ESTABLISHING SUCCESSFUL E-COMMERCE ECOSYSTEMS: EVALUATING STRATEGIES FOR REACHING A CRITICAL MASS OF PARTICIPANTS

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Abstract

Although e-commerce in general and platform business models in e-commerce report steadily increasing revenues, establishing e-commerce ecosystems is not a guaranteed success *per se*. Potential platform owners must carefully plan the ignition of the ecosystem to reach a critical mass of customers. This critical mass is crucial for the platform to benefit from direct and indirect network effects. However, research so far has not provided clear guidance and strategies on how to successfully establish ecosystems in e-commerce. Therefore, we evaluated and demonstrated generic platform ignition strategies in e-commerce. Our evaluation is thereby based upon an established mathematical model for two-sided markets considering utility gains from indirect network effects and costs. The heterogeneity of the individual market sides is reflected in the form of sigmoidal distribution functions. Applying this model, we show that subsidies, seeding, marquee, single side, micro market, piggybacking, opening up, and big bang marketing are potential strategies for reaching a critical mass of participants in e-commerce ecosystems. We provide guidance for practitioners on how to establish successful e-commerce ecosystems. We contribute to the body of knowledge strategies in e-commerce ecosystems by bridging critical mass and network effects.

Keywords: E-Commerce Ecosystem, Platform, Two-Sided Market, Ignition Strategies, Critical Mass, Design Science

Authors' individual contribution: Conceptualization — T.W.; Methodology — T.W. and B.D.; Validation — B.D.; Formal Analysis — B.D.; Investigation — T.W. and B.D.; Resources — T.W.; Data Curation — B.D.; Writing — Original Draft — T.W. and B.D.; Writing — Review & Editing — T.W. and B.D.; Visualization — B.D.; Supervision — T.W. and B.D.; Project Administration — T.W.

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1. INTRODUCTION

A phenomenon of the increasing digitalization at the societal, organizational, and individual levels amplified by the recent COVID-19 pandemic is the proliferation of e-commerce (McKinsey, 2021, 2022). The revenues of e-commerce are expected to reach US$7.4 trillion by 2024 ("Retail ecommerce sales worldwide", 2020). Therefore, a presence in e-commerce is manifesting as a core requirement for most retailers. While e-commerce transactions can take place in traditional dyadic relationships between customer and retailer, more complex intermediary business models have proven to be even more successful in e-commerce (Hagiu & Wright, 2015). Amazon, the largest e-commerce company, generated US$340 billion in revenue from product and service sales in 2020, with more than 60% of revenues resulting from commission fees of third-party sellers on its own platform (Amazon, 2019, 2021). Across industries, the revenue realized by the surrounding ecosystem is up to three times higher than the revenue generated by focal ecosystem participants, such as Amazon or Walmart (Delteil et al., 2020). Retailers are considered focal actors in these e-commerce ecosystems, as they act as intermediaries between manufacturers, customers, and additional ecosystem participants, such as opinion pollsters or advertising agencies (Wulfert et al., 2022).

Irrespective of the successful platforms in e-commerce (e.g., Alibaba.com, Amazon Marketplace, Walmart Marketplace), many other retailers (e.g., Rakuten, Jet.com) have attempted to establish successful e-commerce ecosystems around their own focal platform (Kawa & Wałesiak, 2019; Wulfert et al., 2021). The owner of the focal platform needs to attract a variety of participants to be economically successful (Schirrmacher et al., 2017). It is crucial for a successful platform to attract a critical mass of participants to its ecosystem (Zhu & Furr, 2016). The critical mass is related to the number of participants and transactions orchestrated between them (Wang & Archer, 2007). Direct and indirect network effects require a minimum threshold of participants on a platform to be viable enough for the platform to benefit from them and increase its success of the platform (Armstrong, 2006; Rochet & Tirole, 2006; Shapiro & Varian, 1998). The threshold point for which network effects become evident is an object of interest in critical mass theory (Janiesch et al., 2020). The critical mass constraint is addressed in a number of publications. Hagiu (2006) analyzed critical mass as a two-stage game acknowledging that participants on both sides of the platform can make individual decisions. Fath and Sarvary (2003) introduce indirect network effects and participants' switching costs to critical mass considerations. Caillaud and Jullien (2003) analyze the ignition of a platform as an event rather than a process compared to Evans and Schmalensee (2010). Miric et al. (2021) suggest the acquisition of other niche players to broaden a platform's scope and increase the number of participants in an ecosystem. Alt and Zimmermann (2019) emphasize the importance of a critical mass in platform competition. A mandatory criterion for any established ecosystem is to surpass this critical mass threshold.

Following the importance of the critical mass threshold, a variety of ignition strategies that can support platform owners in establishing an ecosystem have been formulated (Evans & Schmalensee, 2016; Ojanperä & Vuori, 2021; Parker & Van Alstyne, 2016; Parker et al., 2016; Reillier & Reillier, 2017; Wanner et al., 2019). These strategies can be implemented by the owner of the focal platform and aim at increasing the number of participants to reach critical mass and exploit network effects either by attracting the market sides sequentially or simultaneously (Schirrmacher et al., 2017). In an early work, Rochet and Tirole (2003) suggest the means of using subsidies to attract participants to the ecosystems. Wanner et al. (2019), Parker et al. (2016) and Parker and Van Alstyne (2016) suggest an approach, where the perceived value for the participants is stimulated in order to stimulate participation on the platform. Evans and Schmalensee (2016) and Wanner et al. (2019) discuss a way to expand from a traditional one-sided business towards a platform business and show how the critical mass threshold is circumvented. Common of these strategic approaches with additional work in the current literature is, that these strategies are generically described and often stem from the context of software ecosystems and social media networks (Parker & Van Alstyne, 2016). However, the aforementioned publications do not focus on the peculiarities of e-commerce ecosystems.

To define the characteristics of an e-commerce ecosystem, we apply Adner's (2017) ontology describing ecosystems, where e-commerce ecosystems are identified as a special type. E-commerce ecosystems involve a variety of actors (e.g., manufacturers, content providers, and software providers) (Böttcher et al., 2021). Within the broad arena of e-commerce platforms, focal platforms in e-commerce ecosystems match a number of participants based on customers' article demand and enable retail transactions between them. Focal platforms can also behave competitively to other ecosystem participants (i.e., dual role) (Wulfert & Schütte, 2022). The positions of single e-commerce ecosystem participants can evolve dynamically continuously altering relationships between participants and the structure of the ecosystem (Wulfert et al., 2021). Along the research of this paper, we will focus on focal platforms in e-commerce ecosystems as described above.

Seeing the market size and growth potential of e-commerce in the current business world, in combination with the importance of ignition strategies to surpass the critical mass, it is surprising to see that literature has an established set of strategies, but lacks, the best of our knowledge, concrete manifestations of platform ignition strategies and their most suited application for the context of e-commerce ecosystems. Therefore, we strive to resolve the following research question:

RQ1: How can platform owners attract a minimum threshold of participants to successfully establish an e-commerce ecosystem?

Addressing this research question, we introduce eight generic ignition strategies for platform business models to successfully reach a critical mass of participants (Evans & Schmalensee, 2016; Parker et al., 2016; Reillier & Reillier, 2017; Schirrmacher et al., 2017). Following a design science research approach (Sonnenberg & vom Brocke, 2012), we apply the mathematical model by Evans and Schmalensee (2010) to the context of e-commerce ecosystems involving network effects to determine critical mass points and equilibria. The ignition strategies are used to alter demand- and supply-side curves and, thus, influence critical mass points and equilibria. We will compare ecosystem ignition strategies in terms of their influence and applicability.

The remainder of this research paper is structured as follows: First, we introduce related literature on ignition strategies in e-commerce ecosystems and present our modeling approach in Section 2. Section 3 expands on our scientific approach, and then Section 4 concludes on ignition strategies for focal platforms in e-commerce. In Section 5 we discuss our scientific contribution and, finally, in Section 6 we briefly summarize our results.

2. THEORETICAL BACKGROUND

2.1. E-commerce ecosystems

Initially introduced in the business literature by Moore (1993, 1996), the perspective of business ecosystems is grounded in organizational boundary theory (Santos & Eisenhardt, 2005; Teece, 2007; Tsujimoto et al., 2018). Digital business ecosystems are business ecosystems connecting their participants using digital means (Boley & Chang, 2007; Hein et al., 2020). Digital business ecosystems are complex networks of platform-mediated actor-to-actor interactions in which the independent participants are linked by common goals (i.e., the success of the overall ecosystem) (Adner, 2017; Wareham et al., 2014). As defined earlier, within this paper we limit our focus to e-commerce ecosystems, which are manifestations of digital business ecosystems in the context of e-commerce (Choi et al., 1997; Wulfert et al., 2022). Transactions among participants are conducted using digital means in e-commerce ecosystems (Engert et al., 2022; Wulfert et al., 2022). Following Cennamo (2021) the focal platform of the e-commerce ecosystem can be described as a multi-sided transactional market. The value is brought by the facilitation of the transaction between the multiple market sides, such as buyers, sellers, service providers, and developers (Böttcher et al., 2021).

The value of an e-commerce ecosystem for its participants increases with the addition of each participant to the network, resulting in direct and indirect network effects (Shapiro & Varian, 1998). E-commerce ecosystems typically evolve around focal transaction platforms that act as virtual loci over which participants conduct retail transactions (Turban et al., 2017). These transaction platforms match and orchestrate organizations as well as individual participants from various markets and social groups to form a dynamic ecosystem (Corallo et al., 2007; Gawer, 2021). Transaction platforms offer a variety of retail-related services for participants, such as payment or fulfillment services (Wulfert et al., 2021). Besides these transaction services, platforms in e-commerce increasingly provide innovation services (e.g., application programming interfaces, computing power), enabling the development of third-party extensions and the attraction of external developers as additional ecosystem participants (Wulfert et al., 2022). The evolution towards hybrid platforms, which involve transaction and innovation services (Gawer, 2021), increases the reach of the platform owner and the value of the ecosystem for incumbents and new participants (Schütte & Wulfert, 2022).

For our analysis of ignition strategies for the e-commerce ecosystem, we focus on the owner of the focal platform (Hein et al., 2020). In line with research on two-sided markets (Armstrong, 2006; Rochet & Tirole, 2003, 2006), we argue that the focal platform needs to achieve a critical mass of participants on all relevant market sides to operate successfully in economic terms and grow substantially (Alt & Zimmermann, 2019; Eisenmann et al., 2009; McIntyre & Srinivasan, 2017; Reillier & Reillier, 2017). For achieving a critical mass in two-sided platforms, a number of generic strategies exist, that are presented in the following sub-section.

2.2. Platform ignition strategies

The owner of the focal platform in an e-commerce ecosystem is considered the "ecosystem leader" (Moore, 1996, p. 26), which sets and enforces governance rules (e.g., types of platform strategies) (Adner, 2017). To increase the likelihood of participants of either market side joining, platform owners can employ strategic measures that influence the governance of the platform and aim at amplifying network effects (Hein et al., 2020; Parker & Van Alstyne, 2016; Wulfert et al., 2021). Only with active participants on the platform, indirect network effects emerge, and the participants can profit from the platform.

A platform strategy can be defined as "the mobilization of a networked business platform to expand into and operate in a given market" (Parker & Van Alstyne, 2016, p. 1). Following this transaction-oriented perspective (Gawer, 2021), a platform connects (previously independent) actors and enables business transactions between them making use of the economic effects of two-sided markets (Armstrong, 2006; Rochet & Tirole, 2003).

Recent literature covers several ignition strategies to overcome the critical mass criteria. Across all, we base our selection of strategies on the summaries provided by Evans and Schmalensee (2016), Ojanperä and Vuori (2021), Parker et al. (2016), Parker and Van Alstyne (2016), Reillier and Reillier (2017), Wanner et al. (2019) and Zhu and Iansiti (2012). The resulting identified ignition strategies were clustered predominantly using the nomenclature of Eisenmann et al. (2009) and Eisenmann et al. (2006) and by their relevance for the transactional business of the focus e-commerce business. Along this, we identify eight key strategies listed in Table 1. Each strategy will be reflected in more detail in Section 4. While the literature showed a broad compilation of the most established ignition strategies, none of these and, to the best of our knowledge, also no other existing literature, evaluates the strategies to their applicability in the context of e-commerce ecosystems.

Table 1. Summary of platform ignition strategies with relevance for transactional focus e-commerce ecosystems

Strategy	*Description*	*Source*
Subsidies	Reduction of the perceived costs for one market side.	Parker and Van Alstyne (2016), Rochet and Tirole (2003)
Seeding	The platform owner acts as the initial supplier attracting the customer side.	Evans and Schmalensee (2016), Parker et al. (2016), Parker and Van Alstyne (2016), Reillier and Reillier (2017), Wanner et al. (2019)
Marquee actors	Start by onboarding selected key accounts with high value for the other market side (also feasible as a simultaneous strategy for both market sides).	Evans (2009), Reillier and Reillier (2017), Wanner et al. (2019)
Single side	Start by providing your own value for one market side and expanding to a two-sided market later.	Evans (2009), Evans and Schmalensee (2016), Reillier and Reillier (2017), Wanner et al. (2019)
Micro market	Start in a narrow focus market or a small community with stronger network effects between sellers and buyers. Expansion to a broader market occurs later.	Evans and Schmalensee (2016), Ojanperä and Vuori (2021), Parker et al. (2016), Parker and Van Alstyne (2016), Reillier and Reillier (2017), Wanner et al. (2019)
Piggybacking	Using the sellers or buyers from another platform on the own platform.	Parker et al. (2016), Parker and Van Alstyne (2016), Reillier and Reillier (2017), Wanner et al. (2019)
Opening up	Opening the own platform for competitor platforms in order to ease switching behavior and leverage growth from other platforms.	Markovich, (2008), De Reuver et al. (2018)
Big bang	Traditional push marketing attracts a high volume of interest on both market sides.	Parker et al. (2016), Wanner et al. (2019)

3. STUDY FRAMEWORK

For the demonstration of the applicability of generic platform ignition strategies in e-commerce, we follow a design science research approach with a focus on artifact evaluation (Peffers et al., 2007; Sonnenberg & vom Brocke, 2012). The problem, as already stated in the introduction, is a lack of customized platform ignition strategies for e-commerce ecosystems despite the general growth of this economic sector. The ignition strategies should provide guidance for platform owners on how to successfully grow an e-commerce ecosystem with regards to achieving a critical mass of participants on all market sides (Schirrmacher et al., 2017; Zhu & Furr, 2016). Hence, we identified generic platform ignition strategies and evaluate them in the context of e-commerce and perform an Eval2[1] activity asserting the general applicability of the generic strategies in e-commerce (Sonnenberg & vom Brocke, 2012).

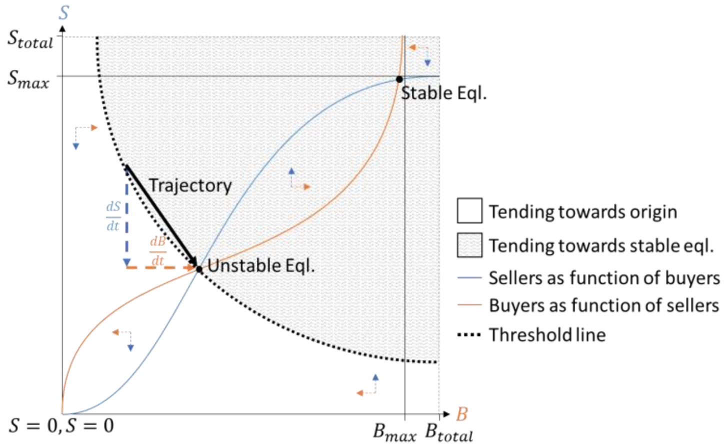
3.1. Critical mass model by Evans and Schmalensee

We use the model by Evans and Schmalensee (2010) to provide a mathematical proof of the applicability of generic platform ignition strategies for e-commerce ecosystems (Cleven et al., 2009). Across the existing literature on mathematical models, the model by Evans and Schmalensee (2010) stands out as the most recent one to introduce a general mathematical model which is generic to a two-sided buyer and seller market. It thereby builds upon other existing and proven models by Armstrong (2006), Caillaud and Jullien (2003) as well as Rochet and Tirole (2003, 2006). As the prediction of a model highly depends upon its fit to the underlying business, the earlier models yield good results for their respective applications (Rochet & Tirole, 2006), but can be deemed to be less suitable for the different markets as present for e-commerce. This research will make use of a mathematical model to analyze strategies for achieving the critical mass and exploiting indirect (i.e., cross-side) network effects. Here a two-sided market is modeled by means of evaluation of the long-term equilibria of sellers' S and buyers' B joining ratios. An individual market player is assumed to join in case its respective net utility, which comprises a negative cost term C and a positive utility gain W, is positive. To reflect the presence of indirect network effects this utility gain is dependent on the respective joining ratios of the other market side. The utility gain for buyers $W_B(S)$ — indicated by an index — is dependent on the number of sellers S present on the platform and vice versa. For multiple players, the heterogeneity across the market players is represented by an arbitrary smooth density function of the utility and the cost encountered with a corresponding distribution function $F_B\ (W_B(S),\ C_B)$ and $F_S\ (W_S(S),\ C_S)$. Following this distribution function, each market side is characterized by a unique equilibria line as illustrated in Figure 1. The intersection of the equilibria lines forms equilibria points. For buyer and seller constellations outside the equilibria points, a vector trajectory $(\frac{dB}{dt}, \frac{dS}{dt})$ is present and defines a time-wise trend, describing the time-wise change of any given point. At the long-time equilibria points, the trajectory is zero. This trend is indicated with dotted arrows in Figure 1.

Following the argumentation of Evans and Schmalensee (2010) we limit the investigation to sigmoidal-shaped equilibria lines with a pass through the origin and the case with three equilibria points. Sigmoidal-shaped equilibria lines are the result of bell-shaped distribution functions (Park, 2018), which are deemed the most realistic and common representation in real-world applications (Lyon, 2014). With sigmoidal-shaped equilibria lines, three different structural scenarios of equilibria points can be classified: a system with one, two, or three equilibria points. Based on the argument made by Evans and Schmalensee (2010) a system with one equilibrium point would indicate a growing platform from the start without any presence of sellers or buyers at first. This seems unrealistic and we thus exclude it from any further observation. The scenario with two equilibria points is a transition state between the case with one and three equilibria points and appears only if the conditions of the other two scenarios coincide. As this is assumed as rather rare, we also exclude it from further observation.

[1] The Eval2 activity is one of four evaluation steps in design science resesearch endeavors as described by Sonnenberg and vom Brocke (2012).

Figure 1. Illustration of equilibrium lines for users and complementors with equilibrium points for the ecosystem



Source: Evans and Schmalensee (2010).

Combining the different earlier described trajectories over time will form a vector path. Ultimately all vector paths end in one of the three equilibria points, as these points form the long-term equilibria. As we selected the scenario with three equilibria points, it becomes apparent from the trajectory positions that two stable and one unstable equilibrium exists. The stable equilibria are characterized by the fact that trajectories from all areas around the equilibrium point, point toward it, while for the unstable equilibrium, an area with trajectories pointing away from the equilibrium materializes. As Evans and Schmalensee (2010) showed the stable equilibria are the origin and the high point, while the center is the unstable equilibrium. The vector paths, which terminate in the unstable equilibrium point form a threshold line. Any combination of initial conditions below the threshold line will ultimately end in the lower equilibrium point (i.e., the origin), while any initial condition above the threshold line will ultimately terminate in the upper equilibrium condition and form a stable platform with sellers and buyers present. Any system below the threshold will collapse and tend towards the origin with no buyers and sellers active. An illustration of these two areas and an arbitrary threshold line is given in Figure 1. This threshold line is the illustration of the critical mass.

The critical mass is reached, and the 'chicken and egg' problem is solved once an ecosystem achieves to traverse this threshold line. The strategy to achieve this is one of the core strategic challenges for any ecosystem in the start-up phase as an entrant e-commerce ecosystem naturally has a low number of sellers and buyers (Caillaud & Jullien, 2003; Kollmann, 2019).

Following the requirement for a pass-through of the origin, as per Evans and Schmalensee (2010), we select a power function as one example to represent the distribution function. For buyers these yields:

$$F_B(S) = B_{max}\left(1 - \frac{1}{1 + \left(\frac{S}{c}\right)^w}\right) \quad (1)$$

with B_{max} representing the maximum number of buyers ($B_{max} \leq B_{total}$), c being a measure for the perceived costs that is related directly to C and w representing the perceived utility (Normand & Peleg, 2013). The resulting density then reads as:

$$f_B(S) = \frac{B_{max}c^w w S^{w-1}}{(S^w + c^w)^2} \quad (2)$$

4. STRATEGIES TO ACHIEVE CRITICAL MASS IN E-COMMERCE ECOSYSTEMS

Following the overview of strategies as given in Table 1, each strategy will be investigated with respect to its effect on the critical mass threshold in e-commerce ecosystems.

4.1. Subsidies

The first approach is to use subsidies. By this method, the platform owner provides support to either or both market sides. The prices for each market side can be adjusted asymmetrically to allow the subsidization of one side (Rochet & Tirole, 2003).

While a subsidy may be profit-reducing on one market side, it can result in an overall profit increase based on indirect network effects on the profit-generating side (Parker et al., 2005). Beyond that, one side of the market may experience an over-proportional utility gain from the other market side, under which circumstances it can be advised to subsidize that side and charge the other side for the over-proportional gain (Bakos & Katsamakas, 2008; Eisenmann et al., 2006; Hagiu, 2014; Parker et al., 2005; Rochet & Tirole, 2006). This subsidy support can be provided in any form and over any period of time, from temporarily during the start-up phase to permanently (Parker & Van Alstyne, 2016; De Reuver et al., 2018). Subsidies may come in the form of discounts on prices for joining or being active on the platform or in the form of cost reductions, e.g., by technical support, for the respective market side.

A challenge with direct price discounts lies in the risk of the market players assuming these prices as permanent and may leave the ecosystem once the discount is weaved (Parker & Van Alstyne, 2016; Salminen, 2014). In the case of direct cash benefits, the challenge increases as the receiving side may take the payment and leave. Direct cash subsidies are feasible for financially liquid platforms only, which may not be given under a start-up scenario. Direct cash-based payments are thus deemed to be better avoided. A more suitable approach may be the provision of coupons or discounts to attract attention and lower perceived costs. Such a method ensures a temporary perception. Such discounts can also come in the form of technical support or integration work by the platform owner to reduce the perceived cost basis for the sellers or buyers. This support can be tuned to be solely relevant to the respective platform (Parker & Van Alstyne, 2016).

For e-commerce ecosystems, the market side required to join the ecosystem first is the sellers.

The offered goods are required before any buyer can benefit from joining the ecosystem. Hence sellers can be considered the first target group in a start-up scenario. Here subsidies in the form of cost reduction for the integration of the new platform may prove as most effective as it reduces the perceived costs and potential entry hurdles for sellers. In an established case or once initial sellers are established, the sellers can be assumed to be the market side with higher benefits compared to the buyers as they generate profits from the buyers' purchases. As such the subsidies would need to shift towards the buyer's side. This can be observed by means of low or no entry fees as well as the application of coupons and discounts to attract more buyers.

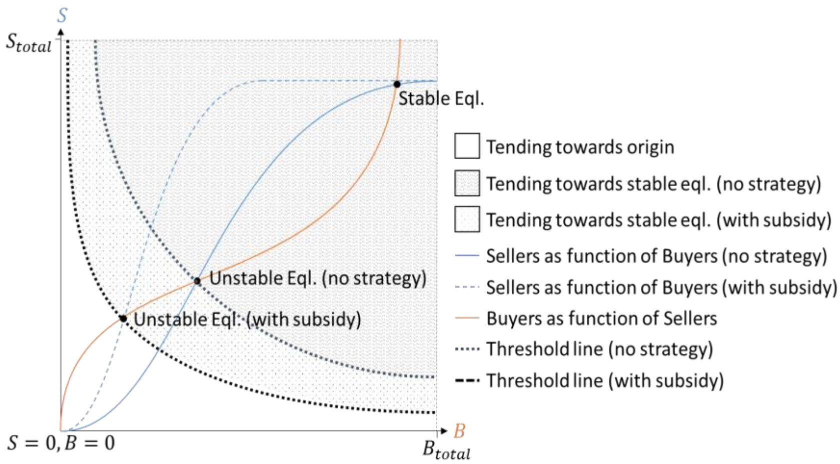
We now apply this strategy in the model on the sellers' side. The utility function changes by the introduction of a subsidy term $C_{Subsidy}$, with $C_{Subsidy} > 0$ indicating the volume of the subsidies. The subsidy reduces the costs C_S. As a first impact the corresponding distribution function $F_S(W_S(B), C_S - C_{Subsidy})$ will have its point of inflection at a lower value. While the origin is maintained as a fixed point, this results in a steeper increase for low numbers of buyers active in the ecosystem. This results in a lower threshold line, as also the unstable equilibrium points shift to a lower required number of buyers and sellers. Hence a lower critical mass threshold is achieved. The described effect is depicted in Figure 2 with the new distribution function depicted as a dotted line under the assumption of a maintained upper limit. The adapted distribution function reads as:

$$F_S(B) = S_{max}\left(1 - \frac{1}{1 + \left(\frac{B}{c - c_{Subsidy}}\right)^w}\right) \tag{3}$$

which confirms the compression along the vertical axis.

A benefit of the *subsidy strategy* is its possibility to work on both market sides in the e-commerce business. Its main contribution is to reduce the perceived entry hurdles, or costs as modeled here. Due to its potential negative effect on immediate profits, it is best suited for platform owners without immediate high-profit needs. The subsidy strategy has no influence on the direct value of the platform, which makes it best suitable for platforms with a clear value proposition.

Figure 2. Illustration of threshold line and ecosystem constellations under the application of subsidies with effect for sellers



4.2. Seeding and marquee actors

A second method is to seed activity by one or both sides of the market. This is achieved by providing enough value add to the respective (Parker et al., 2016; Parker & Van Alstyne, 2016; Wanner et al., 2019) side to switch to or join the respective ecosystem. Thereby the platform owner either develops their own value or uses partners to produce value for one or both sides of the market. In e-commerce, the market side providing goods are the sellers. Hence an initial set of goods for sale need to be introduced to the ecosystem. If the ecosystem owner is the initial seller, the strategy turns rather into a single side-entry, which will be discussed subsequently. Seeding on the buyers side means stimulation of purchase transactions. Such a measure can be better classified as a subsidy, where a guaranteed payment or a number of transactions is ensured towards sellers. Based on the above, seeding is interpreted as an effect for the buyers by seeding initial sales goods through a primary set of sellers.

Related to seeding is the strategy of marquee users. Here a strong partner is bound to the platform with the objective to capture the indirect network strength of that partner (Parker & Van Alstyne, 2016; Wanner et al., 2019). For e-commerce ecosystems, this can be the partnership between the ecosystem owner and a large-scale seller. This seller would launch a variety of goods directly on the platformer or grant exclusive rights to the platform on a good (Eisenmann & Hagiu, 2007). As a direct result, the buyers would be stimulated to join the ecosystem to procure the (exclusive) goods (Evans & Schmalensee, 2016). The marquee user approach can be applied towards sellers and buyers, in a sequential or simultaneous way. Its mathematical implications are identical to the seeding effect.

In the methodological representation, the seeding or marquee approach introduces an offset utility $W_{Seed}(S)$. This additional utility is an adder to the existing utility of the buyers and adapts the buyers' distribution function to $F_B(W(S) + W_{Seed}(S), C_B)$ with $W_{Seed}(0) > 0$. As a result, the corresponding equilibrium line for buyers is shifted down, as depicted in Figure 3. The shift induces a minimum number of buyers B_{Seed}, in the absence of any sellers (despite the seeding sellers). As shown, the seeding lowers the unstable equilibrium point and thus also the threshold line. The long-term stable equilibria points are also affected. The sensitivity of the shift of the individual equilibria point is indirectly proportional to the buyers and sellers numbers at this initial equilibrium point (i.e., for large constellations it remains almost unchanged). The change in the stable equilibrium point is further reduced in case the seeding utility is perceived as smaller for larger numbers of sellers, due to a lower perceived value add.

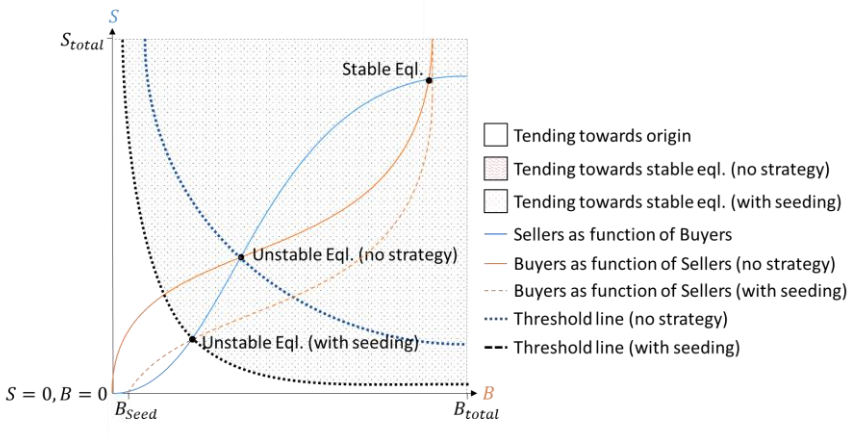
Sticking to an example of a seeding case for buyers and based on the above-introduced increase of $W_B(S)$ by W_{Seed}, the distribution function adapts to:

$$F_B(S) = B_{max}\left(1 - \frac{1}{1 + \left(\frac{S + W_{Seed}}{c}\right)^w}\right) \quad (4)$$

This represents a left shift of the function. Under the depicted coordinate system with seller numbers on the vertical axis and buyers numbers on the horizontal axis, such a left shift converts to the earlier described down-shift.

In the context of e-commerce, we see the seeding strategy best applied to the sellers side (i.e., the platform owner acts as an initial supplier). The case where the platform owner acts as the initial buyer is excluded, as this can be better described as a purchasing system. The clear benefit of seeding is the reduction of the dependence on the seller's market side. The sales activity is partially done by the platform owner. As a direct result of it, the platform owner requires sufficient selling power to be a seeding stimulant. While this is very similar to the later described single-side entry, here the platform allows third-party sellers to use their own platform. This requires the platform owner to set up two business operating systems, one for their own sales activity and one for the platform, which might cause additional efforts. It is best suited for players with strong sales powers, who have a clear approach to entering the platform business.

Figure 3. Illustration of threshold line and ecosystem constellations under the application of seeding



The *strategy of marquee actors* has the advantage to have a clear focus on selected key accounts. These may be from either side, buyers or sellers. As such potential marketing efforts can be streamlined and tuned to these accounts and thus reduce the overall marketing efforts. At the same time, the limit to a selected number of key accounts might slow down the overall ramp-up due to a smaller initial target audience. Competition effects may also be higher for key accounts, as the same players may also be approached by competing platforms due to similar selection logic. Marquee actor approaches hence require good access to these key accounts. It is deemed best in the presence of a heterogeneous market, where certain key accounts exist.

4.3. Single side entries

A strategy that can be considered out of the box is single-side entries. Here the challenges of the threshold boundary are avoided as the market entry follows a traditional one-sided business model (Evans & Schmalensee, 2016; Wanner et al., 2019). As the sellers are the side offering goods for purchase and thus providing the initial value in the ecosystem, a single-side market entry will focus on this side.

The future ecosystem owner then acts as a seller in the beginning (Eisenmann & Hagiu, 2007). Once a sufficiently large buyer base has been established the ecosystem owner can switch to an ecosystem business model. The change should thereby occur after the critical mass of one market side is achieved (Parker et al., 2016). An adaptation is to have the future ecosystem owner act as a merchant or distributor of goods purchased from other sellers and use the ecosystem for the sale towards a buyer base. The value add of a merchant for regular sellers lies in the handling of volume risk (Eisenmann & Hagiu, 2007). and the access to a buyer base, if already established.

A single side entry as a user means the stimulation of purchases at first. This could happen for large organizations taking the place of a large buyer. We would consider such an approach to be more related to a subsidy scheme, where guaranteed purchases are ensured.

The mathematical description thereby follows the argumentation for seeding. The distribution function of potential buyers would adapt to $F_B(W_B(S) + W_{Vendor}(S), C_B)$. Following Evans and Schmalensee (2016) a crossing of the critical mass threshold is however not achieved by a single side entry alone as the threshold line is asymptotically towards both axis and requires a non-zero number of active buyers and sellers.

As described above, the single-side entry has similar implications as the seeding approach. Contrary to seeding, it keeps the focus on the sales activity only at first. This may reduce overall expanses and efforts for the platform owner, as only a setup for its own sales activity is required. To be able to expand towards a platform business later on, the necessary infrastructure needs to be prepared to allow an opening to other sellers. The ramp-up might be further slowed down for single-side strategies as the effect of third-party sellers could slow down the growth of the platforms. It is suitable for players with high selling power, who are open for a future platform business.

4.4. Micro market launch

Another method is to restrict the ecosystem launch to a small or niche market. By this, a strong market penetration within the initial micro market can be achieved and growth can be materialized in a subsequent step (Evans & Schmalensee, 2016; Parker & Van Alstyne, 2016). Under the assumption of a stronger fit of individual needs from buyers and sellers in a specialized micro market compared to a broader market, the strength of indirect network effects is assumed to increase alongside. Hence the utility gain for buyers increases more rapidly by the number of active sellers and vice versa. Following Zhu and Iansiti (2012) a stronger indirect network effect leads to the formation of a monopoly, which will allow the new ecosystem to obtain a monopoly (or at least leading) position within the micro market more easily. Growth is then stipulated from a position of (monopolistic) strengths into adjacent markets (Parker & Van Alstyne, 2016). The initial approach towards niche and potentially less or unserved markets increases the chances to reach the critical mass for an entrant ecosystem. Direct competition against established incumbent ecosystems can prove to be much harder to realize (Bresnahan & Greenstein, 1999).

Based on an overall reduced market size, the total number of potential buyers is reduced alongside to $B_{total-micro} < B_{total}$ and the number of potential sellers to $S_{total-micro} < S_{total}$. Following the argument for stronger indirect network effects, the respective utility function increase to $W_{B|Micro}(S) > W_B(S)$ and $W_{S|Micro}(B) > W_S(B)$. This is depicted in Figure 4. The unstable equilibrium points and the critical mass threshold is reduced. The different market sizes are equally illustrated.

The effect of a micro market launch is comparable to a coring approach. Here a need for one subsection of the market is addressed first before an expansion to adjacent markets occurs (Gawer & Cusumano, 2008). Based on the specialization, again the addressable number of buyers and sellers would be reduced. For the micro market launch strategy, the potential number of buyers and sellers decreases, while the indirect network effects increase:

$$F_B(S) = B_{max-micro}\left(1 - \frac{1}{1 + \left(\frac{S}{c_B}\right)^{w_{B|micro}}}\right) \quad (5)$$

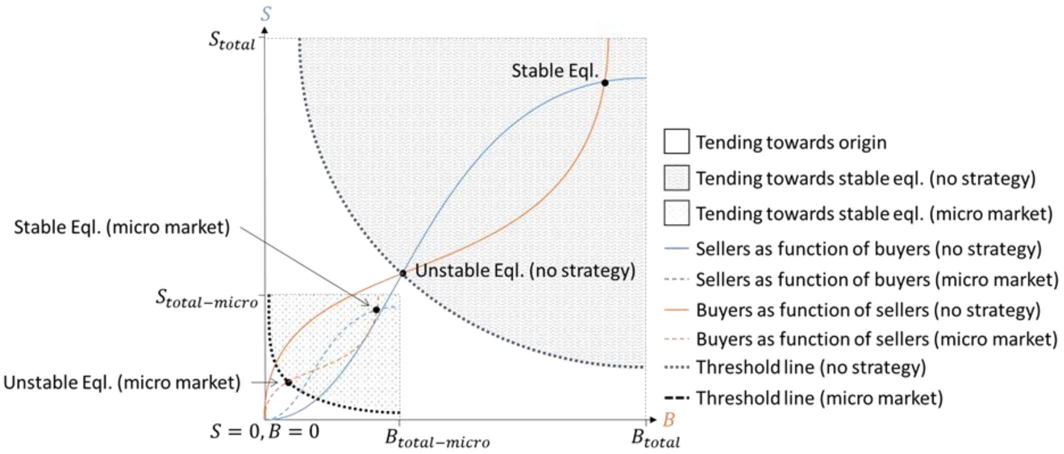
$$F_S(B) = S_{max-micro}\left(1 - \frac{1}{1 + \left(\frac{B}{c_S}\right)^{w_{S|micro}}}\right) \quad (6)$$

with $B_{max-micro} < B_{max}$ and $S_{max-micro} < S_{max}$ and the indirect network effects being stronger $w_{B|micro} > w$ and $w_{S|micro} > w$. In absence of stronger indirect network effects this strategy would result in a higher threshold barrier and be counterproductive.

The micro market approach has the benefit to streamline the value proposition of the platform clearly onto a very specific market segment. While this is also true for the marquee actor strategy, here a whole market segment is approached and not key accounts.

On the downside, a micro market launch reduces the addressable market to this very micro market. This might reduce revenue and growth potential. As such, a micro market launch is best suited if an unaddressed market segment or niche can be filled with a clear and fitting value proposition through the platform.

Figure 4. Illustration of threshold line and ecosystem constellations under the application of a micro market launch



4.5. Piggybacking

Another method is *piggybacking*. Here an ecosystem uses market players from a related ecosystem in order to grow its own buyer or seller base (Parker et al., 2016; Parker & Van Alstyne, 2016; Wanner et al., 2019). Along this method, one side of the ecosystem will be built up using the players from the respective another ecosystem. A positive feedback loop to grow toward the upper stable equilibrium is started (Parker et al., 2016). This method is solely applicable if another ecosystem can be identified that does allow the sharing of either buyers or sellers (Parker et al., 2016). This strategy can be applied to either market side. In theory, an application to both market sides simultaneously would be possible, but no instance is known in real life. In such a scenario two suitable other ecosystems would need to be identified, which increases the efforts. Alternatively, buyers and sellers from a competing ecosystem would need to be used for piggybacking, which can be deemed rather unlikely.

Piggybacking on the buyers' side adds a term $F_{B-Piggyback}(F_B(W_B(S), C_B))$ to the distribution function. This additional term is dependent on the total number of buyers in the ecosystem and will tend towards zero for growing numbers of buyers in the ecosystem. This is to reflect the decreasing importance of piggybacking for a larger ecosystem (Parker et al., 2016). In the case of zero sellers, the additional term is still positive. This reflects the initial number of buyers coming from the piggybacked ecosystem. The concept is illustrated in Figure 5. Especially for small ecosystems, this initial additional number of buyers helps to stimulate the joining of sellers. The remaining argumentation follows the explanation as in the seeding case. In the case of piggybacking on the seller's side the same applies and vice versa.

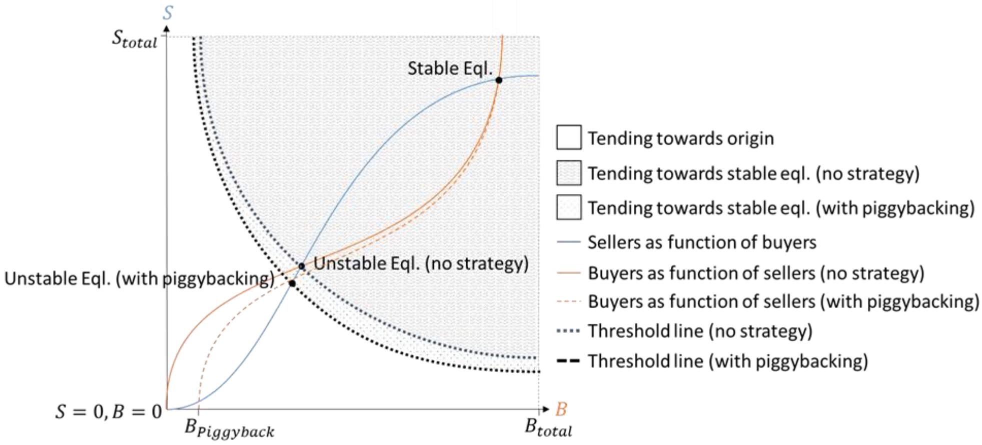
For the piggybacking strategy on the buyers' side, the distribution function rewrite to:

$$F_B(S) = B_{max}\left(1 - \frac{1}{1 + \left(\frac{S}{C_B}\right)^w}\right) + F_{B-Piggyback} \quad (7)$$

This represents a right shift in the representation as illustrated in Figure 5.

Piggybacking comes with the unique advantage of solving the attraction problem for at least one market side. While this is similar to the seeding and single market entry case, here no own efforts or powers by the platform owner are required. At the same time, a clear benefit especially in comparison to the piggybacked partner needs to be established. This will differentiate the new platform. The key challenge for utilizing this strategy is the availability of a piggybacking partner.

Figure 5. Illustration of threshold line and ecosystem constellations under the application of piggybacking on buyers



4.6. Opening up

Beyond these standard techniques within the market entry also the approach to open up across ecosystems may be applied in order to sustain the growth of the own ecosystem. Here an ecosystem opens up its services to competitors. The goal is to attract sellers and buyers, who are active on the other ecosystem (Markovich, 2008; De Reuver et al., 2018). This approach can be observed for ecosystems requiring a certain initial investment to join, like hardware or software access. For free e-commerce platforms without initial joining fees, such a strategy provides no additional value add for either side.

Applied to buyers, this strategy increases the utility as sellers also from another ecosystem can be leveraged: $F_B(W_B(S) + W_{B|Open}(S), C_B)$. The subsequent argumentation follows the seeding strategy. For sellers, an open ecosystem provides advantages in terms of reduced costs as no additional transition costs would occur: $F_S(W_S(B), C_B - C_{S|Open})$. The subsequent argumentation follows the subsidy strategy.

This strategy comes with the opportunity for a faster ramp-up and growth rate at the expanse of an easier takeover by the other platforms. It is as such best suitable for platforms with a strong own unique selling proposition, quality aspect, technological advancement, special user base, or any other special advantages.

4.7. Big bang

A rather direct approach to address the critical mass challenge is large-scale marketing to convince buyers and sellers to join the ecosystem. The goal is to use push marketing strategies to attract a high number of players (Parker & Van Alstyne, 2016; Wanner et al., 2019) and indicate a very positive forward-looking expectation (Zhu & Iansiti, 2012). Obviously, it applies to both market sides. It is especially powerful for new entrants with little recognition (Edelman et al., 2016) and a market with a strong future expectation component (Zhu & Iansiti, 2012). The marketing can thereby comprise several elements mentioned in various case studies and publications. One approach is a communication of a coherent strategy and vision towards both market sides (Argenti et al., 2005). Also, high expectation management for forward-looking buyers or sellers combined with a reputation for past actions supports the reputation build-up (Eisenmann et al., 2006; Zhu & Iansiti, 2012).

Big bang marketing does not lead to any alteration of the equilibria points or the critical mass threshold in terms of its mathematical representation. However, it supports growing from a lower position, which may be within the area tending towards the origin, to an area beyond the threshold line. In case future expectations are valued high, the indirect network effects stimulate growth based on a positive expectation (Zhu & Iansiti, 2012).

The clear benefit of this strategy is its independence from any preconditions despite the availability of a marketing budget (in the form of time, effort, and/or money). On the downside, big bang marketing may produce high amounts of undirected marketing efforts, especially when compared to approaches in the micro market or marquee actor approach. It is thus best suited for entry to mass markets with very homogeneous players. The heterogeneity across the customers or sellers may be addressed best by means of selective marketing techniques.

5. DISCUSSION

A summary of ignition strategies analyzed with their respective characteristics is presented in Table 2. The ignition strategies can thereby be distinguished according to the market side they impact, by the influence the strategies induce, and by their strategic preconditions. The strategies focus either on the buyer or the seller side or on both sides of the market. Thereby, they can be applied in sequence or simultaneously (Schirrmacher et al., 2017). During our analysis, we identified five ecosystem parameters the strategies can influence: the perceived costs for the sellers, the perceived costs for the buyers, the perceived number of buyers by the sellers, the perceived number of offered goods, and the utility strength from indirect network effects. These influenced parameters are based on the model parameters as per the chosen mathematical model. Additional influences may be possible. We intentionally limit our discussion to these five assuming a profit-driven and rational decision-maker. Based on the way how the strategy needs to be implemented, the strategy is subject to intrinsic or extrinsic preconditions (Ojanperä & Vuori, 2021; Parker & Van Alstyne, 2016; Reillier & Reillier, 2017). Intrinsic means that the platform owner can freely implement the strategy provided enough own resources but independent from external preconditions. Extrinsic preconditions mean that the implementation is subject to the fulfillment of an outside precondition, e.g., the existence of an external partner. All observed strategies can thereby be grouped into four clusters, when considering their parameter influence (Table 2).

Table 2. Overview of ecosystem ignition strategies with their affected market side and induced influence.

Induced influence	*Affected market side*		
	Sellers	*Sellers and buyers*	*Buyers*
Reduction of perceived costs	-	Subsidies Opening-up	-
Increase of perceived offered goods or buyers	Seeding * Marquee actors * Single side	Piggybacking * Big bang	-
Increase the strength of indirect network effects	-	Micro market	-

Note: (*) Strategies with external preconditions are marked by an asterisk.

The first group of strategies reduces the participants' perceived costs in e-commerce ecosystems. This group includes the subsidies and the opening-up strategy. The opening up strategy thereby has an indirect cost influence based on reduced switching costs from another ecosystem. As the applied costs are within the influence of the platform owner, these strategies have intrinsic preconditions. While subsidies are a sequential strategy, which can be applied to either market side, an opening-up approach can be characterized as simultaneous approach. However, the opening of the ecosystem can focus on and favor selected market sides. For instance, the implementation of dedicated development boundary resources addresses external developers as additional market side in e-commerce ecosystems (Wulfert et al., 2022).

The second group of ignition strategies for e-commerce ecosystems includes strategies that aim to stimulate value for one market side and induce growth in the number of market participants from the other market side. This includes seeding, utilization of marquee sellers, single-side entry, and piggybacking. These strategies differ in their way of implementation. Seeding and marquee sellers aim to stimulate the introduction of offers to the ecosystem. By this, the joining of buyers is stimulated. Either strategy in this category relies on the presence of an external partner. This is either a seller or a partner ecosystem. A similar effect without external partners is achieved by the single-side entry strategy. Usually, this strategy stimulates buyers only and the ecosystem owner acts as the initial seller. It could also be applied to stimulating sellers by having a strong consumer as the ecosystem owner, like a governmental entity. The piggybacking approach works by lending initial players from another ecosystem. It thus increases the number of sellers or buyers to stimulate the respective another market side to join the platform. Based on this, piggybacking has the extrinsic precondition of the existence of another ecosystem. It can be applied to either or both market sides, while the application to one market side is sole observed case in real-world scenarios (an application to both market sides would mean a copying of an existing ecosystem that would actually need to be a partner).

A subset of the previous group is formed by the big bang marketing approach. Contrary to the above, this approach does not stimulate any value add or indirect network effects. It aims to generate a positive expectation of the platform. Demand and supply sides are expected to join based on these expectations. It can be applied upon the discretion of the platform owner and relies on the power of the platform owner to advertise its own ecosystem in the market. Big bang marketing is advisable for established players with enough resources to fund such an approach.

The last group of ignition strategies approaches the critical mass challenge directly and involves the micro market entry. The micro-market ignition strategy addresses both sides of the market simultaneously. For this approach to work, the utility of the indirect network effects within the micro market needs to be stronger than in the overall market. This entry is powerful for new entrant ecosystems with limited resources as it keeps the market narrow and thus directs any efforts to a narrow market group. Given the presence of a micro market, the ecosystem owner can choose freely to approach this market only.

An increase of participants from solely one side of the market is not capable to pass the critical mass threshold as a non-zero threshold exists for both market sides (Evans & Schmalensee, 2016). All strategies as described above lower the critical mass point but are not able to reduce the critical mass to zero. For an overall successful strategy, it is hence mandatory to combine multiple approaches (Wanner et al., 2019). Real-world examples indicate that tuning of the selected approaches to the underlying market requirements is essential. The key element is the perceived utility gain by both market sides. This perceived utility is not formulated explicitly, but can be represented in special cases for certain conditions like Zhu and Iansiti (2012) explained.

Our analysis of platform ignition strategies in e-commerce also revealed that buyers are rarely addressed as a single market side. The supply side seems mandatory to be stimulated first (Hagiu, 2006). The revenue stream on the supply side forms the basis for the ecosystem proliferation and is hence in focus for ecosystem growth (Bakos & Katsamakas, 2008; Eisenmann et al., 2006; Hagiu, 2014; Parker et al., 2005; Rochet & Tirole, 2006). Existing research on platform ignition strategies

(Evans & Schmalensee, 2016; Ojanperä & Vuori, 2021; Parker et al., 2016; Parker & Van Alstyne, 2016; Reillier & Reillier, 2017; Wanner et al., 2019). emphasize a focus on supply-side participants for igniting a platform in e-commerce. Securing a minimum level of products and services seems to be more important than attracting buyers and generating demand. With a focus on the supply-side, indirect network effects are propelled to attract demand-side participants (Armstrong, 2006). With indirect network effects occurring, direct marketing measures for demand-side participants seem unnecessary from a platform owner's perspective (Cennamo, 2021).

Table 3. Summary of platform ignition strategies with their boundaries and when best suited

Strategy	*Boundary conditions and challenges*	*Best suited for*
Subsidies	• Risk of "take-it-and-leave" from direct cash subsidies; mitigated by cost-reducing discounts • Risk of permanent subsidy perception; mitigated by temporary coupons and discount vouchers	• Reduction of entry hurdles on either market side • Platforms without immediate profit needs
Seeding	• Future platform owner with sufficient selling capabilities • Business setup by platform owner as a platform and as seller • Risk of declining own sales business by other sellers on the platform	• Sellers who decided to expand towards platform business
Marquee actors	• Heterogeneous market with dominant key accounts • Risk of slow platform growth due to focus on key accounts with potential strong competition	• Platform owners with access to key accounts on either market side • Platforms with clear value propositions and focused marketing toward key accounts
Single side	• Potential platform owner with sufficient selling capabilities • Business setup as seller with an option for the platform business	• Sellers who may want the option to expand towards platform business
Micro market	• Platform in the dedicated market segment (e.g., niche) • Risk of slow platform growth in the overall market due to the limited addressable market	• Platforms with clear value propositions within the market segment
Piggybacking	• Access to sellers or buyers from another platform • Risk of differentiation towards another platform	• Platform with access to sellers or buyers from other platforms and differentiation
Opening up	• Presence of established other platforms • Risk of take-over by competitor platform	• Platforms entering a market with established platforms in at least adjacent areas
Big bang	• Sufficient marketing budget	• Homogenous market entry or selective marketing

Based on the derived analysis of the individual strategies as summarized above and conducted in Section 4, each strategy shows certain boundary conditions and strengths. We summarize these in Table 3.

6. CONCLUSION

Focal platforms in e-commerce ecosystems require to attract different types of participants from a number of independent markets to be successful. In total, we have evaluated eight ignition strategies for platform business models in the context of e-commerce (i.e., subsidies, seeding, marquee actors, single side, micro market, piggybacking, opening up, big bang). Our analysis has shown that focal platform owners either focus on sellers or address buyers and sellers simultaneously with dedicated ignition strategies. We used a mathematical model for our analysis, that is based upon indirect network effect-induced utility gains and perceived costs for either market side. Heterogeneity is modeled by a sigmoidal distribution function. We have expanded this existing mathematical model to further understand the effects of the above-mentioned ignition strategies for e-commerce ecosystems. All strategies contributed to lowering the critical mass threshold, which is omnipresent in two-sided markets. This threshold reduction is achieved either by the reduction of the perceived costs for sellers or buyers, by increasing the number of active buyers, by increasing the number of offered goods (assumed to scale with the number of sellers), or by a strengthened indirect network effect. The ignition strategies can either be applied upon the discretion of the platform owner, given enough resources, or underly external preconditions that need to be given, like the availability of respective partners. The strategies further differ by the market side they focus on and the sequence of their approach.

We contributed to the body of knowledge on e-commerce ecosystems by proving that generic ignition strategies from common literature (Eisenmann et al., 2006; Evans & Schmalensee, 2016; Ojanperä & Vuori, 2021; Parker et al., 2016; Parker & Van Alstyne, 2016; Reillier & Reillier, 2017; Wanner et al., 2019), like subsidies, seeding, marquee, single side, micro market, piggybacking, opening up, and the big bang are applicable and promising in the context of e-commerce. Our ignition strategy analysis bridges critical mass (Hagiu, 2006; Janiesch et al., 2020; Zhu & Furr, 2016) and two-sided market theory involving network effects (Armstrong, 2006; Rochet & Tirole, 2006; Shapiro & Varian, 1998) in the context of e-commerce. We point to the use of mathematical models to anticipate the impacts of strategies in practice. We based our analysis on the underlying models for two-sided markets with indirect network effects as derived by Evans and Schmalensee (2016). With this, we derived managerial implications for the individual ignition strategies' applicability in practice. These implications per strategy are what governs the answer to the research question of how an e-commerce ecosystem can be successfully established.

As a managerial implication, we provide guidance for platform owners on how to support establishing successful e-commerce ecosystems by applying a suitable set of ignition strategies. Our research also enables ecosystem participants to anticipate strategic measures taken by the owner of the focal platform and prepare accordingly. Our research emphasizes the affected market side per strategy and indicates ignition strategies with potential preconditions and underlying boundary conditions. Platform owners can select an ignition strategy based on the induced influence. Platform owners especially need to consider ignition strategies with extrinsic preconditions, since these strategies are either not implementable without fulfilling these preconditions and thus not successful in reaching critical mass. Irrespective of the ignition strategy selected, it was shown that no ignition strategy can support a start of an ecosystem without initial participants from both market sides. The strategies rather support the growth of the market share. Ecosystem participants can react to potential ignition strategies. Especially, the supply side (i.e., sellers) can benefit from dedicated ignition strategies such as subsidies or marquee actors.

Our analysis of ignition strategies for e-commerce ecosystems implies the potential applicability of the generic ignition strategies in other domains as well as of the underlying application of the selected mathematical model. Network effects and critical mass are inherent phenomena of platforms with two or multiple market sides despite their domain of application. As a further implication for research, we point to the use of mathematical models to anticipate the impacts of strategies in practice in general and in e-commerce in particular. Although existing models might need to be extended and detailed in future research, they can assist to anticipate the usefulness of strategies before their actual implementation. The used mathematical model can equally be expanded to strategies not covered within this research.

Despite these contributions, this research has also its limitations. In what follows, we elaborate on these potential limitations and describe avenues for future research. First, we focused on well-established ignition strategies for platforms benefitting from network effects (Jacobides et al., 2018; Parker & Van Alstyne, 2016; Schirrmacher et al., 2017). The aim of these ignition strategies is to attract different types of ecosystem participants to pass the critical mass threshold for the platform to self-propel (Armstrong, 2006; Parker et al., 2016). However, these ignition strategies rarely consider acquisition conducted by the focal platform to increase its reach and the number of participants. Miric et al. (2021) identified that platform companies are likely to acquire niche companies as a strategic measure for expanding the scope of the ecosystem. Hence, future research may further investigate the possibilities and implications of acquisition in the ignition stage of an ecosystem and enrich the mathematical model by Evans and Schmalensee (2010).

Second, our analysis of ignition strategies does not account for the subsequent or simultaneous application of multiple ignition strategies. The model needs to be applied several times instead of offering the integration of multiple strategies. Therefore, an important avenue for future research would be to extend the applied theoretical model proposed by Evans and Schmalensee (2010) for the case of strategies applied subsequently and simultaneously as well as cases with more than two market sides. Focal platforms in e-commerce ecosystems frequently orchestrate more types of ecosystem participants despite seller and buyer (e.g., logistic service providers, IT providers) (Böttcher et al., 2021; Schütte & Wulfert, 2022; Wulfert & Schütte, 2022). These extensions can make the theoretical model better applicable to real-world scenarios.

Third, while this research is detailed in depicting the effect of each strategy on the basis of the mathematical model of two-sided markets Evans and Schmalensee (2010) and providing generic recommendations for when to apply which strategy, it falls short to form concrete managerial recommendations. As of now, such recommendations require a full understanding of the respective market conditions and a case-by-case modeling and comparison of the strategies. Hence, an important avenue for future research would be a derivation of archetypal strategic measures to assist focal platform owners in establishing successful e-commerce ecosystems.

Fourth, while our model is detailed to depict the individual implication of each strategy, it is not built to model a combination of multiple strategies as they are often faced in real-world scenarios. Based on a very generic market setup, concrete managerial recommendations are also limited to general statements. We, therefore, encourage further research to expand the model for combined strategy investigation as well as the application of this model in concrete markets. As direct marketing measures for demand-side participants seem unnecessary from a platform owner's perspective in situations with indirect network effects (Cennamo, 2021), it might be worthwhile investigating in future research, if an approach for attracting demand-side participants generates enough tension with regard to indirect network effects to encourage sellers to join the ecosystem.

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