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SINGAPORE'S BEVERIDGE CURVE:
A Comparative Study of the Unemployment and Vacancy Relationship for Selected East Asian Countries

by

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Abstract

This paper explores the relationship between unemployment (U) and job vacancies (V) in the Singapore labour market. Empirical analysis using the framework of the UV Curve (also known as the Beveridge Curve) indicates that Singapore's labour market appears to have improved in its matching efficiency as compared to other East-Asian countries. However, detailed study of Beveridge Curve for the Singapore economy reveals that it has become more inelastic since the Asian crisis, thereby suggesting that the labour market is less responsive in recent years. This might suggest the possibility that employers are now more cautious and selective in their employment decisions.

Introduction

The key function of the labour market is to match unemployed workers with jobs available. New hires (successful matches) are the key output of the matching function. Analysing the unemployment and vacancy relationship in the labour market (the Beveridge Curve) can thus reveal essential information about the flexibility and the current state of the labour market.
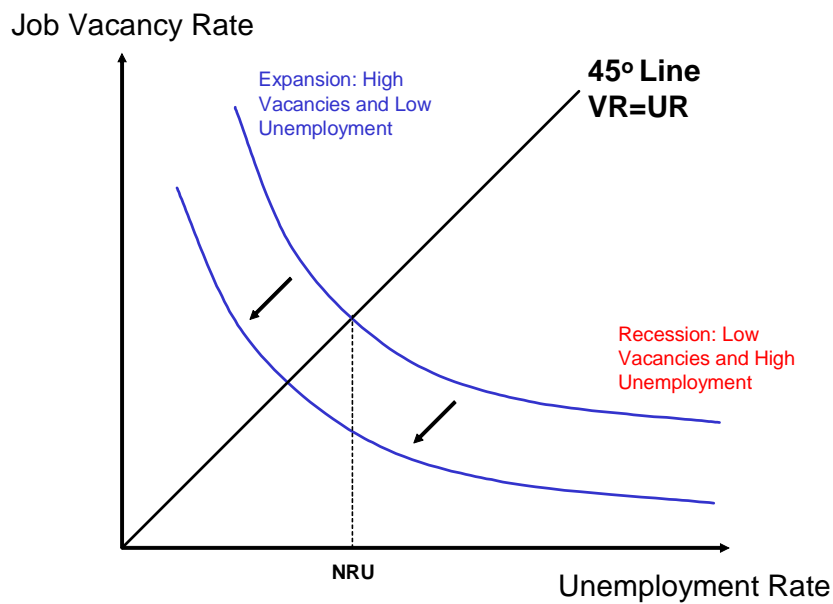
The objective of the paper is to empirically estimate the Beveridge Curve for the Singapore labour market[1]. The paper undertakes the analysis at two levels. First, the paper reports estimates of the Beveridge curves across the selected East Asian countries (Hong Kong, Japan, Taiwan and Singapore) to highlight the trends and any systemic effects across the region. Second, a more detailed study on the Singapore economy is undertaken to account for the structural changes in the labour market, such as changes in the matching technology, and the persistence of structural unemployment from the recent external shocks on the economy.

The Concept of the UV (Beveridge) Curve

The Beveridge Curve draws an inverse relationship between the unemployment rate (U) and the vacancy rate (V) from the matching function of the labour market. The position on the curve can indicate the current state of the economy in any business cycle. For example, the recessionary periods are indicated by high unemployment and low vacancies, corresponding to the lower right end of the curve. Conversely, high vacancies and low unemployment indicate the expansionary periods, corresponding to the high left end of the curve (see Figure 1).

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[1] U = (unemployed / (labour employed + unemployed))*100, V = (vacancies / (labour employed + vacancies))*100

Figure 1: Natural Rate of Unemployment

Job Vacancy Rate

Expansion: High
Vacancies and Low
Unemployment

45º Line
VR=UR

Recession: Low
Vacancies and High
Unemployment

NRU

Unemployment Rate

The position of the curve from the origin indicates the overall activity of the labour market. This would indicate the underlying structure of efficiency of the labour market, the mobility of workers within industries (intra-industry) and between industries (inter-industry). The following would account for shifts in the Beveridge Curve:

a. **Changes in the Labour force** - Increase in the rate of growth of the labour force will shift the curve outwards from the origin as new entrants will add more to the unemployed. For example, changes in the participation rate, aging population and immigration flows will add to the growth of the labour force and thus shift the Beveridge Curve.

b. **Matching "Technology"** - The matching process will determine how efficiently workers are matched with jobs. The improvements in the efficiency of the matching "technology" would shift the curve towards the origin, since an efficient matching process will create faster reduction in the unemployed stock and vacancies. Factors affecting

the matching efficiency of the labour market, include, for example, the introduction of labour market intermediaries, introduction of social insurance, unionisation, and changes in the mobility of labour (Nickell p.4).

c.   **Labour Market "Churn"** - A decrease in the labour market "churn" would decrease the number of firms searching for workers and the number of workers searching for jobs. This would shift the curve towards the origin. Job losses, resignations, and job creation are related to the labour market "churning", or reallocation effects. Increase in the "churning" or reallocation effects will shift the curve outward from the origin.

d.   **Unemployment "Hysteresis"** - Long-term unemployment is positively related to the intercept of the Beveridge Curve. The persistence of long-term unemployment will push the curve outward from the origin. The persistence of structural unemployment could be caused by factors such as deterioration of human capital of the unemployed or a negative perception of the unemployed on the part of the potential employers.
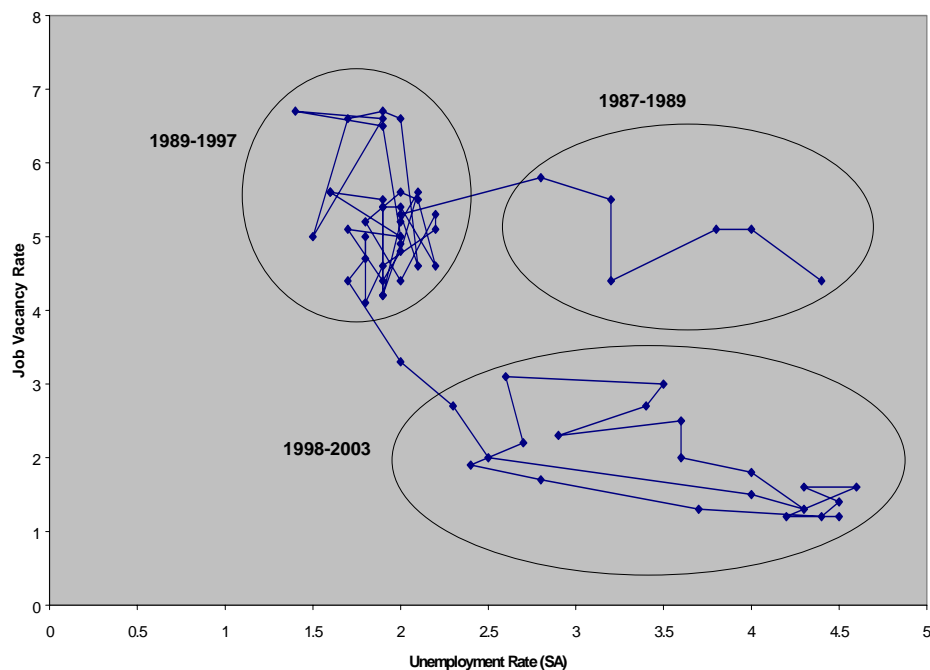
The plot of the relationship between Singapore's unemployment and job vacancies reveals three distinct phases of Singapore's development (see Figure 2), 1987-1989 (Economic Recovery)[2], 1989-1997 (Economic Growth)[3], and 1998-2003

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[2] Singapore's average annual GDP growth for **1987-1989** was **10.3%** (source: DOS) - During the recovery period after the 1985/6 recession, Singapore was enjoying high GDP growth and creating additional jobs through high FDI inflows, but still felt the pinch of the lingering high unemployment rates.
[3] Singapore's average annual GDP growth for **1990-1997** was **8.9%** (source: DOS) - Over the early-mid 90's, the Singapore's economy enjoyed robust growth with high vacancy rates and low unemployment.

(Economic Volatility)[4]. From the visual inspection of Figure 2, the change in the U/V relationship after 1997/8 is quite evident. The change in the business cycle appears to have pushed Singapore's U/V points down towards the lower right end of the Beveridge curve[5], indicating that in 2003 the economy is in a recession. In addition to the downward movements, the curve has shifted inwards. This raises an interesting question about the structural changes in Singapore's labour market after the 1997 Asian financial crisis.

Figure 2: Singapore's U/V plot (Beveridge Curve), 1987:Q1 -2003:Q1

Source: MOM

Theoretical and Empirical Framework: Beveridge Curve

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[4] Singapore's average annual GDP growth for **1998-2002** was **2.9%** (source: DOS) - Singapore's labour market did not fare so well in the more volatile environment post the Asian financial crisis in 1997/8. Diminished external demand for Singapore's goods and services resulted due to the threat of terrorism (post the 9/11 attack), the war on SARS, and the war in Iraq. As a result, the job vacancy rates fell while the unemployment rate hit levels not seen for over 10 years.

The starting point of the Beveridge Curve is the matching function in the labour market, which is given as:

$$M = M(U,V), M_U > 0, M_V > 0. \tag{1}$$

M denotes the number of hires or job matches, U is the number of unemployed workers, and V is the number of vacancies. The matching function summarises the effectiveness of the technology that brings workers searching for jobs together with the employers searching for workers.

We could specify a Cobb-Douglas matching function that exhibits constant returns to scale:

$$M = A(U)^{\alpha}(V)^{1-\alpha} \tag{2}$$

The matching technology is given by the A parameter. In equilibrium the number of separation will be equal to the number of matches and thus we could derive the following (dividing by labour force, L):

$$(\frac{S}{L}) = A(\frac{U}{L})^{\alpha}(\frac{V}{L})^{1-\alpha} \tag{3}$$

This could be written as:

$$Log(s) = A + \alpha \log(UR) + (1-\alpha)\log(VR) \tag{4}$$

where s denotes the separation rate, UR the unemployment rate, and VR the vacancy rate. With a fixed separation rate, the implicit theorem suggests that there exist an inverse relationship between UR (unemployment rate) and VR (vacancy rate) – the Beveridge Curve. The theoretical construct of the basic model is that there is a relationship between the unemployment rate and the vacancy rate in a labour market, represented in the Equation (5).

$$UR_t = a_o + a_1 VR_t \tag{5}$$

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[5] The relationship is expected to be negative and convex to the origin as noted by Christl (2002), Gross (1992), Tse (2002), and Wall (2002).

VR_t = Job Vacancy rate in time t

Equation (5) is transformed into logarithms so that the coefficients can be interpreted in terms of elasticities. This is augmented with a time trend variable (T) to capture improvements in the labour market efficiency over time. We used 1 period lag of vacancies to capture the effects of vacancies as a leading indicator for unemployment. The persistence of unemployment is captured by the lag of unemployment rate. The final form of the equation used is given in Equation (6). To avoid spurious regression, the residuals of the estimated equations are tested for stationarity using the unit-root test. The results indicate that the residuals are stationary for all the regressions, which suggests the above equations are cointegrated and the estimation at levels are valid.

$$\log(UR_t) = b_o + b_1T + b_2\log(VR_{t-1}) + b_3\log(UR_{t-1}) + e_t \qquad (6)$$

where $\log(UR_t)$ = log(Unemployment rate in time t)

$\log(VR_{t-1})$ = log(Job Vacancy rate in time t-1)

T = time trend

e_t = i.i.d error term

Comparative Study of the Beveridge Curve for Selected East Asian Countries (1980-2002)

The Beveridge Curves for Japan, Hong Kong and Taiwan suggest that these countries are moving towards the lower-right end of the curve, i.e., experiencing greater unemployment and low vacancies. However, the results also indicate that

there is an inward shift in the curve for Japan, Hong Kong, and Taiwan in the 1990s. The striking observation across the selected East Asian countries is that the Beveridge Curve for the Singapore economy is getting steeper in the 1990s as compared to the other East Asian countries. The plots of unemployment and vacancy rates for the Japan, Hong Kong and Taiwan are given in Appendix Figures A1 to A3.

From regression analysis, given in Table A1 in the Appendix, we are able to verify the existence of the negative Beveridge Curve for all the East Asian countries. The higher negative coefficient (b_2) for Singapore compared to Japan and Korea suggests that the Singapore's labour market is experiencing higher matching efficiency as compared to these countries. The time trend (b_1), which captures the matching technology or efficiency of labour market matching, is statistically significant and negative for Hong Kong and Singapore, thereby suggesting that there is an inward shift in the curve over time. This indicates that the city-states are experiencing greater matching efficiency in the labour market over time.

In Table A2, we re-estimated the Beveridge Curve using the lagged unemployment rate to account for the persistence of unemployment over time. The unemployment persistence coefficient (b_3), is statistically significant and positive for all the East Asian countries in our study. The positive coefficient suggests that unemployment "hysteresis" has a strong outward effect on the Beveridge Curve creating inefficiencies in the labour market. Whilst the strongest effects are experienced in Japan and Taiwan, Singapore is also experiencing greater persistence of unemployment.

The Beveridge Curve also allows one to derive the natural rate of unemployment (NRU). It must be clarified that the natural rate as defined in the context of the Beveridge Curve is not directly equivalent to the definition of the

natural rate of unemployment as defined by Friedman (1968), which too does not correspond to any particular rate of inflation. The natural rate of unemployment, in the context of the Beveridge Curve, is the equilibrium condition that must exist in a "steady-state" where unemployment rate is equivalent to vacancy rate – equality of the inflow and outflow in the labour market. In equilibrium, this would imply the point(s) where the job vacancy rate is equal to the unemployment rate,[6] plotting a 45° line from the origin (see Figure 1). The NRU is not necessarily the socially optimal nor is it associated with any rate of inflation, but is the rate at which a labour market system is converging for a given underlying economic structure.

The derivation of the natural rate of unemployment is given in Table A3 of the Appendix. Across the East Asian countries, Singapore and Taiwan have experienced higher natural rates of unemployment, around 4 percent. On the other hand, Hong Kong only experienced a natural rate of unemployment around 2.5 percent for 1980 - 2002.

Detailed Study of the Beveridge Curve for Singapore Labour Market 1987:Q1 to 2003:Q1

A more rigorous empirical methodology is undertaken to establish the robustness of the shifts of the Beveridge Curve for Singapore. The result of the regression with the persistence of unemployment (Equation 2 in the Appendix) is given in Table A4. The regression results confirm the negative relationship between unemployment and vacancy rates (the Beveridge Curve), as given by coefficient (b_2). They also indicate that a) the labour market is experiencing decreased levels of mismatches over time (this is consistent with the results from the annual data), as shown by the negative coefficient (b_1); and b) there is a degree of persistence in

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[6] When V = U, vacancy rate [V / (employed + V)] is equal to unemployment rate [U / (employed + U]), requiring the same level

unemployment through time, thereby pushing the Beveridge Curve outwards as shown by the positive coefficient of the lagged unemployment rate (b_3).

To account for the structural changes, the data sample was divided into two parts, 1987:1 - 1995:4 (sample 1: 32 observations) and 1996:1 - 2003:1 (sample 2: 29 observations). The first sample captures the years of economic recovery (1987-1989) and sustained economic growth (1990-1995). The second sample captures the recent external shocks and economic volatility with the recessions in 1998 and 2000. The results of the regressions of the two samples are given in Table A4. The results suggest that the slope of Beveridge Curve is only slightly higher in the second period as compared to the first period.

The change in the elasticity of the unemployment to the vacancy rate has its own implications. While (b_2) was found to be negative for both samples, the slope of the Beveridge curve is more inelastic in the later period. The inelastic slope suggests that the change in unemployment due to a change in the number of vacancies is smaller during the period of 1996-2003 as compared to 1987-1995. This implies a less responsive labour market in the Singapore economy after the 1997 Asian crisis. The reduced responsiveness of the labour market during the recession might imply that employers are becoming selective with regard to new hires (Jackman p. 393) in this period.

The coefficient (b_1) associated with the time trend was negative for both samples. This is an encouraging sign as it implies that the matching technology has been improving over time (inward movement toward the origin). However, the result also suggests that the time coefficient is not statistically significant in sample 2, indicating that there was very little, if not no significant improvements in matching technology during the second period of our sample (1996-2003).

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of inflow and outflow of the labour market.

The major difference between the two sample periods is the persistence of unemployment, as given by the coefficient (b_3). The persistence in unemployment was more evident in the early period of 1987-1995, as compared to 1996-2003. The lack of persistence could reflect the adjustment in workers' expectations to current conditions and an increase in discouraged workers in the labour market.

Summary and Conclusion

Based on the study of the Beveridge Curve for the Singapore, we could summarise the following:

a) Although the results suggest that Singapore's labour market appears to have improved in its matching efficiency, the improvement of the matching efficiency has been declining since the 1997 Asian crisis.

b) The slope of the Beveridge Curve has been more inelastic after the Asian crisis, thereby suggesting that the labour market has been getting less responsive in recent years. This suggests the possibility of greater selectiveness of employers in filling the vacancies.

The responsiveness of the labour market depends not only on the willingness of the unemployed to fill jobs but also on the responsiveness of employers to fill vacancies with workers. In an extended period of business contraction, workers are likely to change their expectations and undergo skills upgrading in order to remain employable. However, the result of an inelastic Beveridge Curve during 1997-2003, together with the increase in "hysteresis" suggests that employers are exercising greater caution and selectiveness in filling their vacancies. Thus policies to address unemployment should not only be directed at re-tooling of skills of the unemployed to

increase the responsiveness of workers, but also to increase the responsiveness of the

employers to fill the vacancies with workers, as an important measure to address the

problem of structural unemployment.

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Appendix

Table A1: Estimates of the Beveridge Curve for Selected Asian Countries (1980-2002) - Dependent Variable: Log(UR)

Independent Variable	Coefficient (t-statistic)			
	HK	Japan	Singapore	Taiwan
(b_0) C	1.975*	0.453	2.265*	0.688
	(11.11)	(0.45)	(6.05)	(0.85)
(b_1) T	-0.0198*	0.0578	-0.0316*	0.0487
	(-2.06)	(1.53)	(-2.13)	(1.28)
(b_2) Log(VR_{t-1})	-0.955*	-0.378*	-0.660*	-0.392**
	(-7.84)	(-2.86)	(-3.78)	(-1.76)
Durbin Watson (DW)	1.810	1.202	1.813	1.394
Adjusted R^2	0.746	0.942	0.631	0.750

Source: Hong Kong - Hong Kong Annual Digest of Stats
Singapore - Datawarehouse (MRSD), Ministry of Manpower
Taiwan - The Statistics of Vocational Training Skill Test & Employment Service, Taiwan Area
Japan - Statistical Yearbook of Japan
* - 5% level of statistical significance, ** - 10% level of statistical significance

Table A2: Estimates of the Beveridge Curve (with Unemployment Persistence) for Selected Asian Countries (1980-2002) - Dependent Variable: Log(UR_t)

Independent Variable	Coefficient (t-statistic)			
	HK	Japan	Singapore	Taiwan
(b_0) C	1.024*	0.500*	1.530*	1.319*
	(3.04)	(7.60)	(4.32)	(5.69)
(b_1) T	-0.00426	0.0101*	-0.0216*	-0.00137
	(-0.437)	(4.56)	(-2.50)	(-0.26)
(b_2) Log(VR_{t-1})	-0.561*	-0.504	-0.563*	-0.708*
	(-3.44)	(-0.782)	(-4.34)	(-6.06)
(b_3) Log(UR_{t-1})	0.469*	0.779*	0.489*	0.762*
	(3.03)	(14.31)	(3.49)	(10.68)
Durbin Watson (DW)	1.858	2.076	1.926	2.096
Adjusted R^2	0.824	0.98	0.746	0.883

* - 5% level of statistical significance, ** - 10% level of statistical significance

Table A3: Estimates of the Natural Rate of Unemployment for Selected Asian Countries, 1980-2002

	Estimates of Natural Rate of Unemployment

	Without Persistence	With Persistence
Hong Kong	**2.72**	**2.54**
Japan	**1.45**	**2.02**
Singapore	**3.84**	**4.07**
Taiwan	**1.70**	**4.03**

Table A4: Estimates of Singapore's Beveridge Curve Quarterly Data (1987:Q1 to 2003:Q1) Dependent Variable: Log(UR$_t$)

Independent Variable	Coefficient (t-statistic)[7]		
	Complete Sample	**Sample 1** 1987:Q1-1995:Q4	**Sample 2** 1996:Q1-2003:Q1
(b$_0$) C	**1.473***	**1.413***	**1.436****
	(7.86)	(3.81)	(7.71)
(b$_1$) T	**-0.005***	**-0.005****	**-0.001**
	(-2.90)	(-1.70)	(-0.12)
(b$_2$) Log(VR$_{t-1}$)	**-0.537***	**-0.549***	**-0.560***
	(-7.13)	(-2.83)	(-6.03)
(b$_3$) Log(UR$_{t-1}$)	**0.327***	**0.427***	**0.151****
	(5.19)	(4.68)	(1.69)
Durbin Watson (DW)	**2.108**	**2.300**	**1.901**
Adjusted R^2	**0.840**	**0.622**	**0.876**

\- 5% level of statistical significance, ** - 10% level of statistical significance

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[7] Two-tailed hypothesis test to test if the coefficient is significantly different from zero (by rejecting H$_o$).
H$_o$: b$_i$ = 0, H$_a$: b$_i \neq$ 0
t-stat < | 1.645 | Do not reject H$_o$ at 90% confidence level.
t-stat < | 1.96 | Do not reject H$_o$ at 95% confidence level.

Figure A1: The Relationship Between Unemployment and Vacancy Rate (Beveridge Curve) for Japan: 1980 to 2002
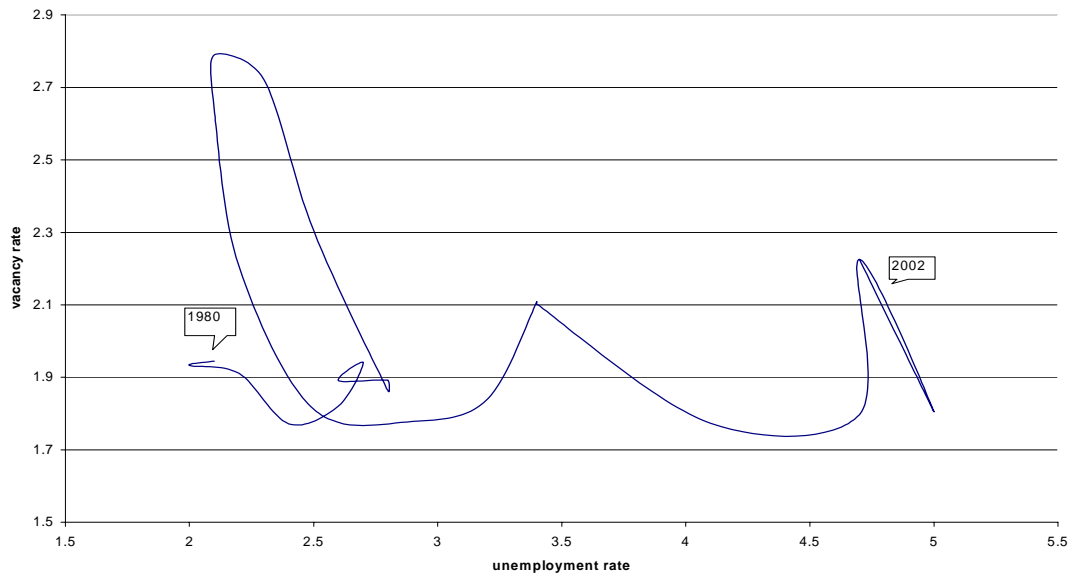

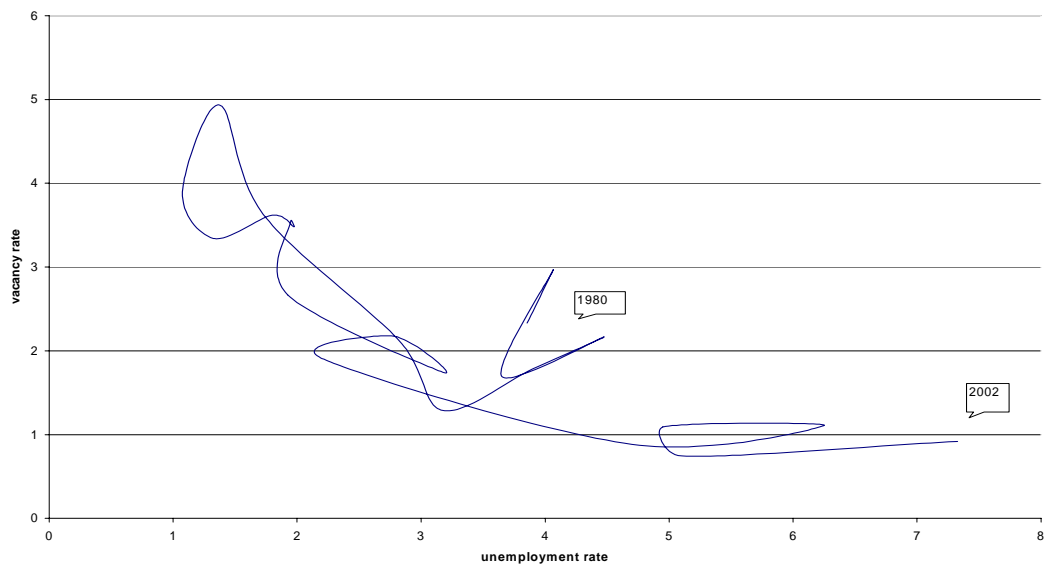**Figure A2: The Relationship Between Unemployment Rate and Vacancy Rate (Beveridge Curve) for Hong Kong: 1980 to 2002**

Figure A3: The Relationship Between Unemployment and Vacancy Rate (Beveridge Curve) for Taiwan: 1980 to 2002