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LINK OF UNEMPLOYMENT RATE BETWEEN TAIWAN AND THE UNITED STATES

ABSTRACT

Unemployment problem is a pressing issue in many countries, but literature on the aggregate relationship between exchange and unemployment rates in Taiwan (TW) is lacking. We investigated the unemployment problem in relation to another country through the bilateral exchange rate and explored the link of unemployment rate between TW and the United States (US). Results corroborate that a 1% increase in the US unemployment rate results in an average of an 0.34%–0.38% increase in the TW unemployment rate.

Keywords: Exchange Rate, Transmission Effect, Unemployment Rate
JEL Classification: F31, J60

RIASSUNTO

La relazione tra il tasso di disoccupazione di Taiwan e degli Stati Uniti

Il problema della disoccupazione è importante per molti paesi. Ciononostante la letteratura sulla relazione aggregata tra cambio e tasso di disoccupazione a Taiwan è carente. In questo studio abbiamo analizzato questo problema tramite il tasso di cambio bilaterale ed abbiamo preso in considerazione la relazione tra il tasso di disoccupazione a Taiwan e negli USA. I risultati confermano che un incremento dell'1% della disoccupazione negli USA si associa in media ad un incremento dello 0.34-0.38% del tasso di disoccupazione a Taiwan.

1. INTRODUCTION

Although the unemployment problem is a pressing issue in many countries, this problem has mostly been tackled as a domestic issue at the aggregate level. Shih *et al.* (2007) inferred that the

suicide rate could express people's mental health situation and that the unemployment rate could express the economic situation of a country. They placed the unemployment rate as a factor of the suicide rate. Their empirical results affirmed that the unemployment rate significantly influences the suicide rate and that the fluctuation of the unemployment rate is influenced by the suicide rate fluctuation, which is expected to increase gradually.

The literature on the aggregate relationship between the exchange and unemployment rates in Taiwan (TW) is surprisingly scant. Regarding research on the relationship between changes in the exchange and unemployment rates of TW, Wang (2009) examined the relationship from 1978 to 2006. They also discussed the positive or the negative relationship between the exchange and unemployment rates in TW and their cause and effect relationship. Empirical estimates compared with the control period are divided into two sections by the appreciation or devaluation of NTD. However, we intend to investigate the unemployment problem in relation to another country through the bilateral exchange rate.

Many small open economies link their currencies to the United States (US) dollar, but numerous studies mainly focus on the monetary and fiscal policy implications. For instance, Kuo and Lan (2015) predicted the exchange rate of NTD/USD. Once an economic event occurs, time-varying weight must be adjusted to improve the bias exchange rate forecast of NTD/USD. Moreover, the corresponding bias and variance of each considered model display dramatic shifts in these recent global economic events, implying that the combination can extract useful information from each considered model to yield more accurate exchange rate predictions.

Fu *et al.* (2014) also explored establishing NTD/USD exchange rate models. To avoid spurious regression, we must implement the unit root test to verify the stationarity of time-series data. The co-integration test is adopted to verify the equilibrium relation between the exchange rate and macroeconomic variables. Hitherto, their findings validate that all the time series data are non-stationary and that a co-integration relation exists between the exchange rate and macroeconomic variables.

Consequently, our research aims at research variables for conducting the unit root and co-integration tests. According to the co-integration test results, more in-depth discussion, such as the error correction model (ECM), will be carried out to determine whether the short-term effects tend to be part of the long-term effects.

Tsaur *et al.* (2013) recently studied imported inflation and unemployment. They confirmed that an increase in the international relative price of oil deteriorates the current account and that the increase of the oil price depreciates real exchange rates and results in a decreased gross domestic product. These are attributable to the reduction of labor employment in the final sector and upturn of employment in the oil sector. Nevertheless, the overall unemployment, the number of the country's unemployed, and the unemployment rate increase. Tsaur and Tsaur (2013) examined the effect of imported inflation in a small open economy importing intermediate inputs for production purposes under a system of flexible exchange rates.

Nevertheless, the implication of such a link in relation to the unemployment rate at the aggregate level has been largely ignored. Overall, we explore the unemployment rate of transmission effect through the link between the exchange and unemployment rates. We propose to ask and answer the following question: How does the unemployment rate from the base currency country influence that of the currency-linked country? Section 2 discusses the basic theory. Section 3 identifies the quantitative methods and Eviews software use. Section 4 describes the data sources and period, selects variables, and reports the results. Section 5 concludes the paper. We summarize the first to third sections and mention the research limitations.

2. BASIC THEORY

We refer to the study of Ran and Zhou (2012) regarding the exchange and unemployment rates. We use two theories, namely, the purchasing power parity (PPP) and the Phillips curve, to create a link between the exchange and unemployment rates. The standard relative form of the PPP in the time adjustment process is stated as Equation (1).

$$p_A(1+\pi_A)=s(1+s^*)p_B(1+\pi_B) \tag{1}$$

Formula variable definitions: p_A and p_B are the prices for countries A and B, respectively; s is the exchange rate well-defined as the home currency price per unit of the foreign currency; s^* is the percentage change in the exchange rate; and πA and πB are actual inflation rates. We divided Equation (1) by $p_A=sp_B$ and acquire Equation (2).

$$s^*=(\pi_A-\pi_B)/(1+\pi_B) \tag{2}$$

The standard augmented Phillips curve in each country is shown as Equation (3).

$$\pi_i = -h(U_i - \bar{U}_i) + \pi_i^e, \quad i = A, B \tag{3}$$

Formula variable definitions: π^e is the expected rate of inflation; U and $\bar{U}$ are the actual and natural rates of unemployment, respectively. We simply take Equation (3) as an identity. We substitute Equation (3) with (2) for the two countries and rearrange to obtain Equation (4).

$$U_A = [h_B U_B - (1 + h_B \bar{U}_B) s^* + (\pi_A^e - \pi_B^e) + (h_A \bar{U}_A - h_B \bar{U}_B) + h_B s^* U_B - \pi_B^e s^*] / h_A \tag{4}$$

Equation (4) expresses clearly that the unemployment rate in one country is a function of the unemployment rate in the other country, the changes in the exchange rate, the expected rate of price change differential between the two countries, the natural rate of the unemployment rate differential between the two countries, and the exchange rate interaction variables with the foreign unemployment rate, and the rate of the foreign price change.

Equation (4) reveals an important relationship among these variables and a new perspective on the unemployment problem, which guides our empirical investigation below. We foresee that the transmission effect is positive, that is, an increase in one country's unemployment rate could contribute to an increase in the unemployment rate of the other country. Additionally, we postulate that the exchange rate change is negatively related to the unemployment rate. The increase of the exchange rate or the depreciation of one country's currency brings a decrease in the unemployment rate of that country because such depreciation increases its export, which presumably increases the output, which in turn increases employment. Conversely, we posit that the percentage change in the exchange rate is zero, as $s^* = 0$, and shorten Equation (4) to gain Equation (5).

$$U_{At} = \beta_0 + \beta_1 U_{Bt} + \beta_2 (\pi_A^e - \pi_B^e) + \varepsilon_t \tag{5}$$

Equation (5) is explained in three points as follows. First, the natural rates of unemployment in two countries are independent from each other, and we treat them together as a constant. Second, the US unemployment rate and inflation are exogenous to the TW economy because the role of TW relative to US is absolutely a follower. Third, the augmented expected inflation differential is also an independent variable. Under the relative PPP and the exchange rate link, either the actual or the expected inflation between the two countries would be equal.

3. QUANTITATIVE METHOD

We refer to Hill *et al.* (2012) about the written principles of econometrics. Chapter 12 of their textbook discusses regression with time-series data: nonstationary variables. On the basis of the material in Chapter 12, we explain why we need unit root tests and state the implications of the null (H_0: α=0) and alternative hypotheses. We learn the meaning of the statement that a series is integrated of order one or I(1). Afterward, we execute Dickey-Fuller and augmented Dickey-Fuller tests for stationarity to avoid a spurious regression. Cointegration test determines whether the series are cointegrated. If cointegration exists, then we select an appropriate model for regression analysis with time-series data.

Hill *et al.* (2008) wrote about using Eviews for the principles of econometrics. Chapter 12 of the reference book is in line with case learning to study software operation.

4. DATA AND RESULT

The sample from the Taiwan Economic Journal database covers the period October 1983 to September 2015. The data frequency is monthly. The four time-series variables are the TW unemployment rate (U_{TW}), TW consumer price index (P_{TW}), US unemployment rate (U_{US}), and US consumer price index (CPI) (P_{US}).

We use three methods to measure the expected inflation. The first method adopts the rational expectation approach such that expected π is equal to actual π, revealed as $\pi_t^e = \pi_t$. CPI treats the expected inflation as the actual inflation. The second method holds that expected π is equal to the actual π differential, as $\pi_t^e = \pi_t - \pi_{t-1}$. This means that CPI treats the expected inflation as the difference in the actual inflation between time *t* and *t–1*. The third method considers that expected π is equal to the percentage change in actual π, shown as $\pi_t^e = (\pi_t - \pi_{t-1})/\pi_{t-1})$. CPI treats the expected inflation as the percentage change in the actual inflation.

We run the Johansen cointegration test, and the outcomes are displayed in the 7th column of Table 1. Three stars indicate the standard 1% significance level in the trace test statistic of the Johansen cointegration test. The 7th column reports three significant cases and rejects the null hypothesis that the dependent and explanatory variables are not cointegrated, thereby empirically confirming that this long-run relationship indeed exists.

With the establishment of the cointegrated relationship and for obtaining the long-run

correction of the short-run effects, we adopt the ECM to obtain our estimation results. The standard form is shown as Equation (6).

$$\triangle U_{At}=\beta_0+\beta_1\triangle U_{Bt}+\beta_2\triangle(\pi_A^e-\pi_B^e)+\beta_3\hat{e}_{t-1}+\varepsilon_t \quad (6)$$

Table 1 shows that all estimated coefficients for β_1 are significant at the 5% level and that transmission effect is positive and robust. The positive sign is consistent with our prediction from the model. Significant β_1 is consistent with the view that Phillips curve tradeoffs exist in the currency base and currency link countries. Furthermore, β_1 is different from one, suggesting that the Phillips curve slopes are not equal in both countries. The tradeoff is less in TW.

Nominal effect β_2 on the TW unemployment rate from the expected price change differential is insignificant, which discredits the belief that the link will fail in the near future.

The last estimated coefficient (β_3) for the lagged residuals normally represents the short-run disequilibrium "correcting mechanism". In theory, this lagged short-run effect could either add to the severity or mitigate the long-run transmission effect. Only the first method estimated coefficient for β_3 is significant at the 5% level, and the sign is negative.

The 8th column in Table 1 reports the calculated TW unemployment rate elasticity with respect to the US unemployment rate from three different estimations with significant Johansen testing results as $\eta U_{TW},U_{US} = (\mathrm{d}U_{TW}/\mathrm{d}U_{US})(U_{US}/U_{TW}) = \beta_1(U_{US}/U_{TW})$. The averages are used in calculation.

TABLE 1- *Taiwan Monthly Unemployment Rate (x) ECM Estimation Results*

	π_t^e	β_0	β_1	β_2	β_3	Johansen	Elas β_1
1	π_t	0.006 (0.616)	0.196 (3.273)**	0.005 (0.421)	-0.024 (-2.131)**	4.421 [0.000]***	0.376
2	$\pi_t - \pi_{t-1}$	0.006 (0.606)	0.179 (2.976)**	-0.001 (-0.067)	-0.010 (-1.389)	3.620 [0.000]***	0.343
3	$\frac{\pi_t - \pi_{t-1}}{\pi_{t-1}}$	0.006 (0.606)	0.179 (2.976)**	-0.064 (-0.089)	-0.010 (-1.400)	3.610 [0.000]***	0.343

Notes 1: ** indicates a significant level of 5%; *** indicates a significant level of 1%.
2: ( ) means t-value and [ ] means p-value.

5. Conclusions

The unit root test shows that the series are I(1). The further test proves that the variables are cointegrated. The Error Correction Model obtains a positive unemployment rate transmission effect and 3 Johansen significant. We conclude that a 1% increase in the US unemployment rate corresponds to approximately a 0.34%-0.38% increase in the TW unemployment rate. The transmission effect is fairly natural. Currency base country has higher unemployment rate, and aggregate demand is lowered such that its imports would decline. This adversely affects currency-linked country as TW, whose unemployment rate would go up.

This study merely considers the transmission effect of the unemployment rate. We learn that the exchange and unemployment rates between TW and the US are linked. Finally, this study has the following limitations: it does not consider the effects of monetary or fiscal policy. The data only cover TW and the US.

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Tsai Lun is the inventor of paper. He lived and served as an official at the Chinese Imperial Court at the Han Dynasty in China at about 1800 years ago. In or about the year 105 A.D., he presented Emperor Han Ho Ti with samples of paper. Chinese records do mention and credit Tsai Lun with the invention of paper. His name is well known in China. Tsai Lun was a eunuch. Because he was an officer, he had the access to lots of resources, including money and human resources, for papermaking research. He was Cai Lun, formerly romanized as Ts'ai Lun, was a Chinese eunuch court official of the Eastern Han dynasty. He is traditionally regarded as the inventor of paper and the modern papermaking process, as he originated paper in its modern form. Although early forms of paper had existed since at least the 3rd century BCE, he occupies a pivotal place in the history of paper due to his addition of important new materials, such as tree bark and hemp ends, which resulted in the large-scale manufacture and rapid Tsai-Lun CHO. person. author-email.