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THE VALIDITY OF CAPM AND ICAPM IN THE ISTANBUL STOCK EXCHANGE

Borsa İstanbul'da Sermaye Varlıkları Fiyatlama Modelleri SVFM ve USVFM'nin Geçerliliği

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Keywords:
ISE, CAPM, ICAPM, Exchange Rate, Emerging Markets, Panel Data Analysis

JEL Codes:
G10, G11, G12

Abstract

This study aims to answer the following research question: Are the Capital Asset Pricing Model (CAPM) and International Capital Asset Pricing Model (ICAPM) valid in the Istanbul Stock Exchange (ISE)? No broad agreement has been reached in the literature on this question, yet. Using an unbalanced panel of daily stock returns of companies in the BIST-30 index and as of BIST-100 index from March 2010 to February 2019, this paper seeks to provide new evidence on this discussion and explores whether the risk-expected return relationship is linear. In the empirical framework, panel regression analysis methodology is employed. Our findings indicate that both linear CAPM and linear ICAPM models are valid in ISE. Moreover, it is observed that the ICAPM outperforms the CAPM in explaining the stock returns for both indices. This outperformance is especially more pronounced for BIST-30 than BIST-100. Depending on these findings, investors can easily prioritize BIST-100 over BIST-30 when constructing portfolios to reduce risk in the Turkish market, given the fact that exchange rate-relevant diversification is greater in BIST-100.

Anahtar Kelimeler:
Borsa İstanbul, SVFM, USVFM, Döviz Kuru, Yükselen Piyasalar, Panel Veri Analizi

JEL Kodları:
G10, G11, G12

Öz

Bu çalışmanın amacı, Borsa İstanbul'da Sermaye Varlıkları Fiyatlama Modeli (SVFM) ve Uluslararası Sermaye Varlıkları Fiyatlama Modeli (USVFM) geçerli midir, sorusunu cevaplamaktır. Alan yazında bu soru üzerine henüz tam bir fikir birliğine ulaşılamamıştır. Bu çalışmada BIST-30 ve BIST-100 endekslerindeki işletmelerin Mart 2010 ile Şubat 2019 arası günlük pay senedi getirilerinden oluşan dengesiz panel veri seti kullanılarak bu tartışmaya yeni kanıtlar sunmak hedeflenmekte ve risk-beklenen getiri ilişkisinin doğrusal olup olmadığı araştırılmaktadır. Ampirik uygulama olarak panel regresyon analizi metodolojisi kullanılmıştır. Bulgularımız Borsa İstanbul'da (BIST) hem SVFM hem de USVFM'nin geçerli olduğunu göstermektedir. Aynı zamanda bulgularımız, her iki endeks için pay senedi getirilerini açıklamada USVFM'nin SVFM'ye göre daha iyi performans gösterdiğini ortaya koymaktadır. Açıklama gücündeki bu yüksek performans BIST-30 endeksinde BIST-100 endeksine kıyasla daha ön plana çıkmaktadır. Bu bulgulara dayanarak yatırımcılar, BIST-100'de döviz kuru ilişkili çeşitlendirmenin daha fazla olması nedeniyle Türkiye piyasasında riski azaltacak portföyler oluştururken yatırımcıların BIST-30 yerine BIST-100'ü kolaylıkla önceliklendirebilirler.

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1. Introduction

Investment theory has been concerned with understanding how risk and expected return are related to each other in various circumstances. This relationship between risk and return underlies the theoretical basis for many investment models, including the Capital Asset Pricing Model (CAPM). CAPM test confronts numerous issues related to statistical assumptions such as return distributions' normality or use of variance as a primary risk metric (Markowitz, 1959). The security market line's determinants define a positive association between betas and expected returns. The foundation of CAPM suggests that all risks should not have an impact on asset values, and that risk can only be mitigated by keeping it in a portfolio of assets with other investments. On the other hand, the International Capital Asset Pricing Model (ICAPM) is derived from CAPM to deal with global investment. ICAPM is used to include currency risk when examining assets in a global context and dealing with multiple currencies, often with the inclusion of an exchange rate premium to the model. In the ICAPM, direct and indirect exposure to foreign currencies, as well as the time value of money and market risk premium are rewarded. Thus, ICAPM enables considering an asset's sensitivity to fluctuations in foreign exchange markets.

This study aims to answer the following research question: Are CAPM and International ICAPM valid in the Istanbul Stock Exchange (ISE)? No broad agreement has been reached in the literature on this question, yet. Answering this question for the Turkish capital market is quite important since it is a developing and relatively risky market, in which investor protection is a major concern for both investors and policymakers. The BIST-100 (XU100) and BIST-30 (XU30) are key stock indices on the Turkish stock market. Comprising 100 stocks from the stars market, BIST 100 represents the performance of the market in general. As a benchmark for investment choices, BIST-30 consists of the 30 most liquid and highly valued equities. When it comes to tracking and directing investments in the Turkish stock market, both indices are quite important.

This study contributes to the literature by shedding light on the usefulness of both models in the context of the Turkish capital market. Various empirical research gives opposing evidence and viewpoints on the validity of the CAPM in different markets of ISE. Some research supports the validity of CAPM, while others argue against it. Additionally, the number of studies about the validity of ICAPM in ISE is limited. This study attempts to contribute to filling this gap by investigating the application of CAPM in the Turkish stock market and also comparing it to ICAPM. In sum, the primary focuses of this study are to find: i) whether the two models are valid in ISE, ii) which model is better suited, by comparing the explanatory power of the two.

Overall, this empirical study tests the legitimacy of CAPM and ICAPM in ISE, using daily stock returns for BIST-30 and BIST-100 companies, which are on the stock exchange without interruption for the ten years from March 2010 to February 2019. In BIST-30 and BIST-100, we observed the relationship to verify the hypothesis that there is a linear relationship between expected return and risk. In empirical analysis, we make panel regression estimations for the following four models. The first model is a baseline model for testing the validity of CAPM. To modify CAPM into ICAPM, the second model introduces USD/TRY, the third model introduces EURO/TRY, and the fourth model introduces EURO/USD as exchange rate variables to the baseline model.

The findings of this study show that both linear CAPM and linear ICAPM models are valid in both BIST-100 and BIST-30. Moreover, ICAPM outperforms CAPM in explaining the stock returns for both indices. This outperforming is especially more pronounced for BIST-30 than

BIST-100. Depending on this finding, we propose that investors can easily prioritize BIST-100 over BIST-30 when constructing portfolios to reduce risk, given the fact that exchange rate-relevant diversification is greater in BIST-100.

Based on our findings, our recommendation for investor protection policies is to consider the significant role of exchange rates in the construction of asset prices. Specifically, policy instruments to improve the context for hedging opportunities would be of crucial importance. This way, investors' confidence in Turkish capital markets would also increase. This increase in investor confidence will contribute to a healthier development of the relationship between risk and expected return and will ensure a healthier balance of financial asset prices in the market. The widespread effect of this will be to contribute to the development of capital markets.

This study has the subsequent organization: In Section 2, a concise review of relevant previous work is provided along with a brief discussion of their findings, and the research design. In Section 3, data and the methodology of the paper are described and empirical analysis estimation results are provided. Lastly, in section 4, the paper is concluded and areas for future studies are highlighted.

2. Empirical Literature Review

The connection between risk premium and return in financial markets has been the subject of much empirical research worldwide. Table 1 summarizes findings from prior studies on the validity of various CAPMs in different financial markets.

Our literature review indicates that there are many different types of CAPM, which have been widely investigated in various financial markets. In some markets, it shows significance, and in some markets, it doesn't. Recently, Güler et al. (2018) evaluate the Turkish stock market's dependence on foreign markets using the CAPM, highlighting the importance of this model in understanding risk exposures and investment trends. Moreover, the traditional ICAPM is used by Sahin et al. (2016) to investigate the determinants of equity home bias in Turkey. Furthermore, most recently, Taha and Tuna (2023) used the expanded ICAPM to examine investments in the Turkish market, with consideration of regional variables. Despite the fact that these studies use CAPM and ICAPM among a few others, there is a gap in the literature about considering the comparison between the two.

Still, in general, CAPM shows significance mostly in developed markets. In the Turkish financial market, there is not enough empirical evidence for reaching a conclusion on the validity of different types of CAPM. This study is going to provide empirical evidence on 1) whether CAPM is valid in the Turkish financial market; and 2) whether ICAPM is valid (by adding the foreign exchange risk factor into the CAPM) in the Turkish financial market. Moreover, this study compares two models to identify their respective explanatory powers.

Table 1. A Summary of Key Findings on the Validity of CAPM Models in Various Financial Markets

Authors (Year published)	Index and / or Market	Method of Analysis	Tested Model	Brief Results / Conclusions
Arda et al. (2023)	Istanbul Stock Exchange	Panel Data Analysis	CAPM, Carhart Four Factor Model (C4F), FF3F and FF5F Models	Both the C4F and the FF3F models are appropriate for use in portfolio-based investigations. In research based on firms CAPM is reliable.
Kaya (2021)	Istanbul Stock Exchange (BIST-100)	Regression Analysis & Spanning Test	CAPM, FF3 & FF5	CAPM, FF3F, and FF5F Models show significance. FF5 Model performs the best among all.
Markowski (2020)	Warsaw Stock Exchange	Cross-sectional Regression Analysis	Downside CAPM	The downside CAPM was validated by the unconditional regressions, which also provide support for an existent risk premium. Risk-return relationships are dependent on the market.
Offiong et al. (2020)	Douala Stock Market (DSX)	Regression Analysis	CAPM	The CAPM is not valid in DSX for individual variables or portfolios of three asset estimations of beta. However, the beta of the two asset portfolios shows significance and has a linear relationship.
Güler et al. (2018)	Istanbul Stock Exchange	Regression Analysis and GRS-F test	CAPM, FF3F and FF5F Models	As in several developed economies including the U.S., CAPM is effective in explaining variances in stock market returns. It is also applicable to emerging markets with dynamics that are distinct from those of developed nations.
Aliyev and Soltanli (2018)	Istanbul Stock Exchange Banking Sector	Regression Analysis	CAPM	CAPM is appropriate for the portfolio of the 12 banks.
Ratra (2017)	Indian Stock Market (NSE)	Regression Analysis	CAPM	CAPM is not applicable in NSE because the gap between expected outcomes and actual outcomes is excessively high at levels of typical risk.
Erdinç (2017)	Istanbul Stock Exchange	Regression Analysis & GRS-F Test	CAPM, FF3 & FF5 Models	FF5 Model performs best, followed by the FF3 Model and the CAPM, which are unable to account for excess return.
Maeda (2016)	Japanese Stock Market (JPX)	Empirical Review	CAPM, C4F, FF3F and FF5F Models	CAPM is a valid model for the JPX. For the Japanese stock market, the author contends, the FF3F model is suitable.
Demircioğlu (2015)	Istanbul Stock Exchange Power Generation and Distribution sector & Cement Sector	Regression Analysis	CAPM	Both Cement and Power generation & distribution industries are insignificant in this research which means there is no validity of CAPM in the mentioned sectors.

Table 1. Continued

Nhu et al. (2015)	Vietnam Stock Exchange	Multivariate Regression	CAPM, FF3F and FF5F Models	The FF5F model explains more anomalies in asset pricing as compared to the FF3F model and CAPM. Additionally, state ownership and stock return are correlated with the value factor, with state ownership providing higher average returns than private firms.
Ferreira and Monte (2015)	Portuguese Stock Exchange	Regression Analysis	CAPM	The multifactor model of the CAPM fits the data more closely than the single-factor model, which is invalid.
Acheampong and Agalega (2013)	Ghanaian Stock Exchange	Regression Analysis	CAPM	CAPM shows no statistically significant correlation between beta and stock returns, proving that the Ghanaian stock market returns were not predicted by the CAPM.
Verma (2011)	MSCI World Index	Regression Analysis	Conditional CAPM	Both positive and negative conditional CAPM models are insignificant.
Perkovic (2011)	Croatian Stock Market (CROBEX Index)	Regression Analysis & ANOVA	CAPM	CAPM is not a worthy model to use for making investment decisions.
Setyowati (2011)	Indonesian stock exchange (IDX)	Regression Analysis	CAPM	The majority of CAPM research uses it for developed markets, for describing the Indonesian stock market return, the CAPM is an inadequate model because IDX is an emerging market.
Theriou et al. (2010)	Athens Stock Exchange (ASE)	Regression Analysis	Unconditional and Conditional CAPM	There is no validity of Unconditional CAPM in ASE but there is validity in a bullish market. Conditional CAPM shows a positive relationship and vice versa.
Minovic and Živković (2010)	Serbian Stock Market	Regression Analysis	CAPM & LCAPM (Liquidity CAPM) Models	LCAPM is more suitable than CAPM in explaining portfolio returns. Also, there are several variables, including a lack of transparency and the relatively small size of the market, that add to the low liquidity of the Serbian stock market.
Choudhary and Choudary (2010)	Indian Stock Market BSE 500 Index	Time Series Analysis	CAPM	CAPM is not sufficient to explain Beta in terms of finding expected returns for the portfolio. Conclude that CAPM is invalid.
Trifan (2009)	Romanian Stock Market	Regression Analysis	CAPM	CAPM is insignificant, but one of the reasons can be that the data taken in this research from a time when there was a financial crisis
Al Refai - 2009	Amman Stock Exchange	Regression Analysis	Unconditional and conditional CAPM	In bullish markets, the researcher discovered a high risk-return correlation, but in declining markets, he observed no such relationship for several of the portfolios.
Knudsen (2009)	MSCI Index	Regression Analysis	ICAPM and CAPM Models	Both models show significance. Furthermore, for small countries, local CAPM and global CAPM do have not much difference, but for developed economies, there is a big difference, and ICAPM is the preferred model.

Table 1. Continued

Gökgöz (2007)	Istanbul Stock Exchange	Time series and Cross-sectional Regressions, GRS-F test	CAPM & FF3 Models	CAPM and the FF3 Model are proven to be appropriate and sustainable. In terms of pricing errors, the FF3 Model performs better than the CAPM.
Gürsoy and Rejepova (2007)	Istanbul Stock Exchange	Regression Analysis	CAPM	The CAPM failed to demonstrate validity in ISE since the researchers did not find any meaningful result to determine the effect of market returns on the portfolio.
Michailidis et al. (2006)	Greek Stock Market	Regression Analysis	CAPM	Beta and excess stock return have no linear relationship. In other words, CAPM is not valid.
Karacabey and Karatepe (2004)	Istanbul Stock Exchange	Regression Analysis	Conditional CAPM	Conditional CAPM is significant because conditional risk-return is linked with developing the stock exchange.
Fraser et al. (2004)	UK Stock Market	GARCH-M model and the QTARCH	Conditional CAPM	Conditional CAPM is performing better in a declining market as compared to an upward-trend market.
Ng (2004)	UK, US and Japan and Germany Stock and FX Markets	Regression Analysis	ICAPM and CAPM	The traditional CAPM, the ICAPM, and the dynamic CAPM are all nestled within the model. For practical purposes, CAPM is the best-performing model.
Fearnley (2002)	American, European and Japanese Stock & Bond Markets	Regression Analysis & GARCH	ICAPM	ICAPM can be used to examine how equities and government bonds are related. ICPAM explains more in stock markets as compared to bond markets.
Fletcher (2000)	MSCI Equity Indices of 18 Developed Markets	Regression Analysis	Unconditional and conditional CAPM	Return and risk are indisputably positively correlated. The conditional relationship between risk and return supports the model, proving the validity of both CAPMs.
Schramn and Wang (1999)	Portfolio of 18 companies from S&P 500 and MSCI	Regression Analysis	ICAPM and CAPM	Traditional CAPM is better if the companies are not engaged in foreign trade. But if the companies have international trade, then ICAPM is more appropriate.
Dumas and Solnik (1993)	UK, US, and Japan Markets Equity Indıces	Regression Analysis	ICAPM and CAPM	ICAPM is more efficient than the traditional CAPM at explaining the global rate of return.

Overall, divergent perspectives on the CAPM in various financial markets have been emerging. One group of studies (Gökgöz, 2007; Maeda, 2016; Güler et al., 2018; Kaya, 2021; Arda et al., 2023, and among others) conclude that CAPM is valid. On the other hand, a different group of studies (Setyowati, 2011; Verma, 2011; Acheampong and Agalega, 2013; Ratra, 2017; Offiong et al., 2020, and among others) conclude that CAPM is not valid. A third collection of studies (Dumas and Solnik, 1993; Schramn and Wang, 1999; Ng, 2004; Knudsen, 2009, among others) claims that the ICAPM performs better than the CAPM. These differences highlight a research gap that calls for an examination of the applicability of CAPM in the Turkish stock market. This study aims to address this gap and compare the significance of CAPM and ICAPM, adding to an effort in the context of the Turkish stock market.

3. Empirical Analysis

Empirical research-wise, we have two major objectives in this study. First, we assess the significance of CAPM by identifying excess return (ER-Rf) and a risk premium (Rm-Rf) relationship. If the correlation between excess return and risk premium is negative or positive, this implies that the CAPM is significant in the stock index, which shows a bullish or bearish trend in the market. Second, we look at the notion of whether there exists an exchange rate and CAPM relationship. To verify this, we need to test the significance of CAPM on the index and then add one more variable, the exchange rate.

3.1. Data

Data is obtained from 76 listed firms in BIST-100 and 28 listed firms in BIST-30 (two of the main indices in ISE) for the 2010–2019 period. Thomson Reuters Database is the main source of data, where we collected the data on stock markets, implied returns, and market returns, as well as exchange rates. In addition, Turkish T-bills data is from the TCMB Data Portal. The daily frequency data used in this research and the time span is from March 2010 to February 2019, i.e., 10 years of data. After neglecting the missing data, we have unbalanced panel data with 76 firms' 10 years of daily data (76 x 2276 = 172.292 observations) for BIST-100 and 28 firms' 10 years of daily data (28 x 2276 = 63.476 observations) for BIST-30 in our analysis.

3.2. Methodology

Panel data analysis is used in this research. First, for testing the validity of CAPM, there are three variables: market prices (BIST index), risk-free return (rf), and BIST index registered companies' prices. Furthermore, by adding one more variable—the exchange rate—to the CAPM, we test the validity of the ICAPM.

For risk-free return, after considering various options, the implied risk-free interest rate (from Thomson Reuters Database) as used by Bianconi et. al (2015) pricing is decided to be used.[1]

[1] Other options for risk-free rates are as follows: As a proxy for risk-free interest rate, Kaya (2021) prefer to use overnight interest rate; Kara (2016) uses 365 days T-bill rate; Eraslan (2013) uses quarterly and bi-annually T-bill rate; Erdinç (2017) uses 3-month Turkish Lira Interbank Offer Rate (TRLIBOR); and Gökgöz (2007) uses Monthly Turkish Government Internal Loan Index (GIL).

The difference between future and spot interest rates for the future is known as the implied interest rate.

Compensation needed for an investor to accept more risk than T-bills or other government bonds is determined by the other half of the CAPM formula. For this, one has to compare the asset's historical returns to market returns and the market premium (rm + rf) using a risk measure (beta).

In the typical CAPM, the following equation is applied to compute an asset's expected return given its risk:

$$(E(Ri) - Rf)_{it} = \beta_0 + \beta_1(E(Rm) - Rf)_{it} + \varepsilon_{it} \quad (1)$$

where; $E(Ri)$: Expected return, Rf : Risk-free rate, β_0 : Coefficient of the security, β_1 : Beta of the security, Ri - Rf : Excess market return, Rm - Rf : Risk premium, ε_{it} : Residuals.

The beta coefficient, according to CAPM, is used to measure systematic risk. This description, however, may not tell the complete story. The activities of companies are subject to the macroeconomic and institutional climate of the country in which they operate. Moreover, most businesses have also expanded their activities beyond their home countries. This reality of open economies creates more complex economic conditions for both domestic and international companies.

CAPM is designed to consider a variety of risk factors. It is assumed that while taking non-systematic risks should not be rewarded, taking systematic risks requires a higher return. Sharpe (1964), Lintner (1965), and Black (1973) estimated CAPM and concluded that the results verified its application, that it is a very elegant model, and that it is useful. It can assist investors in enhancing their investment strategy by providing at least a point of comparison when evaluating financial assets in terms of risk and return. Even certain researchers, such as Roll (1977), contended that one cannot test CAPM since it is very difficult to create a "true market portfolio".

We first evaluate the validity of the CAPM model, then add another risk element, "exchange rate" and assess the model's significance. Finally, we'll compare which model has more power to convey the market return.

Kassouri and Altıntaş (2020) found that real effective exchange rates such as USD/TRY and EUR/TRY, interest rates, and money supply are among the market drivers since they have a significant predictive capacity for stock market volatility at different frequencies. He et al. (2021) also claimed that the exchange rate impacts the Turkish stock market negatively.

We use the BIST-100 and BIST-30 indices' returns as a proxy for the market portfolio. We tested both BIST-100 and BIST-30 with three pairs of exchange rates, which are USD/TL, EURO/TL, and EUR/USD, as below:

$$(E(Ri) - Rf)_{it} = \beta_0 + \beta_1(E(Rm) - Rf)_{it} + \beta_2(USD/TRY)_{it} + \varepsilon_{it} \quad (2)$$

$$(E(Ri) - Rf)_{it} = \beta_0 + \beta_1(E(Rm) - Rf)_{it} + \beta_2(EURO/TRY)_{it} + \varepsilon_{it} \quad (3)$$

$$(E(Ri) - Rf)_{it} = \beta_0 + \beta_1(E(Rm) - Rf)_{it} + \beta_2(EURO/USD)_{it} + \varepsilon_{it} \quad (4)$$

where; $(E(Ri) - Rf)$: Excess return, $(E(Rm) - Rf)$: Market risk premium, USD/TRY: Exchange rate USD to TRY, EURO/TRY: Exchange rate EURO to TRY, EURO/USD: Exchange rate EURO to USD, ε_{it}= Residuals.

3.3. Empirical Results

Table 2 presents the descriptive statistics. The results regarding BIST-100 and BIST-30 for 10 years of data according to descriptive statistics, the significant difference in ranges between BIST-100 and BIST-30 implies that the two indices' excess returns have different levels of variability and dispersion. BIST-100, as a broader market index, has a wider range, meaning higher variability in excess returns than the more targeted BIST-30. The exchange rate variables USD/TL and EUR/TL show high fluctuations, while EUR/USD shows more stability. Investors and analysts can look at the range to determine the degree of return dispersion roughly, which can help them understand and manage the risks associated with various market indices.

According to previous research, Byrne (2013) and Hair et al. (2010) discussed that data is normally distributed if kurtosis is between 7 and +7 and skewness is between 2 and +2. Our data is within the range of skewness and kurtosis as described above by Byrne (2013) and Hair et al. (2010), so we can say that all data are normally distributed.

Table 3 and Table 4 present pooled ordinary least squares (Pooled OLS) estimation results for the BIST-30 index and the BIST-100 index, respectively. The baseline Model (Model 1) has a single explanatory variable, the market risk premium, and a single dependent variable, the excess return. Models 2 - 4 introduce single control variables to baseline Model 1, which are i) the exchange rate between USD (U.S. Dollars) and TRY (Turkish Lira) for Model 2, ii) the exchange rate between the EURO and the TRY for Model 3, and iii) the EURO-USD exchange rate for Model 3, respectively.

Table 2. Descriptive Statistics

Descriptive Analysis	BIST-100 (Excess Return)	BIST-100 (Rm-Rf)	BIST-30 (Excess Return)	BIST-30 (Rm-Rf)	USD/ TRY	EUR/ TRY	EUR/ USD
Mean	-0.039	-0.038	-0.039	-0.039	2.654	3.204	1.238
Standard Deviation	0.030	0.026	0.031	0.026	1.127	1.186	0.112
Sample Variance	0.001	0.001	0.001	0.001	1.271	1.406	0.012
Kurtosis	6.394	2.752	3.341	3.292	1.076	1.886	-1.271
Skewness	-0.507	-0.555	-0.367	-0.940	1.240	1.496	0.021
Range	1.016	0.283	0.453	0.315	5.491	5.939	0.449
Minimum	-0.787	-0.182	-0.243	-0.248	1.388	1.894	1.039
Maximum	0.228	0.101	0.211	0.068	6.880	7.833	1.487
No. of Observations	172 292	172 292	63 476	63 476	2 267	2 267	2 267

Table 3 presents Pooled OLS estimation results for BIST-30. In Baseline Model 1, coefficient of market risk premium is statistically significant at the 1% confidence level, and it is negative, suggesting that there is a negative association between the risk premium and the excess return for the period of analysis. In Models 2-3, coefficients of market risk premium are also statistically significant at the 1% confidence level, with a negative sign. In Model 4, coefficient is also negative, however not statistically significant. Note that coefficient values increase when we incorporate exchange rate to the model.

Table 3. Pooled OLS Estimation Results for BIST-30

	Model 1	**Model 2**	**Model 3**	**Model 4**
E(Rm)-Rf	-0.046*** (0.000)	-0.737*** (0.000)	-0.7609*** (0.000)	-0.1835 (0.234)
USD/TRY		-0.026*** (0.000)		
EURO/TRY			-0.025*** (0.000)	
EURO/USD				0.099*** (0.000)
Constant	-0.039*** (0.000)	-0.003*** (0.000)	0.015*** (0.000)	-0.168** (0.033)
Adjusted R-squared	0.152	0.521	0.536	0.108
No. of Observations	63 476	63 476	63 476	63 476

Notes: *, **, and *** represent significance at 10%, 5%, and 1% levels, respectively. Probabilities are given in parentheses. Baseline Model 1 has a single explanatory variable, the market risk premium, and a single dependent variable, the excess return. Models 2 - 4 introduce single control variables to baseline Model 1, which are i) the exchange rate between USD and TRY for Model 2, ii) the exchange rate between the EURO and the TRY for Model 3, and iii) the EURO-USD exchange rate for Model 3, respectively.

Negative sign of market risk premiums can be associated with the effects of exchange rates, as well as other country-specific macroeconomic circumstances during the analysis period. The effect of these factors is also evident in the goodness of fit level of adjusted R-squared statistics. In the baseline CAPM model for BIST-30, this statistic is 15 percent, while it is approximately 53 percent after including exchange rate variables in Models 2-3, which demonstrates that exchange rates play a substantial role in the BIST-30. The effects of USD/TRY and EUR/TRY on BIST-30 index return is expected because the top 30 index companies are mostly in the manufacturing, financial institutions, petroleum refinery, and technology sectors, which are highly affected by exchange rates. According to the statistics provided by TUIK (Turkish Statistical Institute) and OEC (Observatory of Economic Complexity), the highest-level import of Turkey is from scrap iron, which is an essential element of manufacturing. Banks are also highly affected by exchange rate fluctuations because their reserves depend on the exchange rates. Refined gasoline is one of the biggest imports in the energy sector. Overall, since Turkey exports raw materials at low prices and buys them back in the form of finished products at higher prices, almost all sector trade balances are negative, and sector BIST-30 index responds to the exchange rate accordingly as expected in all of the three models.

In sum, our findings from Table 3 suggest three results. First, since CAPM variables are significant in Baseline Model 1, therefore it is a valid asset pricing model in BIST-30. Similar results were found in the previous empirical literature (see, Karacabey and Karatepe, 2004; Gökgöz, 2007; Erdinç, 2017; Aliyev and Soltanli, 2018; Kaya, 2021, among others). Second, when we incorporate exchange rates in Models 2 and 3, we find that ICAPM variables are significant, therefore it is also a valid model in BIST-30. Third, when we compare the two models, we observe a gradual increase in the goodness of fit levels, implying that ICAPM explains far more than CAPM for BIST-30. This result is consistent with the results of studies that focus on capital markets in developed economies (see, Dumas and Solnik, 1993; Schramn and Wang, 1999; Ng, 2004; Knudsen 2009, among others).

Table 4 presents Pooled OLS estimation results for BIST-100. In all models of BIST-100, the risk premium coefficient is statistically significant at the 1% level of confidence level. In the baseline Model 1 and Model 4, the coefficients for the market risk premium are positive, whereas they are negative in Models 2 and 3. When we compare the baseline CAPM for BIST-30 and BIST-100, we observe that unlike for BIST-30, the coefficient for the market risk premium in the baseline CAPM (Model 1) is positive for BIST-100. In addition, the explanatory power of the baseline CAPM is also higher in BIST-100, when compared with as of BIST-30. These differences in two aspects can be attributed to BIST-100 being more inclusive, and also better diversified, as compared to BIST-30.

Table 4. Pooled OLS Estimation Results for BIST-100

	Model 1	**Model 2**	**Model 3**	**Model 4**
E(Rm)-Rf	0.829***	-0.713***	-0.710***	0.806***
	(0.000)	(0.000)	(0.000)	(0.000)
USD/TRY		-0.026***		
		(0.000)		
EURO/TRY			-0.025***	
			(0.000)	
EURO/USD				0.099***
				(0.000)
Constant	-0.039***	-0.003***	0.015***	-0.168**
	(0.000)	(0.000)	(0.000)	(0.033)
Adjusted R-squared	0.530	0.545	0.545	0.533
No. of Observations	172 292	172 292	172 292	172 292

Notes: *, **, and *** represent significance at 10%, 5%, and 1% levels, respectively. Probabilities are given in parentheses. Baseline Model 1 has a single explanatory variable, the market risk premium, and a single dependent variable, the excess return. Models 2 - 4 introduce single control variables to baseline Model 1, which are i) the exchange rate between USD and TRY for Model 2, ii) the exchange rate between the EURO and the TRY for Model 3, and iii) the EURO-USD exchange rate for Model 3, respectively.

Our findings from Table 4 for BIST-100 suggest similar results from Table 3 for BIST-30, despite the differences in coefficients' signs. First, we conclude that both CAPM and ICAPM are valid in BIST-100. Second, when we compare the two models, we observe a slight increase in the goodness of fit levels, implying that ICAPM explains more than CAPM for BIST-100, although the difference is not as much as BIST-30. It is likely that a big part of this sensitivity to exchange rates comes from BIST-30 companies since BIST-100 includes BIST-30. Moreover, some of the sectors in BIST-100 such as food & beverages, travel & logistics, and textiles are crucial sectors in terms of performing well in times of high volatility in exchange rates.[2] With the support of these sectors, the BIST-100 index does not show as much sensitivity as BIST-30, which is observed in Models 2, 3, and 4.

[2] Companies in BIST-100 index are mostly in the industries of manufacturing, financial institutions, petroleum refinery, travel & logistics, food & beverages, textiles & fabrics, and technology. According to the statistics provided by Observatory of Economic Complexity (OEC) and the World Integrated Trade Solution (WITS), In Turkey the largest export sector is textiles and apparel ($27 million), which is almost three times higher than imports ($9 million). Food and products are worth $8 million, almost double imports ($4 million). The livestock sector is almost three times as large ($2.4 million) as imports ($0.8 million). Except for these sectors, all sectors have almost zero trade balance or a strongly negative trade balance.

All in all, the findings shed light on the application of CAPM and ICAPM in the Turkish stock market, as well as their respective explanatory powers. First, we find that the CAPM and the ICAPM is both valid in BIST-30 and BIST-100 indices of ISE. Second, we find that the explanatory power of ICAPM is far more than the CAPM in BIST-30, suggesting that BIST-30 companies are highly sensitive to exchange rates. However, for BIST-100, we don't find as much difference, other than slightly higher value of adjusted R-squared after adding exchange rates to the baseline model. The goodness of fit level in the CAPM model for BIST-30 is 15 percent. The ICAPM model, on the other hand, describes the model with a goodness of fit level of around 53 percent after including exchange rate variables, demonstrating that exchange rates play a substantial role in the BIST-30. On the other hand, according to the CAPM model for BIST-100, the market risk premium can account for about 53 percent of the variation in stock return. While the ICAPM is used to demonstrate the model that an exchange rate with excess return is explaining a little bit more than a standard CAPM (with an R-square value of around 54.5 percent). These findings implies that explanatory power of CAPM and ICAPM are similar in BIST-100, suggesting that these companies have a lower sensitivity to exchange rates. A possible explanation of the significant role of exchange rate comes from trade facts.[3]

4. Concluding Remarks

Current debates and verifications regarding the validity of CAPM and ICAPM in emerging market stock exchanges remain inconclusive. To contribute to this strand of empirical literature, this study aims to answer the following research question: Are CAPM and ICAPM valid in the Istanbul Stock Exchange (ISE)? Moreover, this paper also compares the explanatory powers of the two models. To make such an analysis, we use an unbalanced panel of 28 companies' daily stock returns in the BIST-30 index and 76 companies in the BIST-100 index, from March 2010 to February 2019.

This study contributes to the literature by shedding light on the usefulness of both models in the context of the Turkish capital market for the analysis period. Various empirical research gives opposing evidence and viewpoints on the validity of the CAPM in different markets of ISE. Some research supports the validity of CAPM, while others argue against it. Additionally, the number of studies about the validity of ICAPM in ISE is limited. This study attempts to contribute to filling this gap by investigating the application of CAPM in the Turkish stock market and comparing it to ICAPM. In sum, the two primary focuses of this study are to find: i) whether the two models are valid in ISE, ii) which model is better suited, by comparing the relevance of the two.

The findings of this study show that both linear CAPM and linear ICAPM models are valid in both BIST-100 and BIST-30. Moreover, ICAPM outperforms CAPM in explaining the stock returns for both indices. This outperforming is especially more pronounced for BIST-30 than BIST-100. In conclusion, both models are applicable for the exercises of forecasting stock returns.

[3] Turkish industry exports raw materials at low prices and purchases them back as finished goods at higher prices. As a result, the trade balance is negative for the BIST-30 (Turkey (TUR) Exports, Imports, and Trade Partners | OECworld, 2020). Because it relies heavily on imports for exports, exchange rates have a significant impact on it. Whereas BIST-100 is less sensitive to the exchange rate fluctuations as compared to BIST-30. The food and the textile industries being the biggest exports of Turkey (Turkey Trade Balance, Exports, Imports by Country, and Region 2020 | WITS Data, 2023), helps to balance imports and exports.

However, it would be better to use the ICAPM model rather than the CAPM model for both indices since the ICAPM model more adequately explains the overall model for BIST-30 and BIST-100, when compared to CAPM. Especially for BIST-30, ICAPM's greater explanatory power suggests that the exchange rate is an important component in the Turkish market. Furthermore, it is undisputed that exchange rates have an essential influence on the capital markets of other emerging markets, too.

Based on these findings and facts, we suggest that investors may mitigate the risk by prioritizing BIST-100 over BIST-30 when constructing their portfolios to reduce the risk of fluctuating exchange rates in Turkey since exchange rate-related diversification is greater in BIST-100. The BIST-30 index is heavily dependent on imports, which explains why the exchange rate has such a larger impact, while the BIST -100 index is less dependent on imports because the food & beverages, travel & logistics, and textile industries help balance imports and exports.

The ICAPM's importance in the Turkish market emphasizes the importance of considering local and global economic issues, notably exchange rates when examining investment opportunities and risk exposures. This has ramifications for investors, policymakers, and financial analysts, stressing the Turkish market's interconnection with global economic dynamics and the significance of incorporating these elements into investment decision-making processes. Based on our findings, our recommendation for investor protection policies to consider the significant role of exchange rates in the construction of asset prices. Specifically, policy instruments to improve the context for hedging opportunities would be of crucial importance. This way, investors' confidence in Turkish capital markets would also increase. This increase in investor confidence will contribute to a healthier development of the relationship between risk and expected return and will ensure a healthier balance of financial asset prices in the market. The widespread effect of this will be to contribute to the development of capital markets.

The models utilized in this study have limitations that are dependent on how effective the capital market is (see, Megginson, 1997; Foerster and Sapp, 2005; Brealey et al., 2014, among others), which can be described as follows. CAPM assumes that financial markets are efficient, meaning that all applicable information is contained in the prices of securities. In this context, earning abnormal returns consistently using publicly available information is not possible. If markets were inefficient, and if some investors had access to privileged information, then the returns from securities would not be solely dependent on their systematic risk as CAPM assumes. Moreover, while coping with risk management measures in the stock market, the possibility of an asymmetric benefit-loss relationship with future returns must be considered. Substantial certainty-equivalent gains are produced through return asymmetries, which boost the weight of emerging countries to roughly 30%. Investing in emerging markets appears to be about having a bigger anticipation of the upside than the downside (Ghysels et al., 2016). The findings of the study have implications for investors and policymakers, providing insights into the reliability of widely used asset pricing models, particularly in emerging countries such as Turkey. Recognizing constraints can help practitioners refine investment strategies and enlighten policymakers about the importance of complex risk management approaches in the dynamic landscape of developing market economies.

Future research for a better understanding of the CAPM and the ICAPM may be achieved by incorporating global and domestic macroeconomic factors in the analysis, which may provide a more accurate assessment, or by exploring the role of across different asset classes to understand

models' applicability to each class. Furthermore, investigating the relevance of these models across different asset classes, including the addition of variables such as Environmental, Social, and Governance (ESG) criteria, could provide a more thorough knowledge of their application in multiple market segments. Finally, the study may also be expanded by considering local characteristics such as country risk and oil price risk exposures, emphasizing their importance in understanding the shifting dynamics of the Turkish capital market and also potentially other emerging markets.

Declaration of Research and Publication Ethics
This study which does not require ethics committee approval and/or legal/specific permission complies with the research and publication ethics.

Researchers' Contribution Rate Statement
The authors declare that they have contributed equally to the article.

Declaration of Researchers' Conflict of Interest
There are no potential conflicts of interest in this study.

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