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Industrial Production and Lead-Time

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Suzanne de Treville is a Professor of Operations Management at the University of Lausanne and is Head of the OpLab.
She obtained her Doctor of Business Administration in operations management from the Harvard Business School. Her research has been published in top management journals and her core research interest lies in using the option value of demand volatility to strengthen manufacturing in developed economies.

Executive Summary
Sustainable growth and low unemployment in Switzerland relies on banks' willingness to support onshore manufacturing. Globalization and foreign exchange have put tremendous strain in 2015 on the competitiveness of the Swiss production sector, ranging from watch makers to automotive suppliers and medical device makers. Financial and credit analysts, loan officers, and investment managers have been concerned with the impact of globalization and the strength of the Swiss Franc on firms' valuation, growth outlook, and credit worthiness. On January 15 alone, the Swiss franc soared 13% and stocks tanked by more than 10% at one point when the SNB scrapped the euro peg. The fears of economic repercussions have been widespread, as "many businesses and investment decisions might not be seen as viable anymore and over time a significant volume of economic production could move outside the country." Some even feared a "tsunami" for Switzerland. But the truth is the ramifications have been far less severe.

Recent research by Schürhoff and de Treville points out why Swiss manufacturing is far more flexible than financial analysts recognize in their spreadsheet models. And, not all manufacturing firms are hit alike by the crisis. Some manufacturers can cope more effectively than others with the pressure to improve production efficiency. The research highlights that analysts should focus their impact analysis on the supply chain and production flexibilities for each industrial sector, and that the sources of value creation are tightly linked to firms' supply chain.

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de Treville (UNIL) created the OpLab (Operations Laboratory at the University of Lausanne) to make Schürhoff's (SFI@UNIL) and her research insights and tools available to managers and policy makers. They give us their insight on the current challenges of onshore industrial production and where the future lies.

Does onshore industrial production still have a future and in which way does it need to evolve?
Although it has generally been agreed that short lead-times have value, over the past two decades manufacturing companies in the developed world have tended to focus on cutting costs rather than looking for innovative ways to create value. This creates a vicious circle: to cut costs, firms seek to standardize and modularize their products to reduce demand-volatility exposure and permit high capacity utilization. But, in manufacturing the products that emerge from this cost-cutting exercise these firms make themselves vulnerable to low-cost offshore producers. First the manufacturing is lost, then innovation follows manufacturing. Quantitative tools are used in finance to capture the value in volatility. The same can be done in the supply chain. Switzerland's competitive advantages such as innovation, quality, and ability to solve customer problems create opportunities for high-margin products whose high demand volatility makes it prohibitively expensive to produce them far away on low-cost but inflexible production lines. This option value, if properly captured, leaves enough money on the table to pay Swiss workers correct salaries and reward them for their expertise.

How can this be achieved?
Using demand volatility to create value requires a combination of capturing option value and creating appropriate portfolios of products. Incorporation of option value into the location decision for high-volatility products makes it obvious to decision makers that local manufacturing may well dominate offshore but unresponsive production. What is less obvious is that such high-volatility products must be produced in combination with products that are less time sensitive. Responsiveness depends on a capacity buffer that may well be several times median demand for the time-sensitive products. The product that is not time sensitive—that is, can be made to stock without quickly losing value—can be used to fill the capacity buffer. This low-volatility product benefits from the innovation that spawns its high-volatility partner, effectively closing off the market to low-cost but unresponsive competition.

What knowledge needs to be transferred over to firms and can it be done in a quick and efficient manner?
Managers need the ability to think in a counterintuitive and nonlinear way in order to tease out this large but hidden value. It is not difficult to implement what our models show. What is more difficult is to be willing to think a couple of moves ahead, rather than go with intuition. We are finding that managers with some exposure to quantitative finance are particularly adept at understanding what the models show and putting it into practice.

OpLab has already collaborated with major Europe-based companies such as Nissan Europe, GSK Vaccines, and Nestlé Switzerland. We are also collaborating with the Groupement Industriel Suisse de l'Industrie Mécanique (GIM-CH), where teams of students have applied our models to companies in the industry that are seeking how to remain competitive with the strong Swiss franc. We are able to show that when a product portfolio is correctly developed, it is possible to produce profitably and competitively in Switzerland without being concerned about the strength of the Swiss franc.

We are developing training materials at all levels. Much of the material is taught in our pre-experience Master of Science in Management program. We are currently considering development of a MOOC (Massive Open Online Course) to get practitioners up to speed as quickly as possible. We are also considering creating a working

group for managers to meet regularly to implement these tools with the support of quantitatively trained masters students.

The challenging currency situation that now exists for Switzerland has had the positive effect of making Swiss industrials open to trying new things, and move away from their business-as-usual model. The SFI is perfectly suited to transfer the knowledge created by OpLab across the country given its ability to reach a large number of industry contacts via its knowledge center, as well as its strong academic credibility that results from its faculty.

To view Norman Schürhoff's and Suzanne de Treville's profiles, please visit:
http://www.sfi.ch/schuerhoff and
www.hec.unil.ch/people/sdetreville

Offshore Production and Valuing Lead-Time

Introduction

In two recently published articles Norman Schürhoff (SFI@UNIL), Suzanne de Treville (UNIL), and co-authors revisit the production-location decision using applied quantitative-finance techniques. The unit price offered by a distant supplier may seem compellingly low, although such offshoring increases the time between deciding what will be produced and knowing what demand will be. We also know that when we don't have a good idea of what demand will be—when the demand variability is high—the task of matching supply to demand is difficult. The production quantity has to balance the cost of stocking out with the cost of being stuck with unsold inventory. As demand variability increases, so does the mismatch cost. Although managers recognize qualitatively that lead-time has a cost, this qualitative realization has not provided sufficient warrant to turn down the apparently compelling cost differentials offered by low-cost suppliers.

> "Banks could help fuel a Swiss industrial comeback by supporting local firms that exploit the specificities of option value and create product portfolios."

Motivation and Research Question

So when can a local producer, who produces based on accurate demand information because of short lead-times, compete against a more competitive offshore supplier with longer lead-times? In order to determine when a local (short-lead-time) producer can be competitive, we need to be able to quantify the impact of increased lead-time. Quantitative finance provides a reasonable approach to capturing how demand variability increases as lead-time gets longer. Managers tend to have a good understanding of how demand variability increases as the time between when the order decision is made and when demand is known increases. The simplest case—corresponding to Black-Scholes option pricing—is that demand volatility increases with the square root of the lead-time. If lead-time increases four fold, from 10 days to 40 days, demand volatility under this scenario will double. There are also cases where as the lead-time increases, demand information no longer arrives in a steady flow, but may be batched because of logistical considerations or promotional campaigns. Here, the forecast-evolution process can be captured using a Heston option-pricing model. A third scenario concerns jumps in demand, which can be captured using the jump-diffusion option-pricing model developed by Merton.

Dynamic Supply Chain Modelling - Cost Differential Frontier

Once we know which forecast-evolution process applies, we are able to quantify the cost of an increase in lead-time with respect to mismatch cost. The marginal value (or cost) of time is estimated using real-option modeling; results can be plotted with an indifference frontier between made-to-order and long-lead-time productions. This cost-differential frontier yields the minimum discount the offshore industrial must offer to compensate for demand-volatility exposure.

> "Financial investors should focus on industrial firms that exploit the expertise of the OpLab."

The on-line interactive tool requires five key parameters (price, make-to-order cost, residual value, minimum service level, and volatility) to plot the cost-differential frontier. The required cost differential is the percent that the cost of acquiring the product from a long-lead-time supplier must be less than the make-to-order cost just to compensate for the increase in demand-volatility exposure. Note that the estimated cost-differential frontier is actually a lower bound when one estimates the marginal cost of time; logistical, quality, and loss of intellectual property issues will further increase the cost of offshoring.

Although the quantitative-finance reasoning is nonlinear and counterintuitive, the online app makes the results accessible to managers with reasonable skills in business analytics. Incorporating the option value into the decision dramatically changes the relative attractiveness of local production.

OpLab – Operations Laboratory at UNIL

The OpLab, with which Schürhoff collaborates and which de Treville leads, focuses on finding academically sound solutions to help industrial groups. As of today, OpLab has shared knowledge with both North American and European industrials.

The Cost-Differential Frontier—developed by Schürhoff and de Treville and available online—is being widely diffused by the United States Department of Commerce as part of the Assess Costs Everywhere (ACE 2.0) initiative. Results demonstrate where and how onshore production remains a valuable option as manufacturing in the United States gains momentum. Understanding the twists and turns of industrial production in Switzerland is equally important.

> "Industrials that exploit the expertise of the OpLab will find the path to higher profits and see their financial value rise."

On the one hand, Switzerland boasts outstanding levels of human capital among its engineers and industrial workers, and industrial production represents a significant share of the country's large positive balance account; on the other hand, this workforce comes with high salary expectations and its exports are largely exposed to foreign exchange rate fluctuations.

The change in Switzerland's FX policy makes the lessons from Schürhoff and de Treville's research even more relevant, as it demonstrates that the option value of flexibility far outweighs the impact of currency fluctuations.

Link:
- cdf-oplab.unil.ch
For more details see:
- acetool.commerce.gov/inventory and
- acetool.commerce.gov/toolbox

Case Studies – Empirical Learnings

The authors have worked closely with major industrial companies producing goods that vary with respect to demand volatility and forecast-evolution regimes. When a company faces high demand volatility—especially for a product that does not retain its value well if not sold during the demand period—it is easy to use the cost-differential frontier to demonstrate that long lead-times may well cause mismatch costs that exceed the cost differential offered.

> "Industrials have a unique opportunity to find the path to higher profits and see their financial value rise."

The work done in these industrial companies shows that lead-time may be costly even for products that at first glance have low volatility and high residual value. Nissan Europe—following the standard "lean production" practice of freezing their production schedule eight weeks before demand is observed—learned that the increase in volatility exposure was likely to cost much more than the efficiency gains from freezing the production schedule.

Nestlé Switzerland learned how demand clustering generated by a promotional campaign caused a low volatility, long shelf-life product to have high salvage losses. GSK Vaccines learned that cost-reduction efforts that extended lead-times were resulting in particularly high mismatch costs, leading management to set lead-time reduction as a primary priority. These results have important implications for competitive manufacturing in a high-cost location like Switzerland.

Production Promotion

Expectations about the profit potential in offshoring to a producer in a low-cost but distant country peaked with the accession of China to the WTO early this millennium. A considerable portion of industrial production shifted to Asia. Fifteen years later, it has become clear to managers across the developed world that the expected gain in profits has simply not materialized. Meanwhile, the economic cost to regions that have lost their manufacturing has been huge. The US, for example, lost a third of its manufacturing jobs during this period. Schürhoff and de Treville's work has added traction to US policy efforts to support reshoring, and there is general agreement that manufacturing is returning to developed countries.

> "Fifteen years later, it has become clear to managers across the developed world that the expected gain in profits has simply not materialized."

Conclusion

The message to managers is surprising and refreshing. After decades of eliminating demand volatility in search of ever-lower cost, taking a quantitative-finance approach to supply-chain planning shows managers how to create value from volatility, and how to value the options emerging from volatility so as to make better decisions. The first take-away is that high volatility, low-residual-value products should be made close to the market with short lead-times.

Many Swiss companies stop there, producing these high-volatility products domestically but shipping low-volatility products to low-cost offshore producers. Many of these companies are facing severe economic difficulties. Fully exploiting option value requires very fast response, which in turn requires free capacity that can be deployed to meet demand peaks when they occur.

The second take-away is that managers should identify and develop low-volatility products that can fill the capacity available to enable the production of time sensitive goods. How to create an ideal portfolio of products and their related options is the topic of Schürhoff and de Treville's ongoing research.

To download the full papers, please visit:
- Production and Operations Management or SSRN
- Journal of Operations Management or SSRN.

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SFI NEWS

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12.11.2015
SFI 10th Annual Meeting, Opportunities in Asset Management, Zurich

03.12.2015
Stresses and Strains on China's Financial System, Prof. Darrell Duffie, Zurich

SFI Advanced PhD Course

Prof. Darrell Duffie, Stanford University, will be giving an SFI advanced PhD course in Financial Benchmarks and Price Transparency in Over-the-Counter Markets at EPFL from December to March 2016. Course is open to all PhD candidates

More info http://bit.ly/1E9Djkl

SFI Practitioner Roundups

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Martin Hoesli
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Felix Kübler and Karl Schmedders
Secondary Buyouts—Creating or Destroying Value for Investors?
François Degeorge

More info http://bit.ly/1MyIp7A

Forthcoming A Publications

The Euro Interbank Repo Market, **L. Mancini**, A. Ranaldo, and J. Wrampelmeyer, *Review of Financial Studies.*

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