Bayesian Hierarchical Decomposition of Dynamic Capability Portfolios: A Multi-Layered Optimization Framework for Competitive Advantage Reconfiguration Under Environmental Volatility

Kim King
Professor
WHU – Otto Beisheim School of Management
Burgplatz 2, 56179 Vallendar, Germany

Drew Rodriguez
Associate Professor
Korea Advanced Institute of Science and Technology (KAIST) College of Business
85 Hoegi-ro, Dongdaemun-gu, Seoul 02455, Republic of Korea

Drew Collins
PhD
Ivey Business School, Western University
1255 Western Road, London, Ontario N6G 0N1, Canada

Abstract. Sustained competitive advantage under conditions of environmental volatility demands a rigorous reconfiguration of dynamic capability portfolios, yet existing frameworks lack the quantitative precision necessary for strategic decision-making at scale. This study introduces a Bayesian hierarchical decomposition model that operationalizes capability-sensing, seizing, and reconfiguring routines as probabilistic latent constructs, enabling multi-level optimization across strategic business units. Drawing on longitudinal panel data from 318 multinational enterprises across 14 industries (2018–2023), the model is estimated via Markov Chain Monte Carlo sampling with nested hyperprior structures. Results demonstrate that capability reconfiguration velocity significantly moderates the relationship between environmental dynamism and Tobin's Q. The proposed framework advances resource orchestration theory and provides executives with a tractable, data-driven protocol for portfolio-level strategic realignment.

Keywords: dynamic capabilities, Bayesian hierarchical modeling, capability reconfiguration, resource orchestration, strategic portfolio optimization, environmental volatility, competitive advantage, Markov Chain Monte Carlo estimation, multinational enterprise strategy

Introduction

The persistence of competitive advantage in the face of accelerating environmental volatility has emerged as one of the most consequential empirical and theoretical challenges in contemporary strategic management. As of 2024–2026, multinational enterprises operate within an unprecedented confluence of disruptions — including geopolitical fragmentation, post-pandemic supply chain restructuring, rapid AI-driven technological displacement, and intensifying regulatory heterogeneity across jurisdictions. These forces collectively

compress the durability of firm-level advantages, rendering static resource positions insufficient as long-term strategic anchors. The dynamic capabilities framework, originally articulated by Teece, Pisano, and Shuen (1997) and subsequently refined through decades of empirical elaboration, posits that firms sustain performance through their ability to sense environmental shifts, seize emerging market opportunities, and reconfigure internal asset configurations accordingly. Despite the theoretical maturation of this paradigm, a critical methodological gap persists: extant operationalizations of dynamic capability constructs rely predominantly on survey-based proxy measures or reduced-form regression specifications that fail to capture the hierarchical, nested, and probabilistic nature of capability accumulation and deployment across strategic business units (SBUs). This inadequacy is particularly acute in the context of multi-divisional firms, where capability heterogeneity across SBUs generates endogeneity challenges and cross-level confounding that standard panel estimators cannot adequately resolve. Furthermore, the strategic management literature has largely neglected the moderating role of capability reconfiguration velocity — the rate at which firms can disassemble, redeploy, and re-integrate capability bundles — as a distinct construct mediating the dynamism–performance relationship. Resource orchestration theory (Sirmon, Hitt, and Ireland, 2007) provides a valuable complementary lens, emphasizing the managerial processes through which resource portfolios are structured, bundled, and leveraged; however, its integration with formal Bayesian inference methodologies remains embryonic. The present study addresses these gaps by developing and empirically validating a Bayesian hierarchical decomposition framework that treats dynamic capability portfolios as probabilistic latent constructs estimated simultaneously at firm, SBU, and industry levels. By embedding Markov Chain Monte Carlo (MCMC) sampling within a nested hyperprior architecture, the model yields posterior distributions over capability parameters that are both interpretable for strategic theory and actionable for executive decision-making. Longitudinal panel data from 318 multinational enterprises spanning 14 industries and a five-year observation window (2018–2023) provide the empirical foundation for model calibration and validation. The remainder of this paper is organized as follows. Section 2 reviews the theoretical underpinnings of dynamic capabilities and resource orchestration theory, identifying the key conceptual gaps addressed by the proposed framework. Section 3 details the Bayesian hierarchical model specification, including the latent construct definitions, hyperprior selection rationale, and MCMC estimation protocol. Section 4 describes the data sources, sample construction, and operationalization of all focal constructs. Section 5 presents the empirical results, including posterior parameter estimates, model fit diagnostics, and robustness checks. Section 6 discusses the theoretical contributions and managerial implications, situating the findings within broader strategic management discourse. Section 7 concludes with limitations and directions for future research.

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