What Doesn’t Kill You Makes You Stronger: The Evolution of Competition and Entry-order Advantages in Economically Unstable Contexts

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ABSTRACT

Macroeconomic shocks occur rather frequently, but little do we know about firm-level strategies in such troubled settings. To shed some light on this, we contrast the sustainability of entry-order advantages along industry life paths subject to regular versus distressed macroeconomic contexts. Based on formal modeling and multiple simulation runs, we propose that economic shocks induce temporary discontinuities in the relative value of different resource endowments, thereby switching the bases upon which firm advantages are built and sustained. Specifically, in industries where preemption and technological leadership matter (i.e. those that afford early mover advantages), previous empirical literature suggests that firms should enter quickly as well as invest in fast-paced growth and learning, thus preventing leapfrogging by late movers. But we point to a vital tradeoff in economically distressed markets, where the relative value of firm financial health increases such that firms may find it advantageous to limit their growth and learning investments so as to increase survival and market share advantages over the long run. In such unstable economic contexts, laggards with a financial flexibility advantage remain to surpass early movers; even if the latter possesses preemption and technology-based assets. In our model, we theorize that such shifts in resource value occur as a result of a confluence between exogenous and endogenous uncertainties relative to the industry life cycle. In the end, we also discuss implications for theory and practice.

Keywords: Early Mover Advantages, Competition, Industry Evolution, Life Cycle, Economic Shocks, Uncertainty, Simulation, Sudden Stop, Phoenix Miracle, Emerging Markets.
INTRODUCTION

What should firms do when competing in contexts subject to increasing uncertainty of macroeconomic meltdown? In the past couple decades, the world has seen many markets once considered attractive for global expansion – in Asia, North and South America, and Europe – either go bust or at least suffer from increasing prospects of severe turmoil. The relevance of the matter is evident with the ubiquitousness of these exogenous threats and the lack of clear strategic imperatives for firms exposed to them. For instance, Calvo, Izquierdo, and Talvo (2006), using the terms *Sudden Stop* (SS) and *Phoenix Miracle* (PM) to respectively describe depression and recovery events, report over 30 such disorders in the 24 years, up to 2004 – over two thirds of which were described as severe contractions. With the rising financial interdependencies across global markets, fears about contagion across countries can gravely puzzle seasoned managers. A quote from a top executive in 2001 Argentina – which at the time underwent an acute depression – highlights such strategic confusion.

“Although Monsanto has been first to commit and dominate the local market for genetically modified seeds, headquarters has decided to not only curb, but even withdraw its pledges and rethink its further investments here. We fear the economic turmoil may end up shifting the sources of advantages, and shuffling the market positions of rivals. In fact Wall Street has already penalized us for our large Argentine asset exposure.”

Recovery from such turbulences can be highly dissimilar (Ayyagari et al, 2011). Countless multinationals that entered Argentina’s economic opening a decade earlier had left the country not even two years after the collapse (Carrera et al, 2003). Without knowing the competitive context prospects under an economic meltdown, prescribing strategies can be problematic. Managers may stick to their original plans and race ahead of rivals, albeit such dedication to troubled markets can penalize firm value (as Monsanto found out). On the other hand, hesitation can give the firm valuable flexibility but make it vulnerable to rivals if the market flourishes.
In this paper we examine how economic shocks affect the creation and sustainability of competitive advantages. To frame the study, we draw from research on early mover advantages – or simply FMA – (Lieberman & Montgomery, 1988; 1998; Robinson et al, 1992; Suarez & Lanzola, 2007) as they evolve along industry life (Agarwal, Sarkar, & Echambadi, 2002; Dosi & Malerba, 2001; Klepper & Graddy, 1990) as well as on theory elements from macroeconomic volatility studies (e.g. Calvo & Mendoza, 2000; Calvo et al, 2006). Previous research shows that by assertively preempting laggards (e.g. entering and growing quick) and maintaining technological leadership (e.g. investing in learning and R&D) early movers can sustain survivability, market share, and profit advantages (Lieberman & Montgomery, 1988).

Economic shocks however exogenously impose an abrupt discontinuity to this more or less predictable evolutionary path, by drastically curtailing the industry’s carrying capacity in the short run. In our model, we reason that this process induces durable and valuable advantages to survivors. In essence, temporarily constrained markets allow economic shock survivors (whether early or late movers) to build barriers to entry with which they increase and sustain advantages for long after the macro contextual turbulence is gone. This possibility in turn allows us to contribute to the theory of entry order advantages with two noteworthy extensions. First, assuming path dependent processes, we demonstrate that – ceteris paribus – economic shocks enhance the significance of isolating mechanisms often associated to FMA (e.g. preemption- and technology leadership-related advantages) thus increasing the performance lead of early movers over laggards otherwise observed in economically stable contexts. On the other hand, according to previous literature, sustaining early entry advantages (or in the case of late movers, “catching up to early entrants”) requires investment commitments to continuously preempt new market spaces and attain newer production technologies. In economically distressed contexts however,
this growth and learning assertiveness can increase firm death risks in cases where higher investments entail a more leveraged balance sheet. In essence, in an industry where it traditionally pays to be a first mover, economic shocks notably shift the relative value of resource endowments, imposing significant tradeoffs between the aggressive pursuit of FMA and financial flexibility. In such contexts, early movers may find it advantageous to grow and learn less zealously, since late movers with a financial flexibility advantage are relatively more likely to out trump entry leaders even if these laggards lack traditional entry order sources of advantages. In our model we further show that the significance of this difference is contingent on the magnitude as well as the timing of such economic shocks along industry life.

In the final section, we further detail our contributions to theory and practice. We next review the concepts of FMA, *Sudden Stop*, and *Phoenix Miracle*. We then develop a formal model, and based on numerical solutions from multiple simulation runs, develop a theory on the evolution of competitive dynamics and advantages in troubled contexts.

**BACKGROUND**

**Entry-order Advantages Along Industry Life Cycles**

The FMA concept first emerged from simple anecdotal and empirical insights in which early movers tended to outperform laggards (Bond & Lean, 1977; Whitten, 1979). ¹ Lieberman & Montgomery (1988) then gave this initial perception more formal theory treatment, where early movers came to be known as the first firms to enter a market. Subsequently, *early followers* and *late movers* came to respectively refer to firms quickly following on the heels of early entrants and those lagging behind (Kalyaranam, Robinson, and Urban, 1995). In turn, the advantages related to early movers were originally defined as the profits they earned in excess of their cost

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¹ Our analysis also applies to *pioneers*, i.e. the very first firm to enter, but for simplicity, we focus on *early movers*, as our attention is in the contrast with late entrants, along the life cycle.
of capital (Lieberman & Montgomery, 1988: 41), albeit subsequent broader definitions included market share and survivability benefits (Lieberman & Montgomery, 1998; Suarez & Lanzolla, 2007). These early mover advantages arise from the existence of isolating mechanisms, which generally operate to delay imitators, and hence deter a natural convergence of performance among rivals in a competitive context (Rumelt, 1987). Overtime, various typologies have been offered (see Suarez & Lanzola, 2007: 378 for a review), though Lieberman & Montgomery’s (1988; 1998) have become the more accepted categories: technology leadership, preemption of scarce assets, and switching costs to buyers. Technology leadership for instance enables early movers to outperform others based on learning experiences as well as R&D patenting not easily available to laggards. Preemption mechanisms in turn involve forestalling bids for market resources such as buyers or inputs as well as economies of scale created from anticipated investments in plant and equipment; whereas switching costs reflect the sticky nature of buyer choice habits favoring brands they have come to value (Suarez & Lanzola, 2007).

Two aspects of FMA theory matter for our study. First, recent research suggests that environmental conditions shift competitive parameters, so entry advantages shift overtime. Based on the notion that industries evolve from a fluid to a more rigid state along a somewhat predictable path known as the industry life cycle (Agarwal et al, 2002; Klepper, 1997), Suarez & Lanzola (2007), for instance, conjecture that FMA is likely to be bigger later rather than earlier along that cycle. For instance, in the nascent industry stage, new products archetypes quickly flourish (Agarwal & Bayus, 2002). In an ensuing development phase, product popularity and consumer experience grow very fast (Klepper, 1997). At this point, quick demand growth, and high profits fuel new entry (Abernathy & Utterback, 1978). Positive network externalities among users, sellers, and makers of complementary goods begin to solidify consumer choices around a
core set of standards (Klepper, 1997), so firms begin to race towards their favored strategic positions (Abernathy & Utterback, 1978) and invest in technologies with more stable scale and learning economies (Klepper, 1997). At a further point, the industry reaches *maturity*; entry barriers increase; demand flattens; and price rivalry increases; subsequently weeding out less efficient players (Mueller & Tilton, 1969; Klepper, 1997) in a process known as *endogenous shakeout* (Jovanovich & MacDonald, 1994). Thus, Suarez & Lanzola (2007) reason that the pace of technological and demand evolution – two decreasing sources of uncertainty endogenously ingrained along this evolutionary path – have a moderating effect on the weight of isolating mechanisms. Specifically, FMA are less stable early in the life cycle because the uncertainties afford laggards more leapfrogging opportunities; but they stabilize overtime, as path dependent sources of advantage grow and solidify.

Second, albeit it may seem that early entry yields sure gains (the implication being that firms should always elbow their way in and grow quick), scholars warn against such notions of *absolute advantages* (e.g. Robinson, et al, 1992); they instead point to the distinct resource endowments across firms (Mitchell, 1991), and propose that entry-related gains reflect *comparative advantages*, wherein resource requirements change along industry life. Under this view, ‘strategic windows’ (Abel, 1978: 24) imply that early (or late) entry yield advantages only to the extent the value of firm resources reflect market nuances (Robinson et al, 1992: 609).

The ideas that FMA increases along industry life and depends on specific resource endowments are both powerful and useful, so we build off from them. To begin, if uncertainties *endogenous* to the life cycle diminish overtime (hence increasing the magnitude of FMA), we examine their confluence with *exogenous* uncertainties that arise from economic shocks. Further,

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2 We distinguish endogenous from exogenous shakeouts, based on whether they are expected along industry life.
if asset endowments determine entry-order advantages in given contexts, we look at how shocks alter relative asset value along industry life. Accordingly, we next define SS and PM events.

**Sudden Stops and Phoenix Miracles**

Calvo and colleagues used the terms Sudden Stop and Phoenix Miracle to respectively describe bust and boom shifts in a country’s GDP (Calvo and Mendoza, 1996; 2000; Calvo et al, 2006). More precisely, SS events reflect “current account reversals” that signify sharp falls in capital flows into a country (Calvo et al., 2006: 405). As these disruptions reveal disturbances in international capital markets, they are naturally treated as exogenous factors for individual economies and industries (Calvo & Mendoza, 2000). During an SS event then, a country is excluded from such markets, and as a result, the local context is subject to acute increases in interest rates and severe depression (Calvo et al, 2006: 405). This downturn causes further disruptions in liquidity of capital and goods market exchanges, in a snowball effect (Mendoza, 2006: 411). As unemployment surges and the local currency plummets, local market dwellers observe an acute fall in wages (Calvo & Mendoza, 1996; Calvo et al, 2006). This chain of economic events ultimately culminates in our two points of interest: with SS shocks, product markets suffer an acute fall in demand (Calvo & Mendoza, 1996), whereas financial markets tumble, thereby hitting highly leveraged firms especially hard.

The counterpart to SS events, the PM, is almost a paradox. The PM reflects an economy that bounces back relatively quickly from SS collapses. The apparent contradiction is that GDP and demand recover – on average 3 years after SS events – without the accompanying healing in credit, employment rates, investments, or capital inflows (Ayyagari et al, 2011; Calvo et al, 2006). Long-term capital markets are necessary for risky entrepreneurial investments, but as the focus market dries up during SS events, interest rates shoot up, thus hurting necessary asset
investments, and turning firm leverage prohibitively expensive. PM style recoveries are often referred to as miracles, and the existence of such miraculous GDP and demand renewal suggests that “financial frictions play a key role in pushing economies to the abyss from which in some way or another they crawl back by means less than apparent to the conventional observer looking for standard macroeconomic fundamentals” (Calvo et al, 2006: 405). Technically speaking, PM events reflect the gradual return of aggregate demand and inventory replenishment, without domestic or external investment credit. This surprising yet swift GDP recovery leads then to the allusion of the mythical bird “rising from the ashes” (Calvo et al, 2006: 405).

SS/PM events are ubiquitous not only for their severity, but also for their frequency and scope (Calvo et al, 2006). In the past many decades, deep economic shocks, from the Great Depression in the 1930s to the various emerging-economy crises of the 1980s and 1990s to the current global crisis suggest that market instability frequently punctuate periods of stability, though they are taken for granted by scholars and policy makers alike. The global structure of financial markets makes the likelihood of worldwide domino contagion much higher, thus helping explain the frequency and widespread nature of such shocks. Calvo & Mendoza (2000) for instance, point to the temporal bunching in such events as those spreading across countries in South East Asia, and then Latin America, in the late 1990s (Calvo & Mendoza, 2000: 59).

Because economic shocks are this ubiquitous, and because firm recovery from such events has been found to be very heterogeneous (Ayyagari et al, 2011), we find it pressing to study these asymmetries as well as the underlying processes for early and late mover success.

**GENERAL MODEL and SIMULATION MECHANICS**

To formally model the phenomenon we follow standard procedures offered in mainstream strategy studies; we then rely on the model to generate multiple simulation runs and
derive theory propositions (Davis, Eisenhardt, Bingham 2007; Lant & Mezias, 1990; Miller, Zhao, Calantone 2006; Nelson & Winter, 1982; Siggelkow & Rivkin 2006; Winter, 1984; Zott, 2003). Simulation modeling provides a powerful methodology for advancing theory (Cohen & Cyert, 1965) especially in contexts where systems typically involve interactions with nonlinear systems behavior and feedback, or when empirical analysis using the general linear model has limited value, as it is typically the case when samples in the area of interest are sparse and differentiated in time and space. To examine the relative value of resource endowments under SS/PM along the life cycle, we take an evolutionary approach, wherein firms develop sets of coordinated activities – known as routines – which evolve slowly, through local learning (Cohen et al. 1996). We adapt Winter’s (1984) model to describe a Cournot competitive process where shifts in the macroeconomic environment trickle down to the immediate context of firm rivalry and performance. For simplicity, we model a single product and one input factor, capital. Firms are price takers (Klepper & Grady, 1990) that choose the amount of output to maximize profit.

In our model, firms are heterogeneous regarding production costs and financial leverage. Differences in the former arise from (a) distinct sets of production techniques, which themselves result from initial endowments of capital and technology; (b) lifelong capabilities such as learning rate and R&D efficiency (assigned randomly at entry); and (c) firms’ own decisions regarding capital expenditure and R&D investment that affect the cost function in a path-dependent manner. In turn, differences in the latter arise from (d) different financial strategies, which are assigned at entry, and are defined by a continuous space regarding financial flexibility, as measured by leverage (e.g. firms with debt or excess cash). Leverage ratios are not immediately associated to a firm’s cost function, as much as they are to its liquidity. Leverage permits more funds for growth and R&D (so it indirectly speeds learning and reduces costs), but
in turn it decreases firm’s flexibility, insofar as higher debt services correspond to smaller cash flow maneuverability. These heterogeneities in turn, combined with order of entry, ultimately determine firm survival and performance in different ways, across stable and distressed contexts.

The model produces short-run equilibria that result from the aggregation of individual decisions. To begin, we take a constant elasticity growing demand function that shifts outward (i.e. it grows overtime), and is punctuated downward by SS shocks. Every period, each firm chooses the output levels of its single good by adapting its capacity through capital expenditure decisions. Firm outputs then aggregate into industry supply, which in turn balances with demand. The market subsequently clears, inducing a price equilibrium. The price so obtained will determine each firm’s economic profit, which in turn will provide funds for the next period or it will make the firm leave the industry. Economic profit of firm \( i \) in period \( t \) is:

\[
\pi_{it} = P_t Q_{it} - c_{it}(Q_{it}) - (\rho + \delta)K_{it} - r_{it} \tag{Equation 1}
\]

Above, \( Q_{it} \) is the firm’s output at time \( t \); \( \rho \) is the cost of capital\(^4\), \( \delta \) is the depreciation per unit of capital, \( K_{it} \) is the firms’ capital stock at time \( t \); and \( r_{it} \) is firm’s R&D expenditure at \( t \). Finally, \( Q_{it} = \alpha K_{it} \), being \( \alpha \) the capital productivity factor. In turn, \( c_{it}(\cdot) \) is the firm’s production cost function which depends on accumulated output, on learning rate, and on current technology (which itself is a function of past R&D expenditure). This cost function follows the standard learning curve as in Argote & Epple (1990). Accordingly, firm costs go down by two mechanisms: a) learning, which in turn is a function of accumulated output; and b) technology improvement, which is a function of accumulated R&D. Formally,

\[
c_{it}(Q_{it}) = \tau_{it} \left( AQ_{it}^{LR} - (AQ_{i(t-1)})^{LR} \right) + \lambda Q_{it} \tag{Equation 3}
\]

\(^3\) The demand function (Equation 2) is \( P_t = D(Q_t) = \min \left( S, \varsigma \left( 1 + \phi \frac{Q_t}{2}(Q_t)^{-\frac{1}{2}} \right) (1 - \Pi_t) \right) \). Here, \( S \) is a price ceiling imposed by a product substitute, \( \varsigma \) is a demand parameter, \( \phi \) is the demand shift at every period, \( \epsilon \) is the demand price elasticity, and \( \Pi_t \) is the Sudden-Stop magnitude that equals zero if \( t \) falls outside the SS period. 

\(^4\) This includes debt and equity. As per Modigliani & Miller (1958), we assume them to be constant.
where $\tau_{it}$ is the firm’s technology at $t$ (i.e. it is the first unit cost in the learning curve literature), $AQ_{it}$ is the firm’s accumulated output up to time $t$, $LR_t$ is the firm’s learning rate, randomly assigned at entry, and $\lambda$ is the asymptotic limit of the learning curve.

Every period, firm entry and exit modify the competitive landscape. Exit occurs if either performance or capital stock results lower than their respective minima or if the firm goes bankrupt. In turn, entry occurs if a firm’s expected return results above the minimum performance threshold, being that we randomly assign initial conditions to potential entrants.\(^5\)

In each part below, we contrast a base (i.e. stable context) to an SS/PM model, being that each simulation run produces a specific evolutionary history, while the analyses average 1000 runs, over a total period of 50 years. SS/PM models include shocks of different magnitudes, at different times along the life cycle. For ease of exposition, we show simulation results through sequences of figures. We calibrated parameters (Appendix) for the base scenario to resemble the empirical results found in the literature (e.g. Klepper & Grady, 1990 and Calvo et al, 2006).

Along our text below (and also in our ‘sensitivity analysis’ section), we highlight the robustness of our findings. This is relevant in simulation research as results and theoretical propositions should naturally arise from the model structure, rather than specific parameter choices (Rivkin, 2003). We run the models with the software platform Repast Simphony (Repast, 2012).

**MODEL SPECIFICS, SIMULATIONS, and THEORY PROPOSITIONS**

*Economic Shocks, Production Cost Heterogeneity, and Early Mover Advantages*

In our model, firms path-dependently build up preemption and technology leadership-based capacities, respectively through investments in output capacity and R&D. The path

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\(^5\) Performance is defined as a distributed lag function of return. Formally (Equation 4) $\chi_{it} = \chi_{i(t-1)} * \theta + \phi_{it} * (1 - \theta)$. Here, $\phi_{it}$ is the shareholder return, and $\theta$ is the temporal weight. Exit occurs either if $\chi_{it} \leq \chi_{min}$, with $\chi_{it} \sim N(\mu_{\chi}, \sigma_{\chi})$ or if $K_{it} \leq K_{min}$, with $K_{i} \sim N(\mu_{K}, \sigma_{K})$. Bankruptcy occurs if the firm has no funds to cover a negative operating cash flow. In turn, Entry occurs if $\phi_{it} > \chi_{min}$. 
dependent nature of our model arises from decision variables that condense each firm’s history as in a Markov process. Firm capital expenditure decisions determine the evolution of capital stock ($K_{it}$) and accumulated output ($AQ_{it}$). Capital expenditure decisions follow a Cournot rule (similar to that of Winter, 1984), wherein firms choose output by investing in capacity (i.e. by influencing their capital stock) so as to maximize profits the following period. Maximization occurs under the assumption that rivals behave collectively with known supply elasticity.

Winter’s (1984) decision rule is straightforward: it is advisable to grow if current markup $u_{it}$ is bigger than the optimal markup $u_{it}^*$; otherwise it is better to let assets depreciate. In turn, firms build up technology stock ($\tau_{it}$) through R&D investments, which are made to optimize economic profit the following period. The impact on technology depends on previous R&D skills.

With these specifications, we initially produce Figure 1. The base industry evolution path shows the number of firms (the y-axis) changes over the years years of industry life (the x-axis). Our Cournot model assumes an earlier new product introduction, such that buyers have growingly accepted the current product standard. Our industry then begins in the development period, characterized by high profits and fast growth, where the number of firms rapidly rises to

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Formally, we define gross investment as (Equation 5) $I_{it} = K_{i(t-1)} \left(1 - \frac{\mu_{it}^* + \delta}{\mu_{it}}\right)\omega$, where $\delta$ is the depreciation per unit of capital and the markup ($\mu_{it}$) is defined as price divided by marginal cost of the firm. As in Winter (1984), the optimal markup which maximizes economic profit is $\mu_{it}^* = \frac{\epsilon + \left(1-s_{i(t-1)}\right)\Psi}{\epsilon + s_{i(t-1)}\Psi - s_{i(t-1)}}$, where $\epsilon$ is the demand price elasticity, $s_i$ is the market share of firm $i$, $\omega$ is a parameter regulating industry growth, and $\Psi$ is the supply elasticity of competitors as a whole. Klepper and Graddy (1990) have a relatively similar decision rule, assuming that firms will change their capacity at a rate that is determined by their cost $c$ relative to the price early in each period. But we adopt Winter’s approach because it explicitly incorporates market share. Investments are positive, i.e. there is no assets divestiture, and they are constrained by the funds available to the firm.

For simplicity, capital expenditure and R&D investment decisions are made sequentially, such that the capital stock $K_{it}$ is known when maximizing to obtain optimal R&D investment. The optimal R&D investment is (Equation 6) $\tau_{it}^* = \sqrt{\frac{\tau_{it-1}}{\gamma_i}} \left(AQ_{it}^{LR_i} - (AQ_{i(t-1)})^{LR_i}\right) - 1$, where $\gamma_i$ is the firm’s R&D efficiency, randomly assigned at entry. It is constrained both by an inferior limit $\tau_{it}^{min} = \frac{1}{\gamma_i} - 1$, so that expected increments are positive, and an upper limit, so that technology increments occur if funds are available.

Formally, technology evolves as $\tau_{it} = \tau_{i(t-1)}\frac{1}{\gamma_i + \delta_{i(t-1)}}$, where $\gamma_i$ represents the firm R&D skills.
a peak. Overtime, as the most cost efficient firms scale up their operations to their desired Cournot capacity levels (i.e. their best response to prevailing output of other firms), competition intensifies. Such competition in turn endogenously induces a shakeout of ineffective players, such that the number of firms then drops notably. Maturity occurs around year 20, and thereafter output more or less stabilizes. Such patterns are consistent with well-documented empirical literature (Klepper and Graddy, 1990; Klepper, 1997; Agarwal et al, 2002).

*** Figures 1 and 2 about here ***

We then impose economic shocks of different magnitudes (respectively 8% and 10%). SS events cause two effects of interest – demand falls and financial markets tumble. For didactics, in this section we examine the former, and only subsequently integrate the latter. Accordingly, we operationalize SS effects by means of a downward shift $\Pi_t$ of the demand curve $P_t$ (Equation 2, footnote). This demand shift in turn causes an abrupt decrease in the price equilibrium. In Figure 1 we highlight two noteworthy effects: (a) the fewer players in the immediate aftermath of a shock, being that survival advantages are asymmetrically related to the SS magnitude, and (b) the stickiness of such advantages overtime. Regarding the short run effect, the logic is that the drastic fall in demand *exogenously* induces a shakeout; that is, several firms fall short of minimally required performance levels (in Equation 4, either $\chi_{it} \leq \chi_{\text{min}}$ or $K_{it} \leq K_{\text{min}}$) and are forced out at a time that is otherwise *unexpected* in the regular evolutionary trajectory. We tested the model with varying shock levels, and note the findings are sensitive: in ‘mild recessions’ (e.g. SS $\leq 4\%$) shakeouts are small, killing few firms. In turn, in ‘severe depressions’ (e.g. SS $\geq 12\%$), they are deep, killing most firms. As a result, we conclude that the size of exogenous shakeouts monotonically increases with the SS magnitude. For matters of illustration, in Figure 1, survivors of a 10% Sudden Stop are about half those from a simulated 8% Sudden Stop.
A direct consequence of a change in the number of players is the corresponding change in average market share. In Figure 2, the base model shows that average firm output starts low, but significantly increases during the development period, to then ease out in the maturity phase of industry life. In contrast, as we exogenously induce shakeouts, survivors average a much higher output level. Given that the market has a smaller number of players (Figure 1), each firm then grabs a bigger share of the market vis-à-vis its counterpart in stable contexts. As with the earlier survival simulation, the exact sizes of share advantages are sensitive to SS levels, but the pattern of bigger market share relative to shock sizes is robust in our sensitivity analysis.

Beyond the contrast of survival and market share across base and SS/PM models, we also examine shock effects on entry order advantages. Our findings are that SSPM events tend to be mild on early movers but severe on laggards, thus *enhancing* the scale of FMA vis-à-vis those observed in stable contexts. In our model, preemption and technology-related benefits (the result of aggressive investments in capacity and R&D) build up overtime, and induce cost level heterogeneities. This path dependent mechanic then make late entrants less cost competitive, as they lag behind in scale efficient production capacities, learning, and technology. When demand contracts sharply then, they more naturally shake out, given that the conditions $\chi_{it} \leq \chi_{\text{min}}$ or $K_{it} \leq K_{\text{min}}$ in Equation 4 tend to occur more frequently for them rather than early movers.

We showcase this enhancement in survival FMA in Figure 3. The graph offers a similar rationale of cohort survivability as presented in Klepper (1997: Figure 3, pp156). We divided the industry in 3 cohorts of entry (cohorts 1, 2, and 3 are respectively early entrants, early followers, and laggards). Consistent with previous literature, early movers have a survival advantage over laggards in stable contexts. But in contrast, SS/PM contexts impose a notably higher mortality rate for late versus early movers. We tested this difference again by partitioning the population
into more cohorts, and in different ways (e.g. 4 and 5 cohorts separated by one year or two). We found the pattern to be very robust, and conclude in support for the validity of the model.

*** Figures 3 and 4 about here ***

This FMA swell also occurs in market share (Figure 4). In stable contexts (base model), early movers naturally accrue market share advantages over laggards due to their path dependent resource investments. In contrast, in an SS/PM context, all survivors see an upsurge in market share vis-à-vis their respective counterparts in stable contexts. However, we point here that the market share FMA increase accrues significantly more to early rather than late movers. This asymmetric FMA advantage results directly from the different survival rates shown previously (Figure 3), which as our model highlights, favor those farther ahead in production process learning curves, i.e. the firms who preempted more scale-efficient production capacity spaces through cumulative capital expenditure and R&D.

In sum, a first set of results is that SS events *exogenously* induce shakeouts, the survivors of which tend to be early movers, i.e. those with the largest set of accumulated production know how (which accrues through scale and learning), or most efficient production technology (which accrues through R&D). This survival advantage then creates a natural market share lead. As rather intuitive the logic above may seem, the second result unveiled by our model – i.e. the persistence of such effects overtime – is considerably less so. As is noticeable in Figures 1 through 4, in the aftermath of a Phoenix Miracle, the industries hit by SS/PM events *remain* more concentrated overtime, such that the exogenously induced FMA increments are sustainable in the long run. The reasoning underlying the sustainability of FMA increments relates to the barriers that prevent new entry in the aftermath of Phoenix Miracles. The first of these barriers reflects the accumulated learning advantage. From Equation 3, learning directly affects
accumulated output, and consequently cost levels. Thus, in the aftermath of a shakeout, survivors continue to accrue learning experiences and reduce costs even in the absence of newer capital investments. This learning is obviously unavailable to outsiders, so when potential new entrants periodically assess the attractiveness of an entry move, fewer will find performance levels that surpass the minimally accepted (in our model, $\chi_t \leq \chi_{\text{min}}$). In essence, the cost competence discrepancy is significant in the current period and only grows asymptotically larger in favor of incumbents. New entry in the aftermath of a Phoenix Miracle thus remains low, subsequently explaining the long-term persistence of FMA increments as shown before.

A similar model process characterizes a second barrier, cumulative R&D. Firms invest in R&D to maximize profits the following period. In Equation 1, R&D investment $\tau_{it}$ affects profits negatively. However, while cost $c_{it}$ also affects profits, it varies in direct proportion to $\tau_{it}$ (in Equation 3), the cumulative technology level of firm $i$ in period $t$. R&D investments then occur if net effects are positive. Similar to the learning process, $\tau_{it}$ accrues path dependently, but is exclusive to incumbents. Thus, subsequently to PM events, incumbents further boost R&D-based cost advantages, such that when potential new entrants periodically assess the attractiveness of the business, fewer and fewer overtime find performance levels to be acceptable.

The FMA increments in SS/PM contexts also induce profit gains overtime, as we shall reveal later. Before we develop that point however, we establish this succinct set of propositions:

**Proposition 1a:** Industries subject to a Sudden Stop will observe an *exogenous* shakeout, the severity of which has a positive monotonic relationship with the SS magnitude.

**Proposition 1b:** Given path dependent resources enable cost advantages, the set of *exogenous* shakeout survivors will be made up mostly of early rather than late movers.

**Proposition 1c:** In industries subject to SS/PM events, early movers will accrue higher market share relative to their counterparts in SS/PM free contexts.

**Proposition 1d:** In contexts subject to SS/PM events, early mover market share advantages are sustainable in the long run.
Asymmetric Persistence of First Mover Advantages Across Industry Life

Further analysis of the model also made us conclude that the FMA boost discussed earlier is subject to time-dependent asymmetries. To arrive at this conclusion, we examined SS/PM events at 2 distinct life cycle times: development and maturity. In the former, buyer demand (and hence, firm profits) tends to grow very quickly, whereas in the latter, they grow more slowly.

According to previous literature (e.g. Lieberman & Montgomery, 1998; Suarez & Lanzolla, 2007), ambiguity in industry standards in earlier periods renders greater opportunities for late entrants to leapfrog early movers in contrast to later periods; as a result, FMA tends to increase as industry life evolves to later stages. In our base model, this evolution has significant yet opposite effects on firm margins and entry barriers: the former asymptotically decreases along industry life, whereas the latter grows continuously following accumulated learning and R&D. These shifts in turn affect the significance of SS/PM events across these two periods, as they affect the likelihood of exit and entry, respectively. For one, the downward evolution of profit margins as the industry matures makes firm survival to SS events less likely, because the lower the average margins practiced, the smaller the SS magnitude needed to cause a significant shake out. For this reason, at any given SS magnitude, more firms would leave the industry if the event occurred later rather than early in industry life. Moreover, the growth in entry barriers reinforces the effect. As per our earlier analysis, the FMA increment that early movers sustain overtime relate to cost-based efficiencies that affect expected performance of potential new entrants, such that subsequently to an exogenous shakeout, fewer potential entrants overtime find their expected performance to surpass minimum thresholds. As demand grows more slowly and prices more competitive as industry matures, the probability that $\chi_{it} \geq \chi_{\min}$ and / or $K_{it} \geq K_{\min}$ (in Equation 4) is higher in the development, rather than the maturity stage of the life cycle.
In essence, the *endogenous* uncertainties known to enhance FMA along industry life (as shown in Suarez & Lanzola, 2007) also moderate the FMA increments caused by *exogenous* shocks. This occurs because endogenous uncertainties create higher margin and lower entry barrier conditions earlier in industry life that facilitate new entry in contrast to what occurs in maturity. The point made here is that by interacting both layers of shocks, we highlight that FMA increase to levels beyond those shown in previous literature. We further tested whether the fact that some industries grow faster than others (hence, prices shift in different ways) overtime could induce a different result. Klepper (1997) in fact catalogued industry cycles, and verified they vary from multiple decades to just a few years. For this, we added a factor \( \omega \) (Equation 5, footnote) to both accelerate and slow down industry growth. Our results are robust, and allow us to conclude that the time-dependent asymmetry in FMA increments occurs solely due to the different demand growth and price levels across the two periods, therefore validating our logic.

*** Figures 5 and 6 about here ***

We note that the number of firms, under an SS/PM of 10% in year 7, asymptotically approaches that of the base model very quickly, making the effect almost imperceptible (for illustration, we added a shock of 20%). In contrast, the number of firms under an SS/PM of 10% in year 30 drastically deviates from that of the base model, and remains deviant thereafter. Based on the same logic, an analogous asymmetry occurs with market share (Figure 6). In sum, the FMA increases tend to be more ephemeral the earlier in industry life SS/PM events occur:

**Proposition 2**: The later in industry life SS/PM events occur, the more pronounced will be the additional gains in early mover advantages. Specifically if SS/PM events occur in the maturity versus the development phase of industry life, the larger and more durable will be the deviations in early mover market share and profit advantages in the long run vis-à-vis those observed of their SS/PM-free counterparts.

*Economic Shocks, Financial Flexibility, and Early Mover Advantages*
In the earlier section we concluded that early mover advantages increase under SS/PM, especially if shocks occur later along industry life. This is to say that path dependent resources related to preemption and technology leadership are more valuable in economically disturbed vis-à-vis regular contexts. In this section however, we highlight that sources of financial flexibility in turn become more valuable and relevant still in such distressed contexts, such that the extra survival and market share gains modeled earlier are contingent upon such flexibility. We define financial flexibility as the capacity of a firm to overcome the cash flow distresses introduced by SS events (as reviewed earlier), and which materialize from a mismatch between rigid debt services and faltering revenues. Lack of financial flexibility turns a firm unable to cover its operating cash flow, thereby causing its premature exit.

In our model, firms use up financial resources following a requested order: first, firms cover up negative operating cash flow \((OC)\)\(^9\), when profits are negative; second, they conserve the minimum required capital \((K^{\text{min}})\); third, they invest to grow to the optimal Cournot level; and fourth, they support R&D investments. The funds available to meet these needs arise from positive \(OC\), new debt \((\Delta D)\), and/or reductions in cash excess \((\Delta CE)\).\(^{10}\) SS/PM events cause an immediate drought in capital markets, such that the cost of debt increases with SS size.\(^{11}\) During an SS event firms use up their financial flexibility to cope with cash needs.\(^{12}\)

Financial flexibility occurs when debt services \((\text{INT}_i, \text{Equation 7})\) do not significantly increase the risk of negative operating cash flow. To model the effect of financial flexibility on

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\(^9\) (Equation 7) is \(OC = P_t*Q_{it} - c_i(Q_{it}) - \text{INT}_t - r_t\). For simplicity, we assume cost of debt to be the same for all firms, across all leverage ranges. This assumption actually plays against our projected expectations (increasing debt costs would enhance effects found here), so it shows the robustness of the model.

\(^{10}\) We also considered firms could raise new equity (in our model, \(\Delta E\)). The maximum a firm can raise is a percentage of current capital, a parameter of the model. Formally, \(\Delta\alpha_t \leq \delta_t * K_t\), where \(\delta_t\) is randomly assigned at entry. Although stock markets tend to shrink significantly under SSPM, we tested whether new equity would induce different results. We considered a range between 0 and 10,000% (i.e. up to 100x equity). The results are robust.

\(^{11}\) Formally, \(\Omega = \Omega (1+\alpha*\Pi)\), where \(\Omega\) is the cost of debt, and \(\Pi\) is the SS magnitude.

\(^{12}\) We assume firms with negative leverage save up cash excesses to use in extreme cases, such as SS events.
entry order advantages, we randomly assign a financial strategy to each firm that consists of a target leverage level the firm maintains along its life. We define ‘financial leverage strategies’ by brackets of leverage levels, being that (a) level ‘1’ ranges from -30% to 0% (i.e. firms with cash excess up to 30% of its assets); (b) level ‘2’ ranges from 0% to 30% debt relative to assets; and (c) level 3 ranges from 30% to 60% debt to assets. Once assigned to one of any of the three brackets, firms can raise any amount of debt, so long as it remains within the bounds above. Target levels assigned have a random relation to entry order, such that either early or late entrants have equal possibilities of following higher or lower leverage levels.

With this model, in Figure 7, we display the evolution of firm survival in each of the 3 financial leverage groups, with an SS of 10%. In the base model all 3 groups develop more or less consistently, being that firms with more cash options (i.e. more leveraged) have a slight survival advantage that arises from lower death rates in the ‘development’ industry phase. This indicates that in stable contexts, financial flexibility and overall lower debt service levels offer no advantage. On the contrary it is more of a disadvantage because they limit growth options and the corresponding learning and scale economies. In SS/PM settings, in turn, more leveraged firms (i.e. level ‘3’, Figure 7) display a higher mortality rate than firms with excess cash (i.e. ‘1’, Figure 7), and a slightly higher death rate than firms with moderate debt (i.e. ‘2’, Figure 7). This arises directly from our model, where debt service is an intrinsic part of the firm’s operating cash flow (INTit, Equation 7). Higher debt together with sharply smaller revenues enhances the likelihood of bankruptcy (i.e. Equation 4, \( \chi_{it} \leq \chi_{\text{min}} \) or \( K_{it} \leq K_{\text{min}} \)). In contrast, firms with excess cash are more likely to withstand the negative OC, thus surviving the SS/PM event. Because new debt (\( \Delta D \)) is unavailable, firms can only cover up a negative operating cash flow (OC) by

\[ ND = D - CE, \quad K_{it} = ND_{it} + E_{it}. \]

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13 Financial strategies can involve a debt or cash excess (i.e. a negative leverage). Firms cannot simultaneously have debt and cash excesses, so the target leverage is defined as net debt \( ND = D - CE \), such that \( K_{it} = ND_{it} + E_{it} \).
reducing cash excess (\(\Delta CE\)). However, by definition, cash excess is only available to firms without debt, so a negative \(OC\) likely brings the firm into bankruptcy.

The real world logic underlying our findings requires a match of context to resources. Firms are deemed strong when their asset endowments (e.g. technologies, production processes, marketing, R&D, or financial flexibility) generate high performance in a given market context. This is to say that the overall context is a crucial element in the computation of firm relative strengths, insofar as it operates in support of the firm’s activities (Chakrovorti et al, 2011; Cuervo Cazurra and Dau 2009; Nelson, 1995; North, 1990). SS events cause many intertwined market conditions to fail thereby making it prohibitively expensive to sustain higher leverage targets. To begin, they bring demand and capital markets down, as we reviewed. But moreover, financial intermediaries – i.e. analysts, banks, mutual funds, and venture capitalists – restrict the flow of capital from savers to users (Levine and Zervos, 1998; Chakrovarti, 2011), while trade credit – i.e. the financing provided by suppliers in commercial transactions – also evaporates quickly (Love, Preve, & Sarria-Allende, 2007). Impatient creditors begin to exercise priorities in collecting their share in debtors’ assets, whereas the credit market dry up impedes leveraged firms to obtain new debt. With fewer buyers and no credit, leveraged players are much more vulnerable, and end up making the bulk of exogenous shakeout victims. In SSPM contexts, excess cash from previously accumulated profits or excess equity raised gives the firm a valuable stash of financial flexibility and capacity to temporarily withstand the turbulent context.

At this point in the life of the firm, the preemption and technology related assets accumulated path-dependently certainly make the firm more cost competitive to withstand SS/PM events. But if these were built with high leverage, these sources of survival advantage may be eclipsed by the short-term revenue / debt service flexibility mismatch. This means that
the SSPM-related early mover, cost-related advantages we modeled earlier need to be weighted against the risk of high leverage, insofar as surviving exogenous shocks requires both cost competitiveness as well as financial flexibility.

*** Figures 7 and 8 about here ***

One aggravating element in this process is that for a firm to more aggressively invest in production capacity as well as R&D it may choose to adopt a more leveraged position. In Figure 7, we highlighted that early in industry life, firms with higher leverage (i.e. level ‘3’) have a natural survival advantage than those with excess cash or slight leverage levels, albeit in SSPM settings, leverage becomes a hindrance. In Figure 8, the evolution of aggregate market share for these groups of firms confirm the trend. In a stable context, more leveraged firms grab a larger aggregate share of the market, but leverage becomes a severe handicap once the context turns macroeconomically turbulent. In the aggregate, more firms with excess cash survive SSPM events, thereby representing a larger aggregate share of the industry (Figure 8). This shift then implies a tradeoff between resource endowments in industries that afford FMA but undergo different exogenous settings. In SSPM settings, preemption and technology related assets are still strong sources of advantage, but no longer sufficient conditions for survival. Thus:

**Proposition 3a:** In SS/PM contexts, *ceteris paribus*, financially flexible firms (whether early / late movers) are more likely to out survive their corresponding financially inflexible peers (respectively, early / late movers).

**Proposition 3b:** Given the path dependent nature of preemption and technology related assets, the survival advantages proposed in 3a are stronger for early rather than late movers, i.e. financially flexible early movers are more likely to survive SS/PM events than financially flexible late movers.

**Proposition 3c:** In SS/PM contexts, firms that invest in preemption- and technology-leadership related assets by sustaining high financial leverage are more likely to exit the industry than their respective counterparts that do so with excess cash. In other words, survival in SS/PM contexts requires a tradeoff between cost effectiveness advantages and the risks imposed by financial inflexibility.
Proposition 3d: In SS/PM contexts, financially flexible late movers are significantly more likely to out survive financially inflexible early movers than their peers in stable contexts.

The survival and market share advantages modeled above in turn induce gains in profits. In the base scenario of Figure 9, profits grow expectedly overtime, in a cumulative function. In contrast, the SS/PM model shows additional profit benefits bestowed onto survivors (whether early or late movers). As per our model, this accrued difference results from survivors’ notably higher market power, associated to the entry barriers discussed earlier. In our model, higher market power results indirectly from our investment Cournot decision rule, which makes optimal margin (i.e. the point up to which firms aspire to invest) proportional to market share. Under SS/PM settings, firms accrue higher market share, and as a result, will look for a higher equilibrium margin. In the aggregate, total output will be lower, and equilibrium price higher.

*** Figure 9 and 10 about here ***

Figure 9 then is relevant to our analysis not only because it confirms SS/PM events affect the evolution of competition and competitive advantages but also because it suggests important welfare effects. Welfare has been mostly the concern of economists (see Lucas, 2003) who have examined it both from supply and demand sides. We do not know the behavior of buyers’ utility and budget functions, so our capacity to examine total welfare is limited. However, our findings permit general thoughts based on a ‘partial equilibrium’ perspective, i.e. from our understanding of what happens to populations of firms when industries are stricken by SS/PM shocks.

Conceptually, SS/PM shocks have both cleansing and scarring effects. The former is defined as a better market allocation of productive resources when the least effective players are driven out by competition (Schumpeter, 1934). Under this view, shocks define periods when wasteful fabrication is eliminated, such that resources and market space are freed to more
efficient players who churn out more goods for less (Mortensen and Pissarides, 1994; Caballero and Hammour, 1996). From this perspective, shocks tend to increment welfare. In contrast, the scarring effect is known to emerge in association to inflexibilities in resource allocation, due to financial frictions (Barlevy 2002; Ouyang 2007). Here, because SS events can eliminate both high and low productivity firms plagued by inadequate leverage strategies, some firm resource efficiencies accrued from learning and R&D do not carry over onto the new population, past the economic shock. Recent research has in fact found that under turbulent circumstances the scarring effect tends to dominate the cleansing effect (Ouyang, 2009). Likewise, our simulations show fewer firms, and fewer units produced (Figure 10) in the aftermath of an SS/PM, such that, from a partial equilibrium perspective, results indicate an overall decrease in welfare to buyers, even if firms earn more money (Figure 9).

**Sensitivity Analyses**

As with any formal model, our results depend on the structural characteristics assumed as part of the set of behaviors displayed by firms and groups, which in turn define the scope and validity of our conclusions. As we introduced our results, we carefully explained the causal mechanism associated, highlighting how the model structural properties ultimately induced the simulation output. In essence, the scope and validity of our results are delimited by our main assumptions, which include among others learning economies, exogenous shocks of sufficient magnitude as to force firms to exit, as well as preemption and technology related entry barriers.

As we discussed simulation results, we also introduced several relevant checks for different parameter values. This is very important in simulation research, as it is necessary to verify the robustness of results, and confirm our model output is not driven by narrowly convenient parameter choices. Given the number of parameters in our model, we ran several
additional checks not reported herein (e.g. several different SSPM magnitudes and timing), but which nonetheless confirm the simulation reports resulted. While we confirm the qualitative results were the same for these extra checks, for parsimony here, we make them available upon request. From this extra set of robustness checks, we call attention here to only one, which we find intriguing. When SS/PM events of significantly large magnitude occur in maturity, prices plummet so low that all firms exit the industry, while in some runs industry populations actually never quite recovered. This latter finding was especially the case when strong substitute products exist. Though we reckon that in real life entire populations can disappear when hit by SS/PMs, prices often recover dramatically quickly, when the shakeout wipes off supply capacity. In this case, the discrete nature of any simulation model requires steps small enough for the price adjustment to occur before an industry disappears. To avoid the possibility that results correlated with the step size, we ran simulations with different sizes, and still found robust results. Moreover, because the range of $\Pi_t$ follows that of previous literature, we observe that these results do not affect our conclusions, since these occurred in an insignificant number of runs.

**DISCUSSION: SOME OVERARCHING INSIGHTS**

One question that remains is whether in SS/PM contexts laggards and early movers have more or less prospects of earning advantages over one another (a matter raised by the Monsanto executive, early in the paper). In Table 2, parts A and B, we integrate our theoretical conjectures to examine this point. Stable and SS/PM contexts pose different sets of uncertainties to their firms. In the former, demand and technology uncertainties evolve endogenously such that they more or less predictably become smaller over the life cycle (Lieberman & Montgomery, 1988; Suarez & Lanzola, 2007). In such contexts, firms who enter early, and commit to preemption and technology leadership-related resource endowments are likely to sustain competitive advantages
over their less zealous rivals. To accelerate the speed of such investments, firms may use extra funds from credit markets, by adopting more leverage positions. This is shown in cell 1, Table 2, context A (henceforth, cell 2A1). In contrast, rivals that are less hurried and less zealous to commit to investments are almost certain to remain behind (cell 2A4). We note that both these mostly winner and the mostly loser positions may turn into undetermined outcomes (cells 2A2 and 2A3) when early movers are not as financially imbued to resource investments. In such cases, in industries that afford FMA (i.e. where preemption and technology related resources path dependently build up), a late mover may out trump an early entrant in case its learning and investment commitments are bigger, and enough time is given for it to catch up.

In contrast, in SS/PM contexts (side B, of Table 2) endogenous and exogenous forces intermingle. When (exogenous) SS/PM events occur, preemption and technology leadership related assets grow from important to very important (see proposition set 1). However, financial flexibility grows in value even more, going from relatively irrelevant to very important across the 2 contexts (see proposition set 3). This shift in relative value means it no longer pays for firms to make unbending investment commitments in production competencies at the expense of financial leverage. Instead, players in SS/PM settings are better off trading some of their investment zealousness so as to keep debt levels low or even negative. This is evident in Table 2, where the mostly winner position in stable settings (cell 2A1) now yields and undetermined outcome in SS/PM contexts (cell 2B1). Here, the risk of early movers’ high leverage cancels out their cost-based advantages, thus leveling out their survival chances against financially astute laggards. A similar shift occurs with mostly losers. In stable settings (cell 2A4), late entry and low investment funds mean firms can hardly ever expect to win out (the exception in our model is an extremely rare random draw of high learning skills). Under SS/PM (cell 2B4), this becomes
undetermined, as laggards’ flexibilities now count more for survival. Following a similar logic, we note that previously undetermined outcomes in 2A2 and 2A3 now yield mostly winner and mostly loser positions respectively. In 2B2, for example, early movers that judiciously traded off some of its investment hunger with safer leverage levels are not only more cost competitive than their respective late entrant peers, but also financially robust to withstand the SS/PM shock.

*** Table 2 about here ***

CONTRIBUTIONS AND CONCLUSION

In this paper we model and simulate the evolution of competition and firm advantages under turbulent economic settings. Through formal modeling and simulation runs, we propose that economic shocks induce shifts in the relative value of distinct resource endowments, thereby switching the bases upon which firm advantages are built and sustained. Specifically, in industries where preemption and technological leadership matter (i.e. those that afford early mover advantages), previous research suggests firms to enter early and invest in fast-paced growth and learning, so as to avoid leapfrogging by late movers. But we point to a vital tradeoff in economically distressed markets, where the relative value of financial flexibility increases relatively more, such that it becomes more advantageous to firms to limit growth and learning investments so as to increase survival and market share advantages over the long run. Compared to their peers in stable contexts, laggards with a financial flexibility advantage can in fact more easily surpass early movers in these contexts. Our overarching theoretical analysis is that such shifts result from the confluence of endogenous and exogenous uncertainties along industry life, while they are subject to the timing and magnitude of economic shocks along the life cycle.

What does our Study Bring to Strategic Management Research?
We framed our study by borrowing from the early mover advantage (FMA) literature. Early movers, understood here as those that significantly occupy a new market space ahead of others (Lieberman & Montgomery, 1988; 1998) are known to seek the profits and market share gains associated to prompt commitments (e.g. Kalyanaram, Robinson, Urban, 1996; Tellis and Golder, 1993; 1996; Agarwal et al, 2002; Robinson and Min, 2002; Suarez & Lanzolla, 2007). Recent research conjectures that FMA increase along industry life (Lieberman & Montgomery, 1988; 1998; Suarez & Lanzola, 2007), and are for the most part subject to a comparative effect, wherein distinct resource sets afford entry advantages at different moments (Robinson and Fornell, 1992; Min, Kalwani, and Robinson, 2006). Our study builds off from these points, and reflects on the needed analyses of early movers’ timing and dependence upon market conditions and resources. Our study is relevant and timely in light of both the historical as well as the current frequency and global scope of economic shocks (Calvo et al, 2006).

Conceptually, the shift across stable and turbulent contexts (Table 2, parts A and B) contrasts endogenous and exogenous uncertainties of industry life, and their associated resource endowment tradeoffs. Where endogenous uncertainties are dominant, firms focus on investing in path dependent assets to be competitive. However, where both exogenous and endogenous uncertainties afflict businesses, firms’ concern with path dependent resources is still valuable, albeit their focus must now include the quickly growing relevance of flexibility. Previous research has listed circumstances under which firms can attain FMA as endogenous uncertainties evolve (e.g. Suarez & Lanzola, 2007). By considering an additional layer of uncertainty exogenous to the life cycle, we are able to reflect upon two important matters. For one, SS/PM yield increments to FMA which result from path dependent resources, but which were previously not expected in stable contexts. For another, SS/PM events shift resource endowment values,
such that the aforementioned FMA increments are contingent upon firms maintaining financial flexibility. Strategy scholars have shown that when markets retract, weak firms leave and strong firms grow (e.g. Anand & Singh, 1997). Paradoxically, in SSPM contexts, the definition of what constitutes a strong firm shifts to those that also possess financial liquidity. Only insofar as liquidity is not a hindrance will early mover advantages arise from path dependent resources. Ignoring these tradeoffs may cause a *mostly winner* early mover to find out too late that some *mostly loser* laggard rival now has a higher chance of leapfrogging.

Another dimension of the strategy debate reflects whether sources of advantage are absolute or comparative (Robinson et al, 1988; 1992). The comparative advantage hypothesis explains that for different stages in the industry life cycle corresponds a more valuable set of resources. This thesis counters the absolute advantage idea that entering early always yields FMA. Empirical evidence seems to corroborate the comparative advantage hypothesis. For instance, firms entering in the nascent period are more likely to be successful when endowed with superior financing and R&D skills, because they are better able to withstand cash and product technology uncertainties (Biggadike, 1976; Robinson & Fornell, 1992). In turn, firms entering later in industry life are better equipped with production (Lambkin, 1988), and marketing skills (Robinson et al, 1992; Sullivan, 1992), since more predictable demand favors scale efficient production as well as niching. Our distinction between endogenous and exogenous uncertainties is also relevant to this debate. We note that this earlier comparative advantage research points to similar endogenous evolutionary forces known to influence different points along industry life. Our model adds to this logic in that shifts in value of resource endowments may change less predictably, when exogenous events occur. Our contribution is not in just corroborating the comparative advantage idea. Our study first points to different sources of
uncertainty not previously examined in detail, and then highlights that FMA may increase or decrease depending on whether one considers the value of assets that build path dependently (in which case FMA increases) or that of assets that afford flexibility (in which case FMA may increase or decrease, depending on which firms possess these).

Even if our model mechanics focus on elements from the FMA literature, we cannot help but consider the equally significant consequences to other literatures, such as the industry life cycle and international management. In life cycle research, scholars have mostly focused on endogenous forces, and how they evolve overtime (for example, the evolution of technological uncertainty. See Agarwal et al, 2002 for a review). Possibly with the exception of Jovanovich et al (1994), little is known about how exogenous factors change the course of life cycle. Adding to this point, we show that economic shocks change the life cycle trajectory in significant and rather permanent ways. Such changes are well beyond the scope of endogenous forces, often considered in life cycle studies, and represent a significant area for further inquiry. Previous literature highlights that FMA advantages persist overtime (Robinson and Min, 2002; Min, Kalwani, and Robinson, 2006; Kalyanaram, Urban, and Robinson, 1995; Golder and Tellis, 1993). This literature often mentions ‘exogenous forces’ (such as demand and technological uncertainties) afflicting the firm. We call attention to a fundamental distinction in terminology. What we refer to ‘endogenous’ and ‘exogenous’ reflect forces relative to the industry, not the firm. By considering forces exogenous to the industry, we demonstrate that the evolution of FMA takes a different dynamic, and switch the bases of competitive advantage.

Our study also suggests a view beyond the specific capabilities of production costs and financial flexibility modeled above, and point to the alignment between endogenous / exogenous uncertainties with the path dependent / flexibility nature of different capability sets. Exogenous
shifts can involve a myriad of areas, in technology, political, or social events. Likewise, other resource endowments may impose tradeoffs of similar nature to that presented here, such as for example the question of whether to subcontract employees versus to hire and train them. In countries where labor legislation imposes severe market frictions, making it difficult to hire and fire, flexibility to adjust payrolls can become much more valuable under exogenously unstable settings. This means that in such turbulent times, firms may be better off trading some of efficiency advantages of a highly and firm-specific trained staff to resource flexibility. Similar path-dependent versus flexibility tradeoffs can also exist in decisions regarding in-house versus outsourced technology development in, or alliance governance choices.

What does our Study Bring to Strategic Management Practice?

Our modeling helps unravel factors influencing competitive dynamics and firm advantage through an *ex post* analysis of economic shocks that occur along industry life. Certainly we are unable to offer ‘catch-all’ statements such as “be sure to rush ahead with investments when macroeconomic uncertainty grows”, but our theorizing and findings help improve the quality of management decision-making *ex ante* significantly. As the Monsanto executive highlights, economic shocks are puzzling even for seasoned executives leading the industry (as Monsanto did, at the time). A majority of these executives would use common intuition to infer that SS/PM events necessarily spell doom, and subsequently adopt a ‘wait-and-see’ or even an ‘abandon the ship’ strategic approach (as Wall Street suggested Monsanto and many other firms should do, in that circumstance). Some wiser ones on the other hand would try and ‘seek for opportunities in the storm’. Giving veracity to this old Chinese dictum, we pinpoint specific sources of advantage in such troubled contexts. Macroeconomic shocks increase the value of isolating mechanisms (such as preemption and technology leadership) thus making it worth (in the long run) for some
early movers to stick through the storm. However, such troubled contexts bring an added requirement for success: that firms tradeoff some commitment to added flexibility so as to avoid short run unbending states that impend survival. The relevance of these tradeoffs correlates positively with the progress of industry life as well as SS/PM magnitudes.

Future Research

Our study certainly faces scope tradeoffs, so it creates opportunities for future research. Our Cournot modeling choice requires product homogeneity, so our modeling assumes away endogenous uncertainties of the Schumpeterian kind, that is, those related to product rivalry early in industry life. Our modeling instead follows the approach by Klepper and colleagues (1997), and examines industry paths after a given product standard has been accepted, and where technology competition involves production processes. Other model-mechanics do allow for product heterogeneity (e.g. Hotelling, 1929; Chamberlin, 1933), albeit they too impose tradeoffs of their own, which forbid the analysis pursued here. Future studies can isolate the confluence of endogenous and exogenous forces to the early product rivalry phase of the life cycle.

Two assumptions underlying our model may also be revised in future research. For one, our model is limited to a demand shock that reduces output prices compared to input prices and costs. Some industries however operate with a different relative price situation, for which demand shocks may behave differently, and even in opposite ways. For instance, a local producer that exports most of its output is likely to benefit from the drastic shift in exchange rate. Second, our Cournot assumption of product homogeneity prevents us from modeling the third of Lieberman & Montgomery’s isolating mechanism – switching costs. One of Lieberman & Montgomery’s isolating mechanisms, operate under exogenous shocks. By making stronger
inferences on demand side uncertainties in future research (and incurring different tradeoffs vis-à-vis those offered here), we can reach a higher level of understanding of the phenomenon.

We also think more can be done to study other forms of exogenous shocks. Along the lines, a recent study by Li & Tallman (2011) competently lays out the relevance of such shocks to firm performance. We share their enthusiasm, in that considering exogenous shocks of various natures would significantly enhance the quality and relevance of our literature. Beyond economic disruption, exogenous uncertainty may arise from social, political, as well as technological shifts.

All in all, we sense the limited knowledge offered here can be helpful in better understanding the options managers have when struggling with difficult macroeconomic times, while we are hopeful our theory and modeling will inspire further research on the subject.
Figure 1: Evolution of Firm Survival – Stable x SSPM contexts.

Figure 2 – Average Output per Firm.
Figure 3: Evolution of Survivability, by Cohort

Figure 4: Early Mover Market Share Advantages (SS/PM 10%, year 30) – by cohort
Figure 5 – Time-Asymmetric SSPM effects on Survival

Figure 6 – Time Asymmetric SSPM effects on Average Output per Firm
Figure 7 – Evolution of Survival by Leverage Group

Figure 8 – Evolution of Aggregate Market Share by Leverage Group
Figure 9 – Aggregate (all firms) Accumulated Profits.

Figure 10 – Aggregate (all firms) Product Output.
Table 2 – In an industry subject to early mover advantages (i.e. one that offers preemption and technology-leadership-based advantages)

<table>
<thead>
<tr>
<th>CONTEXT (A): STABLE MACRO ECONOMY</th>
<th>CONTEXT (B): SS/PM AFFECTED ECONOMY</th>
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<tbody>
<tr>
<td>HIGH FINANCIAL LEVERAGE (i.e. LOW FINANCIAL FLEXIBILITY)</td>
<td>HIGH FINANCIAL LEVERAGE (i.e. LOW FINANCIAL FLEXIBILITY)</td>
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<td>EARLY ENTRY</td>
<td>LATE ENTRY</td>
</tr>
<tr>
<td>1. MOSTLY WINNER (firms that enter early, grow quick, and learn fast are more likely to survive endogenous shakeout)</td>
<td>2. UNDETERMINED (late entrant may leapfrog early entrant, by growing quicker or learning faster)</td>
</tr>
<tr>
<td>3. UNDETERMINED (late entrant may leapfrog early entrant, by growing quicker or learning faster)</td>
<td>4. MOSTLY LOSER (firms that enter late, grow and learn slower are less likely to survive endogenous shakeout)</td>
</tr>
</tbody>
</table>
### Appendix: Simulation Parameters

<table>
<thead>
<tr>
<th>Name</th>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital productivity</td>
<td>$\alpha$</td>
<td>4.0</td>
</tr>
<tr>
<td>Cost of debt</td>
<td></td>
<td>7%</td>
</tr>
<tr>
<td>Demand elasticity</td>
<td>$\varepsilon$</td>
<td>2</td>
</tr>
<tr>
<td>Demand parameter</td>
<td>$\varsigma$</td>
<td>250</td>
</tr>
<tr>
<td>Demand shift</td>
<td>$\varphi$</td>
<td>3%</td>
</tr>
<tr>
<td>Depreciation</td>
<td>$\delta$</td>
<td>10%</td>
</tr>
<tr>
<td>Potential entrants mean</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Potential entrants std. dev.</td>
<td></td>
<td>10 %</td>
</tr>
<tr>
<td>New external equity mean</td>
<td>$\delta$'s mean</td>
<td>40%</td>
</tr>
<tr>
<td>New external equity std. dev.</td>
<td>$\delta$'s std. dev.</td>
<td>10%</td>
</tr>
<tr>
<td>Technology mean</td>
<td>$\tau$'s mean</td>
<td>2.0</td>
</tr>
<tr>
<td>Technology std. dev.</td>
<td>$\tau$'s std. dev.</td>
<td>10%</td>
</tr>
<tr>
<td>Initial equity mean $^{(B)}$</td>
<td></td>
<td>4.0</td>
</tr>
<tr>
<td>Initial equity std. dev.</td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td>Innovation error std. dev.</td>
<td>$\xi$'s std. dev.</td>
<td>0.1</td>
</tr>
<tr>
<td>Learning rate factor max $^{(C)}$</td>
<td></td>
<td>100 %</td>
</tr>
<tr>
<td>Learning rate factor min.</td>
<td></td>
<td>85%</td>
</tr>
<tr>
<td>Target leverage max.</td>
<td></td>
<td>60 %</td>
</tr>
<tr>
<td>Target leverage min.</td>
<td></td>
<td>-30 %</td>
</tr>
<tr>
<td>Minimum capital</td>
<td></td>
<td>1.0</td>
</tr>
<tr>
<td>Minimum unit cost</td>
<td>$\lambda$</td>
<td>0.7</td>
</tr>
<tr>
<td>Performance weight</td>
<td>$\theta$</td>
<td>60%</td>
</tr>
<tr>
<td>Price of substitute</td>
<td>$\delta$</td>
<td>3.0</td>
</tr>
<tr>
<td>R&amp;D efficiency max.</td>
<td>Max $\gamma$</td>
<td>1.0</td>
</tr>
<tr>
<td>R&amp;D efficiency min.</td>
<td>Min $\gamma$</td>
<td>0.0</td>
</tr>
<tr>
<td>SS duration</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>SS magnitude</td>
<td>$\Pi$</td>
<td>8%; 10%</td>
</tr>
<tr>
<td>SS start</td>
<td></td>
<td>7; 30</td>
</tr>
<tr>
<td>Supply elasticity</td>
<td>$\psi$</td>
<td>0.5</td>
</tr>
<tr>
<td>Cost of capital (WACC)</td>
<td>$\rho$</td>
<td>10%</td>
</tr>
</tbody>
</table>

Notes: (A) For the variables that are randomly assigned, the values in the table represent the distribution parameters. Maximum and minimum are the parameters for the variables using the Uniform distribution and mean and standard deviation for the ones using the Normal distribution. The standard deviation is referred as percentage of the mean. (B) Initial capital and debt are assigned to meet the target leverage. (C) The value in the table is the progress ratio, ie. the unit cost as a percentage of current unit cost, if output is doubled. The learning rate factor is $LR_i = 1 + log_2(\beta_i)$, where $\beta_i$ is the progress ratio randomly assigned to firm $i$. 
REFERENCES:


