ENTREPRENEURIAL ROUND TRIPPING: THE BENEFITS OF NEWNESS AND SMALLNESS IN MULTI-DIRECTIONAL VALUE CREATION

Lauren Ortiz-Hunt
Center for Innovation and Entrepreneurship, USA, llortizhunt@stratwa.com

Recommended Citation
Available at: http://digitalknowledge.babson.edu/fer/vol35/iss11/3
ENTREPRENEURIAL ROUND TRIPPING: THE BENEFITS OF NEWNESS AND SMALLNESS IN MULTI-DIRECTIONAL VALUE CREATION

Lauren Ortiz-Hunt, Center for Innovation and Entrepreneurship, USA

Abstract

In this study, we develop and empirically test the theory that new industry entrants hold advantages over incumbents in the shift from unidirectional to multi-directional revenue streams. Using a Cobb-Douglas production function, modified to isolate returns to innovation, we examine data from three distinct contexts: steamships on western rivers (1810-1860), satellite-based Internet services (1965–2010), and food waste recycling (1995-2015). The results reveal that while incumbents attempt to stretch existing technologies to fit emerging circumstances, entrepreneurial innovators achieve greater success by approaching multi-directional value creation as a distinct challenge, one requiring new technologies, organizational forms and business models. Our findings have implications for diverse multi-directional frontiers, including: social networking, commercial space travel, distance education, and medical treatments using nanoscale technologies.

Introduction

Existing theories related to incremental innovation suggest that large-scale incumbents hold an advantage over smaller, newer firms in extracting value from dominant designs (Tushman & Murmann 1998) through efficient-scale replication of existing technologies (Baumol 2004). Accordingly, it may seem logical that incumbents would make the necessary technological and organizational adjustments to dominate the migration from unidirectional to multi-directional value. Sometimes called “round tripping” in supply-chain research (Piotek 2009), multi-directional value refers to profits that are generated from the development of solution sets that allow commercializable goods and services to flow in more than one direction (Beamon 1999).

A contrasting stream instead posits the emergence of entrepreneurial innovators from outside existing industries, who develop and commercialize solutions that drive multi-directional value creation. In this view, ascendant start-ups challenge incumbents through the rollout of destabilizing technological alternatives (e.g. Dosi 1982; Nelson & Winter 2009; Teece 1986; Schumpeter 1934). This perspective notes that once incumbents achieve profitability through efficient scale production, they become “locked into” existing technologies in path dependent fashion (Arthur 1989; Teece et al. 1997). Under this set of assumptions, the logic supporting incumbent supremacy is inverted, so that smallness and newness may be assets rather than liabilities in extracting value from round tripping.

The focal point of our investigation centers on the paradox of incumbency in round tripping: that despite possessing insider knowledge, efficient scale and superior resources, incumbents often fail to develop the leading solution sets for multi-directional flows. We pose the following question: Under what conditions would new firms outperform existing firms in developing and monetizing multi-directional solution sets? We address this question using novel datasets drawn from three
examples of round tripping: (i.) Steamships designed for the U.S. western waterways (1810–1860), which allowed bi-directional portage from New Orleans to Pittsburgh; (ii.) Two-way, satellite-based internet services (1965–2010), which allowed bidirectional flow of broadband content; (iii.) Food waste recycling from restaurants and stores (1995–2015), which is used for compost to grow local organic produce, which is in turn delivered for use by the disposal customers. The findings hold significance for ongoing efforts to understand value creation and appropriation within complex, multi-directional systems, such as social networking, commercial space travel, distance education, and medical treatments using nanoscale technologies.

**Theoretical Development**

The theoretical perspective that we develop in this study has roots extending to the work of Schumpeter (1934), Penrose (1959), and Baumol (1968) who noted that while the improvements derived from innovation are indispensable to economic growth, innovation is not the same as entrepreneurship, nor does innovation in and of itself generate profits. Rather, profitability arises through efficient returns to increasing scale for firms that have ascended an experience curve (Henderson 1974). Incumbents safeguard extant technologies because it is generally profitable to do so. However, this protective orientation makes incumbents susceptible to two forces that are relevant to round tripping: business model disruptions and the errant use of marginal reasoning.

**The Disruptiveness of Multi-Directional Value Creation**

An extensive body of scholarship has examined the tendency of incumbent firms to focus on incremental improvements to existing technology once they have achieved high profitability through efficient returns to scale (e.g. Abernathy & Utterback 1978; Baumol 2004; Methe, et al. 1996). Over short periods of time, this approach can be highly effective in harvesting profits from existing innovations. Over longer spans, as competing technologies arise, the adverse consequence of incrementalism is that incumbents may be rendered ill equipped to survive the emergence of disruptive technologies (e.g. Christensen 1997). As Danneels (2004) asserted, disruptive technologies are often associated with the replacement of incumbents by new entrants. Nonetheless, firms are often unwilling to risk near-term profitability by investing in disruptive activities (Christensen, 1997; Benner & Tushman, 2003). “The short-term certainty of exploitation crowds out exploratory learning and innovation,” noted Levinthal and March (1993:682).

The reluctance of incumbents to depart from profitable existing technologies and business models also impacts the way they frame their respective responses to multi-directional value creation. Multi-directionality is disruptive because it often requires the development of technologies, organizations and business models than differ markedly from those used to exploit unidirectional revenue flows. For example, prior to the advent of river-faring steamships, trading companies would use simple barges to drift downstream with the current. Upon arriving at the appointed destination, barges were often disassembled for the lumber or burned since porting an empty craft upstream required forty men to invest three to six months of arduous labor. The business model underlying the downstream barge industry bore no resemblance to the technologies and organizations that would eventually supplant it through entrepreneurial innovations that exploited multi-directional value creation. In this vein, we therefore predict:

**H1:** Entrepreneurial innovators will outperform incumbent firms in multi-directional value creation when new technologies and organizational structures are required to exploit the multi-directional opportunity.
The Tyranny of Marginal Reasoning

Round tripping that requires incumbents to invest in novel technologies and organizations runs aground when firms compare the existing marginal productivity of unidirectionality to diminished marginal rates stemming from multi-directionality. Optimal returns to a production process are most frequently derived using marginal analysis (Baumol & Hall 1977; Machlup 1946). Once a firm has achieved efficient returns to scale, diminishing margins typically signify erosion in the efficiency of productive processes (Coelli et al. 2005). Applying marginal reasoning frameworks, incumbent firms that are faced with the challenges of multi-directional value creation will often seek to implement some permutation of the existing solution sets, rather than venturing into novel alternatives. We call this strategic direction-setting impediment “the tyranny of marginal reasoning.” Even though aggregate returns may be enhanced through multi-directional models, it is not uncommon for business processes that are optimized for unidirectionality to exhibit lower marginal returns in a multi-directional context. That is: even though aggregate welfare may be greatly enhanced, incremental returns to scale are diminished relative to the rates of return derived from unidirectional models. For this reason, incumbents may be unwilling or unable to develop and implement innovative solution sets for multi-directional value creation. Instead, innovating entrepreneurs may be the key to facilitating this important source of sustainable development.

**H2**: Entrepreneurial innovators will outperform incumbent firms in multi-directional value creation when the marginal returns to multi-directionality are lower than the existing marginal returns to unidirectionality.

**Multi-Directional Value Creation**

**Steamships on the Western Waterways**

Prior to the invention of the steamship, only about 5% of the American population lived west of the Appalachian Mountains, and the mighty western rivers remained an under-utilized resource. Keelboats and flatboats could easily carry goods downstream, but could only travel upstream by tedious, burdensome, and costly methods. The low-grade lumber from flatboats was more often than not simply burned. Keelboats were pulled back upstream, with slaves and immigrants performing this backbreaking work through poling, bushwhacking, cordelling, or warping. A good rate of progress was 12 miles per day. Meanwhile, there were ocean faring steamships. Fulton and others realized the potential commercial opportunity in transferring this technology to rivers. However, incumbent operators faced dramatically different conditions on the rivers. Ocean steamers were substantial crafts that carried large, immensely profitable loads. They were also underpowered for river currents and had limited maneuverability. Traveling upstream required smaller boats with far more powerful engines. Incumbents, including Fulton, sought to modify sea-faring craft, while newcomers embraced radical new hull and engine designs, such as French’s horizontal steam cylinder mount, made possible by the elimination of the condenser and flywheel (Hunter 1947). Unable to compete on technical merit, Fulton and his partner Livingstone resorted to political maneuvering by trying to obtain state-level steamship monopolies. The legislative gambit failed and incumbent operators were left behind as hundreds of new firms implemented the smaller, more powerful technologies.

**Two-Way Satellite Internet Service**

In a fashion similar to upstream travel on the western waterways, the roll-out of broadband internet service to remote areas involved two groups of incumbents: low-speed dial-up providers
and satellite-based content broadcasters. Like flatboats and keelboats, the dial-up providers offered no technologically meaningfully solution sets; and, like the ocean steamers, broadcast satellites were ill-suited for the demands of bi-directional rich-media. Like the enormous loads shipped via ocean steamers, broadcasting via satellite is highly lucrative because it optimizes the mass utilization of a fixed asset that is not intended to be flexibly repurposed for multiple uses. Early pioneers in communications satellites, who made spectacular profits broadcasting a fixed array of content choices, labored for decades to find ways to stretch the existing business model to incorporate high-speed internet access. Unidirectional delivery of content optimizes a satellite’s marginal revenue generation. In comparison, the economics of multi-directionality appear at the margin to be unattractive since it involves individual users tying up satellite capacity for idiosyncratic purposes. Similar to bi-directional river travel, new firms produced novel technologies that were instrumental in making satellite-based broadband financially viable, such as Ka-band spot beams, “bent-pipe” signal reflection architecture, signal amplifiers, attenuation and latency remediators, and ultra-light atmospheric aircraft with onboard solar-charged batteries. Start-ups providers also introduced new business models that focused on ancillary revenue from e-commerce and software offerings as well as novel inter-firm fractional ownership of satellites.

Food Waste Recycling

On average, Americans each annually generate 475 lbs of food waste. In aggregate, this is 70MM tons, nearly 1/3 of the weight-volume in landfills. Many states, and most municipalities, favor steps taken to turn food waste into productive compost. Doing so would alleviate landfill space constraints and reduce vermin concerns. The problem is that for incumbent waste disposal firms, food waste collection involves a marginally unproductive commitment of property, plant and equipment. For firms that have invested heavily in optimizing the collection and disposal of unsorted residential and commercial waste, bi-directional value creation looks unattractive. Just like ocean steamers and large broadcast communication satellites, incumbents have “locked into” solution sets (Arthur 1989) that involve stretching current technologies and practices, but they are reluctant to reconceptualize their business models in the context of multi-directional value creation. Instead, start-up firms have developed novel process flows that involve collecting food waste, transforming into compost, using that compost to grow local produce, and then selling the produce back to the waste disposal customers. The model has required new organizational structures and the use of aggregate rather than marginal reasoning. New firms have sought to make recycled food waste services the primary service offering, to which the disposal of other refuse has been added, versus the existing model that treated food waste as a disruptive inconvenience.

Data, Method and Model

Data

The ability to credibly address our central research question required the use of multiple datasets from contrasting time periods and industry contexts, comprised of technical, operational and financial data. This allowed us to avoid the risk that the social-contextual factors predominating at any given point in time may themselves be the primary driver of observed effects and outcomes. For steamship data, we drew upon government documents and privately sourced records (Hunter 1949; Kane 2004; Mak & Walton 1972) for 510 steamships, owned and operated by 203 different companies. For two-way satellite interconnectivity, we used data from 168 ISPs, obtained through USPTO, SEC and Dun & Bradstreet databases. For the most recent context, involving food waste recycling, we gathered data using a survey that was sent to 114 firms operating in the food waste disposal/recycling segment.
Analytical Design

Our analytical design employs a Cobb-Douglas aggregate production function (CDF), modified to take into account returns to innovation (e.g., Dixit & Stiglitz 1977; Kortum 1997; Solow 1957). Through this function, we fully derived the component sources of long-term economic gains, which were regressed in an econometric model that was structured as a head-to-head comparison between entrepreneurs and incumbents. The basic form of CDF is: 

\[ Q = A L^\alpha K^\beta, \]

where \( Q \) is total output, \( L \) is the quantity of labor, \( K \) is the quantity of capital, and \( \alpha \) and \( \beta \) are output elasticities, such that \( 0 < \alpha, \beta < 1 \), and \( \alpha + \beta = 1 \). While retaining the core CDF structure, we decomposed the capital service function, consistent with Dixit-Stiglitz, to account for the component contribution of innovations to the productive process. This was done because conventional CDF treats technologies as perfect substitutes, but we placed no bounds on the variety or incremental productive capacity of new innovations in our analysis (Peeters & de la Potterie 2006). The final form of our model (for which the detailed derivation can be provided) is:

\[ (1 - I_i) = a + b(k_i - l_i) + cT_i + dD_i + gC + e_i \]

In our model, \( (1 - I) \) is the log of incremental production attributable to firm-level innovation; \( (k - l) \) is the log of physical capital per unit of labor; \( l \) is the log of labor units; \( T \) is an orthogonal set of codes representing industry-level technological variety across unidirectional and multi-directional contexts; \( D \) is an orthogonal set of codes representing the market opportunities for unidirectional and multi-directional value creation; \( C \) is a dummy coded variable for firm type (incumbents: 0; new entrants: 1) \( i \) represents the \( i \)th company for each of the three datasets; \( e_i \) represents error terms; and, \( a, b, c, d, f \) and \( g \) are parameter estimates. Since the sum of the output elasticities always equals 1 in CDF, our model captures the residual component of production \((I)\) that is attributable to innovations that may or may not be operationalized at the firm level.

Key Variables

As indicated above, the dependent variable in our investigation is Returns to Innovation (RTI), which is a continuous value for firm-specific productivity calculated as the logged partial derivative of the innovation component from the decomposed capital service function of our CDF. The two focal predictors are (i.) Firm Type, a discrete dichotomous variable for incumbents and new entrants; and, (ii.) Firm versus Industry Margins, a continuous variable. As indicated in Equation 1, the model also estimates values for labor, industry technology, unidirectional and multi-directional market opportunities. Additionally, we control for a known covariates for productivity: time-series data for macro economic factors, demographics, industry population controls drawn from population ecology (Hannan & Freeman 1977) and fixed firm effects.

Results

The central proposition of our framework is that under certain conditions newness and smallness are assets rather than liabilities in multi-directional value creation. To test the theory, we predicted that new firms would outperform incumbents under two conditions: (i.) when the shift from unidirectional to multi-directional revenue required new technologies and organizations; and, (ii.) when analysis suggested that the marginal rates of return for multi-directional profits were less than unidirectional rates of return. A summary of the regression results is presented below.
For each of the three historical contexts both Firm Type and Marginal Returns were significant predictors of the dependent variable, Returns to Innovation. The comparative ability to harvest returns from multi-directionality are captured in Figure 1.

Returns to innovation – calculated as the partial derivative attributable to firm-level innovation in a multi-directional context -- are, on average, significantly negative for incumbents, indicating existing sources of capital resources are favored to the extent that they extend the marginal returns captured under unidirectional conditions. Meanwhile, new firms derive significant incremental benefit from the technological and organizational innovations they have developed to exploit multi-directional value creation.

**Summary**

As the foregoing results suggest, when confronted with disruptive challenges, incumbents will attempt to stretch existing technologies, organizational forms and business models form unidirectional to multi-directional contexts. This is done in an attempt to preserve the attractive margins that are accrued through efficient returns to scale. Ironically, the marginal reasoning that discourages incumbents from leading multi-directional value creation is a key element in their eventual demise. Despite enjoying a significant head start, incumbent firms appear to eschew the enhanced aggregate profitability that accrues to multi-directional value creators. Meanwhile, entrepreneurs, who are comparatively unencumbered by such biases, develop viable solution sets that endow them with a leadership position in the generation of multi-directional revenue streams.

**CONTACT:** Lauren Ortiz-Hunt; llortizhunt@stratwa.com; (720) 328-3211; Strategic Wealth Advisors; Superior, Colorado 80027.

**Table 1: Summary Regression Results**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p-value for Firm Type</td>
<td>Model F-test</td>
</tr>
<tr>
<td>Western Rivers</td>
<td>&lt; .001</td>
<td>87.4</td>
</tr>
<tr>
<td>2-Way Satellites</td>
<td>&lt; .01</td>
<td>49.3</td>
</tr>
<tr>
<td>Food Waste Recycling</td>
<td>&lt; .01</td>
<td>56.0</td>
</tr>
</tbody>
</table>

**Figure 1: Comparative Returns to Innovation – New Firms versus Incumbents**