An empirical test of the consumption-based asset pricing model (CCAPM) in Latin America


Abstract

This study investigates whether the Consumption-based Capital Asset Pricing Model (CCAPM) is consistent with the data from four Latin-American countries: Brazil, Chile, Colombia, and Mexico. Empirical results showed that there is a statistical significant relationship between mean excess returns and consumption betas in the countries cited above, with the exception of Mexico. Such results are, in part, similar to the results reported in previous studies for the United States of America.

Key words: Capital Markets; Assets Pricing Models; CCAPM; Latin America; Two-Stage Cross-Sectional Regressions

JEL Code: G12, C21.

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(1) An extended version of this very paper has already been published in English as a chapter in the following book:

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1. Introduction

According to Mehra and Prescott (1985), historically, the average return on stock market shares in the United States has exceeded the average return on short-term virtually default-free bond. Analyzing the period from 1889 to 1978, they found that the real average annual return of the Standard and Poor’s 500 Index is 6.98%, while that of the United States Government risk-free debt bond is 0.8%, resulting in an equity premium of 6.18% per year.

In principle, according to asset pricing theory, an equity premium of this magnitude could only be explained by the risk inherent in the stock market, that is, the stocks, as they carry a higher risk than near-risk-free bonds, would need to compensate investors with higher average rates of return, which, in equilibrium, would be sufficient to balance the demand and the supply of these bonds. According to Abel (1991), this basic principle underpins the Capital Asset Pricing Model (CAPM), initially developed in the 1960s and enhanced since then.

However, as demonstrated by Mehra and Prescott (1985), the equity premium observed in the North American financial market, in the period from 1889 to 1978, can not be explained by an intertemporal equilibrium model, more specifically the Consumption-Based Capital Asset Pricing Model (CCAPM), which, according to Abel (1991), is perhaps one of the most important advances of the CAPM. This empirical inconsistency of the model proposed by the modern neoclassical theory of asset pricing has been denominated by Mehra and Prescott (1985) the equity premium puzzle.

According to Kocherlakota (1996), in order to better understand why the equity premium seen in the North American economy constitutes a puzzle, it is useful to review the bases of modern neoclassic theory of asset pricing. According to this theory, the differences between the average returns of the various financial securities are attributed to the level at which the return of these securities would covary with the consumption of the typical investor.

Kocherlakota (1996) asserts that, for the CAPM, the consumption flow of the typical investor is perfectly correlated with the return of the stock market and, thus, the risk of a given asset can be measured by the cova-
riance of its returns with the return of the stock market. In the CCAPM, an intertemporal equilibrium model based on the ‘representative agent’, the consumption flow of the typical investor is perfectly correlated with the per capita consumption and, consequently, the risk of an asset can be measured by the covariance of its returns with the rate of growth of per capita consumption.

Based on these considerations, it is possible to clearly specify what Mehra and Prescott (1985) define as the equity premium puzzle: within a reasonable interval of risk aversion on the part of the representative agent, the covariance of the real average return of the stock market and of the real average rate of the risk-free asset with the real rate of growth of consumption are not sufficiently different to explain the average equity premium of 6.18% per annum seen in the North American data for the period 1889 to 1978. In other words, stocks do not display high enough risk in comparison to the short-term U.S. T-Bill to justify such the higher excess returns.

Prior to Mehra and Prescott (1985) identifying this empirical inconsistency, Grossman and Shiller (1981) and Hansen and Singleton (1983) had already empirically tested the representative agent model and, in both cases, the estimated parameters led to the rejection of the CCAPM for the data from the North American economy. Other empirical studies based on the North American economy have also demonstrated that the CCAPM is inconsistent, particularly the studies of Mankiw and Shapiro (1986) and Grossman, Melino and Shiller (1987). The only evidence found to be favorable to the CCAPM in the North American setting is presented by Breen, Gibbons and Litzenberger (1989), which reported the existence of a statistically significant relationship between expected returns and the consumption beta, although the expected linear relationship between the variables had been rejected.

In the international economy, Campbell (1996) tested the CCAPM in several developing countries and his results revealed the existence of the equity premium puzzle in almost all the countries – of the twelve countries tested only one failed to present the phenomenon – showing that the puzzle is an internationally robust phenomenon.
In Latin America, especially in those countries included in the present study, the findings are mixed. In Brazil, the studies of Issler and Piqueira (2000), Sampaio (2002), Bonomo and Domingues (2002) among others, point to the inexistence of the puzzle, hence corroborating with the CCAPM. However, evidence recently presented by Cysne (2005) indicates that the equity premium puzzle is to be found in Brazil. Opazo (1998) and Bravo and Oyarzún (2001) tested the existence of the puzzle in the Chilean economy and confirmed the phenomenon there. In Colombia, Osorio and Puerta (2004) estimate the relative risk aversion coefficient close to zero, corroborating with the CCAPM.

The equity premium puzzle and all the studies that have demonstrated empirical inconsistencies when testing the CCAPM imply serious restrictions to the representative agent models. Therefore, testing the model in other countries, mainly among the emerging economies, becomes of great importance for the modern neoclassical theory of asset pricing, as favorable evidence for the model, in emerging countries, could shed new light on this theory and could provide the better understanding of the causes of its rejection in other countries; while the rejection of the model in these countries could lead academics to reformulate the theoretical bases supporting the model, incorporating new characteristics, in a way that the model becomes more compatible with the observed behavior of the individuals.

Given this situation, the aim of the present study is to empirically test whether the Consumption-Based Capital Assets Pricing Model (CCAPM) is consistent with the economic data from four Latin American countries: Brazil, Chile, Colombia and Mexico. More specifically, it intends to: 1) verify whether the theoretical implications associated with the CCAPM are confirmed by the empirical test proposed in this study; 2) demonstrate whether the CCAPM is capable of adequately explaining the differences between the returns on financial assets (stocks) in each country analyzed; and 3) compare the empirical results of the tests in this study of Latin American countries with previous studies in the literature.

According to Cochrane (2005, p.41), “the consumption-based model is, in principle, the complete answer to all asset pricing questions, but works poorly in practice”, that is, despite being insightful from the theo-
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...retical point of view, in practice, there are difficulties with the CCAPM that are made evident by the large number of studies that reject the model at the international level. In spite of the empirical rejections, the author emphasizes that instead of inventing, testing and rejecting new models, studies such as those of Mehra and Prescott (1985) and Hansen and Jagannathan (1991), for example, have offered new insights into the characteristics of the model, thus, opening the door to improvements of the model that may allow it to adjust to economic data more easily.

The present study can further the understanding of the CCAPM by testing it in the emerging countries of Latin America, contributing towards the theoretical enhancement of the model and advancing the understanding of the factors that lead to its rejection at an international level.

Furthermore, it should be pointed out that, to the best knowledge of the authors, empirical tests of the nature intended in the present study have not yet been carried out in relation to the CCAPM in Latin American countries. To date, the studies performed in these countries have focused on the estimation of some parameters of the model, such as the risk aversion coefficient and the stochastic discount factor, but have not carried out cross-sectional regressions in order to verify the capacity of the CCAPM to explain the differences between the returns obtained from a certain class of financial assets, as the present study aims to do. Therefore, the findings obtained from the research can be considered original and it is hoped that they will contribute towards improving the understanding of the behavior of the model in these countries.

This study is structured as follows: in section 2, the research method is detailed; in section 3, the results of the empirical test are shown for each country analyzed, and, finally, in the last section, the conclusions drawn in relation to the study are put forward.

2. Method, Hypotheses, Sampling, Data Collection and Treatment

2.1. Estimation process
According to the CCAPM, there is a positive relationship between the expected return and the consumption beta of the assets. In the present...
study, we test this relationship by using cross-sectional regression of the risk premiums on the consumption betas of a given set of assets (shares traded on the stock exchange). In the following paragraphs more details are given regarding to the process of estimating the parameters of the model.

The theoretical model is based on expected returns (ex-ante), nevertheless, such values are not observable and, thus, make estimation of the model unfeasible. To get round this problem, Huang and Litzenberger (1988, p. 304) suggest adopting the assumption of rational expectations, as “under rational expectations, the realized rates of return on assets in the given time period are drawings from the ex ante probability distributions of returns on those assets”. Therefore, based on this assumption, the use of realized returns (ex-post) in the estimation of the empirical model can be justified.

Besides using realized returns, it is convenient to set the model in terms of risk premium of the assets over the risk-free asset, which gives the following cross-sectional regression model:

\[ R_i = \lambda_0 + \lambda_1 \beta_i + \epsilon_i, \]

where:
- \( R_i \) is the risk premium of asset \( i \), \( i = 1, \ldots, N \);
- \( \beta_i \) is the consumption beta of asset \( i \), \( i = 1, \ldots, N \);
- \( \lambda_0 \) and \( \lambda_1 \) are parameters to be freely estimated by the regression model (1).

The theoretical expectation is that the parameter \( \lambda_0 \), the regression constant, equals zero, as the risk premium of an asset whose covariance with the growth rate of per capita consumption is null, theoretically, should be equal to zero. With regard the parameter \( \lambda_1 \), the slope coefficient, the expectation is that it will be positive and statistically significant, given that it should represent the premium for exposure to the risk factor ‘consumption growth rate’ \( \epsilon_i \) is the stochastic error term of the asset \( i \), \( i = 1, \ldots, N \), and it is expected to present the usual properties of white noise.

In the econometric model (1) the explanatory variable is the consumption beta of asset \( i \), a variable that can not be directly observed, but can be estimated from time series regressions. This way, the two-stage cross-sectional regression method proposed by Black, Jensen and Scholes (1972)
and Fama and MacBeth (1973) is employed. In short, this method consists in estimating, in the first stage, the consumption beta for each asset by means of time series regressions and, in the second stage, performing cross-sectional regression of the econometric model (1) using the consumption betas obtained in the previous stage as the explanatory variable.

The choice of this method of regression is made, primarily, because of its extensive use in tests of capital asset pricing models, such as the CAPM and the CCAPM. According to Jagannathan and Wang (1998, p. 1285), although there are more sophisticated methods for testing linear beta-pricing models, the method proposed by Black, Jensen and Scholes (1972) and Fama and MacBeth (1973) has been preferred in many empirical studies. Furthermore, according to the same authors, this method allows a clear interpretation of the results in economic terms, while with more sophisticated methods there is greater difficulty in interpreting the results obtained.

Another relevant aspect in the choice of this method, according to Lettau and Ludvigson (2001, p.1254), concerns the advantages in applying the cross-sectional regression method from Fama and MacBeth (1973) in samples characterized by a small number of time series observations and by a reasonable number of cross-sectional observations, as is the case with the sample studied in the present study. According to these authors, in samples where the number of time series observations is small relative to the number of cross-sectional observations, the use of the Generalized Method of Moments (GMM) with estimation of the weighted matrix is not appropriate, since, in small samples, this form of estimation will result in a poor estimation of that matrix.

This argument can naturally be extended to the maximum likelihood estimation (MLE), since, according to Gujarati (2006, p. 91), the maximum likelihood estimator of the variance of the error terms ($\sigma^2$) can only be considered unbiased in the case that the sample size ($n$) increase indefinitely, that is, the maximum likelihood estimator of $\sigma^2$ is asymptotically unbiased. Corroborating with this limitation, Maddala (2003, p. 64) asserts that “the MLE method is an estimation method for large samples”. Therefore, considering the limited size of our sample, it is understood that (4) Of particular interest among the empirical studies that adopt the two-stage cross-sectional regression method for testing CCAPM are: Mankiw and Shapiro (1986), Elyasiani and Nassah (2000), Lettau and Ludvigson (2001) and Jagannathan and Wang (2005). With regard the tests of the CAPM model, the following empirical studies can be highlighted: Black, Jensen and Scholes (1972), Fama and MacBeth (1973), Blume and Friend (1973), Mankiw and Shapiro (1986), Fama and French (1992), Jagannathan and Wang (1996), Elyasiani and Nassah (2000), Lettau and Ludvigson (2001) and Jagannathan and Wang (2005).
the MLE method is not the most appropriate method for the empirical
tests to be carried out in the present study.

Given these considerations, the estimation of the parameters in (1) by
the two-stage cross-sectional regression method is convenient and suitable,
and, therefore, will be the method adopted in the empirical tests in the pre-
sent study.

2.2. Formulation of hypotheses
In order to ascertain the adherence of the CCAPM to the data from four
Latin American countries (Brazil, Chile, Colombia and Mexico), it is exa-
mined whether the theoretical implications derived from the model can be
confirmed by the empirical test proposed in this study. In this section, the
theoretical implications of the model are defined, and those implications
give rise to the research hypotheses.

According to the CCAPM, the differences between assets returns are
determined by the differences between their consumption betas, the latter
being a measure of exposure of the returns from an asset to the risk factor
‘growth rate of per capita consumption’. The greater the consumption beta
of an asset, the greater its risk and, consequently, the greater its expected
return should be. Therefore, the CCAPM implies a positive linear relation
between the average returns (or average risk premiums) and the consump-
tion betas. This implication is central to the CCAPM and gives rise to the
primary hypothesis:

Primary Null Hypothesis \((H_0)\): There is not a positive and statistically
significant relation between the average risk premiums and the consump-
tion betas of the assets, that is:

\[ H_0 : \lambda_1 = 0, \]

where: \( \lambda_1 \) is the slope coefficient of the cross-sectional regression of the
average risk premiums on the consumption betas.

Primary Alternative Hypothesis \((H_1)\): There is a positive and statisti-
cally significant relation between the average risk premiums and the con-
sumption betas of the assets, that is:
$H_1 : \lambda_1 > 0,$

In the CCAPM, the consumption beta appears as the only measure of systematic risk of the asset, that is, nothing apart from exposure to the risk factor ‘growth rate of per capita consumption’ should systematically affect the expected returns of the assets. Thus, the consumption beta is a complete measure of the risk of any asset. This implication results in the following secondary hypothesis to be tested:

**Secondary Null Hypothesis ($H_0'$):** the consumption beta of an asset is a complete measure of its systematic risk. Thus, it is that:

$H_0' : \lambda_2 = 0,$

where: $\lambda_2$ is the slope coefficient of the residual variances variable in the cross-sectional regression determined by the econometric model (2) below:

$$R_i = \lambda_0 + \lambda_1 \beta_{i,\Delta c} + \lambda_2 VR_i + u_i, i = 1, \ldots, N,$$  \hspace{1cm} (2)

where: $VR_i$ is the variance of the residuals of the time series regression for estimation of the consumption beta of the asset $i$.

**Secondary Alternative Hypothesis ($H_1'$):** the consumption beta of an asset is not a complete measure of its systematic risk, that is:

$H_1' : \lambda_2 > 0.$

Lastly, a specification test of the econometric model (1) is carried out. According to the CCAPM, if all individuals are able to invest or borrow at the risk-free interest rate, the intercept of the regression of the average risk premiums on the consumption betas should be equal to zero (Sharpe-Lintner’s hypothesis). However, if this interest rate does not exist, it can be assumed that an asset exists in the economy whose covariance with the growth rate of per capita consumption is equal to zero (zero-beta) and, hence, the intercept need not necessarily be equal to zero (Black’s hypothesis). It is important to note that the rejection of the Sharpe-Lintner’s hypothesis favors the specification given by Black (1972), while the acceptance of that hypothesis does not imply the rejection of the latter. Thus, the third pair of hypotheses to be tested is:
Third Null Hypothesis \((H_0'')\): There is a risk-free interest rate in the economy at which all individuals are able to invest and borrow, that is:

\[ H_{0''} : \lambda_0 = 0, \]

where: \(\lambda_0\) is the intercept of the cross-sectional regression of the average risk premiums on the consumption betas – econometric model (1).

Third Alternative Hypothesis \((H_1'')\): There is not a risk-free interest rate in the economy in which all individuals are able to invest and borrow, that is:

\[ H_{1''} : \lambda_0 \neq 0. \]

It should be noted that only the primary and secondary hypotheses can lead to the rejection of the CCAPM, given that they both test the theoretical implications of the model, while the third hypothesis is merely a test of the specification and, therefore, does not have the power to reject the pricing model subjected to the empirical tests.

2.3. Description of the sample

The frequency of the data used in the present study is quarterly and this choice is based, fundamentally, on three important aspects related to empirical tests of the CCAPM: i) According to Breeden, Gibbons and Litzenberger (1989), the longer the time interval in which the consumption is reported, the less affected the data are by temporary fluctuations and measurement errors in this variable; ii) Furthermore, according to these authors, in the proportion that the time interval decreases, non-durable consumer goods become “more durable”; and iii) According to Jagannathan and Wang (2005, p.2), “working with a longer horizon attenuates the errors that may arise due to ignoring the effect of habit formation on preferences”.

As can be seen, the use of longer time intervals is preferable when performing tests of the CCAPM. Annual series would be the most recommended. However, in the present study, characterized by a consumption series whose publication only began in the 1990s, the use of a series at such a frequency would result in a very small number of observations.
The period covered by the research in each of the countries (Brazil, Chile, Colombia and Mexico) is determined by the availability of the series of growth in aggregated consumption. Thus, Table 1 shows the period in which these series are available, as well as the number of quarters covered in each country in the present study.

The initial sample of firms, in each country, refers to all the traded stocks whose quotes are available in the database of Economática®. The criteria for firm selection, in the present study, must fulfill two purposes: i) generate a sample of the most traded stocks in each country; and, ii) generate samples with a considerable number of stocks, in such a way as to obtain significant and representative results for each economy in the study.

In the present study, quarterly returns of the financial assets are computed by aggregating the monthly returns into quarters by means of capitalization of these returns. Given that returns are necessary at a monthly frequency, the selection criteria basically refer to the quantity of months, within a determined period, in which the stocks have been quoted. Hence, in order to be included in the sample of their respective country, the stocks must obey the following selection criteria: present one (1) quotes in at least “X” months and “Y” quotes in at least “Z” months, in which “X”, “Y” and “Z” are numbers to be defined for each country according to the number of months available and observing the objective of including a significant number of stocks in the sample. This method of selection is also used by Mellone Junior (1999) when testing the CAPM in Brazil.

Table 2 shows the “X”, “Y” and “Z” values for each country in the study. The period shown in Table 2, includes, besides the monthly frequency, an extra quarter at the beginning of the period in relation to the previous table (Table 1). This occurs because it is necessary to have quotes lagged in one period to calculate the returns of financial assets. Considering the information contained in Table 2 as a whole, it should be clear that the criteria are more restrictive in the cases of Brazil and Chile, requiring one (1) quote in 67% of the months and 11 quotes in 50% of the months, while in Colombia and Mexico these criteria are less restrictive, so that the two aforementioned objectives are fulfilled satisfactorily.
Applying the above defined selection criteria, we get the set of stocks that makes up the sample of each of the countries under analysis. Table 3 shows the number of stocks initially collected from the Economática® database, the number of stocks that are selected according to the previously described criteria, the number of stocks excluded, the number of stocks that constitutes the final sample and the percentage of the final sample in relation to the initial one, for each country in the study.

### Table 1. Period of Study for Each Country

<table>
<thead>
<tr>
<th>Country</th>
<th>Initial Quarter</th>
<th>Final Quarter</th>
<th>Number of Quarters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>1991:Q2</td>
<td>2004:Q4</td>
<td>55</td>
</tr>
<tr>
<td>Chile</td>
<td>1996:Q2</td>
<td>2005:Q2</td>
<td>37</td>
</tr>
<tr>
<td>Colombia</td>
<td>1994:Q2</td>
<td>2005:Q2</td>
<td>45</td>
</tr>
<tr>
<td>Mexico</td>
<td>1993:Q2</td>
<td>2005:Q3</td>
<td>50</td>
</tr>
</tbody>
</table>

### Table 2. “X”, “Y” And “Z” Values of the Selection Criteria for Each Country

<table>
<thead>
<tr>
<th>Country</th>
<th>Period</th>
<th>Total Months</th>
<th>Number of Months ≥ 1 Quote (“X”)</th>
<th>% of Total</th>
<th>Number of Quotes (“Y”)</th>
<th>Number of Months ≥ “Y” Quotes (“Z”)</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>1991:M1-2004:M12</td>
<td>168</td>
<td>112</td>
<td>67%</td>
<td>11</td>
<td>84</td>
<td>50%</td>
</tr>
<tr>
<td>Chile</td>
<td>1996:M1-2005:M6</td>
<td>114</td>
<td>76</td>
<td>67%</td>
<td>11</td>
<td>57</td>
<td>50%</td>
</tr>
<tr>
<td>Colombia</td>
<td>1994:M1-2005:M6</td>
<td>138</td>
<td>69</td>
<td>50%</td>
<td>5</td>
<td>46</td>
<td>33%</td>
</tr>
<tr>
<td>Mexico</td>
<td>1993:M1-2005:M9</td>
<td>153</td>
<td>77</td>
<td>50%</td>
<td>8</td>
<td>51</td>
<td>33%</td>
</tr>
</tbody>
</table>

Observing Table 3, it can be noticed that the selection criteria significantly reduced the number of stocks in comparison with the initial sample. This is necessary because the objective is to obtain a sample with the most traded stocks from each country. It is important to bear in mind that liquidity is an important factor when testing pricing models, as Ribenboim
(2002) states when testing the CAPM with Brazilian data. However, as Rodrigues (2000) notes, upon selecting the most traded firms some degree of bias in terms of survival could be imputed. Nonetheless, it is believed that this bias should not influence the results, as a priori, in an efficient market, there should be no difference in the pricing of “winning” and “losing” assets.

Regarding the exclusions shown in Table 3, these refer to the stocks that underwent extraordinary alterations in their prices overnight (possibly a recording mistake in the Economática® database). It is understood that these exclusions are necessary, given that the average returns of these stocks are clearly influenced by the return on a single day.

It is noteworthy that the final Brazilian sample is the one that has the largest number of stocks, although it is the least representative in relation to the initial sample. Despite this, the sample is composed of the largest Brazilian firms and in terms of market value can be considered representative.

<table>
<thead>
<tr>
<th>Country</th>
<th>Initial Sample</th>
<th>Firms Selected</th>
<th>Exclusions</th>
<th>Final Sample</th>
<th>% Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>860</td>
<td>142</td>
<td>1</td>
<td>141</td>
<td>16%</td>
</tr>
<tr>
<td>Chile</td>
<td>259</td>
<td>75</td>
<td>1</td>
<td>74</td>
<td>29%</td>
</tr>
<tr>
<td>Colombia</td>
<td>77</td>
<td>28</td>
<td>1</td>
<td>27</td>
<td>35%</td>
</tr>
<tr>
<td>Mexico</td>
<td>185</td>
<td>80</td>
<td>1</td>
<td>79</td>
<td>43%</td>
</tr>
</tbody>
</table>

2.4. Data collection
In order to carry out the empirical tests on the CCAPM the following data are necessary: a) returns on stocks; b) aggregate consumption of non-durable goods and services; c) rates of return on risk-free assets; d) consumer price index; e) resident population.

The series of daily stock quotes, adjusted for inflation and dividends, from each of the countries are collected from the Economática® database. The deflator used to adjust the prices in real terms is the Consumer Price Index (CPI) of each country.
With regard the quarterly consumption of non-durable goods and services,\(^5\) in Brazil, this series, is provided by Pessoa (2006). This series is available for the period 1991:Q1 to 2004:Q4. For the remaining Latin American countries, the series of quarterly consumption of non-durable goods and services is collected as shown in Table 4.

Table 4. Sources for the Series Consumption of Non-Durable Goods and Services: Chile, Colombia and Mexico

<table>
<thead>
<tr>
<th>Country</th>
<th>Source</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chile</td>
<td>Banco Central de Chile</td>
<td>1996:Q1-2005:Q2</td>
</tr>
<tr>
<td>Colombia</td>
<td>Departamento Administrativo Nacional de Estadística (DANE)</td>
<td>1994:Q1-2005:Q2</td>
</tr>
<tr>
<td>Mexico</td>
<td>Instituto Nacional de Estadística Geografía e Informática (INEGI)</td>
<td>1993:Q1-2005:Q3</td>
</tr>
</tbody>
</table>

Nevertheless, there is no effective direct measure of individual consumption, but only a measure of the expenditures with consumption. According to Breeden, Gibbons and Litzenberger (1989) this difference between consumption in theory and its measurement in the real world leads to the following problem: goods and services are not necessarily consumed at the same time that they are purchased. In order to minimize this problem, the empirical test involving CCAPM make use of the expenditures with non-durable goods and services of individuals, excluding the expenditures

As proxy for the returns on risk-free assets, the interest rates from each country in the analysis are used. In Brazil, the Selic (Sistema Especial de Liquidação e Custódia) rate is used, which is the basic rate of interest of the economy, serves as a reference for other rates of interest in the country. The nominal monthly series of this rate is collected from the website of the Instituto de Pesquisa Econômica Aplicada (IPEADATA).

In the case of Chile\(^6\) and Colombia\(^7\) the interest rates available from the International Financial Statistics (IFS) database of the International Monetary Fund (IMF) are used. Of those available, the ‘Lending Rate’ is chosen, as it presents the lowest volatility in relation to the other rates of interest. The nominal annualized series of this interest rate is collected on a monthly basis.

In Mexico, the 91-day Cetes (Certificados de la Tesorería de la Federación) are used as proxy for the returns on the risk-free assets. According to Castellanos and Oviedo (2004), these certificates are credit bonds issued by the Mexican Federal Government and liquidated on their maturity. According to the same authors, the yield from these public debt bonds serve as a base for determining the other rates of interest in the Mexican economy, which warrants the use of this bond as a proxy for risk-free asset. The series of nominal monthly yields of the 91-day Cetes are collected from the website of the Banco Central do Mexico.
As the interest rates in Latin American countries are expressed in nominal terms, including those collected from the IMF database, it is necessary to deflate them in order to obtain real series. To ensure coherence regarding the deflator used to adjust the series of stock prices in real terms, the Broad Consumer Price Index (IPCA) for the Brazilian series and the Consumer Price Index (CPI) for the other Latin American countries are used. These price indexes are collected on a monthly basis, as shown in Table 5.

Data regarding the resident population in each quarter is necessary to compute the per capita consumption series. In Brazil the consumption series obtained is already expressed in per capita terms, therefore data is not collected regarding the resident population for this country. In the other Latin American countries the annual estimated population series are collected from the following databases: Chile – Instituto Nacional de Estadísticas (INE); Colombia – Departamento Administrativo Nacional de Estadística (DANE); and Mexico – Comissão Econômica para America Latina and Caribe (CEPAL).

In order to make a comparison with the Latin American countries in the study, data is also collected from the United States. A series of real monthly returns on 25 weight-valued portfolios of Fama and French (1992) and the interest rate of the one-month U.S. Treasury Bill are obtained from Kenneth R. French’s website.8 The series necessary for the formation of the growth rate of per capita consumption of non-durable goods and services are collected from the website of the Bureau of Economic Analysis, Division: National Income and Product Accounts (NIPA).9

Table 5. Sources for the Series Consumer Price Index for Each Country

<table>
<thead>
<tr>
<th>Country</th>
<th>Source</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>Instituto de Pesquisa Econômica Aplicada (IPEADATA)</td>
<td>Monthly Percent</td>
</tr>
<tr>
<td>Chile</td>
<td>IMF’s International Financial Statistics (IFS)</td>
<td>Index</td>
</tr>
<tr>
<td>Colombia</td>
<td>IMF’s International Financial Statistics (IFS)</td>
<td>Index</td>
</tr>
</tbody>
</table>

(6) In Chile a number of different interest rates with durable goods, since the consumption flow of this kind of good is much more difficult to estimate. As only a fraction of the effective consumption is used in empirical tests of the CCAPM, it becomes subject to the same problem reported by Roll (1977) in testing of the CAPM model: the non-observable true market portfolio. However, like Breeden (1979, p. 292), it is believed that the consumption of non-durable goods and services represents a much larger fraction of the true consumption flow of individuals when compared with the fraction that the stock market occupies in the true market portfolio.
could be used as proxies for risk-free asset, for example: the interest rate of the 90-day securities offered by the Chilean Central Bank – PRBC (Tasas de interés de los pagarés y bonos licitados por el Banco Central de Chile), the interest rate of the 90-day bonds and certificates offered by the Chilean Central Bank – PBDC, and the monetary policy rate. However, it was not possible to use these in the present study, due to the unavailability of data covering the entire research period as well as the various structural breaks.

(7) The interest rate series of the 90-day term deposits (Tasa de Interés de los Certificados de Depósito a Término a 90 días), which would represent a good proxy for the risk-free asset in Colombia, underwent a change in its methodology in July 1993. As this change occurred during the period covered by the research in Colombia we decided not to use this series.

(8) http://mba.tuck.dartmouth.edu/pages/faculty

2.5. Data treatment

The data collected is the base for the construction of the time series necessary for application of the empirical test proposed in the present study. The series used in the regressions detailed below, are multiplied by 100 in order to obtain their percentage values. The remaining aspects related to the construction of the series are described below.

Beginning with the daily stock quotes traded on the stock exchange in each of the countries, the simple mean of the prices of each of the stocks in each of the months is obtained. These series of average monthly prices are then used in calculating the monthly return of each stock. This process of calculating the monthly returns is used by Mellone Junior (1999) and Ribenboin (2002) when testing the CAPM in Brazil. This is believed to be the most suitable procedure of all those available, as it takes into consideration all the quotes of a determined month in order to calculate the monthly return, instead of being based on only an initial and final quote, for example. The real quarterly series of stock returns are computed by capitalizing the monthly stock returns.

By the capitalization of the monthly interest rates within each quarter, the nominal quarterly series of interest rates from each one of the countries is obtained. For Chile and Colombia, where the interest rates are annualized, the rates are converted to a monthly base from which the capitalization within each quarter is obtained. The interest rate series from each one of the countries are then deflated by their respective Consumer Price Index, which resulted in quarterly series of real interest rates.

The quarterly risk premiums are formed from the difference between the series of real quarterly returns on stocks and the series of real quarterly returns on the risk-free asset of each country. The risk premiums are the dependent variables in the time series regressions for estimation of the consumption betas of each asset (1st stage of the regression method). The average risk premium of each stock is calculated from these time series, based on the simple arithmetic average of the quarterly risk premiums. These average values are the dependent variables in the cross-sectional regressions carried out in the present study (2nd stage of the regression method).
Given that not all the stocks presented returns in all the quarters of the sample, for the purposes of statistical inference and estimation, the missing observations are substituted by estimates. These estimates are obtained in the following manner:

1) Using the available information for each stock, the intercepts and consumption betas are estimated by means of the econometric model (18);

2) Based on these coefficients and in the growth rate of consumption series, whose observations are available for the entire sample, the missing risk premiums are calculated using the following equation:

\[ R_{i,t}^e = \alpha_i + \beta_{i,c} \Delta c_t \]  

(3)

According to Greene (1997, p. 430), this method of estimating the missing data is widely known as first-order regression. For this author, the method maintains the non-tendentious property of the estimators and apparently produces a gain in efficiency, given that the errors of the model in the formerly missing observations equal to zero. However, the author emphasizes “the gain in efficiency from using these fitted values may be illusory” and that “the overall conclusion seems to be that in the single-equation regression context, filling in missing values of \( y \) is not a good idea”. Despite these warnings, estimates are made of the missing values, as the corrected variance estimates require complete time series of the returns. It should be pointed out that the results do not appear to be sensitive to the use of these estimates.

In order to maintain the comparability of the CCAPM, as suggested in the literature, the series of consumption of non-durable goods and services are adjusted for seasonality. The method chosen for this is the ‘ratio to moving average’ of the E-views statistical software. The Brazilian, Colombian and North-American series are already adjusted for seasonality. The per capita series are constructed based on the series adjusted for seasonality, by dividing them by the quarterly population of each country. The quarterly population series are obtained from the geometric interpolation of the annual series. Lastly, the growth rate of per capita consumption is obtained by dividing the per capita consumption of one quarter by the per capita consumption of the previous quarter and subtracting one.
For the purposes of analyzing the stock market behavior in each country over time, an equally weighted portfolio is formed of all the stocks contained in the final sample. Hence, time series are obtained with the real quarterly returns of the stock portfolio of each one of the countries in the study, including the United States. For the same purposes, a series of the excess returns (risk premium) of the stock portfolio is constructed by the difference between the series of real quarterly returns on the stock portfolio and the series of real quarterly returns on the risk-free asset of each country.

3. Analysis of the Results

Table 6 shows some statistical descriptions of the main time series used in carrying out the empirical tests. For the benefit of comparison, the statistics from the North-American series for the period 1991:Q1-2005:Q2 have also been included. The analysis of this data shows that the average risk premium (equity premium) is positive for all the countries with the exception of Colombia. Brazil has the highest average risk premium, with a value of 4.78% per quarter, followed by the United States, Mexico, and Chile, where the risk premiums are respectively 3.16%, 1.51% and 0.60% per quarter. According to the theory outlined above, the higher the risk premium, the greater the risk aversion of the individuals and/or the greater the risk of the environment (variability of consumption). With regard to Colombia, the existence of a negative risk premium (-2.37% per quarter) suggests that the stock portfolio is less risky than the asset considered to be risk free, an assumption that will be confirmed in the following analysis.

It can be seen that Brazil, Mexico, and the United States have very similar average growth rates of per capita consumption, varying from 0.39% per quarter for Brazil to 0.47% per quarter for the United States. At the extremes is Colombia, with an average growth rate of per capita consumption of 0.05% per quarter, and Chile, whose average growth rate of per capita consumption is 0.72% per quarter.

Looking at the volatility of the stock portfolio and the growth rate of per capita consumption, it can be seen that there are great differences in these figures between Chile and the United States, the stock portfolios being much more volatile than the growth rate of per capita consump-
The greater this difference, the greater the level of risk aversion necessary to explain the variations in the prices in stock market given a variation in the per capita consumption. In the other countries, Brazil, Colombia, and Mexico, the growth rate of per capita consumption is seen to be slightly more volatile than the stocks portfolio, suggesting that the level of risk aversion on the part of individuals is lower in these countries, *ceteris paribus*. Colombia can be seen to have the greatest volatility in the per capita consumption series (15.60) among the countries in the sample, followed by Mexico (5.10), Brazil (3.46), Chile (1.65), and the United States (0.74). It is important to point out that, according to the theory, the greater the volatility in this series the greater the risk in the environment.

When analyzing the covariance between the return and consumption series, it can be seen that in all the countries, with the exception of Chile, the covariance of the returns of the stock portfolio with the growth rate of consumption is greater than the covariance of the returns of the risk-free asset with the growth rate of consumption. In these countries, therefore, the returns of the stock portfolio are shown to be of greater risk than the returns of the asset that is considered risk-free, suggesting that there is a positive risk premium among these assets. In Brazil, Mexico, and the United States there is a positive risk premium (equity premium), corroborating (12) This corroborates the evidence reported in previous studies regarding the excessive variability in the North American share market. See, for example, Grossman and Shiller (1981) and the review made at an international level by Campbell (1996).
the theory. In Colombia, as highlighted previously, the stock portfolio had a negative risk premium,\(^\text{(13)}\) in contrast to the prediction of the theory which suggests that the greater exposure of this portfolio to risk should lead to a positive risk premium in relation to the risk-free asset. With regard to Chile, in the period under analysis, the opposite behavior to that seen in the other countries is found, that is, the returns of the stock portfolio present less risk than the returns of the asset considered risk-free. This fact is really quite intriguing and leads to the following question: how can be explained the positive risk premiums of these assets in the Chilean economy?

Another important aspect to be noted is the magnitude of the differences between these covariances. According to the CCAPM, the greater this difference, the greater the risk of the stock portfolio in relation to the risk-free asset and, so, the lower the level of risk aversion necessary to explain the risk premium among these assets. This relationship between the risk premium, the covariance, and the relative risk aversion coefficient is demonstrated by the equation of the determination of the risk premium of the stocks given by Grossman, Melino and Shiller (1987, p. 316):

\[
E_t(R^e_i) = \gamma \text{cov}(R^e_i, \Delta c),
\]

where: \(\text{cov}(R^e_i, \Delta c) = \text{cov}(R_i, \Delta c) - \text{cov}(R_f, \Delta c)\) \(^\text{(3)}\)

Analysis of these differences, shown in Table 6, reveals that Brazil has the greatest difference between the risk levels of the stock portfolio and the risk-free asset, while among the other countries this distinction is relatively small.

Before proceeding with the analysis of the cross-sectional regressions it is important to verify the stationarity of the series of growth rates of per capita consumption of each country, since this is a property required in the time series regressions necessary for the estimation of the consumption betas. To this end, the Augmented Dickey-Fuller Unit Root Test is performed, in which the null hypothesis is that the time series has a unit root, that is, it is non-stationary. The results reject the null hypothesis at the 1% significance level for the consumption series of Brazil, Chile, and Colombia, and at a significance level of 5.31% for the consumption series of Mexico.
Similarly, it is important to investigate whether or not the model satisfies the main classical hypotheses of the linear regression model, since the desirable properties of the estimators (absence of bias and minimal variance) and the validity of the significance tests depend on their confirmation.\(^\text{(14)}\)

Regarding the homoskedasticity of the residuals, the White test shows that the null hypothesis that the residuals are homoskedastic in the regressions carried out for Brazil and Chile cannot be rejected. In the regressions carried out in Colombia and Mexico, the White test points to the rejection of the null hypothesis at a significance level of 5% and 10%, respectively. The presence of heteroskedasticity, according to Gujarati (2006), does not destroy the properties of non-tendentiousness and of consistency of the OLS estimators, but they do lose efficiency, even in large samples. Therefore, in such cases, caution should be used when interpreting the results obtained.

The Durbin-Watson test points to the absence of first-order serial correlation of the residuals and the Breusch-Godfrey test suggests that the null hypothesis of absence of second-order serial correlation cannot be rejected. These findings are present in all regressions performed.

The normality of the residuals is not rejected in the regressions carried out for Brazil, Chile, and Colombia.\(^\text{(15)}\) In the regression for Mexico, this hypothesis is rejected at the level of significance of 5% for all the applied tests. According to Gujarati (2006), the hypothesis of normality is not essential if the aim is only to obtain an estimate, as the estimators of ordinary least squared are the best linear unbiased estimators (BLUE) whether the residuals are normally distributed or otherwise. However, according to the same author, the usual \(t\)-statistics may not follow the Student-\(t\) distributions, that is, such statistics may not be valid in small samples, affecting the tests of the hypotheses. In this case, therefore, greater caution should be applied to the results obtained with the cross-sectional regression carried out on the Mexican financial assets.

Table 7 shows the results of the cross-sectional regression of the average risk premiums on the consumption betas in each country analyzed: Brazil, Chile, Colombia, and Mexico. The main purpose of the regression is to verify whether the central implication of the pricing model in question can
be confirmed, that is, whether there is a statistically significant relationship between the average risk premiums and the consumption betas.

Table 7. Results of the Cross-sectional Regressions of the Average Risk Premiums on the Consumption Betas

<table>
<thead>
<tr>
<th>Country</th>
<th>Constant</th>
<th>Consumption Betas</th>
<th>R²</th>
<th>Adj. R²</th>
<th>F-Stat</th>
<th>Durbin-Watson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>2.7176</td>
<td>0.3522</td>
<td>0.1183</td>
<td>0.112</td>
<td>18.6513</td>
<td>1.88145</td>
</tr>
<tr>
<td></td>
<td>0.98848</td>
<td>1.35215 *</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chile</td>
<td>0.8861</td>
<td>0.43499</td>
<td>0.141</td>
<td>0.129</td>
<td>11.8141</td>
<td>2.09442</td>
</tr>
<tr>
<td></td>
<td>0.47923</td>
<td>1.4942 *</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colombia</td>
<td>-3.1677</td>
<td>0.3312</td>
<td>0.2048</td>
<td>0.173</td>
<td>6.4389</td>
<td>1.71532</td>
</tr>
<tr>
<td></td>
<td>-2.02802 *</td>
<td>1.92362 **</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mexico</td>
<td>0.7059</td>
<td>0.0738</td>
<td>0.002</td>
<td>-0.011</td>
<td>0.1547</td>
<td>2.12198</td>
</tr>
<tr>
<td></td>
<td>0.46705</td>
<td>0.17122</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

These results refer to the cross-sectional regression of model (19). Coefficient estimates (first line) and Shanken (1992) corrected t-statistics (second line) are reported for each country, alongside the coefficients of determination, F-statistic, and Durbin-Watson statistic for the regressions. * Significant at the 10% level; ** Significant at the 5% level.

Based on the corrected t-statistics, it can be seen that the constant is statistically different from zero only in Colombia, with a significance level of 10%, thus rejecting the third null hypothesis and suggesting that the specification zero-beta, proposed by Black (1972), is more suitable in the Colombian case. In the other countries, this hypothesis cannot be rejected at the usual levels of significance. Therefore, the hypothesis of Sharpe-Lintner, that there is a risk-free asset being freely traded in the economies of Brazil, Chile, and Mexico cannot be rejected.

The slope coefficient of the variable ‘consumption beta’ is shown to be positive and statistically significant in the cross-sectional regressions carried out in Brazil, Chile, and Colombia, rejecting the primary null hypothesis and showing that there is a statistically significant relationship between the average risk premiums and the consumption betas in these countries. These findings corroborate the CCAPM in the above mentioned countries, since the principal implication derived from the model is confirmed by the empirical test. It is of particular note that the level of significance necessary for the rejection of the primary null hypothesis is 10% in
Brazil and Chile and 5% in Colombia. In Mexico the value of the slope coefficient is at 0.0738, although statistically insignificant at the usual levels of significance, failing to reject the primary null hypothesis. The non-rejection of this hypothesis implies the rejection of the CCAPM in Mexico, as there is no positive and statistically significant relationship between the average risk premiums and the consumption betas in that country. It is important to point out that the Shanken (1992) adjusted t-statistics would be based on an asymptotic correction and, therefore, should be analyzed with caution.

By assessing the adjusted $R^2$ and $R^2$, it is possible to get some idea of how well the CCAPM explains the differences between the average risk premiums of the assets in the countries under study. The adjusted $R^2$ values vary from a minimum of -0.011 (Mexico) to a maximum of 0.173 (Colombia), indicating that, taking into account the degrees of freedom, only a small fraction (-1.1% in Mexico and 17.3% in Colombia, for example) of the cross-sectional variations of the average risk premiums are explained by the CCAPM. Coefficients of determination of this magnitude indicate that the model explains poorly the differences between the returns of the diverse financial assets (stocks). Therefore, this finding restricts the practical use of the model in most actual financial decisions, such as: cost of capital, determining expected returns, resource allocation, etc.

The results of the regression of the average risk premiums on the consumption betas and the residual variance, the purpose of which is to test the secondary null hypothesis that the consumption beta is a complete measure of the risk of an asset, are presented in Table 8. In Brazil and Mexico the slope coefficient of the variable ‘residual variance’ is shown to be positive and statistically significant at the levels of 1% and 10%, respectively, rejecting the secondary null hypothesis. These findings show that the consumption beta may not be a complete measure of asset risk and imply the rejection of the CCAPM in these countries. In the other countries, Chile and Colombia, the slope coefficient of this variable is not significantly different from zero at the usual levels of significance, corroborating the secondary null hypothesis and suggesting that the consumption beta could be used as a complete measure of asset risk in these countries.
Lastly, it is appropriate to point out that these regressions are susceptible to the problem of measurement errors in variables and, therefore, their results should be interpreted with caution.

Table 9 presents a summary of the results of the hypotheses tests performed in the four Latin American countries, as well as the benchmark, i.e. the United States. For the United States, the results obtained by Lettau and Ludvigson (2001) based on quarterly data covering the period 1963:3 to 1998:3 are used, which can be found in Table 8 of their paper. In that study, the authors run a cross-sectional regression of the returns of the 25 Fama and French portfolios on the consumption betas of these portfolios.

The primary null hypothesis states that the slope coefficient of the consumption betas is equal to zero. This hypothesis is considered the most important as it refers to the central idea of the model, that is, the existence of positive and statistically significant relationship between the average risk premiums and the consumption betas, consequently its non-rejection would imply the empirical inconsistency of the CCAPM. Analysis of Table 9 shows that the hypothesis is rejected in Brazil, Chile, and Colombia. The rejection of the CCAPM, according to this hypothesis, is verified only for Mexico and the United States (benchmark).
The secondary null hypothesis states that the consumption beta is a complete measure of the risk of an asset, that is, there is no other risk factor, apart from the covariance of the returns with the growth rate of per capita consumption, that systematically affects the returns of the assets. This hypothesis, like the first, can lead to the rejection of the CCAPM. In observing Table 9 it can be seen that this hypothesis is rejected in Brazil and Mexico, suggesting the rejection of the model in these countries. In contrast, in Chile and Colombia there is no such rejection of this hypothesis, thus demonstrating that these countries are the only ones that corroborate all the theoretical implications derived from the model.

The coefficients of determination, represented by the adjusted R² of the cross-sectional regressions in each country, demonstrate that the explanatory power of the CCAPM is very small in the countries under study and also in the North-American benchmark. Even in those countries where there appears to be a positive and statistically significant relationship between the average risk premiums and the consumption betas, the explanatory power of the model is at best 17.3% of the cross-sectional variation of the returns of the assets in the financial market (Colombia).

These combined results suggest that the adherence of the CCAPM to the data from Latin American economies is very weak. Although the data from Chile and Colombia do not reject the CCAPM outright, the explanatory power of the model in relation to these countries, as in the remai-

<table>
<thead>
<tr>
<th>Country</th>
<th>Constant</th>
<th>Consumption Betas</th>
<th>Residual Variances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>0.4641</td>
<td>0.2336 ***</td>
<td>0.0020 ***</td>
</tr>
<tr>
<td></td>
<td>0.78221</td>
<td>3.16688</td>
<td>6.54439</td>
</tr>
<tr>
<td>Chile</td>
<td>0.5069</td>
<td>0.4144 ***</td>
<td>0.0011</td>
</tr>
<tr>
<td></td>
<td>1.08739</td>
<td>3.23547</td>
<td>1.03306</td>
</tr>
<tr>
<td>Colombia</td>
<td>-4.1689 **</td>
<td>0.3147 **</td>
<td>0.0031</td>
</tr>
<tr>
<td></td>
<td>-2.67914</td>
<td>2.36084</td>
<td>0.77365</td>
</tr>
<tr>
<td>Mexico</td>
<td>0.2537</td>
<td>-0.0177</td>
<td>0.0009</td>
</tr>
<tr>
<td></td>
<td>0.52486</td>
<td>-0.08976</td>
<td>1.39997 *</td>
</tr>
</tbody>
</table>

*Source: Lettau and Ludvigson (2001); * Hypothesis not tested explicitly.
ning countries, is unsatisfactory. In the cases of Brazil and México, the findings are even more unfavorable to the CCAPM. In the former, though there is a statistically significant relationship between the average risk premiums and the consumption betas, the residual variance is shown to be statistically significant in the cross-sectional regressions, in contrast to the theoretical prediction of the model. In the latter, besides the variable residual variances being statistically significant, there appears to be no statistically significant relationship between the average risk premiums and the consumption betas, thus leading to the rejection of the CCAPM. Given these restrictions to the model and considering the fact that several studies indicate the rejection of the model at an international level, we conclude that this is a worldwide phenomenon, affecting both developed and developing countries.

As mentioned before, the third null hypothesis is more a specification test than a test of the implications of the CCAPM. It requires a statistically insignificant intercept in the cross-sectional regression. This hypothesis does not have the power to reject the model and its only purpose is to verify which of the alternate specifications is correct (Sharpe-Lintner’s risk-free asset or Black’s zero-beta asset). Based on the results in Table 9, it can be seen that the third null hypothesis is rejected only in Colombia, suggesting that Black’s zero-beta specification (1972) is the most suitable in that country, while Sharpe-Lintner’s more restrictive specification appears to be more consistent with the data from the other Latin American economies.

In summary, the weak performance of the CCAPM in the Latin American countries analyzed in the present study is quite evident. The model is not capable of satisfactorily explaining the realized returns of the assets in these countries and the theoretical implications of the model are only fully confirmed in Chile and Colombia. Considering the evidence from other studies at an international level, it is understood that some assumptions that form the base of the model need to be modified, which represents the main implication of the present study, as well as those of other studies that highlight the inconsistencies of the CCAPM, for the modern neoclassic theory of asset pricing.

At this point, it is pertinent to reflect on the statement made by Mankiw and Shapiro (1986, p. 458) that “the apparent rejection of the con-
an empirical test of the consumption-based asset pricing model (CCAPM) in Latin America

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sumption CAPM is potentially attributable to failure of the one of the many auxiliary assumptions”. According to these authors, the weak explanatory power of the CCAPM could be explained by, among other aspects, non-stable preferences, costs of adjustment in consumption, durability of non-durable goods, and so on.

Nonetheless, it should be borne in mind that, as Cochrane (2005, p. 455) emphasizes, the point of departure for understanding which risks affect the prices and expected returns of assets is: the individual’s first order conditions for saving and portfolio formation, that is, the consumption-based model. Accordingly, models with more restrictive assumptions regarding the investor behavior and the stochastic discount factor could be of help in better understanding the demand for financial assets.

Following this line of thought, it is worth highlighting three studies carried out in the United States that offer encouraging results regarding the CCAPM: the study from Lettau and Ludvigson (2001) that uses a conditional model of CCAPM to explain the differences between asset returns; the study by Parker and Julliard (2005) that defines the risk of an asset as the covariance of its returns with the accumulated growth in consumption over various quarters following the occurrence of returns; and Jagannathan and Wang (2005) study in which they begin with the assumption that the investors revise their consumption and portfolio decisions in the fourth quarter of each year.

Besides proposing modifications to the original model, these three studies also offer evidence that the CCAPM can explain a significant part of the variations in the average returns of the financial assets. In our opinion, the test of these models in the countries of Latin America is the next step to be taken in attempting to increase the understanding of the factors that affect asset risk in financial markets.

4. Conclusions
The objective of this study is to verify whether the Consumption-Based Capital Asset Pricing Model (CCAPM) is consistent with the economic data from the following Latin American countries: Brazil, Chile, Colombia, and Mexico. To this end, the theoretical implications of the model in
question are checked against the data from those countries and, moreover, the capacity of the model to explain the differences between the returns of assets (stocks) in the financial markets of each country is assessed.

In summary, the tests of the hypotheses and the explanatory capacity of the CCAPM suggest the rejection of the model in Brazil and Mexico, while in Chile and Colombia the model only offered unsatisfactory power of explanation of the average risk premiums of the assets. In the United States, the rejection of the model is demonstrated by the study by Lettau and Ludvigson (2001), whose result are reproduced in Table 9.

However, in the same way as Faff (1998), these results need to be seen in the context of several empirical problems and assumptions made in order to make the testing of the CCAPM viable. Thus, it is important to question up to what point the results are influenced by: non-stable betas, durability of the non-durable goods, failure to observe the true flow of individual consumption, asymptotic correction for the problem of errors in variables, etc.

With regard to the objectives of the present study, it is believed that they have been fully achieved, since it is shown to be possible to assess the explanatory capacity of the model and test the implications derived from it. Furthermore, comparisons are made with data previously obtained relating to the United States, whose results are very similar to those found in this study.

The present study has contributed towards increasing the understanding of the behavior of the CCAPM in the Latin American countries under study. The empirical evidence of this study corroborates with the evidence reported for other countries, such as the United States, and suggests that modifications to the original model, such as those proposed by Lettau and Ludvigson (2001), Parker and Julliard (2005), and Jagannathan and Wang (2005), might be implemented in the future in order to allow a better understanding of the CCAPM and of the factors determining risk in Latin American financial markets.

This study has also contributed to the empirical literature in proposing tests with individual assets, instead of the formation of portfolios, in countries characterized by a relatively small number of assets. The use of portfolios is very common in tests of asset pricing models and they are cons-
tructed with the objective of mitigating the problem of errors in variables and reducing the volatility of individual assets. However, as underscored previously, there are some inconveniences associated with the formation of portfolios, mainly in countries characterized by a small number of financial assets, as is the case the of the Latin American countries. Hence, the use of individual assets with a correction for the problem of errors in variables is recommended in the tests.

As a potential theme for future studies in Latin American countries, the application of the conditional CCAPM as proposed by Lettau and Ludvigson (2001) is suggested. With regard to the studies of Parker and Julliard (2005) and Jagannathan and Wang (2005), it is of particular interest that they both require extended time series in order to achieve more reliable results. The execution of studies of such a nature is also recommended with the purpose of correcting the problem of errors in variables aimed at finite samples.

5. References


LETTAU, MARTIN, and SYDNEY LUDVIGSON, 2001, Resurrecting the (C)CAPM: the cross-sectional test when risk premia are time-varying, *Journal of Political Economy* 109, 1238-1287.


