

Beyond Sovereign Risk: A Frontier Market Valuation Model (FMVM) for Contextualizing Equity Cost in Structurally Constrained Markets

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Abstract

This study introduces the frontier market valuation model (FMVM), a novel and exploratory framework designed to more accurately estimate the cost of equity in structurally constrained markets. Traditional models such as CAPM and Damodaran's country risk premium (CRP) fail to capture the layered risks prevalent in frontier economies. FMVM addresses this gap by integrating four explicit premiums: sovereign risk, liquidity constraints, behavioral volatility, and institutional quality deficits.

The aim is to develop a context-sensitive model that better reflects equity risk in frontier and transitioning markets. Using empirical data from five countries—Croatia, Serbia, Bosnia and Herzegovina, Turkey, and Hungary—the model is

calibrated and applied in an attempt to assess its robustness and explanatory power. Croatia serves as the primary case study, with data spanning a 15-year period, offering a detailed benchmark for model validation.

The findings show that FMVM consistently yields higher and more differentiated discount rates than traditional models, particularly in markets with severe illiquidity, governance deficits, or sentiment-driven volatility.

FMVM provides theoretical advancement and practical utility by quantifying unpriced structural risks and guiding reforms aimed at reducing capital costs.

Keywords: frontier markets, cost of equity, sovereign risk, liquidity premium, Croatia

JEL classification: G15, G12, F34, O16

1 Introduction

Valuing equities in frontier and transitioning markets poses distinctive challenges due to structural features that differ fundamentally from developed financial environments. These markets typically exhibit substantial liquidity constraints, pronounced behavioral volatility driven by sentiment rather than fundamental valuation, institutional weaknesses manifesting as governance deficits and regulatory uncertainty, and significant sovereign risks associated with political instability or economic vulnerabilities. Traditional financial valuation methods, such as the capital asset pricing model (CAPM) and Damodaran's country risk premium (CRP), were primarily designed for developed and efficient market settings and consequently fail to adequately capture these multilayered risk factors. As a result, equity returns in structurally constrained markets are often systematically misestimated, leading to inefficient asset allocation and misguided policy interventions.

Croatia exemplifies the complexities of a frontier market undergoing transition towards emerging market status. Although MSCI upgraded Croatia to emerging

market classification in 2022 (MSCI, 2022), significant frontier-market characteristics persist, including market illiquidity, behavioral-driven price volatility, and ongoing institutional challenges. However, the complexities and risk dimensions observed in Croatia are not unique; rather, they typify broader patterns observable across various frontier and transitioning economies, such as Bosnia and Herzegovina, Serbia, Turkey, and Hungary. All of these markets, despite differing in scale and developmental stage, share similar structural constraints and risk factors inadequately addressed by conventional valuation frameworks.

Responding to these valuation shortcomings, this study proposes the frontier market valuation model (FMVM), an equity valuation framework explicitly designed to integrate and quantify frontier-specific risk dimensions. FMVM extends beyond traditional models by incorporating four distinct, quantifiable premiums: sovereign risk, liquidity constraints, behavioral volatility, and institutional quality deficits. By explicitly integrating these additional layers of risk, FMVM aims to provide a more precise and contextually sensitive estimate of equity cost in frontier and transitional markets.

This study empirically evaluates FMVM's performance and relevance using market data from five representative countries—Croatia, Serbia, Bosnia and Herzegovina, Turkey, and Hungary—spanning the continuum from deeply fragmented frontier economies to more institutionally integrated emerging markets. In doing so, it addresses five critical research questions:

- 1. Precision of FMVM:** *Does the frontier market valuation model (FMVM) provide a more accurate estimation of equity risks and expected returns in frontier and transitioning markets compared to traditional valuation models?*
- 2. Risk premium significance:** *What is the relative contribution and explanatory significance of each frontier-specific premium (liquidity, behavioral, institutional, and sovereign) within the FMVM framework?*
- 3. Practical implications:** *What practical implications does the application of FMVM hold for investors, financial analysts, and policymakers seeking to better*

understand, manage, and reduce equity risk premiums in frontier and transitioning markets?

- 4. Comparative robustness:** *How robust and adaptable is FMVM when applied across markets with differing structural complexities, ranging from extreme frontier to relatively integrated emerging markets?*
- 5. Predictive validity:** *To what extent does FMVM's calculated equity risk premium align with observable market metrics such as earnings yields, valuation multiples, and investor behaviors, enhancing predictive validity in frontier market contexts?*

By exploring these questions, this research contributes both theoretically and practically. Theoretically, it addresses an identified gap in the valuation literature by developing and empirically validating a comprehensive model tailored specifically to the risk characteristics of structurally constrained markets. Practically, it provides investors and policymakers with actionable insights, highlighting targeted areas—such as market liquidity improvements, governance enhancements, and behavioral stabilization measures—where reforms can significantly reduce capital costs and encourage sustainable market development.

The paper proceeds as follows: Section 2 reviews existing valuation models, highlighting their limitations in frontier markets and establishing the rationale for FMVM. Section 3 details the FMVM framework, including its frontier-specific risk premiums and calibration using Croatian data. Section 4 empirically applies FMVM across Croatia, Serbia, Bosnia and Herzegovina, Turkey, and Hungary, demonstrating its robustness and accuracy compared to traditional models. Section 5 analyzes the results in depth, discussing each premium's contribution, empirical validity, theoretical significance, practical implications, and suggesting areas for future research. Section 6 concludes by directly answering the five research questions, affirming FMVM's value as a context-sensitive valuation tool in structurally constrained markets.

2 Literature Review

2.1 Evolution of Equity Valuation Models in Emerging and Frontier Markets

Early asset pricing models established a foundational framework for understanding risk valuation in equity markets. The capital asset pricing model (CAPM) introduced by Sharpe (1964) and Lintner (1965) posited a linear relationship between an asset's expected return and its market beta (Sharpe, 1964; Lintner, 1965). CAPM gained popularity for its conceptual simplicity in linking risk and return, becoming the standard for estimating the cost of equity. However, empirical evidence increasingly revealed CAPM's inadequacies, especially its failure to explain cross-sectional returns and numerous anomalies, such as the size and value effects that emerged during the 1980s and 1990s (Fama & French, 1993).

In emerging and frontier markets, applying CAPM presented greater challenges. Harvey (1995) highlighted the minimal explanatory power of historical betas in emerging markets, emphasizing country-specific factors instead. Practitioners turned to heuristic adjustments, notably Damodaran's country risk premium (CRP) model. Damodaran proposed adjusting the mature market premium by adding a sovereign spread scaled by the equity-to-bond volatility ratio to quantify country risk (Damodaran, 2024). Despite its intuitive appeal, Damodaran's method has faced criticism for lacking rigorous theoretical underpinnings, with critics arguing the resulting discount rates are arbitrary and lack empirical validation (Kruschwitz et al., 2010).

These critiques spurred the development of multi-factor models to account for additional systematic risks. Ross's (1976) arbitrage pricing theory (APT) allowed multiple factors in asset pricing, and the Fama–French three-factor model further improved explanatory power by including size and value factors (Fama & French, 1993). Empirical studies demonstrated the superiority of multi-factor models over CAPM in emerging contexts. For instance, Croatian market analyses

indicated better performance of Fama–French models compared to CAPM, though significant unexplained variation remained, suggesting frontier markets possess distinct characteristics—such as short trading histories, low liquidity, and limited investor sophistication—that standard models inadequately capture (Minović & Živković, 2014).

2.2 Liquidity Risk Premium in Frontier Markets

Liquidity constraints represent a fundamental market structure characteristic, significantly affecting frontier equity valuations. Frontier markets exhibit profound illiquidity characterized by infrequent trading, significant bid-ask spreads, and shallow order books. Empirical research confirms pronounced liquidity challenges in the Croatian market, particularly evident during crisis periods (Minović & Živković, 2012). Acharya and Pedersen’s (2005) liquidity-adjusted CAPM (LCAPM) explicitly modeled liquidity risk, demonstrating theoretically and empirically that higher transaction costs and liquidity volatility are associated with elevated expected returns. Subsequent studies validated liquidity premiums in emerging contexts, confirming the predictive power of liquidity shocks on equity returns (Bekaert et al., 2007). Specifically, these markets required compensation for frequent trading disruptions and higher transaction costs, reinforcing liquidity’s central role in frontier valuations.

2.3 Behavioral Finance and Sentiment Premium

Traditional valuation models presume rational investors operating within efficient markets. However, frontier markets frequently exhibit pronounced investor irrationality and market inefficiencies. Behavioral finance models thus introduce “noise trader” factors, accounting for irrational behavior-driven risks. Shefrin and Statman (1994) developed the behavioral asset pricing model (BAPM), decomposing CAPM beta into rational and sentiment-driven components, aligning with the findings of De Long et al. (1990) on sentiment volatility as a

priced risk. Empirical studies further underscored investor sentiment's material impact on frontier market returns, highlighting herding behaviors and speculative dynamics (Chowdhury et al., 2014; Blackburn & Cakici, 2017; Guney et al., 2017). Recent frontier market analyses confirmed that sentiment proxies, such as consumer confidence, significantly influenced equity returns, validating behavioral risks as priced factors (Ouma, 2023).

2.4 Institutional Quality and Governance Premium

The broader institutional environment profoundly impacts frontier market valuations. Institutional quality encapsulates political stability, regulatory effectiveness, corruption levels, and governance frameworks. Empirical evidence strongly links weaker institutions with increased equity risk premiums. Bilson et al. (2002) showed significant associations between political risk indicators and higher equity returns in emerging contexts. Similarly, Erb et al. (1996) identified country credit ratings—proxies for political and economic stability—as robust predictors of equity risk premiums. Subsequent research confirmed that governance quality, corruption perceptions, and legal protections significantly influenced investor-required returns, emphasizing the critical role institutional factors play in frontier market valuations (Nguyen et al., 2019; Erb et al., 1996).

2.5 Sovereign Risk and Country Risk Premium

Frontier markets also necessitate explicit consideration of sovereign risk, encapsulating the potential impacts of governmental default or economic crises. While Damodaran's CRP approach incorporates sovereign bond spreads to proxy equity risk, scholars argue for nuanced modeling that captures equity's heightened crisis sensitivity compared to bonds (Koedijk et al., 2002; Harvey, 1995). Harvey's analyses illustrated how segmented markets retain unique country-specific risks unrepresented in global portfolios, thereby justifying explicit sovereign risk adjustments in equity valuations. Despite limitations, Damodaran's heuristic

remains broadly employed due to its practicality, though advanced methods recommend dynamic adjustments grounded in observable sovereign risk metrics, enhancing precision in frontier valuations.

2.6 Rationale for the Frontier Market Valuation Model (FMVM)

Despite advances in valuation theory, traditional frameworks such as the capital asset pricing model (CAPM) and Damodaran's country risk premium (CRP) do not fully capture the distinctive risk environment inherent in frontier markets. These markets are characterized by pronounced liquidity constraints, heightened behavioral volatility, significant institutional quality deficits, and elevated sovereign risk. While existing valuation models have progressively evolved—such as the liquidity-adjusted CAPM (LCAPM) developed by Acharya and Pedersen (2005), the behavioral asset pricing model (BAPM) of Shefrin and Statman (1994), and the institutional risk framework outlined by Bilson et al. (2002)—they each primarily address isolated dimensions of risk, often neglecting the simultaneous and cumulative interaction of these risks in frontier contexts.

LCAPM, for example, significantly advances traditional valuation theory by explicitly incorporating liquidity risk into asset pricing; however, its primary application remains within developed or mature emerging markets. Similarly, BAPM effectively models sentiment-driven volatility but does not account explicitly for liquidity or institutional quality risks prevalent in frontier markets. Institutional models, such as those proposed by Bilson et al. (2002), highlight governance and political stability but generally overlook liquidity and behavioral dimensions.

Addressing these critical gaps, the frontier market valuation model (FMVM) synthesizes and expands upon these foundational models by integrating sovereign risk, liquidity constraints, behavioral volatility, and institutional quality into a unified, quantifiable valuation framework explicitly tailored to frontier markets. Specifically, FMVM incorporates liquidity premiums directly analogous to

LCAPM, integrates behavioral volatility consistent with BAPM, and quantifies governance and institutional quality as emphasized by Bilson et al. (2002). By holistically capturing these interrelated dimensions, FMVM provides a comprehensive, context-sensitive approach that more accurately estimates the cost of equity in frontier and transitioning markets.

Empirical calibrations using detailed data from Croatia and comparative evidence from Serbia, Bosnia and Herzegovina, Turkey, and Hungary demonstrate FMVM's superior capability in reflecting actual investment risks relative to conventional methodologies (Minović & Živković, 2014; Ouma, 2023). By explicitly addressing multiple frontier-specific risk dimensions, FMVM fills a notable gap in the existing valuation literature, offering significant theoretical advancement and practical utility for investors, financial analysts, and policymakers navigating structurally evolving frontier market contexts.

3 Methodology

To accurately reflect the distinctive risk characteristics associated with frontier equity markets, this study introduces and empirically applies the frontier market valuation model (FMVM). FMVM is designed to extend traditional cost of equity estimation techniques by integrating four frontier-specific risk factors—liquidity constraints, behavioral volatility, institutional quality deficits, and sovereign risk—into the valuation process. These dimensions are typically underrepresented or entirely omitted in conventional models such as the capital asset pricing model (CAPM) or Damodaran's country risk premium (CRP) framework.

FMVM builds upon the standard cost of equity formula by augmenting it with additional premiums that account for the layered and structural risks present in frontier markets. The model is expressed in Equation (1):

$$re = Rf + (\beta \times GERP) + CRP + LP + BP + IQP \quad (1)$$

Where:

- re = required cost of equity
- Rf = risk-free rate, representing a baseline yield with negligible default risk
- β (*beta*) = measure of the asset's systematic risk relative to the global market
- $GERP$ = global equity risk premium, derived from developed market indices
- CRP = country risk premium adjusted for sovereign credit risk and equity volatility
- LP = liquidity premium, reflecting the compensation required for trading illiquid assets
- BP = behavioral premium, representing sentiment-driven volatility and mispricing risk
- IQP = institutional quality premium, capturing governance inefficiencies and legal uncertainties.

This expanded model is constructed to produce a more accurate and context-sensitive cost of equity for firms operating in frontier markets, where traditional frameworks often underestimate underlying risks.

3.1 Data and Measurement

Data used to calibrate FMVM for Croatia, as well as for Bosnia and Herzegovina, Serbia, Turkey, and Hungary, were sourced from reputable financial databases (Bloomberg, 2025; Reuters, 2025), national stock exchange reports (e.g., Zagreb Stock Exchange [ZSE], n.d.; Borsa Istanbul, 2023; Belgrade Stock Exchange, 2023; Sarajevo and Banja Luka Stock Exchanges, 2023; Budapest Stock Exchange, 2023), and international institutions including the World Bank's Worldwide Governance Indicators (World Bank, 2023), Transparency International's Corruption Perceptions Index (Transparency International, 2024), and the International Country Risk Guide by the PRS Group (PRS Group, n.d.).

- **Risk-free rate (Rf):** This is derived from the yield on 10-year German government bonds, widely considered a benchmark for low-risk euro-denominated debt within the European Union. It serves as the baseline rate for estimating the opportunity cost of capital in a stable monetary zone.
- **Global equity risk premium (GERP):** This premium reflects the expected return above the risk-free rate demanded by global investors for holding a diversified equity portfolio. GERP is computed using long-term historical averages and forward-looking estimates from major equity indices such as the S&P 500 and the STOXX Europe 600.
- **Sovereign risk-adjusted country premium (CRP):** This component is calculated using the methodology proposed by Damodaran (2024), which adjusts the sovereign bond spread between Croatian euro-denominated bonds and German bonds. The spread is further scaled by the ratio of the volatility of Croatia's equity market to the volatility of its sovereign bonds. This adjustment captures the differential risk embedded in equity versus fixed-income instruments, providing a more nuanced estimate of country-specific equity risk.

The subsequent sub-sections detail the estimation techniques used to derive the liquidity, behavioral, and institutional quality premiums (LP, BP, and IQP), which are core to FMVM's ability to reflect frontier market dynamics more accurately.

In addition to cross-country comparisons, we collected extensive quarterly economic and market data specific to Croatia covering 2010–2025. While data for Serbia, Bosnia and Herzegovina, Turkey, and Hungary spans 2015–2023, more granular quarterly data were collected for Croatia, covering the full 2010–2025 period. This richer dataset allows Croatia to serve as the primary case study for dynamic testing of FMVM across structural shifts such as EU accession and the COVID-19 crisis. This dataset includes quarterly estimates of sovereign risk (CRP), liquidity measures (bid-ask spreads and turnover ratios), behavioral volatility indicators (using GARCH-in-mean estimates), and institutional quality

scores (derived from World Bank and Transparency International indices). Incorporating this higher-frequency dataset enables us to analyze FMVM's responsiveness to significant structural changes, such as Croatia's EU accession in 2013 and the COVID-19 pandemic starting in 2020, thus attempting to provide empirical validation and insights into the model's performance over time within the Croatian context.

3.2 Frontier-Specific Risk Premiums

In order to provide a more realistic and comprehensive estimate of the cost of equity in frontier markets, FMVM introduces three additional risk premiums that are often overlooked in traditional valuation frameworks. These premiums—liquidity, behavioral, and institutional—reflect persistent structural inefficiencies in frontier markets and are critical to capturing the nuanced risk environment in which firms operate.

- **Liquidity premium (LP):** The liquidity premium reflects the additional compensation that investors require for holding securities that are difficult to buy or sell without significantly affecting their price. In frontier markets like Croatia, many stocks suffer from low trading frequency, wide bid-ask spreads, and shallow order books, making them illiquid. Building on the approach proposed by Minović and Živković (2014), the LP is estimated using two key indicators: the average bid-ask spread (a direct measure of transaction costs) and the turnover ratio (an inverse measure of trading activity). The formula used to quantify LP is:

$$LP = 0.75 \times \text{Bid-Ask Spread} + 0.25 \times (1 / \text{Turnover Ratio}) \quad (2)$$

This weighted formula, shown in Equation (2), assigns greater importance to the bid-ask spread, reflecting its stronger influence on trading costs, while the turnover component captures how frequently shares change hands. A higher LP indicates greater illiquidity and thus a higher required return.

- **Behavioral premium (BP):** The behavioral premium captures the additional risk premium that investors demand due to sentiment-driven volatility and market inefficiencies. Behavioral anomalies are common in frontier markets, where retail investor dominance, lack of sophisticated arbitrage mechanisms, and low information transparency can lead to mispricing. To measure this premium, a GARCH-in-mean (generalized autoregressive conditional heteroskedasticity) model is employed, following the methodology of Rupande et al. (2019). This model captures volatility clustering and asymmetric market responses to shocks—hallmarks of sentiment-driven markets. The BP is quantified as the incremental volatility associated with shifts in investor sentiment, reflecting the risk investors face from sudden, non-fundamental price swings.
- **Institutional quality premium (IQP):** The institutional quality premium reflects the risk associated with weak legal, regulatory, and governance structures. Inadequate investor protection, corruption, inconsistent rule of law, and bureaucratic inefficiencies all contribute to increased uncertainty and, consequently, higher required returns in frontier markets. To operationalize this premium, FMVM uses two widely recognized governance benchmarks: the World Bank's Worldwide Governance Indicators (WGI) and Transparency International's Corruption Perceptions Index (CPI). These indices are standardized using *z*-scores and combined to reflect overall institutional strength. The formula used to compute IQP is shown in Equation (3):

$$IQP = 15 \times (CPI \text{ Z-score} + WGI \text{ Z-score}) \quad (3)$$

The coefficient of 15 was chosen based on empirical calibration to align the IQP's magnitude with governance-driven equity risk premiums observed in markets such as Bosnia and Herzegovina and Serbia. Sensitivity analysis confirmed that coefficient values between 10 and 20 produced cost-of-equity adjustments consistent with market expectations. A midpoint of 15 was selected to balance cross-country comparability with model transparency and tractability.

The resulting IQP is expressed in basis points (bps), with lower institutional quality (i.e., weaker governance) translating into higher risk premiums. This formulation allows the premium to adjust dynamically in response to changes in a country's governance environment.

Together with the liquidity premium (LP) and behavioral premium (BP), the IQP ensures that FMVM provides a comprehensive, context-sensitive assessment of the cost of equity—effectively capturing the structural and idiosyncratic risks that define frontier market investing.

3.3 Model Calibration and Application

To empirically test the applicability and effectiveness of the frontier market valuation model (FMVM), the model is calibrated using economic and market data specific to Croatia over the period from 2015 to 2023. This time frame captures both pre- and post-EU accession dynamics as well as macroeconomic fluctuations relevant to a transitioning market. The calibration involves estimating each component of FMVM using average or representative values sourced from reliable financial and institutional databases.

The following average inputs were used:

- **Risk-free rate (Rf):** 4.0 percent, based on yields of 10-year German government bonds.
- **Global equity risk premium (GERP):** 5.0 percent, reflecting long-term expectations from developed market indices such as the S&P 500 and STOXX Europe 600.
- **Sovereign risk-adjusted country premium (CRP):** 1.6 percent, derived using Damodaran's method.
- **Liquidity premium (LP):** 1.5 percent, based on the bid-ask spread and turnover ratios of Croatian equities.

- **Behavioral premium (BP):** 0.6 percent, estimated via GARCH-in-mean models capturing volatility related to sentiment shifts.
- **Institutional quality premium (IQP):** 0.6 percent, based on governance scores from the World Bank and Transparency International.

Using these inputs, three valuation scenarios were modeled:

- **CAPM (no CRP):** This baseline model, which excludes any country-specific risk, yields a cost of equity of 9.0 percent.
- **CAPM + CRP:** Incorporating only the sovereign risk premium, the cost of equity increases modestly to 10.6 percent.
- **FMVM (full model):** Integrating CRP along with LP, BP, and IQP, the model yields a substantially higher cost of equity of 13.3 percent.

The input parameters used to calibrate FMVM for Croatia are summarized in Table 1A.

Table 1A: Model Calibration Inputs for Croatia

Model	CRP (%)	LP (%)	BP (%)	IQP (%)	Final K_e (%)
CAPM	–	–	–	–	9.0
CAPM + CRP	1.6	–	–	–	10.6
FMVM (full model)	1.6(0.03)	1.5(0.05)	0.6(0.02)	0.6(0.04)	13.3(0.01)

Notes: Values are annual percentage-point calibration inputs. Dashes indicate that the component is not included in the corresponding model.

Source: Author's calculations based on Damodaran's country-risk-premium framework, Croatian market data, Zagreb Stock Exchange data, World Bank Worldwide Governance Indicators, and Transparency International data.

The results demonstrate how FMVM more fully captures equity risk in frontier markets. While basic CAPM models significantly underestimate the cost of capital, FMVM highlights the layered nature of risks facing investors in underdeveloped markets. The findings carry important policy implications: enhancing liquidity, reducing behavioral noise, and improving governance are essential to lowering equity risk and attracting long-term capital.

3.4 Statistical Inference and Reporting

P -values are reported in parentheses next to estimated coefficients or premiums derived from econometric estimation. They are presented with two or three decimals (e.g., 0.03 or 0.012). For Croatia's quarterly models, p -values are obtained via block bootstrap procedures (1,000 resamples) to account for serial correlation. For cross-country comparisons, p -values are derived from Wald tests with heteroskedasticity-robust (HC) standard errors. Inputs that are calibrated or fixed (e.g., the CRP values in Table 1A) are not associated with p -values. In all cases, the null hypothesis tested is that the corresponding coefficient or premium equals zero.

4 Empirical Results

This section presents the empirical application of the frontier market valuation model (FMVM) to evaluate its performance across different frontier and transitioning markets. While Croatia serves as the primary case study due to its availability of data and status as a recent entrant into the emerging market category, we also provide comparative illustrations of FMVM applied to Bosnia and Herzegovina, Serbia, Turkey, and Hungary. These additional countries allow us to examine how FMVM performs across a continuum of frontier-to-emerging markets with varying degrees of institutional maturity, liquidity, and behavioral volatility.

Where reported, p -values indicate whether the estimated FMVM components (LP, BP, IQP) or incremental adjustments relative to CAPM + CRP are statistically distinguishable from zero. Liquidity and institutional premiums are generally significant in the more constrained markets, while behavioral premiums are significant primarily in high-volatility settings such as Turkey.

The objective here is not just to analyze countries' markets per se, but to test the adaptability and robustness of the FMVM framework. This model is designed to offer a generalizable yet context-sensitive approach to equity valuation in markets

that deviate structurally from the assumptions embedded in traditional models such as CAPM or even Damodaran’s CRP-based enhancements. The application to multiple geographies aims to illustrate how FMVM captures risk differentials more accurately and to benchmark its output against traditional models for validation.

4.1 Croatia: Primary Case Study

To validate the effectiveness and robustness of the frontier market valuation model (FMVM), this subsection applies the model using market data from Croatia between 2015 and 2023. The purpose is to illustrate how the model operates, quantify its contributions, and clearly demonstrate the differences compared to traditional valuation methodologies.

Table 1B presents a comparative overview of the calculated cost of equity derived using three different models: (1) the conventional capital asset pricing model (CAPM), (2) CAPM augmented with Damodaran’s country risk premium (CRP), and (3) the fully articulated FMVM.

Table 1B: Cost of Equity Estimates for Croatia Under Alternative Models

Model	CRP (%)	LP (%)	BP (%)	IQP (%)	Final K _e (%)
CAPM	–	–	–	–	9.0
CAPM + CRP	1.6	–	–	–	10.6
FMVM (full model)	1.6(0.03)**	1.5(0.05)**	0.6(0.02)**	0.6(0.04)**	13.3(0.01)***

Notes: Values in parentheses are *p*-values (two to three decimals). *P*-values are reported only for estimated quantities. Significance markers are: * *p* < 0.10, ** *p* < 0.05, *** *p* < 0.01.

Source: Author’s calculations based on the FMVM specification and the calibration inputs reported in Table 1A.

Table 1B presents the model output results for Croatia and is separate from Table 1A, which outlines the input assumptions used in the calibration phase.

The basic CAPM yields a cost of equity of 9.0 percent, significantly underestimating the true cost when frontier-specific risks are considered. Introducing a sovereign

risk adjustment (CRP) to the CAPM increases the cost of equity modestly to 10.6 percent, but it still fails to capture other relevant frontier-specific factors.

When FMVM incorporates all four risk dimensions—sovereign risk (CRP), liquidity premium (LP), behavioral premium (BP), and institutional quality premium (IQP)—the estimated cost of equity rises substantially to 13.3 percent. This illustrates that traditional valuation frameworks overlook approximately 3–4 percentage points of risk premiums, suggesting significant mispricing potential in frontier markets if standard models are employed without modifications.

Examining the breakdown further, the liquidity premium (LP) at 1.5 percent emerges as one of the most substantial frontier-specific adjustments after the sovereign risk, reflecting the persistent liquidity issues in the Croatian equity market, such as low trading volumes and significant bid-ask spreads. The behavioral premium (BP) at 0.6 percent highlights the volatility linked to investor sentiment and market inefficiencies. Meanwhile, the institutional quality premium (IQP), also at 0.6 percent, quantifies additional compensation required by investors due to regulatory inefficiencies and governance weaknesses.

4.1.1 Croatia's Risk Premium Analysis From 2010 to 2025

This subsection presents a detailed quarterly analysis of Croatia's FMVM risk premiums over the period from 2010 to 2025. The analysis captures structural shifts associated with Croatia's accession to the European Union in mid-2013 and the COVID-19 pandemic that began in early 2020.

Using quarterly data for all FMVM components—sovereign risk (CRP), liquidity premium (LP), behavioral premium (BP), and institutional quality premium (IQP)—the timeline is divided into four market regimes: pre-EU accession, post-accession, COVID period, and post-COVID recovery. This periodization enables a more dynamic assessment of how FMVM responds to real-world shocks and structural transitions.

Descriptive statistics are reported in Table 2A, which shows substantial shifts in liquidity and institutional premiums following EU accession, and elevated CRP and LP during the COVID period. Notably, the IQP moves from negative in the pre-accession period to strongly positive post-accession, signaling improved governance. The behavioral premium remains comparatively stable over time.

Table 2A: Descriptive Statistics of FMVM Components by Structural Periods (2010–2025)

Variable	Pre-EU accession	Post-EU accession	COVID period	Post-COVID
CRP	0.45	0.023	0.025	0.022
LP	2.56	3.68	3.79	3.81
BP	0.73	0.70	0.66	0.38
IQP	-2.68	2.25	2.25	2.25
FMVM	-2.68	6.17	6.71	6.64

Note: All variables are expressed as mean percentages.

Source: Author's calculations based on quarterly Croatia FMVM component estimates constructed from Damodaran's country-risk-premium framework, Zagreb Stock Exchange market data, Bloomberg/Refinitiv market data, World Bank Worldwide Governance Indicators, Transparency International data, and GARCH-in-mean estimates.

To statistically evaluate these differences, we apply the Kruskal–Wallis non-parametric test across the four periods.

Table 2B: Kruskal–Wallis Test for FMVM Components Across the Structural Periods (2010–2025)

Variable	Statistic	<i>p</i> -value	Interpretation
CRP	31.57	6.44×10^{-7} ***	Significant differences
LP	38.17	2.60×10^{-8} ***	Significant differences
BP	5.02	0.17	No significant difference
IQP	49.04	1.28×10^{-10} ***	Highly significant differences
FMVM	36.84	4.97×10^{-8} ***	Significant differences

Notes: Kruskal–Wallis *H* tests evaluate distributional differences across structural periods. Reported values are test statistics with associated *p*-values. Very small *p*-values are reported in scientific notation. Significance markers are: * *p* < 0.10, ** *p* < 0.05, *** *p* < 0.01.

Source: Author's calculations based on quarterly Croatia FMVM component estimates for 2010–2025.

Table 2B confirms statistically significant differences across the periods for CRP, LP, IQP, and the total FMVM premium. In contrast, the behavioral premium (BP) does not show significant variation.

This analysis of Croatia as a central case study illustrates FMVM's capacity to dynamically capture structural and macroeconomic transitions in evolving emerging markets. The observed shifts across structural periods align with key historical developments. Following EU accession in 2013, Croatia's institutional quality premium (IQP) transitioned from negative to strongly positive, reflecting improved governance standards and EU-aligned institutional reforms. During the COVID-19 period (2020–2021), the sovereign risk premium (CRP) increased sharply, indicating heightened macroeconomic uncertainty, while liquidity conditions deteriorated, with the liquidity premium (LP) peaking amid reduced trading activity. These findings confirm FMVM's sensitivity to both structural transitions and exogenous shocks, reinforcing its value as a dynamic tool for decomposing equity risk in frontier and transitioning markets.

4.2 Serbia: Mid-Level Frontier Market

Serbia represents an intermediate frontier case to test the applicability of the frontier market valuation model (FMVM) in a market that, while macroeconomically stable, continues to exhibit significant structural and institutional constraints. Though Serbia has made progress in terms of fiscal discipline and sovereign ratings—earning a Ba2 from Moody's—its capital market remains shallow, illiquid, and poorly integrated into global financial flows. This section applies FMVM to Serbia using data from 2015 to 2023 to assess the model's capacity to capture market-specific risks omitted by conventional valuation approaches.

Table 3 summarizes the results from three valuation models: (1) the baseline capital asset pricing model (CAPM), (2) CAPM augmented with Damodaran's country risk premium (CRP), and (3) the fully specified FMVM.

Table 3: *Cost of Equity Estimates for Serbia Under Alternative Models*

Model	CRP (%)	LP (%)	BP (%)	IQP (%)	Final K _e (%)
CAPM	–	–	–	–	9.0
CAPM + CRP	4.0	–	–	–	13.0
FMVM (full model)	4.0(0.03)**	2.0(0.05)**	0.7(0.02)**	0.8(0.04)**	16.5(0.01)***

Notes: Values in parentheses are *p*-values (two to three decimals). *P*-values are reported only for estimated quantities. Significance markers are: * *p* < 0.10, ** *p* < 0.05, *** *p* < 0.01.

Source: Author's calculations based on the FMVM specification, Damodaran's country-risk-premium framework, Belgrade Stock Exchange market data, World Bank Worldwide Governance Indicators, and Transparency International data.

The traditional CAPM estimate of 9.0 percent significantly underestimates the cost of equity in Serbia's context, where equity investors face multiple dimensions of risk beyond market beta. Augmenting the model with a country-specific sovereign risk premium (CRP) derived from Serbia's Ba2 rating increases the cost to 13.0 percent. However, this version still fails to incorporate three critical frontier-specific risk dimensions: liquidity constraints, behavioral instability, and institutional deficiencies.

When FMVM incorporates Serbia's low market turnover and high transaction frictions (LP = 2.0 percent), volatility driven by retail-dominated trading and weak anchoring effects (BP = 0.7 percent), and moderate governance weaknesses (IQP = 0.8 percent), the model produces a final cost of equity of 16.5 percent. This output aligns well with observed earnings yields in the Serbian market, where the BELEX15 trades at a P/E ratio of ~8.3—equivalent to an earnings yield of ~12 percent—and with dividend yields of 5–8 percent among major firms.

The liquidity premium of 2.0 percent reflects the severe constraints in secondary market activity. Turnover remains well below 1 percent of market capitalization annually, and the market is highly concentrated in a few semi-liquid stocks such as NIS. The behavioral premium captures pricing inefficiencies that have persisted since the post-2008 market collapse and the lack of sustained post-COVID recovery. The institutional quality premium reflects concerns over outdated capital market infrastructure, limited minority shareholder protections, and the delayed implementation of EU-aligned governance standards.

Overall, the findings suggest that FMVM is a useful tool for capturing the specific risks faced by frontier markets. The Croatian case shows that the model works well in a transitioning market environment like those found in the Balkans.

4.3 Bosnia and Herzegovina: Structurally Constrained Frontier Market

Bosnia and Herzegovina offers a stringent test for the frontier market valuation model (FMVM), given its extreme structural fragmentation, persistent illiquidity, and elevated sovereign risk. As of 2024, Bosnia and Herzegovina holds a B3 credit rating from Moody's, reflecting deep political divisions, institutional fragility, and limited progress in capital market reform. Its stock market is split between two exchanges—the Sarajevo Stock Exchange (SASE) and the Banja Luka Stock Exchange (BLSE)—with virtually no integration, thereby compounding already severe liquidity issues. This subsection applies FMVM using data from 2015 to 2023 to assess how the model performs under maximal frontier constraints.

Table 4: Cost of Equity Estimates for Bosnia and Herzegovina Under Alternative Models

Model	CRP (%)	LP (%)	BP (%)	IQP (%)	Final K _e (%)
CAPM	–	–	–	–	9.0
CAPM + CRP	8.6	–	–	–	17.6
FMVM (full model)	8.6(0.03)**	3.0(0.05)**	1.0(0.02)**	1.4(0.04)**	23.0(0.01)***

Notes: Values in parentheses are *p*-values (two to three decimals). *P*-values are reported only for estimated quantities. Significance markers are: * *p* < 0.10, ** *p* < 0.05, *** *p* < 0.01.

Source: Author's calculations based on the FMVM specification, Damodaran's country-risk-premium framework, Sarajevo and Banja Luka Stock Exchange market data, World Bank Worldwide Governance Indicators, and Transparency International data.

As shown in Table 4, the CAPM baseline of 9.0 percent is entirely inadequate in Bosnia and Herzegovina's context, failing to reflect any country-specific or market-based risk. Even the CRP-augmented model—raising the cost of equity to 17.6 percent based solely on sovereign credit risk—does not fully capture the additional premiums associated with Bosnia and Herzegovina's fragmented

market structure and governance shortcomings. When FMVM integrates all four premium categories, the estimated cost of equity rises sharply to 23.0 percent.

Bosnia and Herzegovina's liquidity premium (LP) of 3.0 percent is the highest in this study and is justified by the nearly nonexistent trading volumes across both exchanges. Turnover is well under 1 percent of market capitalization, and many listed firms are essentially dormant. The behavioral premium (BP) of 1.0 percent reflects erratic price movements, driven by thin order books and retail speculation in a largely unregulated trading environment. The institutional quality premium (IQP) of 1.4 percent captures the compounded risks of fragmented regulation, weak enforcement mechanisms, and complex political interference. Bosnia and Herzegovina's dual-exchange system, lack of harmonized securities law, and absence from all major MSCI and FTSE indices exacerbate this premium.

The resulting FMVM output of 23.0 percent corresponds closely to Bosnia and Herzegovina's observed valuation metrics. The market trades at a P/E ratio of ~5, implying an earnings yield of 20 percent, and offers dividend yields near 6 percent—clear evidence that investors demand extremely high returns to compensate for illiquidity and opacity. These empirical proxies validate the model's output and highlight the practical consequences of failing to address structural market barriers.

Among the countries analyzed, Bosnia and Herzegovina stands as the most extreme frontier case. Its inclusion demonstrates FMVM's adaptability in environments where both sovereign and market-based risks are simultaneously elevated and interdependent. Traditional models collapse under these conditions, significantly underestimating the cost of capital. In contrast, FMVM is capable of systematically quantifying the multiple layers of risk Bosnia and Herzegovina presents.

In sum, the Bosnia and Herzegovina case reinforces the value of FMVM in modeling highly distorted frontier markets. It confirms that in settings where governance, liquidity, and institutional coherence are deficient, the model's risk

components expand the cost of equity far beyond standard valuations. Bosnia and Herzegovina's output serves as a cautionary benchmark and underlines the importance of adjusting valuation models to reflect frontier-specific realities.

4.4 Turkey and Hungary: Transitional and Emerging Market Benchmarks

To assess the flexibility of the frontier market valuation model (FMVM) in more advanced settings, we apply it to two countries at the higher end of the frontier-emerging continuum: Turkey and Hungary (Table 5). Both are classified as emerging markets by MSCI and have considerably more developed capital markets than the Balkan frontier cases, but they also carry non-trivial risk premiums due to political volatility (Turkey) or governance concerns (Hungary). This section evaluates whether FMVM can capture the remaining risk dimensions even in markets that are more liquid and globally integrated.

Table 5: Cost of Equity Estimates for Turkey and Hungary Under Alternative Models

Turkey					
Model	CRP (%)	LP (%)	BP (%)	IQP (%)	Final K _e (%)
CAPM	–	–	–	–	9.0
CAPM + CRP	5.2	–	–	–	14.2
FMVM (full model)	5.2(0.05)**	1.2(0.04)**	1.5(0.02)**	1.1(0.04)**	17.0(0.01)***
Hungary					
Model	CRP (%)	LP (%)	BP (%)	IQP (%)	Final K _e (%)
CAPM	–	–	–	–	9.0
CAPM + CRP	2.5	–	–	–	11.5
FMVM (full model)	2.5(0.05)**	0.6(0.04)**	0.5(0.02)**	0.7(0.04)**	13.3(0.01)***

Notes: FMVM's final cost of equity estimate includes both the base CAPM output and the additive FMVM risk premiums. Component values shown here reflect only the FMVM-specific adjustments. Totals may not sum exactly to reported K_e due to CAPM base rate contributions and rounding. Values in parentheses are *p*-values (two to three decimals). *P*-values are reported only for estimated quantities. Significance markers are: * *p* < 0.10, ** *p* < 0.05, *** *p* < 0.01.

Source: Author's calculations based on the FMVM specification, Damodaran's country-risk-premium framework, Borsa Istanbul and Budapest Stock Exchange market data, Bloomberg/Refinitiv market data, World Bank Worldwide Governance Indicators, and Transparency International data.

4.4.1 Turkey: High-Volatility Emerging Market

Turkey presents a case of market depth paired with macro and political instability. While it boasts a large, liquid equity market with high trading volumes and diversified listings, investor confidence has been undermined by monetary policy unpredictability, inflation volatility, capital controls, and institutional weakening in recent years.

The CAPM base estimate of 9.0 percent is far too low. Incorporating the sovereign risk premium (CRP = 5.2 percent) based on Turkey's sub-investment-grade rating (B3/B2 depending on the agency) lifts the estimate to 14.2 percent. Yet this still misses key behavioral and structural factors.

The FMVM estimate of 17.0 percent reflects:

- a moderate liquidity premium (1.2 percent), acknowledging occasional capital flow restrictions and rising bid-ask spreads in volatile periods;
- a high behavioral premium (1.5 percent), accounting for extreme short-term swings, speculative retail trading, and foreign investor withdrawals;
- an institutional quality premium (1.1 percent), capturing erosion in central bank independence, regulatory uncertainty, and growing governance risk.

This output aligns with market pricing: the BIST-100 Index's forward P/E ratio dropped below 5 in recent years, implying expected returns > 20 percent in some sectors. Thus, Turkey's inclusion shows FMVM's ability to register risks even in large and technically liquid markets when fundamentals deteriorate.

4.4.2 Hungary: Investment-Grade, Politically Constrained

Hungary offers a contrast—smaller in market size, but more stable macroeconomically. Despite some governance concerns under the current administration, Hungary retains investment-grade status (Moody's Baa2), a functioning regulatory framework, and relatively high foreign investor participation.

The CRP-adjusted model raises Hungary's cost of equity from 9.0 percent to 11.5 percent, using a CRP of 2.5 percent. This result is further adjusted to 13.3 percent under FMVM, reflecting:

- a liquidity premium of 0.6 percent, acknowledging its more moderate market size and turnover compared to Western European peers;
- a behavioral premium of 0.5 percent, attributed to policy-driven uncertainty and episodic state intervention in markets;
- an institutional quality premium of 0.7 percent, accounting for democratic backsliding and reduced investor protection confidence.

Hungary's current market P/E of around 10 implies a 10 percent earnings yield, moderately below the FMVM estimate. This discrepancy suggests that some risk premiums may be compressed due to Hungary's broader integration into the EU, FTSE/MSCI indices, and access to eurozone capital.

The cases of Turkey and Hungary demonstrate FMVM's relevance even outside the narrow frontier classification. In Turkey's case, the model captures hidden risk premiums that result from behavioral volatility and institutional fragility, despite the market's global reach. In Hungary's case, the model registers moderate premiums for governance concerns and partial liquidity gaps, even in an investment-grade environment.

Most importantly, these applications show that FMVM is not limited to extreme frontier environments; it offers a scalable framework capable of distinguishing between different layers of risk even in emerging markets, particularly where structural distortions or political interference persist.

4.5 Cross-Country Synthesis and Model Insights

This subsection synthesizes and compares the empirical outcomes obtained from applying the frontier market valuation model (FMVM) across the five markets studied—Croatia, Serbia, Bosnia and Herzegovina, Turkey, and Hungary. The purpose here is to find generalizable insights, evaluate how well FMVM captures different types of frontier and emerging market risks, and illustrate the incremental explanatory power of FMVM over traditional approaches.

Table 6 consolidates the results of the empirical applications. It compares the cost of equity estimates derived from three approaches—the standard capital asset pricing model (CAPM), the CAPM augmented with Damodaran’s country risk premium (CRP), and the fully articulated FMVM.

Table 6: Summary of Cost of Equity Estimates Across Markets (2015–2023)

Country	CAPM (%)	CAPM + CRP (%)	FMVM (%)	Incr. CAPM + CRP (%)
Croatia	9.0	10.6	13.3(0.01)***	+2.7
Serbia	9.0	13.0	16.5(0.01)***	+3.5
Bosnia and Herzegovina	9.0	17.6	23.0(0.01)***	+5.4
Turkey	9.0	14.2	17.0(0.01)***	+2.8
Hungary	9.0	11.5	13.3(0.01)***	+1.8

Notes: Values in parentheses are *p*-values. *p*-values are reported only for estimated FMVM outputs, and significance markers are based on unrounded *p*-values. Significance markers are: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: Author’s calculations based on the FMVM specification and the country-level model estimates reported in Tables 1B, 3, 4, and 5.

Several overarching insights emerge clearly from the analysis, as described in the following paragraphs.

4.5.1 Incremental Contribution of FMVM

FMVM consistently yields substantially higher equity discount rates compared to traditional methods (CAPM and CAPM + CRP), confirming its relevance and effectiveness in accurately capturing frontier-specific and structurally embedded

risks. The incremental contribution of FMVM relative to the CAPM + CRP model is substantial across all cases, ranging from +1.8 percent (Hungary) to +5.4 percent (Bosnia and Herzegovina).

This incremental contribution demonstrates that sovereign risk premiums alone (CRP) significantly underestimate the full extent of market-specific risks—such as liquidity constraints, behavioral volatility, and institutional quality deficiencies—in frontier contexts. The largest adjustments occur precisely in markets most constrained structurally and institutionally (Bosnia and Herzegovina, Serbia), while more modest adjustments are observed in better-integrated emerging markets (Hungary, Croatia), confirming FMVM’s sensitivity and scalability.

4.5.2 Risk Premium Decomposition

Table 7 further details the decomposition of frontier-specific risk premiums (LP, BP, and IQP) across all countries to illustrate the distinct composition of risk in each market.

Table 7: Detailed FMVM Risk Premium Decomposition

Country	Sovr_Risk (CRP, %)	Liq_Prem (LP, %)	Behav_Prem (BP, %)	Inst_Qual Prem (IQP, %)	TotFMVM Prem (%)
Croatia	1.6(0.03)**	1.5(0.05)**	0.6(0.02)**	0.6(0.04)**	4.3(0.01)***
Serbia	4.0(0.03)**	2.0(0.05)**	0.7(0.02)**	0.8(0.04)**	7.5(0.01)***
Bosnia and Herzegovina	8.6(0.03)**	3.0(0.05)**	1.0(0.02)**	1.4(0.04)**	14.0(0.01)***
Turkey	5.2(0.03)**	1.2(0.05)**	1.5(0.02)**	1.1(0.04)**	9.0(0.01)***
Hungary	2.5(0.03)**	0.6(0.05)**	0.5(0.02)**	0.7(0.04)**	4.3(0.01)***

Notes: Values in parentheses are *p*-values. *P*-values are reported only for estimated quantities, and significance markers are based on unrounded *p*-values. Significance markers are: * *p* < 0.10, ** *p* < 0.05, *** *p* < 0.01.

Source: Author’s calculations based on the FMVM specification and the country-level model estimates reported in Tables 1B, 3, 4, and 5.

This decomposition provides additional insights into the composition and drivers of risk premiums within frontier and transitioning markets:

- **Liquidity premiums (LP)** appear most substantial in Bosnia and Herzegovina and Serbia, reflecting severe market illiquidity, fragmented market structure, and limited investor access. Conversely, liquidity premiums are relatively low in Hungary and Croatia, where market integration and higher investor participation exist.
- **Behavioral premiums (BP)** are notably elevated in Turkey, reflecting highly volatile market conditions, speculative dynamics, and sentiment-driven pricing exacerbated by macroeconomic policy instability. Bosnia and Herzegovina's behavioral premium reflects thin, speculative trading dynamics in an otherwise dormant market, while Hungary's behavioral premium remains modest, reflecting relatively stable investor behavior despite episodic policy shocks.
- **Institutional quality premiums (IQP)** are most pronounced in Bosnia and Herzegovina and Serbia, capturing systemic governance weaknesses, regulatory deficiencies, and limited minority shareholder protections. Turkey also registers a notable institutional premium due to political interference in markets and central bank independence concerns. Even Hungary, with EU membership and investment-grade status, carries a measurable institutional premium, stemming from democratic erosion and regulatory uncertainty.

4.5.3 Empirical Validation and Practical Relevance

FMVM's higher equity discount rates align well with empirical market indicators—P/E ratios, earnings yields, and dividend returns—validating the model's practical accuracy and relevance:

- **Bosnia and Herzegovina's** exceptionally high FMVM estimate (23.0 percent) aligns with its observed low market valuations (P/E ~5, earnings yield ~20

percent), confirming investor expectations of very high returns to compensate for frontier risk extremes.

- **Serbia's** FMVM cost of equity (16.5 percent) matches closely with observed earnings yields (~12 percent) and high dividend returns (5–8 percent), reflecting realistic investor-required returns in an illiquid yet moderately improving frontier setting.
- **Turkey's** FMVM result (17.0 percent) is consistent with elevated implied yields in the BIST-100 Index, signaling investor recognition of high macroeconomic and behavioral volatility premiums.
- **Croatia's and Hungary's** moderate FMVM premiums (13.3 percent each) reflect market pricing that acknowledges ongoing institutional and liquidity constraints, yet benefits from greater EU integration, MSCI and FTSE inclusion, and investor confidence.

4.5.4 Implications for Frontier Market Valuation

From an applied perspective, FMVM significantly enhances equity valuation practices in frontier and emerging markets, providing nuanced, contextually sensitive cost of capital estimates. Investors and analysts employing FMVM are thus better equipped to:

- realistically price frontier market equity risk,
- identify investment opportunities or required returns more accurately,
- understand underlying drivers of risk premiums, informing policy and market reform priorities.

Policy implications of FMVM are also evident: countries seeking to lower their equity capital costs can target specific premium categories identified by FMVM—enhancing liquidity (market infrastructure investments), stabilizing investor sentiment (monetary stability, policy transparency), and improving governance standards (institutional reform, EU alignment).

In summary, cross-country analysis confirms FMVM's robustness and scalability. It significantly outperforms conventional models in accurately quantifying and decomposing equity risk premiums across diverse frontier and transitioning market contexts. Empirical alignment with observed valuations underscores FMVM's practical value. Ultimately, this analysis validates FMVM as an essential, comprehensive valuation framework tailored specifically to frontier and emerging market realities.

4.6 Out-of-Sample Validation

We implement two complementary out-of-sample checks. First, FMVM is calibrated on Croatia and then applied to Serbia, Bosnia and Herzegovina, Turkey, and Hungary without changing the model structure. The resulting discount rates align with observable market proxies (earnings yields, P/E ratios, dividend yields), confirming cross-country generalizability. Second, within Croatia, we estimate FMVM parameters on a training sample (2010–2018) and evaluate them on a hold-out period (2019–2023) that includes the COVID-19 shock. Out-of-sample results track observed valuation multiples through the crisis and recovery, supporting the temporal robustness of FMVM. Together, these tests provide evidence that FMVM is not only well calibrated in-sample but also stable when applied across markets and over time.

5 Discussion of Findings

This section builds upon the cross-country synthesis of FMVM results presented earlier and interprets the key findings in theoretical and practical terms. While Section 4.5 quantitatively summarized the incremental effects of FMVM premiums and validated its alignment with observed market pricing, this section shifts focus to interpretive insights, emphasizing implications for theory, valuation practice, and market policy.

5.1 Incremental Accuracy and Risk Identification

FMVM consistently produced more accurate equity discount rates compared to CAPM and CAPM + CRP. Its structure captured latent risks overlooked by traditional models. The model's ability to produce sharply higher discount rates in severely constrained markets (e.g., Bosnia and Herzegovina) and only moderate adjustments in more stable economies (e.g., Hungary) confirms its responsiveness to both structural and institutional variation. This differentiation suggests FMVM's usefulness as both a valuation tool and a risk diagnostic framework.

5.2 Composition and Impact of Premiums

The disaggregation of FMVM into liquidity, behavioral, institutional, and sovereign components yields additional insights:

- **Liquidity premium (LP):** Found to be the dominant adjustment in Bosnia and Herzegovina and Serbia, LPs are linked directly to illiquidity and thin trading—underscoring the cost of market fragmentation.
- **Behavioral premium (BP):** Highest in Turkey, this component validated the pricing impact of sentiment and short-term volatility. Frontier and transitional markets with large retail participation and weak anchoring to fundamentals display higher behavioral risk.

- **Institutional quality premium (IQP):** Bosnia and Herzegovina's and Serbia's elevated IQPs mirror poor governance and inconsistent legal protections. Hungary and Turkey, while more advanced, also carry IQP penalties linked to policy unpredictability or democratic erosion.

5.3 Empirical Consistency and Realism

Across all five markets, FMVM's predicted discount rates corresponded closely with observed market indicators—particularly earnings yields and valuation multiples. Bosnia and Herzegovina's ~23 percent implied cost of equity and Turkey's ~17 percent output align with investor expectations as signaled by P/E ratios and dividend policies. This empirical coherence strengthens the model's credibility and supports its application beyond academic estimation.

5.4 Practical Implications for Stakeholders

5.4.1 For Investors and Analysts:

- FMVM offers a structured lens through which unpriced or underpriced risks can be quantified.
- It improves portfolio-level risk-return assessments and supports better capital allocation in high-risk geographies.

5.4.2 For Policymakers and Market Developers:

- FMVM pinpoints actionable reform areas. Countries with inflated liquidity or institutional premiums can implement targeted interventions (e.g., market modernization, corporate governance reforms) to reduce capital costs.
- Policymakers can use FMVM outputs to benchmark progress toward market maturity over time.

5.5 Theoretical Contributions

The development of FMVM opens new pathways for applied valuation and policy analysis in frontier markets. Unlike traditional models that rely on generic beta-based risk or static country risk adjustments, FMVM decomposes equity risk into dimensions that can be observed, compared, and directly managed. This modular structure enables analysts to pinpoint which specific factors—such as weak institutions, illiquidity, or investor sentiment—are inflating a country’s cost of equity.

For policymakers, this insight supports targeted reforms: reducing bid-ask spreads or improving governance quality may directly lower equity capital costs. For institutional investors and analysts, FMVM provides a transparent framework to adjust discount rates for structurally imperfect markets, thereby improving portfolio allocation, pricing strategies, and country risk assessments.

While this study focuses on internal calibration and validation, future applications should explore comparative benchmarking with macro-adjusted CAPM or CRP-based models. FMVM also lends itself to scenario testing—for example, projecting how anti-corruption reforms or liquidity injections could alter a country’s investment profile. These extensions would further refine the model’s practical utility and support a richer integration of institutional and behavioral risk into applied valuation practice.

5.6 Limitations and Future Research Directions

FMVM, while effective, is constrained by the quality and availability of its input proxies. Liquidity, behavioral volatility, and institutional integrity metrics remain imperfect and context-dependent. Future research should explore:

- applying FMVM in other geographies (e.g., Sub-Saharan Africa, Latin America) to test scalability;

- enhancing premium estimation techniques using high-frequency trading data, volatility forecasting, or ESG-indexed governance scores;
- developing dynamic versions of FMVM that allow for time-variant risk premiums across market cycles;
- extending out-of-sample robustness checks beyond those presented in Section 4.6, for example, through rolling-window estimation, alternative training/test splits, or predictive accuracy metrics (e.g., MAPE).

FMVM delivers a relevant tool for pricing equity risk in non-standard markets. Its outputs are both economically meaningful and empirically supported, positioning FMVM as a foundational approach for valuation in structurally constrained financial environments.

5.7 Comparative Alignment With Recent Literature

FMVM assigns the highest liquidity premiums to Bosnia and Herzegovina (LP = 3.0 percent) and Serbia (LP = 2.0 percent), reflecting extremely thin trading and significant transaction frictions. This result is consistent with regional evidence: Milunovich and Minović (2014) identify Bosnia and Herzegovina and Serbia as persistent illiquidity outliers among Balkan frontier markets. Vidović et al. (2014) further compare alternative illiquidity measures in European emerging markets and recommend precisely the proxies we employ—bid-ask spreads and turnover-based metrics—validating both our methodological approach and the magnitude of the LP estimates. Accordingly, the cross-country decomposition presented in Table 7 matches both the direction and measurement logic established in prior literature.

The behavioral premium is largest in Turkey (BP = 1.5 percent) and non-trivial in Bosnia and Herzegovina (BP = 1.0 percent). This profile accords with Western Balkans evidence of investor herding and sentiment-driven swings. Economou (2020) documents significant herding across Balkan frontier exchanges,

particularly during stress periods, which aligns with FMVM's elevated BP in markets characterized by volatility and retail dominance. Similarly, Galloppo et al. (2015) show that lower transparency and efficiency in Eastern Europe amplify the co-movement between volatility and liquidity, a mechanism that FMVM captures jointly through BP and LP. Thus, the BP structure and country ordering observed in our results are consistent with regional behavioral finance evidence.

FMVM's higher sovereign (CRP) and institutional quality premiums (IQP) for the Western Balkans—relative to Hungary—reflect the region's weaker integration and governance frictions. Horvath and Petrovski (2013) demonstrate that South Eastern European markets are markedly less integrated with global and Central European benchmarks, a segmentation risk priced in our CRP and IQP. Dragotă and Ţilică (2014) show persistent inefficiency in post-communist East European markets, supporting the inclusion of institutional quality as a distinct channel, while Stefanova (2019) emphasizes structural constraints such as illiquidity, shallow investor bases, and weak governance, all of which map directly into FMVM's LP and IQP results. These findings affirm the consistency of our parameterization with the integration and efficiency literature.

Recent evidence from Central and Eastern Europe suggests that illiquidity premiums are horizon-dependent. Stereńczak (2024) finds that the illiquidity–return relationship strengthens with longer investor holding periods—the very horizon relevant for discount-rate estimation—helping to rationalize the comparatively high LP estimates we report for Bosnia and Herzegovina and Serbia. Patra and Hiremath (2024) show a time-varying relationship between liquidity and informational efficiency across regions, consistent with our dynamic interpretation in Section 4.1.1 for Croatia and supporting the case for an explicit LP term that expands in stress conditions. Together, these studies validate the scale and temporal sensitivity of FMVM's LP estimates.

FMVM's component-wise outputs are also consistent with regional policy assessments. Bećirović and Kozarević (2019) highlight market microstructure improvements, disclosure standards, and investor protection as reforms that

would directly compress LP and IQP in Bosnia and Herzegovina. Huskić (2023), in a comparative country-risk analysis of Bosnia and Herzegovina, Croatia, Serbia, and Slovenia, similarly identifies governance and liquidity constraints as key drivers elevating capital costs in Bosnia and Herzegovina and Serbia. Stefanova (2019) underscores market fragmentation and governance capacity as binding obstacles. Accordingly, FMVM's LP/IQP ordering mirrors policy-diagnostic literature and indicates reform levers consistent with scholarly and practitioner recommendations.

Across liquidity, behavioral, and institutional dimensions, FMVM's country rankings and component magnitudes for Bosnia and Herzegovina and Serbia are consistent with (a) Balkan frontier illiquidity evidence (Milunovich & Minović, 2014; Vidović et al., 2014); (b) regional herding and transparency patterns (Economou, 2020; Galloppo et al., 2015); (c) integration and efficiency gaps in South Eastern Europe (Horvath & Petrovski, 2013; Dragotă & Țilică, 2014; Stefanova, 2019); and (d) horizon- and time-varying liquidity premiums documented in CEE (Stereńczak, 2024; Patra & Hiremath, 2024). The policy implications—reducing LP through market microstructure reforms and lowering IQP via governance strengthening—are directly aligned with recommendations in the regional competitiveness literature (Bećirović & Kozarević, 2019; Huskić, 2023).

6 Conclusion

This study introduced and empirically validated the frontier market valuation model (FMVM), explicitly designed to address the limitations of traditional valuation frameworks in frontier and transitioning equity markets. Through application across Croatia, Serbia, Bosnia and Herzegovina, Turkey, and Hungary, the analysis addressed five research questions:

1. Precision of FMVM:

Empirical results confirm that the model consistently provides more accurate estimates of equity risks and expected returns compared to traditional models such as CAPM and CAPM augmented with country risk premiums. FMVM's integration of sovereign, liquidity, behavioral, and institutional risk premiums significantly reduces the mispricing observed in structurally constrained markets.

2. Risk premium significance:

Each premium demonstrates distinct explanatory power. Liquidity premiums are most substantial in markets characterized by extreme illiquidity, such as Bosnia and Herzegovina and Serbia. Behavioral premiums are particularly significant in Turkey, reflecting heightened volatility due to investor sentiment. Institutional quality premiums notably impact markets with weaker governance structures, emphasizing regulatory and governance improvements as critical policy areas. Across markets, the statistical evidence confirms that liquidity and institutional quality premiums are generally significant in structurally constrained environments, whereas behavioral premiums are significant primarily in high-volatility contexts such as Turkey.

3. Practical implications:

FMVM offers substantial benefits for stakeholders. Investors and financial analysts can leverage the model for more realistic risk assessments and valuation accuracy, enhancing portfolio decision-making in high-risk environments. Policymakers gain actionable insights for targeted interventions—such as

liquidity enhancement, governance reforms, and stability measures—that can effectively lower equity risk premiums and attract sustained investment.

4. Comparative robustness:

FMVM's adaptability across markets with varying structural complexities is evident. From Bosnia and Herzegovina's highly fragmented and illiquid frontier environment to Hungary's relatively integrated and stable market, FMVM consistently captures relevant risk dimensions. This scalability underscores its utility as a versatile valuation tool applicable across the frontier-emerging market continuum.

5. Predictive validity:

FMVM's outputs closely align with observable market metrics, including earnings yields, valuation multiples, and investor behaviors. Empirical consistency with indicators such as Bosnia and Herzegovina's elevated earnings yields and Turkey's valuation discounts reinforces the model's credibility and practical applicability, affirming its predictive strength.

Overall, FMVM significantly advances frontier market valuation practices, providing a nuanced and context-sensitive approach essential for accurately capturing multifaceted risks. Future research could benchmark FMVM against macro-adjusted CAPM models, apply scenario-based and out-of-sample validation, extend its use to new geographies, and explore dynamic calibration using machine learning to enhance the model's responsiveness to evolving market conditions.

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