Relationship between Second Job Holding and Unemployment in the Czech Republic: The Engle Granger Cointegration Analysis

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[Abstract]

In order to reveal the long run association between second job holding and unemployment in the Czech Republic, this study uses quarterly data from Eurostat for the period of 1998Q1 to 2008Q4. Application of the Engle Granger two-step method of cointegration analysis confirms the long run equilibrium relationship between second job holding and unemployment in the Czech Republic. Absence of a statistically significant error correction term suggests that it is not possible to create a meaningful error correction model to analyze the short-run dynamics between second job holding and unemployment. The Granger causality test indicates that there is a one-way causal relationship from second job holding to unemployment. Therefore, second job holding is considered as a contributing factor to unemployment in the Czech Republic.

Keywords: *Second job holding, Engle Granger Cointegration Analysis, Granger Causality Test*

I. Introduction

In modern economies, an increasing number of people are pursuing second jobs in addition to their main employment due to flexible work arrangements (Baines and Newell (2004)). Almost every advanced economy encounters the challenge of many second job holding by workers (Combos, McKay and Wright (2007)). The primary worry is that when people work for several jobs, especially in a competitive labour market, it may result in less opportunities for others, particularly those who are still looking for job. When a people hold multiple positions in a competitive domain, it can create bottlenecks for new entrants. This perception is especially strong when work possibilities are few or certain industries are contracting. This raises the possibility that holding a second job may have some impact on unemployment rates. This argument prompted us to investigate the impact of having a second job on unemployment in the Czech Republic.

The association between second job holding and unemployment is ambiguous. It is dependent on the relative strength of income and substitution effects. During a recession, the income effect from reduced wages or working hours may reduce the demand for jobs because huge unemployment raises the opportunity cost of being employed. With fewer jobs and lower wages available, the incentive to search for work decreases during recession. When income falls, people frequently review the marginal utility of time, and leisure becomes more appealing. As the consequence, during a recession, second job holding is predicted to be declining. The substitution effect of being employed works in the opposite direction as the income effect. The relation between having a second job and unemployment can be either positive and negative, depending on the relative influence of income and substitution effects. Economic Policy Institute (1999) found that multiple job holding may become more common during economic downturns as people strive to compensate for lost income or protect

themselves from potential job uncertainty. This is consistent with the strong income effect over substitution effect that people work harder when their earnings fall.

Stinson (1987) revealed that multiple job holding in the United States increased during periods of economic expansion, particularly between 1960 and 1970. This implies that when the economy expands and work options multiply, individuals may take on second jobs to profit on increased demand, higher earnings, or personal ambition. Interestingly, this pattern did not hold during recessions, showing that economic downturns may not necessarily force people into multiple job holding, perhaps due to less available positions or more job insecurity.

Partridge (2002) provided a compelling counterargument to the notion that multiple job holding is countercyclical. His study, which used state-level data from the United States, exposed that multiple job holding is pro-cyclical, meaning it increases during times of economic expansion and labor shortages. Amuedo-Dorantes and Kimmel (2005) conducted a thorough study of multiple job holding throughout the business cycle and observed that moonlighting and unemployment are negatively related. According to them, throughout periods of economic growth, there are more job opportunities, which allow workers to pursue second employment more easily. On the other hand, during economic downturns, job availability declines, resulting in individuals often struggling to find appropriate second jobs, even if they wish to take on extra work. Conway and Kimmel (1998) suggested that because of the diversity in jobs, a rise in non-wage income could result in a decrease in second job holding. This reasoning implies that second job holding is countercyclical.

Hirsch, Husain, and Winters (2016) claimed that, while approximately 5% of U.S. workers hold multiple jobs, multiple job holding is essentially acyclic, meaning that it does not rise or fall sharply with unemployment rates. Local labor markets with high unemployment tend to have moderately lower rate of multiple job holding, although no consistent association over time have been found. The widely held view that multiple job holding is countercyclical is not strongly backed by the data.

Following the Velvet Revolution in 1989, the communist state of Czechoslovakia was divided into two separate states: the Czech Republic and Slovakia. Both countries underwent economic reforms and privatizations to develop a market economy. Globalization and privatization were widely successful in the country. Second Job Holding (or Moonlighting) has had a huge impact on the Czech economy, as it has on all other industrialized nations ((Munich, Jurajda and Cihak (1999); Cazes and Nesporova (2004); Sliter and Boyd (2014)).

This study seeks to reveal the cointegration or long-run relationship between multiple job holding and unemployment in the Czech Republic by employing the Engle-Granger Two-Step Cointegration Method. This paper is organized as follows: Section II covers the methodology, Section III describes the empirical results, and Section IV summarizes the findings.

II. Methodology

Cointegration suggests that although separate time series may display non-stationary patterns, a linear combination of these series can lead to a stationary outcome, indicating the presence of a long-term equilibrium relationship. If two variables X_t and Y_t are integrated of order one ($I(1)$), and if their linear combination is integrated of order zero ($I(0)$), then these variables are regarded as cointegrated. Consequently, there exists a long-term equilibrium relationship between the variables. This encapsulates the core of Engle-Granger's (Engle and Granger (1987)) two-step procedure for examining long-term equilibrium associations.

In the initial phase of the Engle-Granger cointegration analysis, it is necessary to verify the stationarity of the variables. Stationarity in time series designates a condition in which the statistical properties of the series, including mean, variance, and covariance, remain constant over time. The Augmented Dickey–Fuller (ADF)

test introduced by Dickey and Fuller (1979) along with the Phillips–Perron (PP) test suggested by Phillips and Perron (1988) will be conducted to assess the stationarity of the data.

An improvement to the Dickey-Fuller (DF) test for tackling higher order structural effects (autocorrelation) in time series analysis is the Augmented Dickey-Fuller (ADF) test. The ADF test of stationarity of a time series Y_t is based on the testing of the null hypothesis of a unit root ($H_0: \delta = 1$) by OLS estimation of the following equation:

$$\Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \sum_{i=1}^{m} \gamma_i \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

Presence of unit root implies $\delta = 1$, t is the deterministic time trend, γ_is are the lag coefficients and ε_t is the white noise error term. The Schwarz information criterion (SC) or the Akaike information criterion (AIC) are used to determine the lag order i. The Phillips–Perron (PP) handles serial correlation and heteroskedasticity in the error terms differently, by using non-parametric corrections rather than adding lagged terms.

The second stage of the Engle-Granger Cointegration analysis involves performing Ordinary Least Squares (OLS) regression on the equation below:

$$Y_t = \beta_0 + \beta_1 X_t + u_t \quad (2)$$

If the estimated $\hat{\beta}_1$ appears to be significant, the stationarity of the residual series

$$e_t = Y_t - \hat{\beta}_0 - \hat{\beta}_1 X_t \quad (3)$$

confirms cointegration of Y_t and X_t.

After establishing the cointegration that indicates a long-term equilibrium relationship among the variables, an Error Correction Model (ECM) can be utilized to analyze the short-run dynamics between the dependent and independent variables. The ECM requires OLS estimation of the following model:

$$\Delta Y_t = \alpha + \beta \Delta X_t + \gamma e_{t-1} + \epsilon_t \quad (4)$$

where γ is speed of adjustment which shows the speed at which the dependent variable returns to equilibrium. A notable and negative α indicates a strong correction.

The Granger Causality test is used when there is cointegration relationship between Y_t and X_t. A time series variable X_t is considered to Granger cause another time series variable Y_t if it holds valuable information that can help forecast future values of the latter. Granger Causality test involves estimation of the following model:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{p} a_i \Delta Y_{t-i} + \sum_{j=1}^{q} b_i \Delta X_{t-j} + \epsilon_{1t} \quad (5)$$

$$\Delta X_t = \alpha_0 + \sum_{i=1}^{p} c_i \Delta Y_{t-i} + \sum_{j=1}^{q} d_i \Delta X_{t-j} + \epsilon_{2t} \quad (6)$$

If $\hat{b}_i = 0, X_t$ does not cause Y_t. Similarly, if $\hat{c}_i = 0$, Y_t does not cause X_t.

In our case, Y_t is the Number of Second Job Holders and X_t is the rate of unemployment. To look into how unemployment and second job holding is related in the long run in the Czech Republic, quarterly data from Eurostat for the period of 1998 Q1 to 2008 Q4 is used. Eurostat regularly releases data on "total employed

individuals (NEP)", "total employed individuals with a secondary job (NESJH)", "average weekly working hours in the primary job", and the "unemployment rate" (UNEMP). Subsequently, the rate of secondary job ownership (SJH) is computed as the percentage of NESJH to the NEP $\left(\text{SJH} = \frac{\text{NESJH}}{NEP} \text{x} 100\right)$.

Eurostat publishes regularly data on "number of employed persons (NEP)", "number of employed persons having second job (NESJH)", 'average number of actual weekly hours of work in main job' and the "unemployment rate" (UNEMP). Then rate of second job holding (SJH) is calculated in terms of percentage of SJH to the NEP $\left(\text{SJH} = \frac{\text{NESJH}}{NEP} \text{x} 100\right)$.

III. Empirical Analysis

To find out the cointegration long run relationship between second job holding and unemployment in the Czech Republic, the following model is considered:

$$SJH_t = \beta_0 + \beta_1 UNEMP_t + u_t \qquad (7)$$

Table – 1 presents the summary statistics. The mean value of SJH and UNEMP are 2.44 and 7.36 respectively. SJH varies from a very low 1.56 to a considerably high value 3.42. Likewise, UNEMP spans from a minimum of 4.3 to a notably high value of 9.6. Since Jarque-Bera of SJH is 0.203726 with p-value 0.903153, the null hypothesis that the data follows a normal distribution is accepted with 90 percent level of significance. Similarly, the Jarque-Bera test statistic for UNEMP is 5.331892, accompanied by a p-value of 0.069534, indicating that we fail to reject the null hypothesis, which states that the data follows a normal distribution at a significance level of six percent.

Table – 1: Summary Statistics

	SJH	UNEMP
Mean	2.442075	7.356818
Median	2.450537	7.800000
Maximum	3.417624	9.600000
Minimum	1.563205	4.300000
Std. Dev.	0.462953	1.416907
Skewness	-0.100078	-0.839195
Kurtosis	2.733428	2.697819
Jarque-Bera	0.203726	5.331892
Probability	0.903153	0.069534
Sum	107.4513	323.7000
Sum Sq. Dev.	9.215985	86.32795
Observations	44	44

Source: Own computation based on secondary data

Table – 2: Unit Root Test of Variables

	ADF Test Statistic				PP Test Statistic			
	Intercept		Trend and Intercept		Intercept		Trend and Intercept	
	Level	First Difference	Level	First Difference	Level	First Difference	Level	First Difference
SJH	-1.8259	-4.3644***	-2.6570	-4.4098**	-1.6607	-4.3732***	-2.2357	-4.4282***
UNEMP	-0.3426	-3.5305**	-1.3154	-3.4093*	-0.7197	-5.9593***	-2.2889	-7.0539***

Notes: ***, ** and * denotes rejection of null hypothesis that the data has a unit root at the 1%, 5%and 10% level of significance, respectively.

Source: Own computation based on secondary data

Table – 2 presents the unit root test results of SJH and UNEMP. Both the ADF Test (using the SIC as lag length selection criteria) and Phillips–Perron (PP) Test (applying the Newey-West bandwidth) suggest that SJH and UNEMP are non-stationary in level but stationary in first difference. Therefore, both the SJH and UNEMP are integrated of degree one, $I(1)$.

Since all variables are $I(1)$, Engle-Granger Cointegration analysis involves carrying out Ordinary Least Squares (OLS) estimation of equation (1). The estimated OLS equation is presented by equation (8).

$$\widehat{SJH}_t = 1.045138 + 0.189883UNEMP_t \quad (8)$$
$$t\ statistic = (4.628094) \quad (3.401471)$$
$$P\ Value = (0.0001) \quad (0.0015)$$

The OLS results indicate that UNEMP significantly affect SJH. The next step of the Engle-Granger Cointegration analysis necessitates that the residual series from (8) exhibit stationarity. We have calculated residual series from (8). The ADF Test Statistic value of the residuals of (8) is estimated at −4.249223. The Engle Granger critical value for 5% and 10% level of significance are −3.67 and −3.28 respectively. Since −4.249 < −3.67, i.e., the test statistic is more negative than the 5% critical value, the residuals of the OLS regression are stationary and we reject the null hypothesis of no cointegration at 5% level of significance. Therefore, cointegration between SJH and UNEMP is confirmed in Engle-Granger sense. There is long run equilibrium relationship between SJH and UNEMP.

Since there is a long run equilibrium relationship among the variables, an Error Correction Model (ECM) is employed to examine the short run dynamics between SJH and UNEMP. The Error Correction Model (ECM) entails the Ordinary Least Squares (OLS) estimation for equation (9):

$$\Delta SJH_t = \alpha + \beta\Delta UNEMP_t + \gamma ECT + v_t \quad (9)$$

where ECT (Error Correction Term), is the one period lagged series of the residuals of estimated equation (8) and v_t is the white noise error. γ is the speed of adjustment which shows the speed at which the SJH returns to equilibrium. ECT is referred to as the equilibrium error correction term, which directs the variables SJH and UNEMP towards restoration of equilibrium in the short term. The estimation of equation (9) gives

$$\widehat{\Delta SJH}_t = -0.036896 + 0.012596\Delta UNEMP_t - 0.060335ECT \quad (10)$$
$$t\ statistic = (-2.625711)\ (0.315677)\ (-1.276408)$$
$$P\ Value = (0.0122)\ (0.7539)\ (0.2092)$$

The coefficient of the error correction term (ECT) is -1.276408, which is negative but insignificant. The insignificant ECT indicates that the error correction mechanism is either inactive or lacking in strength. The insignificant ECT also suggests that short-term shifts away from equilibrium are not being rectified efficiently. Consequently, while there is a verified long-run relationship between unemployment (UNEMP) and second job holding (SJH) within the Engle-Granger framework, it is not feasible to construct a sensible error correction model for the short-term dynamics between SJH and UNEMP.

Table – 3: Lag Selection Criteria

VAR Lag Order Selection Criteria						
Endogenous variables: SJH UNEMP						
Exogenous variables: C						
Sample: 1998Q1 2008Q4						
Included observations: 40						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-55.37288	NA	0.060380	2.868644	2.953088	2.899176
1	33.62031	164.6374	0.000862	-1.381016	-1.127684	-1.289419
2	43.60708	17.47684*	0.000640*	-1.680354*	-1.258134*	-1.527693*
3	45.71010	3.469979	0.000707	-1.585505	-0.994397	-1.371779
4	47.84956	3.316173	0.000783	-1.492478	-0.732482	-1.217688
* Indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Source: Own computation based on secondary data

Table – 4: Granger Causality Tests

Pairwise Granger Causality Tests			
Sample: 1998Q1 2008Q4			
Lags: 2			
Null Hypothesis:	Observations	F-Statistic	Prob.
UNEMP does not Granger Cause SJH	42	1.18924	0.3158
SJH does not Granger Cause UNEMP	42	25.6883	0.0000001

Source: Own computation based on secondary data

In order to conduct the Granger Causality Test accurately, it is essential to determine the optimal lag length. Table -3 presents various optimal lag length selection criteria. All criteria suggests that lag order two is optimal. Using lag order 2, we have performed Granger Causality Test and presented the result in Table – 4. The results suggest that the null hypothesis of "UNEMP does not Granger Cause SJH" is accepted while the null hypothesis of "SJH does not Granger Cause UNEMP" is rejected. There is unidirectional causality from SJH to UNEMP. Therefore, it is concluded that SJH Granger causes UNEMP, i.e., we can suggest for SJH as a factor determining UNEMP in the Czech Republic.

IV. Conclusion

This study is aimed to explore the long run relationship between second job holding (SJH) and unemployment (UNEMP) in the Czech Republic by utilizing the Engle-Granger Two-Step Cointegration analysis, by using quarterly Eurostat data from 1998Q1 to 2008Q4. Application of the ADF and the PP tests confirmed that both the variables are stationary at their first differences. Since all the variables are integrated of order one, Engle-Granger cointegration analysis has been applied. The residual series obtained from OLS estimation between SJH and UNEMP exhibit stationarity. The cointegration between SJH and UNEMP in the Engle-Granger sense is confirmed with the stationarity of the residual series. Therefore, the long run relationship between SJH and UNEMP has been validated for the period of 1998Q1 to 2008Q4 in the Czech Republic.

An Error Correction Model (ECM) has been employed to examine the short run dynamics between SJH and UNEMP. Since the error correction term is negative but insignificant, the presence of any error correction mechanism is ruled out despite the existence of a long run equilibrium relationship between SJH and UNEMP. The Granger causality test suggests that there is unidirectional causality from SJH to UNEMP. Hence, second job holding is considered to be a contributing factor to unemployment in the Czech Republic.

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