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The Interface of Finance, Operations, and Risk Management

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Foundations and Trends® in Technology, Information and Operations Management

Published, sold and distributed by:
now Publishers Inc.
PO Box 1024
Hanover, MA 02339
United States
Tel. +1-781-985-4510
www.nowpublishers.com
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Outside North America:
now Publishers Inc.
PO Box 179
2600 AD Delft
The Netherlands
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The preferred citation for this publication is

Volodymyr Babich and John R. Birge. *The Interface of Finance, Operations, and Risk Management*. Foundations and Trends® in Technology, Information and Operations Management, vol. 15, no. 1–2, pp. 1–203, 2021.

ISBN: 978-1-68083-797-1

Foundations and Trends® in Technology, Information and Operations Management
Volume 15, Issue 1-2, 2021

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Foundations and Trends® in Technology, Information and Operations Management, 2021, Volume 15, 4 issues. ISSN paper version 1571-9545. ISSN online version 1571-9553. Also available as a combined paper and online subscription.

Contents

The Interface of Finance, Operations, and Risk Management

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ABSTRACT

In this work we define the characteristics of the interface of finance, operations, and risk management (iFORM) research and provide examples of iFORM research questions. We illustrate why this is an interesting area and discuss where the two disciplines overlap in a meaningful way. Our goal is to lower the entry cost for new researchers by providing primers on (1) key finance results and papers that OM researchers endeavoring to enter into this field must know; (2) key OM results and papers that finance researchers endeavoring to enter into this field must know. Furthermore, we offer our perspective on resources to help readers to accelerate their iFORM research and on how to write, publish, and referee iFORM papers.

Volodymyr Babich and John R. Birge (2021), "The Interface of Finance, Operations, and Risk Management", Foundations and Trends® in Technology, Information and Operations Management: Vol. 15, No. 1–2, pp 1–203. DOI: 10.1561/0200000101.

1

Introduction

There are many business problems where it is difficult to separate operations from finance. Consider, for example, the US shale oil and gas boom, which has transformed the U.S.A. from a net importer to a net exporter of oil and oil-based products for the first time in 75 years (Blas, 2018). As a result, the U.S.A. has become the world's largest oil producer, with production exceeding those of Russia and Saudi Arabia (Egan, 2018). The key source of shale oil is the Permian Basin of West Texas and New Mexico, whose output alone rivals those of Iran or Iraq (Sider and Olson, 2018).

Recently, the oil production in the Permian Basin has been threatened by operational bottlenecks. Sider and Olson (2018) report that producers are encountering pipeline congestion as well as shortages of materials and workers. To relieve shortages, producers bring workers from outside, straining local resources. Hotel prices in the area spiked to $600 per night. Because pipelines take a long time to build, oil producers are relying on oil transport by trucks. However, there is a shortage of qualified truck drivers and their salaries are rising (to $140,000 per year), while the schools that are teaching how to pass the test for the commercial driver's license are packed (Wethe, 2018).

In this example, to forecast future oil prices, one needs to understand how the oil production, transportation, and refinement systems operate, identify bottlenecks, predict how capacity investments will relieve them, and where new bottlenecks will arise. These are essential operational problems and questions.

Another motivating example has to do with how financial constraints and working capital utilization affect operational decisions of the firms. Extending an example from Babich and Kouvelis (2018), Walmart had $47 billion in accounts payable in January of 2019,[1] the amount exceeding short-term ($1.9 billion) and long-term ($44 billion) debt combined. Accounts payable represent what Walmart owes its suppliers on trade credit contracts for goods that Walmart has already received, but has yet to pay for. This is typical. Trade credit is the largest source of short-term financing for companies and trade finance is the essential enabler of international trade. According to the Bank for International Settlements (2014), trade finance was involved in $12 trillion out of $18 trillion of exports annually. Empirical evidence suggests that the availability of trade credit affects operational metrics (e.g., capacity utilization, inventory, stockouts) and firm growth (Fisman, 2001; Fisman and Love, 2003). Thus, to evaluate operational performance and make operational decision, it helps to understand how trade credit financing works.

Another motivating example of the link between operations and finance is the financial crisis of 2007–2008. Campello *et al.* (2010) conducted a survey of 1,050 CFOs in 39 countries and found that financially constrained companies planned to cut their spending on investments, technology, marketing, and employment. Garicano and Steinwender (2016) compared the spending of Spanish firms against those of multinational firms, following the financial crisis, and found that Spanish firms, being more capital constrained, had to cut investments, employment, and spending on process innovation. Again, there is clearly a link between finance and operations.

Motivated by these and many other examples, in this monograph we aim to define and describe the research field at the *interface of Finance,*

[1] https://finance.yahoo.com/quote/WMT/balance-sheet?p=WMT.

Operations, and Risk Management (iFORM), provide examples where operations and finance overlap in meaningful ways, outline promising research directions, and reduce the entry cost for anyone who would like to explore this new and exciting research field. The intended audience for this monograph includes both PhD students in operations management (OM), finance, economics, who are looking for dissertation topics, and experienced researchers, who are looking for novel applications of their expertise.

The *Interface of Finance, Operations, and Risk Management (iFORM)* is a research field that studies business problems where finance, operations, and risk management interact in salient ways. In an introductory article to the *M&SOM* special issue, Babich and Kouvelis (2018) offer a sample list of iFORM topics, including Supply Chain Finance, propagation of financial information in supply chains, interactions between financial claimholders and operational claimholders of a firm, risk issues and hedging in commodity procurement.

The long list in Babich and Kouvelis (2018) is far from being exhaustive. It does not explicitly refer to topics in FinTech, such as Blockchain, or to novel entrepreneurial financing options, such as crowdfunding. Both the practice and theory of iFORM are developing rapidly in response to business, economic, and societal trends (e.g., Birge, 2015; Kouvelis *et al.*, 2019, 2020; Pinedo and Xu, 2017). A new field, like iFORM, offers researchers many opportunities for introducing new ideas and for picking "low-hanging fruit."

The following outlines the rest of this monograph. In §2, we compare perspectives of finance and operations on the same topic: the firm. This motivates the key questions in finance, which we present in the finance primer in §3 and key questions in OM, which we present in the OM primer in §4. Having discussed key ideas from these disciplines separately, in §5 we discuss how OM and finance intersect in meaningful ways and suggest several promising research directions. In §6 we present our "dos and don'ts" list for publishing and reviewing iFORM papers. All proofs are in the Appendix. Table 1.1 illustrates the structure of the monograph and summarizes main ideas and tools discussed in finance and OM primers.

Table 1.1: Outline of the monograph, new ideas and tools in finance and OM primers

1 Introduction			
2 The blind men and a firm parable			
3 Finance primer		4 Operations Management primer	
Section	New ideas and tools	Section	New ideas and tools
3.1 Corporate Finance 3.1.1 MM world	A firm as a collection of claims; debt and equity; default on debt; terminology: principal, interest, dividend, stock repurchase; valuation function; perfect capital markets; Modigliani and Miller propositions; cash-flow table; a no-arbitrage proof	4.1 Overview: a struggle to reconcile demand and supply	Supply does not equal demand in real systems; approaches for managing a mismatch
3.1.2 Static tradeoff theory: interest tax shield vs. bankruptcy costs	Corporate taxes; corporate tax shield advantage of debt; bankruptcy; bankruptcy costs; static tradeoff theory between bankruptcy costs and debt tax shield	4.2 Order commitment and the newsvendor model	Overage and underage costs, newsvendor's critical fractile
3.1.3 Moral hazard as financial frictions	Moral hazard with respect to the entrepreneur's private effort; pledgeable capital; moral hazard cost; feasibility condition for external financing; underinvestment in economically viable projects problem; and debt overhang	4.3 Demand risk (or inventory) pooling	Multi-location firm, benefits due to Jensen's inequality, benefits due to reduction in inventory, examples of demand pooling
3.1.4 Other agency problems due to debt	Managers' non-diversifiable investment in their jobs; debt-induced discipline; hold-up problem; risk-shifting incentives	4.4 Little flexibility goes a long way	Partial flexibility, chaining
3.1.5 Asymmetric information as a capital market friction: an overview	The pecking order theory; asymmetric information; assets in place; pooling and separating equilibria; sequential equilibrium; difference between debt and equity contracts; the first-best value	4.5 Dynamic management of resources: inventory and capacity expansion	Risk pooling over time, inventory management and capacity expansion models

Continued.

Table 1.1: Continued

1 Introduction 2 The blind men and a firm parable			
3 Finance primer		4 Operations Management primer	
Section	New ideas and tools	Section	New ideas and tools
3.2 Risk management	Risk definition	4.5.1 Order-up-to inventory policies	Periodic-review model, inventory level, inventory position, order-up-to structure of the policy
3.2.1 Why do corporations manage risk?	Four reasons for corporate risk management; distortion of investments due to capital risk? market imperfections	4.5.2 Balancing fixed and variable costs: (s,S) and EOQ inventory policies	Fixed ordering costs, K-convexity, Economic Order Quantity
3.2.2 Risk-management cycle	Risk-management cycle	4.6 Endogenous sources of variability in supply chain procurement: Bullwhip Effect	A Beer Game, bullwhip effect: causes and consequences
3.2.3 How to measure risk?	The expected utility and risk measures approaches for capturing risk preferences; Value at Risk; Conditional Value at Risk; coherent risk measures	4.7 Contracting in supply chains	Double-marginalization, wholesale price contract, linear contract, affine contract, two- part tariff contract, buyback contract, revenue-sharing contract
3.2.4 How to mitigate risk?	Six responses to risk; hedge ratio, optimal hedge ratio, managerial flexibility, real options	4.8 Mass, lean, and Just-in-Time (JIT) production	Non-value-added work; mass production; lean systems; Just-in-Time production
3.2.5 Corporate risk management using financial markets	Basis risk; derivatives markets	4.9 Quality management	Statistical process control; special causes of variation; common causes of variation; process not in control; fishbone diagram

Continued.

Table 1.1: Continued

1 Introduction 2 The blind men and a firm parable			
3 Finance primer		4 Operations Management primer	
Section	New ideas and tools	Section	New ideas and tools
3.2.6 How to price risk?	Financial vs. actuarial risk pricing	4.10 Pricing, revenue management, and assortment planning; 4.10.1 Pricing	Revenue management; dynamic pricing
3.3 Capital markets: a few key results from the asset pricing theory	Absolute and relative pricing; the fundamental pricing equation; pricing kernel	4.10.2 Capacity controls in revenue management	Yield management; Littlewood's rule; booking limit; protection level; overbooking; network revenue management; bid-price LP
3.3.1 The fundamental pricing equation: economic motivation and derivation	Consumption optimization; Law Of One Price; arbitrage, absence of arbitrage; complete and incomplete markets	4.10.3 Assortment planning	Efficient subsets
3.3.2 Risk-return trade off and factor pricing equations: CAPM	Risk-adjustment; efficient portfolio; efficient frontier; Capital Asset Pricing Model; wealth portfolio; factor models	4.11 Making customers wait: queueing theory	Little's law; M/M/1 queueing system; steady state distribution; system utilization; formulas for the expected number of customers and waiting time; Pollaczek-Khinchine formula for M/G/1 systems; Kingman's approximation for G/G/1 system
3.3.3 Risk-neutral pricing	Risk-neutral measure; equivalent martingale measure; numeraire asset; Arrow-Debreu securities; contingent claims		

Continued.

Table 1.1: Continued

1 Introduction 2 The blind men and a firm parable			
3 Finance primer		4 Operations Management primer	
Section	New ideas and tools	Section	New ideas and tools
3.3.4 Derivatives and derivative pricing	European Call and Put options; Black-Scholes-Merton equation and formula; Put-Call parity		
5 Intersection between OM and finance and promising research directions			
5.1 When does finance matter in OM research?		5.2 When does OM matter in finance research?	
5.1.1 Lack of access to external capital		5.2.1 Supply chain relationships, asset pricing, risk management, and global crises	
5.1.2 Objectives different from the profit maximization or cost minimization		5.2.2 Market micro-structure with frictions	
5.1.3 Agency problems and operational choices		5.2.3 ESG investments, B corporations	
5.1.4 Supply Chain Finance		5.2.4 Operational risk	
5.1.5 FX Risk		5.2.5 Crowdfunding	
5.1.6 Commodities		5.2.6 Blockchain technology	
5.1.7 Financial data as an input into operational decisions			
6 How to write, publish, and referee iFORM papers A Proofs			

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