, 1965-2002

Series	Without Trend				With Trend				
	k^*	α	μ	HL_α	k^*	α	μ	β	HL_α
u^R(AUS)	-				4	0.94	-0.15	0.0068	11.20
						(-0.58)	(-0.54)	(0.98)	
u^R(CAN)	-				0	**0.62**$^{\mathbf{a}}$	0.50	-0.0049	**1.45**
						(-4.76)	(5.21)	(-4.09)	
u^R(FIN)	-				1	**0.49**$^{\mathbf{c}}$	0.28	0.0077	**0.97**
						(-3.56)	(3.08)	(2.52)	
u^R(GER)	1	**0.81**$^{\mathbf{d}}$	0.24	**3.29**	4	0.76	0.43	-0.0058	2.53
		(-2.74)	(2.71)			(-2.54)	(3.21)	(-2.73)	
u^R(JAP)	0	**0.73**$^{\mathbf{d}}$	0.26	**2.20**	-				
		(-2.69)	(2.61)						

Note: The superscripts 'a,' 'b,' 'c,' and 'd' denote respectively significance at the 1%, 2.5%, 5% and 10% significance level. The finite sample (T=50) critical values are taken from Table 4.2, pp. 103 in Banerjee, Dolado, Galbraith, and Hendry (1993). The critical values for the ADF unit-root tests (t_μ) without trend are: -2.60 at the 10% level, -2.93 at the 5% level, -3.22 at the 2.5% level, and -3.58 at the 1% level. The critical values for the ADF unit-root tests with trend (t_τ) are: -3.18 at the 10% level, -3.50 at the 5% level, -3.80 at the 2.5% level, and -4.15 at the 1% level. The numbers in the parenthesis under the estimated trend-function coefficients are the respective t-statistics for the null hypothesis that the parameter is equal to zero. The number in parenthesis under the estimate coefficient of the first lag is the t-statistic for the null hypothesis that it is equal to one.