



DOES THE BULLWHIP STILL STRIKE?

DETECTING VARIABILITY IN THE SUPPLY CHAIN

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Most operations and supply chain managers have been confronted with the “bullwhip effect”. The term was first coined by Procter & Gamble (P&G) to describe an occurrence observed in baby diapers. While end-consumer demand for diapers was relatively stable, P&G noticed a large variability in the orders placed upstream in the supply chain (i.e. to suppliers). Subsequently, the bullwhip effect has been defined as the phenomenon whereby demand variability is amplified upstream in the supply chain (from customer to supplier)¹ – see Figure 1.

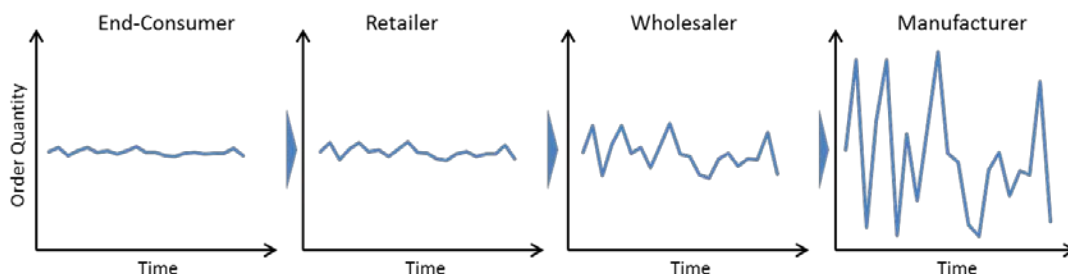


Figure 1. The bullwhip effect refers to the phenomenon whereby orders become more variable upstream in the supply chain.

The bullwhip effect is known to cause great inefficiencies and costs through excess inventory, lost revenues, superfluous capacity or poor customer service. For these reasons, the phenomenon has received strong attention from both researchers and practitioners for almost two decades. Hence, we now know a great deal of the factors that cause the bullwhip effect and what we can do to reduce it.

Over the past decade firms have made significant investment to counter the bullwhip effect in the forms of more elaborate IT systems and collaborative efforts. POS data sharing systems, Vendor Managed Inventory (VMI) and Collaborative Planning, Forecasting and Replenishment (CPFR) are examples of such programs. Various case studies have illustrated their success in increasing operational efficiency. So, *where do we stand today? Does the bullwhip still strike?*

The answer, according to our research², is a resounding YES! In a study of 15,000 firms over a period of 36 years *we observe no significant decrease in the bullwhip effect over time*. This is both surprising and worrying given recent company efforts. Have these efforts been in vain or are there additional factors at play that off-set any progress made over the years? One explanation might lie in recent trends linked to globalization and an increasingly complex market place.

During the past two decades firms have been exposed to higher product variety, shorter shelf-lives and an increased dependency on supply chain partners³. Additionally, outsourcing is a widespread practice that increases lead time and limits the possibility of information sharing.

The good news is that not all firms bullwhip. The orders from the average firm to its suppliers are 90% more variable than incoming demand². However, there are large variations across firms and industries, suggesting that it is indeed possible to dampen, or even quench the bullwhip. In general, firms that are further away from the end-consumer exhibit a stronger bullwhip effect. This supports the idea that a lack of demand visibility is an important underlying cause.

¹ Lee, H. L., V. Padmanabhan, S. Whang. 1997. Information distortion in a supply chain: The bullwhip effect. *Management Science* 43(4) pp. 546-558.

² Isaksson, O. H. D. and R. W. Seifert (2015) “Quantifying the Bullwhip Effect Using Two-Echelon Data: A Cross-Industry Empirical Investigation,” forthcoming in the *International Journal of Production Economics*.

³ PwC (2013), PwC and the MIT Forum for Supply Chain Innovation: Making the right risk decisions to strengthen operations performance, <http://www.pwc.com/gx/en/operations-consultingservices/publications/supply-chain-risk-management.jhtml>.

Table 1. Generic causes of the bullwhip effect and potential mitigation strategies¹.

Bullwhip cause	Mitigation Strategy
1) Batch ordering occurs due to economies of scale (fixed ordering costs) and positively correlated demand (e.g. seasonalities).	<ul style="list-style-type: none"> Reduction of fixed ordering costs through electronic data exchange and consolidated truck loading. Regular delivery schedule to cope with correlated demand.
2) Forecasting errors occur when true is distorted due to repetitive forecast with limited visibility of end-demand.	<ul style="list-style-type: none"> Information sharing (Point-of-Sales data). VMI, CPFR. Lead time reduction.
3) Price fluctuations incentivize firms to build up stocks when prices are low.	<ul style="list-style-type: none"> Everyday low prices (price guarantee). Purchase contracts.
4) Shortage gaming occurs when firms inflate orders to anticipate a shortage in the market.	<ul style="list-style-type: none"> Allocating scarce products based on past sales. Capacity reservation.

So, what can be done? In light of the aforementioned discussion, managers need to take a step back and think about how traditional bullwhip mitigation strategies have been affected by recent trends. Practices such as outsourcing can reduce costs on the short term, but certain bullwhip mitigation strategies, like real-time information sharing, might be less viable with an overseas supplier.

In today's global economy, margins are put under pressure and the supply chain, not the firm, is increasingly seen as the unit of competition. Although demand amplification to suppliers might not have a direct effect for the focal firm, it can rebound in the form of higher costs and a decrease in service and quality.

Overall it is important to keep in mind that:

- The bullwhip effect is still widely present and continues to cause great inefficiencies.
- Mitigation strategies to counter the bullwhip effect have been successfully deployed by some companies but risk being counteracted by recent trends that increase demand variability and supply chain complexity.
- This situation creates a trade-off which managers need to balance with care: On the one hand, recent trends can lead to reduced costs and stronger sales. On the other hand, the same trends can cause great inefficiencies and potential supply chain disruptions.

Operations and supply chain managers should continuously monitor if their company's supply chain suffers from a bullwhip effect. Being well aware of it doesn't mean that you have conquered it. All too often it is a moving target and detecting artificial demand variability instead of investing in more sophisticated forecasting systems or more manufacturing capacity may ultimately win the day.

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