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Value Appropriation Antecedents and Value Creation Consequences of Lead Firm Entry into Ecosystem Niches

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Abstract

Firm success depends not only on its internal resources and capabilities, but also on how it manages its collaborations and dependencies with external partners. We build on prior work on value creation and appropriation to discuss how leading firms within an ecosystem ? those belonging to the niche which captures the most value ? react to changes in value appropriation among niches, and how these responses affect total ecosystem value creation. We propose that the likelihood of lead firm entry into a target niche depends on changes in value appropriation in both target and lead niches, while the effects of entry on value creation depend on the extent of competition in the target niche. We test our hypotheses using quarterly panel data on the global semiconductor industry.

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ABSTRACT

Firm success depends not only on its internal resources and capabilities, but also on how it manages its collaborations and dependencies with external partners. We build on prior work on value creation and appropriation to discuss how leading firms within an ecosystem – those belonging to the niche which captures the most value – react to changes in value appropriation among niches, and how these responses affect total ecosystem value creation. We propose that the likelihood of lead firm entry into a target niche depends on changes in value appropriation in both target and lead niches, while the effects of entry on value creation depend on the extent of competition in the target niche. We test our hypotheses using quarterly panel data on the global semiconductor industry.

Keywords: Ecosystem, value creation, value appropriation, lead firm, niche entry.

INTRODUCTION

Research on inter-organizational value creation and appropriation (e.g. Brandenburger and Stuart, 1996) suggests that for a focal firm to profit from its products and technologies, it must rely on other players in its environment. Firms are increasingly aware that intrafirm efforts are not sufficient to retain competitive advantage; i.e, that no firm is an island (Gawer and Cusumano, 2002; Iansiti and Levien, 2004; Adner and Kapoor, 2010; Adner 2012). As such, interdependencies affect how value is distributed among industry participants (Jacobides,

Knudsen, and Augier, 2006). As industries evolve from vertical integration to specialization (Jacobides and Winter, 2005), interdependencies become more important as entrepreneurial opportunities in vertically specialized niches become viable. However, little attention has been paid to how the structure of interdependencies influences the total value creation and the distribution of this value among firms operating in different niches.

Interdependences among firms have been the focus of resource dependence theory (Pfeffer and Salancik, 1978), and may pose risks as it enables opportunistic behavior when contracts are incomplete (Williamson, 1975). To analyze such interdependence, the literature has examined different levels of analysis, such as the dyadic or the relational level (Teece, 1986; Dyer and Singh, 1998), network or portfolio level (Lavie, 2007; Ozcan and Eisenhardt, 2009), and the business ecosystem (Moore, 1993; Iansiti and Levien, 2004; Kapoor and Lee, 2013) or innovation ecosystem level (Adner, 2006; Adner and Kapoor, 2010). In an ecosystem, a group of firms is linked by transactions and complementarities, and engaged collectively in the provision of a product or service to end users (Iansiti and Levien, 2004; Adner and Kapoor, 2010).¹ Within such systems, firms, transactions, dyadic relationships, and value creation/appropriation regimes are characterized by complex co-evolutionary dynamics. As industries evolve, templates for division of labor (“who does what?”) and value appropriation (“who receives what?”), i.e., their industry architecture (Jacobides et al., 2006), also evolve. While industry evolution is a macro level phenomenon, understanding relevant underlying mechanisms often benefits from micro level evidence (see e.g. Brusoni et al., 2009; Tee and Gawer, 2009).

With increasing specialization, firms establish competitive positions for themselves in the emerging architecture. Focal firms that have the power to design the division of labor and

¹ These include different groups of firms which support each other in bringing products and services to market such as, component suppliers, partners, developers, users, buyers, complementors, rivals, universities, research institutions, and communities.

surplus, gain dominance through inducing coordination and stimulate value creation among several other groups of component providers and complementors, and initially appropriate the majority of the created value (Jacobides et al., 2006). Over time, templates for division of labor and value appropriation in ecosystems also evolve, creating opportunities and threats for different firms (Gulati and Singh, 1998; Gulati and Sytch, 2007). Building on previous work that has examined ecosystem level collaboration (e.g. Pierce, 2009; Adner and Kapoor, 2010), we focus on how lead firms in an ecosystem (those belonging to the niche which appropriates the most value) react to changes in the shares of value appropriated by different ecosystem niches, and how these reactions influence the total value created in the ecosystem.

We contribute to the literature by proposing that lead firms are more likely to enter niches whose share of value appropriation is increasing, and that this relationship is strengthened when the share of value appropriated by the lead niche is falling; when firms in the lead niche have more slack resources; and when firms in the lead niche possess more of the capabilities required to compete in the target niche. The effects of lead firm entry into a target niche on total value creation in the ecosystem depend on the extent of competition in the target niche, characterized by the extent to which niche output is concentrated in the hands of a few firms, and on the size of the acquiring firm relative to target niche firms. We test our hypotheses using quarterly data on the global semiconductor ecosystem between 2004 and 2011.

THEORY AND HYPOTHESES

Interdependencies between ecosystem partners are a natural result of greater specialization (Gulati, Puranam, Tushman, 2012). Therefore, the structure of collaboration between firms at the ecosystem level will have an important effect on the different outcomes of

asymmetries among complementary players' interdependences (Gulati and Singh, 1998). In this paper, we draw on the conjecture that firms are embedded in ecosystems of interdependent activities, and the way these activities are designed, i.e., the structure of interdependencies, underlie the total value created by the ecosystem and firms' ability to capture greater proportion of this value. Using this framework, we reflect a broader ecosystem level competition for dominance where partners may come from various industries, both downstream and upstream (Adner and Kapoor, 2010).

Ecosystems can be seen as meta-organizations², and like any organization, they embody key structural elements that can be designed (Gulati et al., 2012). In the meta-organization view, both formal and informal authority can lead to asymmetric dependence. In turn, this can lead to higher bargaining power and accrue benefits such as expertise, reputation, status, gatekeeping privileges, or control over key resources which sustain a firm's ability to capture more value from the ecosystem. Several studies have pointed the importance of different strategic moves by ecosystem owners, such as inducing coordination and stimulating value creation among ecosystem partners (Gawer and Cusumano, 2002), incentivizing partners to join and invest in the ecosystem (Gawer and Henderson, 2007), and more broadly, designing the 'rules of the game' in the ecosystem (Iansiti and Levien, 2004; Jacobides et al., 2006). Therefore, two conditions are necessary for an ecosystem lead firm³ to be successful; 1) incentivize partners to join the ecosystem and thus increase the total value created, 2) design and orchestrate the ecosystem in

² Meta-organizations comprise networks of firms or individuals not bound by authority based on employment relationships, but characterized by a system-level goal (Gulati et al., 2012).

³ The term 'lead firm' is used by Williamson and De Meyer (2012) and defined as the firm that plays an active role in shaping the ecosystem around it, and it is not necessarily the largest firm in the ecosystem. Similar terminology (with different emphases) is used in the literature. Some examples are hub firm (Jarillo, 1988), key actor (Knoke, 1994), triggering entities (Doz, Olk and Ring, 2000), strategic centers (Lorenzoni and Baden-Fuller, 1995), flagship firms (Rugman & D'Cruz, 2000), network orchestrator (Hacki and Lighton, 2001), keystone firm (Iansiti and Levien, 2004), platform leader (Gawer and Cusumano, 2002, 2008), relationship-centered organization (Gulati and Kletter, 2005), and ecosystem architect (Gulati et al., 2012).

such a way that it appropriates a significant proportion of aggregate value. Failing in one of these conditions will result in losses, or even in the dissolution of the ecosystem.⁴

In this section, we briefly review and build on several research strands relevant to our research question. In particular we look at resource dependence theory and its applicability to ecosystems, the literature on determinants and mechanisms of ecosystem-wide value creation and appropriation, and the literature on struggles between lead firms and their ecosystem partners to capture value while maintaining co-operative relationships.

Complementarities and Interdependencies. We focus on how interdependence among resources affects value capture, and therefore draw on existing research that has focused on organizational interdependence, in particular resource dependence theory (Pfeffer and Salancik, 1978). Work using this theoretical lens has addressed how an organization's environment, comprised of other organizations whose actions constrain the focal organization's actions and outcomes, affects organizations and how such interdependencies can be managed. In particular, resource dependence theory proposes that organizations manage interdependencies with their environment by using mergers and acquisitions (Casciaro and Piskorski, 2005), joint ventures (Pfeffer and Nowak, 1976), recruitment of board members (e.g. Lester et al., 2008), political action (e.g. Meznar and Nigh, 1995), and executive succession (e.g. Dalton and Kesner, 1983), with the aim of reducing uncertainty around their ability to access resources that are critical to organizational survival. In particular, resource dependence theory proposes that organizations manage interdependencies with their environment by using mergers and acquisitions (Casciaro and Piskorski, 2005), joint ventures (Pfeffer and Nowak, 1976), recruitment of board members

⁴ For example, when Nokia came up with the first 3G supported mobile device in 2002, the 6650, it did everything right in terms of product innovation. What Nokia missed was that the success of the new product would be dependent on many complementary products and services, such as mobile infrastructure or third-party content providers. Other partners in the ecosystem that would have supported Nokia in its efforts were not ready. 6650 was a Ferrari in a world with no roads and failed in the marketplace (Adner 2012).

(e.g. Lester et al., 2008), political action (e.g. Meznar and Nigh, 1995; Mullery et al., 1995), and executive succession (e.g. Dalton and Kesner, 1983; Guthrie and Olian, 1991), with the aim of reducing uncertainty around their ability to access resources that are critical to organizational survival.

Subsequent work in this stream has substantially improved our understanding of the organizational actions listed above, and empirical work has generally found evidence in support of resource dependence logic, while also pointing out the influence of other factors and contexts (Hillman et al., 2009). Our work, while not focused on further development of resource dependence theory as a primary goal, discusses how types of actions that are studied by resource dependence theory, such as mergers and acquisitions, can be used by ecosystem participants to manage their interdependencies with other ecosystem members.

The performance consequences of these actions taken to manage interdependencies have not received much attention from researchers (Pfeffer and Salancik, 1978 [2003]). Our discussion of the conditions under which lead firm strategic actions are more likely to succeed in altering the value creation and value capture architecture of the ecosystem in a way which favors the focal organization can then be seen as contributing to this under-explored area of study. By considering the value appropriation antecedents and value capture consequences of mergers and acquisitions within the semiconductor ecosystem, we propose and test an explanation for such activity that is complementary to the one provided by resource dependence theory.

Value Creation and Appropriation in Ecosystems. Recent scholarly contributions on the topic of interfirm competition use cooperative game theory to examine value creation and appropriation (Brandenburger and Stuart, 1996). Saloner et al. (2001: p.39) state that a firm will thrive not only when it creates value, but also when it is able to capture it. In this ‘value-based

strategy' view of the firm, value creation is defined using the Porter's (1980) framework of the value chain. Firms are concerned with value capture, which is related to how much value a firm adds to the value chain (MacDonald and Ryall, 2004). A necessary condition for a player to capture value is that the player creates positive added value (Brandenburger and Stuart, 1996).⁵ MacDonald and Ryall (2004) further show in their model, how much total value is created plays a decisive role in how that value will be distributed. Different sources of "What determines how much value each player will appropriate?" are investigated in the literature. Some examples are asymmetries and vertical chain activities of the firm (Brandenburger and Stuart, 1996), capabilities, absorptive capacity, environmental turbulence, and agility (Wenerfelt, 1984, Brandenburger and Stuart, 2007), uniqueness, inimitability, and competition (Macdonald and Ryall, 2004). The common premise in this work is to erect barriers around own created value to inhibit their loss due to competition and try to erode/appropriate other's created value as much as possible. Consistent with what has been done in neoclassical economics, these studies suggest that superior value capturing is associated with resources and positions of players in the value chain.

Struggles for Dominance between Ecosystem Partners. Application of the value-based strategy of the firm to ecosystems, although an extension of similar benefits to be gained among multiple component providers and complements, is not straightforward. Compared to conventional bilateral relationships, ecosystems are greater in size, draw on a more diverse set of relationships, and involve more durable arrangements. They require the lead firm to strategically build an overall architecture and to define interfaces and incentives which significantly reduce

⁵ Added value is the difference between value created by all the players in the vertical chain and the value created by all the players minus the one in question (Brandenburger and Stuart, 1996).

the effort required to sustain the ecosystem in the future, in order for the ecosystem to become a self-organized structure (Williamson and De Meyer, 2012). Using value-based strategy of the firm, it can be argued that the lead firm aims to promote an ecosystem where each specialized partner community provides positive added value.

It is important to note that parties involved in an ecosystem retain their individual interests.⁶ As a result of this, cooperating firms, especially if they are also involved in similar activities, can also be competing at the same time (Teece, 1992). As ecosystems are based on the interactions between varying parties from different industries for common value creation, the basis of competition in ecosystems is different from that of conventional competition. For ecosystem lead firms, lack of capabilities in other industries makes prediction of future outcomes extremely difficult.

Leveraging the ecosystem to maximize value capture, while incentivizing a network of specialized contributors to join the ecosystem, is the main purpose of a lead firm. Our main argument is that while the structure of interdependencies can emerge organically, the lead firm can also shape the architecture (see also Jacobides et al., 2006). The critical question is how to do this strategically. Ecosystems require orchestrating many difficult-to-manage relationships between diverse set of different participants (Dhanaraj and Parkhe, 2006). Rather than scaling up standard operating principles for these parties, every niche in the ecosystem requires rethinking the strategy by the lead firm so that the whole ecosystem functions in harmony. This might be even more difficult when the lead firm's aim is to align all these parties and unite them in a way that strengthens its profits (Williamson and De Meyer, 2012).

⁶ In contrast to e.g. strategic alliances, which aim at achieving common strategic purpose of partners (Das and Teng, 1998: 491).

Value appropriation antecedents of lead firm entry. Strategies within an ecosystem might turn out to be risky for lead firms as profits might leak to other parties (Williamson and De Meyer, 2012). When the growth rate of the share of value appropriated by firms operating in one of the non-leading niches increases, a lead firm could attempt to recapture some of this ‘leaking’ value by entering that niche through acquisition, for example. This is in line with the observation of different organizational forms ranging from arm’s length to hierarchical relationships as a result of interdependencies among ecosystem members (Kapoor and Lee, 2013).

Hypothesis 1: An increase in the growth rate of the share of total value captured by members of an ecosystem niche increases the likelihood of a lead firm entering that niche.

The likelihood of lead firm entry into a target niche whose share of value appropriation is growing at an increasing rate will be even greater if the lead firm has reason to suspect that the increase in value appropriation in the target niche is coming at the expense of value appropriation growth in the leading niche. A slowdown in the growth rate of the share of value appropriated by the leading niche combined in an increase in the growth of target niche value appropriation share will also make the target niche more attractive relative to the leading niche, making entry by a lead firm more likely.

Hypothesis 2: The smaller the growth rate of the share of total value captured by the lead firm, the stronger the relationship between the growth rate of the share of total value captured by niche members and the likelihood of a lead firm entering that niche.

Niche entry requires resources which are needed either to acquire a firm or business unit already operating in the target niche, or to establish a new business unit. Without access to the required resources, a lead firm will not be able to enter an attractive target niche even if it wishes to do so. While firms may be able to borrow to finance investment in acquisitions or new business unit creation, firms which possess sufficient slack financial resources are able to make these investments with greater ease and at lower cost than firms which must finance them through borrowing. Possession of slack financial resource therefore enables lead firms to acquire targets in other niches.

Hypothesis 3: The greater the amount of slack resources possessed by a lead firm, the stronger the relationship between the growth rate of the share of total value captured by niche members and the likelihood of a lead firm entering that niche.

Another concern for a lead firm when deciding on whether to enter a target niche is the extent to which it has the ability to be competitive with niche incumbents. To be competitive with firms in a target niche, a lead firm needs to possess the capabilities that are used by firms already present in the target niche. Possession of such capabilities will enable the firm to compete in the target niche, and will therefore increase its likelihood of entry in response to increasing growth in the share of total value appropriated by the target niche.

Hypothesis 4: The greater the extent to which the lead firm possesses capabilities used by niche members, the stronger the relationship between the growth rate of the share of total value captured by niche members and the likelihood of a lead firm entering that niche.

Value creation consequences of lead firm entry. Lead firm entry into a niche can alter the extent of within-niche competition, affecting not just firms operating within the niche, but also those upstream and downstream firms that sell to or buy from the focal niche's firms. If the target niche into which the lead firm entered was highly concentrated, with a handful of firms accounting for the majority of the niche's output, it is likely that lead firm entry into the niche will increase the degree of competition between firms operating within it. This increase in competition is likely to be beneficial for ecosystem members upstream and downstream from the niche. Upstream firms selling to niche members are likely to have an increased range of potential buyers to sell to, with these buyers having a lower degree of monopsony power following lead firm entrance. Downstream firms are also likely to benefit from an increased range of suppliers for the inputs they require, with the suppliers having a lower degree of monopoly power following lead firm entrance. In cases where the target niche had been extremely concentrated prior to lead firm entry, this increase in competition may act to remove a bottleneck from the ecosystem which, by extracting maximum value from transactions with upstream and downstream firms, had prevented entry into and growth of these upstream and downstream niches.

Hypothesis 5: Lead firm entry into a target niche increases the total value created in an ecosystem if target niche output was highly concentrated prior to lead firm entry.

However, there may also be downsides to lead firm entry into another niche. This is because such a move can diminish the incentives of other ecosystem members to increase their commitment to the ecosystem. As mentioned before, clearly defined interfaces avoid overlaps among how different niches contribute to the total value created. Observing the presence of the

lead firm in their niche, it is quite likely that the ecosystem partners feel threatened that the lead firm might squeeze their profit potential (Williamson and De Meyer, 2012).

These disincentivizing effects are likely to be most keenly felt by other ecosystem members if the lead firm is significantly larger than incumbent firms within the target niche. In such a case the entry of a large lead firm may signal a reduction in within-niche competition as this firm could dominate the niche, squeezing the value appropriated by other firms within the niche and by upstream and downstream ecosystem members.

Seeing a lead firm acting in such a manner will likely also make prospective new entrants into the ecosystem question the wisdom of doing so. If success within a niche results in the entry of a large firm from the lead niche which can then proceed to squeeze out incumbents, the risk of this happening is likely to prevent as many new firms from joining the ecosystem as would have done so in the absence of such action by lead firms. The entry into a niche of a lead firm that is significantly larger than incumbents is therefore likely to reduce the total value created in the ecosystem by reducing the degree of competition with the niche and by discouraging new entrants from joining the ecosystem.

Hypothesis 6: Lead firm entry into a target niche decreases the total value created in an ecosystem if the lead firm is much larger than other firms in the target niche.

EMPIRICAL CONTEXT AND DATA

Our theory is motivated by the recent changes in the structure of the global semiconductor industry. The historical evolution of this industry fits with how the structure of interdependencies was built from vertically integrated closed systems (also known as integrated device manufacturers (IDMs)) to specialized firms partnering with each other in an ecosystem.

The structure of the semiconductor industry after 1980s went through vertical disintegration (Kapoor, 2013), which in turn created business opportunities for specialized fabless companies. By 1990s, increased modularity and horizontal specialization in the semiconductor industry suggested that not many companies would be capable of surviving by doing everything in house, which in turn provided the emergence and legitimization of different groups of firms with special skills, such as intellectual property (IP) providers, fabless design companies, and foundries (Kapoor, 2012, 2013). As different components with different supply-demand dynamics are needed for semiconductor design and production, these new groups of firms combined their specialization, focusing on new ways of collaborating.

The current semiconductor ecosystem requires partnership among various parties such as electronic design automation (EDA) firm, IP licensors, fabless companies, foundries, assembly and test firms, and other suppliers (such as equipment providers). The complex structure of the semiconductor ecosystem, both in number and types of actors, appears to be an especially suitable context in which to observe strategies driven by ecosystem interdependencies. The illustration of the semiconductor ecosystem can be seen in Figure 1.

----- Insert Figure 1 here -----

Data. We test our hypotheses using data on the global semiconductor industry. Our main source of data for this study is obtained through the Global Semiconductor Alliance (GSA), an industry association responsible of collecting and providing data for fostering collaboration. A useful characteristic of the GSA database is that it provides data on every niche of the ecosystem including fabless/IDM firms, IP, EDA, foundry, and back-end (assembly, test and packaging). Our data covers all publicly traded semiconductor companies, and their in depth quarterly

financial data together with funding, IPO and M&A activity over 32 quarters between 2004 and 2011. These panel data consist of many variables such as company type (e.g., Fabless, IDM, IP, EDA, foundry, Backend etc.), quarterly revenues, net income, R&D Expenses, market capitalization, growth rates, funding, IPO and M&A activities of more than 270 semiconductor companies per quarter worldwide. The dataset consists of 8,879 firm-quarter observations. The M&A activities are reported as whether the type of the acquirer and the acquired firm is fabless/IDM (which are the lead firms in the ecosystem), or a supplier (IP, EDA, foundry etc), whether the firm is public/private, the amount paid and the payment type. Overall, 958 M&As are reported, of which 486 (51%) are done by the lead firms.

EMPIRICAL ANALYSIS

H1-4 focus on value capturing antecedents of lead firm entry, and test the impact of growth rate of the share of total value captured by members of an ecosystem niche (lagged) on the likelihood of a lead firm entering that niche. Our full empirical model is as follows:

$$P(y_{ijt}) = \gamma_j + \sum_{J=1}^J \beta_1 \sigma_{J,t-1} + \sum_{J=1}^J \beta_2 \sigma_{i,t-1} * \sigma_{J,t-1} + \sum_{J=1}^J \beta_3 C_{i,t-1} * \sigma_{J,t-1} + \sum_{J=1}^J \beta_4 D_{i,t-1} * \sigma_{J,t-1} + \alpha X_{i,t-1} + \varepsilon_{jt}$$

Where y_{ijt} signifies the lead firm entry dummy, which takes the value of one if a lead firm (fabless/IDM) enters niche j in quarter t , zero otherwise.⁷ γ_j is firm-niche fixed effects. $\sigma_{J,t-1}$ is our main covariate which accounts for the growth in the share of total value captured by members of niche j in quarter t (lagged). The second covariate interacts the growth rate of the share of total value captured by the lead firm (lagged) with the first covariate. The third

⁷ Alternatively, we also use total number of M&A deals and total amount of money offered in these deals as dependent variables.

covariate, $C_{i,t-1}$, interacts the amount of slack resources possessed by a lead firm (lagged), measured as cash and cash equivalents, with the first covariate. The fourth covariate, $D_{i,t-1}$, interacts the extent to which the lead firm possesses capabilities used by niche members, measured by a dummy indicating whether the target niche is upstream (IP and EDA) or downstream (foundry and backend). Our argument is based on the fact that decoupling between design and manufacturing in semiconductor industry signifies the different capabilities required, therefore we say that the extent to which the lead firm possesses capabilities used by upstream niche members will be greater than those used by downstream ones. $X_{i,t-1}$ includes a set of controls such as firm size and age. We estimate the model using random-effects panel data methods.

H5-6 are about value creation consequences of lead firm entry, and test the impact of lead firm entry into a target niche on the total value created in an ecosystem. Our full empirical model for this part will be as follows:

$$V_t = \beta_1 y_{ij,t-1} + \sum_{j=1}^J \beta_2 H_{j,t-2} * y_{ij,t-1} + \sum_{j=1}^J \beta_3 \bar{\mu}_{ij,t-1} * y_{ij,t-1} + \alpha X_{i,t-1} + \varepsilon_{jt}$$

Where V_t signifies the total value created in an ecosystem in quarter t. $H_{j,t-1}$ interacts Herfindahl index of niche j (lagged) with $y_{ij,t-1}$, and $\bar{\mu}_{i,t-1}$ takes the difference between lead firm size and the mean size of firms in niche j in quarter t and interacts it with $y_{ij,t-1}$.

RESULTS

We report our descriptive findings. Looking at gross profits per quarter, we observe the following changes in the shares of total value captured by each niche in the semiconductor ecosystem (see Figure 2). We see that fabless companies give certain portion of the total value

created in the ecosystem to their collaborating parties; however, they are dominant by capturing around 80% of the value created on average. This is in line with our definition of the ‘lead firm’ in the ecosystem, that fabless firms are the lead firms in semiconductor ecosystem.

----- Insert Figure 2 here -----

Expectedly, the general structure of interdependencies is stable. This suggests that the lead firms are doing a good job of managing the ecosystem. If the lead firm was not capable enough to build this structure and orchestrate the ecosystem (Dhanaraj and Parhe, 2006), we would have seen extreme changes in Figure 2, and then sustainability of the ecosystem architecture would have been in danger. We can say that semiconductor ecosystem is a healthy ecosystem, in other words a virtuous cycle of self-organized architecture is built by the lead firms where contributors enter and exit and interact with each other with no interference by the lead firm. Even though we do not observe a lot of changes in value capturing regimes, that the structure of interdependencies are not fluctuating frequently, some patterns, like the one in 2009q1, are worth mentioning. In this recession period, all downstream ecosystem partners, such as foundries and backend suppliers, lost their shares of value captured to upstream partners, IP and EDA suppliers. Fabless companies increased their share most in this period. This is worth mentioning, as the effect of crisis is bear by certain niches while others take advantage of it.

This can also be seen in Figure 3. During moments of extreme variance within value appropriation shares of ecosystem niches, uncertainty reigns in the ecosystem, increasing divergent investment paths followed by participants. In other words, when the lead firm fails to provide a clear roadmap indicating how the ecosystem architecture will evolve, we observe a lot

of changes in value capturing regimes as the structure of interdependencies are fluctuating frequently, resulting in reluctance in commitments from partners to value creation, thus a decrease in total value creation.

----- Insert Figure 3 here -----

In Figure 4, we convert the patterns in Figure 2 to growth rates. This will be our main covariate to test H1-4. As can be seen, during moments of extreme value capturing growth rates by certain niches, such as 2008q1 for design services niche, or 2009q2 for backend niche, or 2010q1 for IP niche, asymmetries within the ecosystem's interdependencies might result in lead firm's entry into that niche.

----- Insert Figure 4 here -----

Regarding H5-6, we take into account lead firm's number of entries, measured in the number of M&As done by lead firms each quarter. As hypothesized, that will have an impact on total value created in the ecosystem. Figure 5 shows that such an effect appears to exist, following an increase in lead firm's entry in terms of M&As basically decreases total value created, with a lag of 2-4 quarters.

----- Insert Figure 5 here -----

DISCUSSION AND CONCLUDING REMARKS

In this paper, we aimed at tackling two important questions: how do lead firms react to changes in value appropriation, and how do these reactions in return affect total value creation among collaborators. Lead firms face two conditions for their ecosystem to function in their favor; 1) incentivize partners to join the ecosystem and thus increase the total value created, 2) design and orchestrate the ecosystem in such a way that maximizes appropriation of the created value. We show that these conditions might easily conflict, in other words under certain conditions lead firm entry into another niche might positively influence value creation by removing a bottleneck, whereas under other conditions it might threaten ecosystem partners, diminishing the incentives to invest and commit to the ecosystem. As such, we build on existing work that has highlighted strategies for lead firms to resolve the tension between value capture and creation (e.g. Gawer and Cusumano, 2002, 2008; Iansiti and Levien, 2004; Gawer and Henderson, 2007; Williamson and De Meyer, 2012). As this work has shown, entry into other niches can harm the viability of the ecosystem by reducing incentives to invest in the future – our empirical evidence underlines this view. We build on the existing literature by empirically demonstrating how ecosystem value might increase by removing a bottleneck. As such, we also contribute to recent work that has highlighted the role of “bottlenecks” as strategy to increase value capture (Jacobides et al., 2006). Our findings provide a useful complement to the latter stream of work on industry architecture (Pisano and Teece, 2007; Brusoni et al, 2009). Instead of maximizing value appropriation by “becoming” a bottleneck, a firm might increase ecosystem wide value creation by the elimination a bottleneck and increasing activity in that segment.

Our study knows several important limitations. First, as we have focused on a single industry, we have to be cautious in generalizing to other settings. Second, our data cover a relatively short period of time, which we hope to expand on in future work.

Despite these limitations, we believe our effort can be taken as an important step to highlighting how asymmetries among complementary players' interdependencies affect value creation and their subsequent effects on value capture in ecosystems.

FIGURES

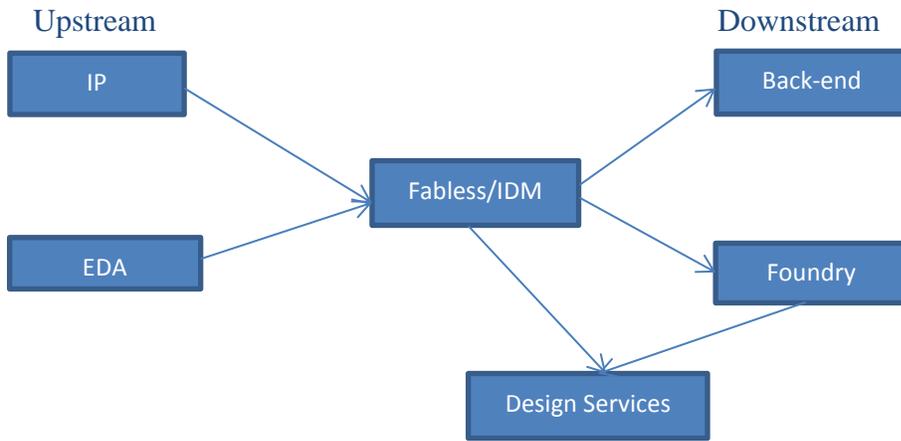


Figure 1. Structure of the semiconductor ecosystem

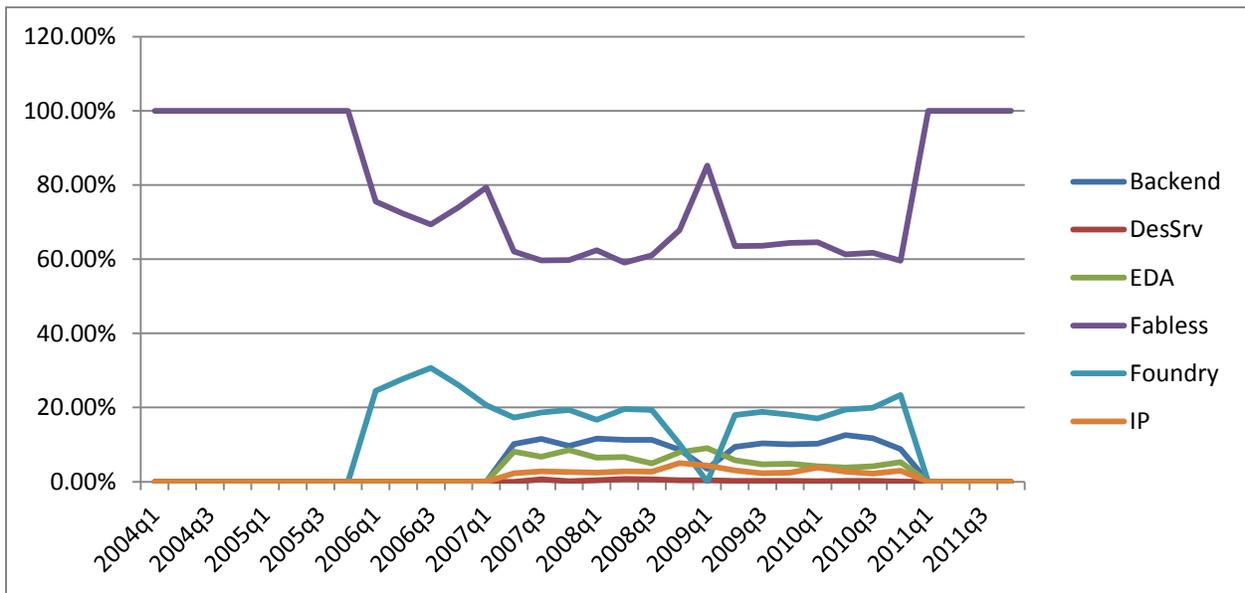


Figure 2. Shares of total value captured by each niche over time.

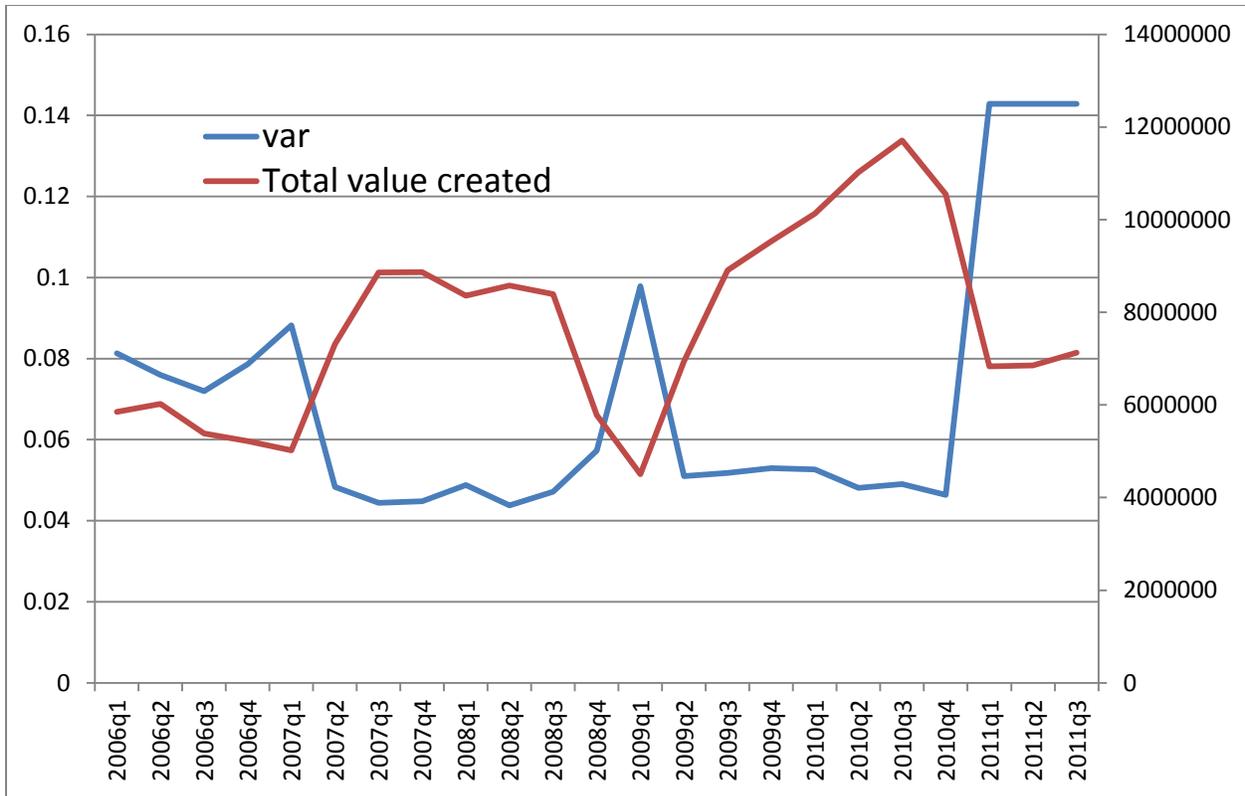


Figure 3. Variance in shares of total value captured by each niche over time and total value created in the ecosystem

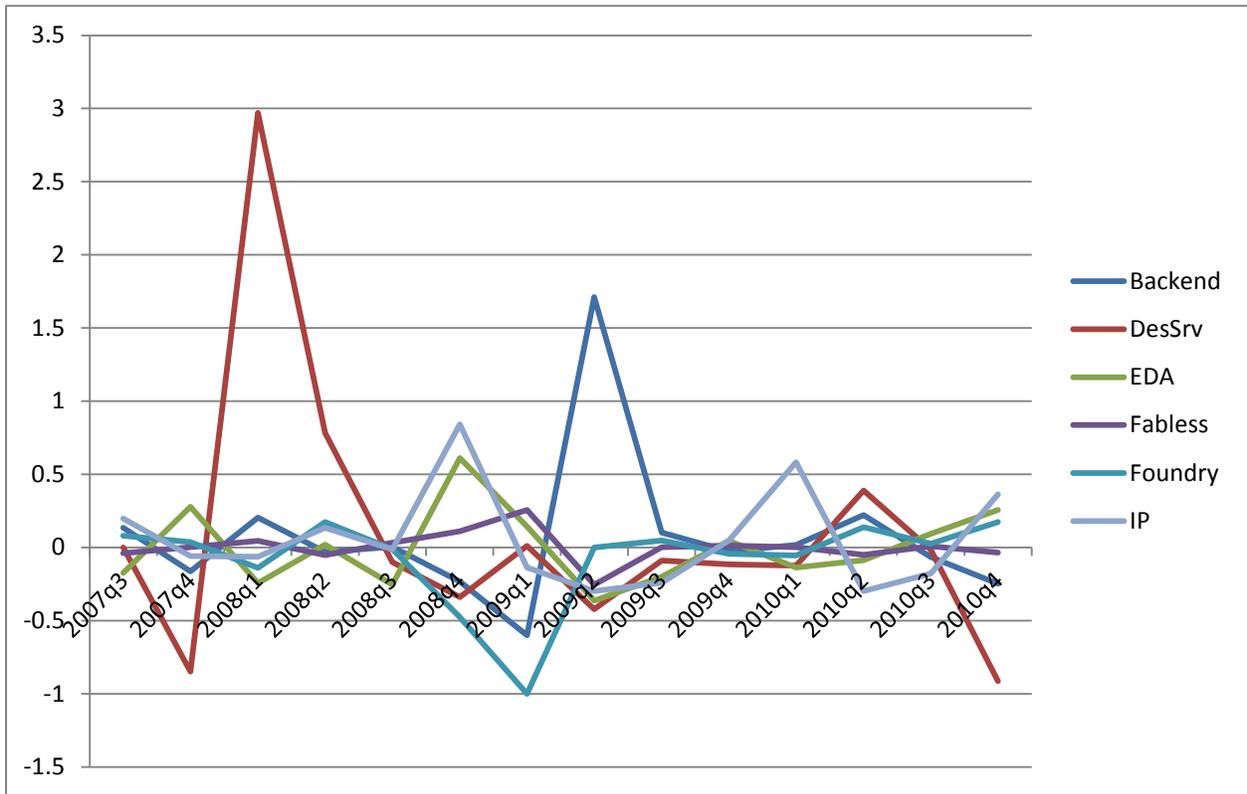


Figure 4. Growth rates of the shares of total value captured by each niche over time.

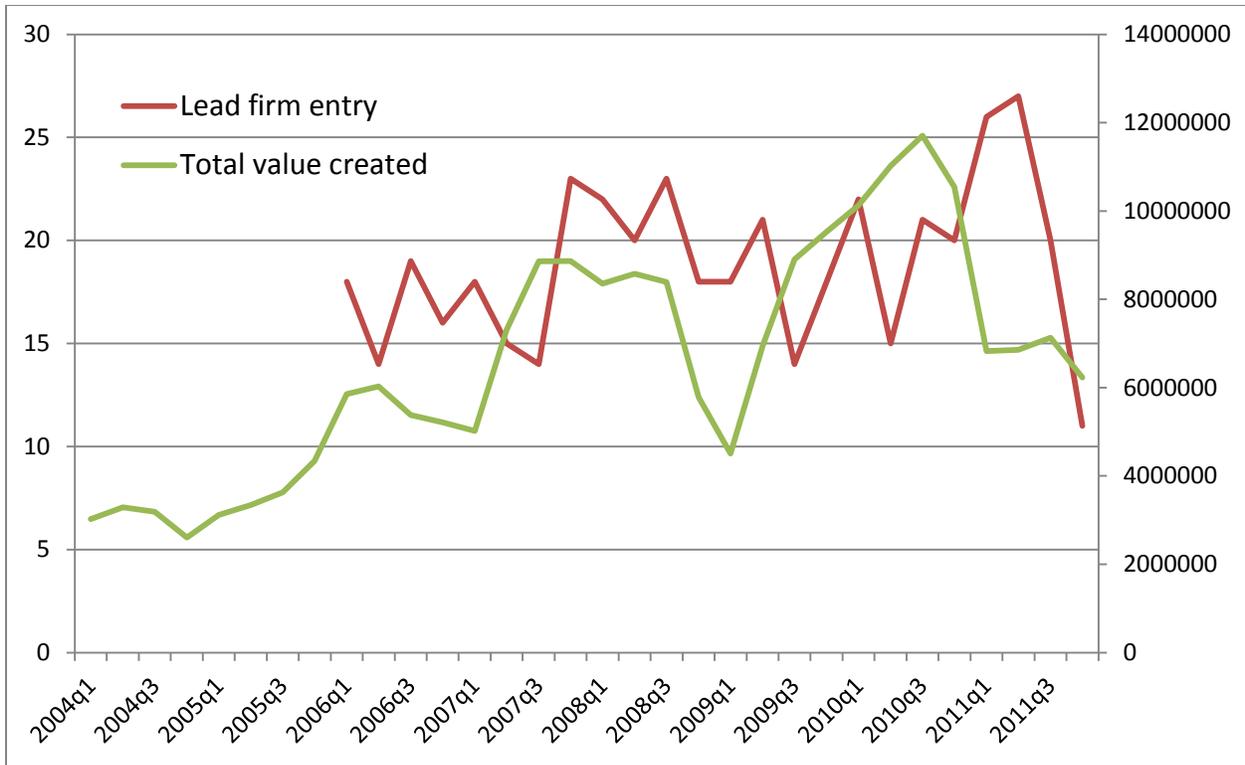


Figure 5. Number of lead firm entries (M&As) and total value created in the ecosystem.

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