THE ASIAN FINANCIAL CRISIS AND NATURAL RATE OF UNEMPLOYMENT: ESTIMATES FROM A STRUCTURAL VAR FOR THE NEWLY INDUSTRIALIZING ECONOMIES OF ASIA*

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1. Introduction

The "natural rate of unemployment" is an important concept in macroeconomics. Not only does it assume a central role in macroeconomic theory, policy-makers also explicitly employ such a concept in their implementation and evaluation of public policies. For example, the former financial secretary of Hong Kong, Mr. Donald Tsang Yam-kuen, recently commented that full employment in Hong Kong would be achieved if the unemployment rate reaches approximately 3 percent, as he reassured the people of Hong Kong that the economy was recovering from the Asian financial crisis of 1997-98.[1]

The newly industrializing economies (NIEs) of Asia have made a remarkable recovery from the crisis of 1997-98. As shown in Table 1, their real GDP growth is estimated to recover to their average pre-crisis levels by 2000. However, despite the rapid recovery in their growth rates, there has been a growing concern that the unemployment rates of these so-called "dragon" economies is unlikely to return to their pre-crisis levels soon. For example, Hong Kong's unemployment rate remains at 4.6 percent in April 2001, which is much higher than the level of 2.4 percent in 1997 (see Table 1). Further, both South Korea (Korea) and Singapore still experience a rate of unemployment that is roughly two percentage points higher in 2000 than their historical levels. On the other hand, Taiwan's unemployment did not worsen significantly over the crisis period, but has been gradually increasing since the early 1990s.

Table 1: Real GDP Growth and Unemployment Rates (percent p.a.)

Country	1970-96 Average GDP	1997		1998		1999		2000	
		GDP	U	GDP	U	GDP	U	GDP^e	U
Hong Kong	7.5	5.3	2.4	-5.1	4.7	3.0	6.1	8.2	5.1
Korea	8.4	5.0	2.6	-6.7	6.9	10.7	6.2	8.6	4.2
Singapore	8.2	8.0	1.8	0.4	3.3	5.4	3.5	9.1	3.5
Taiwan	8.3	6.3	2.7	4.6	2.7	5.7	2.9	7.0	2.2

Sources: Figures for 1970-96 are taken from *The Economist* (1998), 'Frozen Miracle', 7 March. Figures for other years are taken from *The Economist Intelligence Unit*, 'Latest Country Analysis', various issues. An "^{e}" denotes estimates.

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[1] His remark was reported on the HKTV evening news. Mr. Tsang predicted in late August 2000 that the unemployment rate would drop from five percent to three percent by the end of 2001. However, the unemployment rate in Hong Kong rose by 0.1 of a percent point to 4.6 percent in March 2001 (*South China Morning Post*, April 27 2001).

What accounts for the different labor market experiences in these countries over the crisis period? Why has the unemployment rate failed to return to pre-crisis levels despite the strong growth recovery? Is the rise in the unemployment rate a temporary phenomenon or has there been a longer-term effect? Can we expect the unemployment rates to return to their previous "natural" rates or have these natural rates themselves been affected by the crisis? Models of hysteresis in the unemployment rate predict that there may be permanent effects of at least some shocks to the unemployment rates. Examples of models generating hysteresis in the unemployment rate are the insider-outsider theory and the hypothesis that there are scarring effects on the long-term unemployed during prolonged increases in the unemployment rate.

In this paper, we address the above questions by estimating time series for the natural rates of unemployment for the four Asian NIEs.[2] We then examine the natural-rate estimates for the presence of long-term shifts at the time of the crisis and evaluate the differences between the actual and natural rates. Our method for estimating the natural rates is based on the structural vector autoregressive (SVAR) model of Blanchard and Quah (1989). It involves estimating a two-variable VAR and restricting it to allow us to identify supply and demand shocks. Within this framework we define the natural rate as the rate of unemployment that would have prevailed had there been no demand shocks.

The structure of the paper is as follows. In the next section we provide a brief discussion of the way in which the NIEs have been affected by the crisis in order to provide a background against which to interpret our empirical results later in the paper. The following section (section 3) will discuss and justify our definition of the natural rate of unemployment and set out the model we use to implement our definition. The data we use are reported and evaluated in section 4 and estimated model is presented in section 5. The estimated natural rate series are presented and discussed in section 6 and conclusions are presented in the final section.

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[2] We have been able to find very little empirical research on the natural rate of unemployment for the four Asian NIEs. Wong, Liu and Siu (1991) report estimates of the natural rate of unemployment for Hong Kong using Okun's Law that relates the output gap to cyclical unemployment. They estimated the natural rate of unemployment for Hong Kong at 2.6 percent. This, however, is only a single estimate and therefore not able to tell us whether the natural rate has shifted in response to the crisis.

2. Financial crisis and labor markets in Asian NIEs

i.   *Hong Kong*[3]

The contagion effect of the financial crisis caught Hong Kong off-guard when currency speculators attacked the Hong Kong dollar on 23 October 1997. While other Asian economies such as Korea, Malaysia, Indonesia, Taiwan and Thailand depreciated their currency by as much as 79 percent of the original value, Hong Kong maintained its link with the US dollar at 7.75 HKD/USD. This brought about a sudden and substantial loss of competitiveness vis-à-vis its neighbours in competing goods and services. Moreover, the Currency Board System in use in Hong Kong caused the interest rate to rise sharply each time the Hong Kong dollar was under speculative attack. Although the interest rate eventually fell, it stayed at a relatively high level even after the attack receded, leading to severe contractions in domestic demand for goods and services.

Property and retail were the two hardest hit sectors that catered mainly to local demand. Prices of residential property fell by more than 50 percent in 1998. Prices of commercial properties fell even more sharply.[4] It was obvious then that the bubble economy leading up to Hong Kong's changeover had burst. In 1998, Hong Kong's GDP growth fell to a negative growth (-5.1 percent) for the first time in its history. The unemployment rate soared to 4.7 percent at the same time. Interestingly, unit labour costs did not fall in response to the increase in the unemployment rate. They actually increased by 8.5 percent in 1998, as shown in Table 2 below.

Table 2: Changes in Unit Labor Costs (percentage)

Country	1996	1997	1998	1999	2000	2001
Hong Kong	5.6	5.1	8.5	-3.1	-1.0	2.5
Korea	5.1	-8.2	-7.8	-6.2	1.4	1.7
Singapore	0.6	-0.2	-0.6	-10.8	1.3	-4.4
Taiwan	-5.4	-5.9	-13.5	-3.9	0.9	-6.8

Sources: Figures are taken from *The Economist Intelligence Unit*, 'Latest Country Analysis', various issues.

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[3] A concise discussion of the impact of the financial crisis on Hong Kong's economy and the challenges that Hong Kong faces after the crisis can be found in Liu Pak-wai (1998). Edward K. Y. Chen (2000) provides a summary of Hong Kong's economic development leading up to the financial crisis.

[4] Property prices also fell because of the government's proposal to sharply increase the supply of land after the changeover in order to bring down the extraordinarily high prices of properties at the time.

ii. *Singapore*[5]

Singapore weathered well the financial crisis of 1997-98, although it could not completely escape the contagion. GDP growth slowed down from 8 percent in 1997 to 0.4 percent in 1998. The unemployment rate rose from 1.8 percent to 3.3 percent for the same period. However, unlike its close neighbors such as Malaysia, Thailand and Indonesia, Singapore did not suffer extreme disruptions to its capital flows mainly because of its better financial position and regulations. For example, Singapore's M2 to foreign reserves ratio (1.1 in 1996), an indicator of the vulnerability of the financial system to external shocks, was much lower than that of Malaysia (3.3), Thailand (5.7) and Indonesia (4.7) [International Monetary Fund, 1997]. As such, although the Singapore dollar depreciated 16 percent against the US dollar, it appreciated by about 20 percent against the ringgit and baht, and 60 percent against the rupiah (Siriwardana and Schulze, 2000, p. 234).

Much of Singapore's economic slowdown was caused by contagion of the crisis through trade linkages (Chia, 1998).[6] Singapore accounts for around half of all intra-ASEAN trade. Its exports of communication, financial, transportation and tourism services are mostly to its ASEAN neighbors. Moreover, Singapore is a major source of direct foreign investment in the ASEAN countries. Given this unique role played by Singapore in the region, the financial crisis had a rippling effect on its economy. First, the income effect directly lowered the demand for Singapore's goods and services. Second, Singapore's international competitiveness was eroded by the increase of its prices relative to those of its trading partners in competing goods and services. The crisis, therefore, had both demand and supply effects on the Singaporean economy.

iii. *Korea*[7]

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[5] For a concise evaluation of Singapore's performance during the financial crisis, the reader is referred to Siriwardana and Schulze (2000).

[6] We thank the second anonymous referee for pointing out that in addition to trade linkage, financial linkage is also important in spreading the crisis to other countries. One source of financial linkage is the *common lender effect*, which arises when countries compete intensively for funds from banks highly exposed to crises countries. If banks are confronted with losses in their securities portfolio or a rise of non-performing loans in one country, they are likely to try to reduce their overall value at risk by reducing their exposure in markets that have historically been correlated.

[7] Much of the discussion in this section is borrowed from a recent OECD study (2000) that looks at the changes in the labor market in Korea after the financial crisis. Dipak Mazumbar (1994) provides a discussion of Korea's development, its labor market structure and wage determination.

The financial crisis has severely shaken Korea's economy. Its GDP fell by 6.7 percent in 1998 despite a financial support package negotiated with IMF in December 1997. In retrospect, the weaknesses that exposed the country to the crisis can be identified as low profitability and high debt levels of the corporate sector, combined with the poor functioning of the financial system and the large size of short-term foreign debt (OECD, 1999). It has been observed that the ratio of short-term foreign liquefiable liabilities to international reserves in Korea was dangerously high prior to the outbreak of the crisis. When short-term liquefiable liabilities are measured as the sum of short-term external debt, accumulated portfolio liabilities and six months' imports, this ratio exceeds 500 percent in Korea prior to the crisis (Yan, 2002). Furthermore, poor functioning of the financial system in Korea results in the so-called "over-borrowing" syndrome.

Due to a large fall in nominal and real wages, unit labor costs fell by 8.2 percent in 1997, 7.8 percent in 1998 and 6.2 percent in 1999 as shown in Table 2. As a result of flexible wages, a significant depreciation of the won and a quick response by the government, Korea's recovery from the crisis has been strong, with an 11 percent growth rate in GDP in 1999 followed by 8 percent in 2000. Reduced wages and currency depreciation improved corporate profits and increased international competitiveness, leading to an export-led recovery. The unemployment rate had fallen to about 4.0 percent in the second quarter of 2000 and employment had increased by about 300,000 jobs by the end of 1999.

iv.   *Taiwan*[8]

Taiwan is the only NIE that has managed to escape the severe blow of the financial crisis. Unit labor cost fell by 13.5 percent in 1998 in Taiwan, which may explain why there was no drastic increase in the number of unemployed in Taiwan following the onset of the crisis in 1997. Taiwan maintained a GDP growth rate of 4.6 percent in 1998, 5.7 percent in 1999 and 7.0 percent in 2000, while its unemployment rate was relatively stable at 2.7 percent in 1998, 2.9 percent in 1999 and 2.2 percent in 2000 (Table 1).

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[8] Chen and Ku (2000) and Wang (2000) provide comparative studies on Taiwan and Korea relating to the financial crisis of 1997-98. Kao (1996) studies the labor market structure in Taiwan before the financial crisis and Schive (1998) examines Taiwan's economic role after the crisis. A study (in Chinese) by Jiang (1997) discusses the causes of Taiwan's increasing trend of unemployment rate since the early 1990s.

Although the unemployment rate increased only slightly, there were some signs of contagion of the crisis in Taiwan's labor market. The ratio of the number of openings to job applicants dropped from 2.47 in 1997 to 1.54 in 1999, reflecting a decreasing number of jobs available per job seeker. Taiwan's labor force participation rate also dropped slightly from 58.3 percent in 1997, to 58.0 percent in 1999 and 57.9 percent in 2000, implying a slight increase in the number of discouraged workers.

3. A model of the natural rate of unemployment

Friedman was the first to introduce the concept of the natural rate of unemployment. In his famous 1968 Presidential Address to the American Economic Association, Friedman proposed the following definition:

> "The natural rate of unemployment is the level which would be ground out by the Walrasian system of general equilibrium equations, provided that there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the costs of mobility, and so on." (Friedman, 1968, p. 8).

Clearly, Friedman's definition is not operational as it stands. It poses several difficulties. One difficulty arises from the catchall "and so on", which appears at the end of his definition. It points out that the definition is incomplete, but it does not give any hint as to what the missing features might look like. Another difficulty of a more practical nature is that producing a numerical model that mimics the hypothetical economy underlying the definition is no easy task; and without such a model we have no basis for the natural-rate estimation. Because of these difficulties, Friedman's definition has never been used as a starting-point for estimating the natural rate.

Nevertheless, there have been many reports of natural-rate estimates for the industrialized countries. These natural-rate estimates were obtained using a wide variety of alternative definitions, which share a common feature with Friedman's definition. That is, they all define the natural rate as the hypothetical unemployment rate, which would be observed if certain conditions prevail in the economy. Among them, two alternative definitions have been most commonly used. The first one defines the natural rate as the unemployment rate that would have been observed over a particular period if the economy had been continuously in equilibrium (see, for

example, Layard and Nickell, 1985, for the UK, Nickell and Jackman, 1991 for a number of OECD countries and Ooi and Groenewold, 1992,for Australia). The second one identifies the natural rate with the non-accelerating-inflation rate of unemployment (NAIRU), which is estimated within the context of a Phillips Curve (see, for example, Gordon, 1997, and Staiger, Stock and Watson, 1997, for the US and Crosby and Oleklans, 1998 and Gruen, Pagan and Thompson, 1999, for Australia).

In this paper, we propose to compute the natural rate for the Asian NIEs from a model, which uses a common feature of both the equilibrium and NAIRU approaches without the need to choose between them. To do this we use a model with minimal theoretical structure and argue that these two concepts of the natural rate share a common feature: the natural rate would be observed only after shocks to aggregate demand have completely worked their way through the economic system. Thus, our definition of the natural rate is the unemployment rate that would have been observed if demand shocks had been zero from time $-\infty$ to the end of the sample period being analyzed.[9] The analytical tool we employ is a vector-autoregressive (VAR) model on which we impose a simple identification restriction based on Blanchard and Quah (1989). We use this structural VAR (SVAR) model to produce a quarterly time-series natural rate for each of the four Asian NIEs using data for the longest common sample period of 1982 to 2000.

The definition is not complete until the term, "demand shocks" is properly defined. The precise meaning we give to this term is tied up with the procedure we use to generate our natural-rate series from the estimated SVAR model, a matter we now turn to.

We begin with a two-equation linear dynamic stochastic macroeconomic model in real output and the unemployment rate:

$$
\begin{aligned}
b_{11}(0)u_t + b_{12}(0)y_t &= b_{10} + b_{11}(1)u_{t-1} + ... + b_{11}(p)u_{t-p} \\
&\quad + b_{12}(1)y_{t-1} + ... + b_{12}(p)y_{t-p} + \varepsilon_{1t} \\
b_{21}(0)u_t + b_{22}(0)y_t &= b_{20} + b_{21}(1)u_{t-1} + ... + b_{21}(p)u_{t-p} \\
&\quad + b_{22}(1)y_{t-1} + ... + b_{22}(p)y_{t-p} + \varepsilon_{2t}
\end{aligned}
\tag{1}
$$

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[9] For an application of this definition to Australian data see Groenewold and Hagger (2000).

The model can be motivated in a manner similar to that of Blanchard and Quah (1989) who motivate their model by starting with a four-equation macro model (aggregate demand, employment, wage- and price-setting equations) plus autoregressive processes for the money supply and productivity as well as a definition of the unemployment rate. They reduce this model to two equations in Δy and u and capture the exogenous variables as well as the random error terms of the autoregressive processes in the random variable ε_1 and ε_2. We identify ε_1 as a demand shock and ε_2 as a supply shock. The demand shock therefore captures the effects of both monetary and fiscal variables while the supply shock captures the effects of variables such as labor productivity and the labor force.

To use this model to generate the natural rate according to our definition, we estimate the model and simulate it with ε_1 set at zero for all t. As it stands the model is not identified since the two equations are observationally equivalent. We identify the equation by making four assumptions. The first two are normalization restrictions: the variance of each of ε_1 and ε_2 is set at 1. The third restriction is that the structural errors have a zero covariance. The final restriction is based on the assumption that the demand shock has only a temporary effect on y but that the supply shock has a permanent effect on y. Neither shock has a permanent effect on u since Blanchard and Quah found u to be stationary while y was found to be I(1). Under these assumptions all the elements of equations (1) can be obtained from an estimated version of a standard VAR in u and Δy.[10]

In summary, the model uses data on just two variables – real output and the unemployment rate – and uses the former to decompose the latter into that component driven by supply shocks (the natural rate) and that part driven by demand shocks. The decomposition is based on a model in which real output is non-stationary and the unemployment rate is stationary – both of these accord with our priors since real output is likely to be subject to a (stochastic) trend based on population and productivity growth whereas the unemployment rate, being a percentage of the total labor force, is bounded between 0 and 100 and, realistically, by much narrower bounds and therefore could be expected eventually to return to a given level following a shock, but possibly subject to structural shifts.

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[10] For a detailed exposition of the estimation and simulation of a two-variable SVAR of the B-Q type see Enders (1995), Chapter 5.

4.   The data

Data for the unemployment rate and real GDP were used for each of the four countries. We chose the largest sample period common to all four countries. Data were used at a quarterly frequency since generally GDP data are available only at this frequency. The longest common sample period was 1986:1-2000:2. Singapore unemployment rate figures were not available before 1986:1 at a quarterly frequency although earlier data were available on an annual basis. By interpolating the annual data for the period 1982-1986 we were able to extend the sample to start in 1982:3. We interpolated by assuming the annual change in the unemployment rate to be evenly spread over four quarters of the year in question. Thus, finally, our data ran from 1982:3 to 2000:2.

All data were used in seasonally-adjusted form since we wished to abstract from seasonal fluctuations, given our focus on the long-run underlying unemployment rate. Where data were unavailable on a seasonally-adjusted basis from the country's official statistical agency, we adjusted the data using an exponential smoothing procedure which automatically chose whether to include a trend and whether to use additive or multiplicative seasonal factors. The series seasonally adjusted in this way were real GDP for Hong Kong and the unemployment rate for Korea.

Before estimating the model, we tested the data for stationarity both as a standard preliminary econometric procedure and because the model has implications for stationarity as set out at the end of the previous section – the model's scheme for identifying demand and supply shocks is based on the plausible assumption that the unemployment is stationary and that the (log) of real GDP is non-stationary.

Table 3 reports ADF tests for stationarity of the two variables for various lags in the "ADF equation" – we felt that a maximum of four was sufficient given that quarterly data were used.[11] The results in the table show quite clearly that neither variable is stationary using the ADF test based on conventional critical values. The outcomes are not dependent on the lag length. This conclusion is not unexpected for y given results for other countries and other time periods reported in the literature.

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[11] See Dickey and Fuller (1981).

Table 3: Stationarity: ADF Tests

Country	Variable	Lags				
		0	**1**	**2**	**3**	**4**
HK	**u**	-0.9750	-1.3625	-1.3953	-2.2291	-2.4528
HK	**y**	-2.1089	-1.9242	-2.3711	-2.1461	-2.4332
Singapore	**u**	-1.1907	-1.5838	-1.8160	-2.2184	-1.9132
Singapore	**y**	-1.7675	-2.1502	-2.4775	-3.1463	-2.7293
Sth Korea	**u**	-1.3632	-2.6690	-2.8372	-2.1968	-2.4917
Sth Korea	**y**	-1.2281	-1.5255	-1.5533	-1.7271	-1.3923
Taiwan	**u**	-1.5300	-1.5457	-1.6694	-1.6563	-1.8683
Taiwan	**y**	-0.2409	-0.7394	-0.9320	-0.8583	-1.0754

Notes: (1) u = unemployment rate, y = log of real GDP;
(2) the ADF equation for y includes a trend term and the equation for u does not;
(3) the 5% critical value for the test statistic is –2.9048 for u and –3.4626 for y.

However, the results are somewhat surprising for the unemployment rate since, as we have pointed out earlier, u is bounded by 0 and 1 so that it cannot wander about completely arbitrarily. Further, other studies such as Blanchard and Quah (1989) find that u is stationary for the US. Our finding of non-stationarity may be the result of applying the tests for a long-run property such as stationarity to a relatively short data series over a period where there have been major structural changes in the labor market, a situation which Perron (1989) first argued could seriously bias the results of standard tests for a unit root. This is especially important in the present application since our maintained hypothesis is that there has been a structural break in the unemployment rate due to the crisis of 1997/98. The application of the Perron test including a structural break requires the precise identification of the break point which may be different for different countries and, instead, we applied Zivot and Andrews' (1992) tests for a unit root in the presence of a break in mean and/or in trend at an indeterminate point in the sample. The results are in Table 4.

Table 4: Stationarity Tests for u: Zivot and Andrews (1992)

Country(lag)	Break in mean		Break in trend		Break in mean and trend	
	Statistic	Break	Statistic	Break	Statistic	Break
HK (1)	-4.0771	1998:1	-3.7511	1997:4	-3.0728	1988:3
HK (2)	-4.0174	1998:1	-3.6947	1997:4	-3.0874	1988:3
HK (3)	-4.5028	1998:1	-4.3382	1997:4	-4.1410	1988:3
HK (4)	-4.7464	1998:1	-4.5787	1997:4	-4.7153	1988:3
Sing (1)	-3.0013	1987:1	-3.9732	1987:1	-3.7690	1987:1
Sing (2)	-3.0808	1987:1	-4.0135	1983:1	-3.7699	1987:1
Sing (3)	-3.4328	1986:4	-4.0219	1986:4	-3.7605	1986:4
Sing (4)	-3.2640	1987:1	-3.6352	1987:1	-3.7796	1992:1
S Korea (1)	-4.7904	1997:4	-6.2235	1997:4	-5.9594	1998:1
S Korea (2)	-5.3811	1997:4	-7.6802	1997:4	-5.7337	1998:1
S Korea (3)	-4.4574	1997:4	-6.9338	1997:4	-3.8781	1995:1
S Korea (4)	-4.7572	1997:4	-7.5611	1997:4	-4.5518	1995:4
Taiwan (1)	-2.4419	1995:4	-4.0011	1986:2	-3.8991	1986:2
Taiwan (2)	-2.5678	1995:4	-4.0111	1986:2	-3.8546	1986:2
Taiwan (3)	-2.5784	1995:4	-3.7887	1986:2	-3.4688	1986:2
Taiwan (4)	-2.7142	1995:4	-3.9498	1986:2	-3.6655	1986:2

Note: The 5% critical values for the three tests are –4.80, -4.42 and –5.08 respectively.

The results reported in Table 4 indicate that the null hypothesis of non-stationarity is clearly rejected for Korea at most lags and for all three forms of the test. It is interesting that for almost all cases the optimal break date is at the end of 1997 or the beginning of 1998, which coincides exactly with the onset of the crisis. The non-stationarity null is also rejected at the 5% level for Hong Kong for the case of a shift in trend and is also close to being rejected for a break in mean. Again, for both these breaks the optimal break date is the end of 1997 or the beginning of 1998. There seems, therefore, to be clear evidence for Korea and Hong Kong that a definite break occurred in the process which generates the unemployment rate in late 1997 or early 1998 and that, once these breaks are taken into account, the unemployment rate is stationary. The evidence for the other two countries is less clear-cut, however. In each case there is some weak evidence of stationarity if a break in trend is allowed. However, it is interesting that in these cases the optimal break date is in the mid-1980s and therefore does not coincide with the crisis.

In a recent paper, Arestis and Mariscal (1999) test for unit roots while allowing for two breaks in level and/or in trend at unspecified points, using extensions of the Zivot and Andrews procedure proposed by Clemente, Montanes and Reyes (1998) and Lumsdaine and Papell (1997). They found that for a majority of OECD countries the unemployment rate was stationary when two breaks were allowed even

though all countries' unemployment rates were found to be non-stationary using a standard ADF test. We therefore applied both tests to the unemployment rates for the four countries over our sample. The results (which we do not report[12]) confirm the outcomes of the Zivot and Andrews test – for Korea there is strong evidence of stationarity and for Hong Kong the unemployment rate is stationary in some cases. For both these countries the dominant break coincides with the crisis. There is no change in the conclusions we reached for Singapore and Taiwan – there is only weak evidence of stationarity and the optimal break does not coincide with the crisis.

We conclude, on the basis of the outcomes of the range of tests described, that in general the evidence for our four countries is not inconsistent with our theoretical prior that the unemployment rates are stationary and real GDP is non-stationary. We, therefore, proceed to estimate the model incorporating the Blanchard and Quah identifying restrictions.

5. Model estimation

Before the model can be estimated, the order of the VAR needs to be chosen. We do that on the basis of the Akaike Information Criterion (AIC), the Schwarz Bayesian Criteriod (SBC) and a χ^2 test for the appropriate lag length (from four lags, the maximum number we entertain, to the number of lags in question). The values of the criteria and the probability values for the χ^2 test are reported in Table 5.

Table 5: Choice of VAR lag length

Country	Criterion	Lags				
		0	**1**	**2**	**3**	**4**
HK	**AIC**	41.1010	137.3253	138.8269	139.9592*	139.9517
HK	**SBC**	38.8669	130.6229*	127.6564	124.3204	117.8448
HK	χ^2	0.000	0.038	0.135	0.483	---
Singapore	**AIC**	76.0818	162.3174	164.5116*	162.0506	160.9076
Singapore	**SBC**	73.8771	155.7034*	153.4881	146.7178	141.0654
Singapore	χ^2	0.000	0.106	0.472	0.293	---
S. Korea	**AIC**	53.3857	154.3925	159.4816*	156.6960	155.5404
S. Korea	**SBC**	51.1810	147.7784	148.4581*	141.2632	135.6981
S. Korea	χ^2	0.000	0.030	0.534	0.295	---
Taiwan	**AIC**	203.7366	296.4855	297.9382	298.0993*	269.1437
Taiwan	**SBC**	201.7366	289.1576*	285.7249	281.0008	274.1599
Taiwan	χ^2	0.000	0.053	0.196	0.455	---

Note: an * denotes a row maximum.

[12] They are available from the corresponding author on request.

As is common in the choice of lag length, there is some conflict between the indications given. For Hong Kong the AIC suggests a lag length of 3 while the SBC suggests 1. A lag length of 1 is rejected by the χ^2 test at the 5% significance level. Thus possible acceptable lag lengths for Hong Kong are 1, 2 and 3. We experimented with both 1 and 3 but report results only for lag 1 since the general characteristics of the resulting series for the natural rate are not greatly affected by the choice, especially at the end of the sample, which we are particularly interested in. In the case of Singapore the main choice is between 1 and 2 lags. The χ^2 test did not reject the reduction of lags from 4 to 1 at the 5% level and we therefore estimated the model with a single lag. For Korea all three criteria agree that a lag of 2 is appropriate and the results reported below therefore incorporate two lags. Finally, the criterion values reported in Table 5 for Taiwan conflict with the AIC suggesting a lag of 3 while the SBC suggests that 1 lag is optimal. Since the χ^2 test cannot reject the reduction of lags from 4 to 1, we estimated the model for Taiwan with only a single lag.

Once the lag length had been chosen, the models were estimated by OLS with the Blanchard and Quah restrictions imposed on them. The resulting restricted models were then simulated to produce series for the natural rate: the unemployment rate, which would have obtained if the demand shocks had been zero for the entire sample period. The resulting natural rate series are reported and compared to the unemployment rates actually observed in the following section.

6. Results and discussion

Our results are pictured in Figure 1. The behavior of the natural rates differs considerably across countries. For two of the four countries in our sample, Hong Kong and Taiwan, the natural rate has varied very little over the two decades despite the substantial fluctuations in the actual unemployment rate. On the other hand, the model findings for Korea and Singapore are that there have been significant fluctuations in the natural rate, with the results for Singapore being most striking — there the natural rate and the actual rate have moved very closely together.

Figure 1: Actual and Natural Unemployment Rates

(quarterly)
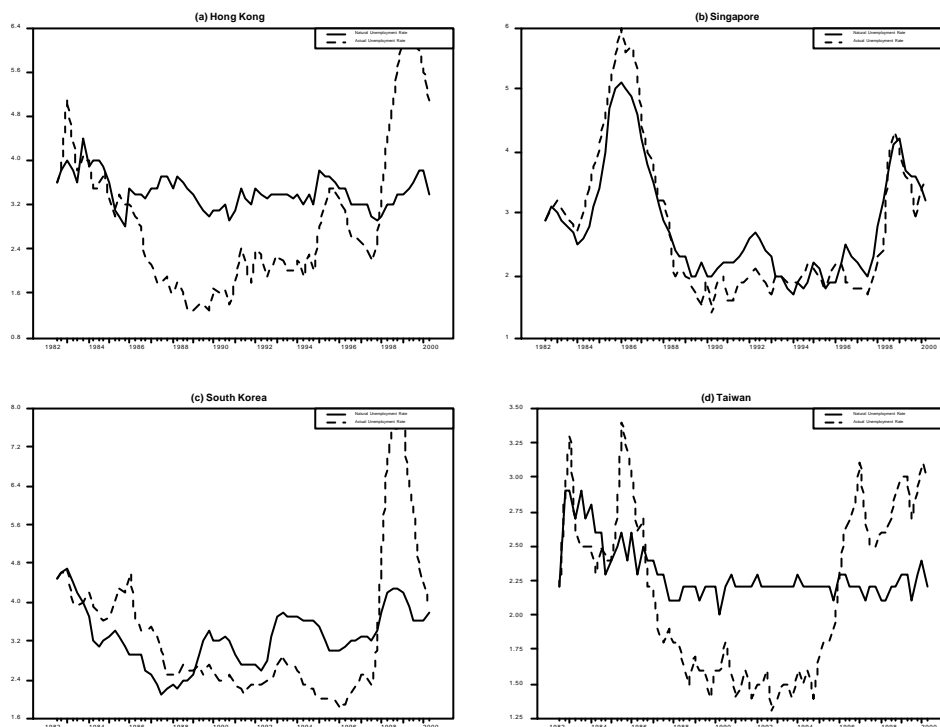
In Hong Kong, the natural rate has been relatively stable over the entire
sample period with, perhaps, a weak tendency for it to drift downwards over the
period as a whole. It is clear that, according to our modeling, there has been no
noticeable effect of the Asian crisis on the natural rate – the significant worsening of
the unemployment picture in the late 1990s is only a temporary deviation of the actual
rate from its natural path. For much of the decade from the mid-1980s to the mid-
1990s the actual unemployment rate was below the natural rate, suggesting
considerable demand pressure in the labor market.

Hong Kong had been facing a labor shortage since 1985. The increasingly
tight labor market caused the real wage rate to maintain a steady growth after 1984 in
all sectors, especially in business services, and continued into the later 1990s, as can
seen in Table 2. Several factors contributed to this tight market. The most important
factor is the transformation of Hong Kong's economy from a manufacturing-oriented
to a service-oriented economy. The opening of China in late 1970s saw Hong Kong
manufacturers moving their labor-intensive, low-tech production to south China to
take advantage of the abundant cheap labor there, leaving the front-end and back-end

of manufacturing processes, such as sourcing, merchandizing, marketing and design in Hong Kong. Since most of the output produced by Hong Kong manufacturers in south China were re-exported through Hong Kong, it stimulated a fast growth in re-export trade in Hong Kong and a demand for supporting activities including transportation, storage, business services, insurance and trade financing (Liu, 1998, p. 2). Thus the shift of labor-intensive industry out of the country, which might have lead to an increasing unemployment rate, was more than compensated for by the rapid expansion of alternative sources of employment.[13]

A second factor in Hong Kong's low unemployment rate in the 1980s and 1990s is that the growth of the labor force could not keep up with the growth of demand for labor. The growth of the labor force slowed down from an annual rate of 2.5 percent between 1981-85 to less than one percent in 1986-92. One important cause of the labor shortage was the substantial fall in the participation rate for those who were aged between 15-19 and 20-24. Due to the rapid expansion of secondary and tertiary education in Hong Kong in the 1980s, many youngsters deferred entry into the labor force. Emigration also played a big role in explaining the reduction in labor supply. The number of emigrants was between 18,000 and 22,000 throughout the first half of the 1980s, but it increased sharply after the June 4 incident in 1989 in Beijing and reached a peak of 66,000 in 1992. Emigration affected the service sectors most severely since most of the emigrants were employees of the service sectors. At the same time, the desire of the government to ease the labor shortage by introducing a labor importation scheme in 1992 was met with considerable political resistance (Liu, 1998, p. 9). Eventually, only about 27,000 workers were imported at the peak of the program. The supply side of the labor market therefore seemed to experience persistent shocks which would normally reduce the natural rate, helping to offset the effects of industrial transformation described in the previous paragraph.

A final factor is the booming property sector and rapid growth of re-export trade. High wage growth and high inflation were the manifestations of such a booming economy. However, after the bubble burst in 1997 following the sudden collapse of the property market and the slowdown in the re-export trade, downward

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[13] Thus, Lilien (1982), for example, built a theory of the natural rate based on the frictions caused by rapid changes in the industry mix in the economy. This theory would have predicted a rise in the natural rate during the sustained shift in Hong Kong's industrial composition in the 1980s and 1990s. Our results suggest that the labor market coped with this shift in composition efficiently enough to leave the natural rate unaffected.

cost adjustments appeared to be too small and too slow to restore full employment in Hong Kong, a fact again clear from the date in Table 2.

What appears to have worsened Hong Kong's unemployment situation after the crisis is the sudden reversal of the declining growth rate of the labor force in 1996. The growth rate of the labor force rose from less than one percent in 1986-92 to 4 percent in 1997 and to about 6 percent in the latter part of 1998. The return of the emigrants from foreign host countries to seek jobs in Hong Kong after 1997 and the increased number of legal immigrants from Mainland China were mainly responsible for the rise in the growth rate of the labor force. Coupled with falling demand and a pessimistic economic outlook following the crisis, the accelerated growth rate of the labor force raised the unemployment rate to a peak of 6.2 percent in 1999.

The behavior of Singapore's unemployment rate and natural unemployment rate has been quite different to Hong Kong's, as shown in Figure 1(b). Singapore's actual unemployment rate has been low and stable for most of the decade from the late 1980s to the late 1990s. Second, the rise in the unemployment rate in the wake of the crisis has been much smaller than Hong Kong's. Third and most remarkably, the natural rate and the actual rate have moved very closely together. This implies that the model explains most of the fluctuations in Singapore's unemployment rate as change in the natural rate with little by way of demand-induced movements about the natural rate. This is consistent with a strong hysteresis effect in the Singapore labor market where shocks to demand have permanent effects, perhaps through an insider-outside effect or through the scarring effects of unemployment. The insider-outsider effect is supported by the information reported on labor costs in Table 2 which show that the Singaporean wage level is not very downward sensitive to demand pressure – despite growing unemployment in the late 1990s, it was 1999 before there was a substantial fall in unit labor costs. Added to this was the rise in the real exchange rate vis-à-vis its Asian competitors caused by the relatively small fall in the nominal exchange rate.

A key factor that helped Singapore to smooth the effects of demand shocks on unemployment during the late 1980s and 1990s and to alleviate its unemployment situation following the onset of the crisis is the sheer size of its foreign workforce. Foreign workers constituted about one-third of its labor-force growth between 1975 and 1979. In 1980, there were 80,293 foreign workers on employment passes (Saw, 1984, p. 26). The number increased to 150,000 in 1985 and to about 300,000 in 1990

or from about 12 percent of the labor force in 1985 to about 20 percent of the labor force in 1990. The government imposes a levy on employers who import foreign workers. The amount of levy per worker imposed is an instrument of industrial policy as well as of keeping the wage of the foreign workers in line with that of the local workers.

A large contingence of foreign workers often creates social unease, but it has an advantage of keeping the unemployment rate relatively low in Singapore when recessions hit. The majority of foreign workers are from neighboring countries such as Malaysia or Indonesia and they can only remain in the country if their employment passes are renewed periodically. During economic downturns when a surplus of workers appears, the government may decide to repatriate some of the foreign workers by not renewing their employment passes. The financial crisis of 1997-98 illustrates the effectiveness of this policy when Singapore's unemployment rate rose only by 2.6 percentage points from the third quarter of 1997 to the last quarter of 1998 compared to the 3.5 percentage-point increase experienced by Hong Kong and a 5.3 percentage-point by Korea for the same period. Thus, systematic changes in the labor force have helped Singapore to virtually eliminate the effects of demand disturbances on unemployment. However, the sheer size of the shocks associated with the Asian crisis of the late 1990s defeated even the Singapore government and both the actual and the natural rates increased substantially.

Figure 1(c) shows that the results for Korea fall between those of Hong Kong and Singapore. Like Singapore's experience, there have been substantial fluctuations in the Korean natural rate but, in contrast, there are also been substantial and sustained deviations of the actual rate from the natural rate, in particular in the reaction of the Korean economy to the crisis. Here we see a modest increase in the natural rate but most of the rise in the actual rate is explained by the actual rate moving substantially above the natural rate.

It is clear that the Korean economy was very hard hit by the crisis. From a relatively low unemployment rate of about 2.5% for most of the 1990s, it rose to a level of 6.9 percent in the second quarter of 1998 to a peak of 7.8 percent in the first quarter of 1999. The number of unemployed went up from 0.5 million before the crisis to 1.5 million in 1998 and 1.8 million in February 1999. Offsetting this, however, labor force participation rate fell by 1.5 percentage points in 1998, thus ameliorating the rise in the measured unemployment rate. Further, the flexible labor

market and weak union sector enabled rapid labor costs adjustment to the adverse effects of the crisis. Due to a large fall in nominal and real wages, unit labor costs fell by 8.2 percent in 1997, 7.8 percent in 1998 and 6.2 percent in 1999 as shown in Table 2. These supply-side adjustments, together with the significant fall in the real exchange rate ensured that the natural rate did not rise significantly during the crisis and, as a result, Korea's recovery from the crisis has been strong, with an 11 percent growth rate in GDP in 1999 followed by 8 percent in 2000. It is likely, therefore, that Korea will soon return to a natural rate of unemployment, which has been relatively little affected by the crisis.

Finally, we consider Taiwan's experience, as shown in the last panel of Figure 1. Like Hong Kong, Taiwan's natural rate of unemployment has been relative stable over the sample period, while there have been substantial fluctuations of the actual rate about the natural rate. From the point of view of their reactions to the crisis, there is, however, an important difference between them. We have seen that Hong Kong suffered a significant adverse effect of the crisis in the form of a large rise of the actual rate above the natural rate. Taiwan's experience, however, was that the unemployment rate started to rise well before the crisis and when the crisis hit, there was no noticeable effect on the unemployment rate, although there is evidence of a weak discouraged worker effect after the crisis with the participation rate falling from 58.3 in 1997 to 57.9 in 2000.

There are several factors contributing to the rise in the unemployment rate in the mid-1990s (Kao, 1996, p. 53). The most plausible in terms of the outcome of our modeling is that, like Hong Kong, Taiwan's industries have been increasingly moving their labor-intensive, assembly-line production offshore to Southeast Asian countries, particularly to China more recently since the late 1980s. Unlike Hong Kong, however, there has not been as rapid a rise in employment in other industries to absorb the surplus workers, thus reducing the demand for workers and raising the unemployment rate. This appears as a rise in the actual unemployment rate towards the relatively constant natural rate in the mid-1990s.

7. Conclusions

This paper has set out to address the question of whether the rapid rise we observed in the unemployment rates in three of our four Asian NIEs (Hong Kong, Singapore, South Korea and Taiwan) in response to the Asian financial crisis of the

late 1990s was a reflection of a rise in the underlying structural or natural unemployment rate or of a rise in the gap between the actual and natural rates.

We analyzed this question by estimating time series for the natural rates of unemployment for each of the four NIEs and comparing these with the observed rates.

Our findings were that the behavior of unemployment rates differed considerably across these economies. In particular, the dramatic rise in the unemployment rate observed in Hong Kong and Korea was mainly the result of demand shocks rather than structural changes, while in Singapore the unemployment rate rise reflected almost entirely a rise in the natural rate. We offered tentative explanations for these differences in terms of the different economic characteristics (particularly labor market features) of the four countries. Ultimately, however, these must remain conjectures. Our model is specifically designed to avoid the necessity of structural modeling, the cost of which, of course, is that identification of specific structural factors can only be *obiter dicta.* What we have shown is that there are interesting differences between the countries. Identifying the factors, which determines these differences requires a structural model of the natural rate in contrast to the astructural approach in this paper.

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<u>Appendix</u>: Actual and Natural Unemployment Rates

Table A1: Actual and Natural Unemployment Rates

Date	HK: u	HK: u*	SN: u	SN: u*	SK: u	SK: u*	TW: u	TW: u*
82/Q3	3.6	3.6	2.9	2.9	4.5	4.5	2.2	2.2
82/Q4	3.9	3.8	3.1	3.1	4.6	4.6	2.9	2.9
83/Q1	5.1	4.0	3.2	3.0	4.7	4.7	3.3	2.9
83/Q2	4.4	3.8	3.1	2.9	4.0	4.4	2.6	2.7
83/Q3	3.8	3.6	3.0	2.8	3.9	4.2	2.5	2.9
83/Q4	4.1	4.4	2.8	2.7	4.0	4.0	2.5	2.7
84/Q1	4.0	3.9	2.7	2.5	4.2	3.7	2.5	2.8
84/Q2	3.5	4.0	3.1	2.6	3.9	3.2	2.3	2.6
84/Q3	3.5	4.0	3.4	2.8	3.8	3.1	2.5	2.6
84/Q4	3.8	3.9	3.8	3.1	3.6	3.2	2.4	2.3
85/Q1	3.3	3.6	4.1	3.4	3.7	3.3	2.4	2.4
85/Q2	3.0	3.1	4.6	4.0	4.0	3.4	2.7	2.5
85/Q3	3.4	3.0	5.1	4.7	4.3	3.3	3.4	2.6
85/Q4	3.2	2.8	5.5	5.0	4.2	3.1	3.2	2.4
86/Q1	3.2	3.5	6.0	5.1	4.6	2.9	3.0	2.6
86/Q2	3.0	3.4	5.6	5.0	3.7	2.9	2.6	2.3
86/Q3	2.8	3.4	5.7	4.9	3.4	2.9	2.7	2.5
86/Q4	2.2	3.3	5.3	4.6	3.4	2.6	2.2	2.4
87/Q1	2.1	3.5	4.4	4.2	3.5	2.5	2.2	2.4
87/Q2	1.8	3.5	4.0	3.8	3.3	2.3	1.9	2.3
87/Q3	1.8	3.7	3.8	3.5	3.0	2.1	1.8	2.3
87/Q4	1.9	3.7	3.2	3.1	2.5	2.2	1.9	2.1
88/Q1	1.6	3.5	3.2	2.9	2.5	2.3	1.8	2.1
88/Q2	1.8	3.7	2.8	2.7	2.5	2.2	1.8	2.1
88/Q3	1.6	3.6	2.0	2.4	2.7	2.4	1.6	2.2
88/Q4	1.3	3.5	2.1	2.3	2.6	2.4	1.5	2.2
89/Q1	1.3	3.4	2.0	2.3	2.6	2.5	1.7	2.2
89/Q2	1.4	3.2	1.9	2.0	2.7	2.9	1.6	2.1
89/Q3	1.4	3.1	1.7	2.0	2.5	3.2	1.6	2.2
89/Q4	1.3	3.0	1.5	2.2	2.7	3.4	1.4	2.2
90/Q1	1.7	3.1	1.9	2.0	2.5	3.2	1.6	2.2
90/Q2	1.6	3.1	1.4	2.0	2.4	3.2	1.6	2.0
90/Q3	1.7	3.2	1.9	2.1	2.4	3.3	1.8	2.2
90/Q4	1.4	2.9	2.0	2.2	2.5	3.2	1.6	2.3
91/Q1	1.8	3.1	1.6	2.2	2.3	2.9	1.4	2.2
91/Q2	2.4	3.5	1.6	2.2	2.2	2.7	1.5	2.2
91/Q3	2.1	3.3	1.9	2.3	2.1	2.7	1.6	2.2
91/Q4	1.8	3.2	1.9	2.4	2.3	2.7	1.4	2.2
92/Q1	2.4	3.5	2.0	2.6	2.3	2.7	1.5	2.3
92/Q2	2.3	3.4	2.1	2.7	2.3	2.6	1.5	2.2
92/Q3	1.9	3.3	2.0	2.6	2.4	2.8	1.6	2.2
92/Q4	2.1	3.4	1.9	2.4	2.4	3.3	1.3	2.2
93/Q1	2.3	3.4	1.7	2.3	2.7	3.7	1.4	2.2
93/Q2	2.2	3.4	2.0	2.0	2.9	3.8	1.5	2.2
93/Q3	2.0	3.4	2.0	2.0	2.7	3.7	1.5	2.2
93/Q4	2.0	3.3	1.9	1.8	2.7	3.7	1.4	2.2
94/Q1	2.2	3.4	1.9	1.7	2.6	3.7	1.6	2.3

94/Q2	1.9	3.2	1.9	1.9	2.3	3.6	1.5	2.2
94/Q3	2.3	3.4	2.0	1.8	2.3	3.6	1.6	2.2
94/Q4	2.0	3.2	2.2	1.9	2.2	3.6	1.4	2.2
95/Q1	2.8	3.8	2.1	2.2	2.0	3.5	1.7	2.2
95/Q2	3.1	3.7	2.0	2.1	2.0	3.2	1.8	2.2
95/Q3	3.5	3.7	1.8	1.8	2.0	3.0	1.8	2.2
95/Q4	3.5	3.6	2.0	1.9	2.0	3.0	1.9	2.1
96/Q1	3.2	3.5	2.2	1.9	1.8	3.0	2.3	2.3
96/Q2	3.1	3.5	2.2	2.2	1.9	3.1	2.6	2.3
96/Q3	2.6	3.2	1.9	2.5	2.1	3.2	2.7	2.2
96/Q4	2.6	3.2	1.8	2.3	2.3	3.2	2.8	2.2
97/Q1	2.5	3.2	1.8	2.2	2.5	3.3	3.1	2.2
97/Q2	2.4	3.2	1.8	2.1	2.5	3.3	2.7	2.1
97/Q3	2.2	3.0	1.7	2.0	2.3	3.2	2.5	2.2
97/Q4	2.5	2.9	2.0	2.3	3.0	3.4	2.5	2.2
98/Q1	3.5	3.0	2.3	2.8	5.2	3.8	2.6	2.1
98/Q2	4.4	3.2	2.4	3.2	6.9	4.2	2.6	2.1
98/Q3	5.0	3.2	4.0	3.8	7.6	4.3	2.7	2.2
98/Q4	5.7	3.4	4.3	4.1	7.6	4.3	2.9	2.2
99/Q1	6.2	3.4	4.0	4.2	7.8	4.2	3.0	2.3
99/Q2	6.1	3.5	3.6	3.7	6.5	3.9	3.0	2.3
99/Q3	6.1	3.6	3.5	3.6	5.9	3.6	2.7	2.1
99/Q4	6.0	3.8	2.9	3.6	4.7	3.6	2.9	2.3
00/Q1	5.6	3.8	3.4	3.4	4.4	3.6	3.1	2.4
00/Q2	5.0	3.4	3.5	3.2	3.9	3.8	3.0	2.2

Notes: HK = Hong Kong, SN = Singapore, SK = South Korea, TW = Taiwan, u = actual
unemployment rate and u* = natural unemployment rate.