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Searching For Signs of Technological Innovation In The Ruins of the American Economy

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Introduction: Does The "S" Curve Explain Anything About American Technological Innovation?

I always enjoy listening to the historian Doris Kearns Goodwin when she appears on NPR or MSNBC to discuss her historical interpretation of American presidents. I like listening for the underlying tension in her presentation about the appropriate timing for a historian to enter her judgment of history on a contemporary president.

The radio and television hosts are always trying to goad her and trick her into offering her historical judgments on the current occupant of the White House prematurely. This is like the delicacy of talking badly too soon about a recently departed, exactly how long does a person need to wait before offering their judgment of history?

Goodwin always obliges and delights her liberal listeners by opening up her historical kimono just enough to let her audience see that she thinks the "judgment of history" may not be kind to the current occupant of the White House.

I had been thinking about this topic in my deliberations on how the concept of the S curve of technology could be used to offer a judgment on the collapse of the American economy. My dilemma, like Goodwin's, is that it may be too soon to offer a definitive economic assessment.

There are still many economic forces actively at work outsourcing the technological innovation capacity of the American economy. Even with the help of the S curve, it may be too soon to write the economic analysis of what went terribly wrong for America's experience in the free trade global economy.

I wondered if following the S Curve backwards in time could be used to explain why outsourcing innovation caused the American economy to lose its ability for radical product innovation. Using current economic theory with supply and demand curves and marginal rates of efficiency somehow seems inadequate if the end state to be explained is economic extinction and not equilibrium.

In evolutionary theory, what currently exists today could easily have been something else if some earlier genetic crossover had occurred. For example, would the S curve be useful in predicting where the American economy would have been in 20 years from now if the multi national corporations had not begun outsourcing America's technological innovation capacity around 1985?

Or, alternatively, can the S curve be used to look back in time to explain how the early decisions, around

1985, to outsource corporate innovation to India began the American economic decline? The series of speculative bubbles since then has tended to mask the underlying fundamental weakness of the economy, which is related to inadequate rates of domestic innovation and, consequently, inadequate market demand in America's internal domestic industrial supply chains.

Perhaps, it would be enough simply to use the S curve to explain why the vacuous phrases like "transition to a knowledge economy," or remaining "globally competitive," are such barren platitudes about the disastrous effects of free trade when it is the nation's capacity for innovation that is being freely traded away.

In the absence of domestic technological innovation, America's initial factors of production, its cultural values of innovation and individual initiative, can not perform their economic function of creating new markets. New markets result from radical innovation, and cause the creation of new streams of wealth and new paths of upward occupational mobility for citizens at the lower ends of the income ladder.

Following the S curve backwards may help in identifying the time when the citizens of America began their transition from working in an innovation economy to subsisting in a third world welfare state.

Following the S curve forward provides clues to the much need economic revitalization of technological innovation in America, especially the metro regional economies that are being gutted by free trade.

What Would The S Curve Say?

In their research article, "*Technological Evolution and Radical Innovation*," Ashish Sood and Gerard J. Tellis (Journal of Marketing, Vol. 69 July 2005), begin by mentioning the conventional wisdom associated with the S curve of innovation.

"Currently, the literature suggests," they note, "that a new technology seems to evolve along an S-shaped path, which starts below that of an old technology, intersects it once, and ends above the old technology. This belief is based on scattered empirical evidence and some circular definitions."

They conducted historical analysis on the emergence 14 radical innovations taken from four markets in order to examine the shape and competitive dynamics of technological evolution.

They were interested in finding answers to the following questions:

- How do new technologies evolve?
- Do they follow the S shaped curve or some other pattern?
- Are technological changes predictable?
- Is the rate of technological change increasing?

Among the many fascinating conclusions they made was that the conventional interpretation of the S curve is wrong. "The results," they noted about their study, "contradict the prediction of a single S-curve. Instead, technological evolution seems to follow a step function, with sharp improvements in performance following long periods of no improvement. Moreover, paths of rival technologies may cross more than once or not at all."

Their description of long periods of stasis, followed by outbursts of innovation, sounds similar to the new Darwinian interpretation of evolution that biologists call "punctuated equilibrium." The implications of S

curve punctuated innovation for America is that if long periods of stasis are not interrupted by a burst of innovation there will not ever be future bursts of innovation because the genetic technological diversity in America never occurred.

It occurred somewhere else, as a result of the MNCs outsourcing innovation, primarily to India and China.

For Sood and Tellis, "In nine technologies, we did not find a single S curve. Rather, we found long periods of static performance interspersed with abrupt jumps in performance. The plots suggest a series of step functions, each of which could approximate an S curve."

Another challenge to conventional wisdom they found was that radical innovations occur in really big corporations, like the American multi national corporations that have been outsourcing innovation since 1985.

"In contrast to the dominant view in the literature (H8)," they stated, "we find only 1 platform innovation introduced by small entrants. All the remaining 13 platform innovations came from large firms (7 incumbents and 6 new entrants). Although our results run counter to the dominant view in the literature, they are consistent with two recent findings in the literature (Chandy and Tellis 2000; Sorescu, Chandy, and Prabhu 2003)."

Even with their deep financial pockets for radical innovation, it takes the large corporations about 15 years to run through a radical innovation cycle. In terms of what they call gestation time, they concluded, "We also examined the gestation time of each technology, which is defined as the time it takes for a firm to convert a patent to a commercial product. The average gestation time for technologies is 14.5 years for display monitors, 14.3 years for desktop printers, 9.7 years for desktop memory, and 22.7 years for data transfer technologies. The overall average for all categories is 15.1 years."

To provide some historical perspective, the innovations that occurred around 1985 have already run their course, ending up as obsolete products in the junkyard of the global market. Those earlier innovations partially occurred offshore, without providing the benefit of technological diversity for future innovation in America. The current pace of outsourcing America's innovation has dramatically increased since 2003.

America is about 5 years in to the 15-year innovation cycle that began offshoring in 2003, about 44% of which has occurred in China. Without new firms and new innovation, there will be no new markets created in America, and the future economic prospects for the nation look very bleak beginning around 2018.

Looking forward, the S curve is telling us that the transition from an innovation economy to a third world welfare state should just about be completed in America by around 2015.

Outsourcing the American National Culture of Radical Innovation

In "*Innovation in Firms Across Nations: New Metrics and Drivers of Radical Innovation*," Gerard J. Tellis, Jaideep C. Prabhu and Rajesh K. Chandy (TPC), (Marshall Research Paper Series Working Paper MKT 03-07, February 2007), begin by offering a much needed definition of radical innovation.

"We define radical innovation," state TPC, "as the commercialization of new products that are based on substantially different technology and provide substantially higher customer benefits relative to existing products in the market."

Their definition is valuable to the policy debate about free trade in America because it emphasizes product technology, not some loopy ill-defined concept like global competitiveness, and it ties technology to the market, which is the mechanism of evolutionary selection.

In the biological metaphor of punctuated innovation, it is product technology that evolves as a result of technological cross-over, and it is new markets that emerge as a result of market selection. (Predicting Technology, 2007).

They investigated 759 firms drawn from 17 major world economies. As in most of their other research on radical innovation, they note that their "results contradict many prior assertions about the appropriate metric for innovation and the drivers of innovation."

No matter what factor they investigated or how they sliced and diced the statistical inquiry, they identified one single primary cause of innovation. "The internal culture of a firm," TPC concludes, "is the strongest driver of radical innovations. Its impact exceeds that of all other factors proposed in the literature."

To paraphrase an earlier titan of industry, is what is good for explaining innovation at GM also good for explaining innovation in America? In other words, are America's cultural values the most important economic resources for explaining technological innovation in America?

TPC cite Hofstede (2003) to explain how national cultural values affect technological innovation. Hofstede suggests five dimensions of country culture: individualism-collectivism, uncertainty avoidance, power distance, masculinity-femininity, and long-term orientation.

TPC applied the national cultural values of Hofstede to large corporations to investigate how firms with certain types of corporate cultural configurations were successful in managing the innovation process. When these corporations managed innovation successfully, they were strongly rewarded by the marketplace. As they noted, "In sum, our results suggest that:

- 1) markets strongly reward radical innovation over and above any returns to patents, R&D, and other control variables; and
- 2) radical innovation is a more powerful metric of commercial value/performance than patents."

The broad economic effects of radical innovation that they discovered were pervasive. They concluded that radical innovation "creates entirely new markets and improves the quality of products while also reducing prices. It can propel small outsiders into industry leaders and can bring down large incumbents that fail to innovate. Firms at the leading edge of innovation tend to dominate world markets and promote the international competitiveness of their home economy. Thus, radical innovation simultaneously drives firms' success, economic growth, and consumer welfare."

TPC fail to mention exactly how the secret sauce of corporate innovation promotes the global competitiveness of the home economy when the geographical location of the radical innovation is not the home economy.

How does that magic work, exactly? The MNCs, as they note, are at the edge of innovation and tend to dominate world markets, and the outsourced innovation allows the MNCs to internalize the benefits of innovation because their operations "transcend" national boundaries.

They contradict their own evidence with their insight that MNCs have become just like sovereign nations. As they note, "More importantly, firms in these countries can draw on the experiences of their

counterparts from around the world. This universal accessibility means that firms are special forms of organization that increasingly transcend national boundaries, constraints and systems."

If the MNCs transcend national boundaries, how do the citizens in a sovereign nation obtain the benefits of free trade comparative advantage? The industrial supply chains in America that used to do the work for the MNCs, no longer do the work, and they have pretty much all died (gone extinct).

Looking backward in time, how does the outsourcing of America's technological innovation in 1985 lead to an S curve of future punctuated innovation and the emergence of new markets?

Outsourcing Innovation to Internalize MNC Corporate Profits

Outsourcing and offshoring innovation can be described in terms of the financial welfare of the MNC, or it can be described from the welfare perspective of citizens who live in a nation.

In research on innovation entirely seen from the perspective of the MNC, A. Y. Lewin, S. Massini and C. Peeters, (LMP), raise the fundamental question about innovation and outsourcing: Why are American MNCs outsourcing American technological innovation?

In their article, "*Why Are Companies Offshoring Innovation? The Emerging Global Race for Talent*," (CEB Working Paper 08/009, March 2008) LMP examine 880 cases of American corporate innovation offshoring.

They had access to a treasure trove of private survey data obtained from the Offshoring Research Network (ORN) at Duke University, a smallish private Methodist college located in Durham, North Carolina. The ORN is an ongoing multi-year international project tracking the offshoring of administrative and technical work by companies in the US and Europe.

They investigated offshore implementations initiated by US firms between 1990 and 2006. In particular, they investigated the determinants of firms' decision to offshore product development activities (i.e. R&D, product design and engineering services).

In other words, they studied how MNCs have offshored the heart and soul of America's innovation capacity for radical product innovation.

While they identify the earlier period beginning around 1985 as the start of the innovation offshoring trends, they also find, like other researchers, that something dramatically bad has occurred in very recent economic history, beginning around 2003.

"In the early 1980s," they explain, "several leading edge companies such as Texas Instruments, Motorola, and General Electric established technology centers in India and China to secure strategic advantages such as favorable political treatment (Delios and Henisz, 2003) and access to talent."

"In comparison," they note to the earlier period of offshoring factory jobs, "the offshoring of high-value adding white collar activities – pioneered by a few companies in the 1980s - is still a relatively undiffused practice (Amiti and Wei, 2005). However, Dossani and Kenney (2007, p.779) conclude that "in less than six years, services offshoring has evolved from an exotic and risky strategy to a routine business decision".

The MNCs are now, according to LMP, "offshoring increasingly complex and advanced activities requiring more and more qualified workers (Lewin and Peeters, 2006). This trend is enabled by trade liberalization policies, advances in information technologies (Doh, 2005; Levy, 2005; Dossani and Kenney, 2006), and by the ability of companies to disintermediate and modularize almost any process, including knowledge creating."

They cite Apte et al. (2006) who writes that "new product development is becoming the fastest growing offshoring segment in India."

They also cite Kuemmerle (1999b), who shows that in 1965, 32 multinational firms in his paper carried out 6.2% of their R&D efforts outside of their home country boundaries, while in 1995 the corresponding figure was 25.8%.

In terms of what has happened since around 2003, they write, "More surprising is the finding that 26% of offshore implementations involve product development activities. This suggests that companies are offshoring innovative activities that constitute the core of a firm differentiation and value creation strategy, that are expected to remain under direct control."

The innovation outsourcing is more pronounced in some industries than others. They found that "In the Software and Programming industry, almost 50% offshore implementations concern product development. In Business and IT services, Health/Biotech/Pharma Manufacturing, and Technology industries about one third (33%) of offshore implementations are in product development.

As noted above, China is now the most favored nation for trading away America's innovative capacity.

"Regarding offshore locations," they note, "the proportion of product development implementations out of total offshore implementations is the highest for China (44%)."

The connection to the demise of the American economy occurs as a result of work formerly done in American industrial supply chains now being done in foreign countries. As seen from the perspective of the welfare of American citizens, the current trend in innovation offshoring leads to something they call *HBR, Home-Base Replacing*. The loss of jobs and economic vitality is not directly within the MNC, it is indirectly in the intermediate demand marketplaces.

"Recalling our earlier definition of offshoring, it appears that offshoring strategies are evolving from *home base augmenting* (HBA) to what we can define as *home-base replacing* (HBR) innovation capabilities. This seems to be the case for larger MNEs, whose strategies have been extensively discussed in the IB literature, whereas smaller and medium sized companies (SMEs) may be adopting innovation offshoring strategies that augment their limited innovation capabilities."

Exactly how does the secret sauce of free trade comparative advantage work if it leads to HBR? What does the S curve tell us about punctuated innovation in the case of HBR?

The American MNCs are engaged in innovation outsourcing in order to obtain the comparative advantage of internal profit maximization. Internal corporate profit maximization leads to a bifurcated economy, one that features MNCs who are doing very well financially, and the other 90% of the population that ain't doing so good.

LMP cite Dunning's research (1980) about this internalization of benefits. Dunning's approach "suggests

that foreign direct investment (FDIs) are explained by the combination of firm-specific, location-specific and internalization advantages. Within that literature, offshoring can be seen as a new form of internationalization by which firms disaggregate their value chain across multiple locations, potentially externalizing portions of it to third party service providers."

The two episodes of outsourcing, the earlier one involving the manufacturing jobs in America, and the most recent one outsourcing America's innovation capacity are connected. As LMP note, "As firms establish manufacturing facilities abroad and assign increasingly complex products to them, locating R&D sites in close proximity to factories becomes a requisite feature. These sites support the transfer of knowledge and prototypes from the firm's home location to actual manufacturing. The importance of co-locating some firm R&D efforts with manufacturing operations and local demand has been described not only in the international business literature, but also in industrial geography (Howells, 1990) and technology management literature (Clark and Fujimoto, 1991; Hayes and Wheelwright, 1988; Nonaka and Takeuchi, 1995; von Hippel, 1988)."

In the new and skewed bifurcated American economy, the internalization of benefits derived from free trade inure to the comparative advantage of the MNCs.

From the perspective of American citizens, the internalization of benefits means the transformation of working in the formerly innovative economy to subsisting in a new type of welfare state.

Radical Innovation as the Source of Revival, Revitalization, and Reversal of American Economic Decline

Unlike the ethical dilemma confronting Doris Goodwin about the right time to reveal the judgment of history on a current President, the right time to have a policy debate about free trade is right now.

Something dramatically bad has been happening to the American economy since around 1985, and the situation has become much worse since around 2003. As noted by LMP, "Although this strategic objective was not an important driver of firms' decision to offshore Product Development up to 2002, it became a highly positive and significant determinant of PD offshore implementations initiated from 2003."

The S curve can tell us that it takes about 15 years for an innovation to run a cycle, and the American economy is now in about the 5th year of a 15 year downward spiral.

Unlike past economic depressions, this downward cycle represents an irreversible ratchet down. Like the disease which destroy a brain's neurons, the downward innovation ratchet is irreversible because the innovation capacity of the nation is being destroyed. As LMP conclude, the current pattern of offshoring activities by American companies that emerge from the ORN study does not fit the traditional story of companies simply trading non core low level workers in the US with low cost labor offshore."

The MNCs are trading away America's brain neurons. Innovation work that was formerly done in America's industrial value chains, the neurons, have been outsourced. LMP note, that "In the knowledge IT-enabled economy, entire segments of companies' value chains are relocated to where the requisite human capital is located as a necessary condition for executing certain business functions and processes. In one sense, offshoring is nothing more than the mechanism through which companies achieve such reorganizations."

It is also nothing less than how MNCs internalize profits without ever redistributing profits back into the domestic U. S. economy.

In evolutionary theory, what currently exists today could easily have been something else if some earlier genetic crossover had occurred. Likewise, what currently exists in the form of free trade laws could easily have been something else with better national economic leadership that targeted the welfare of American citizens.

All of the major research findings on radical innovation, from the perspective of MNCs, describe corporate cultural values as the driver for innovation. What is true for innovation at GM is true for America. What is not true is that America has the luxury of time to correct the demise.

The S curve can tell us how innovation works, how long it takes and where to look for likely sources of innovation. In the case of judging the history of America's economic demise, the S curve will have us searching for signs of past innovation in the ruins of the American economy.

About Our Guest Columnist:

Thomas Vass is an economist who writes about technology innovation and an investment advisor who advises small high tech companies on raising capital. Parts of his economic theory about technological evolution are combined with his investment advisory practice at an online investment newsletter, [The Technology Stock Advisor](#). He is also founder of the [RTP Tech Event at Charlie Goodnight's](#). For more background information and links to related websites, check out [Thomas' Archives](#) as well as more from the [RTP Product Pipeline](#).

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