Many countries in recent years have progressively removed economic and financial barriers and this process has provided easier access to their capital markets. Further, such liberalization measures can impact upon the risk-return relationship between assets. This paper investigates whether the Australian stock market is segmented from or integrated into the world equity market. The aim is to ascertain if the liberalization undertaken in the Australian economy, in the form of financial deregulation in the early 1980s, has resulted in its integration with the world equity market. Consistent with expectations, we find evidence that the stock market was segmented in the pre-deregulation period but integrated following financial deregulation. The hypothesis that industry factors may impact upon integration could not be supported. © 1999 Elsevier Science Inc.

Keywords: Australia; Deregulation; Integration

JEL classification: F36; G12; G15

I. Introduction

The globalization of financial markets gained momentum in many countries during the last two decades as a result of liberalization measures undertaken by various governments. This phenomenon has enhanced the interest of researchers in the integration of capital markets. It is expected that the relaxation or complete removal of investment barriers results in integration of markets. Capital markets are considered to be integrated if assets with identical risk earn the same risk-adjusted return regardless of domicile. Hence, in integrated markets, the risk return relationship is determined by purely international factors. Conversely, in the case of segmentation, only domestic factors influence that relationship. This is an important issue as it has wide-ranging implications. For example,
in segmented capital markets, investors only diversify away domestic unsystematic risk. While in a completely integrated market, an investor with a well-diversified portfolio only faces international systematic risk and under this scenario domestic portfolio diversification becomes a special case of international portfolio diversification. Also, firms tend to have a lower cost of capital in integrated markets.

Integration has proved difficult to test, and the degree of integration is difficult to measure due to the plethora of restrictions that can impact on the market. However, there is a consensus that barriers to investment, legal or otherwise, are the major reasons for capital market segmentation. One of the first studies to allow for investment barriers in asset pricing was by Black (1974), who incorporated the effect of differential foreign taxation. Access to markets can also be impeded by restricting the level of foreign ownership in local firms. Errunza and Losq (1985) and Eun and Janakiramanan (1986) showed that given a specific asset pricing model, the barrier results in mispricing of assets with investors willing to pay premiums for restricted stocks.1

Liberalization of financial markets can take the form of removal of either capital and exchange controls or ownership barriers. The revision of the Foreign Exchange Law and Foreign Trade Control Law in 1980 in Japan is an example of this type of liberalization. This law eliminated regulations on short-term capital movements and has been used as a trigger for a change in regime in the Japanese economy. Campbell and Hamao (1992) and Gultekin, Gultekin and Penati (1989) hypothesise that following the implementation of this law, the US and Japanese markets are likely to be integrated. Tests for integration between the Canadian and the US stock markets are conducted by Jorion and Schwartz (1986) using both domestic and interlisted Canadian stocks. Contrary to expectations, they are unable to find in favor of integration which they attribute to legal restrictions. Using a time period, (1977–1986), that is characterized by liberalization measures, Mittoo (1992) shows that Canada and the US are integrated in recent years. More recently, Bekaert and Harvey (1995) using a regime-switching model show that the degree of integration is time-varying. They show that in most developing countries there is a regime-switch to integration when policies that encourage foreign investment are instituted by the government. They also posit that it is possible that their integration measure also captures the change in exchange rate regimes but are unable to find evidence of a link between integration and exchange rate regimes. Bekaert and Harvey find that, for developed markets, their results support integration for the full sample period.2

This paper extends this literature by examining the issue of integration from an Australian perspective. Australia was a relatively closed economy until the early 1980s. The process of financial liberalization in Australia was a result of the Financial System Inquiry, Final Report, 1981, which recommended less government intervention in the financial system. Financial deregulation was embraced in the form of the floating of the Australian dollar and the abolition of most exchange controls, hence facilitating greater capital mobility in December 1983 [evidence is provided by the Wallis Report (Financial System Inquiry Final Report, 1997) who document greater capital inflows into Australia

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1 Another barrier faced by investor includes exchange rate risk. Exchange rate risk, if undiversifiable, could impact on, among other things, asset pricing and the cost of capital. The impact of exchange-rate risk on asset pricing and segmentation is examined by Choi and Rajan (1997).

2 Bekaert and Harvey (1995) demonstrate (in pg. 435) that when their model is applied to a developed market (Germany) the results indicate that it is fully integrated for the entire sample period. The results for countries that could now be considered to be developed, like Greece, they find that it is integrated for nearly the entire sample period.
and the rise in overseas investment by Australians. Other measures include the deregulation of the Australian stock exchange and the securities industry in 1984 and the granting of licenses to deal in foreign exchange to non-banks and also to foreign banks from 1985 onwards to open up the domestic market to more competition.

A comprehensive stocktake of the various measures of financial deregulation of the Australian market during the 1980s is provided by the Wallis Report (Financial System Inquiry Final Report, 1997). Specifically, it contends that the implementation of the recommendations of the Campbell Report has improved the efficiency and international competitiveness of Australia's financial system. The deregulation of the financial market was shown to have significant impact on industry betas by Brooks and Faff (1995 and 1997) and Harper and Scheit (1992). As an extension to the previous analysis, we hypothesize that financial deregulation of the Australian economy may have had a more significant effect and resulted in the greater integration of the Australian capital market into the world capital market. To test this hypothesis we utilize the methodology developed by Jorion and Schwartz (1986). Specifically, we examine 23 value-weighted Australian industry portfolios, using the MSCI world index as a proxy for the global market portfolio.

In the Australian context, it is plausible that the resource and industrial sector companies are fundamentally different from each other in their international exposure. Grinold, Rudd and Stefek (1989) show that some industries have an “international presence,” whereas others are largely domestic in nature, and, hence, it is likely that these industries will be influenced by global factors. The Australian market is dominated by resource companies which belong to the most global of industries. Hence, it is quite possible that different Australian industries or industrial sectors may display differential degrees of integration/segmentation. Roll (1992) argues that a country’s stock market is influenced by its industrial composition, and that any change in behavior of returns reflects the nature of the change in international influence on the industries. One simple dichotomy that may capture this is a division based on industrial sectors.

We argue that the output of mining and resource companies is dependent on international commodity markets and these traded goods are likely to be impacted by changes in macroeconomic variables and consequently the resource sector is more likely to be integrated into the global market. Along similar lines, Griffin and Karolyi (1998) document that, for industries that do not produce traded goods, “country factors tend to explain a larger proportion of the variation in index returns.” They also posit that overseas macroeconomic events and shocks to exchange rates are likely to have a greater impact on the traded goods sector. Accordingly, in addition to testing for integration and segmentation holding the degree of integration constant across all industries, we also classify the industries into one of two categories: industrials and resources and allow the degree of integration to vary between these two broad categories.

The structure of the paper is as follows. Section II sets out the methodology for testing for integration. The empirical results are discussed in Section III, and Section IV concludes the paper.

II. Data and Methodology

Data

Monthly continuously compounded rates of return for the 23 ASX value-weighted industry portfolios and the value-weighted market index compiled by the Center for
Research in Finance (CRIF) at the Australian Graduate School of Management are analyzed. In addition, the Morgan Stanley Capital International Australian, United States and the World indices were used as proxies for the market indices. Returns are calculated in excess of 13-week Treasury notes published by the Reserve Bank of Australia and obtained from the CRIF database.

The time period used for analysis is from January 1974 to December 1992. In addition to the full sample period, subperiods pertaining to pre and post deregulation: January 1974 to November 1983 and February 1984 to December 1992, respectively, were also analyzed. These subperiods are chosen to reflect the possible structural change in the Australian market associated with the decision to liberalize Australian capital markets by floating the dollar in December 1983. The timeframe used is consistent with the analyses of financial deregulation and bank beta risk by Harper and Scheit (1992) and Brooks and Faff (1995) and with financial deregulation and more general industry beta risk by Brooks and Faff (1997). These studies indicate that, with respect to beta changes, floating of the exchange rate appears to be the key regulatory event.

Because the returns correlations of the CRIF Australian market index and the Morgan Stanley Australian Index with the Morgan Stanley US and World indices are similar, the Morgan Stanley Australian Index is used as a proxy for the local market index. Table 1 reports these correlations. All data have been converted to Australian dollars, using the end of month bilateral AUD/USD exchange rate. Interestingly, the results indicate that correlations have dropped in the post-deregulation subperiod contrary to expectations that increasing globalization would lead to higher correlations between countries.3 However, there is no evidence in the literature of a relationship between integration and correlations between markets.

**Methodology**

The methodology described below adapts the maximum likelihood procedure developed by Jorion and Schwartz (1986) to the Australian context to test for both integration and

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3 The difference in correlations in the pre- and post-deregulation periods is found not to be significant. This is ascertained by building confidence intervals around the bilateral correlation for the two subperiods. Because the two confidence intervals overlap, we can conclude that the difference is not significant. See Devore (1991).
segmentation. To test for integration, we make the assumption that the value-weighted industry portfolios are priced solely according to the global index. Consistent with this assumption, excess returns for the portfolios are given by

\[ E(\tilde{r}_i) = \gamma_0 + \gamma_1 \beta_i^G \]  

(1)

where \( \gamma_0 \) is the expected excess return on a zero beta portfolio, \( \gamma_1 = E(\tilde{r}_G) - \gamma_0 \), the market risk premium and \( \beta_i^G \) is the relative risk of portfolio \( i \) relative to the global index, \( \tilde{r}_G \).

Stehle (1977) argues that because both the domestic and global indices are likely to be correlated, it is inappropriate to use a single factor model to test either for integration or segmentation. Therefore, we obtain the orthogonolized component \( \tilde{V}_{A,G} \), by using the residuals from the simple regression of one market index against the other.

\[ \tilde{r}_A = c_0 + c_1 \tilde{r}_G + \tilde{V}_{A,G} \]  

(2)

where \( \text{cov}(\tilde{V}_{A,G}, \tilde{r}_G) = 0 \), \( \tilde{r}_A \) is the excess return on the Morgan Stanley Australian returns and \( \tilde{r}_G \) is the excess returns on the US or World indices. The two-factor model to test for integration is given as

\[ E(\tilde{r}_i) = \gamma_0 + \gamma_1 \beta_i^G + \gamma_2 \beta_i^{A,G} \]  

(3)

where \( \beta_i^{A,G} \) is the systematic risk relative to the residual \( \tilde{V}_{A,G} \). Under the null hypothesis of integration, the portfolios are priced solely relative to the global index (i.e., \( \gamma_2 = 0 \)). Using the procedure adopted by Jorion and Schwartz (1986), we decompose the excess return on the portfolios into two components: the expected return and an innovation. The returns are expressed as

\[ \tilde{r}_i = E(\tilde{r}_i) + \beta_i^G (\tilde{r}_G - E(\tilde{r}_G)) + \beta_i^{A,G} \tilde{V}_{A,G,i} + \tilde{e}_i \]  

(4)

Substituting the expression for expected returns ie. equation (3) in the above equation we get

\[ \tilde{r}_i = \gamma_0 + \gamma_1 \beta_i^G + \gamma_2 \beta_i^{A,G} + \beta_i^G (\tilde{r}_G - E(\tilde{r}_G)) + \beta_i^{A,G} \tilde{V}_{A,G,i} + \tilde{e}_i \]  

(5)

\[ \tilde{r}_i = \gamma_0 + \beta_i^G (E(\tilde{r}_G) - \gamma_0) + \gamma_2 \beta_i^{A,G} + \beta_i^G (\tilde{r}_G - E(\tilde{r}_G)) + \beta_i^{A,G} \tilde{V}_{A,G,i} + \tilde{e}_i \]  

(6)

\[ \tilde{r}_i = \gamma_0 (1 - \beta_i^G) + \gamma_2 \beta_i^{A,G} + \beta_i^G \tilde{r}_G + \beta_i^{A,G} \tilde{V}_{A,G,i} + \tilde{e}_i \]  

(7)

The null hypothesis of integration and mean variance efficiency implies that, \( \gamma_2 = 0 \). The alternative hypothesis is not one of segmentation as \( \gamma_2 \) cannot be assumed to be the premium associated with domestic risk factors as \( \gamma_1 \) is expressed as a function of the expected return on a global index (\( \gamma_1 = E(\tilde{r}_G) - \gamma_0 \)), which is not a valid assumption when markets are segmented.

The use of the maximum likelihood estimation developed by Gibbons (1982) to estimate non-linear equations enables us to avoid the error-in-variables problem that is normally encountered in the Fama and MacBeth (1973) two-pass approach as the parameters are estimated simultaneously. Also, the validity of the CAPM is tested using the likelihood ratio test (\( \chi^2 \)) suggested by Gibbons (1982).

A similar methodological set-up applies to the tests of segmentation, where the roles of the domestic and US markets are reversed. Tests of segmentation likewise revolve around
the assessment of whether segmentation parameters denoted by $\delta$ equal zero. These tests are not outlined here in order to conserve space.

### III. Empirical Results

We conduct the tests for both integration and segmentation using continuously compounded monthly rates of return on 23 CRIF industry portfolios and the MSCI World and US indices as proxies for the global index. In the first phase of the analysis, the test for integration and segmentation is carried out by holding the integration parameter ($g_2$) or the segmentation parameter ($d_2$) constant across all industries. In the next phase, the industries are classified into two categories: resources and industrials and the integration and segmentation parameters are held constant across the two main categories to determine if different results are obtained for resources and industrials. Further, the sample period is split into two subperiods, pre and post deregulation, in order to determine if the Australian capital market has become more integrated following the financial deregulation of the market in the early 1980s.

Table 2 provides the results for both integration and segmentation when the integration/segmentation parameters are held constant across all industry portfolios. For the twenty three portfolios, a test of integration is $g_2 = 0$. Panel A indicates that $g_2$ is significantly different from zero at the 5% level of significance, thereby rejecting integration for the full

**Table 2. Tests of Integration/Segmentation where the Pricing Parameter for all Industries is Held Constant**

<table>
<thead>
<tr>
<th>Panel A: Tests with Integration as the Null Hypothesis</th>
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</thead>
<tbody>
<tr>
<td><strong>Projection of the Australian index on the Morgan Stanley World Index</strong></td>
</tr>
<tr>
<td><strong>Full Sample Period:</strong> $\hat{r}<em>{At} = 0.0007 (0.16) + 0.5115 (5.49)^* \hat{r}</em>{Gt}$, $R^2 = 0.1175$</td>
</tr>
<tr>
<td><strong>Pre-Deregulation:</strong> $\hat{r}<em>{At} = 0.0005 (0.09) + 0.7553 (5.25)^* \hat{r}</em>{Gt}$, $R^2 = 0.1904$</td>
</tr>
<tr>
<td><strong>Post-Deregulation:</strong> $\hat{r}<em>{At} = 0.0004 (0.06) + 0.3503 (2.84)^* \hat{r}</em>{Gt}$, $R^2 = 0.0712$</td>
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<table>
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<tr>
<th>Panel B: Tests with Segmentation as the Null Hypothesis</th>
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</thead>
<tbody>
<tr>
<td><strong>Projection of the Morgan Stanley World Index on the Australian Index</strong></td>
</tr>
<tr>
<td><strong>Full sample period:</strong> $\hat{r}<em>{Gt} = 0.0036 (1.22) + 0.2297 (5.49)^* \hat{r}</em>{At}$, $R^2 = 0.1175$</td>
</tr>
<tr>
<td><strong>Pre-deregulation:</strong> $\hat{r}<em>{Gt} = 0.0034 (0.99) + 0.2521 (5.25)^* \hat{r}</em>{At}$, $R^2 = 0.1904$</td>
</tr>
<tr>
<td><strong>Post-deregulation:</strong> $\hat{r}<em>{Gt} = 0.0039 (0.76) + 0.2031 (2.84)^* \hat{r}</em>{At}$, $R^2 = 0.0712$</td>
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<tr>
<th>For orthogonalized Australian Returns against MS World Returns</th>
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<tbody>
<tr>
<td><strong>Full Sample</strong></td>
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<tr>
<td>$g_0$</td>
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<tr>
<td>$g_2$</td>
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<td>$\chi^2$</td>
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<tr>
<th>For orthogonalized MS World Returns against Australian Returns</th>
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<tr>
<td><strong>Full Sample</strong></td>
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<tr>
<td>$d_0$</td>
</tr>
<tr>
<td>$d_2$</td>
</tr>
<tr>
<td>$\chi^2$</td>
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</tbody>
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1. The t statistics are in parentheses.
2. Significance at the 5% level is indicated by $^*$. 

The t statistics are in parentheses.
Significance at the 5% level is indicated by $^*$.
sample period and the pre-deregulation subperiod when the MSCI World index is used. While we reject the null hypothesis of integration, this does not necessarily imply that $\gamma_2$ is the premium associated with domestic factors. In the post-deregulation subperiod the null hypothesis of integration is not rejected. The coefficients are negative indicating that no reliable conclusion can be arrived at when we use the Morgan Stanley world index for the global market index.

Panel B reports the results when we use segmentation as the null hypothesis. The results for the full-sample period and the two subperiods are internally consistent with the integration results reported in Panel A. Specifically, when we test for segmentation using the MSCI World index, we do not reject the null hypothesis of segmentation for the full sample period and the pre-deregulation subperiod. The insignificance of the segmentation parameter despite its magnitude could be attributed to imprecise estimation. By construction, the segmentation parameter is loaded on to the beta relative to the global index which may be close to zero. This, imprecise estimation may result in large standard errors. In the post-deregulation period, the hypothesis of segmentation is rejected, and, because the segmentation parameter is non-zero, we can conclude that purely international factors are crucial to the pricing of Australian assets. Therefore, we conclude that Australia in the post-deregulation subperiod, is indeed integrated into the world capital market and hence the price differential for risk between the Australian and the world markets is insignificant. Finally, as seen in Table 2, we do not reject the parameter restrictions as implied by the CAPM using the likelihood ratio test. Therefore, we can conclude that economic liberalization has resulted in the integration of the Australian capital market into the world capital market. These results can be compared to that of Japan for which Gultekin et al. (1989) show that the main liberalization measure (Foreign Exchange Law and Foreign Trade Control Law) in 1980 had served to integrate the two countries. An important economic implication of this result is suggested by Obstfeld (1994) who argues that when markets are integrated the allocation of resources improves due to greater risk-sharing between countries as investors are more willing to accept high-risk projects. The shifting of savings into higher risk projects results in an increased growth rate.

Another feature of this paper is that we test the integration/segmentation hypotheses allowing for the gammas and deltas (the integration and segmentation parameters, respectively) to vary between the resources and industrial sectors. We hypothesize that industrial factors could impact upon integration and to that end we test this hypothesis using two broad industrial classifications. The intention is to test for integration for resources and industrials separately. The separation of the 23 portfolios into two main categories is motivated by the fact that resources tend to be priced internationally and hence the resource sector equities may be more integrated into world equity markets than industrial sector equities.

The results in Table 3-Panel A, reveal the outcome of a test for integration (Equation 4 Wood (1990) shows that when segmentation is tested, the alternative hypothesis is consistent with integration when $\delta_2 > 0$.

5 In a variation of the experiment reported here, the MSCI US index is used as a proxy for the global index. In this case, the hypothesis of segmentation is rejected for the entire sample period while, for the pre-deregulation subperiod, segmentation is rejected. For these two periods the results are internally consistent, in that integration is rejected pre-deregulation and not rejected for the full sample period. However, in the post-deregulation period the results fail to indicate both hypotheses. This result is consistent with Chan, Karolyi and Stulz’s (1992) argument that the US index is no longer an appropriate proxy for the world market portfolio following the decrease in the capitalisation of the US stocks. These results are available from the author on request.
7) using the Morgan Stanley World index (converted to Australian dollars) as proxies for the global market index. Specifically, this is the test for significance of $\gamma_2$ (industrials) and $\gamma_3$ (resources), the premia associated with domestic factors. We test for the joint null hypothesis of market integration and the zero-beta CAPM versus the alternative that $\gamma_2$ ($\gamma_3$) is non-zero. The results indicate that, for resources in the full sample period and the pre-deregulation subperiod, we reject the null hypothesis of integration. In the post-deregulation subperiod we do not reject this hypothesis. For industrials, the null hypothesis of integration is only rejected for the pre-deregulation subperiod. The inconclusiveness of this analysis could be a result of classifying of industries into two overly broad categories and could in part be attributed to the decrease in the market share of the resource sector. For instance, in 1980 the resource sector accounted for 57% of the All Ordinaries Index, while currently it accounts for 30% of the market. Thus, a division into resources and industrials is likely to be inconclusive given the changing importance of these sectors over time. Finally, the likelihood ratio tests indicate that the parameter restrictions on the models as implied by the CAPM are not rejected.

### IV. Conclusion

In this paper, we test for integration and segmentation of the Australian capital market pre- and post-financial deregulation. We contend that the liberalization of the Australian financial market in the early 1980s constituted a change in regime that could have resulted
in the greater integration of the Australian capital market into the world capital market. This paper not only tests for integration and segmentation holding all integration and segmentation parameters constant, but also allows for a possible differential effect between resources and industrial sector portfolios. The evidence indicates that in the period preceding deregulation of the financial sector, the Australian market was segmented while the liberalization measures of the mid-1980s served to integrate the Australian economy into the world market. The benefits that flow from integration have been widely documented and these include access to a larger pool of external finance, a larger investment opportunity set and increasing the growth rate. However, the hypothesis that integration could vary across two broad industry sectors could not be supported.

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References


