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Contents

Capacity Planning in the Cloud Computing Industry Under Time and Demand Uncertainties

Shi Chen

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ABSTRACT

The rapid digital transformation of business organizations has catalyzed the unprecedented growth of the public cloud services industry. However, this surge has brought forth formidable challenges for cloud service and infrastructure providers, particularly in capacity planning for data center expansion. Key challenges include the extended and fluctuating lead times coupled with uncertain demand. This monograph elucidates the typical data center capacity planning problem, emphasizing two pivotal challenges: time and quantity uncertainties. We introduce two distinct modeling frameworks, drawing inspiration from two prominent studies in other industries, to tackle these challenges individually. Moreover, we highlight that a comprehensive perspective on cloud capacity planning is needed, advocating for an integrated approach that accounts for both time and demand quantity uncertainties. Such a holistic viewpoint promises to inspire novel and impactful avenues for future research in this domain.

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Fishing for Value (Anchovies Are Not Just for Pizza)

Matthew J. Sobel

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ABSTRACT

Profit optimization is the default criterion in recent literature on the selection of fishery catch sizes. This work contrasts the operational effects of that criterion with those of the optimization of shareholder value. The latter criterion is the valuation of the sequence of monetary payouts received by the owner of the assets used in fishing. The results in the monograph are driven by the need for working capital to bridge the delay between payment of operating costs and receipt of revenue at a later time. The assumptions are reasonably consistent with the Peruvian anchoveta fishery (the world's largest) and have the following implications: if the interest rate on short-term loans is not too high, then working capital should be funded entirely with short-term loans; it is easy to adapt profit-driven practices and research to optimize value; and, although value-optimal escapements generally differ from profit-optimal escapements, they are the same if exogenous uncertainty does not affect the prices or unit costs of catches. Also, the work briefly considers these issues for a fishery (unlike Peruvian anchovetas) that can separately select the size of each age or size class.

Matthew J. Sobel (2024), "Fishing for Value (Anchovies Are Not Just for Pizza)", Foundations and Trends® in Technology, Information and Operations Management: Vol. 18, No. 1, pp 22–43. DOI: 10.1561/0200000114-2.

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Value of Reverse Factoring under Make-to-Order Production Environments

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ABSTRACT

Reverse factoring has received significant attention as a means for small and medium-sized firms to access capital. In this monograph, we explain the value creation mechanism of reverse factoring and derive the value of reverse factoring contracts for firms in make-to-order (MTO) production environments. Empirical and other theoretical work on reverse factoring exists in research literature, but our model constitutes the first analytic treatment of the problem for a pure MTO setting. We show how the value of reverse factoring results from and is conditioned by (1) the spread in deadweight external financing costs, (2) payment period extensions, (3) volatility in cash flows, (4) working capital policy, and (5) the risk-free interest rate. Thus, in addition to providing managerial insights on value reverse factoring

Fehmi Tanrisever, Matthew Reindorp, Hande Cetinay and Jan C. Fransoo (2024), "Value of Reverse Factoring under Make-to-Order Production Environments", Foundations and Trends® in Technology, Information and Operations Management: Vol. 18, No. 1, pp 44–83. DOI: 10.1561/0200000114-3.
Online Appendix available from: http://dx.doi.org/10.1561/0200000114-3_app

contracts, our findings disclose an important relation of these elements to the broader macroeconomic context.

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Outsourcing as a Risk Management Mechanism for Domestic Manufacturing Capacity Investment

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ABSTRACT

We propose two perspectives on the shift from U.S. domestic manufacturing to Asia in 1990–2011: production cost arbitrage and the management of supply-demand mismatch. In our model, a firm facing demand uncertainty decides between investing in domestic or overseas production capacity. The model predicts greater investment overseas when the cost arbitrage is high, switching cost is low, demand volatility is high, and the systematic risk in demand is above a certain threshold. Empirically, we observe strong support for the cost arbitrage motive in 1990–2000 and the risk management motive in 2001–2011, i.e., after China's entry into the WTO. We estimate that investing into risk mitigation could have saved more than 400,000 U.S. manufacturing jobs.

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Appendix

Table A.1: Model variables

Variable	Definition	Source
Log-employment	$\ln(\text{Emp}_{it})$	ASM
Log-production hours	$\ln(\text{ProdH}_{it})$	ASM
Volatility	St. Dev. of daily VWRETD in a year	CRSP
Beta	Regression of daily portfolio returns on the VWRETD in a year	CRSP
R-index	Redeployability index	Kim and Kung (2016)
PPI	Annual measure	NBS China
China FX reserves, YoY change	$1 - \text{FXR}_{t-1}/\text{FXR}_t$	PB China
Labor cost	$(\text{Annual Pay})_{it}/\text{EMP}_{it}$	ASM
Labor intensity	$(\text{Annual Pay})_{it}/$ $(\text{Value of Shipments})_{it}$	ASM
Skill intensity	$\ln(1 - (\text{Production Workers})_{it}/$ $\text{EMP}_{it})$	ASM
Gross margin	$(\text{Value Added}_{it} - \text{Annual Pay}_{it})/$ $(\text{Value of Shipments})_{it}$	ASM
Share of imported intermediate inputs (siii)	$(\text{Value of imported intermediate inputs}_{it})/$ $(\text{Total value of inputs}_{it})$	BEA
China's share of final demand	$\text{Cons}_{it}^{\text{Chn}}/(\text{Cons}_{it}^{\text{Chn}} + \text{Cons}_{it}^{\text{US}})$	WIOD
Predicted PNTR losses	Year-by-year regression of centered rec on NTR gaps for years 2001–2007	Pierce and Schott (2016)
TFP5-growth	$\text{TFP5}_{it} - \text{TFP5}_{i,t-1}$	NBER-CES, Becker *et al.* (2013)

Table A.2: The results for dynamic panel estimates

Variables	(1) 1990–2000	(2) 2001–2011	(3) 1990–2000	(4) 2001–2011	(5) 2001–2018
Volatility	−0.1342***	−0.1505***	−0.0330	−0.0491**	−0.0642***
	(0.0358)	(0.0198)	(0.0411)	(0.0235)	(0.0235)
Beta	0.0233***	−0.0374***	0.0181***	−0.0197	−0.0225***
	(0.0074)	(0.0074)	(0.0068)	(0.0126)	(0.0066)
1(betahigh)				0.0019	
				(0.0182)	
Beta ∗ 1(betahigh)				−0.0201	
				(0.0162)	
PPI	0.0005***	0.0032***	0.0005***	0.0016***	0.0002
	(0.0002)	(0.0004)	(0.0002)	(0.0004)	(0.0004)
R-index	−0.6004***	−0.6313***	−1.0295***	−0.1085	−0.0566
	(0.1213)	(0.1246)	(0.1804)	(0.2560)	(0.2582)
Margin			−0.3324***	−0.4120***	−0.4211**
			(0.1239)	(0.1176)	(0.0959)
Labor cost			0.0001	−0.0017∗	−0.0024***
			(0.0009)	(0.0009)	(0.0007)
Labor int.			0.9221***	−0.1636	−0.3248
			(0.2014)	(0.1802)	(0.2020)
Skill int.			−0.0355	0.0883***	0.0265
			(0.0305)	(0.0174)	(0.0220)
Imp.Int.Input				0.0151***	0.0174***
				(0.0018)	(0.0018)
Loss_PNTR				0.7669∗∗∗	0.8228***
				(0.1641)	(0.1887)
China demand			−0.0003	−0.0001	−0.0004
			(0.0006)	(0.0006)	(0.0006)
TFP5-growth			0.5563***	0.4388***	0.3701***
			(0.0807)	(0.0641)	(0.0500)
ln(Emp) = L,	1.0552***	0.9531***	1.0521***	0.9833***	0.9991***
	(0.0189)	(0.0091)	(0.0236)	(0.0115)	(0.0126)
Observations	5171	5,203	5,171	5,203	6612
Number of iid	473	473	473	473	473

Notes: Robust standard errors in parentheses.
$^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table A.3: Employment in year 2001, actual employment changes from 2001 to 2011, total and attributable to high demand volatility and systematic risk

NAICS3	Name	Emp(2001) (Thousand)	Emp(2011)-Emp(2001) (Thousand)	Losses Due to Syst. Risk	
				%	(Thousand)
331	Primary metals	531.8	−161.8	25.4%	41.1
321	Wood products	556.5	−233.2	15.3%	35.8
327	Nonmetallic mineral products	506.9	−172.1	14.8%	25.4
335	Electrical equipment and appliance mfg.	553.4	−226.1	12.0%	27.1
333	Machinery	1317.2	−353.7	11.9%	42.1
336	Transportation equipment	1713.6	−474.8	10.2%	48.4
332	Fabricated metal products	1722.0	−446.2	8.3%	36.9
314	Textile product mills	208.9	−102.6	7.7%	7.9
325	Chemicals	874.4	−187.7	7.6%	14.2
337	Furniture and related products	608.1	−286.6	7.5%	21.4
334	Computer and electronic products	1580.6	−773.2	6.8%	52.9
313	Textile mills	296.0	−194.2	5.8%	11.2
323	Printing and related support activities	798.6	−342.9	4.3%	14.9
322	Paper	530.2	−183.7	4.3%	7.9
326	Plastics and rubber products	1028.2	−351.5	2.7%	9.4
324	Petroleum and coal products	101.9	−2.8	2.5%	0.1
315	Apparel	454.5	−360.8	2.4%	8.6
339	Miscellaneous manufacturing	727.5	−170.8	1.7%	2.9
316	Leather and allied products	61.3	−34.1	0.6%	0.2
311	Food	1496.5	−150.3	0.0%	0.0
312	Beverage and tobacco products	177.5	−38.2	0.0%	0.0
31–33	All manufacturing	15845.6	−5247.3	7.8%	408.2

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Multi-Objective Assortment Optimization: Profit, Risk, Customer Utility, and Beyond

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ABSTRACT

Assortment optimization is a fundamental challenge in revenue management, aiming to offer a subset from all products on hand to maximize expected revenue. However, businesses often face multiple goals that go far beyond revenue, and these goals are sometimes even in conflict with each other. In this study, we introduce a comprehensive framework and a new reformulation technique for tackling multi-objective assortment optimization problems. We focus on the sum of multiple convex objective functions (i.e., the tradeoff between distinct objectives), and we propose a reformulation that effectively "linearizes" the problem. We demonstrate that this reformulated problem is equivalent to the original

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and provides a unified solution approach for various multi-objective contexts. Our method covers a broad range of operational objectives, such as risk, customer utility, market share, costs with economies of scale, and dualized convex constraints. We analyze the multi-objective problem in the context of the multinomial logit model, the nested logit model, and the Markov chain choice model, and demonstrate the efficiency and practicality of our approach through extensive numerical experiments. Our work presents a powerful and versatile tool for addressing multi-objective assortment problems frequently encountered in real-world revenue management scenarios.

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Empowering Economic Growth: Government Loans for Supply Chains in Emerging Markets

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ABSTRACT

MSMEs (Micro, Small and Medium Enterprises) play a crucial role in emerging markets, despite facing various challenges that impede their growth and success. One primary challenge is the limited access to affordable financing programs. A typical policy intervention is providing affordable government loans to these MSMEs. Motivated by the Indian example, we develop a game-theoretic model to investigate the interaction between the cash-constrained manufacturer and retailer in the context of interest-free government loans. Our research yields the following main insights. First, the value of trade credit can demonstrate both complementary and substitutional relationships with the government loan budget, contingent on the level of the government loan budget. Second, while the government loan consistently enhances the manufacturer's profit, it may adversely impact the retailer. Finally, in the design of a loan policy, it may be more beneficial for social welfare if the government retains some

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of the loan budget rather than lending the entire available amount to the supply chain.

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