Dynamic Multibeta Macroeconomic Asset Pricing Model
at NAFTA Stock Markets

Francisco López-Herrera

Division de Investigación, Facultad de Contaduría y Administrzación

Universidad Nacional Autónoma de México 04510 Mexico, D.F.

Tel: (5255)-56-228-458   E-mail: francisco_lopez_herrera@yahoo.com.mx

Edgar Ortiz (corresponding author)

Graduate School of Political and Social Sciences, Universidad Nacional Autónoma de México

Apartado 21-244   Col Coyoacan   Del Coyoacan   04000, Mexico, D.F.

Tel: (5525)-56-581-949   E-mail: edgaro@unam.mx

Abstract

Applying a multifactor beta model, this papers examines the case of the NAFTA countries, Mexico, Canada and United States. Its objectives are, first, identifying the relationship between local macroeconomic factors and asset pricing at each market; and, second, examine the integration of each market to global market macroeconomic variables. Results show that local factors weight more than international factors at each market, revealing mild segmentation among these markets. The level of integration of local markets with global variables is greater for United States, while for Mexico is the lowest.

Keywords: Systematic risk, Macroeconomic variables, Asset pricing, Capital markets, NAFTA

1. Introduction

Financial globalization has increased correlations and cointegration among the world stock markets, making international portfolio diversification less attractive. However, financial research continues to confirm the presence of market segmentations among the international markets particularly for the case of emerging and developed markets. Since intrinsic risk can be diversified away, determining the sources and impact of systematic risk at emerging markets and their patterns of integration with the world markets has become a key issue and has led to wide research in the financial literature. Built on the foundations laid down by Markowitz (1952; 1959) and Tobin (1958), the Capital Asset Pricing Model, CAPM, advanced by Sharpe (1963; 1964), Lintner (1965) and Mossin (1966) asserts that the only source of systematic risk is the comovement of financial assets with the market. However, an ample body of empirical evidence suggests that one or more additional factors may be required to explain asset returns.

Arbitrage Pricing Theory (APT) put forth by Ross (1976) and the Multi-Beta Capital Asset Pricing Model (MBCAPM) developed by Merton (1973) are the main theoretical approaches dealing with the existence of several systematic risk factors. Based on general equilibrium arguments, the Merton MBCAPM shows that whenever the risk free rate is stochastic, then other sources of risk, including macroeconomic variables, affect the investment opportunities set and market risk is only one of the relevant risk sources. APT was introduced as an alternative to CAPM, but not requiring the identification of the theoretical market portfolio, as CAPM does. Based on the absence of arbitrage opportunities in large, well informed markets, it asserts that asset value fluctuations is influenced not only by the market factor, but by other factors as well, including macroeconomic factors. Macroeconomic and financial variables, suggested by economic theory, have been used to capture systematic risk. Chen, Roll and Ross (1986) propound a five-factor model. Other studies have favored corporate financial variables.

Extending systematic risk analysis to an international investment environment raises some concerns. The level of integration between markets bears important implications both for asset pricing theory and for portfolio selection. Cho, Eun and Senbet (1986) sustain that assets from different, but integrated, markets are priced jointly. On the contrary, for the case of segmented markets, assets from different markets although might show the same level of risk have different expected returns when expressed in a common currency, creating arbitrage opportunities assuming that there are no cross-border barriers to investments. Currently, financial globalization should be leading towards integration of capital markets. Thus, in domestic capital markets fully integrated to the world capital market, local trading and valuation should be based only on international risk factors; only systematic world risk factors become relevant. On the contrary, at segmented domestic capital markets, assets are valued exclusively based on impacts from domestic systematic risk sources. Cho, Eun and Senbet (1986) find these results with an international APT specification. Applying cointegration analysis Cham and Lai (1993), Pérez de Gracia and Cuñado (2000), and

Da Costa and Cereta (2001) obtain similar results. Nonetheless, various cross-country studies find, with some caveats, that the importance of local risk factors is receding among developed markets. Nikkinen and Sahlström (2004) find that U.S. macroeconomic news announcements are valuable information on European stock markets, while domestic news releases seem to be unimportant. Finally, a study by Vajhekoshi and Nummelin (2005) evidence that international segmentation changes overtime. In the case of emerging markets the evidence on the importance of local macroeconomic factors on asset pricing is limited; moreover, numerous studies conclude that emerging markets returns are weakly correlated to international variables. Contributing to the debate on this issue, this paper tests: a) the extend of capital markets integration among Mexico, Canada and United States, members of the North American Free Trade Agreement (NAFTA); and b) integration of each of those markets with the world capital market.

2. Literature review

The literature on systematic risk analysis for the case of United States is ample. In a pioneer work, Chen, Roll and Ross (1986), based both in economic intuition and empirical research propound two classes of systematic sources: forces that change the discount rate used to discount future expected cash flows, and forces which influence the expected cash flows levels. Testing an empirical multifactor systematic risk model they determine as priced risk factors the yield spread between long and short interest rates for U.S. government bonds, expected inflation, unexpected inflation, industrial production growth and default premium (measured as the spread between corporate high and low-grade bonds). Van den Goorbergh, De Roon and Werker (2003) confirm that interest rates continue being an important variable to explain U.S. assets' returns. Carmichael and Samson (2001) also find evidence on the significance of interest rates to explain the returns of assets listed at the Toronto Stock Exchange.

Evidence on the relationship between stock market returns and interest rate behavior has been also found relevant for the case of other stock markets. Alam and Uddim (2009) present evidence for both developed and developing countries, Dropsy and Nazarin (1995), and Drehman and Manning (2004) have detected such relationship for several developed stock markets, including the U.S. and Canadian markets; Clare and Thomas (1994) show evidence for the United Kingdom stock market; Groenewold and Fraser (1997) and Kazi (2009) for the Australian market. Evidence has also been found by Schor, Bonomo and Pereira Valls (1998) for the Brazilian stock market, and Ratner and Leal (2001) for the emerging markets from Argentina, Brazil and Chile. Navarro and Santillán (2001), Márquez, Islas and Venegas (2003), and Al-Shanfari (2003) and Bucio Pacheco (2009) have found evidence that interest rate behavior is a relevant Mexican stock market risk factor.

Financial theory also points out that equities could serve as a hedge against inflation; hence a positive sign relationship should be expected. However, several studies suggest that inflation and equities returns are negatively related; e.g. Fama (1981), Spyrou (2001) and Ionnidis *et al* (2005). De la Calle (1991), Nava (1996), Doshi, Johnson, Ortiz and Soenen (2001), Ratner and Leal (2001), Navarro and Santillán (2001) and Cabello, de Jesús and Ortiz (2006) have found evidence suggesting that Mexican assets' returns are positively related with inflation. Choudry (2001) also confirms a positive relationship between stock returns and inflation for the cases of Argentine, Chile, Mexico and Venezuela and López Herrera and Vázquez (2002) and Bucio Pacheco (2009) show that changes in price levels contribute to explain returns in a sample of Mexican stocks. Gargopadhyay (1994), Qi and Maddala (1999) and Van den Goorbergh, de Roon and Werker (2003) have found also evidence on the relationship between stock returns and inflation at US stock market, and Carmichael and Samson (2001) at Canadian stock market. Several studies confirm industrial production growth as a significant risk factor for stock returns. Gargopadhyay (1994) and Qi and Maddala (1999) present evidence for the U.S. stock market. Koutoulas and Kryzanowsky (1996) and Kryzanowsky, Lalancette and To (1997) reach similar results for the Canadian stock market. Nonetheless, it is important to note that the evidence presented by Islas and Levy Mangin (2002) underlies the fact that market returns are the only variable that explains share returns for the Spanish capital market; macroeconomic variables, including industrial production do not have any explanatory power. Research for the Mexican stock market has generally failed to find a significant relationship between stock returns and industrial production growth. However, recently, Ortiz, de Jesus and Cabello (2007) found a bilateral Granger causality between the stock market and industrial production. The relationship between stock returns and industrial production has been found significant for the stock exchanges from Brazil (Schor, Bonomo and Pereira Valls, 1998), Greece (Hondroyiannis and Papapetrou, 2001), and United Kingdom (Al-Shanfari, 2003; Darsinos and Satchell, 2003).

Empirical research also identifies other variables as sources of equities risk and returns. Money supply seems to contribute to explain Mexican stock returns, as suggested by the results reached by De la Calle (1991), Nava (1996), Navarro and Santillán (2001), Al-Shanfari (2003) and Bucio Pacheco (2009). Similar results have been reported by Qi and Maddala (1999) and Rapach (2001) for the U.S. stock market case. Navarro and Santillán (2001) have found that exports behavior is a significant variable to explain Mexican stock market returns. Koutoulas and Kryzanowsky (1996) and Kryzanowsky, Lalancette and To (1997) have found evidence of the importance of exports growth to explain Canadian assets and portfolio returns. Bailey and Chung (1986), Nava (1996), Navarro and Santillán (2001) and, Cabello, de Jesús and Ortiz (2006) report evidence of exchange risk relevance for the Mexican stock market; Koutoulas and Kryzanowsky (1996) and Kryzanowsky, Lalancette and To (1997) obtained similar results examining risk-return behavior of Canadian assets and portfolios.

A myriad of studies have been devoted to analyze the relationship between national markets. During the 1970's research reported low correlations among them, and provided evidence concerning the importance of local factors in the risk-return generating process (Eun and Shim, 1993). This has apparently changed over time.due to globalization processes. Nikkinen and Sahlström (2004) find that U.S. macroeconomic news announcements are valuable information on European stock markets, while domestic news releases seem to be unimportant. For the Canadian and U.S. markets, Perez Caldwell (1997) using an APT framework finds that neither Canadian factors influence U.S. returns, nor U.S. factors affect Canadian returns; these markets are therefore not integrated. However, Xinga and Howe (2002) document a significant positive relationshjp between world stock returns and the variance of returns in the United Kingdom. Similar evidence is reported by Leong and Felmingham (2003) who examine the interdependence of five developed Asian markets. Their evidence reveals that correlation has strengthened following the Asian crises; moreover, half bivariate pairings of stock indexes from those countries indicates nonbreaking bivariate cointegration, while four are cointegrated subject to a structural break. More recently, Southall (2009) using weekly data for a ten year study shows that macroeconomic variables have had increasing importance in the European capital markets; the importance of international macroeconomic variables has also increased for the new member countries from the Europeand Union, while at the same time local macroeconomic factors decrease in importance.

For the case of emerging markets the evidence is limited and contradictory. Wongbangpoa and Sharma (2002) find that in the case of five ASEAN countries long and short term relationships can be observed between stock prices and selected macroeconomic variables. Moreover, changes on the macroeconomic variables in these countries cause and are caused by stock prices in the Granger sense. Bilson, and Hooperb (2005) find only moderate evidence to support the contention that local macroeconomic variables have explanatory power over stock returns in emerging markets. However, Ewing *et al* (1999) examine the NAFTA countries stock markets for the period 1987:11-1997:03. They find no cointegration present in these markets even when the passage of NAFTA is taken into account; segmentation of these three markets remains and long-run diversification across them is possible. However, using daily, weekly and monthly data for the period June 1, 1989 to April 2002 Darrat and Zhong (2005) using cross-correlations, multivariate price cointegrating systems, speed of convergence, and generalized variance decomposition found intensified market linkages among the NAFTA capital markets since the agreement was enforced. Finally, Verma and Ozuma (2005) find little evidence that Latin American stock markets are responsive to movements in cross-country Latin American macroeconomic variables. However, their results show that Mexico's stock market affects other Latin American stock markets but not vice-versa; this could be a side effect of Mexico's close ties with the United States.

3. Data and methodology

Monthly data from market returns and selected local and international variables are used for the period January1984 to December 2004, which can be identified as a "first generation" integration period among the NAFTA members. Rather than constructing portfolios for each market, a dynamic Merton like multibeta capital asset pricing model is estimated on market returns of each country. This approach allows to evidence directly the existence of different asset pricing processes at each country, as well as evidence on their integration to international economic activity. Mexican, Canadian, and U.S. share price indexes and all domestic and international macroeconomic series, all expressed in U.S. dollars, were gathered for the period December 1983 to December 2004 from IMF's *Financial Statistics* CD; US exchange rate from FREDII Databank; WTI oil prices from Financial Forecast Center website, and the the proxy for the world capital market portfolio is the Morgan Stanley Capital International (MSCI) index.

Succinctly, the multi-beta CAPM asserts that the return on any security to the security's sensitivity, i.e. systematic risk, to a set of influences:

$$r_i - r_f = \beta_{im}(r_m - r_f) + \beta_{iI1}(r_{I1} - r_f) + \beta_{iI2}(r_{I2} - r_f) + \beta_{iI3}(r_{I3} - r_f) + ... \tag{1}$$

Here, r_i = return on asset i; r_f = risk free rate; β_{im} = sensitivity to the market risk premium; and β_{iIj} = sensitivity to other I factors risk premium, j = 1 …n.

For the empirical analysis carried out in this work, the linear multibeta model extended into a dynamic regression analysis and can be stated as follows:

$$, \quad t = \quad r_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i r_{t-1} + \sum_{i=1}^{k} \sum_{j=0}^{l} \beta_{i,j} X_{i,t-j} + \psi'\delta + \varepsilon_t \qquad 1,2,...,T \tag{2}$$

where r_t is the market return in excess of the risk free rate, i.e., the market risk premium. X_t are observations of explicative variables values, i.e., systematic risk factors in excess of the risk free rate; hence these factors can be regarded as premiums for the risk factors. δ is a matrix with *m dummy* variables which capture the effects of events whose nature can alter the probabilistic distribution of the market risk premium. The α_i's, β_i's and the vector ψ' are parameters to be estimated, and show the relationship between risk factors and market risk premium; these parameters therefore show the reward for systematic risk bearing; ε_t is a contemporary disturbance term.

Lagged variables are included because the set of information available to investors for decision making includes past events. In addition the impact of macroeconomic variables are felt during and after several periods ahead. Thus, the dynamic model represented by equation (2) acknowledges the influence of past and current economic variables on investors expectations about securities values. Chosen risk factors are those determined by López Herrera and Ortiz (2005) as proxies for systematic risk sources for the Mexican, Canadian and U.S. capital markets. Applying principal component analysis (Tabachnick and Fidell, 1989), factors identified derive from a set of 13 macroeconomic variables found as relevant in the financial literature, such as those identified in the previous section. Principal components were obtained from the correlation matrix of rates of growth and changes in domestic and global financial and macroeconomic variables. Thus, risk factors used in this study are built as linear combinations of such rates of growth and changes. The set of domestic variables for each country includes: money market interest rate, short-term treasury bill rate, money supply, prices level, industrial production, international reserves, exports, imports and exchange rate. Additionally, to capture global systematic risk, four international variables are included: World Capital Market portfolio returns, world exports rate of growth, one-month LIBOR rate, and changes on the WTI oil prices. Following conventional criteria for the selection of factors, López Herrera and Ortiz (2005) find that only three risk factors are relevant to Mexican and Canadian cases, and for U.S. three to four factors are relevant.

4. Empirical analysis

Table 1 presents the basic descriptive statistics of log returns for the stock market index series from Canada, United States and Mexico. As shown there, the Mexican stock market mean return is the highest for the full period under consideration. Indeed, mean return for the Mexican stock market is five times greater than mean returns reported by the Canadian stock market, and almost twice as big as average monthly return from the U.S. market; Mexico's average return for the 1984-2002 period was also two and a half times higher than the world capital market monthly return. However, Mexico´s stock exchange volatility is the highest among the three countries, which is consistent with recent trends of higher returns and high volatility at emerging markets as compared with mature markets (Chukwuogor-Ndu, 2007). Hence, it is worth noting that using the mean/standard deviation ratio as an over all measure of risk taken to be rewarded, the U.S. market provided higher returns per unit of risk taken (0.175), while the Canadian market offered the lowest reward to units of risk taken (0.073); the risk premium from the Mexican market (0.12) was lower than that offered by both the U.S. market and the world market (0.14). Finally, it is worth noting that all four markets are skewed left and that their distribution is leptokurtic; corroborating these characteristics the Jarque-Bera statistic indicates non normality. Risk premiums corresponding both to each local stock market and the various risk factors were estimated from the local stock market return, or else the principal component proxy for the risk factor, minus the domestic risk free rate. To represent the risk free rate for each market, the domestic short-term government bills rate was chosen (Canadian Bills, Treasury Bill and Certificados de Tesoreria from Mexico).

The variables finally selected for the model are:

MXSMRP = Mexican capital market risk premium

MXCP1RP = Domestic Mexican stock market risk factor 1 risk premium

MXCP2RP = Domestic Mexican stock market risk factor 2 risk premium

MXCP3RP = Domestic Mexican stock market risk factor 3 risk premium

CNSMRP = Canadian capital market risk premium

CNCP1RP = Domestic Canadian stock market risk factor 1 risk premium

CNCP2RP = Domestic Canadian stock market risk factor 2 risk premium

CNCP3RP = Domestic Canadian stock market risk factor 3 risk premium

USSMRP = US capital market risk premium

USCP1RP = Domestic US stock market risk factor 1 risk premium

USCP2RP = Domestic US stock market risk factor 2 risk premium

USCP3RP = Domestic US stock market risk factor 3 risk premium

USCP4RP = Domestic US stock market risk factor 4 risk premium

Principal components for each market, derived by Lopez-Herrera and Ortiz (2005) include innovations in the following variables (signs shown in parenthesis): Mexico: risk factor 1: (-) peso/US dollar depreciation; (+) industrial production, (+) inflation, (+) money supply: risk factor 2: (+) domestic exports, (+) domestic imports; (+) world exports; risk factor 3: (+) domestic interest rates, (+) Mexican Treasury Bills. Canada: risk factor 1: (+) Canadian dollar/US dollar depreciation; (+) industrial production, (+) inflation, (+) money supply; risk factor 2: (+) Canadian bills, (+) Libor rate; risk factor 3: (+) Canadian exports, (-) world capital market. United States: risk factor 1: (+) US exports, (+) US imports, (+) world exports, (+) interest rates, (+) Libor rate; risk factor 2: (-) US exports, (-) world exports), (+) interest rates, (+) dollar relative price; risk factor 3: (-) dollar relative price, (+) World capital market, (+) TBills, (+) Libor rate; Risk factor 4: (+) price index, (-) exchange rate depreciation.

Previous to estimating the model, unit root tests are in order for all variables involved, to determine whether or not they presented a long-run equilibrium relationship. That is, making sure that the variables are stationary involved in the regressions and avoiding spurious relationships. Table 2 shows the results for the Dickey-Fuller and Phillips-Perron unit root tests. The evidence provided by the unit root tests, confirm stationarity for almost all variables at one percent level of significance. Only two cases could cast some doubt about their stationarity. Under any alternative specification, the Dickey-Fuller test does not reject the hypothesis of the existence of an unit root for the risk premium corresponding to the third domestic Canadian stock market risk factor (CNCP3RP). However, the Phillips-Perron tests points out in the opposite sense, that is, it rejects the existence of a unit root for that series at one percent of significance. This conflictive result can be viewed as the lack of power of the Dickey-Fuller test to reject the null hypothesis, or else, alternatively, derived from other characteristics of the series' behavior such as structural breaks. To avoid any Type II error, it seems adequate in this case to accept the evidence provided by Phillips-Perron test. In the case of the risk premium related to the second domestic U.S. stock market risk factor (USCP2RP), the Dickey-Fuller test including an intercept and a linear trend also fails to reject the null hypothesis, while the Phillips-Perron test again suggests the opposite. But the non-rejection is only marginal (the marginal significance level is of 0.0528); similarly, the linear trend coefficient is very small and not significant at any level.

To capture the impacts that certain events can exert on the stock markets risk premium, *dummy* variables were added into the model equations. These dummy variables intend to pick the effects of market cracks: CRACK87, TEQUILA, DRAGON, VODKA and BRASIL were included to represent, respectively, the effect of the 1987 October market crash, and the Mexican, Asian, Russian and Brazilian crises, each represented by a value of one for the month occurring the crisis and zero for any other month. Finally, the variable NAFTA was added to the equations with a value of 1 since January of 1994 and cero for the previous months, to asses any impact of this agreement on the stock exchanges of these three countries; similarly the *dummy* variable FTAUSCAN was included in the equations corresponding to the risk premium of Canadian and US stock markets to capture the effects of the commercial agreement signed between Canada and US; its assigned values are 1 since January 1989, and cero for all previous months. Another variable named STABILIZATION is also included to depict the efforts to control inflation in Mexico; enforced since December 1987. Financial economic literature sustains that a reduction on market and asset risk premiums must be observed after a liberalization date. Mexico's financial liberalization process is captured with the dummy variable ADR. Although economic and financial liberalization started before the first issuing of ADR's, the liberalization process between 1983 and 1988 was a response to financial restrictions faced by Mexico in the aftermath of the 1982 foreign debt problem (Cabello, 1999). Following the nationalization of the banking system both government authorities and private entrepreneurs saw in this market an appropriate mechanism to promote savings and channeling them to productive investments. The adequacy of first ADR issuing date to capture the effects of liberalization can be explained by the fact that it is on this date that foreign investors have effective access to the assets before restricted to them; and it is the date when local domestic firms have effective access to foreign financing. Errunza, Hogan and Hung (1999), and Bekaert, Harvey and Lumsdaine (2002), have found evidence that the date in which a country issues its first ADR has a significant effect on the local market of the issuing firm; The importance of ADR's in integration processes has also been confirmed by Evans and Hanatkovska)(2005), and Chen, Choi and Kini (2008). Hence, the dummy variable ADR has a value of 1 beginning September 1989, the month when the first Mexican ADR was listed at NYSE, and cero in any other previous month. Applying a sequential reduction procedure, final estimation models were obtained. Equation (2) is transformed in the following operational model:

$$r_t = \alpha_0 + \sum_{i=1}^{12} \alpha_i r_{t-1} + \sum_{i=1}^{3}\sum_{j=0}^{12} \beta_{i,j} X_{i,t-j} + \psi'\delta + \varepsilon_t \qquad t = 1,2,\ldots,T \qquad (3)$$

Here, the multibeta model is extended to include twelve lags of both dependent and independent variables and for the case of three principal components, which are the cases of Canada and Mexico. A similar model can be extended for the case of United States which includes four principal components.

Including the dummy type variables, the empirical model is further extended to:

$$r_t = \alpha_0 + \sum_{i=1}^{12} \alpha_i r_{t-1} + \sum_{i=1}^{3}\sum_{j=0}^{12} \beta_{i,j} X_{i,t-j} + \psi_1 CRACK87 + \psi_2 STABILIZATION$$

$$+ \psi_3 ADR + \psi_4 NAFTA + \psi_5 VODKA + \gamma WCMPRP + \varepsilon_t \qquad t = 1,2,\ldots,T \qquad (4)$$

A similar approach is followed in this study for the cases of Canada and United States. Tables 3, 4 and 5 show, respectively, the OLS estimations for Mexican, Canadian and U.S. stock market risk premium.

As shown in Table 3, almost all the estimated coefficients are highly significant, the only exception is the coefficient of the tenth lag of *potrmanteu* MXCP3RP which is only significant at a marginal level superior to 5%. The R^2 confirms that the variables in the model jointly explain a bit more than 60% of the variations of the risk premium in the Mexican stock market. The Jarque-Bera statistic fails to reject the residual normality hypothesis. There is no evidence of heteroscedasticity and the Ramsey Reset test does not show evidence of problems in specification. The

Breusch-Godfrey LM test rejects autocorrelations up to twelve lags. Nevertheless, is worth noting that Ljung-Box test shows positive autocorrelations at second and fifth lags, but they are only significant at a10% level. The ARCH LM test and *pormanteu* test of squared residuals exhibit the presence of a significant ARCH effect.

Only MXCP1RP, both contemporaneous and lagged, and lagged values of MXCP3RP are significant to explain Mexican stock market risk premium. Neither present period nor lagged values of MXCP2RP are significant. Following López Herrera and Ortiz (2005), MXCP1RP, MXCP2RP and MXCP3RP could be identified, respectively, as risk premiums to exposition to economic activity conditions, foreign trade activity behavior, and money market conditions. Consequently, results underlie the importance of real economic and monetary conditions on stock market performance. Evidence of significant lagged variables is similar to Hondroyiannis and Papapetrou (2001) and Dritsaki-Bargiota and Dritsaki (2004), who find that in the Athens stock market past inflation rate and past changes on interest rate cause Granger stock market returns. Finally, it is important to stress that World capital market risk premium is also significant to explain the Mexican stock market risk premium.

The empirical evidence also suggests that official efforts to stabilize the Mexican economy had some effects on stock market risk premium. Similarly, underscoring the importance of economic integration, NAFTA has induced a significant reduction in the level of risk premium (almost 3.1%). The first issue of corporate Mexican ADRs also led to a decrease of six percent in risk premium, almost twice as much as the NAFTA impact. It is also worth noting that the official announcement date about Mexico´s securities market liberalization was not significant; seemingly to investors is more important the effective access date than the official liberalization announcement. Concerning market crashes, only the October crack of 1987, and the Russian crisis of 1998 are significant, but neither the Asian nor the Brazilian crises affected market returns in Mexico.. Surprisingly, the Mexican tequila crisis apparently did not exerted effects on the Mexican equities market. Considering the magnitude of the impacts caused by that crisis on the entire economy, its negative impacts most likely are fully reflected in other economic variables, which are captured in the model.

In the case of the Canadian stock market risk premium, as Table 4 shows, the estimated model performs even better. R^2 is higher and the conventional measures used for statistical evaluation show no evidence of problems in estimation. It is worth noting that all contemporaneous values of the three risk factors premia are statistically significant, as well as some of their lagged values, albeit some at only at a five percent level of significance. Consistent with previous findings by López Herrera and Ortiz (2005), risk factors associated to the Canadian case are very similar to the Mexican case, almost identical in composition; the high level of significance of the risk rewards evidence the relevance of macroeconomic risk factors to explain risk premium at the Canadian stock market. Commercial agreements signed with U.S., and with United States and Mexico (NAFTA), have impacted risk premium at the Canadian stock market. Concerning crises, findings reveal that only the October 1987 world market crash and the Russian crisis have had some effect on risk premium at the Canadian stock market.

The U.S. stock market risk premium estimated model does not present any problem of specification; as shown in Table 5; however, its R^2 is lower than those obtained for the adjusted models for Mexico and Canada. Nevertheless, the model is satisfactory in statistical terms. It is worth noting that OLS estimates reported, derived from sequential analysis, include only three principal components as significant regressors. Only contemporaneous values of the first and third factors risk premiums are significant, at one percent level of significance; yet lagged values of the first second and third factors risk premiums are also significant, although in some cases only at 10% significance level. As previously reported, Lopez and Ortiz (2005) using principal components analysis identify four relevant risk factors for the U.S. Their findings suggest that the first risk factor captures effects sprung from the degree of openness of the U.S. economy, both from a commercial and financial perspective; the second risk factor captures the effects of U.S. trade balance deficit; the third risk factor represent local financial relationships; surprisingly, the fourth risk factor, eliminated by sequential analysis, depicts the influence of economic uncertainty derived from inflation and exchange rate changes. Significant coefficients results suggest that only the level of openness and domestic financial conditions are important to explain U.S. stock market risk premium. That explains why U.S. commercial agreements with Canada and Mexico have had no effects on risk premium. However, the market crack of October1987, coupled with the 1997 Asian crisis and Russian 1998 crisis seemingly affected U.S. stock market risk premium.

Finally, segmentation of the stock markets from the NAFTA countries is confirmed by the different levels of integration of each market to international macroeconomic variables. Principal component analysis suggests for the total world exports is the only international variable relevant for the Mexican case. The importance of this variable included in the regression analysis indicates that at least to some degree the Mexican stock market is sensitive to international systematic risk sources. At any rate, in the Mexican case it also stands out the fact that principal component analysis suggested not to include in the model returns from the world portfolio market because it does not contribute with relevant information to explain variability of the entire set of economic variables analyzed. In other words, considering the Mexican case, world market returns is a variable totally independent from the set of variables relevant for this market. However, including the world market risk premium (world returns minus LIBOR rate) in the OLS regression, as shown in Table 3, the corresponding coefficient is highly significant. All these results

imply a partial segmentation of the Mexican market with respect to the world market, since local macroeconomic risk factors remain important, while only some international risk factors seem to weight in its variability of returns.

In the case of Canada, results show that returns from the world market and the LIBOR interest rate contribute to explain variability of the set of economic series included in the analysis; however, total world exports are excluded as a relevant variable for the Canadian case. At any rate, in the regression analysis performed for this country, the relevant risk factors are comprised of local and international sources of systematic risk; hence the Canadian stock market is case is a clear case of mild segmentation.

Of the three countries participating at the NAFTA, the U.S. capital market shows a greater exposition to international risk factors, which is confirmed by principal components analysis, albeit domestic macroeconomic variables remain important. Regression results confirm that three international variables are important to determine systematic risk at the U.S. market. Table 5 incorporates therefore in the regression analysis the over all impact from local and international in the variability of returns in this market.

5. Conclusions

Mexican, Canadian and U.S. stock markets sources of risk premiums have been analyzed in this paper on the basis of multifactor systematic risk models, one for each stock market. Risk factors were chosen from principal components analysis previously applied for these markets by Lopez Herrera and Ortiz (2005). Results show that linear combinations of variables studied, i.e., the principal components, are relevant to explain the corresponding risk premium at the markets under study. The set of series used includes both domestic and international economic variables; the high significance of the estimated risk factors' coefficients built with these variables implies that domestic and foreign sources of systematic risk coexist driving returns in NAFTA area stock markets. Domestic and international sources of systematic risk explain at a high degree of significance risk premiums of Mexican, Canadian and U.S. stock markets. It can therefore be concluded that each one of these markets is partially segmented from the world capital market. Local risk factors matter for each country, and different international risk factors are relevant for each market. This is confirmed by the multibeta regression analysis carried out for each market, extending the model with sequential analysis to include dynamic impacts from the risk factors on the returns of each market. The evidence confirms the fact that the markets from Canada, Mexico and United States respond differently to international risks factors. The empirical evidence provided in this paper offers some empirical support to the hypothesis of partial segmentation among Mexican, Canadian and US stock markets. The greater number of significant coefficients in the Canadian and US stock markets estimated equations in comparison with the number of significant coefficients in the Mexico's stock market equation, suggests that more economic information is used by investors in the former two markets. The significant coefficients of lagged variables in the three markets show that past economic information is valuable for investors. To enhance economic development of these nations, further development and integration of their capital markets is in order, particularly considering that integration between Mexico and its neighboring partners has taken place in asymmetrical terms, a developing economy vis a vis two developed countries.

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Table 1. Stock maket indexes descriptive statistics. January 1984 - December 2002

Variable	Mean	Standard	Skewness	Kurtosis	Normality[1]	p-value[2]
	%	Deviation %			χ^2	
MXSMR	1.56	12.98	-1.46	8.38	355.64	< 0.01
CNSMR	0.31	5.28	-1.19	7.81	273.44	< 0.01
USSMR	0.83	4.74	-1.19	7.73	266.40	< 0.01
WCMPR	0.64	4.43	-0.71	4.65	44.95	< 0.01
MXSMR = Mexican stock market return; CNSMR = Canadian stock market return						
USSMR = US stock market return; WCMPR = World capital market portfolio return						
[1] Jarque-Bera Normality Test; [2] Corresponding to Jarque-Bera Normality Test						

Table 2. Unit-root tests.   January 1984 - December 2002

Variable	Dickey-Fuller			Phillips-Perron		
	$\hat{\tau}_\beta$	$\hat{\tau}_\mu$	$\hat{\tau}$	$\tilde{t}_\beta$	$\tilde{t}_\mu$	$\tilde{t}$
MXSMRP	-11.8859	-11.90629	-11.88975	-11.58902	-11.62544	-11.62727
	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
MXCP1RP	-4.715812	-4.004314	-3.983363	-12.16695	-9.984977	-9.623234
	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
MXCP2RP	-4.105369	-4.989822	-5. 19312	-17.17264	-16.67433	-16.01074
	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
MXCP3RP	-6.332118	-3.777054	-4.039627	-9.002729	-7.009106	-6.60967
	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
CNSMRP	-13.68538	-13.71624	-13.72409	-13.64112	-13.67688	-13.68573
	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
CNCP1RP	-15.69266	-15.11491	-8.59651	-15.76772	-15.12122	-8.59651
	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
CNCP2RP	-13.32813	-6.020712	-4.966256	-13.765	-13.40314	-12.34138
	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
CNCP3RP	-2.349826	-2.091389	-1.281338	-17.16467	-16.7641	-14.47754
	(0.4049)	(0.2484)	(0.1842)	(< 0.01)	(< 0.01)	(< 0.01)
USSMRP	-15.25422	-15.25979	-15.18532	-15.48099	-15.45182	-15.27842
	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
USCP1RP	-3.90788	-3.954336	-3.30804	-13.20581	-13.23523	-12.65507
	(0.0136)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
USCP2RP	-3.409153	-3.224223	-2.56797	-13.75375	-13.54463	-12.59578
	(0.0528)	(0.0199)	(0.0102)	(< 0.01)	(< 0.01)	(< 0.01)
USCP3RP	-14.86461	-14.90263	-13.15324	-14.86437	-14.90057	-14.00308
	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)
USCP4RP	-12.68851	-11.55161	-5.128514	-12.79716	-12.03036	-11.44356
	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)	(< 0.01)

Lags choice in Dickey-Fuller test (ADF) is performed with Schwarz Information Criterion and with the Newey-West band in Phillips-Perron test.

$\hat{\tau}_\beta$ and $\tilde{t}_\beta$ corresponding to the test with intercept and a linear trend: $\Delta x_t = \mu + \gamma x_{t-1} + \beta_t + \eta_t$

$$H_0 : x_t = x_{t-1} + \eta_t \; ; H_a : x_t = \mu + \Phi x_{t-1} + \beta_t + \eta_t \; \; ; \Phi < 1, \Phi - 1 = \gamma$$

$\hat{\tau}_\mu$ and $\tilde{t}_\mu$ corresponding to the test with intercept and no linear trend: $\Delta x_t = \mu + \gamma x_{t-1} + \eta_t$

$$H_0 : x_t = x_{t-1} + \eta_t \; ; H_a : x_t = \mu + \Phi x_{t-1} + \eta_t \; \; ; \Phi < 1, \Phi - 1 = \gamma$$

$\hat{\tau}$ and $\tilde{t}$ corresponding to the test with no intercept neither linear trend: $\Delta x_t = \gamma x_{t-1} + \eta_t$

$$H_0 : x_t = x_{t-1} + \eta_t \; ; H_a : x_t = \Phi x_{t-1} + \beta_t + \eta_t \; \; ; \Phi < 1, \Phi - 1 = \gamma$$

Numbers between parenthesis are MacKinnon *p values*, denoting the test marginal significance level.

Table 3. Mexican stock market risk premiums   January 1984 - December 2002

$$r_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i r_{t-1} + \sum_{i=1}^{k} \sum_{j=0}^{l} \beta_{i,l} X_{i,t-j} + \psi'\delta + \varepsilon_t$$

Variable	Coefficient	Standard error	t	p-value
Intercept	29.79453	3.467057	8.593608	< 0.01
MXCP1RP	3.333101	0.339130	9.828400	< 0.01
MXCP1RP$_{t-7}$	0.699068	0.347269	2.013043	0.0454
MXCP3RP$_{t-5}$	1.386047	0.483189	2.868537	< 0.01
MXCP3RP$_{t-7}$	1.583049	0.489634	3.233125	< 0.01
MXCP3RP$_{t-10}$	0.851159	0.436956	1.947926	**0.0528**
CRACK87	-73.56751	6.506447	-11.30686	< 0.01
STABILIZATION	-22.37618	3.407775	-6.566213	< 0.01
ADR	-6.170827	2.288154	-2.696858	< 0.01
NAFTA	-3.097350	1.420947	-2.179778	0.0304
VODKA	-22.96762	8.701067	-2.639632	< 0.01
WCMPRP	0.688886	0.138953	4.957704	< 0.01
R squared	0.604155			
Adjusted R squared	0.583018			
χ^2 normality (Jarque-Bera)	1.313496			0.518135
F autocorrelation (12 lags)	1.072840			0.385041
χ^2 autocorrelation (LM Breusch-Godfrey), 12 lags	13.56646			0.329245
$F_{heteroskedasticity}$	1.175003			0.287627
χ^2 heteroskedasticity	19.79570			0.284812
Arch-12	25.70875			0.011799
F RESET	0.174280			0.676773

Table 4. Canadian stock market risk premiums.   January 1984 - December 2002

$r_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i r_{t-1} + \sum_{i=1}^{k} \sum_{j=0}^{l} \beta_{i,l} X_{i,t-j} + \psi'\delta + \varepsilon_t$				
Variable	*Coefficient*	*Standard error*	*T*	*P-value*
$CNSMRP_{t-1}$	-0.113360	0.057105	-1.985140	0.0485
$CNSMRP_{t-2}$	-0.075743	0.042365	-1.787880	**0.0753**
$CNSMRP_{t-9}$	0.125749	0.052150	2.411306	0.0168
$CNSMRP_{t-12}$	-0.119731	0.040537	-2.953644	< 0.01
CNCP1RP	-1.806084	0.117337	-15.39224	< 0.01
$CNCP1RP_{t-1}$	-0.507908	0.150298	-3.379353	< 0.01
$CNCP1RP_{t-6}$	-0.267669	0.118317	-2.262306	0.0248
$CNCP1RP_{t-7}$	-0.290540	0.117664	-2.469239	0.0144
$CNCP1RP_{t-9}$	0.372095	0.149571	2.487743	0.0137
CNCP2RP	-0.942160	0.189872	-4.962068	< 0.01
$CNCP2RP_{t-4}$	0.488078	0.184870	2.640113	< 0.01
CNCP3RP	1.662172	0.213798	7.774499	< 0.01
$CNCP3RP_{t-1}$	1.657927	0.252172	6.574582	< 0.01
$CNCP3RP_{t-2}$	0.626961	0.232273	2.699242	< 0.01
$CNCP3RP_{t-3}$	0.805694	0.202664	3.975519	< 0.01
$CNCP3RP_{t-11}$	0.692567	0.201046	3.444811	< 0.01
CRACK87	-16.28601	3.339931	-4.876151	< 0.01
FTAUSCN	2.376313	0.611934	3.883283	< 0.01
NAFTA	-1.197348	0.567335	-2.110478	0.0361
VODKA	-16.36974	3.283867	-4.984897	< 0.01
R squared	0.707868			
Adjusted R squared	0.679549			
χ^2 normality (Jarque-Bera)	1.747899			0.417300
F autocorrelation (12 lags)	0.696172			0.753977
χ^2 autocorrelation (L-M Breusch-Godfrey), 12 lags	9.370266			0.671022
F heteroskedasticity	1.034620			0.424959
χ^2 heteroskedasticity	37.20390			0.413409
Arch-12	9.123443			0.692352
F RESET	1.543741			0.215554

Table 5. U.S. stock market risk premiums.   January 1984 – December 2002

$$r_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i r_{t-1} + \sum_{i=1}^{k} \sum_{j=0}^{l} \beta_{i,l} X_{i,t-j} + \psi'\delta + \varepsilon_t$$

Variable	Coefficient	Standard error	T	p-value
Intercept	1.161529	0.340119	3.415071	< 0.01
USSMRP$_{t-7}$	0.099762	0.052735	1.891776	**0.0600**
USSMRP$_{t-9}$	0.145816	0.064304	2.267584	0.0244
USSMRP$_{t-11}$	0.150638	0.062429	2.412953	0.0167
USCP1RP	-0.489019	0.174393	-2.804126	< 0.01
USCP1RP$_{t-2}$	-0.327338	0.166958	-1.960602	**0.0513**
USCP1RP$_{t-6}$	-0.285797	0.168206	-1.699088	**0.0909**
USCP1RP$_{t-8}$	0.315647	0.184085	1.714681	**0.0880**
USCP1RP$_{t-9}$	0.315247	0.176527	1.785834	**0.0757**
USCP1RP$_{t-12}$	0.406553	0.172078	2.362604	0.0191
USCP2RP$_{t-9}$	0.558397	0.201689	2.768599	< 0.01
USCP2RP$_{t-10}$	-0.503209	0.209159	-2.405865	0.0171
USCP3RP	2.196201	0.257078	8.542934	< 0.01
USCP3RP$_{t-5}$	0.713167	0.230922	3.088344	< 0.01
USCP3RP$_{t-9}$	-0.543719	0.274368	-1.981710	0.0489
USCP3RP$_{t-11}$	-0.517751	0.274362	-1.887110	**0.0606**
CRACK87	-19.65779	3.674967	-5.349108	< 0.01
DRAGON	-6.580707	3.510101	-1.874791	**0.0623**
VODKA	-12.11189	3.533418	-3.427812	< 0.01
R squared	0.536858			
Adjusted R squared	0.494540			
$\chi^2_{normality}$ (Jarque-Bera)	1.243182			0.537089
$F_{autocorrelation}$ (12 lags)	0.593937			0.845449
$\chi^2_{autocorrelation}$ (L-M Breusch-Godfrey), 12 lags	8.012839			0.784126
$F_{heteroskedasticity}$	0.770117			0.811112
$\chi^2_{heteroskedasticity}$	26.46589			0.782567
Arch-12	7.657551			0.811287
F_{RESET}	1.016584			0.314574