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Kuchin Ilia Igorevich

Assessment of currency risk impact on asset pricing

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PhD Dranev Y.

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Motivation

Currency risk, as defined in academic literature on asset pricing, is the risk of a change in the value of an asset associated with currency fluctuations [Shapiro, 1974; Dumas, 1978; Choi, 1986; Jorion 1991].

Exchange rate fluctuations can affect the value of companies for many reasons. Currency risk can directly or indirectly affect both the cash flows and the assets and liabilities of the company [Madura, 1989]. Exporters, importers, and financial organizations depend to a large extent on exchange rate fluctuations. The exchange rate has an impact not only on companies involved in foreign trade, but also on firms attracting foreign investment. A stable exchange rate reduces the risk of doing business for investors, exporters and importers, thereby promoting investment.

Currency fluctuations lead to an increase in cash flow volatility and reduce the value of a company by reducing profitability, increasing bankruptcy costs or increasing tax payments [Shapiro, 1974; Guay, 1999]. Currency movements should be taken into account in the expected cash flows of the company [Muller, Verschoor, 2007]. The degree of influence of exchange rates on the activities of firms depends on the structure of currency flows, the company's competitive position in the market and the methods used in risk management [Marshall, 2000]. Reducing the volatility of cash flows as a result of hedging currency risks can increase the value of a company [Allayannis, Weston, 2001].

In countries with emerging capital markets, despite the high potential of domestic demand, favorable conditions for the organization of export-oriented production, as well as the undervalued commodity market and capital market, investors demand an increased risk premium, including due to the high volatility of national currencies [Muller and Verschoor, 2006]. Particularly strongly the volatility of cash flows increases during periods of crisis, which are accompanied by a

decrease in export earnings (as a result of a fall in global demand for the products of these companies) when saving level of costs of servicing a foreign debt denominated in foreign currency and for the purchase of imported technologies, equipment and materials.

The arguments presented suggest that investors should take into account the effect of exchange rate fluctuations on expected returns when making investment decisions, which means that currency risk should be taken in asset pricing models. Theoretical models explaining the effect of currency risk on pricing in financial markets have been presented in a number of works [Solnik, 1974; Sercu, 1980; Adler and Dumas, 1983; Harvey, 1991].

Consider a general view of the multifactor pricing model, in which the expected excess of the return of the risk i -th asset over the risk-free (excess return) R_i depends on various risk factors (see, for example, Cochrane, 2009):

$$E(R_i) = \sum_j \beta_{ij} \lambda(F_j) \qquad (1)$$

where β_{ij} – exposure (or sensitivity) of asset i to factor F_j risks;

$\lambda(F_j)$ – price of F_j risk-exposure.

Exposure to risk depends on the covariance of the return on the risk asset and the risk factor. ***Exposure to the currency risk*** of an asset is determined through the covariance of the asset's return and change in the exchange rate (in the more general case, changes in the currency risk factor). Exposure to currency risk is often estimated by researchers through the regression of asset returns on exchange rate changes [Adler, Dumas, 1983; Jorion, 1990]. Changes in exchange rates or currency indices, as well as portfolio returns that mimic the effect of currency risk on the capital market can serve as currency risk factors in pricing models [Doidge et al., 2006]. In the latter case the foreign exchange risk premium may be determined by the expected return of imitating portfolios.

There are several theoretical approaches to explaining the role of currency risk in pricing models. Solnik, Sercu [Solnik, 1974; Sercu, 1980], Adler and Dumas [Adler, Dumas, 1983] were one of the first to include the covariance of currency risk

with asset returns in an asset pricing model based on Ross's arbitration pricing theory [Ross, 1976]. Harvey [Harvey, 1991] adapted the CAPM model of Sharpe and Lintner [Sharpe, 1964; Lintner, 1965] for international capital markets, including the currency risk factor.

Accounting for currency risk is possible not only as a separate factor in the pricing model, but also as one of the instrumental variables (or state variables) that affects the change in asset yield covariance and other risk factors in intertemporal models [Campbell and Vuolteenaho 2004; Campbell et al., 2018]. In other words, foreign exchange risk can affect the change in exposure to other risk factors.

Despite the large number of theoretical models explaining the effect of currency risk on asset pricing within different approaches [Bodnar and et. al., 2002], the results of empirical testing are contradictory — in some studies a small number of companies were exposed to currency risk, and the currency risk premium was insignificant (see, for example, Jorion, 1991). Bartram and Bodnar [Bartram, Bodnar, 2007] called this phenomenon the exchange rate puzzle (exchange puzzle) and tried to explain the insignificance of currency risk by the wide use of currency risk hedging tools and the disadvantages of the models used.

The use of hedging instruments does not always affect the value of the company and cannot completely eliminate the influence of currency risk (especially operational). For example, Carrieri and Majerbi [Carrieri, Majerbi, 2006] in their work, as a factor in currency risk, used the change in the real exchange rate and showed its significant impact on stock returns in emerging capital markets. The authors noted the impossibility of complete hedging of currency risk, explaining this result by the strong dependence of firms from emerging markets on foreign trade.

The article by Kim and Chance analyzes approaches to hedging currency risks [Kim, Chance, 2018]. On a sample of Korean companies, the authors demonstrate the significant shortcomings of risk management in terms of hedging currency risks, which are associated more with management's attempts to speculate with currency than with the desire to reduce the volatility of cash flows and achieve growth in the value of the company.

In a number of studies on the relationship between hedging currency risks and firm value, it is noted that companies with options (or opportunities) of growth tend to hedge currency risks. Froot and co-authors [Froot et al., 1993] argued that hedging currency risks allows us to maintain a sufficient level of our own funds to realize growth opportunities (prospective acquisitions or new projects). Nance and co-authors [Nance et al., 1993] noted that hedging currency risks reduces the level of agency costs associated with conflicts between shareholders and creditors, which makes it possible to exercise growth options. Geczy and co-authors [Geczy et al., 1997] suggested that firms with good growth opportunities and low levels of free cash would prefer to reduce currency risks using hedging tools in order to maintain growth options for options.

Thus, when analyzing the impact of currency risk, it is necessary to take into account the heightened propensity to hedge it (which means lower exposure to currency risk) for firms with growth opportunities. In the conditions of accelerating technological development, the growth opportunities of companies are largely determined by the costs of research and development [Vassalou, Apedjinou, 2003; Trigeorgis, Lambertides, 2014]. The possibility of commercialization of internally developed technologies becomes higher with an increase in the predictability of cash flows as a result of hedging one of the key risks - currency. For companies that are not very actively investing in their own research and development, in some cases, hedging of currency risks may be not so relevant. In the absence of hedging, the effect of currency fluctuations on the volatility of cash flows of such companies may be higher.

According to many researchers, the success of testing the impact of currency risk is also determined by the correct choice of pricing model in various capital markets. For example, the results of testing in the US market of static (with constant levels of exposure to currency risk) models turned out to be significantly worse than taking into account the change in exposure to dynamic models [Du, Hu, 2012].

Much of the research testing the effects of currency risk is devoted to the US stock market. But a number of works analyze the effect of currency risk on the

profitability of assets, taking into account the specifics of other developed and emerging markets. He and Ng [He, Ng, 1998] proved the significant effect of the exchange rate on company stock returns in Japan. Bartram and Karolyi [Bartram, Karolyi, 2006] revealed that the introduction of the single currency (euro) in 1999 reduced the exposure of the exchange rate to the returns of shares of transnational companies in the countries of the European Union. Similar results were obtained in the work of Dominguez and Tesar [Dominguez, Tesar, 2006]. Parlapiano with co-workers [Parlapiano, Alexeev, Dungey, 2017] evaluated the impact of the exposure of foreign exchange risk of European companies, taking into account fluctuations in the exchange rate of the US dollar, yen, pound sterling and Swiss franc against the euro. The authors found that a firm's exposure to foreign exchange risk depends on the level of international participation, industry, firm size, and country of origin.

Research in emerging capital markets led to conflicting conclusions. Vassalou [Vassalou, 2000] argued about a weak exposure to foreign exchange risk in a sample of companies from 10 emerging capital markets. However, Muller and Verschoor [Muller and Verschoor, 2006] found that in developing capital markets a significant share of companies exposed to foreign exchange risk is greater than in developed ones. Cuestas and Tang [Cuestas, Tang, 2017] using a dynamic non-linear autoregressive distributed lag model found a higher exposure to currency risk in Chinese companies that are focused on the domestic market compared to export-oriented companies. The authors conclude that it is precisely currency risk that needs to be hedged, the level of which does not decrease when systematic risk hedges.

Results of studies of currency risk influence in various capital markets allow us to conclude that it is necessary to develop models presented in the literature, including taking into account country specificities. Thus, this dissertation research aimed at improving approaches to assessing the impact of currency risk in developed and emerging financial markets using various pricing models is ***relevant.***

Objectives of the research

The aim of the research is to assess the impact of currency risks on asset pricing.

With this aim the following objectives were set:

1. To investigate and classify approaches to modeling and empirical testing of the effect of currency risk on the value of assets;
2. To analyze the theoretical background of asset pricing models that can be used to assess the impact of currency risk;
3. To consider approaches to assessing currency risk exposure and accounting for this exposure in asset pricing models;
4. To develop a model for estimating the premium of investors for the currency risk factor;
5. To develop a model for assessing the impact of currency risk on asset pricing, taking into account country specificities using the example of the Russian financial market;
6. To estimate the foreign exchange risk premium of companies in the non-financial sector in emerging capital markets;
7. To assess the cumulative effect of currency risk, among other macroeconomic factors, on asset pricing in the Russian financial market;
8. To identify the relationship of exposure to currency risk and other pricing factors on the example of a risk factor associated with the costs of research and development of companies.

Object and subject of research

The object of research is public companies.

The subject of research is the effect of currency risk factor on asset pricing.

Literature review

The degree of scientific development of the problem is quite high. Capital markets have a large number of researchers affecting asset profitability [Jorion, 1990; Jorion, 1991; Aggarwal, 1981; Bodnar, Gentry, 1993; Amihud, 1994; Marston, 2001; Bodnar, Dumas, Marston, 2002] and empirical testing of pricing models that take into account currency risk [Hung, 1992; Bodnar, Bartow, 1994;

Chow et al., 1997; Griffin, Stulz, 2001, Williamson, 2001; Kolari, Murman, Sorescu, 2008; Huffman et al., 2010; Bartram, Brown, Minton, 2010; Lewellen et al., 2010; Du, Hu, 2014].

In emerging capital markets, the effect of currency risk on asset pricing has also been studied in a number of studies [Chiang, Yang, 2003; Ramasamy, Yeung, 2002; Phylaktis, Ravazzolo, 2005; Pan et al., 2007; Chue, Cook, 2008; Yau, Nieh, 2009; Zhao, 2010; Beirne et al., 2010; Kutty, 2010; Diamandis, Drakos, 2011; Ye, Hutson, Muckley, 2014; Jeon, Zhu, Zheng, 2017]. Some studies compare currency risk exposure in developed and emerging capital markets [Dominguez, Tesar, 2001; Kiymaz, 2003; Carrieri, Errunza, Majerbi, 2006; Parsley, Popper, 2006; Chue, Cook, 2008; Aysun, Guldi 2011; Lin, 2011].

The specifics of pricing in the Russian financial market has been studied by several authors. The work of Teplova and Selivanova [Teplova, Selivanova, 2007] is devoted to the study of asset pricing models, including the one-way risk model (risk of lower asset prices) - DCAPM. The authors showed that the DCAPM model is more suitable for assessing the average profitability of the Russian market than the classical CAPM model. A similar result was obtained in other studies on the Russian market, where the CAPM model did not show an ability to explain the profitability of stocks [Bukhvalov, 2006, Teplova, Shutova, 2011].

A number of authors [Lucey, Voronkova, 2005; Peresetsky, Ivanter, 2000, Fedorov, Sarkissian, 2000] demonstrated the effect of integrating the Russian stock market into the global financial system on macroparameters, including the exchange rate. Part of the literature was devoted to assessing the impact of the exchange rate on the Russian stock market [Saleem, Vaihekoski, 2010; Anatolyev, 2008; Goriaev, 2004; Goriaev, Sonin, 2005] and its relationship with other macroeconomic indicators [Spatafora, Stavrev, 2003; Kalcheva, Oomes, 2007; Sosunov, Ushakov, 2009; Trunin et al., 2010; Sultonov, 2016].

Methodology

Taking into account the analysis of literature, the methodology of the dissertation research is presented by three types of models developed by the author:

1. Models that take into account currency risk as a pricing factor;
2. Models for assessing the impact of currency risk on the sensitivity of stock returns to changes in pricing factors;
3. Models of the relationship of currency risk exposure and the pricing factor of risk intensity of research and development costs.

1. Models that take into account currency risk as a pricing factor

When developing this model, the currency risk factor has been added to the multi-factor asset pricing model. Factors are built using portfolio construction. Using a portfolio approach reduces the impact of a company's specific risks on empirical results. The currency risk factor modeling in the pricing model will be conducted by three alternative methods for building stock portfolios. The first method is based on the construction of a currency risk factor through portfolios ranked in absolute terms as the ratio of exchange rate differences to the company's revenue. The second approach is to build portfolios with positive and negative exchange rate differences to revenue, and the third is through portfolios built on the sensitivity of stocks to strengthening and depreciating the exchange rate. The use of exchange rate differences in building portfolios to form a currency risk factor has not previously been applied in the literature on asset pricing models that take into account currency risk. The indicator of exchange rate differences in reporting companies allows you to consider how well the company hedged its risks.

Model 1 will be presented as follows:

$$\mathbb{E}(r_i - r_f) = \beta_i \mathbb{E}(r_m - r_f) + s_i \mathbb{E}(SMB) + h_i \mathbb{E}(HML) + e_i \mathbb{E}(EMZ) \quad (1),$$

where r_i is return on asset i, r_f is risk-free rate of return, r_m is return on market portfolio, $\mathbb{E}(SMB)$ is size premium (expected difference in return on small and big companies, “small minus big”), $\mathbb{E}(HML)$ is value premium (expected difference in return on value stocks (high book-to-market) and growth stocks (low book-to-

market), "high minus low"), $\mathbb{E}(EMZ)$ is currency premium (expected difference in returns on stocks exposed to currency risk and not exposed, "exposed minus zero").

In the first model, companies that do not report positive and negative exchange rate differences are not divided. However, investors may relate differently to companies with positive or negative exchange rate differences. Therefore, in the second model, two factors of currency risk are designed to identify differences in investor preferences for companies that publish negative and positive exchange differences:

$$\mathbb{E}(r_i - r_f) = \beta_i \mathbb{E}(r_m - r_f) + s_i \mathbb{E}(SMB) + h_i \mathbb{E}(HML) + ep_i \mathbb{E}(PMZ) + en_i \mathbb{E}(NMZ)$$

where r_i is return on asset i, r_f is risk-free rate of return, r_m is return on market portfolio, $\mathbb{E}(SMB)$ is size premium (expected difference in return on small and big companies, "small minus big"), $\mathbb{E}(HML)$ is value premium (expected difference in return on value stocks (high book-to-market) and growth stocks (low book-to-market), "high minus low"), $\mathbb{E}(PMZ)$ is currency premium (expected difference between firms that have highly positive currency gain-to-sales ratio and companies with this ratio close to zero, "positive minus zero"), $\mathbb{E}(NMZ)$ is currency premium (expected difference between firms that have highly negative currency gain-to-sales ratio and companies with this ratio close to zero, "negative minus zero").

Finally, a completely different approach is to use the extent to which company's returns and currency returns covary. Based on article by Koutmos and Martin we estimate exchange rate exposure of a company, using the following model (Koutmos, Martin, 2003):

$$r_{j,t} = \alpha_j + \beta_{j,market} r_{m,t} + \beta^{+}_{j,currency} r^{+}_{c,t} + \beta^{-}_{j,currency} r^{-}_{c,t} + \varepsilon_{j,t} (10),$$

where $r^{+}_{c,t}$ is change in exchange rate (domestic currency per US dollar) multiplied by dummy variable which takes value 1 if currency return is positive (currency depreciates), $r^{-}_{c,t}$ is change in exchange rate multiplied by dummy variable

which takes value 1 if currency return is negative (currency appreciates), $\beta_{j,m}$ coefficient of sensitivity of a company's stock j to changes in market returns, $\beta_{j,c}^{+}$ и $\beta_{j,c}^{-}$ – coefficient of sensitivity of a company's stock j to currency appreciation and depreciation, $\varepsilon_{j,t}$ – standard error.

The pricing model then takes the following form:

$$\mathbb{E}(r_i - r_f) = \beta_i \mathbb{E}(r_m - r_f) + s_i \mathbb{E}(SMB) + h_i \mathbb{E}(HML) + ep_i^{+} \mathbb{E}(PMZ^{+}) + ep_i^{-} \mathbb{E}(PMZ^{-}) + en_i^{+} \mathbb{E}(NMZ^{+}) + en_i^{-} \mathbb{E}(NMZ^{-})$$

Each of the three models is tested using the Fama-Macbeth econometric procedure [Fama, MacBeth, 1973] with standard errors in the Newey-West form [Newey, West, 1987] to take into account possible autocorrelation of factors in the model.

2. *Models for assessing the impact of currency risk on the sensitivity of stock returns to changes in pricing factors*

To assess the relationship between currency risk and the sensitivity of stock returns, an intertemporal model has been developed for assessing the effect of currency risk on asset pricing in the financial market. Using the methodology [Campbell et al., 2018], to build risk factors, the financial market was decomposed into cash flow ($N_{CF,t}$), discount rate ($N_{DR,t}$) and market volatility ($N_{V,t}$). The intertemporal asset pricing model is as follows:

$$\overline{R_i^e} = g_0 + g_1 \widehat{\beta_{i,CF_M}} + g_2 \widehat{\beta_{i,DR_M}} + g_3 \widehat{\beta_{i,V_M}} + \varepsilon_i$$

$$\beta_{i,CF_M} = \frac{Cov(r_{i,t}, N_{CF,t})}{Var(r_{M,t} - E_t r_{M,t})}$$

$$\beta_{i,DR_M} = \frac{Cov(r_{i,t}, N_{DR,t})}{Var(r_{M,t} - E_t r_{M,t})}$$

$$\beta_{i,V_M} = \frac{Cov(r_{i,t}, N_{V,t})}{Var(r_{M,t} - E_t r_{M,t})}$$

where $\overline{R_i^e} = \bar{R}_i - \overline{R_{rf}}$ – expected return on each asset *i*, β_{i,CF_M} – sensitivity of stock returns to changes in cash flow, β_{i,DR_M} – sensitivity of stock returns to changes in discount rates, β_{i,DR_M} – sensitivity of stock returns to changes in the financial market volatility factor.

To determine the shocks that affect the profitability of the market, the first-order vector autoregression model is used (VAR):

$$x_{t+1} = a + \Gamma x_t + \sigma_t u_{t+1}$$

$\mathrm{x_{t+1}} = \left(r_{t+1}, \mathrm{EVAR_t}, c_t, F_{1,t+1}, F_{2,t+1}, \dots, F_{n-2,t+1}\right)$ - stationary variable vector, r_{t+1} – market return, $\mathrm{EVAR_t}$ – expected market variance, c_t – changes in nominal exchange rate, $F_{1,t+1}$ – state variables describing the local financial market, a – constant variable and Γ – nxn matrix, respectively.

The state variables for the intertemporal model are: market returns, volatility of the lag values of all other variables from market dispersion, inflation, exchange rates, Brent oil prices, credit default swap and time yield spread. The full specification of the vector included in the VAR model includes six main variables:

$x = (\mathrm{RM}, \mathrm{EVAR}, \mathrm{Brent}, \mathrm{CDS}, \mathrm{ExRate}, SpBond)$,

RM is the difference between market profitability and inflation. EVAR - expected market deviation. Brent is the yield of brent crude oil prices. CDS is a credit default swap. ExRate is the nominal dollar exchange rate. SpBond - the difference between the yield of long-term (five-year) and short-term (three-month) government bonds.

Three of the variables considered correspond to the Campbell model [Campbell et al., 2018]. To take into account the specifics of the Russian market, the following were added: exchange rate - exchange rate, credit default swap and the price of Brent crude.

3. *Models of the relationship of currency risk exposure and the pricing factor of risk intensity of research and development costs.*

The intensity of the research and development of companies is calculated either through the ratio of the research and development of companies to their market capitalization [Shi, 2003; Gu, 2016], or through the ratio of the research and development of companies to their revenues [Chan, Lakonishok, Sougiannis, 2001; Branch, Chichirau, 2010; Cohen, Diether Malloy, 2013, Eberhart et al., 2008; Chan, Lakonishok, Sougiannis, 2001]. In the current study, several approaches will be proposed to measure the intensity of expenditures on research and development of companies based on market capitalization and company revenues:

$$RDI(TR)_t = \frac{RD_t}{TR_t} \text{ и } RDI(MC)_t = \frac{RD_t}{MC_t}$$

where RDI_t – the intensity of the research and development of companies in the fiscal year t, RD_t – research and development companies for the fiscal year t, TR_t – company revenue at the end of the fiscal year t, MC_t – market capitalization of companies at the end of the fiscal year t.

The asset pricing model presented in the current study is a modification of the three-factor model Fama and French [Fama and French, 1993], in which the growth factor (HML) is calculated through various measures of the intensity of research and development costs of companies:

$$R_{ik} - r_{fk} = \beta_{im} * \left(E(R_{mk}) - r_{fk}\right) + \beta_{iSMB} * SMB_k + \beta_{iHMLRD} * HMLRD_k$$

где R_{ik} – portfolio returns i on month k, r_f – risk-free rate, $E(R_{mk})$– expected profitability of the market portfolio m per month k, SMB_k – risk factor of company size in the form of a low market capitalization of a company, $HMLRD_k$ – risk factor compensating for the high intensity of costs for research and development of companies per month k, β_{im} – portfolio exposure to market risk factor m, β_{iSMB} – portfolio exposure to risk factor size in the form of a low market capitalization of the company, β_{iHMLRD} – exposure of the portfolio i to a risk factor compensating for the high intensity of expenditures on research and development of companies.

Many studies [Ho et al., 2004; Chan et al., 2001; Kothari et al., 2002; Chambers et al., 2002; Amir et al., 2007] found a relationship between the intensity of the research and development of companies and systematic risk. The intensity of research and development costs can be associated not only with idiosyncratic, but also with the systematic risk of the firm. To test this assumption, we studied the relationship between the intensity of the research and development of the company and its exposure to currency risk, which correlates with systematic risk [Cho et al., 2016].

To assess the exposure to currency risk in this study, a modification of the Miller approach [Miller, Reuer, 1998] is used, where the coefficient of determination is used as a proxy factor for exposure to exchange rate fluctuations. The coefficient of determination (R-square) is determined from the evaluation of the following regression model:

$$\widehat{R_{i,t}} = \widehat{\alpha_{i,t}} + \widehat{\beta_{ExR_t}} * ExR_t + \epsilon_{i,t}$$

где ExR_t - country exchange rate and $R_{i,t}$ – assets return firm i in period t.

Further, the exposure to currency risk regresses to the intensity of expenditure on research and development:

$$Z_i = \widehat{\alpha_i} + \widehat{\beta_i} * \widehat{\overline{RDIl_i}} + \epsilon_i$$

where Z_i is the value of 1 minus R-squared for i-th firm and $\widehat{\overline{RDIl_i}}$ is the average R&D intensity measured one of the four following ways.

A measure of the intensity of research and development costs is calculated in one of several ways. Four measures of intensity will be selected to assess the impact of the intensity of expenditures on research and development on currency exposure: *RDI1* represents the firm's R&D expenditures to total sales, *RDI2* is the firm's R&D expenditures to total market capitalization, *RDI3* was calculated determining the average R&D expenditures to total revenues for each firm by two late years, *RDI4* represents two-year growth moving averages ratios.

For testing the models presented in the study, econometric analysis methods were used: analysis of panel data, vector autoregression and two-step regression with Newy-West corrections. The analysis was carried out using the programming languages R, VBA, as well as using the statistical packages Stata and EViews.

Information base of research. The dissertation research used information from databases used in academic literature, including: Bloomberg, Thompson Reuters, and Compustat. When testing the intertemporal pricing model in the Russian market, macroeconomic data was collected, including data from Rosstat and the Central Bank of Russia.

Contribution

This study's contribution is as follows:

1. A pricing model was developed in which the currency risk factor is determined using stock portfolios generated from exchange rate difference reporting data. Previously, this indicator was not used in the scientific literature on the modeling of currency risk factors.
2. An intertemporal asset pricing model was developed that takes into account the specifics of the Russian capital market. The author for the first time included currency risk in the number of state variables affecting the change in asset exposure to components of systematic risk.
3. A new approach has been developed to assess the relationship between the research and development costs and the exposure to foreign exchange risk of companies.
4. Significant estimates of foreign exchange risk premiums were obtained in the capital markets of Russia, Brazil, South Africa and India, including taking into account the asymmetry of its effect on stock returns. Earlier in the academic literature, there were no premium estimates that take into account the asymmetric effect of currency risk on the Russian market.
5. Significant premium estimates were obtained for the systematic risk components in the Russian market as a result of testing an intertemporal

model using currency risk as one of the state variables. The early intertemporal model with several state variables in the Russian market was not tested.

6. A significant positive premium for the risk factor associated with the intensity of costs for research and development of companies was found, which, in turn, is negatively related to exposure to currency risk in the markets of Korea, Israel and Finland.

The theoretical application of this research is to develop new and adapt existing models in order to assess the impact of currency risk on asset pricing in three ways. First, a pricing model has been developed that takes into account currency risk as one of the pricing factors (one of the factors F_j in the general form of the pricing model (1)). Secondly, an intertemporal model has been developed that allows to take into account the effect of currency risk on the change over time of exposure to other risk factors (that is, the change in β_{ij} exposure in the pricing model (1)). The intertemporal model is adapted to the country specifics on the example of the Russian stock market. Thirdly, an influence model has been developed of the exposure of currency risk to other pricing factors by the example of a risk factor associated with research and development costs. For empirical testing of a model from a set of costs for research and development of factors designed to hedge risk, a factor has been chosen that is pricing for the financial markets of high-tech developed economies.

The dissertation research complements the existing methods of testing the effect of currency risk on asset pricing in developed and developing capital markets and suggests approaches to estimating currency risk premiums.

Practical significance. The results of this work can be used in making investment decisions in developed and emerging capital markets, as well as when companies work out development strategies that take into account the effect of currency risk on value. Theoretical models and approaches to their empirical testing

can be used in courses on risk management and asset pricing theory for students of master's programs.

Publications

List of publications on the dissertation:

1. Kuchin I.I. Currency risk and local intertemporal asset pricing model. Case of Russia. Journal of Corporate Finance Research. 2016. Vol. 10. № 2. pp. 27-38;
2. Yury Dranev, Albert Levin, Ilia Kuchin. R&D Effects, Risks and Strategic Decisions: Evidence from Listed Firms in R&D-intensive Countries. Foresight. 2017. Vol. 19. No. 6. pp. 615-627;
3. Ilia Kuchin, Maria Elkina, Yury Dranev. The impact of currency risk on firm's value in emerging countries. Journal of Corporate Finance Research. 2019. Vol. 13. № 1. pp. 7-27.

Other publications:

1. Kuchin I.I. Exchange rate risk exposure in asset pricing theory. World of economics and management. 2016. Vol. 16. № 3. pp. 31-41;

The results of the studies were presented at international conferences:

1. 7th International Academic Conference for Students and Graduate Students «Statistical Methods for Analysis of the Economy and Society», HSE, Moscow, May 2016. Report: «Currency risk and local intertemporal asset pricing model».
2. 12th Interdisciplinary Workshop On Intangibles, Intellectual Capital And Extra-Financial Information, HSE, Saint Petersburg, September 2016. Report: R&D Expenditures And Cross Section Of Stock Returns In R&D Intensive Markets.
3. Analytics for Management and Economics Conference (AMEC-2018), HSE, Saint Petersburg, September 2018. Report: The Impact of Currency Risk on Cost of Equity in Emerging Countries.
4. 5th GSOM Emerging Markets Conference, HSE, Saint Petersburg, October 2018. Report: The Impact of Currency Risk on Firm's Value in Emerging Countries.

The results were discussed during the following seminars:

1. Workshop in Corporate Finance Center (2015, Moscow);
2. PHD Workshop in Doctoral School of Economics (2016, Moscow);
3. Scientific seminar in Department of Finance: «Empirical Corporate Finance» (2016, Moscow);
4. PHD Workshop in Doctoral School of Economics (2017, Moscow).

Main findings

1. Approaches to modeling and empirical testing of currency risk were analyzed, and their significance for investors was highlighted. Theoretical background of pricing models was reviewed and the specifics of assessing the impact of currency risk on asset pricing in developed and emerging capital markets were identified.
2. Based on the pricing model developed by the author of the dissertation research, it is shown that currency risk is a pricing factor and is taken into account in the cost of capital of companies from Brazil, Russia, India and South Africa. The results show a different impact of exposure to currency risk on the cost of equity in the markets of different countries. In Russia, investors demand higher returns for stocks of companies that demonstrate a higher exposure to currency risk. In Brazil, India and South Africa, the low value of the module for exchange rate differences is associated with a higher expected return. In this case, we can talk about the rejection by investors of hedging currency risks within companies.
3. Based on the intertemporal model developed by the author, the cumulative effect of currency risk and other macroeconomic factors on asset pricing in the Russian financial market is revealed. Significant risk premiums for risk factors were found related to cash flow and volatility in the Russian market. Exposure to these risk factors varies, including as a result of exchange rate fluctuations.

4. On the basis of the methodology developed by the author, it is proved that there is a significant negative relationship between the intensity of expenditures on research and development of a company and the exposure of the exchange rate using the example of science-intensive economies of Finland, Israel and Korea. It was found that the higher the intensity of the company's research and development costs, the lower the exposure to currency risk.

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