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Analise de Fatores Preditivos para os Retornos de Ações Brasileiras: Um Estudo de Determinantes Econômicos e Financeiros

Analyzing Predictive Factors for Brazilian Stock Returns: A Study of Economic and Financial Determinants

Análisis de Factores Predictivos para los Rendimientos de Acciones Brasileñas: Un Estudio de Determinantes Económicos y Financieros

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Resumo

Objetivo: Este artigo tem como objetivo de testar se os seguintes determinantes econômicos e financeiros podem ser uma boa forma de prever o retorno esperado das ações das empresas brasileiras de capital aberto: 1) elasticidade-renda da demanda; 2) grau de alavancagem operacional; 3) grau de alavancagem financeira; 4) os seis tipos de balanços, segundo o Modelo Dinâmico; 5) e a elasticidade da demanda da taxa de juros. Após a execução de quinze modelos de regressão linear com diferentes combinações dos determinantes sugeridos, os resultados indicaram que a elasticidade da demanda da taxa de juros foi o melhor determinante para calcular o retorno anual das ações das empresas brasileiras de capital aberto (de 2010 a 2019), em comparação com os demais quatro determinantes.

Palavras-chave: *tradeoff* de risco-retorno; mercado de capitais; modelo multifatorial de risco-retorno

Abstract

This paper aims to testing if the following economic and financial determinants can be a good way to forecast the stock expected return for the Brazilian publicly-traded companies: 1) income elasticity of demand; 2) degree of operating leverage; 3) degree of financial leverage; 4) the six types of balance sheets, according to the Dynamic Model; 5) and the interest rate elasticity of demand. After running fifteen linear regression models with different combinations of the suggested determinants, the results indicated that interest rate elasticity of demand was

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the best determinant to calculate the annual stock return for the Brazilian publicly traded companies (from 2010-2019), compared to the other four determinants.

Keywords: risk-return tradeoff; Capital Market; multifactor risk-return model.

Resumen

Este artículo tiene como objetivo probar si los siguientes determinantes económicos y financieros pueden ser una buena manera de predecir el retorno esperado de las acciones de las empresas brasileñas de capital abierto: 1) elasticidad ingreso de la demanda; 2) grado de apalancamiento operativo; 3) grado de apalancamiento financiero; 4) los seis tipos de balances, según el Modelo Dinámico; 5) y la elasticidad de la demanda de la tasa de interés. Después de ejecutar quince modelos de regresión lineal con diferentes combinaciones de los determinantes sugeridos, los resultados indicaron que la elasticidad de la demanda de la tasa de interés fue el mejor determinante para calcular el retorno anual de las acciones de las empresas brasileñas de capital abierto (de 2010 a 2019), en comparación con los otros cuatro determinantes.

Palabras clave: *tradeoff* de riesgo-rendimiento; mercado de capitales; modelo multifactorial de riesgo-rendimiento.

INTRODUCTION

The Risk-Return Tradeoff plays an essential role in the financial market industry. A stock with high uncertainty about its expected return is seen as a riskier investment, making the investor require a higher discount rate in order to be an attractive investment. In other words, the investor may be willing to buy a risky asset only if it provides a return that minimally equalizes its risk.

A standard methodology to estimate the risk of a specific asset is to take a single regression of that asset's historical returns with the returns of a market index – for example, in Brazil, the Ibovespa–, as a proxy of the total market volatility. The resulting coefficient of that single regression is known at the Capital Asset Pricing Model (CAPM) as beta. If that beta is

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greater than 1, it indicates that the specific stock was more volatile and, as a result, riskier than a market portfolio. On the other hand, if the beta is lower than one, it indicates that that specific asset's stock price fluctuated less than the market portfolio, suggesting that it is less risky than the market portfolio.

Alternatively to the risk-return methodology indicated in the previous paragraph, this paper aims to test if the following economic and financial determinants can also be a good way to forecast the stock expected return for the Brazilian publicly traded companies:

1. Type of business;
2. Degree of Operating Leverage;
3. Degree of Financial Leverage;
4. The six types of balance sheets, according to the Dynamic Model;
5. Interest Elasticity of Demand;

Damodaran suggested the first three determinants listed above are a better way to predict a company's beta. Moreover, as a complement of those three determinants, this paper will test whether the model can get more robust by including, as a factor, the six different types of balance sheet structures (as a fourth determinant to be tested), developed by Michel Fleuriet, and the interest elasticity of demand (as a fifth determinant to be tested).

The organization of this paper is as follows. Section 2 reviews the fundamentals about each determinant and their expectation on the tested models. Section 3 presents the statistical models, and section 4 indicates the best of the proposed models. Section 5 discusses the determinants results over the tested models. Section 6 suggests some recommendations for future studies, while section 7 concludes the study.

A BRIEF EXPLANATION OF THE FIVE DETERMINANTS AND THEIR EXPECTANCY ABOUT THE MODEL

Type of Business

According to Damodaran, the more sensitive a business is to market condition, the higher is its beta. This work will then calculate this sensitiveness as the yearly percentage

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change in revenue from 2010 to 2019 divided by the annual percentage change in GDP from 2010 to 2019, also known as the income elasticity of demand.

After calculating the yearly income elasticity of demand for all the Brazilian publicly-traded companies from 2010 to 2019, the next stage is to separate the values into different factors. In this way, all results below -0.25 have been replaced by factor 1; all values between -0.25 and 0.25 have been replaced by factor 2; all values between 0.25 and 0.75 have been replaced by factor 3; all values between 0.75 and 1.25 have been replaced by factor 4, and all values above 1.25 have been replaced by factor 5.

It is essential to mention that all factors for this determinant have been distributed based on the economic fundamental for income elasticity of demand, that distinct the goods in: inferior goods, with negative elasticity (as factor 1); goods that the demand suffers no effect with the income variation, with elasticity close to zero (as factor 2); necessity goods, with low elasticity (as factor 3); normal goods, with elasticity relative to 1 (as factor 4); and superior goods, with elasticity above 1 (as factor 5). Therefore, keeping all the other variables constant, it is expected that companies with factor 3 to be the least risky, resulting in a lower required beta, while companies with factor 1 and 5 to be the most risk, resulting in a higher required beta.

Degree of Operating Leverage

Damodaran asserts that a firm with high operating leverage has higher variability in earnings before interest and taxes. Therefore, a higher beta is required for that business. For this study, the degree of operating leverage will be calculated as the percentage change in operating income divided by sales percentage change.

The next stage is to set the results in different factors, such as processed in the first determinant. To do that, the factors segregations will be based on the database quartiles. So, the results for these determinants placed before the first quartile will be set as factor 1; the results placed between the first and the second quartile will be set as factor 2; the results placed between the second and the third quartile will be designated as factor 3; and the results placed above the third quartile will be set as factor 4. Therefore, it is expected that, keeping all the other variables constant, a company with a factor of 1 to have the lowest beta, while the company with the factor 4, the highest beta.

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Degree of Financial Leverage

Damodaran affirms that an increase in financial leverage will increase a firm's beta as it increases the firm fixed cost. This determinant will then be calculated as the percentage change in net income divided by the percentage change in earnings before interest rate and taxes.

As well as done in the previous determinant, the next step is to substitute the calculated values to four different factors, organized by quartile. So, the companies with a factor equal to 4 are the ones with the highest financial leverage – then, the riskiest ones –, while the companies with a factor equal to 1 are the ones with de lowest financial leverage – then, the least risky ones.

The six types of balance sheet structures, according to the Dynamic Model

To apply the Dynamic Model, developed by Michel Fleuriet, it is necessary to reclassify the balance sheet accounts in permanent, operational, and financial.

On the asset side, the permanent account will be, for example, the machinery used for production, the equipment, the land, the intangible assets, and the buildings. The operational assets will be formed essentially by values related to the business's primary purpose, such as inventories, prepaid expenses, and accounts receivable. Finally, the erratic assets – also called financial assets – are formed by accounts that are not related to the business's primary purpose, such as cash and cash equivalents.

On the liability side, the permanent account will be the long-term capital resources, such as shareholders' equity and long-term debt. The operational liabilities are the obligations related to each specific business's core, such as accounts payable, wages payables, and taxes related to the operations. Finally, the erratic liabilities – also called financial liabilities – are the short-term bonds, loans, and bills payables, for example.

Once the balance sheet is reclassified, the next step is to calculate the Liquid Working Capital, the Working Capital Necessity, and the Treasury Balance for each Brazilian publicly-traded company from 2010 to 2019. The Liquid Working Capital is the permanent liabilities (the long-term resources) minus the permanent assets. The Working Capital Necessity equals

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to the operating assets minus the operations liabilities, and the Treasury Balance equals to the erratic assets minus the erratic liabilities.

Then, the next step is to cluster each company in six different types of balance sheet structures, as follows:

Type 1: Negative Liquid Working Capital, positive Working Capital Necessity and negative Treasury Balance;

Type 2: Negative Liquid Working Capital, negative Working Capital Necessity and negative Treasury Balance;

Type 3: Positive Liquid Working Capital, negative Working Capital Necessity and negative Treasury Balance;

Type 4: Negative Liquid Working Capital, negative Working Capital Necessity and positive Treasury Balance;

Type 5: Positive Liquid Working Capital, positive Working Capital Necessity and positive Treasury Balance;

Type 6: Positive Liquid Working Capital, negative Working Capital Necessity and positive Treasury Balance

It is expected that the bottom-down groups (types 1 and 2, especially type 1) are riskier than the other groups, since the long-term resources of capital are not enough to finance all the permanent assets and, also, the companies are highly dependable on short-term debts – with negative Treasury Balance. If the borrower, for any reason, rejects to roll over the debt, the company may face a dangerous situation in terms of liquidity. Moreover, type 1 companies may experience an even tougher position to increase their sales. As much as they sell and expand their operations, keeping everything else constant, the working capital necessity may also increase, making the company even more dependable on short-term debt.

On the other hand, it is expected that the bottom-up groups (types 5 and 6, especially type 6) to be less risky than the other groups because their long-term resources of capital are not only enough to finance their permanent asset, but it also remains a positive Treasury Balance as a left-over. Companies at type 6 are even in a better situation in terms of liquidity risk because

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the operation is also a source of short-term capital (since the working capital necessity is negative), which leads to lower risks of an eventual insolvency scenario.

Thus, for this determinant, the present study will cluster the companies in 3 different factors: types 1 and 2 companies as Factor 1; types 2 and 4 companies as factor 2; and types 5 and 6 companies as factor 3. So, it is expected that Factor 1 companies (types 1 and 2) will demand the highest required beta, and Factor 3 (types 5 and 6) companies to demand the lowest required beta.

Interest Elasticity of Demand

Similar to the Type of Business determinant calculated in this study, it is expected that the more sensitive a business is to the interest rates variability, the higher will be its beta. This work will then calculate this sensitiveness as the yearly percentage change in revenue from 2010 to 2019 divided by the annual percentage change in the average annual interest rate from 2010 to 2019. It is important to mention that this work will use the Selic Index, published by the Brazilian Central Bank, as a proxy of the interest rate.

Thus, after calculating the yearly interest elasticity of demand for all the Brazilian publicly-traded companies from 2010 to 2019, the next stage is to separate the values in different factors. In this way, the factor will be clustered by quartiles. So, the results for these determinants placed before the first quartile will be set as factor 1, then, the results placed between the first and the second quartile will be designated as factor 2; next, the results placed between the second and the third quartile will be set as factor 3, and the results placed above the third quartile will be set as factor 4. Therefore, it is expected that, keeping all the other variables constant, a company with a factor of 1 to have the lowest beta, while the company with the beta 4, the highest beta.

THE STATISTICAL MODELS

To analyze the efficiency of the chosen determinants in order to calculate the risk-return tradeoff, this work will run 15 different linear regression models. Each model's independent variables will be set as a unique combination of the chosen determinants for this works, while the dependent variable will be the annual stock log return from 2010 to 2019, collected at the Google Finance Platform. Also, in some models will be included a 6th

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determinant: the annual stock return divided by the annual market return (proxied by the Bovespa Index).

Model 1:

$$Return = \frac{SR}{IbovR}$$

Where:

- Return = the annual stock return divided;
- SR/IbovR = the annual stock return divided by the annual market return (proxied by the Bovespa Index), determinant 6.

Model 2:

$$Return = TB + OL + FL$$

Where:

- Return = the annual stock return divided;
- TB = Type of business, determinant 1;
- OL = Degree of Operational Leverage, determinant 2;
- FL = Degree of Financial Leverage, determinant 3.

Model 3:

$$Return = DM$$

Where:

- DM = The six types of balance sheets, according to the Dynamic Model (Fleuriet 2015), determinant 4.

Model 4:

$$Return = IE$$

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Where:

- IE = Interest Elasticity of Demand, determinant 5.

Model 5:

$$Return = TB + IE$$

Model 6:

$$Return = \frac{SR}{IbovR} + TB + OL + FL$$

Model 7:

$$Return = \frac{SR}{IbovR} + DM$$

Model 8:

$$Return = \frac{SR}{IbovR} + IE$$

Model 9:

$$Return = \frac{SR}{IbovR} + TB + IE$$

Model 10:

$$Return = \frac{SR}{IbovR} + TB + OL + FL + DM$$

Model 11:

$$Return = \frac{SR}{IbovR} + TB + OL + FL + DM + IE$$

Model 12:

$$Return = TB + OL + FL + DM$$

Model 13:

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$$Return = TB + OL + FL + IE$$

Model 14:

$$Return = TB + OL + FL + DM + IE$$

Model 15:

$$Return = DM + IE$$

THE REGRESSION MODEL RESULTS

After organizing the dependent and independent variables, the database got composed of 1593 observations. Table 1 outlines the p-value and the adjusted R-squared for each ran models

Table 1 - p-value and the adjusted R-squared for each tested model

Model	p-value	Adjusted R-squared
1	0.9466	-0.001656
2	0.02986	0.005673
3	0.1771	0.0009196
4	2.538e-06	0.01607
5	5.006e-06	0.01863
6	0.0961	0.004044
7	0.5788	-0.0007547
8	4.746e-05	0.01473
9	4.179e-05	0.01735
10	0.1202	0.003845
11	9.585e-05	0.01881
12	0.04408	0.005482
13	7.042e-06	0.02065
14	1.922e-05	0.02013
15	7.855e-06	0.01648

Of the 15 ran models, ten were statistically significant, with a p-value below 0.05 – models 2, 4, 5, 8, 9, 11, 12, 13, 14, and 15. Also, the adjusted R-squared of the 15 models ranged between -0.001656 (model 1) and 0.02065 (model 13).

Moreover, it was applied the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), the Log-Likelihood (LogLik), and the Deviance statistics tests as a way of selecting the best model. According to Colonescu (2016), the model with the lowest

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AIC and BIC value might be chosen concerning the other models. However, if one model has the lowest AIC and another model the lowest BIC, the best model, according to these criteria, is the one with the lowest LogLik and the highest Deviance. Table 2 presents the results of the diagnoses of AIC, BIC, LogLik, and Deviance.

Table 2 - AIC, BIC, LogLik, and Deviance criteria to determine the best model

Model	LogLik	AIC	BIC	Deviance
1	-3.494.694	7.089.388	7.358.056	1.446.408
2	-3.411.097	7.022.195	7.559.532	1.431.307
3	-3.479.201	7.038.401	7.253.336	1.443.597
4	-3.352.519	6.805.037	7.073.706	1.420.819
5	-3.311.648	6.803.297	7.286.901	1.413.547
6	-3.409.037	7.078.074	7.776.613	1.430.937
7	-3.477.495	7.094.990	7.471.127	1.443.288
8	-3.348.230	6.856.459	7.286.329	1.420.054
9	-3.306.909	6.853.818	7.498.623	1.412.706
10	-3.400.552	7.101.105	7.907.111	1.429.413
11	-3.264.864	6.889.727	7.856.935	1.405.268
12	-3.402.570	7.045.139	7.689.944	1.429.775
13	-3.275.106	6.810.212	7.508.751	1.407.077
14	-3.269.222	6.838.444	7.644.450	1.406.038
15	-3.339.162	6.818.323	7.194.460	1.418.438

Although model 5 has the lowest AIC value, model 4 has the lowest BIC value. Also, model 4 has the lowest LogLik value and the highest Deviance value compared to model 5. Then, applying the methodology used in this study, model 4 is preferred over the other 14 models. Curiously, model 4 considers only one determinant: the interest rate elasticity of demand. Table 3 presents the summary of model 4.

Table 3 - Summary results for model 4

Determinant	Coefficients	Std. Error	t value	Pr(>|t|)
Intercept	0.07327	0.02235	3.278	0.00107
IE (factor 2)	-0.09469	0.03939	-2.404	0.01633
IE (factor 3)	-0.09472	0.03304	-2.867	0.00420
IE (factor 4)	0.02012	0.02399	0.839	0.40178

One way of interpreting the results of model 4 is that companies with interest rate elasticity of demand between -0.85 and 0.82 have a lower stock return – on average of -0.947 – when compared to companies with interest rate elasticity of demand below -0.85 or above 0.82.

THE BETAS BEHAVIORS PER DETERMINANT

The betas behaviors per determinant

Factor 4 was statistically significant for all nine models that considered the Type of Business determinant. Also, the coefficient for factor 4 ranged from 0.05596 to 0.063166. On the other hand, none of the other factors for that determinant were statistically significant. The results indicate that, keeping everything else equal, companies that market normal goods (with income elasticity of demand close 1) tend to have an annual increase in stock return between 0.05596 to 0.063166. However, the models were not able to predict the annual stock return behavior for the other factors.

Degree of Operational Leverage

None of the degrees of operations leverage factors were statistically significant at the seven models that included that determinant. So, the study was not able to quantify the risk-return tradeoff for this determinant.

The six types of balance sheets, according to the Dynamic Model

The Dynamic Model factors could not quantify the risk-return tradeoff on this study, since none of that determinant factors were statistically significant on any of the six models that included this variable.

Interest Rate Elasticity of Demand

Factor 2 and 3 were statistically significant on all of the eight different models that included the Interest Rate Elasticity of Demand determinant, while factor 4 was not statistically significant on any ran model. Also, factors 2 and 3 had a negative sign on every model, indicating that, keeping everything else equal, companies with Interest Rate Elasticity of Demand between -0.85 and 0.82 tend to have a lower return than companies with Interest Rate Elasticity of Demand below -0.85 or above 0.82.

RECOMMENDATIONS

Although the study indicated that there is a relationship between annual stock return with income elasticity of demand and interest rate elasticity of demand, it is recommended that future studies improve the methodology used in this work by:

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3 Testing some models applying nonlinear regressions or other statistic methods;
4 Substituting the dependent variable used in this study by the annual stock volatility, or the annual sharp ratio per stock, or the annual return on invested capital, or the annual excess stock return;
5 Separating the database in small-cap companies and large-cap companies as a proxy for domestic and international companies;
6 Adjusting the inflation impact in the database; and
7 Testing the models in other markets, especially the American one, due to the large number of companies

CONCLUSION

This study aimed to test the following five different risk determinants as an alternative to the CAPM methodology: 1) income elasticity of demand; 2) degree of operating leverage; 3) degree of financial leverage; 4) the six types of balance sheets, according to the Dynamic Model; 5) and the interest rate elasticity of demand.

After running fifteen linear regression models, the results indicated that only two determinants were statistically significant to explain the annual stock return: demand's income elasticity and the interest rate elasticity of demand. Moreover, after applying the AIC, BIC, LogLik, and Deviance methodology, the preferred model was the one that included only the interest rate elasticity of demand as a determinant.

For the first determinant (income elasticity of demand), the results indicate that, keeping everything else equal, companies that market normal goods (with income elasticity of demand equals 1) tend to have an annual increase in stock return between 0.05596 and 0.063166. Besides, for the fifth determinant (interest rate elasticity of demand), the results indicated that, keeping everything else equal, companies with Interest Rate Elasticity of Demand between -0.85 and 0.82 tend to have a lower return than companies with Interest Rate Elasticity of Demand below -0.85 or above 0.82.

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