

“I’m not hoarding, I’m just stocking up before the hoarders get here.” Behavioral causes of phantom ordering in supply chains



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ABSTRACT

When suppliers are unable to fill orders, delivery delays increase and customers receive less than they desire. Customers often respond by seeking larger safety stocks (*hoarding*) and by ordering more than they need to meet demand (*phantom ordering*). Such actions cause still longer delivery times, creating positive feedbacks that intensify scarcity and destabilize supply chains. Hoarding and phantom ordering can be rational when customers compete for limited supply in the presence of uncertainty or capacity constraints. But they may also be behavioral and emotional responses to scarcity. To address this question we extend Croson et al.'s (2014) experimental study with the Beer Distribution Game. Hoarding and phantom ordering are never rational in the experiment because there is no horizontal competition, randomness, or capacity constraint; further, customer demand is constant and participants have common knowledge of that fact. Nevertheless 22% of participants place orders more than 25 times greater than the known, constant demand. We generalize the ordering heuristic used in prior research to include the possibility of endogenous hoarding and phantom ordering. Estimation results strongly support the hypothesis, with hoarding and phantom ordering particularly strong for the outliers who placed extremely large orders. We discuss psychiatric and neuroanatomical evidence showing that environmental stressors can trigger the impulse to hoard, overwhelming rational decision-making. We speculate that stressors such as large orders, backlogs or late deliveries trigger hoarding and phantom ordering for some participants even though these behaviors are irrational. We discuss implications for supply chain design and behavioral operations research.

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1. Introduction

During World War II, as the Allies faced shortages of food and basic goods, hoarding became a serious threat. A cartoon at the time showed a stern store manager confronting a shopper attempting to buy dozens of cans of food despite rationing. Caught red-handed, the shopper says, “I’m not hoarding, I’m just stocking up before the hoarders get here.” Is such behavior a rational, if anti-social, response to scarcity, or an emotional reaction driven by fear and panic?

Hoarding, defined here as attempts to accumulate large private stocks of goods when people perceive threats to supply, is closely related to phantom ordering in which people react to uncertain supply by ordering more than they actually desire, or ordering from

multiple suppliers, then planning to cancel their excess orders once they get what they desire. Not limited to wartime, hoarding and phantom ordering remain persistent, destabilizing and costly phenomena in supply chains. For example, during the great technology boom of the late 20th century, firms such as Cisco Systems, Lucent, Nortel, and JDS Uniphase experienced huge surges in incoming orders. Deliveries could not keep pace. Customers were placed on allocation, receiving only a fraction of what they ordered. Desperate for product, many customers ordered still more, often placing orders through multiple channels—in some cases, three or more times the number of units they actually desired (Goetz, 2005). These phantom orders further inflated backlogs, causing still longer delivery times and smaller allocations, a positive feedback that intensified scarcity. After a lag, production increased and allocations were eased. Suddenly able to get all the product they wanted, customers cancelled their phantom orders, leaving suppliers with huge excess stocks, excess capacity and deep losses. Cisco was forced to write off \$2.2 billion in excess inventory. Others fared far

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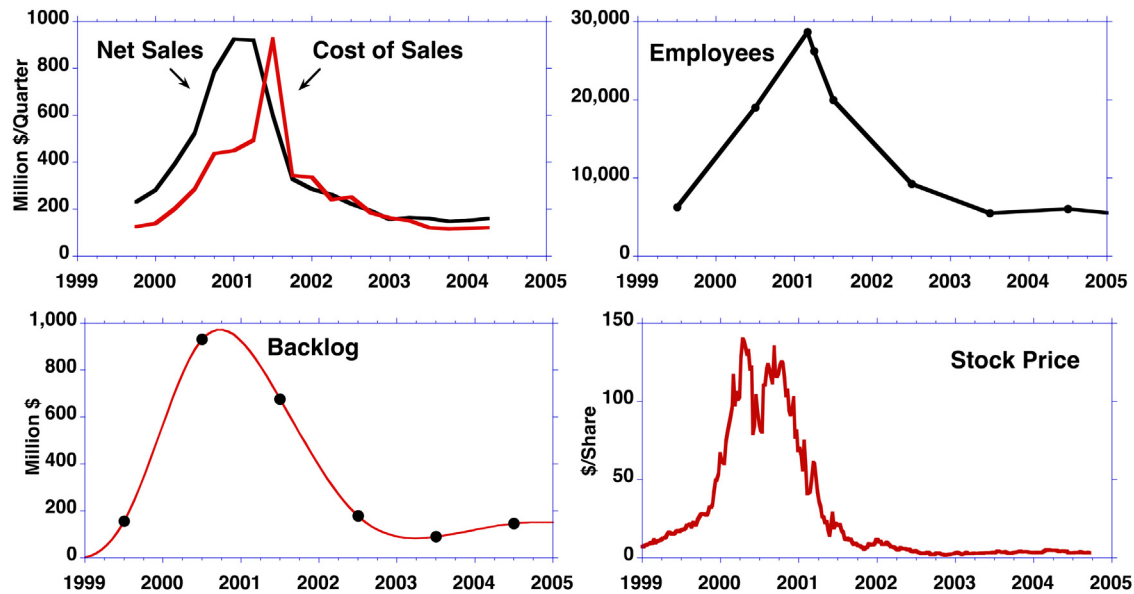


Fig. 1. JDS Uniphase: Sales, cost of goods sold, backlog, employees and stock price. Source: 10K, 10Q, and Annual Reports. Cubic spline between data points for backlog.

worse. During the boom, the order backlog of equipment maker JDS Uniphase exploded, rising 3000% from mid 1998 to mid 2000 (Fig. 1). Sales quadrupled between the end of 1999 and beginning of 2001. Uniphase expanded capacity and employment dramatically. As output grew and product became available, new orders dried up and customers cancelled orders. Backlog collapsed, and sales fell 83% by the end of 2002. Uniphase cut employment by more than 23,000 (81%) and saw its stock price fall 99%.

Prior research offers two categories of explanation for hoarding and phantom ordering, and supply chain instability generally: *operational* and *behavioral*. Operational theories focus on the physical and institutional structure of supply chains, while assuming that decision makers are rational agents who make optimal decisions given their local information and incentives. Physical structure includes the network linking customers and suppliers and the placement of inventories and buffers within it, along with capacity constraints and time delays in production, order fulfillment, transportation, and so on. Institutional structure includes the degree of horizontal and vertical coordination and competition among firms, the availability of information, and the incentives faced by each decision maker. Behavioral explanations also capture the physical and institutional structure of supply chains, but view people as boundedly rational actors with imperfect mental models of the environment who use heuristics to make decisions (Morecroft, 1985; Sterman, 2000; Boudreau et al., 2003; Gino and Pisano, 2008; Bendoly et al., 2010; Croson et al., 2013). These heuristics may yield excellent or suboptimal results depending on the complexity of the situation (Simon, 1969, 1982). Behavioral explanations also recognize that decision framing can alter decisions (Kahneman et al., 1982), that situational factors such as time pressure and poverty consume scarce cognitive resources that can lead to poor decisions (Shah et al., 2012) and that decisions made in conditions of stress can be strongly conditioned by fear, anger, and other psychophysiological reactions (Lo and Repin, 2002; Rudolph and Reppenning, 2002).

Are hoarding and phantom ordering rational, strategic responses to scarcity, or emotional, behavioral reactions triggered by stress? What may look like hoarding and phantom ordering could be rational responses to scarcity, particularly when there is

uncertainty about final demand, supplies are subject to stochastic shocks and interruptions, capacity constraints may limit production, the consequences of shortages are high, storage and order cancellation costs are low, and multiple customers compete for limited supplies (Lee et al., 1997; Cachon and Lariviere, 1999; Armony and Plambeck, 2005).

Alternatively, scarcity may cause stress, anxiety, fear or panic, leading people to build their private stocks or place orders for more than they need even when it is not rational to do so. To illustrate, gasoline supply disruptions have sometimes caused retail service stations to run out, leading to “Sorry—No Gas” signs; episodes include the 1979 gas crisis in the US, transport strikes in Europe in 2000, and the aftermath of Superstorm Sandy on the east coast of the US in 2012. In each case, gas shortages led people, including many with nearly full tanks, to queue for fuel, often for hours; the long lines themselves then increased the perception of shortage in a positive feedback. For example, after Superstorm Sandy,

“... drivers waited in lines that ran hundreds of vehicles deep, requiring state troopers and local police to protect against exploding tempers.

... The lines themselves only exacerbated the problem; reports in the local media provoked drivers to buy gasoline before stations ran out. Some spent what fuel they had searching for more and could be seen pushing vehicles toward relief.

‘I just want to have it, because you don’t know how long this is going to last,’ said Richard Bianchi, waiting in the half-mile line at the Sunoco in Union [New Jersey] with a tank that was three-quarters full.

‘People are panicking,’ said Jimmy Qawasmi, the owner of a Mobil in the Westchester County town of Mamaroneck.”¹

Of course any situation may involve a mix of strategic, rational action and behavioral, emotional responses, and it is difficult to disentangle the contribution of each in naturalistic settings. Here we explore the extent to which hoarding and phantom ordering are behavioral phenomena through an experimental study using the

¹ New York Times, 2 November 2012, <http://www.nytimes.com/2012/11/02/nyregion/gasoline-shortages-disrupting-recovery-from-hurricane.html>.

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