A Disaggregated Approach to test Financial Integration in North America using the four factors model

ABSTRACT

This paper examines financial integration across North American stock markets from January 1984 to December 2003, using an arbitrage pricing theory (APT) framework. We test several forms of the integration hypothesis, from complete to mild integration. The risk factors considered are the three domestic and international Fama and French factors augmented with momentum for both countries. We perform a detailed analysis in time series and in cross section. In both cases, we define and evaluate various financial and statistical specifications to account for different degrees of integration. In particular, we assess equality of factor sensitivities (the coefficients of the factors in multivariate time series regressions of portfolio returns on the risk factors) and of risk premiums (the coefficients of the pre-estimated BETAS in the cross sectional regression of average excess returns on the pre-estimated BETAS). In other words, we assess equality of risk sentivities and premium for each factor at a time and we also consider the simultaneous contribution of all factors. This framework serves to identify the factors which *facilitate* integration in the following sense. A factor *facilitates* integration when: (i) the factor's own sensitivities or premium are equal; (ii) accounting for this factor leads to accepting the hypothesis that [individual, cumulative or joint] sensitivities or premium associated with other considered factors are equal. All tests are multivariate (across portfolios or countries) tests over decile portfolios and 5 years sub-periods. Indeed, estimated factor sensitivities vary across portfolios and in time, which motivates our disaggregate analysis. Results in time series are the following. First, sensitivities to the market factor appear, in general, equal in single and multi-factor models; however, evidence in favor of equal sensitivities is weaker for the other risk factors. Second, tests with international factors suggest an increasing trend for integration (measured in terms of equal factor sensitivities) over time; in contrast, tests with domestic factors fail to support this trend. Third, integration measured in term of equality of factor sensitivities seems to hold more often for small portfolios than for large ones. Results in cross section can be summarized as follows. First, risk premium are, in some cases, statistically not significant, especially for the Canadian market. Second, tests with international factors suggest an increasing trend for integration (measured in terms of equal risk premiums) over time. Indeed, all (i.e. individual and joint) tests support integration in the 1999-2003 sub-period. In line with our time series results, tests on equality of domestic risk premiums fail to support this trend. While, the evidence are mixed for the international risk factors, results suggest that the domestic market, size and momentum are factors which *facilitate* integration.

Key words: Integration tests, APT models, Fama and French factors, momentum.

1 Introduction

This paper examines the financial market integration of Canadian and U.S. stock markets in the 1984-2003 period. The impact of market globalization on financial markets has been extensively studied, mostly in the 1980's. The results from these studies show that the trend is for an increase in international market integration over time (see Mittoo (1992), Errunza, Losq and Padmanabhan (1992), for example), though some studies find that markets are still segmented or at least mildly segmented (see Jorion and Schartz (1985) and King and Segal (2006), for example). At first glance, this is a surprising result. Indeed, we have witnessed over the years different legal agreements such as the Free Trade Agreement that have reinforced the economic links between Canada and the US. Yet, the literature also suggests that there are noticeable differences between the two countries.

With respect to the underlying specification, the financial market integration literature can be categorized into: 1) International CAPM [ICAPM] based tests, and 2) Arbitrage Pricing Theory [APT] based tests. Interestingly, our literature review reveals that most ICAPM based studies support financial market integration between Canada and the United States (see Mittoo (1992), for example). In contrast, most APT based tests using macroeconomic factors suggest partial segmentation/integration (see Koutoulas and Kryzanowski (1994), for example). Such conflicting evidence provides a motivation for further analysis, given that the asset pricing literature has evolved toward multifactor models based on Fama and French factors (Fama and French (1992, 1993)). In this paper, we enquire whether an international Fama and French framework would disentangle integration from segmentation trends in North America. On this issue, the paper has three main contributions.

First, we revisit financial market integration between Canada and the United States on the basis of the Fama and French framework augmented with momentum. To this end, we propose various formal definitions for the notion of financial market integration. As may be checked from the literature, and despite the widespread use of the term "market integration" by media and academia, a precise and formal definition of the concept is not readily available. So a uniform (or at least unified) testable hypothesis which defines the implications of financial market integration seems to be lacking. Indeed, with an ICAPM framework, a test of financial market integration is conducted as a significance test on the risk premium associated with an integrated/segmented market factor (see Mittoo (1992), for example). When an APT model is adopted, integration tests are often conducted via a joint test for the equality of the risk factors coefficients (see Mittoo (1992) and Koutoulas and Kryzanowski (1994)).

For the purpose of this article, we define financial market integration in general as a consistent pricing of domestic or international risk factors by Canadians and Americans portfolios. This definition closely relates to the one used in Jorion and Schwartz (1985) which will be presented below. Furthermore, for statistical test purposes, we posit more structure into this definition. Specifically, we define and test three degrees of financial integration: partial, cumulative and complete (joint) integration. We assess partial integration through the hypothesis that coefficients (either sensitivities in time series or risk premiums in cross section) are individually equal. Cumulative integration hypothesis tests that the sum of the effect of all four factors is the same. Finally, joint integration requires that the coefficients are jointly equal. Moreover, we study the factors that *facilitate* integration. A factor can facilitate integration in two ways: the factor's own sensitivities or premium are equal or the accounting for this factor leads to accepting the hypothesis that [individual, cumulative or joint] sensitivities or premium associated with other considered factors are equal.

Secondly, we provide a valid statistical comparison of risk sensitivities of Canadian stock returns to the Fama and French (1993) and momentum factors. Our approach relates to L'her, Masmoudi and Suret (2004) who qualitatively [these authors did not apply formal statistical tests] compare the risk premiums in Canada and the US. Our statistical comparisons rely on estimating the model considered for both countries in a multivariate framework. Moreover, following Griffin (2002) and Moerman (2005), we estimate the factor model with international risk factors as well as the traditional domestic ones. As argued above, we view this comparison of risk premiums as a financial market integration test. This question has direct implications on portfolio diversification, given that if domestic sensibilities were shown to be similar across both countries, it would imply a diminished opportunity of diversification for investors in both countries.

Thirdly, we address the econometric shortcomings associated with two-pass estimations. We aim to improve the procedure used in Mittoo (1992) by correcting for the well known error in variables problem (see Dufour (2003) for a recent survey of the econometric literature) encountered in a two pass estimation of risk premiums (see Chen and Kan forthcoming, and Shanken and Weistein, 2006). While the financial literature on portfolio efficiency for example (see Shanken (1996) and Campbell, Lo and MacKinlay (1997, chapter 5), and the reviews in Dufour and Khalaf (2002b), Beaulieu, Dufour and Khalaf (2007) and (2005) acknowledges that attention must be given to the testing procedure paired with an asset pricing model, in the context of financial market integration, interest in econometric improvements is, by contrast, relatively limited. In this context, we will introduce a split sample methodology.

We present results using time series and a cross sectional analysis. In time series, sensitivities to the market factor appear, in general, equal in single and multi-factor models; however, evidence in favor of equal sensitivities is weaker for the other risk factors. Second, tests with international factors suggest an increasing trend for integration (measured in terms of equal factor sensitivities) over time; in contrast, tests with domestic factors fail to support this trend. Third, integration measured in term of equality of factor sensitivities seems to hold more often for small portfolios than for large ones. Results in cross section can be summarized as follows. First, risk premium are, in some cases, statistically not significant, especially for the Canadian market. Second, tests with international factors suggest an increasing trend for integration (measured in terms of equal risk premiums) over time. Indeed, all (i.e. individual and joint) tests support integration in the 1999-2003 sub-period. In line with our time series results, tests on equality of domestic risk premiums fail to support this trend. While, the evidence are mixed for the international risk factors, results suggest that the domestic market, size and momentum are factors which *facilitate* integration.

The remainder of this paper is organized as follows. In Section 2, we present a brief literature review. Data is presented in Section 3. Section 4 presents our test methodology and the integration hypothesis tested. Our empirical analysis is reported in section 5. Section 6 concludes the paper.

2 Context and research question

To set focus, it is useful to briefly review the relevant published works, with emphasis on methodology and results. Market integration tests first show up in the literature in the late 70s, following regulatory changes on international capital flows and resulting increased capital mobility. Stehle (1977) presents one of the first studies on the integration of the American market vis-à-vis the international market. Unfortunately, it is now recognized that rejection of integration as reported by the author is due to serious collinearity problems between the two markets under study.(see Jorion and Schwartz, 1985)

For the Canadian case, Jorion and Schwartz (1985) provide one of the first formal studies; their work has led to several published articles along the same line of work (surveyed in Mittoo (1992)). Jorion and Schwartz (1985) test integration and/or segmentation of the Canadian financial market vis-à-vis the American one. Their study presents one of the first formal definitions for market integration: markets are integrated when assets with similar risk in the two different markets obtain the same return on their respective markets. Moreover, to formulate a testable version of the latter definition, the authors use a Multivariate Linear Regression (MLR) based CAPM framework, where integration (or segmentation) yield non-linear constraints estimable and testable via maximum likelihood procedures. The underlying intuition is the following: if markets are segmented, the only risk factor that should be rewarded is the one representing the Canadian market index. Inversely, if markets are integrated, the global market index is the only factor that should be significant. They use a sample of 749 companies traded on Toronto Stock Exchange for the period of 1963-1982. Results (based on asymptotic although Likelihood based procedures) strongly reject integration for the whole period for all portfolios formed. Three subsequent influential studies are noteworthy for the Canadian case: Errunza, Losq and Padmanabhan (1992), Mittoo (1993), Koutoulas and Kryzanowski (1994).

Errunza, Losq and Padmanabhan (1992) formulate and test (via a maximum likelihood procedure) three hypotheses: integration, mild segmentation and segmentation. Tests are conducted over a group of eight developing countries and on Canada vis-à-vis the American market. The data used are the monthly returns and dividends of 871 assets for developing countries and 20 Canadian assets for the 1975-1987 period. Results for both developing countries and Canada suggest a non-polar market structure, which means that markets nor fully integrated and not fully segmented. However, results seem to show that Canada is more integrated than segmented and that the developing countries are more segmented than integrated.

Mittoo (1992) formulates and tests (via a maximum likelihood procedure on a multivariate equation system) integration in the context of two asset pricing frameworks (the CAPM and APT(with macro economic factors) and across various sub-periods. Results show that North American markets tend, over time, to become more integrated. Integration is rejected for the first sub-period and for the whole sample period, but not in the second sub-period. Results also indicate that inter-listed stocks seem to be more integrated than non inter-listed ones.

Koutoulas and Kryzanowski (1994) study the Canadian financial market integration vis-à-vis the American market using an APT framework (based on macro-economic factors) during the 1969-1988 period. In order to specify relevant risk factors, they refer to the exchange rate literature. The econometric approach used in order to test for market integration and segmentation is a SURE system with linear equations. Results show that: (i) the Canadian market is partially integrated, (ii) Canadian stock returns are influenced by a few domestic factors (such as term structure and the lagged industrial production level) and by some international factors (such as the Eurodollar rate).

Other studies are important to motivate our work, although they do not relate directly to financial market integration but rather to the Fama and French model. Indeed, the choice of the Fama and French risk factors augmented with momentum could be arguable, as always. Indeed, concerns have been expressed in the literature about the accuracy of those pricing factors (see Petkova, 2005 and Shanken and Weinstein 2006) We choose to use them nonetheless for two main reasons. The first one is to differentiate our study from the previous ones which used macroeconomics factors (see Mittoo (1992) and Koutoulas and Kryzanowski (1994)), we preferred to use financial risk factors. In the area of financial risk factors, Fama and French factors and momentum have been used frequently since the publication of Fama and French (1992). Second, to our knowledge, those factors have been scarcely used in the Canadian case. Indeed, we found only two studies using them on Canadian data: Griffin (2002) and L'her, Masmoudi and Suret (2004) . Given this relative lack of evidence on the Canadian case, our study will be able to shed some light on the matter.

Griffin (2002) tests the Fama and French factor model on several countries (including Canada) for the 1981-1995 period. He compares the performance of the international Fama and French factors versus a domestic Fama and French model. He finds that the addition of foreign factors to domestic model leads to a less accurate pricing both in and out of sample. In the present paper, we test financial market integration with both domestic and international risk factors, even though Griffin (2002) found that international factors were not useful in pricing. We do so for two major reasons. First, our objective is to test financial market integration through test of equality of the estimated coefficient on the Fama and French factors. In this context, the international factor provide a new dimension to the question. Indeed, the equality of Canadian and American risk premiums on a single international factor is a more restrictive definition of integration than the equality of the premiums attached to domestic risk factors. Second, an extension of Griffin to the Euro zone, Moerman (2005), finds that although the domestic model stills outperforms the international one, the later's performance is improving with time.

Finally, L'her, Masmoudi and Suret (2004) test the Fama and French three-factor pricing model augmented by a momentum factor on the Canadian stock market. A particular attention is given to the regularities of those risk factors at turn of the year and their behavior under different economic conditions. The estimated coefficients are found to be different from zero for the entire 1978-1996 period. They also compare these premiums qualitatively with the American risk premiums on the same factors. However, those comparisons cannot be viewed as proper statistical test. In order to achieve this result, a multivariate framework needs to be introduced.

Overall, the above studies suggest that: (i) integration is empirically upheld in post-80s samples, and is rejected prior to the 80's; (ii) a tendency toward integration is observed over time, although recent studies on this issue for the case of Canada are not prevalent and (iii) the empirical test prior 1980's are generally based in ICAPM while post 80's use multifactor macro based asset pricing model. In our view, this paper is contributing to the existing literature in many ways. First, this paper bridges the gap between the asset pricing model literature, such as Griffin (2002), and previous works on financial market integration like Mittoo (1992). The former paper concludes that Fama and French factors are domestic ones and implicitly suggests that markets are segmented with regards to those factors. Our paper tries to reconcile this finding with the fact that most studies on financial market integration finds an increasing tendency toward integration. Moreover, we want to identify which risk factors in the four factor model facilitate integration. Moreover, we believe that a disaggregate approach to the question of financial integration would improve our comprehension and help in interpreting conflicting results. Our analysis is disaggregated in three ways: First, because we test integration in time series on groups of portfolios rather than on the whole market. Second, we define and test many degrees of financial market integration. Third, we look at two statistical framework: time series, which allow a high degree of disaggregation, and cross section, which is more aggregated. Finally, we use a split sample procedure to correct the error in variable in a two-step estimation in cross section. This simple method introduced by Angrist and Kruger (2001) and Dufour and Jasiak (2001) has not yet received a lot of attention in empirical finance. We will now describe our dataset.

3 Data

In this section, we present the data used to conduct our analysis on financial market integration. We focus on the 1984-2003 period. We have opted for Fama and French factors (see Fama and French (1992) (1993)) augmented with momentum (see Carhart (1997)). Those four factors are: MKT, market factor, SMB, a factor related to size, HML, a factor related to book to market ratio and MOM, a factor related to momentum. In fact, these four factors are expected to proxy the common risk factors in asset pricing. The market factor (MKT) is a portfolio that mimics the return on the domestic market. The size of a company is related to its profitability since small firms tend to have lower earnings on assets than big firms. There seems to be a negative relation between size and average return, especially in the 80s. The SMB (small minus big) factor is the difference between the return of portfolios constituted of small firms and portfolios constituted of big firms. As for the book to market ratio, firms that have a high BE/ME ratio (a low stock price compared to its book value) tend to have low earnings. Inversely, low BE/ME firms (a high stock price relative to book value) are associated with high earnings. The HML (high minus low) factor is the differential between portfolios constituted of high BE/ME ratio and portfolios constituted of low BE/ME ratio. Finally, momentum is the differential between stocks with high past return and stocks with low past returns. While these factors were readily available for the American case through Kenneth French's web site, we had to construct them for the Canadian market. Note that all factors are taken in excess of the risk free rate. Also, we use Kenneth French's 25 portfolios as dependent variables for both countries. French's portfolios consist of American stocks sorted first by size with breaks at each 20^{th} percentile. This operation generates 5 groups sorted by size and each of them are then sorted into 5 groups with respect to book-to-market ratio with break points at each 20^{th} percentile. Given these two consecutive sorting, it provides us with a total of 25 portfolios in which the individual stocks are ranked by size and BE/ME. In the American case, portfolios were taken again from Kenneth French's web site and we formed their Canadian counterpart. Portfolios returns are in excess of the domestic risk free rate for both countries. The notation used with these portfolios refer to their ranking with respect to size and then, BE/ME. For example, portfolio M1B1 is the portfolio with the smallest 20 percentile with respect to market value with the smallest book to market ratio.

Table 1 reports descriptive statistics for all the risk factors used in this study. We report the average monthly return in excess of the risk free rate, its associated standard error and finally, the cumulative returns for all risk factors. All the descriptive data associated with the risk factors were computed for the whole sample period (1984-2003). On average, the American market factor has an higher return than the Canadian one (by 0.28% a month), with a similar variance. On an annual basis, the Canadian average excess return over the period is about 4.9% whereas the American average excess return is 8.5% for an average differential of 3.60% annually. This differential cumulates to almost 200% over the 20 years period. This is in accordance with the findings of Jorion and Goeztmann (1999) who finds that The United States market returns is substantially larger than most developed countries. The average return of the size factor in excess terms is the same in both countries with an average annual value of -4.4%. Also, the variance of the size factor is almost the same in both countries. These data show that the size risk factor is very similar in both countries. Whether or not it is priced the same way in the two economies remains to be seen. The sign of the book to market factor is the same for both countries but in a fairly different magnitude. The Canadian BE/ME risk factor average annual excess return is lower than the American BE/ME risk factor by a almost 40% and its variance is higher by 3%. Given those data, we can say that the BE/ME is very different in both countries. Moreover, the momentum factor is higher in Canada by an annual average differential of 7.2% and the variance of the Canadian momentum factor is larger than the American one by 26%. Perhaps, we can explain the higher variance in the Canadian case in the last two factors by the smaller number of firms in the Canadian market, implying a smaller degree of diversification and hence, a greater variance. Finally, the international risk factor are a value weighted combination of the two countries' excess returns. Given that about 93% of the weight is allocated to the United States, it is obvious that the later risk factors are very similar to the American risk factors.

Table 2 presents the descriptive statistics for the Fama and French 25 portfolios sorted successively by size and BE/ME ratio. Returns reported at a monthly frequency and the average size is in millions of domestic dollars. The descriptive statistics reported are computed for the 1984-2003 period. The first striking difference between the two countries is the average number of firms in each portfolios. There is a difference ranging between 800 for the smallest portfolios to about 15 in the largest portfolios. In particular, there seems to be a lot more small firms in the United States whereas Canadian size seems to be more evenly distributed. Given this result, the higher standard error on Canadian portfolios' returns is not surprising given that they are less diversified. American firms in the portfolios are larger than the Canadian one and the difference seems to be larger in the medium size portfolios. BE/ME ratios seems to be higher for Canadian firms than for their American counterparts especially for the highest percentile given the BE/ME ratios. Moreover, monthly average excess return is higher in the United States mostly due to the poor performance of the small stocks portfolios in Canada, an observation confirmed by the geometric average of the 25 average monthly excess returns being negative in the Canadian case (whereas we found a value weighted average monthly excess return on the Canadian market of about 0.4% previously). The above discussion suggests that the matching of portfolios is not perfect. Nevertheless, our design maintains the size and book-to-market distribution within each country and controls for the intrinsic differences between the two countries which allows a meaningfull comparison for our test purposes.

4 Methodology

In this section, we present our methodology. We first discuss the model and estimation strategy associated with the time series analysis in part (4.1). The methodology used in the cross section analysis is presented in section (4.2). In both approaches, we are careful to define all the integration hypotheses tested and the statistical inference methods introduced.

Table 1
Descriptive Statistic for the Risk Factors in % for the 1984-2003 period.

	ave. rtn	St. error	cum. rtn
MKT^C	0.40	4.58	103.06
MKT^U	0.68	4.59	292.07
MKT^I	0.66	4.54	279.19
SMB^C	-0.36	3.21	-99.6
SMB^U	-0.36	3.20	-63.22
SMB^I	-0.36	3.12	-70.71
HML^C	-2.93	4.14	-99.9
HML^U	-0.20	3.73	-47.59
HML^I	-0.34	3.64	-63.29
MOM^C	0.31	6.71	17.00
MOM^U	0.87	4.44	545.70
MOM^I	0.85	4.23	520.51

The first column present the average monthly returns in % for each Canadian, American and international factor. The second column is the standard error associated with the average return. The last column is the cumulative return over the 1984-2003 period for each risk factor.

4.1 The Time Series Analysis of the Four Factors Model

In the time series analysis of the four factor model, the framework adopted in this paper extends the conventional estimation. Indeed, the main feature of the estimation in time series is the joint estimation of Canadian and American coefficients. This framework is motivated by our research question. Mainly, we ask whether the Canadian and American BETAS and the average contributions associated to the four risk factors are statistically the same. Also, we want to determine the risk factors in the model that facilitate integration. In order to achieve that, we add one risk factor at the time to the market risk factor and estimate the model in each phase. In each estimation, we test our integration hypotheses in order to see if the number of non rejection of the null hypotheses of financial integration (as defined below in table 2) is increased by the addition of the new factor.

Formally, the model takes the general form of a SURE system of equation:

$$R_i^J = X^J \beta_i^J + u_i^J \tag{4.1}$$

In (4.1), R_i^J is the excess monthly return of portfolio i in country J (J= C for Canada and U for the United States). R_i^J is of dimension TN x 1, where $T = 60$, the number of observations in each sub-period and N= 10, the number of portfolios estimated in the system. X^J is risk factors' matrix of dimension TN x $10k$, where k is the the number of risk factors (including a constant) present in the model. Given our approach, k varies from 2 to 5 in the different estimation phases. β_i^J is the $10k$ x1 vector of estimated BETA coefficients. Finally, u_i^J is the error term for portfolios i in country J. The latter is correlated across portfolios and across countries.

Table 2
Descriptive statistics for the 25 Canadian and American Fama and French portfolios.

	ave # firms		ave. size (in millions)		ave. BE/ME		ave. rtn (monthly %)		std. error (monthly %)	
	CAN	US	CAN	US	CAN	US	CAN	US	CAN	US
M1B1	13	763	22,07	53,32	0,29	0,22	-0,81	-0,88	10,44	8,42
M1B2	14	446	22,98	57,82	0,71	0,48	-2,19	0,79	8,22	7,09
M1B3	14	452	22,84	55,34	1,13	0,67	-2,97	0,88	7,14	5,49
M1B4	14	524	26,17	49,66	1,78	0,90	-3,52	1,14	7,66	5,04
M1B5	14	831	22,57	35,83	18,13	1,60	-4,01	1,07	7,77	5,21
M2B1	13	226	59,99	275,13	0,26	0,21	0,58	0,30	9,06	7,62
M2B2	14	153	59,67	277,89	0,55	0,44	-0,41	0,61	7,25	5,83
M2B3	14	152	62,22	283,77	0,82	0,63	-0,97	0,92	6,31	4,85
M2B4	14	124	66,96	280,20	1,17	0,84	-1,80	0,94	6,49	4,76
M2B5	14	90	79,15	271,57	3,38	1,42	-3,22	0,88	7,22	5,32
M3B1	13	158	136,82	682,35	0,23	0,21	1,26	0,47	8,61	7,10
M3B2	14	104	145,85	692,30	0,48	0,44	0,56	0,74	7,25	5,39
M3B3	14	93	144,29	694,89	0,71	0,63	0,03	0,70	5,09	4,62
M3B4	14	75	153,50	698,06	1.06	0,87	-0,75	0,86	5,68	4,57
M3B5	14	52	175,21	715,61	2,87	1,38	-1,44	1,07	5,64	4,93
M4B1	13	117	413,75	1808,30	0,22	0,22	1,91	0,75	7,87	6,37
M4B2	14	83	436,47	1800,53	0,47	0,44	0,58	0,75	6,46	5,05
M4B3	14	70	444,21	1805,79	0,69	0,63	0,39	0,79	5,10	4,91
M4B4	13	59	451,50	1817,67	0,96	0,90	-0,35	0,91	5,35	4,38
M4B5	14	41	494,92	1797,24	3,27	1,37	-1,09	0,92	5,29	4,91
M5B1	14	118	4259,34	16817,70	0,26	0,22	1,46	0,73	7,28	5,03
M5B2	14	70	6083,19	12216,96	0,46	0,44	0,80	0,81	5,09	4,08
M5B3	14	54	5548,57	10546,42	0,62	0,64	0,53	0,74	5,23	4,49
M5B4	14	48	3745,53	8300,89	0,82	0,86	0,20	0,72	4,51	4,33
M5B5	14	31	2642,54	7983,18	1,50	1,29	-0,55	0,74	4,79	4,96

The first two columns report the average number of firms over the 1984-2003 period in each portfolio. Next, the average size and average Book-to-market ratio of a firm in each portfolio is presented. Finally the average return of the portfolio and its associated standard error are presented.

More specifically, model (4.1) is estimated a maximum likelihood SURE procedure, for 10 portfolios at the time (5 Canadians and 5 Americans). The first 20th centile portfolios according to size of each country are estimated together, then we proceed to estimate another SURE system of 10 equations using the portfolios ranked between the 20th and 40 th centile according to size and so on so fourth. In total, we estimated 5 SURE systems each containing 10 equations (5 for each countries). This approach is justified by two considerations: first, the degrees of freedom would be insufficient to estimate jointly the coefficients and variance matrix on 50 portfolios with only 60 observations. Second, we feel that a disaggregate approach is required in order to test integration in a sound manner. Indeed, the estimated BETAS coefficients are not only expected to vary across countries but also across portfolios. More precisely, we expect the estimated BETAS to vary across size. Given that, we wish to compare BETAS across countries of similar portfolios, in order to test for financial market integration. This approach implies that integration will not be tested on the whole economies together but rather on similar portfolios according to size. In this context, we perform usual Wald tests on a set of null hypotheses that are tested jointly in each system.

As mentioned above, an objective of this paper is to assess the risk factors that facilitate financial market integration. In order to do that, we will first estimate the model with a single market risk factor and a constant. Then, the other factors (size, market to book and momentum) will be progressively added to the analysis and their contribution to integration will be assessed. Table 1 reports the different combinations of risk factors that are sucessively estimated; from the single factor model to the full four factors model. Equation (4.2) is an example of the model estimated in the case of the four factors model.

$$R_{it}^J = \alpha_i^J + \beta_{MKTi}^J MKT_t^J + \beta_{SMBi}^J SMB_t^J + \beta_{HMLi}^J HML_t^J + \beta_{MOMi}^J MOM_t^J + e_{it}^J \tag{4.2}$$

where R_{it}^J is the excess return on portfolio i in country J at time t and α_i^J is the intercept in the equation which is allowed to vary across countries and portfolios. In addition, β_{MKTi}^J, β_{SMBi}^J, β_{HMLi}^J and β_{MOMi}^J are respectively the BETAS coefficients associated with the market (MKT^J), size(SMB^J), book-to-market ratio(HML^J) and momentum (MOM^J) risk factors in country J. Finally, e_{it}^J is a random shock, which is correlated across portfolios of similar size and across countries. Finally, these models are estimated both with domestic and international risk factors. The estimation of the model is done separately on domestic and international risk factors. It is worth noting that although the methodology is the same in both set of risk factors, the risk factors are the same in both countries for the international risk factors. For clarity, the notation is general and does not differentiate both cases.

4.1.1 Testing Methodology in Time Series

We now define a set of twelve hypotheses of financial integration in table 2. The first six hypotheses (those which are labelled with the AV (average contribution) superscript) refer to test on the equality of the average contribution. We consider these to measure the marginal impact of a given factor because each estimated BETA coefficient is scaled by the mean return on the risk factor over the period considered. Given that we use return, these hypotheses are the

Table 3: The models estimated in time series	
$R^J_{it} = \alpha^J_i + \beta^J_{MKTi} MKT^J_t + e^J_{it}$	$(TS1)$
$R^J_{it} = \alpha^J_i + \beta^J_{MKTi} MKT^J_t + \beta^J_{SMBi} SMB^J_t + e^J_{it}$	$(TS2)$
$R^J_{it} = \alpha^J_i + \beta^J_{MKTi} MKT^J_t + \beta^J_{SMBi} SMB^J_t + \beta^J_{HMLi} HML^J_t + e^J_{it}$	$(TS3H)$
$R^J_{it} = \alpha^J_i + \beta^J_{MKTi} MKT^J_t + \beta^J_{SMBi} SMB^J_t + \beta^J_{MOMi} MOM^J_t + e^J_{it}$	$(TS3M)$
$R^J_{it} = \alpha^J_i + \beta^J_{MKTi} MKT^J_t + \beta^J_{SMBi} SMB^J_t + \beta^J_{HMLi} HML^J_t + \beta^J_{MOMi} MOM^J_t + e^J_{it}$	$(TS4)$

Table 3 presents the different models estimated in time series. The objective is to assess whether each factor facilitate financial market integration. $(TS1)$ evaluate the traditional Capital Asset Pricing Model (CAPM) while $(TS2)$ estimates the BETA coefficients for the market and size factors. $(TS3H)$ and $(TS3M)$ estimate the model including the market and size factors augmented with respectively, the book-to-market and momentum risk factor. Finally, $(TS4)$ estimate the full four factor model. In each model, R^J_{it} is the excess return on portfolio i in country J at time t and α^J_i is the intercept of the model for portfolio i in country J. β^J_{MKTi}, β^J_{SMBi}, β^J_{HMLi} and β^J_{MOMi} are the estimated BETA coefficients of portfolio i in country J associated respectively with the market (MKT^J_t), size (SMB^J_t), book-to-market (HML^J_t) and momentum (MOM^J_t). Finally,e^J_{it} is the error term associated with the estimation of the model for portfolio i in country J.

equivalent of testing the equality of portfolios returns' elasticity to each factor. These tests allow for a comparison of the marginal impact of each factor to the portfolio return, controlled for possible differences in the magnitude of the domestic risk factors between the two countries[1]. The first four hypotheses respectively test for the equality of the average contribution of each single risk factor: market, size, book-to-market and momentum. The next hypothesis, H^{ME}_{0SUM}, tests for the equality of the sum of each risk factor's average contribution, excluding the constant term. Moreover, H^{ME}_{0joint}, tests for the joint equality across the two countries of all average contributions. The next set of hypotheses, H_{0MKT}, H_{0SMB}, H_{0HML} and H_{0MOM} respectively test the equality of each estimated BETA coefficient between Canada and the United States. Moreover, H_{0SUM} test the equality of the sum of the estimated BETAS in the same fashion as in Jorion and Schwartz (1986).Finally, H_{0joint} test the joint equality of Canadian and American BETAS, excluding the constant. Given our objectives, we designed a testing methodology and the hypotheses tested to allow for three specific considerations. First, it must be used in a multivariate framework. In this context, our tests are joint tests on all portfolios i present in the SURE system estimated. For example, a test on the equality of the market BETA is performed jointly on all Canadian and American portfolios in the same size quintile. Second, it must allow for a disaggregated measure of integration across size. This constraint is meet with the design of our SURE system presented above. Third, given that we want to assess the degree of financial integration, tests on several hypotheses are in order. In fact, the twelve hypotheses presented in table 2 reflect different degree of financial integration. This is so because some are more restrictive than others. Hypotheses that test jointly all the risk factors in the model

[1] Note that the tests on marginal effect are performed only in the domestic model. Given that the risk factors are the same in the international model, test on the BETAS are equivalent to test on marginal effects.

Table 4 :List of the null hypotheses tested in the time series analysis against their two-sided alternative.	
H_{0MKT}^{ME} :	$\beta_{MKTi}^{C}\,\overline{MKT_t^C} = \beta_{MKTi}^{U}\,\overline{MKT_t^U}, \quad \forall i$
H_{0SMB}^{ME} :	$\beta_{SMBi}^{C}\,\overline{SMB_t^C} = \beta_{SMBi}^{U}\,\overline{SMB_t^U}, \quad \forall i$
H_{0HML}^{ME} :	$\beta_{HMLi}^{C}\,\overline{HML_t^C} = \beta_{HMLi}^{U}\,\overline{HML_t^U}, \ \forall i$
H_{0MOM}^{ME} :	$\beta_{MOMi}^{C}\,\overline{MOM_t^C} = \beta_{MOMi}^{U}\,\overline{MOM_t^U}, \ \forall i$
H_{0SUM}^{ME} :	$\sum_{k=1}^{K}\beta_{ki}^{C}\,\overline{X_{kt}^C} = \sum_{k=1}^{K}\beta_{ki}^{U}\,\overline{X_{kt}^U}, \ \forall i$
H_{0joint}^{ME} :	$\beta_{ki}^{C}\,\overline{X_{kt}^C} = \beta_{ki}^{U}\,\overline{X_{kt}^U}, \quad \forall i, \ \forall k,$
H_{0MKT} :	$\beta_{MKTi}^{C} = \beta_{MKTi}^{U}, \quad \forall i$
H_{0SMB} :	$\beta_{SMBi}^{C} = \beta_{SMBi}^{U}, \quad \forall i,$
H_{0HML} :	$\beta_{HMLi}^{C} = \beta_{HMLi}^{U}, \quad \forall i,$
H_{0MOM} :	$\beta_{MOMi}^{C} = \beta_{MOMi}^{U}, \ \forall i$
H_{0SUM} :	$\sum_{k=1}^{K}\beta_{ki}^{C} = \sum_{k=1}^{K}\beta_{ki}^{U}, \ \forall i$
H_{0joint}:	$\beta_{ki}^{C} = \beta_{ki}^{U}, \quad \forall i, \ \forall k.$

Table 4 presents the list of twelve hypotheses tested in time series. H_{0MKT}^{ME}, H_{0SMB}^{ME}, H_{0HML}^{ME} and H_{0MOM}^{ME} test the equality of average contributions for each risk factor included in the model while H_{0MKT}, H_{0SMB}, H_{0HML} and H_{0MOM} test the equality of each estimated BETAS coefficient of the two countries. H_{0SUM} and H_{0SUM}^{ME} states that the sum respectively the BETAS and the average contribution are the same for both countries. We define the non rejection of the latest two hypotheses as evidence for mild financial integration. Finally, the non-rejection of the joint hypotheses of equality of the BETA and average contributions respectively H_{0joint} and H_{0joint}^{ME} is defined as evidence of strong financial integration. All 12 hypotheses are tested against their respective two sided alternative.

such as H_{0SUM}^{ME}, H_{0joint}^{ME}, H_{0SUM} and H_{0joint} are by definition easier to reject than hypotheses on a single factor because they are more restrictive. Similarly, we argue that joint hypotheses all risk factors are more restrictive hypotheses on the sum of their effect. This is so because the first ones require the simultaneous equality of all coefficients whereas the second ones only require that in total, they should have the same effect on portfolios returns. Finally, a non rejection in the domestic model implies that both countries portfolios returns are influenced by the same domestic factors whereas a non rejection in the international model implies that both countries'returns responds in the same sign and magnitude to a common North American risk factor. In this context, it is easy to see that a non rejection in the international model entails a higher degree of integration than in the domestic case. We proceed next to present the methodology for the tests in cross section.

4.2 The Cross section analysis of the Four factors Models

The approach we now describe is based on the APT framework proposed by Mittoo (1992), modified as follows, in view of our stated research objectives. First, we use an observed risk free fate (hence, we evaluate the model in excess return). Moreover, the risk factors used are financial rather than macroeconomic. Given the latter modification, we are also led to adjusting the definition of the integration hypotheses tested. Whereas Mittoo (1992) tests the joint equality of the risk premiums [which makes sense given macro-economic factors], we will test a wide range of hypotheses, equivalent to the ones presented in the previous section on time series. Furthermore, we introduce an alternative approach to deal with the non-observability of the BETAS. Let us first review the theoretical APT model presented in Mittoo (1992).

The APT theory assumes that several risk factors intervene in the evaluation of an asset. The basic APT model is the following:

(4.3) $$R_{it} = E_{it} + \sum_{k=1}^{s} \beta_{ik}\delta_{kt} + u_{it}$$

where R_{it} and E_{it} represent respectively the actual and expected return of asset i at time t; δ_{kt} is the kth risk factor at time t; β_{ik} is the sensitivity of asset i to risk factor k and finally, u_{it} is the error term at time t, which is often assumed to be normal with mean zero. In order to test integration within the latter model, similar portfolios from Canada and United States will be evaluated. If markets are integrated, it implies that similar assets respond in a similar way (in the same magnitude) to the same risk factors.

If there are no arbitrage possibilities, the expected return of an asset can be written as a linear function of the risk factors sensitivities:

(4.4) $$E_{it} = R_{Ft} + \sum_{k=1}^{s} \lambda_k \beta_{ik}$$

where R_{Ft} is a scalar representing the risk free rate at time t; λ_k is the risk premium associated with risk factor k and β_{ik} (as defined above) is the sensitivity of asset i to risk factor k.

Combining equations (4.3) and (4.4) will generate the empirical model of interest:

(4.5) $$R^J_{it} = R^J_{Ft} + \sum_{k=1}^{s} \lambda^J_k \beta^J_{ik} + e^J_{it}, \quad i = 1, ..., n, \quad t = 1, ..., T$$

with an error term :

(4.6) $$e^J_{it} = \sum_{k=1}^{s} \beta_{ik}\delta_{kt} + u_{it}$$

where J =(C) , (U) refers respectively to Canada and United States; in other words, the return of asset i [Canadian or American] at time t is the scalar R^J_{it}, the risk free rate [Canadian or American] is the scalar R^J_{Ft} , λ^J_k is the risk premium (sensitivity of the BETA) for the k^{th} risk factor [Canadian or American], β^J_{ik} represents the sensibility of asset i [Canadian or American] to factor k at time t. The composition of the error term reflects the fact that factors are not observable. Moreover, the American dollar is always used as a numeraire.

The empirical problem with this model is that the "BETAS" are not observable but estimated with error. Typically in this case, it is necessary to adopt a two steps procedure: (1) estimate the assets sensibility to the risk factor (the "BETAS"), and (2) evaluate the risk premium associated to each risk factor. The BETAS are obtained by regressing the assets return on the risk factor without a constant term (a standard multivariate regression). Then, the risk premiums are estimated by a maximum likelihood procedure on the following SURE system of equations:

$$
\begin{aligned}
\overline{R_i^C} &= \alpha^C + \textstyle\sum_{k=1}^{s} \widehat{\beta}_{ik}^{C} \lambda_k^C + \upsilon_i^C, \\
\overline{R_i^U} &= \alpha^U + \textstyle\sum_{k=1}^{s} \widehat{\beta}_{ik}^{U} \lambda_k^U + \upsilon_i^U.
\end{aligned} \tag{4.7}
$$

where $\overline{R_i^C}$ and $\overline{R_i^U}$ are the sample mean excess return of portfolio i $[i = 1, ..., n]$ over the period of estimation.

As we outline in the review of the literature, it is a major problem encountered in a two pass estimation. Indeed, pre-estimating the BETAS leads to contemporaneous correlation between the regressors and its error terms in the second pass, since the same sample is used to evaluate the parameters in both steps (the sensitivities and risk premiums). Given the seriousness of this econometric issue, different methodologies have been proposed to correct the error on variable. For example, Mittoo (1992) used the same sample of observation in both steps but the pre-estimation of the BETAS is accounted for with an adjusted Hotelling test statistic (see Shanken (1985)). A contribution of the present paper is to propose an alternative correction for the error in variables. In order to bypass this problem, the econometric method that will be used here is the "split sample".

The split sample methodology was recently introduced in econometrics for a different (although related) test problem involving error-in-variables (see Angrist and Kruger (2001), Dufour and Jasiak (2001) and Dufour (2003)).[2] The intuition for this method as it applies to the present problem is to use one part of the available sample to estimate the BETAS and the remaining part to evaluate the risk premium. It is usually recommended to save a larger sample for the second pass.

In this paper, we tested different sample splits . First, we will follow Gultekin, Gultekin and Penati (1989), and split the sample in two time consecutive parts: the first sub-sample is used to estimate the BETAS and the second one to evaluate the risk premium. Two breakpoints will be tested; 30% and 40% of the sample used for BETAS and the 70% and 60% for the risk premium. However, a problem with this approach is that BETAS are likely to change over time. Then, it is possible that BETAS estimated in the 1984-1989 sample period are not representative of the BETAS in 2000. We thus consider an alternative split sample, using the observations of March, June, September and December of each year to estimate BETAS and the remaining months to estimate risk premiums. Finally, the last type of split sample we consider is to use the months of April, August and December of each year to estimate BETAS and the remaining months to estimate risk premiums. Given that we found no difference in the results using different splits, only one will be reported where 40% of the sample is used for the BETAS and 60% for the risk

[2] Formal proofs of its validity in a two-stage procedure involves the case where the fitted values of the first stage regression are used in the second stage; here, the second pass uses the estimated parameters (rather than the fitted values) from the first pass.

Table 5: The models estimated in cross section	
$\overline{R_i^J} = \alpha^J + \lambda_{MKT}^J \widehat{\beta}_{iMKT}^J + \upsilon_i^J$	$(CS1)$
$\overline{R_i^J} = \alpha^J + \lambda_{MKT}^J \widehat{\beta}_{iMKT}^J + \lambda_{SMB}^J \widehat{\beta}_{iSMB}^J + \upsilon_i^J$	$(CS2)$
$\overline{R_i^J} = \alpha^J + \lambda_{MKT}^J \widehat{\beta}_{iMKT}^J + \lambda_{SMB}^J \widehat{\beta}_{iSMB}^J + \lambda_{HML}^J \widehat{\beta}_{iHML}^J + \upsilon_i^J$	$(CS3H)$
$\overline{R_i^J} = \alpha^J + \lambda_{MKT}^J \widehat{\beta}_{iMKT}^J + \lambda_{SMB}^J \widehat{\beta}_{iSMB}^J + \lambda_{MOM}^J \widehat{\beta}_{iMOM}^J + \upsilon_i^J$	$(CS3M)$
$\overline{R_i^J} = \alpha^J + \lambda_{MKT}^J \widehat{\beta}_{iMKT}^J + \lambda_{SMB}^J \widehat{\beta}_{iSMB}^J + \lambda_{HML}^J \widehat{\beta}_{iHML}^J + \lambda_{MOM}^J \widehat{\beta}_{iMOM}^J + \upsilon_i^J$	$(CS4)$

Table 5 presents the different models estimated in cross section. $(CS1)$ evaluate the Capital Asset Pricing Model (CAPM) while $(CS2)$ estimates the model using market and size. $(CS3H)$ and $(CS3M)$ estimate the model including the market and size factors augmented with respectively, the book-to-market and momentum risk factor. Finally, $(CS4)$ estimate the full four factors model. In each model, $\overline{R_i^J}$ is the mean excess return on portfolio i in country J and α^J is the intercept of the model in country J. λ_{MKT}^J, λ_{SMB}^J, λ_{HML}^J and λ_{MOM}^J are the estimated risk premium coefficients for country J associated respectively with the pre-estimated BETA on each portfolio i of the market $(\widehat{\beta}_{iMKT}^J)$, size $(\widehat{\beta}_{iSMB}^J)$, book-to-market $(\widehat{\beta}_{iHML}^J)$ and momentum $(\widehat{\beta}_{iMOM}^J)$. Finally, υ_i^J is the error term associated with the estimation of the model for portfolio i in country J.

premiums.

Furthermore, as in time series, we want to determine the factor that facilitate financial integration between the two countries. In order to achieve this objective, the cross section methodology will be estimated on several model presented in table 5. First, we estimate the model and test integration using only the market risk factor. Then, we introduce the other risk factors in the same fashion as in time series. Finally, the cross section estimation is also performed on sets of domestic and international risk factors. Both estimations are done separately and use the same methodology described above. We now present the hypotheses tested in cross section.

4.2.1 Testing methodology in Cross section

In this section, we present the hypotheses tested in cross section. Compared to the first approach, this two-pass approach differs subtly from the one-pass case. First, the integration hypotheses are defined in terms of the λs rather than the βs. These coefficients capture different although related effects. Indeed, tests on the βs examine the sensibility of a given portfolio to the variation in a risk factors whereas tests on the λs examine the impact on the mean excess return of a portfolio i $(\overline{R_i^J})$ of a change in these BETAS. Also, the estimation of the sensibilities of the BETAS are done in a two equation system, one for each country, implying a single estimated λ_k coefficient for each country. Given that feature, the cross section analysis is a much more aggregated approach than the time series methodology. Our intention here is not to compare both method but rather to complement our time disaggregate time series analysis with the results in cross section. Table 3 reports the hypotheses tested in cross section. Again, the first six hypotheses presented test the equality of Canadian and American average contribution of

Table 6 : List of the null hypotheses tested in cross section against their two-sided alternative.	
H_{0MKTC}^{ME} :	$\lambda_{MKT}^{C}\ \overline{\beta_{MKTi}^{C}} = \lambda_{MKT}^{U}\ \overline{\beta_{MKTi}^{U}}$
H_{0SMBC}^{ME} :	$\lambda_{SMB}^{C}\ \overline{\beta_{SMBi}^{C}} = \lambda_{SMB}^{U}\ \overline{\beta_{SMBi}^{U}}$
H_{0HMLC}^{ME} :	$\lambda_{HML}^{C}\ \overline{\beta_{HMLi}^{C}} = \lambda_{HML}^{U}\ \overline{\beta_{HMLi}^{U}}$
H_{0MOMC}^{ME} :	$\lambda_{MOM}^{C}\ \overline{\beta_{MOMi}^{C}} = \lambda_{MOMi}^{U}\ \overline{\beta_{MOMi}^{U}}$
H_{0SUMC}^{ME} :	$\sum_{k=1}^{K} \lambda_{k}^{C}\ \overline{\beta_{ki}^{C}} = \sum_{k=1}^{K} \lambda_{k}^{U}\ \overline{\beta_{ki}^{U}}$
$H_{0JOINTC}^{ME}$:	$\lambda_{k}^{C}\ \overline{\beta_{ki}^{C}} = \lambda_{k}^{U}\ \overline{\beta_{ki}^{U}}, \forall k$
H_{0MKTC} :	$\lambda_{MKT}^{C} = \lambda_{MKT}^{U}$
H_{0SMBC} :	$\lambda_{SMB}^{C} = \lambda_{SMB}^{U}$
H_{0HMLC} :	$\lambda_{HML}^{C} = \lambda_{HML}^{U}$
H_{0MOMC} :	$\lambda_{MOM}^{C} = \lambda_{MOM}^{U}$
H_{0SUMC} :	$\sum_{k=1}^{K} \lambda_{k}^{C} = \sum_{k=1}^{K} \lambda_{k}^{U}$
$H_{0JOINTC}$:	$\lambda_{k}^{C} = \lambda_{k}^{U}, \forall k$

Table 6 presents the list of twelve hypotheses tested in cross section. H_{0MKTC}^{ME}, H_{0SMBC}^{ME}, H_{0HMLC}^{ME} and H_{0MOMC}^{ME} test the equality of average contributions for each risk factor included in the model while H_{0MKTC}, H_{0SMBC}, H_{0HMLC} and H_{0MOMC} test the equality of each estimated BETAS coefficient of the two countries. H_{0SUMC} and H_{0SUMC}^{ME} states that the sum respectively the BETAS and the average contribution are the same for both countries. We define the non rejection of the latest two hypotheses as evidence for mild financial integration. Finally, the non-rejection of the joint hypotheses of equality of the BETA and average contributions respectively $H_{0JOINTC}$ and $H_{0JOINTC}^{ME}$ is defined as evidence of strong financial integration. All 12 hypotheses are tested against their respective two sided alternative. Finally, to differentiate the notation between the hypotheses tested in time series an those in cross section, a subscript $_C$ was added in cross section.

the risk premiums, given that each λ_k is scale by the average β_{ki} over all 25 portfolios of each country. The remaining six hypotheses test the equality of the risk premiums. As explained in (4.1.1), we believe that the non rejection of those hypotheses of financial integration implies a different degree of integration. The next section will present the results for both the time series and cross sectional approaches.

5 Results

In this section, we present the results of our analysis on market integration in North America. This section is divided in two: Section 5.1 presents results for the time series analysis whereas Section 5.2 presents results for the cross sectional study. Both sections report results for the domestic factor model and the international factor.

5.1 Results for the time series analysis

5.1.1 The domestic factors

First, we report results on the time series analysis performed on the domestic Fama and French factors. Results are obtained by estimating (4.1) in a SURE system. As mentioned above, we estimate the coefficients on the risk factors for 5 portfolios with similar size in each country. Figure 1 to 4 present comparisons of the average estimated coefficients for the five portfolios in each sub-period. Coefficients are presented in this fashion for brevity given the high number of coefficients estimated. Although they do not constitute a proper statistical hypothesis testing, these graphs are informative for our purpose of assessing the degree of financial integration. First, we see that the sensibility to the market factor is similar in both countries as across different portfolios. There seems to be a drop in the American sensibility to the market factor in the last sub-period whereas it is not the case for Canada. The sensibilities associated with the size factor seem to be also similar across the two countries but they decrease as the size of the firm increases. Indeed, the sensibilities to the size risk factor are negative for the largest firms. It is not however unexpected given the way the risk factor is constructed. In fact, it is the difference between the excess return of small firm minus big firms. As this differential becomes more negative, it implies either that the excess returns of large firms become larger or that the excess return of small firm becomes smaller. Figure 2 shows signs of both effects given the large positive sensibility of small firm portfolios and the small but negative sensibility of large firm portfolios. Finally, figures supports our disaggregate approach. Given that the sensibilities of the risk factors (more particularly the size factor) varies greatly across portfolios, the single estimation of one sensibility to each risk factor per country (such as in L'her Masmoudi and Suret 2004 for example) could be misleading.[3] The sensibilities on HML and Momentum appear to be different across the two countries. In addition, sensibilities to the book-to-market risk factor increases over time, although the Canadian tendency is not as strong. Canadian momentum sensibility varies a lot with respect to the portfolios' size and the sub period. Momentum sensibility is not very large. In order to assess the significativity of each risk factor, we performed a joint significativity test on all five portfolios of a given country in each system of equations for each risk factor. Results show that market, size and book to market were significant at the 5% level for all portfolios in every sub period. Momentum however, was not always as significant, especially in the Canadian case. In fact, Canadian momentum's BETAS were not jointly significant in 14 cases out of the 20 tests done. In the American case, momentum was not significant in 7 out of the 20 tests performed. Even though these results are raising doubts regarding the inclusion of the momentum factor in the model, we decided to keep the factor in the model because it was significant in individual portfolios cases and because it was significant on a joint test on each countries' 25 portfolios. Overall, figures suggest that the coefficients vary across countries, size and through time leading us to three conclusions: 1) a formal setting of hypothesis testing is needed to assess the equality of risk factors, 2) a single constrained estimate of a country' sensibility to a risk factor appear to be inappropriate and 3) given that the BETAS vary through time, an analysis in sub-period is required.

[3] Indeed, the constraint that all Canadian (or American) portfolios have the same sensibility to the risk factors was strongly rejected.

We now present the results for the hypothesis testing in time series. We tested four hypothesis of integration; two mild ones, H_{0SUM} and H_{0SUM}^{ME}, and two more constraining ones H_{0JOINT} and H_{0JOINT}^{ME}. Moreover, we performed equality tests on each factor's average contribution separately with hypotheses H_{0MKT}^{ME}, H_{0SMB}^{ME}, H_{0HML}^{ME} and H_{0MOM}^{ME}. Finally, we test the equality of each estimated BETA coefficients with hypotheses H_{0MKT}, H_{0SMB}, H_{0HML} and H_{0MOM} to be able to assess each factor's contribution to integration/segmentation. Results are presented in tables 7, 8, 9, 10 and 11. Those tables list the system of equations for which the hypotheses were not rejected at a 5% confidence level in a given sub period, hence suggesting financial integration[4]. Regarding the four factor model, results presented in table 11 show that the equality of market and size coefficients factor hold in 70% of the case (14/20) while the book-to-market coefficients were equal in only 40% of the case and momentum's coefficients showed a 60% non rejection rate. Given that the literature on financial integration based on the CAPM tend to conclude to financial market integration in North America, the first result was expected. The equality of the average contribution for individual factor and the overall model was widely rejected, except for the momentum risk factor, where the average contributions of Canadian and American momentum were equal in 80% of the test. As for the integration test (H_{0SUM}) and (H_{0JOINT}), they were not rejected in the four factor model in respectively 50% and 25% of the case studied. These results might be lower than we expected and suggest partial segmentation but they are in line with the literature using APT macroeconomic factors. Table 11 also show that integration does not seems to increase with time, given that the total number of non rejection decrease in each sub period. Finally, another interesting result of table 14 is that financial market integration seems higher in the smaller portfolios. Indeed, table 14 show that the number of non rejection decreases as the size of portfolios in the system increase. Those last two finding were quite unexpected. Indeed, Mittoo (1992) and Koutalas and Kryzanowski (1994) found in increasing tendency toward integration. We believe the difference is due to the fact that we are looking at a more recent sample, which includes several important shocks such as the tech bubble and 9/11. As for the size being inversely related to financial market integration, we find it hard to explain. Perhaps, it show that small stocks are more exposed to the North American economic conditions while larger stocks are more subject to international risk.

The simultaneous analysis of Table 7, 8 ,9, 10 and 11 show what happens when factors are added to the analysis. As mentioned above, the market risk factor seems to facilitate financial integration, given the equality of its coefficients is not rejected in more than 70% of the case. Size also seem to facilitate integration given that its equality is non rejected in 70% of the case but to a lesser extend than the market risk factor, given that the equality of the market factor decreases with the introduction of size (from TS1 to TS2). Book to market does not seem to facilitate integration, given that its introduction decreases the number of non rejection for the joint hypothesis (from TS2 to TS3H and from TS3M to TS4) and momentum (from TS3M to TS4) and leave unchanged the number of non rejection of H_{0SUM}. Also, the equality of the book-to-market coefficient is rejected in the four factor model in 60% of the case. Finally, momentum seems to facilitate integration, given that its introduction increases the number of

[4] The results presented are synthethised for brevity. Although the exact p-values are not reported, they are available upon request.

non rejection of the joint equality (from TS2 to TS3M) and H_{0SUM} (from TS2 to TS3M and from TS3H to TS4) and because the equality of its coefficient is not rejected in 60% of the case.

Overall, we draw the following conclusions from the time series analysis with domestic factors: 1) results tend toward financial market integration when tests are performed on the market factor only but toward partial segmentation when other factor and joint tests are included. This finding is in accordance with the previous literature review. 2) There does not seem to be a greater tendency toward integration through time. This is mainly due to our last sub period, 1999- 2003, in which stock markets were subject to numerous important shocks. 3) Small stocks show greater sign of integration than the bigger ones. However, it is always possible that this results is specific to our sample data. 4) Market, size and momentum are factors that facilitate integration while book to market does not. Finally, we found that in most case, the equality of average contribution was rejected, even though the equality of the estimated coefficients was not. Perhaps this finding reflects the difference in the two countries risk factors that were highlighted in Table 1. We now present the results for the time series analysis with international risk factors.

5.1.2 International risk factors

We now turn to the results of the time series analysis estimated with international Fama and French factors. The international factors are obtained by computing the weighted average of both countries' excess return. Figures 5, 6, 7 and 8 present the average of the estimated coefficients for all systems of equations. Table 9 presents the joint significativity tests on each SURE system for the international risk factor. In graph 5, we see that the average coefficients on the international market factor is larger is the United States than in Canada. P-values for the joint significativity tests on the international market factor are still significant at 5%. Also, the international size risk factor is significant for most portfolios and sub period except for the largest size portfolios in Canada where joint significance is rejected for three sub-periods. Also, it seems to show the same decreasing trend as size increases as observed with the domestic factor. Finally, the Canadian average coefficients are much larger than the American ones in the first sub-period. The book-to-market international risk factor has lost significance in Canada compared to the domestic one because some estimates are not jointly significant anymore. Moreover, estimates are larger in Canada then in the United States. Finally, the momentum factor is still not jointly significant in many cases, especially in Canada and again, estimates have a larger magnitude in Canada. Overall, we find that the significance of the international risk factors is lower then the domestic risk factor especially for book-to-market in Canada and momentum in both countries. This results is in accordance with Griffin (2002). The fact that both countries do not seem sensible to the international momentum factor is not necessarily bad new for financial market integration as defined in this paper because both countries seem to be reacting in the same way but it is obviously less informative.

Results for the hypothesis testing are presented in tables 12, 13, 14, 15 and 16. First, in the four factor model, the level of non rejection for the equality of the market risk factor has decreased by 35% in the international model. This is an evidence for partial segmentation given that in an highly integrated economy the risk factor would have the same effect in both countries. Also, figures 1and 5 show that Canadian coefficients are smaller on average for the international risk factor than the domestic one. Given that the international factors are very

Figure 1: CAN/US Comparison in sub-periods of the average estimated coefficients of the domestic market risk factor

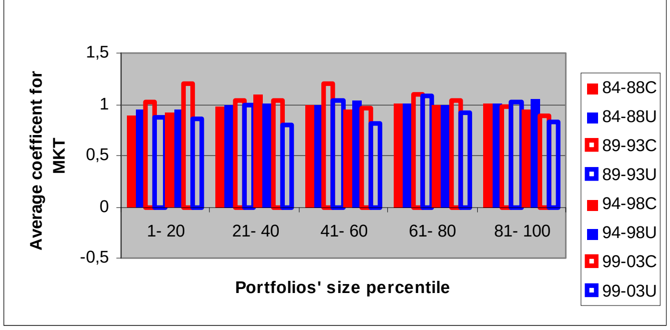


Figure 2: CAN/US comparison in sub-periods of the average estimated coefficients of the domestic size risk factor

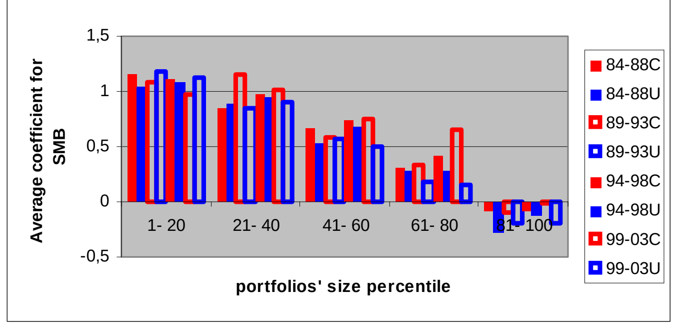


Figure 3: CAN/US Comparison in sub-periods of the average estimated coefficients of the domestic book-to-market risk factor

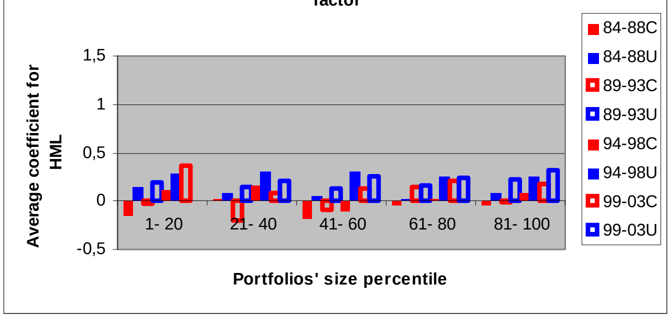
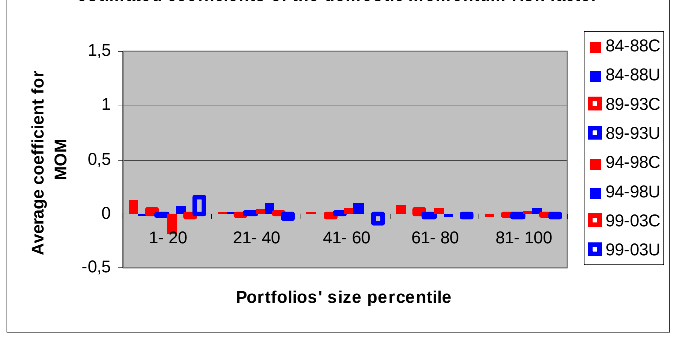


Figure 4: CAN/US Comparison in sub-periods of the average estimated coefficients of the domestic momentum risk factor



Figures 1 to 4 presents the average estimated BETA coefficients for respectively the market, size, book-to-market and momentum domestic risk factors. Results are reported for each group of portfolios sorted by size with break points at 20^{th} percentile. The grey bars represent the Canadian average Beta while the black bars represent the American ones. Finally, the four sub periods studied are represented for each group: the 1984-1988 and 1994-1998 sub periods are depicted with full bars while the 1989-1993 and 1999-2003 sub-periods are depicted with outlined bars.

Table 7

Results for the single factor model in time series (TS1).Results report the number of non rejection for each hypothesis tested in the four sub-periods considered

Hypotheses	1984-1988	1989-1993	1994-1998	1999-2003	total (/20)
H_{0MKT}^{ME}	-	-	-	-	0
H_{0MKT}	3, 4	1, 2, 3, 4, 5	4, 5	1, 2, 3, 4, 5	14
Total (/10)	2	5	2	5	14/40

Table 8
Results for the two factor model in time series (TS2). Results report the number of non rejection for each hypothesis tested in the four sub-periods considered

Hypotheses	1984-1988	1989-1993	1994-1998	1999-2003	total (/20)
H_{0MKT}^{ME}	-	-	-	-	0
H_{0SMB}^{ME}	4	5	-	-	2
H_{0SUM}^{ME}	-	-	-	-	0
H_{0joint}^{ME}	-	-	-	-	0
sub-total (/20)	1	1	0	0	2/80
H_{0MKT}	1, 2, 3, 4	1, 2, 3, 4, 5	1, 3, 5	1, 2, 3, 4, 5	17
H_{0SMB}	1, 2, 4	1, 3, 4, 5	1	-	8
H_{0SUM}	1	1, 3	-	-	3
H_{0joint}	1, 2, 4	1, 3, 4, 5	1	-	8
sub-total (/25)	11	15	5	5	36/80
Total (/50)	12	16	5	5	38/160

Table 9
Results for the three factor model with book-to-market in time series (TS3H). Results report the number of non rejection for each hypothesis tested in the four sub-periods considered

Hypotheses	1984-1988	1989-1993	1994-1998	1999-2003	total (/20)
H_{0MKT}^{ME}	-	-	-	-	0
H_{0SMB}^{ME}	4	-	-	5	2
H_{0HML}^{ME}	1, 2,4	2, 3, 4	1	2	9
H_{0SUM}^{ME}	4	-	-	-	0
H_{0joint}^{ME}	-	-	-	-	0
sub-total (/25)	5	3	1	2	11/100
H_{0MKT}	1, 2,3 4, 5	1, 2, 3 4, 5	1, 3, 4	3, 4, 5	16
H_{0SMB}	1, 2, 3, 4	1, 3, 4	1, 2, 3, 4	2	12
H_{0HML}	2, 4	1, 4	1, 2	2, 3, 4	9
H_{0SUM}	3, 5	1, 3	1, 2	2	7
H_{0joint}	1, 2, 4	1	1	-	5
sub-total (/25)	16	13	12	8	49/100
Total (/50)	21	16	13	10	60/200

Table 10
Results for the three factor model with momentum in time series (TS3M). Results report the number of non rejection for each hypothesis tested in the four sub-periods considered

Hypotheses	1984-1988	1989-1993	1994-1998	1999-2003	total (/20)
H_{0MKT}^{ME}	-	-	-	-	0
H_{0SMB}^{ME}	4	-	-	5	2
H_{0MOM}^{ME}	1, 2,3, 4, 5	1, 2,3, 4, 5	1, 2,3	2, 4, 5	16
H_{0SUM}^{ME}	-	-	-	-	0
H_{0joint}^{ME}	-	-	-	-	0
sub-total (/25)	6	5	3	4	18/100
H_{0MKT}	1, 2,3, 4, 5	1, 2,3, 4	1, 3, 4, 5	1, 3, 4, 5	17
H_{0SMB}	1, 2, 4	1, 3, 4, 5	1	1	9
H_{0MOM}	2, 3, 4,5	1, 2,3, 4, 5	1, 2, 3	2, 4	14
H_{0SUM}	2, 4	1, 3, 4	-	-	5
H_{0joint}	1, 2, 3, 4	1, 3,4 ,5	1, 3	-	10
sub-total (/25)	18	20	10	7	55/100
Total (/50)	24	25	13	11	73/200

close to the American risk factor, this shows that Canadian portfolios are more influenced by domestic conditions than the situation in the United States. The remaining results are pointing in opposite directions: the level of non rejection of equality of coefficients between Canada and the United States has increased for book-to-market, momentum and the sum of the coefficients compared to the domestic model, but it has remained almost constant for the size factor and the joint hypothesis. The lack of significativity in the international book-to-market and momentum factors weakens the evidence for financial integration because most of the non rejection in those two cases are due to the fact that both estimates are not significant and therefore both equal to zero. While it does not imply segmentation, the fact that both countries are not sensible to a risk factor is not a very strong argument for financial integration. Finally, results for the four factor model with international risk factor show an increasing tendency toward integration. The total number of non rejection is increasing with time, especially in the third sub period where it reaches 23.3% of the case considered.

The simultaneous analysis of tables 13 to 16 suggests that the international market factor is at least partially segmented, given that the number of non rejection is never greater than 55% of the case. Also, the international size factor does not facilitate integration as much as the domestic ones, given that the total number of non rejection is the lowest with 45% when size is added (TS2). Finally, international book to market and international momentum seem to facilitate integration, especially when they are added together (TS4). In fact, when both are present in the equation it increase the number of non rejection for the market and size (from TS2 to TS4) as well as the total percentage of non rejection that increases by 17,5 % (from 45% in TS2 to 62,5% in TS4). Again, those findings toward integration must be tempered with the possible non significativity of those factors. In general, the analysis in time series with international factors show a lesser degree of integration than the domestic ones. Given that

Table 11

Results for the four factor model in time series (TS4). Results report the number of non rejection for each hypothesis tested in the four sub-periods considered

Hypotheses	1984-1988	1989-1993	1994-1998	1999-2003	total (/20)
H_{0MKT}^{ME}	-	-	-	-	0
H_{0SMB}^{ME}	4	-	-	-	1
H_{0HML}^{ME}	1, 2, 4	1, 3, 4	1, 2, 4, 5	2	11
H_{0MOM}^{ME}	1, 2,3 4,5	1, 2,3 4, 5	2, 3, 4 ,5	2	15
H_{0SUM}^{ME}	4	-	-	-	1
H_{0joint}^{ME}	-	-	-	-	0
sub-total (/30)	10	8	8	2	28/120
H_{0MKT}	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2,3,4	3, 4, 5	14
H_{0SMB}	1, 2, 3, 4	1, 3, 4	1, 2, 3, 4, 5	1, 2	14
H_{0HML}	1, 2, 4	1, 4	1	2, 3, 4	8
H_{0MOM}	1, 2	1, 2, 3	2, 3, 5	1, 2, 4, 5	12
H_{0SUM}	2, 3, 5	1, 3	1, 2	1, 2, 3	10
H_{0joint}	1, 2	1, 3	1	-	5
sub-total (/30)	18	17	16	15	61/120
Total (/60)	28	25	24	17	89/240

Tables 7, 8, 9, 10 and 11 respectively report the non rejection of the hypotheses tested the estimated coefficients for domestic risk factors in model TS1, TS2, TS3H, TS3M and TS4. A non rejection of the hypothesis is defined as a p-value greater than 5%. Each model was estimated in 5 different SURE system of equations which contained 5 portfolios of each countries. Portfolios were rank according to size and the break points were the 20^{th} percentile. In the columns, the numbers refer to the group portfolios estimated for which a given hypothesis had a p-value greater than 5%: 1 being the first 20 percentile and 5 being the last 20 percentile according to size.

the hypotheses tested in the international model entail a higher degree of integration because they are more restrictive, it is not surprising. It does however suggest that the use of domestic factor are more appropriate than international ones.

In conclusion, the time series analysis show that, while there are disparities across countries in the influence of the Fama and French factors suggesting partial segmentation, there are also considerable difference in their influence across portfolios. Indeed, the estimated coefficients were different across size and varied in time. These findings justify a disaggregate approach to financial market integration and the use of sub-periods. Moreover, domestic factors seem to perform better than the international ones, a result in line with the findings in Griffin (2002). While we find that the domestic market, size and momentum facilitate financial market integration, we also find that the domestic book-to-market and the international market and size do not. The evidence for the international book-to-market and momentum is that they facilitate integration but it is weaken by the low significativy of those risk factors. We now turn to the analysis in cross section.

5.2 Results for the Cross Section Analysis analysis

We now present our results for the cross sectional analysis. In both domestic and international models, results were obtained using a two pass estimation method. The first pass consists in estimating the BETA coefficients for each portfolios using a country per country multivariate system of equations. The second pass estimates the country risk premium associated with those BETAS using a SURE model with one equation for each country. In the second pass, the average excess returns of each portfolios were regressed on their BETAS in order to get risk premium estimates. In order to avoid the error-in-variable problem discussed above, a split sample procedure was introduced. We used the first 40% of the data in each sub period in order to estimate the BETAS in the first pass and the remaining 60% of the data to estimated the risk premium. It is worth noting that many split sample procedure were tried, each with different cut off points. In order to control for the possibility of time-varying BETAS within a sub-period, we used certain months in the first pass and the remaining ones in the second pass. However, our results were robust to the split sample procedure and only the split procedure described above is presented. This suggests that although the BETAS vary across sub-periods of five years (as demonstrated in the time series analysis), they are stable within sub period itself. We first present the results with the domestic risk factors.

5.2.1 The domestic factors

Results for the two pass cross section analysis with domestic risk factors are presented in tables 18 and 19. Technically, the figures reported in Table 18 are the sensibilities of the mean return in one country to a change in the value of the BETAS estimated. In other words, these estimates reflect how a country's stock market reacts to a change in sensibility (BETA) for a given factor. First, we see that the market risk premium is often not significant, which was also the conclusion reached in Fama and French (1992) cross sectional study. The slightly more surprising fact is that size, book to market and momentum are not significant in the first two sub periods. However, factor's significance increases in the last two sub period. At first glance, we see obvious sign differences between Canada and the United States for the market,

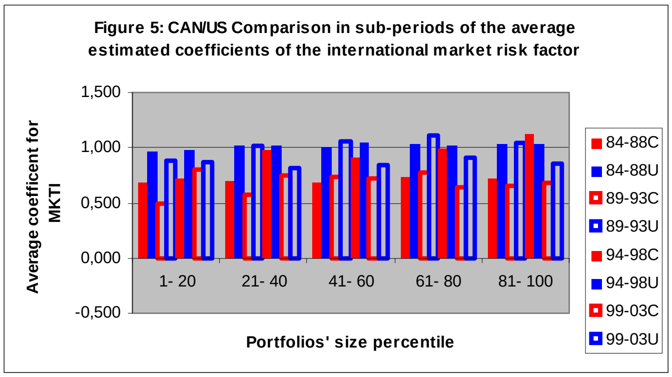


Figure 5: CAN/US Comparison in sub-periods of the average estimated coefficients of the international market risk factor

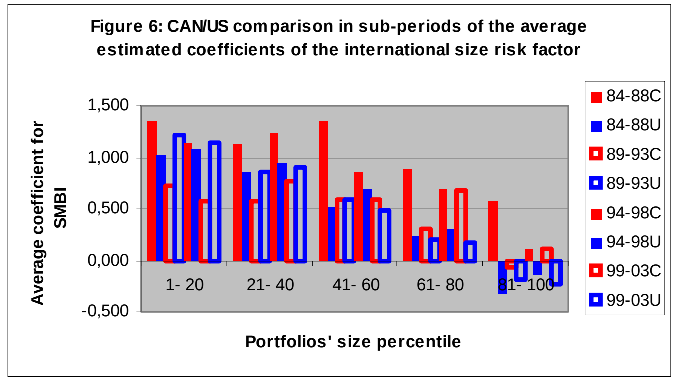


Figure 6: CAN/US comparison in sub-periods of the average estimated coefficients of the international size risk factor

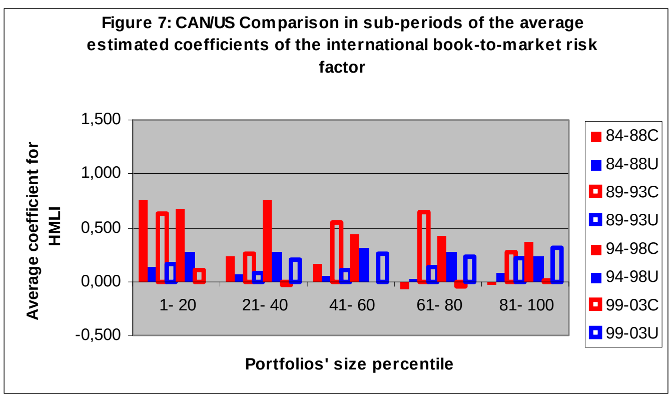


Figure 7: CAN/US Comparison in sub-periods of the average estimated coefficients of the international book-to-market risk factor

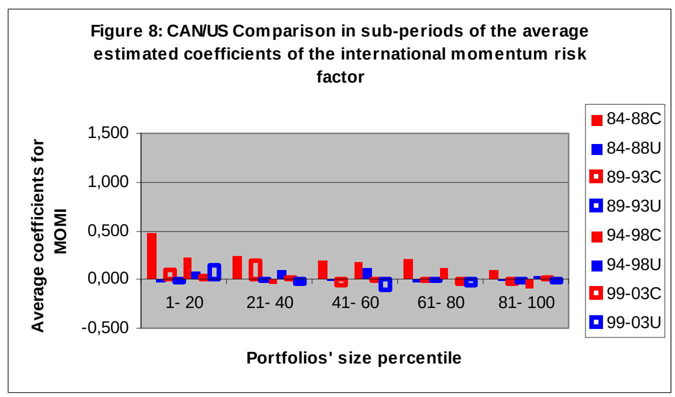


Figure 8: CAN/US Comparison in sub-periods of the average estimated coefficients of the international momentum risk factor

Figures 5 to 8 present the average estimated BETA coefficients for respectively the market, size, book-to-market and momentum international risk factors. Results are reported for each group of portfolios sorted by size with break points at 20^{th} percentile. The grey bars represent the Canadian average Beta while the black bars represent the American ones. Finally, the four sub periods studied are represented for each group: the 1984-1988 and 1994-1998 sub periods are depicted with full bars while the 1989-1993 and 1999-2003 sub-periods are depicted with outlined bars.

Table 12
Results from the joint tests of significativity of the estimated 5 coefficients for each international risk factors in the two countries for each SURE system estimated. Reported below are the p-values of the tests.

1-20	MKTI		SMBI		HMLI		MOMI	
	CAN	US	CAN	US	CAN	US	CAN	US
84-88	.000	.000	.000	.000	.049	.000	.281	.000
89-93	.081	.000	.136	.000	.086	.000	.008	.503
94-98	.004	.000	.002	.000	.023	.000	.237	.036
99-03	.000	.000	.014	.000	.150	.000	.682	.064
21-40	MKTI		SMBI		HMLI		MOMI	
	CAN	US	CAN	US	CAN	US	CAN	US
84-88	.000	.000	.000	.000	.112	.000	.037	.040
89-93	.000	.000	.032	.000	.000	.000	.067	.151
94-98	.000	.000	.000	.000	.050	.000	.205	.000
99-03	.000	.000	.000	.000	.055	.000	.090	.516
41-60	MKTI		SMBI		HMLI		MOMI	
	CAN	US	CAN	US	CAN	US	CAN	US
84-88	.000	.000	.000	.000	.140	.000	.207	.004
89-93	.000	.000	.011	.000	.050	.000	.887	.964
94-98	.000	.000	.000	.000	.114	.000	.181	.001
99-03	.000	.000	.000	.000	.000	.000	.658	.188
61-80	MKTI		SMBI		HMLI		MOMI	
	CAN	US	CAN	US	CAN	US	CAN	US
84-88	.000	.000	.000	.000	.426	.000	.112	.159
89-93	.000	.000	.096	.000	.025	.000	.015	.005
94-98	.023	.000	.005	.000	.006	.000	.882	.027
99-03	.000	.000	.000	.000	.000	.000	.789	.520
81-100	MKTI		SMBI		HMLI		MOMI	
	CAN	US	CAN	US	CAN	US	CAN	US
84-88	.000	.000	.005	.000	.103	.000	.031	.005
89-93	.000	.000	.174	.000	.269	.000	.646	.027
94-98	.000	.000	.857	.000	.000	.000	.659	.106
99-03	.000	.000	.585	.000	.000	.000	.102	.246

Table 12
Results for the international CAPM in time series (TS1). Results report the number of non rejection for each hypothesis tested in the four sub-periods considered

Hypotheses	1984-1988	1989-1993	1994-1998	1999-2003	total (/20)
H_{0MKT}	1, 5	-	2, 3, 4, 5	1, 2, 3, 4, 5	11
total (/5)	2	0	4	5	11/20

Table 13

Results for the two international factor model in time series (TS2). Results report the number of non rejection for each hypothesis tested in the four sub-periods considered.

Hypotheses	1984-1988	1989-1993	1994-1998	1999-2003	total (/20)
H_{0MKT}	-	-	2, 3, 4, 5	1, 2, 3, 5	8
H_{0SMB}	1, 2	1, 2, 3, 4, 5	1, 2, 3, 5	2	12
H_{0SUM}	1	1, 4	2, 3, 5	3	7
H_{0joint}	4	-	2, 3, 4, 5	2, 3	7
total (/20)	4	7	15	8	34/80

Table 14

Results for the three international factor model augmented with book-to-market in time series (TS3H). Results report the number of non rejection for each hypothesis tested in the four sub-periods considered

Hypotheses	1984-1988	1989-1993	1994-1998	1999-2003	total (/20)
H_{0MKT}	1	1	1, 2, 3, 4, 5	1, 2, 3	10
H_{0SMB}	1, 2	1, 3, 4, 5	1, 2, 3	2, 3	11
H_{0HML}	1, 2, 3, 4, 5	1, 2, 3, 5	1, 3, 4, 5	1, 2	15
H_{0SUM}	1, 3, 5	1, 3	1, 2, 3, 4, 5	1, 2, 3, 4	14
H_{0joint}	-	-	1, 3, 4, 5	2, 5	6
total (/25)	11	11	21	13	56/100

Table 15

Results for the three international factor model augmented with momentum in time series (TS3M). Results report the number of non rejection for each hypothesis tested in the four sub-periods considered

Hypotheses	1984-1988	1989-1993	1994-1998	1999-2003	total (/20)
H_{0MKT}	-	-	2, 3, 4, 5	1, 2, 3, 4, 5	9
H_{0SMB}	1, 2	1, 2, 3, 4, 5	1, 2, 3, 5	2, 3	13
H_{0MOM}	2, 3, 4, 5	2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	18
H_{0SUM}	1	1, 2, 3, 4, 5	1, 2, 3, 4, 5	-	11
H_{0joint}	-	-	1, 2, 3, 4, 5	2	6
total (/25)	7	14	23	13	57/100

Table 16
Results for the four international factor model in time series (TS4). Results report the number of non rejection for each hypothesis tested in the four sub-periods considered

Hypotheses	1984-1988	1989-1993	1994-1998	1999-2003	total (/20)
H_{0MKT}	-	1	1, 2, 3, 4, 5	1, 2, 3	9
H_{0SMB}	1, 2	1, 2, 3, 4, 5	1, 2, 3, 5	2, 3	13
H_{0HML}	2, 3, 4, 5	1, 2, 3, 5	1, 2, 3, 4, 5	1, 2	15
H_{0MOM}	2,3, 4, 5	1, 2, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5	18
H_{0SUM}	1, 3, 5	1, 3	1, 2, 3, 4, 5	1, 2, 3, 4, 5	15
H_{0joint}	-	-	1,3, 4, 5	2	5
total (/30)	13	16	28	18	75/120

Tables 12, 13, 14, 15 and 16 respectively report the non rejection of the hypotheses tested the estimated coefficients for international risk factors in model TS1, TS2, TS3H, TS3M and TS4. A non rejection of the hypothesis is defined as a p-value greater than 5%. Each model was estimated in 5 different SURE system of equations which contained 5 portfolios of each countries. Portfolios were rank according to size and the break points were the 20^{th} percentile. In the columns, the numbers refer to the group portfolios estimated for which a given hypothesis had a p-value greater than 5%: 1 being the first 20 percentile and 5 being the last 20 percentile according to size.

size and book-to-market factors. This suggests that the equality hypothesis will probably not hold often. This observation is confirmed by tables 19, showing the sub periods for which the tested hypotheses were not rejected at a 5% confidence level in each model. Table 19 show that, in cross section, when the equality of the estimated average contributions holds, the equality of the estimated marginal coefficients often hold as well. Moreover, the equality for the book to market's average contribution is not rejected only in one occasion.

In the four factor model (CS4), we find that the equality of the market risk premiums is not rejected in two sub period whereas the equality of its average contribution is rejected only in the third sub-period. As for size, the equality of its average contribution and estimated coefficient is not rejected only in the first sub period while the equality of its estimated risk premiums is not rejected only in the second sub period. Finally, the equality of momentum' s average contribution and estimated coefficient is never rejected. Even though some factor are not statistically different from zero, we feel the issue here is less important then in the time series analysis for two reasons: first, because at least in the market case it was not unexpected and second, because it is rarely not significant in both countries at the same. The later fact implies that we can compare the risk premium without risking to make a false statement about market integration. For example, non significance for both countries (often implying a non rejection of the equality hypothesis) does not enable us to discriminate between two case: either the factor should not be in the model because its irrelevant or the factor should be there in order to improve the predictability of the model and has the same impact in both countries. When at least one of the risk premium is significant however, we know that it should be in the model and can rely on the hypotheses testing effectively.

Table 18
The risk premiums estimates for the four domestic factors APT model (CS4).

	λ_{mc}	λ_{smbc}	λ_{hmlc}	λ_{momc}	λ_{mu}	λ_{smcu}	λ_{hmlu}	λ_{momu}
1984-88	1.556 (.05)	−.283 (.40)	−1.225 (.02)	.391 (.66)	−.381 (.28)	−.455 (.00)	.417 (.00)	1.418 (.00)
1989-93	1.003 (.38)	−.694 (.07)	.022 (.96)	.443 (.82)	−.887 (.05)	.584 (.00)	.535 (.00)	−1.381 (.00)
1994-98	5.516 (.00)	−3.241 (.00)	−1.871 (.04)	2.061 (.16)	−1.211 (.00)	−.765 (.00)	.380 (.02)	−.860 (.05)
1999-03	−.374 (.76)	−1.383 (.05)	−1.939 (.01)	−4.408 (.07)	−1.283 (.01)	1.109 (.00)	1.668 (.05)	−.461 (.65)

First, BETAS coefficients are obtained through a multivariate regression for each country using 40% of the data. Then, risk premium are obtained for each country in cross section using a SURE system. The remaining 60% of the data is used in the second step. P-Values for the significativity test are shown in parenthesis.

Table 19 also show that tendency toward financial market integration of domestic risk factor is not increasing through time. In fact, most of the non rejection occurred in the first sub-period Moreover, the equality of market's average contribution and risk premiums is not rejected half the time. Adding size does not increase the number of non rejection of the market factor, although the addition of book-to-market does increase it to 62.5%. Given the later figure, we can conclude that the domestic market factor facilitate integration given that it is not rejected half the time. As for the size risk factor, it does not seem to facilitate integration in cross section, given that the equality of its average contribution and risk premium is not rejected in only 37.5% of the case in CS2 and that the former model has the lowest proportion of non rejection of the five. Also, the addition of book to market facilitate the integration of the market factor but decrease the number of non rejection for the equality of size, the joint hypothesis (H_{0joint}^{ME}) and the sum of coefficient (H_{0SUM}). Moreover, the equality of book to market risk premium and average contribution is rejected in 6 out of 8 cases in the four factor model. Thus, we conclude that book-to-market does not facilitate integration. Finally, given that the equality of momentum's average contribution and risk premiums is never rejected and that its introduction increase the evidence of integration for (H_{0SUM}), (H_{0SUM}^{ME}) and (H_{0joint}^{ME}), we conclude that it facilitates integration. Next, we present the results for the international risk factor.

5.2.2 The international factors

This section presents the results for the analysis in cross section using the international risk factors. Again, results were obtained using the two pass procedure described above matched with a split sample procedure with a 40-60% break point. Table 20 presents the estimated coefficients on the risk premium and their given p-values for each factors in all sub periods. First, we see that significance is not very high in the Canadian case. Indeed, for Canada, the market factor and momentum are not significant except in one sub period. As for size and the book-to-market risk factors, they are significant in Canada in 50% of the sub-periods. In the United States, size and book-to-market are always significant while the market and momentum risk factor are significant in 75% of the case. Results in table 20 suggest that while a change

Table 19

Results of the hypothesis testing in cross section with domestic risk factors. Results reports the sub periods for which the hypotheses tested were not rejected in each model estimated

Hypotheses	CS1	CS2	CS3H	CS3M	CS4
H_{0MKT}^{ME}	2, 4		1, 2, 4		1, 2, 4
H_{0SMB}^{ME}	-	1, 4		1	1
H_{0HML}^{ME}	-	-	2, 3	-	1
H_{0MOM}^{ME}	-	-	-	1, 2, 3, 4	1, 2, 3, 4
H_{0SUM}^{ME}	-	2, 3	2, 4	2, 3, 4	1, 2, 3, 4
H_{0joint}^{ME}	-	1	-	1, 4	1
sub-total	2/4	5/12	7/16	10/16	14/20
H_{0MKT}	2, 4		2, 4	4	2, 4
H_{0SMB}	-	1	1	1	1
H_{0HML}	-	-	2, 3	-	2
H_{0MOM}	-	-	-	1, 2, 3, 4	1, 2, 3, 4
H_{0SUM}	-	3,4	1, 2, 3	1, 2, 3, 4	1, 2
H_{0joint}	-	1	-	-	-
sub-total	2/4	4/12	8/16	10/16	10/20
Total	4/8	9/24	15/32	20/32	24/40

Table 19 shows the sub periods for which the hypotheses were not rejected at a 5% confidence level for each model estimated. For brevity, the sub period are numbered from 1 to 4; 1 : 1984-1988, 2:1989-1993, 3: 1994-1998 and 4: 1999-2003. The models are estimated on domestic risk factors using the following system SURE system with two equations: $\overline{R_i^J} = \alpha^J + \sum_{k=1}^{s} \widehat{\beta}_{ik}^J \lambda_k^J + \upsilon_i^J$ and the tests are performed on the λ_k^J coefficients. The model requires the pre estimation of the BETA and we used a split sample procedure to correct the error on variable.

in the international factors's sensibilities has an impact in the United States, it does not affect the Canadian average return greatly.

Table 21 presents the sub period for which the tested hypotheses were not rejected in each model. In the four factor model (CS4), we find that the equality of the market risk premium is rejected only in the third sub-period while the equality of the risk premium on size, book-to-market, momentum and on the sum of the risk premium is not rejected in 50% of the sub periods. However, this evidence must be taken with caution, given that many pair of Canadian and American risk premium were simultaneously not significant. The total number of non rejection show that the proportion of non rejection is the highest in the four factor model (60%). Size facilitate integration, given that it introduction increase the proportion of non rejection (from 50% in CS1 to 58.3% in CS2). Book to market and momentum facilitate integration but only when they are added together in the model. Finally, results show that integration is strongest in the last sub period, given that 54% of the non rejection occurred in the 1999-2003 sub period.

In conclusion, results in cross section show the Fama and French factor are not as significant in cross section than in time series, especially in the Canadian case. Although Fama and French (1992) reached the same conclusion for the market risk factor, low significance of all factors in the Canadian case was, to our knowledge undocumented so far in the literature. We find that the domestic factors do not show an increasing trend toward integration while the international risk factors did. Domestic market and momentum risk factor facilitate integration while size and book-to-market are not. As for the international risk factor, market and size facilitate integration while book to market and momentum also facilitate integration, but only when coupled together.

Overall, the cross sectional analysis results are less conclusive than the ones in time series. We believe the time series analysis generated more conclusive results for two reasons: first, because many factors are not significant in cross section. Second, because this is a more aggregated approach which measure the equality of the impact of a change in BETA on average return. As we have demonstrated in the time series analysis, those BETA vary across portfolios. In this context, an average measure for each country may not be appropriate.

6 Conclusion

In this paper, we have tested integration for North American financial markets from 1984 to 2003. In order to do that, we used the domestic and international Fama and French risk factor in time series and in cross section. We tested an extensive set of hypotheses in order to assess qualitatively the degree of financial integration in North America. Finally, we added the risk factors sucessively to assess the factors that factor that facilitate integration.

In time series, we find that integration is often not rejected in the context of the CAPM while APT models show weaker evidences of integration. The domestic market , size and momentum facilitate financial integration as well the international book-to-market and momentum. While the domestic four factor model do not show a trend toward integration, the international model does. Moreover, we found the degree of financial integration to be inversely related to the size of the portfolios studied. We believe it may be caused by a regional contagion phenomenon where the small firms are more subject to North American risk while the bigger firms are not subject to

Table 20

The risk premium estimates for the four international risk factors model.

	λ_{mc}	λ_{smbc}	λ_{hmlc}	λ_{momc}	λ_{mu}	λ_{smcu}	λ_{hmlu}	λ_{momu}
1984-88	1.027 (.147)	.820 (.002)	−1.713 (.000)	−1.829 (.011)	−.395 (.240)	−.431 (.000)	.309 (.002)	1.279 (.000)
1989-93	1.656 (.195)	.664 (.311)	−1.317 (.008)	.433 (.396)	−1.070 (.027)	.567 (.000)	.572 (.000)	−1.067 (.003)
1994-98	4.788 (.000)	−2.703 (.002)	−.505 (.592)	.561 (.623)	−1.173 (.003)	−.732 (.000)	.356 (.019)	−.725 (.078)
1999-03	.734 (.572)	1.130 (.254)	−1.029 (.419)	1.986 (.205)	−1.481 (.008)	.949 (.000)	.939 (.044)	−.710 (.491)

First, BETAS coefficients are obtained through a multivariate regression for each country using 40% of the data. Then, risk premium are obtained for each country in cross section using a SURE system. The remaining 60% of the data is used in the second step. P-Values are shown in parenthesis.

Table 21

Results of the hypothesis testing in cross section with international risk factors. Results report the sub periods for which the hypotheses tested were not rejected in each model estimated

Hypotheses	CS1	CS2	CS3H	CS3M	CS4
H_{0MKT}	2, 4	1, 4	2, 4	4	1, 2, 4
H_{0SMB}	-	1, 2, 4	4	2, 4	2, 4
H_{0HML}	-	-	2, 3, 4	-	3, 4
H_{0MOM}	-	-	-	2, 3, 4	3, 4
H_{0SUM}	-	4		1, 4	2, 4
H_{0joint}	-	4	4	4	4
Total	2/4	7/12	7/16	9/16	12/20

Table 21 shows the sub periods for which the hypotheses were not rejected at a 5% confidence level for each model estimated. For brevity, the sub period are numbered from 1 to 4; 1 : 1984-1988, 2:1989-1993, 3: 1994-1998 and 4: 1999-2003. The models are estimated on domestic risk factors using the following system SURE system with two equations: $\overline{R_i^J} = \alpha^J + \sum_{k=1}^{s} \widehat{\beta}_{ik}^J \lambda_k^J + \upsilon_i^J$ and the tests are performed on the λ_k^J coefficients. The model requires the pre estimation of the BETA and we used a split sample procedure to correct the error on variable.

regional shock as much because they are more diversified internationally. Finally, an analysis of the estimated coefficients show that they vary across portfolios from a same country and across time. This last observation justify a disaggregate approach and the use of sup-periods.

In cross section, we find again that the domestic factor model do not show an increasing trend toward integration while the international model had its strongest evidence toward integration in the last sub period. Also, we find the Fama and French factor (both domestic and international) are not always significant, especially in the Canada. While this was expected for the market risk factor, it is was undocumented for the other factors, especially in the Canadian case. Size and momentum seem to facilitate integration in the domestic model as market size and the Book-to-market momentum couple. Overall the cross sectional analysis is less conclusive due to the diminished significativity of the models and its aggregated nature.

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