Global Integration of the Banking Industry: Evidence from A Renowned International Financial Centre Based on A Markov Regime Switching Approach

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Abstract

Due to the crucial role that banks play in the economy and the financial system, the issue of global integration of banks is of utmost importance. However, at present, the evidence on this issue is mixed. We therefore re-examine this issue with respect to a well-known international financial centre – Singapore. We test whether Singaporean banks are globally integrated. We investigate the extent, duration and speed of co-movement between the bank stock prices of Singapore and those of the top three global financial centres - the U.S., U.K. and Japan, based on a Markov regime switching approach. This approach allows us to incorporate market cycles into the analysis. Our results provide evidence of the integration of the Singaporean banking industry with that of the US and to a lesser extent with that of the UK; but not with that of Japan, however.

Keywords: Global Banking, Banking Integration, Markov Regime Switching

JEL Classification: G21, C32

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1. INTRODUCTION

Given the crucial role that banks play in a country's economy especially in relation to the conduct of monetary policy and the maintenance of stability of the financial system, the issue of global integration of the banking industry is one that is of high importance. If banks are found to be globally integrated, this increases international contagion risk or spill-over effects. This also means that the benefits of international portfolio diversification and the sharing of risks between banks in different countries are diminished. This then puts the stability of the financial system itself at risk.

Unfortunately, at present, it is not clear whether or not banks are globally integrated. The evidence from existing research is mixed. Some studies found that there is limited integration in the banking industry (Buch, 2002; Cabral, Dierick and Vesala, 2002; Berger, Dai, Ongena and Smith, 2003; Manna, 2004; Moerman, Mahieu and Koedijk, 2004; Rugman and Brain, 2004), while others found that integration in the banking industry was in the advanced stages for developed countries (De Nicolo and Kwast, 2001; Hartmann, Maddaloni and Manganelli, 2003; Simpson and Evans, 2005).

We therefore re-examine this issue of global bank integration. We undertake our investigation in the context of Singapore. Singapore, being a well-known international financial provides an excellent natural laboratory for the examination of this issue. We test whether Singaporean banks are globally integrated. We do this by testing whether Singaporean bank stock prices are significantly affected by the US, UK and Japan bank stock prices using a Markov regime switching approach

(Hamilton 1989 and Krolzig 1997). The US, UK and Japan are the top three global financial centres and therefore analysing the links of Singapore with these countries in terms of bank share prices would therefore be very appropriate in gauging banking globalisation.

Singapore, being a renowned international financial centre, provides an excellent laboratory for the investigation of the issue of global banking integration. The financial industry in Singapore is a significant integrant of Singapore's economy. Serving the needs of an international customer base, Singapore provides a wide range of banking and financial related services through more than 700 local and foreign banking and financial institutions within the state. Singapore continues to attract top financial institutions from beyond its shores. Some of the banks that already have regional bases in Singapore include ABN AMBRO, Citibank and Union Bank of Switzerland.

Singapore's largest domestic banks have set up branches, agencies, representative offices, affiliates, offshore banks and subsidiaries regionally and globally. Needless to say, countries with a well-developed banking system engage in more cross border intermediation. The strong expansion of Singapore banks abroad is evident from their loans and assets and liability management to foreign counterparts, opening foreign branches and acquiring shareholdings in foreign banks. Not only have all Singapore banks expanded regionally, but they have also expanded internationally. Singapore banks have established themselves in major financial centres and followed the business of their corporate customers. It is also well established that Singaporean banks have substantial presence in Japan, the U.K. and the U.S (MAS, 2006 and Tschoegl,, 2001).

Trade and investment are major contributing factors to banking integration. In terms of these factors, Singapore is very substantially integrated with the US, UK and Japan. Singapore's major trading partners are the U.S., Europe and Japan. The U.S. is one of the most important trading partners for Singapore. The U.S. is Singapore's second largest trading partner and the second top export destination after Malaysia. The U.S. was Singapore's top source of imports and exports of services in 2004. The U.K. imports of services from Singapore amounted to S$5.2 billion in 2004 and exports of services was considerably low when compared to Japan and the U.S. Japan's imports of services from Singapore totalled S$5 billion for that same year but exports were higher, at S$7.4 billion. Major destination for Singapore's direct investment was the U.S. with S$9 billion, the U.K. with S$7.6 billion and Japan with S$3.3 billion. The majority of investments originate from Japan, the U.K. and the U.S. Japan, the U.K. and the U.S. are the three largest foreign investors in Singapore. The U.S. was by far Singapore's largest foreign direct investor in 2000. In 2001, US$27.3 billion or 2.2 percent of the U.S. foreign investments were in Singapore (MAS, 2006).

As stated earlier, we undertake our investigation using the Markov regime switching approach. This method allows us to obtain more robust results in our analysis. As further discussed in Section 2, this approach takes into account market cycles, which is endogenously identified in the Markov model. It is well-established in the financial and economic literature that cycles characterise markets (Fabozzi and Francis, 1977, 1979; Chen, 1982; Bhardwaj and Brooks, 1993; Schaller and van Norden, 1997;

Granger and Silvapulle, 2002). The relationship between economic or financial variables could therefore differ between cycles. Thus, using the Markov switching model enables us to determine the extent of integration between Singaporean and US, UK and Japanese banks in a more robust manner, as we will be able to see whether the integration occurs only in one or in more phases of the market cycle. As far as we know, our paper is the first to use this particular approach in examining the issue of bank global integration.

Our paper therefore contributes to the existing literature on banking integration in the following manner. Firstly, none of the present literature on this issue have focused on Singapore vis-à-vis the US, UK and Japan. Secondly, as far as we know, none of the existing studies relating to banking integration have taken into account market cycles and none has also made use of the market regime switching approach. Thus, our paper hopes to provide fresh and robust evidence relating to this issue.

The results of the Markov regime switching analysis show that the interaction of the banking industry of Singapore with that of the US, UK and Japan occur within four distinct regimes. We find evidence of the Singaporean banking industry being globally integrated with the US market as the US influences Singapore in all four regimes. It is also, to a limited extent, integrated with the UK as the UK has some significant effect on Singapore in two regimes. It is not, however, integrated at all with Japan inspite of Singapore's heavy economic involvement with Japan and Japan being located within the same region. Our results therefore provide further evidence of the banking industry being globally integrated, particularly with the US.

This study is organised as follows. Section 2 discusses the methodology and data while Section 3 presents the empirical results. Section 4 provides the conclusion.

2. METHODOLOGY AND DATA

As argued by Kenen (1976): "… integration refers to the degree to which participants in any market are enabled and obliged to take notice of events occurring in other markets. They are enabled to do so when information about those events is supplied into the decision making processes of recipients. They are obliged to do so when it is supplied in ways that invite them to use it in order to achieve their own objectives…". Hence, integration implies co-movement of prices and consequently, integration may be measured by the degree of price co-movement[1]. The greater the degree of integration, the higher the co-movement of prices and the faster the response of prices in one market to the movement of prices in the other market. Thus, we test the extent of integration of the Singaporean banking industry with that of the US, UK and Japan by determining the extent, speed and duration of the co-movement of bank stock prices between Singapore and the latter countries.

We regress the bank stock prices of Singapore against those of the US, UK and Japan. We use a recently developed advanced econometric technique that allows the regression to take into account different cycles of the market - the Markov-regime switching technique based on the work of Hamilton (1989) and Krolzig (1997). With

[1] Financial integration implies equality of prices. In the case of equities, this means equality of risk-adjusted returns. Measuring integration in this particular manner necessitates the use of asset pricing models or return models. A fundamental weakness of this approach in testing for financial integration, however, is that it becomes a joint test of the asset-pricing model as well as integration. Interpretation of the results of the test therefore becomes difficult. We do not utilize this approach in this paper. For a summary of different approaches in measuring financial integration, the reader may want to refer to Roca (2000), pp. 10-17.

this approach, the regression coefficients are able to vary or switch across different market conditions. The model endogenously identifies the different market regimes. The probability of occurrence (called regime probability) as well the duration of each regime is also determined. In addition, the probability of switching to another regime when one is in a certain regime is identified as well. This so called "transition probability" therefore provides another indication of the volatility of a certain regime.

We also decompose each regression coefficient to trace the co-movement of the Singaporean banking industry with those of the US, UK and Japan. We do this by performing an impulse response analysis (see Ehrmann, Ellison and Valla, 2001, pp. 10-11). All this analysis is performed within the context of a Vector Autoregression (VAR), which involves multivariate and simultaneous system of equations (see Sims, 1980).

In this study, we consider VAR models with changes in regime (Markov switching-VAR). In the most general specification of an MS-VAR model, all parameters of the VAR are conditioned on the state s_t of the Markov chain. Denoting the number of regimes by m and the number of lags by p and the observed time series vector y_t is given by:

$$y_t = \begin{cases} v_1 + B_{11} y_{t-1} + \ldots + B_{p1} y_{t-p} + A_1 u_t & \text{if } s_t = 1 \\ \vdots & \\ v_m + B_{1m} y_{t-1} + \ldots + B_{pm} y_{t-p} + A_m u_t & \text{if } s_t = m \end{cases} \tag{1}$$

where :

$y = [y_1, y_2, y_3, y_4]$

y_1 = returns on the Singaporean bank market;

y_2 = returns on US bank market;

y_3 = returns on the UK bank market;

y_4 = returns on the Japanese bank market.

v represents the regime-dependent intercept term;

B is the parameters shift functions;

s_t is assumed to follow the discrete time and discrete state stochastic process of a hidden Markov chain;

u_t is the vector of fundamental disturbances, is assumed to be uncorrelated at all leads and lags:- $u_t \sim$ NID $(0, I_K)$; K is the dimension of the coefficient matrix A (i.e. it describes the number of endogenous variable).

In order to determine the appropriate Markov Switching (MS) model to use, we conduct a number of diagnostic tests. We test the data for unit roots (using the Augmented Dickey Fuller and Phillips-Perron tests) and hetersoskedasticity (based on the White Test). We also test for the optimal number of regimes and number of lags for the model based on the Akaike Information Criterion. After we have determined the specific form of the MS model, we then estimate the model and derive the following based on the procedures developed by Hamilton (1990) and Krolzig (1997) regime probabilities[2],

(a) transition probabilities,

(b) parameters or coefficients.

[2] In order to save space, we do not provide a detailed explanation of the estimation of the Markov-Switching model. Rather, we refer the interested reader to Appendix 1 of Roca and Wong (forthcoming).

We then conduct an impulse response analysis using the Choleski decomposition method[3].

This study covers the period January 2, 1992 to June 30, 2006. We use daily data as this allows us to capture fluctuations that may last only a few days (Eun and Shim, 1989; Chowdhurry, 1994). There were a total of 3,781 observations during the study period. The data is based on the Dow Jones Total Market (DJTM) banking indices in Singapore dollars obtained from Datastream. The DJTM banking index covers 95 percent of the stocks in the banking industry.

3. EMPIRICAL RESULTS

Diagnostic Test Results

To test for unit roots behaviour in each of the returns time series, the study performed the Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) tests. For each data series, the null hypothesis of non-stationary (unit root) and the alternative hypothesis of stationary (no unit root) are tested for, in their original form. Table 1 presents the calculated *t*-statistics. Both the ADF and PP tests reject the null hypothesis of a unit root at 5% level of significance, suggesting that Singaporean, US, UK and Japanese bank returns are stationary. Furthermore, Krolzig (1997) stated that there would not be considerable changes in the results when differenced dataset are used, as the Markov switching smoothed regime probabilities are analogous whether the estimation is performed using level or differenced dataset. Therefore, without

[3] We also refer the reader to Appendix 1 of Roca and Wong (forthcoming) for further discussion.

differencing further or testing for cointegration, the returns time series will be applied in the following analysis. Thus, this study will employ the MS(m)-VAR(p) model.

[INSERT TABLE 1]

We then tested the null hypothesis of no heteroskedasticity against heteroskedasticity of some unknown general form based on the White test. The result shows a Chi-square of 1748.56 with 160 degrees of freedom, signifying the data contain heteroskedasticity, therefore the study will employ the Markov switching MSIAH(m)-VAR(p) model.

The Schwarz Information Criterion (SIC) criterion values for 2-5 regimes and 1-2 lags for bank and stock market returns are presented in Table 2. The result shows that the lowest SIC values for both bank and stock market returns corresponds to 4 regimes and 1 lag. Therefore, this study uses the Markov switching MSIAH(4)-VAR(1) model. A number of other studies have used the four-regime model and have found that this model is able to capture and forecast market conditions relatively well (Jerzmanowski, 2005; Bollen, Gray and Whaley 2000; Guidolin and Timmerman, 2005).

[INSERT TABLE 2]

Regime and Transition Probabilities

The results shown in Table 3 show that the data is characterised by four regimes. Regime 1 has the highest return (0.0110) followed by regime 3 (0.0065), regime 2

(0.0017) and then regime 4 (-0.0363) with the lowest return. We label regime 1 as "boom" state, regime 3 "recession" state, regime 4 "trough" state and regime 2 "recovery" state. Regimes 1 and 4 are the most volatile states. Regime 2 has the longest duration (16.57 days) followed by regime 1 (14.5 days). Regimes 3 and 4 have relatively much shorter duration (only 8.78 days and 5.27 days, respectively). Regimes 2 and 1 also have the highest probability of occurrence (0.3720 and 0.3387, respectively) while regimes 3 and 4 have much lower probabilities (0.1995 and 0.0898, respectively). This therefore implies that the analysis of the co-movement of the bank returns between Singapore and those of the US, UK and Japan must be done in four different regimes or cycles of the market.

[INSERT TABLE 3]

We now analyse the stability of each regime. The probabilities of switching between regimes or transition probabilities are shown in Table 4. The probabilities in the first row show the likelihood of regime 1 switching into regime 1, 2, 3 and 4, respectively. Thus, the first numeral (0.9311) in the first row indicates that there is a probability of 93.11% that regime 1 will switch to regime 1 (meaning, it will stay in its own regime); the second numeral (0.0102) indicates that there is a probability of 1.02% of regime 1 switching into regime 2; and so, on. The second, third and fourth rows show the probabilities of switching for regimes 2, 3 and 4, respectively, into regimes 1, 2, 3 and 4.

[INSERT TABLE 4]

The probability of each regime remaining in its own regime is shown by the numerals in the diagonal line. For instance, the number 0.9311 on the top-left hand side of the table (along the diagonal) indicates that the probability of regime 1 remaining in its own regime is 93.11 percent. The second numeral along the diagonal is 0.9396, which means that regime 2 has a 93.96 percent probability of remaining in this regime. The third numeral along the diagonal, 0.8861 indicates that there is a 88.61 percent probability of regime 3 remaining in its own regime. Finally, the last numeral along the diagonal, 0.8104, shows that there is 81.04 percent probability of regime 4 remaining in regime 4.

It can be seen in Table 4 that the probabilities are quite high for switching between regimes 3 and 2 with a probability of 9.52 percent of regime 3 (recession) switching into regime 2 (recovery) and a probability of regime 2 (recovery) switching into regime 3 (recession) of 4.69 percent. The probabilities are even greater for switching between regimes 4 and 1, with a probability of 17.77 percent of regime 4 (trough) switching into regime 1 (boom) and a probability of 4.63 percent of regime 1 (boom) switching into 4 (trough). This confirms what was shown previously in Table 3 – that regimes 4 and 1 are the most volatile states.

Figure 2 provides a graphical representation of the regime probabilities and the transition probabilities. It can be seen from Figure 2 that regime 2 or the recovery state of Singapore bank returns has most of the observations remaining in its own regime and has the longest duration of 16.57 days on average as discussed in Table 3, hence this regime may be considered as a more stable state.

[INSERT FIGURE 2]

It can be seen further from Figure 2 that regime 3, defined as the recession state of Singapore bank returns, has captured events of financial distress such as the Exchange-Rate Mechanism Crisis in 1992, the 1994 Mexican crisis, the Asian crisis in 1997, the World crisis in late 1998, the September 11 attacks in 2001, the Bali bombing in October 2002, the Enron bankruptcy in mid-2002, the technological bankruptcy of Worldcom and Delphia in early 2003, the War in Iraq in March 2003 and the London bombing in July 2005. The events captured by the recession state of Singapore bank returns are predominantly events that occurred in the U.S. This indicates that the U.S. market has significant influence and major impact affecting the sensitivity of Singapore bank returns.

Model Coefficients

The estimated parameters of the MSIAH(4)-VAR(1) model are presented in Table 5 This table provides information on the sensitivity of Singapore bank returns to the bank returns of Japan, the U.K. and the U.S. corresponding to each regime. The coefficients that are statistically significant are those corresponding to the U.S. bank returns in regimes 1, 2, 3 and 4; and the U.K. bank returns in regime 2. These coefficients are all positive which indicate that Singapore bank returns move in the same direction with these markets.

[INSERT TABLE 5]

The U.S. bank returns significantly affect Singapore bank returns during all states. The U.K. bank returns, however, only affected Singapore bank returns in the recovery state. This is consistent with the findings of Simpson and Evans (2005), who found interrelationships between the banks of the U.K. and Singapore. Thus, the U.S. and the U.K. do play a role in influencing Singapore bank returns, with the U.S. being the dominant party of influence in all states of bank returns, while the U.K. only has an effect in the recovery state of bank returns. However, it is surprising to note that though Japan is a leading international financial centre in the world which is geographically located in Asia, and heavily involved with Singapore economically in terms of trade and investment, Singaporean banks are not at all integrated with the Japanese banking industry. The coefficients for Japan's bank returns in regimes 1, 2, 3 and 4 are not statistically significant. During the boom, recovery, recession, and trough states of bank returns, Japan has no significant influence over Singapore bank returns. This non-integration of Singaporean banks with those of Japan could most probably be due to the fact that the Japanese financial market, compared to the US and the UK, is still saddled with regulatory constraints inspite of the significant deregulation, which occurred particularly since the late 1980s.

Impulse Response Analysis

Further investigation is performed by analysing the speed and duration of response of Singapore bank returns to the bank returns movements of Japan, the U.K. and the U.S. through the use of impulse response analysis based on the Markov switching model. The impulse response analysis shows the expected change in Singapore bank returns after a one standard deviation shock to the Japan, the U.K. and the U.S. bank returns under the boom, recovery, recession and trough states of bank returns. Figure 3 shows the impulse response of Singapore bank returns to the U.K. bank returns in regime 2 and the U.S. bank returns in all states as these have significant coefficients in the Markov switching model.

[INSERT FIGURE 3]

The results of the impulse response analysis show that Singapore bank returns react to movements in the U.K. and the U.S. bank returns with the same speed and duration. As can be seen in Figure 3, Singapore bank returns immediately respond to the U.S. bank return shocks, followed by a negative response within the first day in all four regimes. The same response applies to the U.K. bank returns but they are only significant in regime 2.. The biggest response of the U.S. bank returns is in regime 4 (trough state) followed by regime 3 (recession state) and regime 1 (boom state), while the response is the smallest in regime 2 (recovery state). This implies that Singapore bank returns are most sensitive to the U.S. market during the trough state and less sensitive during the recovery state. Generally all of Singapore's responses are completed within two days. It is well-accepted in the international finance literature that this represents a quick response and indicative of market efficiency (Eun and Shim, 1989). This can therefore be taken as further evidence of the integration of the Singaporean banking industry with that of the US and the UK.

4. CONCLUSION

In this paper, we re-examine the issue of global bank integration within the context of a renowned international financial centre - Singapore. We test the extent of integration of the Singaporean bank industry with that of the US, UK and Japan based on a Markov regime switching approach which allows us to take into account market cycles or regimes into the analysis. We find that four distinct regimes characterise the co-movement of bank stock prices and stock market prices. The Singaporean bank prices are significantly affected by the US and to a limited extent by the UK. Japan does not affect Singaporean banks at all. We find that the response of Singaporean banks to movement in prices in the US, UK and Singapore occur within two days, which implies efficiency in response and therefore further indicative of integration.

Thus, our results from the analysis of Singapore provide evidence of the banking industry being globally integrated, at least with the US and to some extent with the UK. Our results also provide further support to the claim by previous studies (see, Roca, 2000 for instance) that the US is the global influence in financial markets so that even in Asia, it is the driving force rather than Japan. Our findings also reinforce the view that interactions in the financial markets, particularly involving the US and other markets, is generally considered to be efficient. These results imply that the possibility of contagion risk particularly from the US can be a concern. In terms of monetary policy transmission, the role of the US and UK banks should also be a consideration. For investors in the banking industry, events in the US would therefore affect systematic risk and therefore should be factored into the pricing of bank share prices.

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Table 1
Unit Root Tests

	Augmented Dickey-Fuller	Philips-Perron
Singapore Bank Returns	-54.3456*	-54.3812*
Japan Bank returns	-54.9270*	-54.6327*
U.K. Bank returns	-31.1356*	-58.4381*
U.S. Bank returns	-59.6516*	-59.9500*

Notes: Critical value at 5% level of significance: -3.45
* rejects the null hypothesis at the 5% level of significance

Table 2
SIC Values for Markov Switching Model

	2 regimes	3 regimes	4 regimes	5 regimes
Lag 1	-23.1528	-23.1836	-23.2654 *	-23.2136
Lag 2	-23.0947	-23.1524	-23.1409	-23.0707

Note: * lowest SIC value.

Table 3
Probabilities and Characteristics of Each Regime

	Probability	Average Duration	Number of Observations	Average Returns	Average Volatility*
Regime 1 (Boom)	0.3387	14.50	1275.8	0.0110	0.0353
Regime 2 (Recovery)	0.3720	16.57	1416.8	0.0017	0.0044
Regime 3 (Recession)	0.1995	8.78	747.4	0.0065	0.0149
Regime 4 (Trough)	0.0898	5.27	340.1	-0.0363	0.0598

Note: * average volatility is the average variance of the stock returns

Table 4

Probabilities of Switching between Regimes

From: \ To:	**Regime 1** (Boom)	**Regime 2** (Recovery)	**Regime 3** (Recession)	**Regime 4** (Trough)
Regime 1 (Boom)	0.9311	0.0102	0.0124	0.0463
Regime 2 (Recovery)	0.0134	0.9396	0.0469	0.0001
Regime 3 (Recession)	0.0122	0.0952	0.8861	0.0065
Regime 4 (Trough)	0.1777	0.0001	0.0119	0.8104

Table 5

Estimated Coefficients

Independent variables	**Regime 1** (Boom)	**Regime 2** (Recovery)	**Regime 3** (Recession)	**Regime 4** (Trough)
Japan Bank returns	–0.0026 -(*0.0909*)	–0.0018 -(*0.1220*)	–0.0111 -(*0.6264*)	–0.1176 -(*1.8742)*
U.K. Bank returns	–0.0023 -(*0.0780*)	0.0473 (*2.9637*)*	0.0471 (*0.9706*)	0.0742 (*1.0285)*
U.S. Bank returns	0.1699 (*4.8169*)*	0.0746 (*3.7710*)*	0.2048 (*3.5756*)*	0.3235 (*4.4489)**

Notes: t-values are shown in parentheses; * significant at 5%.

Figure 1

Econometric Techniques and Data Used

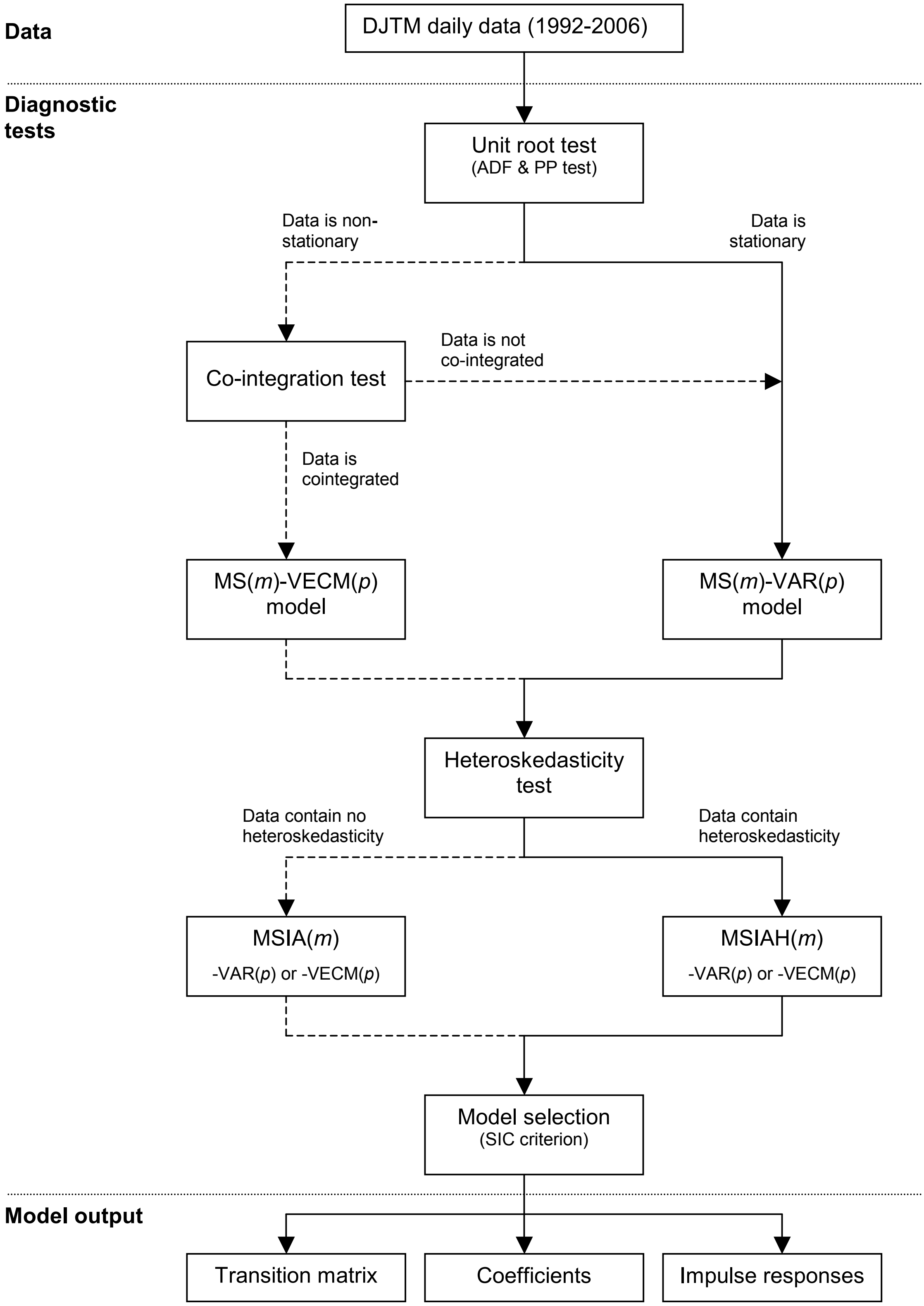

Figure 2

Regime Probabilities

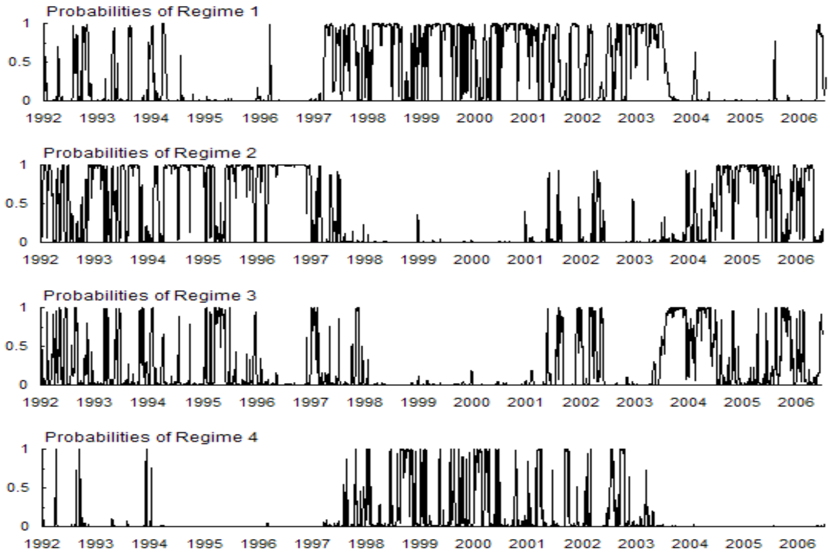

Figure 3

Impulse Response of Singapore Bank Returns to a Shock
in the U.K. and the U.S. Bank Returns