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Exchange-Traded Private Equity and Venture Capital Companies and Macroeconomic Factors in Brazil

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ABSTRACT. This article indirectly investigates whether private equity and venture capital (PEVC) constitute an asset class different from publicly traded stocks with respect to the influence of macroeconomic risk factors. It uses a portfolio of three Brazilian exchange-traded asset management companies with PEVC funds to represent this asset class in vector autoregression models. The portfolio of PEVC stocks failed to present an attractive historical return and behaved similarly to portfolios of large and small stocks with respect to their risk exposure profile in relation to these factors. This limited sample does not suggest that these PEVC managing companies are a different class of assets, but does not reject the view of regulators and practitioners that PEVC funds are a different asset class.

RESUMEN. Este artículo examina indirectamente si el capital privado y el capital de riesgo (Private Equity and Venture Capital, PEVC) constituyen una clase de activo diferente a las acciones cotizadas públicamente, con respecto a la influencia de los factores de riesgo macroeconómicos. Se utilizó una cartera de tres gestores de activos negociados en la bolsa brasileña, que administran fondos PEVC, para representar esta clase de activo en modelos con un vector autorregresivo. La cartera de activos PEVC no presentó ningún retorno histórico atractivo y su comportamiento fue similar al de las carteras de grandes y pequeñas acciones con respecto a sus perfiles de exposición al riesgo en relación a estos factores. Este tamaño limitado no sugiere que estas empresas administradoras de fondos PEVC sean un diferente clase de activos, pero no rechaza la visión de los reguladores y practicantes de que los fondos PEVC son un diferente clase de activos.
Private equity (PE) refers to investments through equity interest via modalities that may vary according to the stage the investee firm is in vis-à-vis its life cycle. Venture capital (VC) is the investment in pre-operational or very young privately held companies. PE is the investment in the equity capital of more operationally developed companies, also privately held. Private investment in public equity (PIPE) is the equity investment in publicly held companies whose shares are not traded or display low liquidity on a stock exchange (Agência Brasileira de Desenvolvimento Industrial [ABDI], 2011; Metrick & Yasuda, 2011). The Brazilian Association of Private Equity and Venture Capital (Associação Brasileira de Private Equity & Venture Capital [ABVCAP], 2014, p. 11) asserted that the PE modality corresponded to 92.1% of such investments in Brazil, with VC amounting to 4.0% and PIPE to 3.9%.

Corporate finance via private equity and venture capital (PEVC) is growing in Brazil. Bain & Company (2011) noted that Latin America received 25% of PEVC resources earmarked to developing countries in 2010, and Brazil appeared, after India and China, as the third-most favored destination for this type of investment among emerging markets. Ernst & Young (2010) pointed out several characteristics of the Brazilian economic environment that facilitate the development of the PEVC industry, including the largest population in Latin America; tax incentives for certain types of investments; opportunities for seasoned investors and capital to promote the consolidation of fragmented industries; the degree of development of the capital market; multiple
industries with outsized growth potential; and significant need for infrastructure investment. ABVCAP (2014, p. 6) showed that the committed capital volume was as much as USD $42.8 billion by the end of 2013 or about 2.1% of the gross domestic product (GDP).

Ennis and Sebastian (2005) and Conroy and Harris (2007) highlighted that PEVC investors should refer to a qualified professional to evaluate each investment opportunity and supervise the progress of the projects jointly with PEVC managers. Furthermore, it is necessary to have a high tolerance for risk and acceptance of the lack of liquidity, since typically divestment is not available for at least five years, which restricts potential investors to mainly institutional or ultra-high net-worth individuals.

The growth of PEVC investment combined with the natural interest of institutional investors motivates the quest for a better understanding of this mode as an asset class. Brazilian pension funds are the main type of institutional investor in PEVC, and their beneficiaries consist of the millions of Brazilians whose future is contingent on the successful performance of their pension assets. Metrick and Yasuda (2011) and Conroy and Harris (2007) argued, however, that studies on the results of PEVC investments are, as yet, still scarce and are hampered by important limitations due to the unavailability of data. Comparing the performance of this alternative class of assets with others is difficult because of the lack of available data in Brazil, although Minardi, Kanitz, and Bassani (2013) have made an initial attempt to measure the performance of PEVC funds, not adjusted for liquidity and other risk factors. Their results suggest that PE investments may be attractive, but VC performance was not as good.

Thus, the objective of this article cannot be to analyze for investors the performance of PEVC funds, because the appropriate data, such as project cash flows used in Minardi, Kanitz, and Bassani (2013), is simply not available to us. Instead, this article (a) focuses on the behavior of a portfolio of listed asset management companies that also manage PEVC funds and (b) presents estimates of a model of macroeconomic risk factors for a portfolio of these firms. Burmeister, Roll, and Ross (1994, p. 3) defined a risk exposure profile as the pattern of economic betas obtained in relation to risk factors in an asset-pricing model. The goal is to investigate whether there are grounds to consider these selected listed asset managers as a different class of equity according to the risk exposure profile estimated by a model of macroeconomic risk factors compared to that of large portfolios of public companies.

These asset managers were the only ones listed that also managed PEVC funds when data were collected. Obviously, they are a small fraction of all PEVC managers in Brazil, based on the Brazilian Industrial Development Agency’s (ABDI, 2011) count of upwards of 180 in 2009. Minardi, Kanitz, and Bassani (2013) asserted that their sample contains 78 PEVC fund managers. Some of the companies sampled manage other types of investments, such as investment funds, and share ownership in liquid listed companies. Thus, it is reasonable to
expect that their macroeconomic risk exposure profiles derived from the models estimated herein are not PEVC specific and different from those of other companies traded on the Brazilian exchange. On the other hand, even given these limitations, if there are indications that their microeconomic risk factor exposure profile is significantly different from other listed companies, this article will be able to suggest that PEVC constitutes a different asset class. Naturally, this will only be confirmed with greater assurance when a study considering the risk factors of the returns of PEVC investors is possible. Leal and Mendes (2010), for example, found that Brazilian hedge funds represent a different asset class from the standpoint of Brazilian pension funds. The Methodology section offers more details about the sampled companies.

Different risk exposure profiles may constitute evidence for treatment as a different asset class. Investment in PEVC is already treated this way and is subject to the respective allocation limits set by the authorities that regulate institutional investors in Brazil. If the shares of the selected asset managers behave distinctly from other shares, they would constitute an interesting alternative for diversification, including for investors who only have access to shares that trade on the stock exchange. On the other hand, the evidence may suggest that the stock of these selected asset managers behave the same way in relation to a pricing model with macroeconomic risk factors—whether via PEVC or via publicly traded shares—and does not constitute, at least according to this point of view, a different asset class. The practical consequence of this result, if confirmed, would be that the treatment of PEVC and shares trading on the stock exchange as distinct asset classes must be justified based on aspects other than the macroeconomic factors contemplated here, such as liquidity or level of interference of PEVC general partners in the management of investee companies.

This article, more specifically, examines whether the macroeconomic factors that can influence the returns of listed PEVC management companies are the same and do so with the same sign and intensity as compared to other stocks. The article looks at the stock returns of three asset management companies (each an investment portfolio comprising PEVC and other investments), the Brazilian Small Cap (SMLL) index, and the Bovespa index (Ibovespa), which represents the largest companies. Vector autoregression (VAR) models are used to reduce possible endogeneity between macroeconomic factors.

The main results indicate that the asset management companies studied behaved similarly to the other listed shares in relation to macroeconomic risk factors. However, these companies failed to offer an attractive average return per unit of standard deviation when compared to the SMLL and Ibovespa. There is no evidence to suggest that these companies are a different class of assets, due to their engagement with PEVC, according to the risk exposure profile of selected macroeconomic factors. The results also do not allow one to conclude that PEVC is a different asset class, because important aspects,
such as the liquidity of the investments made by PEVC managers and their level of intervention in the running of investee companies, which were not considered, may warrant categorizing PEVC as a separate asset class.

If the findings of Franzoni, Nowak, and Phalippou (2012) of zero alpha for the liquidity risk of PEVC investments—consistent with the historically poor return found in this study—could be measured and held for Brazil, such combination of results would constitute an unfavorable view of PEVC as an investment, with relevant practical implications for asset allocation decisions, particularly when considering its growing importance. This would also contradict the conclusions of Minardi, Kanitz, and Bassani (2013) regarding their findings on the performance of PEVC funds, not adjusted for risks. Naturally, this remains as an open question for future inquires.

Of course, the small number of publicly listed asset management companies that are PEVC general partners, the indirect nature of the empirical exercise herein (by examining the returns of the general partner companies and not of the investors in the specific PEVC funds), the relatively short time series, and, perhaps, the method used to measure the macroeconomic factors and their impacts, are possible constraints faced in this work and render the results preliminary and dependent on the sample and period analyzed. Nonetheless, it is hoped that this article will contribute to providing more information about a little-studied segment of the capital market of Brazil.

**REVIEW OF THE LITERATURE**

This section begins with a brief discussion of the problems of measuring the performance of PEVC investments, then continues with a review of works directly linked to the method used (which concerns the representation of macroeconomic factors in asset pricing models), and concludes by examining the use of autoregressive vector models in this context.

**PEVC Performance**

Even though the main objective of this article is not to investigate PEVC fund performance per se, from the point of view of the investor, or limited partner, it is worthwhile to review the difficulties in performance measurement in order to understand the route taken in the ensuing analysis. Harris, Jenkinson, and Kaplan (2014) admitted that the theme of PEVC performance is a controversial one. Authors such as Conroy and Harris (2007), Metrick and Yasuda (2011), and Franzoni and colleagues (2012) do not believe that PEVC can generate alpha, that is, a superior risk-adjusted return, in a general and systematic way.

Metrick and Yasuda (2011) and Conroy and Harris (2007) listed three ways to measure the performance of PEVC investments. The first is the return
at the fund level, net of administration costs and taxes paid by the investor, the inclusion of which leads to a loss of information about the cash flows of the investments, particularly when there are losses. Lopes and Furtado (2006) found that a major source of bias in such information is that the respective calculations strongly depend on the estimated residual value of the enterprise.

Direct measurement of the results of the companies in a PEVC fund portfolio is the second way to measure performance. This information, however, is difficult to obtain because the investigator must have access to the cash flows of the projects as well as to the composition of the portfolios of the PEVC fund management organizations; moreover, the PEVC fund investee companies do not report their results in a frequent, systematic, and easy-to-access manner.

Harris and coauthors (2014) and Franzoni and associates (2012) are important exceptions in the international literature. The former employed a quality database with detailed information on 598 private equity funds and 775 venture capital funds. They failed to find superior performance for VC funds in relation to listed stocks. In contrast, they claimed that buyout funds—those in which the fund acquires control of young or mature companies, listed or private—perform, on average, 3% per annum better than the shares listed on public US markets. Franzoni and colleagues (2012) used information from a single, comprehensive database of the monthly cash flows of 4403 liquidated investments of 117 foreign PEVC firms, the origin of which was not identified.

Minardi, Kanitz, and Bassani (2013) claimed to be first to analyze PEVC fund returns in Brazil. They analyzed the performance of 46 funds with vintage between 1990 and 2008 that exited or liquidated at least 60% of their portfolios. The data came from a proprietary database. The median gross limited partner (investor) return was 23% in USD terms, and the median multiple of money was 2.5 times the invested capital for a median holding period of 4.6 years. The authors stated that this absolute performance of Brazilian PEVC funds were better than US funds in the 1998–2008 period and attributed this good performance to the Brazilian economic success up to 2012, improvements in the institutional settings, and PEVC market competitive inefficiencies, among other potential factors.

Some studies used the market returns of companies that went public and were previously funded by PE, and compared them with other companies that also went public. These cases, however, are a small part of the investments in PEVC, and this method can only gauge the result of PEVC indirectly insofar as the return of the investee company is only assessed after the probable exit of PEVC investors. Minardi, Ferrari, and Tavares (2013) adopted this strategy and reported conflicting results for Brazilian companies that went public between 2004 and 2008. The companies financed by PE garnered abnormal cumulative returns larger than the others; however,
a significant positive relationship between financing via PE and the abnormal cumulative returns was only significant for one subperiod (2004–2006). The chosen period—both short and affected by the financial crisis—possibly did not contribute to successful results.

The third and final type of yield is the measurement of the market return obtained from PEVC fund management firms traded on the stock exchange or PEVC fund indices. The indices commonly used in the United States for measuring these returns present problems, such as lagging prices of the assets comprising the PEVC portfolio, lack of liquidity, short history, difficult access to data, and information asymmetry between investors. As of the time of preparation of this article, no index of PEVC returns existed in Brazil. Martin and Petty (1983) and Kleiman and Shulman (1992) are examples of pioneering studies using market returns of a small sample of PEVC management organizations in the United States in a manner similar to this article. The use of market returns paves the way to employ risk-factor models. Metrick and Yasuda (2011) noted that taking into account the lag of these factors is important due to the problem of lagging prices of assets in PEVC funds.

Successful exits from investments is an alternative to returns for measuring the result of PEVC investments. Siqueira, Carvalho, and Gallucci Netto (2011) measured the success of PEVC investments in Brazil as the number of exits made by 60 PEVC vehicles through IPO, strategic sale, or sale to another investor. Their approach links the characteristics of funds, managers, and investments to gauge success. They claimed that the amount of committed capital, the number of investments, the experience of management and their ties with foreign entities, co-investment, and focus on more mature companies are among the determinants of success in PEVC.

**Representation of Macroeconomic Factors**

This section presents relevant aspects about the choice of macroeconomic factors for the pricing model and its form of representation. Chen, Roll, and Ross (1986) found that the joint movement of financial asset returns suggested the influence of economic factors and that their identification had not yet occurred. Chen and colleagues (1986) studied the effect of innovations of economic variables on the returns of stock portfolios. The term “innovations” refers to new, unanticipated information about these factors. Representing factors as innovations would address the problem of endogeneity. Chen and associates (1986) chose variables that represent state-of-the-economy factors that would systematically influence the price of assets in the stock market. Their article established a pattern that was followed by many, including Burmeister and coauthors (1994) in the United States and Schor, Bonomo, and Pereira (2002) in Brazil, and that is frequently cited in textbooks as an empirical test of Arbitrage Pricing Theory (APT). Schor and colleagues (2002) pointed out that APT did not determine how many,
or what are, the relevant factors in the process of generating returns; therefore, the challenge lies in selecting these factors and building variables containing relevant information in the form of innovations.

Chen and coauthors (1986) pointed out that macroeconomic factors do not usually capture the changes in expectations of market participants that have occurred between two consecutive disclosures, and that one should expect much noise and little significance in the relationship between stock portfolios and macroeconomic innovations. Stock indices, on the other hand, respond very quickly to information that influences the future cash flows of companies, and, therefore, the authors included two portfolios made up of the constituent stocks of the New York Stock Exchange (NYSE)—one value-weighted and another equally weighted—among their explanatory variables.

Chen and colleagues (1986) defined four main variables to represent macroeconomic factors. Innovation in inflation was defined as the difference between actual and expected monthly inflation. The authors determined the expected inflation from the difference between the US Treasury Bill nominal yield and an estimated real rate of interest obtained from Fama and Gibbons (1984). The second variable was the innovation in the industrial product defined as the logarithmic difference between its rate of change observed in two consecutive months.

The credit risk premium—the third main variable—is a measure of aversion to credit risk in the economy and was estimated as the log difference between the returns of bond indices of companies with Baa ratings or worse and long-term government bonds. The term structure of interest rates was also used to capture changes in risk aversion according to the investment period and was calculated as the log difference between the return on the US Treasury bonds index and the Treasury Bill index. This is the fourth main variable.

Chen and colleagues (1986) also considered, as additional explanatory variables, the per capita consumption in real terms and the log difference between the Producer Price Index and the price of oil to investigate whether this commodity influenced stock returns. The dependent variables were 20 selected stock portfolios equally weighted according to their market value at the beginning of the analysis period.

The monthly growth rate of industrial production and unanticipated changes in the credit risk premium and inflation were significant throughout the period studied by the authors, the first two having positive coefficients, the last, negative. The unanticipated change in risk aversion in the term structure was marginally significant with a negative coefficient. The variables of returns of the equally weighted and value-weighted portfolios of NYSE companies were not significant. The alternative variables of annual growth rate of industrial production, consumption, and oil were not significant for any period.
Schor and colleagues (2002) replicated the study of Chen and associates (1986) with adaptations to the Brazilian context. Production was represented as the difference between the forecast at the beginning and end of the period for the growth rate of industrial production, because the actual value is not released immediately. The authors used a structural model to capture the trend, seasonality, and cycle to obtain the desired variable. The data used came from the national industrial production index without seasonal adjustment, as calculated by Instituto Brasileiro de Geografia e Estatística, the Brazilian national statistics authority.

The unexpected inflation was obtained by the difference between the observed rate of inflation and the expected rate of inflation at the initial period, as obtained from a structural model with categorical variables to capture the changes in level and slope of the series due to stabilization plans during the study period. The authors also used the difference between the average rates on fixed-rate Bank Certificates of Deposit and the one-day Interbank Certificates of Deposit (CDI), a kind of repo rate, to represent unanticipated inflation.

Credit risk was estimated as the standardized difference (i.e., with zero mean and variance equal to one) between the average interest rate of working capital loans reported monthly by the Central Bank of Brazil and the daily CDI interest rate accumulated in the month. The real interest rate was estimated as the standardized difference between the CDI rate and the expected inflation rate for the reference month.

The market portfolio was the residual series of the regression of the excess return of the Bovespa index in relation to the CDI on the factors described. The dependent variables were 10 portfolios with few stocks—a total of 39—organized according to sectors of activity in the period between 1987 and 1997. Schor and colleagues (2002) found significant coefficients in most portfolios for unanticipated innovations of the factors related to credit risk (negative), inflation (negative), real interest rate (positive), and the residuals of the market portfolio (positive). The coefficients for industrial production were not significant. However, the risk premiums implied by the coefficients and average returns of the portfolios of each factor were not significantly different from zero. This evidence partially diverges from Chen and associates (1986) and suggests that stock portfolios in different jurisdictions may not be influenced equally by macroeconomic factors.

**Macroeconomic Factors and Autoregressive Vectors**

The stock market is considered a leading indicator of the economy. Risk aversion can affect interest rates, which in turn affect consumption and industrial production, which influence the stock market. The system of variables, therefore, may be endogenous and subject to delayed effects. The use of VAR is indicated when the variables of interest may be endogenous and
influenced by autoregressive processes. The method will be presented in more detail in the section on methodology.

Campbell and Ammer (1993) used VAR to analyze the economic factors that might explain the behavior of excess stock returns and excess 10-year bond returns in the United States and revealed that the real interest rate influences the excess returns of bonds but not of stocks. Nasseh and Strauss (2000) argued that VAR and cointegration models are consistent with three characteristics of the stock market: (1) their activity explains future production; (2) their volatility is larger than the corresponding macroeconomic activity; and (3) real economic activity best explains their long-term variation.

Nasseh and Strauss (2000) employed Johansen's cointegration tests and methods of decomposition of variance with quarterly data from 1962 to 1995. They showed that there is a long-term domestic relationship between stock prices and industrial production and between statistics of production orders and the long-term domestic interest rate. Both on the domestic and international settings, their results revealed long-term relationships between the short-term interest rate, stock prices, and industrial production in six European countries (France, Germany, Italy, the Netherlands, Switzerland, and the United Kingdom).

The industrial production index and the production orders statistics were used as a proxy for real economic activity. The hypothesis posited a positive relationship between these two variables and stock prices. The nominal returns of the main stock indices of each nation represented stock prices in each country. The authors considered consumer inflation as one of the explanatory variables to ascertain whether it was neutral with respect to the stock price indices.

Cheung and Ng (1998) employed a similar method to that of Nasseh and Strauss (2000) in order to assess the existence of joint movements between stock price indices and aggregate economic activity measures. However, the factors chosen were different. Cheung and Ng (1998) used gross national product (GNP) as a measure of economic activity, which would, therefore, have influence in forecasting the cash flows of companies and, ultimately, stock prices. The amount of money circulating in the economy (money supply) influences the changes in the composition of portfolios and in inflation expectations, with impacts on the price of stocks. Consumption and oil prices were the other factors.

The analysis of Cheung and Ng (1998) on the innovation effect of each of these factors on the stock price indices of the five countries (Canada, Germany, Italy, Japan, and the USA) revealed that oil price innovation had an inverse relationship with stock prices. This finding is consistent with the increase in production costs that usually accompanies an increase in oil prices. Innovation in the consumption data showed a positive correlation with stock prices. Finally, the study showed ambiguity in the relationship between both stock price indices and the money supply on GNP.
The evidence reviewed suggests it is reasonable to expect difficulties in obtaining consistent statistical significance for the coefficients of macroeconomic factors for PEVC management companies in Brazil, and that the variables used may—even in the form of innovations—be endogenous, with delayed effect, which indicates utilization of VAR, as is detailed in the next section.

**METHODOLOGY**

The first part of this section provides an overview of the PEVC management companies traded on the Bolsa de Valores, Mercadorias e Futuros (BM&FBovespa) included in the sample. The second part details the method for calculating the macroeconomic factors employed, and the third and final part briefly describes the econometric method used.

**Sample of PEVC Management Companies and Stock Market Indices**

There are few PEVC management companies publicly traded in Brazil. Ideiasnet, GP Investments, and Tarpon Investimentos were the only ones identified as of March 2011. It is possible that a portfolio of these management companies may not represent the PEVC industry and PEVC investments of institutional investors since each one represents a portfolio of holdings in many companies. These companies may manage additional types of assets, such as other types of investment funds and a portfolio of equity interests, minority or not, in liquid listed companies. Thus, the results from the proposed asset pricing models may reflect the returns to the shareholders of these asset managers, and possibly to the general partners of the PEVC funds they manage, instead of those of the investors of the PEVC funds, the limited partners.

Ideiasnet (symbol IDNT3) was the first PEVC management company to go public on June 8, 2000. The stock, however, only reached sufficient turnover to generate a consistent series of prices after 2002, which thus determined the beginning of the study period. The end of the period corresponds to the end of the data collection phase. The returns and innovations of factors used, therefore, are monthly in the period from January 2002 to April 2011.

Ideiasnet was the only VC company with shares traded on the BM&FBovespa at the time of data collection. It developed projects and acquired stakes in companies in the technology, media, and telecommunications industries and had 17 companies in its portfolio. Ideiasnet shareholders could attribute their returns to a portfolio of VC investments with an emphasis in the technology arena. Ideiasnet established VC funds from 2009 and became an asset manager.
GP Investments (symbol GPIV3) has been traded on the Brazilian stock exchange since June 8, 2006 through Brazilian Depositary Receipts (BDR), which are share deposit certificates issued in Brazil representing the shares of public companies headquartered abroad. Even though the company is headquartered in Bermuda, its main shareholders are well-known Brazilian citizens. Their main area of expertise has been in PE, with a focus on Latin America, and was the market leader. At the time of data collection, GP Investments had holdings in 17 companies in various sectors of the economy in its portfolio (shopping centers, power distribution, food, medical services, construction, education, consumer goods, etc.). GP Investments is a diversified asset manager, with interests in PE, liquid listed companies, and infrastructure businesses, some which could be categorized as PIPE. There are minor interests in real estate and in other and more general asset managers. GP Investment stock returns derive from revenues of a diversified asset manager, which will include fees from its funds as well as cash inflows from its investments in other companies.

Tarpon Investimentos (symbol TRPN3) has been traded via BDRs since May 26, 2009 and displays investments in exchange listed companies and PE in its management strategy. The company is also headquartered in Bermuda. Its portfolio is concentrated and they allege to focus on a small set of high impact ideas. It carries out its investments by means of funds and its shareholders obtain returns stemming from asset management fees, and not from the portfolios of investments. At the time of the IPO, the company managed other funds and declared to invest in listed companies and PEVC, but claimed to be an alternative investments manager. The company did restrict its interest to specific sectors of the Brazilian economy and its main holdings at the time of the IPO included many well-known listed companies.

The object of analysis was the return of an equally weighted portfolio of these stocks. The “PEVC portfolio” held only Ideiasnet shares until July 2006, and later included two companies as of July 2006 and three as of May 2009. Therefore, two time intervals for analysis were considered. The interval with the full sample runs from January 2002 to March 2011. The partial sample begins with the IPO of GP Investments in July 2006 and runs until March 2011. In cases where no trades were executed on the last day of the month, the closing price of the last day of the month on which trades were executed with one of the stocks was used to form the PEVC portfolio. This occurred a few times between 2002 and 2004 when the portfolio was composed only of Ideiasnet stock.

The models were also estimated (1) for the Bovespa index (Ibovespa), considered the main stock index in Brazil representing large market capitalization companies and (2) for the small-cap index (SMLL) of the BM&FBovespa for comparison. Ibovespa is used in the two periods and SMLL only in the more recent one because it began in August 2005. Table 1 provides a detailed description of each variable.
Macroeconomic and Market Factors

Macroeconomic factors were measured as innovations to avoid being auto-correlated and correlated. Table 1 gives details on the calculation of each of the macroeconomic factors that represent inflation (INFL), industrial production (PROD), credit risk premium (CRP), the real interest rate (REAL), and the residual of the Ibovespa monthly returns in relation to these factors to represent what is not captured by them (MKT).

Schor and colleagues (2002) used the difference of the expected growth rate of industrial production in t-3 in relation to t-2 to represent innovation in industrial production because it is released more than two months after the reference month. They claimed to use only information that investors would

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
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<tr>
<td>CRP</td>
<td>The credit risk premium was calculated as the difference between the average cost of loans for working capital, as published monthly in the Central Bank of Brazil credit report, and the CDI rate, as obtained on the Central de Custódia e Liquidação Financeira de Títulos website, minus its average to shift it to the neighborhood of zero.</td>
</tr>
<tr>
<td>IBOV</td>
<td>Ibovespa (Bovespa index) return, calculated as ln(P_t/P_{t-1}), where P_t is the closing level of the index in month t obtained from Bloomberg®.</td>
</tr>
<tr>
<td>INF</td>
<td>Inflation innovation or unanticipated inflation represented by the residuals of fitting an additive linear trend model and seasonality estimated by ordinary least squares and applied to the rate of change in the Índice Nacional de Preços ao Consumidor Amplo obtained from the IPEADATA website. Details of the model fitting are available from the authors.</td>
</tr>
<tr>
<td>MKT</td>
<td>Residuals of the regression of the excess return of the Ibovespa in relation to the CDI rate of the month on the macroeconomic factors INFL, PROD, CRP, and REAL.</td>
</tr>
<tr>
<td>PEVC</td>
<td>Return of the equally weighted portfolio of PEVC management companies calculated as the simple arithmetic average of the monthly returns of each company obtained as ln(P_t/P_{t-1}), where P_t is the last closing price observed in the month t. PEVC consists only of Ideiasnet until June 2006, includes GP Investments as of July 2006, and Tarpon Investimentos as of May 2009. Daily closing prices of PEVC shares were obtained from Bloomberg®.</td>
</tr>
</tbody>
</table>
| PROD     | Innovation in industrial production is represented by the residuals of fitting an additive linear trend model and seasonality estimated by ordinary least squares and applied to the growth rate of industrial production posted on the IPEADATA website. The trend was calculated using the 12-month centered moving average, 

\[ m_t = \frac{\sum_{s=6}^{t} x_{t-s} + \sum_{s=5}^{t} x_{t-s} + 12}{12} \]

where x_t is the industrial production growth rate series. An estimate for the additive effect of each month can be obtained by subtracting the value of the time series of the month from the moving average amount for that month. The calculation of the average of these monthly values over the sample is taken as the seasonality factor of the month. |
| REAL     | The real interest rate was calculated by subtracting the expected inflation rate from the CDI of the month. The expected inflation is the forecast of a step in the structural model used to estimate INFL. |
| SMLL     | The SMLL index return, calculated as ln(P_t/P_{t-1}), where P_t is the closing level of the index in month t obtained from Bloomberg®. |
have at the end of the reference month, but found no significance to this factor. PROD, therefore, was represented by the residuals of an adjusted moving average model applied on the rate of growth of industrial production in the month corresponding to the return of the portfolio of interest. In addition, the lagging effects of PROD will be considered in the VAR model. The other factors were constructed similarly to Schor and coauthors (2002). Table 1 provides details on the construction of the variables.

Autoregressive Vectors

VAR models may be understood as multivariate versions of autoregressive models (AR). A VAR model of order \( p \), \( \text{VAR}(p) \), describes the behavior of a set of endogenous variables as a function of \( p \) lags. The model may also include exogenous variables. The number of lags must be parsimonious in order to best portray the dependency dynamics in the system. The method was chosen because the variables used may be endogenous and because Metrick and Yasuda (2011) recommended the use of lagged factors since PEVC prices are obsolete or outdated (stale).

Pfaff (2008) observed that VAR is the main tool in econometrics for the analysis of multivariate time series. In its basic form, \( \text{VAR}(p) \) is defined by Equation 1, where \( y_t \) is a vector of \( K \) endogenous variables (\( y_{1,t}, \ldots, y_{k,t}, \ldots, y_{K,t} \)), \( A_0, A_1, \ldots, A_p \) are vectors of coefficients of order \( k \times 1 \), \( X_t \) is a vector of exogenous variables, \( B_t \) is the vector with their coefficients and \( u_t \) is \( K \)-dimensional white noise with defined positive covariance matrix \( E(u_tu_t') = \sum u_t \).

\[
y_t = A_0 + A_1y_{t-1} + \cdots + A_py_{t-p} + B_tX_t + u_t (1)
\]

A VAR system (1) is represented by Equations 2 and 3 for one lag \( (p=1) \), two endogenous variables \( (k=2) \), and no exogenous variable, for example, where \( y_1 \) could be the return of a portfolio of PEVC management companies and \( y_2 \) the factor for inflation. Each endogenous variable has an equation that explains it as a function of its lags and of the lags of the other endogenous variables of the system. This article will show the analysis of the coefficients of Equation 2 (PEVC) and not of Equation 3 (inflation) of the example, for the sake of brevity. Finally, it should be noted that Equations 1 through 3 do not include contemporary dependencies between \( y_1 \) and \( y_2 \).

\[
y_{1,t} = A_{1,0} + A_{1,1}y_{1,t-1} + A_{1,2}y_{2,t-1} + u_{1,t} (2)
\]

\[
y_{2,t} = A_{2,0} + A_{2,1}y_{1,t-1} + A_{2,2}y_{2,t-1} + u_{2,t} (3)
\]
RESULTS

This section has three parts. The first presents descriptive statistics and correlations between variables. The second shows the results of the Granger causality analysis. The third presents the results of the VAR models.

Descriptive Analysis

Table 2 shows some descriptive statistics. The returns of the portfolio of PEVC asset managers are much more dispersed than those of the Ibovespa and SMLL indices. The average return per unit of standard deviation was 0.24 for the Ibovespa, 0.21 for the SMLL, and 0.10 for the PEVC portfolio, which, therefore, provided a historic return per unit of standard deviation much smaller than representative portfolios of large and small cap companies. This result contrasts with the returns for a sample of PEVC funds reported in Minardi, Kanitz, and Bassani (2013) and may suggest that returns to general and limited partners may be very different.

Macroeconomic factors have zero averages by definition. All series are stationary according to the Phillips-Perron test. Pfaff (2008) stated the Phillips-Perron test is more robust for not taking into consideration that the returns can be heteroscedastic. It was assumed, then, that all series are stationary since this behavior is typical of monthly returns of financial assets series, and the Phillips-Perron test confirmed the stationarity.

Table 3 shows the correlation coefficients between the variables used for the full sample period (January 2002 to March 2011) and the partial period (August 2006 to March 2011). The linear relationship of the portfolio of PEVC asset managers is significant and positive with the Ibovespa and SMLL indices

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<th>TABLE 2</th>
<th>Descriptive Statistics of Returns and Macroeconomic Factors</th>
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<tr>
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<td>Max.</td>
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<tr>
<td>PP</td>
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</tr>
<tr>
<td>n</td>
<td>110</td>
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Notes: All variables are defined in Table 1. “SD” is the standard deviation. ADF is the Augmented Dickey-Fuller test. PP is the Phillips-Perron test. “n” is the number of observations. * indicates significance at the 5% level. The null hypothesis of the ADF and PP tests is that the series is not stationary. The statistics were calculated for the full sample, except for SMLL index, which began to be published in July 2005. Source: The authors.
and with the MKT and REAL factors, and negative with PROD. The returns of the Ibovespa and SMLL indices did not show significant correlations with macroeconomic factors. Unsurprisingly, the negative correlation between the real interest rate (REAL) and inflation (INFL) is the only significant one among macroeconomic factors. VAR analyzes the intertemporal dependence between lagged factors and this is not expected to be problematic. The correlation between the MKT and other factors is zero by construction of the model.

Granger Causality Tests

The Granger causality test estimates the linear intertemporal dependence relationship in a set of variables and indicates that \( y \) Granger-causes \( x \) if a one-way relationship exists of \( x \) with lagged \( y \) and that \( x \) Granger-causes \( y \) if a one-way relationship exists of \( y \) with lagged \( x \). There is a cross-relation between \( x \) and \( y \) when these two cases are true. The term “Granger causality” refers to the fact that the Granger test measures only the significance of the linear relationship between two variables and not a causal relationship posited by an economic model (Tsay, 2005). Investigations pertaining to Granger causality capture the linear lagged relationship between return variables and economic factors.

Table 4 shows the results of the univariate analysis of Granger causality for both the complete and partial samples, considering a return variable (\( y \)) and three lags of a macroeconomic factor (\( x \)). Each macroeconomic factor is included on the right side of the equation separately and not simultaneously.

### TABLE 3 Correlations between Variables

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<tr>
<th></th>
<th>IBOV</th>
<th>INFL</th>
<th>REAL</th>
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<th>PEVC</th>
<th>CRP</th>
<th>PROD</th>
<th>SMLL</th>
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Note: *Indicates significance at the 5% level. The SMLL index began publication in July 2005. The variables are defined in Table 1.

Source: The authors.
with others. PROD, CRP, and MKT Granger-cause IBOV, PEVC, and SMLL. These initial results suggest that the IBOV, PEVC, and SMLL portfolios behave similarly with respect to macroeconomic factors and may have similar risk-exposure profiles, thus indicating that PEVC, as represented by a sample of PEVC manager companies do not constitute a separate asset class.

**VAR Models**

The models were estimated with and without the MKT as an explanatory variable for PEVC and SMLL, without MKT for the Ibovespa, and with up to three lags for each macroeconomic factor. The complete and partial samples were used for the PEVC and the Ibovespa. SMLL was only analyzed with the most recent partial sample. Therefore, 12 models were estimated for PEVC: one, two, and three lags, with and without MKT, and two sampling periods. For the Ibovespa, six models were estimated: one, two, and three lags, two sampling periods, without the MKT factor. Finally, for SMLL, six models were also estimated: one, two, and three lags, with and without MKT, but only for the most recent partial period. Thus, 24 models were estimated. The limit of three lags privileges parsimonious models. The R software was used to code the models, and the code is available from the authors.

Table 5 presents the coefficients of the 10 VAR models with the best fit, among the 24, according to the following criteria, whose values are in the Appendix: (1) the lowest values of the information criteria; (2) the highest number of significant coefficients at the 5% level; (3) the greatest log-likelihood; and (4) the largest adjusted $R^2$. The Appendix also shows the Jarque-Bera test, whose null hypothesis is normality; the Portmanteau test, which checks the null hypothesis of absence of cross-correlation; and the ARCH test, whose null hypothesis is the existence of heteroscedasticity, to analyze the behavior of residuals.

The coefficients of macroeconomic factors for PEVC that showed statistical significance at the 5% level are the first lags of PROD and MKT (positive).
The coefficients of macroeconomic factors for SMLL that showed statistical significance at the 5\% level are the second lag of MKT (positive) and the third lag of CRP (positive). The third lag of CRP is the only macroeconomic factor that has a positive and significant coefficient at 5\% level in relation to the Ibovespa, since MKT was not used in the Ibovespa model. No model displayed more than one macroeconomic factor with a significance level of 5\% and, considering all lags, the factor that has significance at this level is not the same between models. These inconclusive results refer to the 10 models with best specification.

The evidence in Table 5 shows some consistency with Schor and colleagues (2002) and Chen and associates (1986). There is also some consistency, albeit weaker, with the Granger-causality analysis in Table 4. The results of VAR models that used the alternative macroeconomic factors proposed by Cheung and Ng (1998) were worse, and constituted a test of robustness. The factors were GDP innovation, consumption, monetary aggregate (M1), and the oil price. They are omitted for brevity but are available from the authors.

The low significance and consistency found in many of the models in Table 5 provides no basis for the conclusion that the PEVC, SMLL, and IBOV...
portfolios relate differently to macroeconomic factors. That is, there is no
evidence that the risk exposure profile of the PEVC asset managers’ portfolio
is different in this regard. The evidence of univariate Granger-causality tests
in Table 4 also fails to provide grounds to suggest that the PEVC, SMLL, and
IBOV portfolios were influenced differently by macroeconomic factors. Note
that the portfolio of PEVC asset managers had an average return per unit
of standard deviation of less than half of the returns provided by SMLL
and IBOV.

The macroeconomic factors employed were not able to suggest that the
returns generation processes of PEVC, SMLL, and IBOV are distinct and,
therefore, it cannot be said, based on these results, that the portfolio of PEVC
asset managers is an asset class different from SMLL and IBOV. Additionally,
the evidence is inconclusive regarding the returns to limited partners (inves-
tors) of PEVC funds because our inference is indirect, at best, because the
returns to the shareholders of these three companies reflect, in part, the fees
they receive as general partners and their gains as investors. The findings of
Minardi, Kanitz, and Bassani (2013) indicated that returns to limited partners
on fund level data may display a positive alpha, but because they did not
employ a risk-adjusted model, their evidence is preliminary in this regard.

CONCLUSION

The growth of PEVC financing, the increased allocation of Brazilian insti-
tutional investors in these funds, which are considered a different class of
assets by regulatory authorities, and the lack of studies in Latin America
are reasons to try to better understand whether the shares of PEVC asset
management companies traded on the stock exchange present a different risk
profile of exposure to macroeconomic factors. Different asset classes should
present different risk exposure profiles.

No Brazilian database is available on the historical performance of these
funds. The alternative was to study three PEVC management companies
whose shares trade in the Brazilian stock market. This choice poses a clear
limitation. The returns to investors in PEVC funds may, at best, only be
indirectly reflected in the stock returns of these companies because (a) they
may have managed an assortment of investments in the period that have
included other types of holdings besides PEVC funds and (b) the stock price
behavior of these companies may reflect the fees received by their asset man-
agement activities and, only partially, the success or failure of the PEVC fund
investments that they manage.

By way of comparison, an analysis was made with the Ibovespa index
and the BM&FBovespa SMLL (Small Cap) index. The macroeconomic factors
used took the form of innovations in the growth rate of industrial production,
inflation, credit risk premium, real interest rates, and Ibovespa index
residuals in relation to these factors. VAR was the model chosen because these variables may form an endogenous set and the asset prices of the PEVC management companies can be obsolete (so-called stale prices). Univariate analyses of Granger causality and VAR with alternative macroeconomic factors were also performed.

The PEVC management portfolio had average returns, relative to standard deviation, of less than half the SMLL and the Ibovespa returns. The univariate analysis of Granger causality indicated that the factors that represented industrial production, credit risk premium, and the market residual Granger-caused in a similar fashion the portfolio of PEVC asset managers and the SMLL and Ibovespa indices. Few VAR models exhibited a reasonable ability to explain the variables of interest and significant coefficients, which changed according to the version of the model. It was not possible to say, therefore, that the macroeconomic factor risk exposure profile is different between the PEVC asset managers and the two stock indices utilized. This study found no support for PEVC to be considered as an asset class different from other publicly traded stocks, at least from the standpoint of macroeconomic aspects and considering that PEVC returns were only indirectly reflected in the stock returns of the asset managers sampled.

This study, of course, has important limitations. One is the lack of historical data with appropriate frequency on the performance of most PEVC funds. It can always be argued that the three publicly traded PEVC management companies selected are not representative of the whole industry or that they are not even representative of returns to PEVC fund investors because they are a mix of general and limited partner returns as well as of PEVC and other asset classes returns. Another limitation is the short time series of returns. Future studies will have recourse to longer time series and possibly consider longer subperiods. Given the weak nature of the risk profile results, however, it seems that two or three additional years of return data would probably not change the conclusions that the risk profile of these three asset managers are different from the indices considered. We believe that what drives our results is the small number of asset managers, the fact that they do not exclusively manage PEVC funds, and that their shares may reflect returns to the general partners of these funds and not to their investors.

While macroeconomic information is released slowly and late, market prices are swift to incorporate new information, as previously pointed out by Chen and colleagues (1986). The empirical method used, with regard to the available data, failed to capture this influence accurately. The search for more extensive data, of better quality and over longer periods, and alternative metrics for macroeconomic factors to explain the risk-adjusted performance of these funds is a challenge for future research. The measurement of risk-adjusted returns to limited partners of Brazilian PEVC funds also remains
as a challenge. This study found, albeit tentatively, no evidence for considering the PEVC management companies as a class of assets different from stocks in general, according to their exposure to macroeconomic risk factors.

REFERENCES


APPENDIX—Characteristics and statistics of the VAR models

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<th>Def.</th>
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<th>HQ</th>
<th>SC</th>
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<th>LV</th>
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Note: “Mod.” is the model identifier number. *indicates that the model coefficients were included in Table 4. Models 1 through 9 utilize the full sample from January 2002 to March 2011. The other models utilize the partial sample from August 2006 to March 2011. “RET.” is the dependent variable of portfolio return. MKT is defined in Table 1. “Def.” is the number of lags of the model. AIC is the Akaike Information Criteria. HQ is the Hannan and Quinn Information Criteria. SC is the Schwarz Information Criteria. NC is the number of significant coefficients at the 5% level. LV is the log-likelihood. $R^2$ is the adjusted coefficient of determination. JB is the Jarque-Bera test, whose null hypothesis is normality of residuals. PORT is the Portmanteau test, which checks the null hypothesis of absence of cross-correlation between residuals. ARCH is the Autoregressive Conditional Heteroscedasticity (ARCH) test, whose null hypothesis is the existence of heteroscedasticity. The values shown for tests JB, PORT, and ARCH are the test values.