Cross-Platform Effects: Towards a Measure for Platform Integration Benefit

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Abstract (as submitted – cannot be modified)

The advancement of technologies and the ongoing digitization have triggered the development of a large variety of innovations. Media and other information goods have been transformed into bits and bytes and barriers between formerly distinct industries burst. Both incumbent and insurgent players jumped on the digitization train and develop completely new business models that are often tailored around over-the-top (OTT), i.e. Internet-based platforms. It has been convincingly postulated that the success of the leading new Internet-based media and communications companies is attributable to exactly this business set-up. Platform companies profit from cross-sided network effects which lead to increased market concentration (winner-takes-it-all dynamic) and high entry barriers (chicken-and-egg effect).

Initially, platform markets consisted of a simple set-up of a handful of platforms. By now, these markets evolved towards an ecosystem of interrelated and layered platforms that have been conceptualized as Platform Networks (PNs). In PNs, platforms operate not only next to each other in direct horizontal competition, but also on top of each other in the value chain. By vertically coupling platforms with one another, platform companies also intertwine the platforms' cross-sided network effects. We refer to this coupling effect as cross-platform effects. As a result, platforms self-accelerate their growth by building close vertical systems in form of Platform Silos (PSs). Still, from both a research and practice point of view, neither the competitive advantage achievable through PS nor its implications have been assessed yet.

In this paper, we aim to make a first step towards closing this gap. Building on prior work on cross-sided network externalities, multi-product pricing and the theory of two- and multi-sided markets, we propose a variance model to capture a user's platform utility (operationalized via intention to use and willingness to pay) for an individual platform and a vertical combination thereof. We conceptualize platform utility as a composite of network value, functional value and value from transaction cost reduction. We conclude by proposing how the model can be used to capture advantageousness of PSs from the perspective of the providers involved.

Finally, we discuss the implications for the sustainability of PNs. We conclude that while the increasing emergence of PSs might lead to the emergence of power houses of innovation in
the short term, their strong competitive position might under certain circumstances hamper innovative efforts in the long-term.
Introduction

In the last decades, media and telecommunications markets all over the world have been changing fundamentally. Liberalization, deregulation, and globalization have reshaped the power structure in the sector (see e.g. Garnham, 1990; Mansell, 2004). These went hand in hand with digitization and a range of technological innovations such as smartphones, IPTV, or e-book readers that opened media and telecommunications markets to international technology companies and affected the sector most profoundly. As a result, well-established media and telecommunications companies with an incumbent position in their industry, notwithstanding their long period of success, are facing intensive competition from new players.

Many of the new entrants have a business set-up different from their incumbent and operate as over-the-top (OTT), i.e. Internet-based platform businesses.

Platforms work as mediating entities that create value by facilitating interactions in a triangular fashion between upstream and downstream agents such as sellers and consumers. This enables them to exploit cross-sided network effects and to gain massive market power (Evans & Schmalensee, 2007; Rochet & Tirole, 2003; 2006).

It has been convincingly postulated that the success of the leading new Internet-based media and communications companies is attributable to exactly this business set-up. (Lee, 2014; Schlesinger & Doyle, 2016, Hagiue & Wright, 2015; Parker et al., 2016, Hagiu & Jullien, 2014)

All of this is compounded by an issue that is not yet widely discussed or understood, i.e. that the simple set-up of a handful of platforms around which markets gravitate is already becoming a thing of the past. As a response to the significant competitive advantage of being a platform, incumbents have adapted to the competitive situation by striving for platform-based business models themselves. They have transitioned their companies progressively from classical downstream buyers or upstream suppliers of products or services to platform businesses.

By now, we have whole ecosystems of platforms in which platforms operate not only next to each other in direct horizontal competition but also on top of each other in the value chain. As a result, the media and communication sectors have converged to a system of interrelated and layered platforms to which we refer in the following as Platform Networks (PNs) (see Hoelck & Ballon, 2015). For example, in the smartphone world, platform competition encompasses Apple’s iOS and Appstore, Google’s Android and Google Play, alternative operating systems such as Firefox OS or Samsung Tizen, but also Samsung and Huawei’s Android overlays and ‘skins’ and even platform applications such as Facebook Mobile, Facebook Home, Whatsapp, iTunes, Spotify, YouTube and many others.

This platformization of the media and telecommunications industry not only affects the market structure, but also the economic interactions within those increasingly complex ecosystems, leading to major power shifts. In this multi-layered platform setting, platform companies follow strategies not available to merchant companies. This provides them with competitive advantage within many sectors. Innovation becomes a product of the attempts of all these semi-overlapping, competing, yet often also cooperating platforms to outdo each other.

The paper aims to investigate which strategic possibilities for platforms arise in PNs. Especially it seeks to answer the question:
Which benefits can platforms attain by interacting with vertically aligned platforms?

The paper proposes a theoretical framework and variance model, which will make it possible to assess those benefits in various industry contexts.

While there is a growing body of literature on the economics of platforms, little attention has so far been devoted to the rise of multi-layered platform ecosystems and especially possible platform-specific strategies within them. The results of such work do not only have impact on the day-to-day business of companies, but bear also implications for innovation efforts and the intensity of competition within the sector.

In the following, first, we will devote a section to the nature of cross-sided network effects as well as some theoretical explanation about the emergence of PNs. Then, possible platform-specific strategies within PNs are outlined. Subsequently, their possible benefits are empirically assessed. Finally, the findings of the paper are discussed, its limits outlined and a conclusion is drawn.

The field of platform theory

In the past decade, within the strand of Industrial Organization (IO) two-sided market theory (TSM) (e.g., Caillaud & Jullien, 2003; Eisenmann et al., 2006; Parker & van Alstyne, 2000; Rochet & Tirole, 2004; 2006) has emerged, which describes the characteristics, strategies and impacts of platforms.

The research strand builds on prior work on network externalities, compatibility, vertically related markets, and multi-product pricing (see e.g. Economides & White, 1994; David, 1985; Farrell & Saloner, 1985; Katz & Shapiro, 1985, Rochet & Tirole, 2004). Much of the earlier literature offers a rather ‘static’ analysis in the sense that it concentrates on price decisions and equilibrium of single platforms (e.g. Hagiu, 2009; Rochet & Tirole, 2006; Roson, 2005; Weyl, 2010) or in relation to competition between two platforms (e.g. Armstrong, 2006; Armstrong & Wright, 2007; Caillaud & Jullien 2001; Eisenmann et al., 2011; Mantena & Saha, 2012; Roson, 2005), largely taking the perspective of the platform provider. Models are usually characterized by a high level of generalization and abstraction (e.g. Caillaud & Jullien, 2001; Rochet & Tirole, 2004; Weyl, 2010). Afterwards, researchers started to conduct more ‘dynamic’ analyses that focus on two-sided platform strategies and business models, the evolution of platform boundaries, and inter-platform interactions (see e.g. Ballon, 2009; Eisenmann et al., 2009; Hagiu, 2009).

Most two-sided network literature refers hereby to platforms as mediating entities, which facilitate the interaction of at least two distinct user groups that mutually attract each other through network externalities (Anderson & Coate, 2005; Eisenmann et al., 2006; 2011; Evans, 2003; Evans & Schmalensee, 2007; Landsman & Stremersch, 2011; Rochet & Tirole, 2003; 2004; 2006; Rysman, 2009). For this purpose, the platform provides infrastructure and rules (Parker & van Alstyne, 2005). It designs pricing in order to get the connected user groups ‘on board’ (Rochet & Tirole, 2004; Roson, 2005), so that they can benefit from having access to each other (Evans & Schmalensee, 2007).\(^1\) When only two user groups are present, one

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\(^1\) We use the term ‘two-sided markets’ synonymously to equivalent terms in the literature, such as ‘two-sided network’ (Eisenmann et al., 2006), ‘two-sided platform’ (Evans & Schmalensee, 2007), and ‘platform-mediated market/network’ (Eisenmann et al., 2011).
frequently represents a supply side and one a demand side (Eisenmann et al., 2011; Landsman & Stremersch, 2011).

Yet, the understanding of the platform concept varies within the literature. One group of authors, among them Gawer & Cusumano (2002), regard platforms as ‘technological foundation’ on which further elements are built in a modular system architecture. Examples include operating systems like Apple’s operating system iOS, running on their phones and tablet PCs. This view is inspired by studies of the high-tech industry, especially computing and telecommunications (Bauer, 2014). In contrast, we adopt a broader, economic understanding of the platform concept in this paper. It goes beyond the purely technological definition of platforms by also including services such as online retail services (e.g. Amazon.com) or products such as credit cards (e.g. VISA) in the definition. Hence, according to our understanding, platforms can, but do not have to, have a technological basis. This understanding is inspired by the work of authors such as; Parker et al., 2016, Hagiu & Wright, 2015 or Schlesinger & Doyle, 2016 who refer to platforms as ‘intermediaries’. As such, this view originates in classical economic studies of two-sided markets, which focus on a variety of industries, yet, it was also quickly adopted by other social sciences such as communication studies.

Summing up, platform companies have a rather distinct and complex business logic. In the following, we explain their economic logic in further depth.

**The economics of cross-sided network effects**

To start with, platform companies’ set-up is considerably different from the architecture of traditional merchant firms.

Merchant companies operate in linear bilateral ‘retail’ markets and follow the rational of linear bilateral exchange: they acquire the necessary complements from an upstream seller and sell the finalized product to a downstream consumer, thus operating in a linear fashion (Hagiu, 2007). Conversely, platforms follow the logic of a triangular affiliation: they create value by facilitating interactions between seller and customers affiliating with the platform (Armstrong, 2006, Evans & Schmalensee, 2007, Rochet & Tirole, 2003; Eisenmann et al., 2006) Their utility is affected by participation and usage on the opposite side of the market (Gawer & Henderson, 2007; Jacobides et al., 2006; Jullien, 2004; Rochet & Tirole, 2003).²

As pointed out by Evans and Schmalensee (2007), platforms thus arise in situations in which network externalities exist and in which transaction costs prevent the user groups from solving these externalities directly. User group members cannot ‘arbitrage around the platform’ (Evans, 2003; Parker & van Alstyne, 2005). A platform serves as a way of solving these network externalities by facilitating exchange in a way that minimizes transaction costs. Contrary to merchant markets, cost and revenues arise on both sides in platform markets (Eisenmann et al., 2006).

² IO models that cannot recognize interdependent demands can thus usually not be applied to platform markets. As Rochet & Tirole (2004) for example outline, a value creation from one customer group for the other indeed violates the Coase theorem (1960). In two-sided markets, a clear property right situation, zero transaction costs and information symmetry are not sufficient condition for an efficient transaction volume.
The network externalities, which platform companies solve by reducing transaction costs and by facilitating value-creating exchange, are indeed ‘cross-sided network effects’ and the defining feature of platform markets.

Cross-sided network effects (Armstrong, 2004; Caillaud & Jullien, 2003; Rochet & Tirole, 2003) occur if an increased usage on one market side creates benefits for the distinct user group on the other side(s) of the (Rochet & Tirole, 2003; 2006, Evans & Schmalensee, 2007; Le & Tarafda, 2010). Thus, contrary to same-sided effects, cross-sided effects run ‘across markets’ and can only occur in at least two-sided markets (Parker & Van Alstyne, 2005, p. 1495; see Figure 1). For example, the more sellers offer their products on eBay, the more interesting the platform becomes for buyers and vice versa.

Cross-sided network effects do not necessarily have to be positive. Indeed, it is sufficient, if one market side experiences positive externalities from joining the platform as long as the benefits of the exchange outweigh the costs of the other market side. As an example, consumer do not appreciate advertising, however, as long as the advertiser benefits outweigh the consumers costs of being confronted with advertisements, the platform will use the possibility of a a value-creating exchange (Evans, 2014; Roson, 2005).

In addition, the markets in which the intermediaries occur cannot be only two- but also multi-sided (Ballon et al., 2012; Evans, 2003). The web-based professional network platform LinkedIn for example, is mediating between not two, but three market sides: users, recruiters and advertisers.

Cross-sided network effects enable platforms to pursue a pricing strategy which is not feasible for merchant firms, i.e cross-subsidization. Concretely, platform companies can charge prices at one side below marginal cost (P < MC), in some cases prices can even be 0 or negative and derive profit on the other side(s) of the market. Platforms can attract with this pricing

Figure 1: Platform types.
structure additional participants on the subsidized side of the market to foster participation on the profit-making side (Evans & Schmalensee, 2007).

Also, the presence of cross-sided network effects results in two paradigmatic effect in platform markets, namely the ‘chicken-and-egg’ problem and the ‘winner-takes-it-all’ dynamic.

In the case of the first effect, due to cross-sided network effects, a platform has to attain a critical mass of participants on one market side to attract participants on the other side and vice versa. Thus, it is very difficult to start a platform and to enter in market competition (Hagiu, 2007; Melody, 2007; Rysman, 2009). While it is difficult to start, a platform companies’ maintenance is facilitated by the second effect. Due to cross-sided network effects, an increasing amount of group members on one market side will attract further group members on the other markets side(s), which, again, attract new members on the other side – a positive feedback effect is in place. Thus, once an installment base has been procured, it becomes almost impossible to stop a successful platform (Eisenmann et al., 2006; Eisenmann, 2008; Melody, 2007; Bresnahan & Greenstein, 1999). Gawer & Cusumano (2008) describes the situation as ‘tipping’, in which a platform war of at least two competing players ends with the domination of one of them.

To recapitulate, while same-sided network effects can arise in markets with merchant and platform companies alike, cross-sided network effects are a precondition for platform companies’ raison d’être. It enables them to cross-subsidize market sides and to profit from the chicken-and-egg and winner-takes-it-all dynamic, which gives them a potential competitive advantage over merchant companies.

**The economics of Platform Networks**

As alluded in the introduction, markets which gravitate around a handful of platform are a thing of the past.

The increasing amount of new entrants, especially from the software industry, and the striving of the incumbents to built their own platform business in order to compete in digital platformized market spaces lead to the emergence of multi-layered platform ecosystems or, as we refer to them, *Platform Networks (PNs)* (Hoelck & Ballon, 2015).

Figure 2 provides a simplified illustration of the concept of PNs. It shows as an example three layers of platforms interacting with each other. The platforms in the same horizontal layer offer substitutes, while the platforms in the adjacent vertical layers offer complements, thus representing the different sides of the market.

Since the economic logic of platform companies differs from merchant companies, the set-up of platform-dominated ecosystems is distinct from those in merchant ecosystems. The market structure of platform ecosystems is gravitating towards concentration, since platform markets are characterized by a winner-takes-it-all dynamic and the chicken-and-egg problem, which give platform companies the opportunity to gain massive market power while reducing competition and creating high entry barriers (Eisenmann, 2008). Thus, the ecosystem’s layers

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3 The platforms in the figure are for reasons of simplicity two-sided. A multi-sided platform setting would require a three-dimensional depiction.
are usually served by a single monopoly platform or a few large fiercely competing platforms in each layer. Due to vertical expansion it might also be possible that companies compete in more than one horizontal layer of the ecosystem. Yet, in each layer the company is then competing in different markets for different products and services with possibly varying other competitors. Furthermore, the ecosystem is becoming far more complex since platforms have at least a triangular transaction structure. Thus, there are multiple points of business connections with varying directions in platform ecosystems making them no loose and simple company clusters but rather complex networks in which the different platform layers also start interacting with each other. Additionally, the ecosystem’s inherent economic logic differs. Companies usually compete in terms of price and product quality. Yet, network effects change the nature of competition in an ecosystem (see e.g. Koski & Kretschmer, 2004; Tremblay, 2011). Platforms pricing structure diverges heavily from the pricing structure of merchant companies. Through cross-subsidization, platform can subsidize one market side, thereby undermining competitors pricing, to gain new participants on the other market sides to enhance profit maximization (Evans and Schmalensee, 2007). Furthermore, platforms in digital ecosystems enjoy first-mover advantages connected with a bandwagon effect, and lock-in tendencies due to high switching costs, which favors big successful platform companies entering the market at an early stage regardless of the quality of their product (Gottinger, 2003; Farrell & Klemperer, 2007, see also Doyle, 2013).

Figure 2: Platform Network (PN).

The platforms in the ecosystem create often crucial common assets and need to cooperate to foster each others growth. Thus, the platforms companies within PNs are in the paradoxical situation in which they have to balance between competition and cooperation: On the one hand, the platform companies have to consolidate their market position, on the other hand they have to support the creation and maintenance of a sustainable ecosystem. This leads to the inter-firm dynamic of ’co-opetition’, i.e. the collaboration between firms with incomplete congruence of interests, often in the presence of market power asymmetries (Brandenburger & Nalebuff, 1996; Dagnino & Padula, 2002). As a result, companys’ strategic incentives are directly at odds with the platform ’ecosystem’ logic (Weyl, 2008).

Summing up, the market structure of platform ecosystems is denser due to concentration tendencies, more complex due to the at least triangular set up of platforms and follows a different inherent business logic when it comes to pricing and the quality of products.
Strategies within Platform Networks

Alike merchant ecosystems, PNs are characterized by certain competitive dynamics.

Horizontal dynamics occur between companies which are competing next to each other i.e. in the same horizontal layer. Also, companies might be subject to vertical (intra-layer) competitive dynamics. The relationship between companies which operate on top of each other in the same vertical value chain layer might be fraud with tension over prices and quantities i.e. characterized by vertical rivalry. Finally, there might be diagonal (cross-layer) competitive dynamics. Companies exploit those dynamics when entering the PN from outside the ecosystem, especially when ecosystems are overlapping.

It is clear, that platform companies have a different set of competitive strategies available due to their two- or even multi-sided market set up. Yet, existing literature mainly focuses on pricing strategies (Hagiu, 2014; Parker & van Alstyne, 2005; Evans, 2014; Evans & Schmalensee 2007), or the general pursue of platforms to attain more power e.g. Gawer & Cusumano’s (2008) description of platform leadership.

Accounts, which explicitly focus on a platform’s strategic action within an industry or ecosystem are rare. Parker & van Alstyne (2012) provide in an exception with their concept of ‘platform envelopment’ (see also Novelli, 2012; Zhang & Duan, 2012). Platform envelopment entails that a platform extends its value proposition by bundling it with another platform’s proposition and by offering it in a multi-platform bundle, possibly even for a lower price, levering overlapping user bases and harnessing cross-sided network effects to extend its power. During an envelopment attack, a platform is using the advantage of cross-sided network effects to not take over its rival but forces him systematically to leave the market. Although the authors describe this attack also to be used to attack substitute (horizontally aligned) and complementary (vertically aligned) platforms, it is possibly most often observable to attack so-called ‘functionally unrelated platforms’ i.e. to enter other ecosystems through the exploitation of diagonal dynamics. Indeed, Apple, Google and Amazon used similar approaches to enter the several industries oft the media and telecommunications sector (Hoelck et al., 2014; 2015; 2016).

Yet, two other integration strategies are commonly observable, which have not been described so far. With integration, we refer to any intermediate form between loose cooperation to mergers or acquisitions resulting in an entirely new platform.

Silo competition

The first strategy can be described as silo competition. Then, a platform is combating a platform next to it in the same horizontal layer by increasing its grip on the downstream or upstream layers by gathering suppliers and sellers through the creation of a closed ecosystem. This can be achieved via strategic growth, acquisition or strategic cooperation. In the case of strategic growth, a company is creating a line of interconnected platforms over several vertical layers in the PN, thus incorporating and platformizing all necessary functions within the value chain. This strategy is for example carried out on a frequent basis by Apple. In the telecommunications sector Apple created and owns all important platform layers i.e. device (iPhone), operating system (iOS), and application store (App Store). Of course, Apple could have also acquired the necessary platforms e.g. through mergers or acquisitions and integrated them into its ecosystem. In the case of strategic cooperation, an exclusivity agreement permits users to multi-home. The platform uses then exclusivity as a means of competition and differentiation since it enables the provider to charge higher prices and deter market entry of rivals, therefore expanding its profits and market dominance (Lee, 2013). An example is the
exclusivity agreement between Facebook and Google. In April 2013, Mark Zuckerberg announced Facebook’s new home screen Facebook Home, a launcher between a phone’s OS and applications. It replaces the standard home screen with a Facebook home screen that allows the customer to chat, see status updates, receive notifications and watch full-screen pictures even while using other applications than Facebook. According to Zuckerberg, it would in the near future only be available for the Android OS and not for Apple’s iOS or phones with a Windows OS (Olanoff, 2013). This is ensuring Google a unique selling proposition and thus a competitive advantage in the mobile OS market (see also Hoelck & Ballon, 2015).

**Vertical Commodityization**

The second strategy can be described as *vertical commoditization*. A platform can cause the economic disappearance of a whole horizontal layer in a PN, thus lowering the possibility of vertical rivalry, which decreases with the number of vertical layers. The platform expands with a new subsidy in an aligned upstream or downstream layer. Indeed, the task of the introduced platform subsidy, which is vertically integrated with the mother company, is not profit earning but to offer the value proposition of the other companies in the prevailing layer for a huge discount or even for free via cross-subsidization and reliance on cross-sided network effects. It is therefore decreasing the rivals’ profits and may even force them to leave the market, while increasing the value of its own major platform. This strategy is for example repeatedly carried out by Google. Google internet-based platform services Google docs or Google maps are offered for free and are connected to Google larger ecosystem.

Both strategies have in common that they draw alike envelopment on the power of cross-sided network effects. Yet, contrary, they do not simply exploit these externalities. Instead, by coupling two (or more) platforms, the platform providers also interconnect the platform’s cross-sided network effect (Figure 3; see also Hoelck & Ballon, 2015).

As a result, an increasing number of user on platforms 1 can then lead to increasing number of participants on platform 2, thus transforming cross-side network effects into *cross-platform effects*. The growth of both platform is coupled and platform silos (PSs) are created. This in turn is supposed to lead to an increase of the value of the platform for the user as well as a higher profitability for the platform provider.

In conclusion, next to envelopment, platform can exploit two further cross-sided network effect based strategies, namely silo competition and vertical commoditization. Both rely on cross-platform effects and result in a form of platform silos. In the following, the results of these effects are formalized.
A Model for Measuring Platform Integration Benefit

In this section, we propose a model to measure platform integration benefit for an integrated platform dyad. With integration, we refer to any intermediate form between loose cooperation to mergers or acquisitions resulting in an entirely new platform.

We choose the individual, actual or potential platform user as unit of analysis. Platform users constitute a readily available and low-cost data source with comparatively high predictive validity regarding platform integration benefit. Platform integration benefit is operationalized via users' usage intention and willingness to pay (WTP) for platform membership and usage. We imply that the platforms' financial outcome – ex-ante and ex-post to integration – can be approximated via a survey of WTP and usage intention of a representative user sample from every user group affiliated to the platform(s).

This approach enables us to abstract from a detailed analysis of the platform provider's pricing decisions and its financial outcome before and after integration. Instead, we impose that the platform provider can, via its pricing structure and all else being equal, translate an increase in users' usage intention and WTP for platform membership and usage into an increase in the platforms financial outcome.

We target the model to both explain a change in the financial outcome for past platform integrations as well as predict the change for future ones. The model is intended to serve as a first building block for the understanding of the dynamics of more complex Platform Networks, which can be represented as a configuration of multiple platform dyads.

**Dependent variables**
As stated before, we choose the following two dependent variables

\[
\text{Intent}_i: \quad \text{Intention of individual } i \text{ to use the platform,}
\]

\[
\text{WTP}_i: \quad \text{Willingness to pay of individual } i \text{ for platform membership/usage.}
\]

**Independent variables**

**Network value**
A large body of research has shown that cross-sided network externalities, partially internalized by the platform, are a main mechanism for value creation in platform markets (Anderson & Coate 2005; Eisenmann et al. 2006, 2011; Evans, 2003; Evans & Schmalensee, 2007; Landsman & Stremersch, 2011; Rochet & Tirole, 2003; 2004; 2006; Rysman, 2009). In line with the individual platform user as unit of analysis, we first operationalize network value and define

\[
N_{Utility}_{ijk}: \quad \text{Total network utility derived by individual } i \text{ from user group } j \text{ from platform presence and/or usage of user group } k.
\]

We hypothesize

\[
H_{1a}: \quad \text{The higher } N_{Utility}_{ijk}, \text{ the higher is the intention of individual } i \text{ from user group } j \text{ to use platform (Intent}_{ij}).
\]

\[
H_{1b}: \quad \text{The higher } N_{Utility}_{ijk}, \text{ the higher is willingness to pay of individual } i \text{ from user group } j \text{ for platform membership / usage (WTP}_{ij}).
\]

Network utility derived from presence of another user group has been shown to depend on the size of that user group, but also on the heterogeneity of users and user roles (Afuah, 2013). We define
$U_{\text{Amount}}_{ijk}$: Total network utility derived by individual $i$ from user group $j$ from platform presence and/or usage of user group $k$,

$U_{\text{Heterogeneity}}_{ijk}$: Heterogeneity of users perceived by individual $i$ from user group $j$ in user group $k$,

$R_{\text{Heterogeneity}}_{ijk}$: Heterogeneity of user roles perceived by individual $i$ from user group $j$ in user group $k$,

and hypothesize

$H_2$: The higher $U_{\text{Amount}}_{ijk}$, the higher is $N_{\text{Utility}}_{ijk}$,

$H_3$: The higher $U_{\text{Heterogeneity}}_{ijk}$, the higher is $N_{\text{Utility}}_{ijk}$,

$H_4$: The higher $R_{\text{Heterogeneity}}_{ijk}$, the higher is $N_{\text{Utility}}_{ijk}$.

Both the theory of reasoned action (Fishbein & Ajzen, 1975) and its refined version to consumption contexts, the Fishbein Model (Ajzen & Fishbein, 1977) predict that for the individual's attitude formation not only the perceived existence of an attribute, such as the size of a cross-sided user network, is of importance, but also the individual's preference regarding that attribute. We capture the preference assessment by defining

$\text{Pref}_U_{A_{ijk}}$: Preference assessment by individual $i$ from user group $j$ regarding the size of user group $k$,

$\text{Pref}_U_{H_{ijk}}$: Preference assessment by individual $i$ from user group $j$ regarding the heterogeneity of user group $k$,

$\text{Pref}_R_{H_{ijk}}$: Preference assessment by individual $i$ from user group $j$ regarding the heterogeneity of user roles in group $k$.

We hypothesize

$H_5$: $\text{Pref}_U_{A_{ijk}}$ positively moderates the relationship between $U_{\text{Amount}}_{ijk}$ and $N_{\text{Utility}}_{ijk}$,

$H_6$: $\text{Pref}_U_{H_{ijk}}$ positively moderates the relationship between $U_{\text{Amount}}_{ijk}$ and $N_{\text{Utility}}_{ijk}$,

$H_7$: $\text{Pref}_R_{H_{ijk}}$ positively moderates the relationship between $U_{\text{Amount}}_{ijk}$ and $N_{\text{Utility}}_{ijk}$.

**Functional value**

A second area responsible for the shaping of users' platform usage intention and WTP is that of platform's functional value. Especially when integrating platforms, the combination and complementarity of platform functionalities plays a crucial role for creating value in a super-additive manner (Eisenmann et al., 2011).

We split functional value into an assessment of the favorability of the platform's functionality and the favorability of the complementarity of a pair of platform functionalities. With the latter, we aim to capture the source for functional value creation for the integration of two platforms, beyond the favorability assessment of the individual platforms' functionalities.

We define

$FP_{\text{Utility}}_{ijl}$: Utility derived by individual $i$ from user group $j$ from presence of the functionality / product $l$ in the platform,
**C_Utilityijl:** Utility derived from complementarity of two platform functionalities l and m, assessed by individual i from user group j.

We hypothesize

H₈ₐ: The higher FP_Utilityijl, the higher is the intention of individual i from user group j to use platform (Intentᵢⱼ),

H₈ₖ: The higher FP_Utilityijl, the higher is willingness to pay of individual i from user group j for platform membership / usage (WTPᵢⱼ),

H₉ₐ: The higher C_Utilityijl, the higher is the intention of individual i from user group j to use platform (Intentᵢⱼ),

H₉ₖ: The higher C_Utilityijl, the higher is willingness to pay of individual i from user group j for platform membership / usage (WTPᵢⱼ).

In line with the argument used in H₂ to H₇, we introduce two variables to capture the perceived presence of one platform functionality and the favorability assessment for that functionality.

**FP_Presenceijl:** Perceived degree of presence of a single functionality or product l in the overall bundle of functionalities or products offered by the platform, from the perspective of individual i from user group j (the functionality or product has to be sufficiently central in the platform's overall value proposition)

**Pref_FPPijl:** Preference assessment by individual i from user group j regarding the presence of a single functionality or product l.

We hypothesize

H₁₀: The higher FP_Presenceijl, the higher is FP_Utilityijl,

H₁₁: Pref_FPPijl positively moderates the relationship between FP_Presenceijl and FP_Utilityijl.

We further define

**Complementarityij:** Perceived complementarity of two platform functions l and m, assessed by individual i from user group j

and hypothesize

H₁₂: The higher Complementarityij, the higher is C_Utilityijl.

**Value from Transaction Cost Reduction**

A third area of value generation, partially beyond cross-sided network externalities and functional value, is the actual level of transaction cost reduction achieved via the platform architecture.

We define

**TCR_Utilityij:** Utility derived from transaction cost reduction by individual i from group j, compared to conventional, one-sided market,
SI_Costs ij: Level of search and information cost reduction, compared to conventional, one-sided market, as perceived by individual i from user group j,

B_Costs ij: Level of bargaining cost reduction, compared to conventional, one-sided market, as perceived by individual i from user group j,

PE_Costs ij: Level of policing and enforcement cost reduction, compared to conventional, one-sided market, as perceived by individual i from user group j.

We hypothesize

H_{13a}: The higher TCR_Utility_{ij}, the higher is the intention of individual i from user group j to use platform (Intent_{ij}),

H_{13b}: The higher TCR_Utility_{ij}, the higher is willingness to pay of individual i from user group j for platform membership / usage (WTP_{ij}).

H_{14}: The higher SI_Costs_{ij}, the higher is TCR_Utility_{ij},

H_{15}: The higher B_Costs_{ij}, the higher is TCR_Utility_{ij},

H_{16}: The higher PE_Costs_{ij}, the higher is TCR_Utility_{ij},

Figure 4 summarizes the research model.

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**Figure 4: Summarized research model.**
Discussion

The paper outlined how platforms can integrate in the form of silos (PSs), in order to profit from cross-platform effects, and thus accelerate the growth of their business. In the following, we discuss the implications of PSs for the sustainability of PNs. The paper is hereby considering three aspects: competition, innovation and regulation.

**Competition**

As outlined before, platforms’ exploitation of cross-sided network effects gives them a competitive edge towards merchant companies whose business are not subject to these effects. Platforms can cross-subsidize market sides, foster their growth and raise entry barriers for new entrants. Likewise, cross-platform effects help platforms to attain a competitive advantage towards other platforms. Via integration, e.g. by building PSs, platform can couple cross-sided platform effects, thus further advancing and accelerating their growth and potentially their profits.

Thus, the creation of PSs enforces the already existing tendency in platform networks towards concentration of market power. Yet, platform silos should not be equaled with lacking operability i.e. openness. Closedness can but must not be a feature of platform silos.

As an example, Apple’s platform system in the mobile sector represents a PS that is clearly not open. Coming back to the example from above, neither the iPhone, nor iOS or the Appstore are compatible with other devices, software, or services from other providers. Yet, the growth of all three platforms is naturally associated i.e. with a growing amount of iPhone owners – c.p. increasing the use of iOS and the amount of apps in the Appstore. Google’s silo of platforms in the mobile telecommunications sector is less clearly identifiable, mainly because it is not based on integration or acquisition but on cooperation. Device manufacturers such as LG, Sony or Nokia make use of Google’s Android operating system, application store Google Play and even designated Google applications such as Google Maps or YouTube. As such, also their platform growth is connected by cross-platform effects, i.e. an increasing user base for Sony devices leads to a higher use of Android and pre-installed Google applications such as Maps. The ‘the more open’ ecosystem can therefore even be regarded as more powerful, since it enables Google to reach users outside of its platform system – a reason for Apple to decouple its platform from Google’s platform silo by banning Google Maps from its device and introducing Apple Maps (see also Hoelck & Ballon, 2015).

**Innovation**

The emergence of PSs partly explains the explosion of innovations that platforms engender in adjoining markets, not only originating from third parties that make use of the platform, but also by platforms themselves. The extraordinary efforts by e.g. Google and Apple to create attractive services that are exclusive to their own platform (silo competition) or on the contrary are open to all and are meant to break open formerly closed markets (vertical commoditization) serve as convincing examples of this.

However, if the assumption is correct that PSs are a.o. driven by powerful cross-sided network externalities and potential transaction cost reductions, we can expect a gradual strengthening of their competitive position. This is not necessarily to the extent that monopolization occurs.

Still, the economies of scale inherent in platformization and the strong incentives that PNs provide for platforms to enter and possibly also leverage market power in adjoining markets, point to a reduction of innovation by third parties in the longer term. It is clear that there is a
need for further exploration and investigation of the present dynamics of e.g. the mobile market in this light, yet it may already be so that current developments related to mobile maps and traffic, music, communication and other applications are exhibiting a slowdown of innovation by non-platform parties.

So, while the increasing emergence of PSs might lead to the emergence of power houses of innovation in the short term, their strong competitive position might under certain circumstances hamper innovative efforts in the long-term.

**Regulation**

Should PSs thus be specifically targeted by regulators? The increasing concentration tendencies evoked by cross-platform effects might support such an argumentation. It also becomes apparent that since PS can be both open or close, neither feature is mitigating the concentration of market power. Yet, as argued above, innovation is flourishing within these powerful silos. As such, the potential harmfulness or desirability of PSs depends on the time-frame and prevailing context in which they arise.

In the short term, PSs can serve as powerhouses of innovation since the necessary resources and talents to innovate are available. In the long term, however, the cost of concentration might outweigh its benefits for innovation in certain industries. In industries concerned with infrastructure, service and product provision PSs might prove to be advantageous, since they guarantee a certain a degree of efficiency. In other sectors, however, especially those concerned with content provision, there is the danger that platform providers foster their growth at the expense of values such as pluralism and diversity.

Yet, to finally judge PSs, they will have to be investigated empirically. The introduced model based our framework of cross-platform effects, is a very first step in this direction. The model can be tested with various data sets e.g. derived from a survey. In the case of a survey, the sample could consist of either actual platform users or potential platform users that demonstrate some degree of familiarity with the platform(s) and the markets it/they operate(s) in. The model would be then tested both for two individual platforms as well as an actual or fictitious integration version of these platforms. It might also be interesting to differentiate between platform silos which have been created through silo competition, i.e. strategic growth, merger and acquisition, and cooperation or vertical commoditization. Additionally, the benefits of open versus closed PS could be compared.

**Conclusion**

The paper discussed how an increasing platformization of media and communications markets leads to the emergence of Platform Networks (PNs). In PNs, platforms operate not only next to each other in direct horizontal competition (horizontal layer), but also on top of each other in the value chain (vertical layer).

It was outlined, that platforms have the possibility to exploit novel strategies in these new environments by interacting with platforms in neighboring layers. By using the strategy of silo competition or vertical commoditization, platforms create Platform Silos (PSs). PS enable platforms to couple their cross-sided network effects and therefore their growth, thus pushing their reach and possibly their profit to new dimensions. We referred to this phenomenon as cross-platform effect.
The paper introduced a model based on this theoretical framework, which will make it possible to measure the benefit of such a platform integration, i.e. coupling of platforms through organic growth, merger and acquisition, or cooperation. Building on prior work on cross-sided network externalities, multi-product pricing and the theory of two- and multi-sided markets, the variance model captures a user's platform utility (operationalized via intention to use and willingness to pay) for an individual platform and a vertical combination thereof. We conceptualized platform utility as a composite of network value, functional value and value from transaction cost reduction.

The paper concluded that the emergence of PSs leads to a further concentration of market power in platformized industry contexts. It emphasized, however, that an increasing emergence of PSs should not be equated with an increased amount of closed platform systems. PSs exist in open and closed forms, depending on their origin. Indeed, PSs could prove to be power houses of innovation in the short term. In the long term, their strong competitive position might be harmful in industries with a large public interest at stake such as the media content industries though.
References


