Coherences on Privacy in Social Network Services

A Qualitative System Dynamics Analysis

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Abstract. In this paper, we built up a qualitative system dynamics model of social network services based on a literature review of 41 research papers concerning multi-sided platforms and privacy in social networks. Analyzing the model, we found the source for decreasing user privacy in unintended data disclosure caused by various factors. Further, the only element to directly sustain privacy is the implementation of efficient privacy policies and controls. Another notable result is that user multihoming behavior increases market competition for user time spent in a network and prompts providers to include more platform features. This leads to a raise in users' data disclosure and switching costs, which might lead to a winner-takes-it-all outcome for the social network service market on the long run.

Keywords: Social Networks Services · Online Social Networks · System Dynamics · Privacy · Multi-Sided Platforms · Two-Sided Markets

1 Introduction

"Privacy as we knew it in the past is no longer feasible!" stated Prof. Margo Seltzer from Harvard University in 2015 at the Davos Forum [1]. One year later, the EU commissioner for competition Margrethe Vestager warned that "if just a few companies control the data (...), that could give them the power to drive their rivals out of the market" [2]. A majority of those data-centric businesses aggregating and controlling the aforementioned data are constituted as social network services (SNS) [3]. Considering that current research on SNS as multi-sided businesses (MSP) reveals a coherence between the positive network effects within SNS and increasing market power [4], this leads to the question if these effects and the increasing market share of just a handful SNS on the one side and the increasing threat to personal privacy on the other side is somehow related to each other. If the former question can be answered positively it is also of interest in which way those relations function. Consequently, the aim of this paper is to shed some light into the darkness of SNS market by investigating the complex field conducting a qualitative system dynamics (SD) analysis on a basis of an interdisciplinary literature review.

adfa, p. 1, 2011.

1.1 Essential Concepts and Definitions

To taper the scope unmistakable on SNS, we draw on the updated definition of Kane et al. [5], which builds up on the early SNS definition of Ellison [6]. According to this definition an SNS has to contain the following features: "users (1) have a unique user profile that is constructed by the users, by members of their network, and by the platform; (2) access to digital content through, and protect it from, various search mechanisms provided by the platform; (3) can articulate a list of other users with whom they share a relational connection; and (4) view and traverse their connections and those made by others on the platform" [5]. Further, we add the restriction that the main revenue source of the SNS should be advertising to ensure the multi-sided platform character for our object of investigation. Hence, the scope of our investigation covers SNS like Facebook, Google+ and Twitter, but also services like YouTube. However, we mainly draw on Facebook for our analysis, simply because it is currently the largest SNS and object of investigation for most studies.

Mentioning multi-sided platforms (MSP), also known as two-sided platforms or markets, this paper orients on the major characters compiled from the most influential literature by Staykova and Damsgaard [7]. Accordingly, MSP (1) enable direct interaction between two or more participants affiliated to them; (2) are containing homing and switching costs for those participants; and (3) include direct and indirect network effects [7] (see Fig. 1). In this context, homing costs are the possible costs in money, effort, time and other aspects of entering and using an MSP. Moreover, switching costs are similar costs that occur for participants switching from one platform to another. Further, network effects occur when the value of the platform or its product for one user depends on the number of other users (of the same or another group). Those effects can be both positive or negative and are seen as a key aspect of MSP [8].

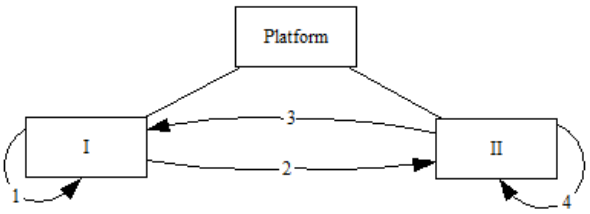

Fig. 1. MSP model, including platform participants (I&II), same-side network effects (1&4), and cross-side network effects (3&4) [40].

The final definitions we have to make beforehand are our understandings of privacy and personal data. For the former, we build upon Westin's definition of privacy. He states privacy as "the claim of individuals, groups or institutions to determine for themselves when, how, and to what extent information about them is communicated to others" [9]. For him, "[t]his, also, involves when such information will be obtained and what uses will be made of it by others" [10]. In the context of our work, we transfer this characterization and consider privacy the ability of SNS users to (1) *control their personal data*, its collection, aggregation, and analysis by the provider or third

parties within the platform; (2) *optimize the amount of personal data*, and its security against misuse with respect to their preferences.

For the clarification of the term personal data, we draw on the broad scope from Nolte who defines personal data as "any data revealed by user action, starting from simple likes, to direct personal information and even analysis of users click and browse behavior" [11]. We use a similar broad definition for user generated content (UGC) and claim anything a user enters by herself directly (name, pictures, status updates) and indirectly (e.g. Facebook like at an external website) to an SNS.

1.2 Methods

For our research purpose, we conducted an interdisciplinary literature review with scope on SNS user behavior, internet privacy, advertising in SNS and MSP to identify economical as well as behavioral coherencies and feedback-loops within certain SNS and in general the SNS market. Therefore, we focused primarily but not exclusively on the impact of network effects and multi-homing in an MSP perspective on the SNS environment. Further, building upon that objective the worked out coherencies, including cross-border connections, are modeled with SD to visualize and thereby clarify economical and behavioral interdependencies.

The advantage of the SD approach is that it targets the study of information feedback: "it treats the interactions between the flows of information, money, orders, materials, personnel, and capital equipment in a company, an industry, or a national economy" [12]. Thus, the method seems appropriate to target the complexity of the SNS market and to combine the findings of behavioral economics studies regarding user behavior within SNS and the theoretical as well as empirical results from both general and SNS focused MSP research.

1.3 Structure

The paper is structured as follows: Initially, we present our literature review and thereby give an overview over current MSP and SNS research, discussing the most relevant and also controversial findings. Building upon that, coherencies and feedback-loops relevant for SNS are extracted and modeled bottom-up using SD. Firstly by using the findings from our literature analysis to create an SNS core model containing the fundamental platform parts. Then, in a second step, we implement further results into our SD model to complete our exposition. Thereafter, we examine the crucial and controversial parts, including the implications for SNS users' privacy to match them with evidence from other empirical studies, market statistics and media references. Finally, our major findings and their implications are summarized and discussed, before we come to our conclusion.

2 Literature Review

Conducting the literature review we focused on influencing works from the last 15 years handling the topics of either MSP, SNS or privacy in the internet age in general. We identified this literature by searching Google Scholar and the Freiburg University library catalogue for the keywords "multi-sided platforms" and "two-sided markets", as well as "(online) social network (services)" and "Facebook", alone or in combination with "privacy". Moreover, we only kept papers which contained results directly connected or transferable to SNS or the SNS environment and identified further appropriate literature from their resources. Hereafter, we sorted the review results by the aforementioned topics MSP, SNS and privacy, and the categories framework, discussion, modeling and empirical work. Where a framework is an overall consideration and structuring of the topic, while a discussion is a consideration of certain research-results, modeling means the generation of a theoretical model and empirical work is the conduction and evaluation of surveys or market statistics. Hence, we ended up with a database of 41 papers matching our research purpose. The accurate distribution can be found in the table below (see table 1).

Table 1. Literature review distribution.

Category / Topic	**MSP**	**SNS**	**Privacy**	Sum
Framework	1	1	0	2
Discussion	5	7	4	16
Modeling	5	3	1	9
Empirical work	2	9	3	14
Sum	13	20	8	41

2.1 Approach

While analyzing the papers and carving out our results we used the following structure, loosely based on the MSP framework of Staykova and Damsgaard [7], to identify the components for our SD modelling.

Firstly we distinguished between four different SNS layers:

- ***Platform Participants:*** Participants in the SNS environment (e.g. provider, users, and advertiser), including competing SNS.
- ***Platform Architecture:*** The core features of an SNS platform as well as later integrated features, included apps and taken over services.
- ***Platform Governance:*** Possibilities of platform access, interactions, pricing policies in monetary and non-monetary forms, privacy policies and so on.
- ***Platform Effects:*** The different effects between participants or caused by the platform architecture or governance.

Further, we follow the evolutionary SNS approach of Staykova and Damsgaard [7] with our analysis. Thus, we first work out the ***SNS core*** consisting of the primal and fundamental features, participants and including effects of an SNS followed by the

SNS periphery consisting of all the additional participants, features and resulting effects. This approach is later also used to build up our SD model.

2.2 Platform Participants

According to the analysis of Staykova and Damsgaard the actual market dominating SNS Facebook started as one-sided platform to evolve to a multi-sided platform later [7]. A strategy which is also known from many other SNS, too. This finding is also supported by the study of SNS history by Ellison [6]. Hence, the core participants of an SNS are not more but the users and the provider.

When it comes to the SNS periphery we firstly have to recognize competing platforms, a factor which is crucial for most MSP considerations [13–15]. Moreover, the leading income source for the SNS is advertisement [7, 16]. Thus, another important participant are advertisers [6, 7, 16–18]. Additionally, current leading integrated an API to motivate outside developers to enlarge their SNS features with apps and games. Hence, app developers are another important participant in the SNS periphery [7], especially because SNS features seem to play a significant role when it comes to users value an SNS [5, 7, 19–21] and spending time within [21], while one important competition between different platforms is about the time users spend with them [19].

2.3 Platform Architecture

The core architecture of SNS contains the basic features which are the possibility for users to create a profile, to post user generated content (UGC), to build up a network with other users and to message them [5, 7, 19].

In the periphery we find additional SNS features like event management, group specific messaging and boards, external apps and games as well as overtaken and included services (e.g. Instagram in case of Facebook) and identity management services (e.g. Facebook Login). For simplicity we will combine all the aforementioned features in a simple quantitative proxy for the SD analysis. Further, the periphery contains the most important component for monetizing the platform: The possibility to show targeted advertisement to the users and the interface for advertisers to purchase those advertisement spaces [7, 17]. Finally, we also find user privacy controls in the periphery because they are generally implemented in a later stage of the SNS when the core already attracted a high amount of users [6, 22].

2.4 Platform Governance

Considering the governance of the platform core there are two regulations to observe. First, the access policy of an SNS determining who is allowed to join the platform and under what terms [7]. For example, Facebook allowed only students to join their platform in the early stage and ensured this policy due approving only applications with a university email-address [6]. Second, we identified the pricing policy as core element of platform governance. Under pricing policy we understand the monetary fees collected in a platform as well as non-monetary payments like the right to

gather and analyze user data for commercial purpose. Here it is to observe that all successful SNS have chosen the way of free access and gathering user-data for targeting advertisement as prevalent business model [5–7, 16].

Further, another part of the governance are the interactions provided and allowed between the different platform participations. For the platform core we found here only the interactions between the platform users as essential [cf.7] which are necessary for the SNS to gain user-generated content (UGC) and gather user data which later can be analyzed. Moreover, the gathered user data and users interest in privacy and control leads to the implementation of privacy policies to transparently illustrate the data use to users and improve their trust due privacy control options [5, 21, 23–27] even though only a minority of SNS users seems to understand and use them [11, 28].

Looking at the platform periphery, we firstly find that the access policy is enhanced by regulations not only for advertisers as expected but also for app developers when an open API is integrated and for login services if the SNS decides to enhance its service to serve as an identity management tool (cf. Facebook, Google+ or Twitter sign-in-services). Once the access policy has to be extended the pricing policy must be extended, too, since advertisement space in SNS is usually auctioned to the highest bidder for a certain keyword or target group [18], app developers have to share their revenue gained from a platform with the providers and commonly the user pays for using the sign-in-services with the thereby disclosed information.

Also the provided interactions are extended with the periphery. Platform users can now not only interact with each other's but with celebrity and company fan-sites and their advertisements, use apps integrated by external app developers and use their SNS profile as identity management tool to sign-in to external services and websites. Moreover, companies can not only run advertisements for specific target groups but are also allowed to create confirmed company profiles to provide events or special offers via the SNS to their followers. Furthermore, the external app-developers are allowed to collect money through their apps to gain profit. Finally, taken-over services are integrated into the platform and their UGC and users coalesces with the original SNS (cf. Facebook & Instagram).

2.5 Platform Effects

Core effects resulting from all the above-mentioned platform layers are straightforward. First, we find the same-side network effects between users of an SNS, meaning that each user makes the platform more valuable for other users by her membership and with contributing more UBC, resulting in a higher adoption rate [29–31]. Secondly, with a higher amount of UGC and higher platform activity comes in correlation a higher quantity of unintended disclosed user data [21, 32] which itself is by definition a decrease of users' privacy. Thirdly, the number of SNS features has also a positive influence on the UGC and on the time user spend within a network [19–21], while the latter has logically a positive influence on the user experience with the SNS. Finally, implementing privacy policies and controls has not only a positive effect on users' privacy but also on their trust in an SNS and their awareness regarding data usage by the provider [5, 27, 33–35], where increased trust itself can lead users to be

more willing to add UGC [22, 24, 36] but also may have the opposite effect when users are becoming more suspicious regarding the data claims of their provider [37].

The SNS periphery adds with the integration of additional platform participants more notable effects to the overall image. Firstly, indirect network effects resulting from the mass of users make the platform more valuable for advertisers and app developers and have thereby a positive influence on their adoption rate [3, 7, 14, 38]. While the creativity of the app-developers and the thereby newly created SNS features seem valuable for SNS users [19, 20], the user acceptance of advertising still seems not clarified. While Knoll finds that SNS users generally accept advertising "as long as it keeps a valued service free of charge" [17], Tucker suggests that social advertising in SNS can "backfire" and should be flanked with adequate privacy controls [26, 35], other research comes to similar findings [21, 21, 36, 38, 39].

With the existence of competitive SNS the effect of multihoming arises when users are using various SNS parallel [14]. Hereof, findings in research about multihoming implications are manifold and also in some cases contradictory. Firstly, Haucap and Heimeshoff suggest that multihoming for SNS is "principally easy" [14], and Hyytinen and Takalo find that consumer awareness enhances multihoming [40]. Those assumptions are supported by recent statistics showing that more than half of all online adults in the US use at least two SNS [41]. Nevertheless, Mital and Sarkar argue that smaller networks are only attractive for multihoming with exclusive content [42] and Choi supports this position with the finding that multihoming can only be welfare enhancing if there is exclusive content for each platform [43]. Moreover, Zhang and Sarvary find that multihoming leads to an overlap in content and thus to a winner-takes-it-all equilibrium [31]. These outcomes lead to the expectation of a rising competition between different SNS for users and their generated content which somehow contradicts the findings of Doganoglu and Wright, who argue that multihoming weakens competition [44].

Furthermore, a competition about users will lead in theory to a greater regard of user interests by SNS. A conjecture, which is partly supported by Eisenmann et al. in 2006 who find that the more price sensitive side of platform is subsidized in case of multihoming [30] if we consider users as the more price sensitive side because they seem not willing to pay a significant amount of money for using an SNS which maintains their privacy [45] or that users are also price sensitive regarding the disclosure of personal data [11]. Opposing seem the results of Rochet and Tirole from 2003 that multihoming on one side will intensify price competition on other side [15] supported by the findings of Armstrong in 2006 that the singlehoming side will be treated well and multihoming side interests will be ignored by the platform provider [13]. However, we lack findings about the multihoming behavior of the advertiser side to assess the discrepancy of those results.

3 System Dynamics Modeling of SNS Environment

As aforementioned in this chapter a system dynamics (SD) model for SNS will be built resulting from our literature analysis. This task is divided into two steps: Primar-

ily, the core model will be created, containing only the fundamental platform participants, architecture, government and its resulting effects (cf. subchapter 2.1), giving us a first idea about the coherences in SNS and their influences on user privacy. Building upon that we will create a more complex SD model to also illustrate the SNS periphery and its influence on user privacy.

The box variables of the core model are blue to differentiate them from the black elements of the periphery. Moreover, the positive connections of the core model are also blue unless they cut across other elements. If the latter is the case, they are green for better differentiation. Same holds true for the negative connections which are red for the core model or orange for the periphery model but pink in case of overlaps.

3.1 The Core

Building the SD SNS core model (see Fig. 2) we firstly find that our literature review reveals that the core only contains two participants: the SNS provider and users. However, for simplicity we spare an own variable for the provider in our model and only include the architectural items, regulations and effects proceeding from her. We model the users in two variants: as variable *Potential Users* which represents all internet users who are not part of the SNS yet but could possibly join it and as variable *Users* which denotes the actual users of the SNS. Both are connected with the *Adoption Rate U* which represents to which rate people are joining the SNS. The quantity of *User* has a positive influence on the adoption rate representing the positive direct network effect of the user to potential users. Further, the *Adoption Rate U* has negative influence on the *Potential User* showing simply that the more people join the network the less potential users are left.

As architectural item we included the variable *SNS Features* vicarious for the quantity of all features available for SNS users from simple profile creation up to event handling tools. The more features an SNS provides the more time users spend within the platform [19] represented by the variable *Time Users Spend in SNS*, and the more features they use the more *User Generated Content* they contribute. Further, the more time users spend in an SNS the more data they disclose unintendedly mostly not aware that all their actions in the SNS are being tracked [11, 46]. We find the same quantitative correlation consequently also with the total number of users: the more users an SNS has the more UGC is created within. Further, with time spent in a network and the creation of UGC itself comes often *Unintended Data Disclosure*, this variable stands for the quantity of data disclosed unknowingly to the SNS by the users and gives us a proxy for the loss of privacy. However, we also included the variable *Privacy* for reasons of clarity and comprehensibility. Consequently, *Unintended Data Disclosure* has a negative impact on *Privacy*.

Furthermore, the SNS governance variable *Access Policy* has negative influence on the *Adoption Rate U*, representing the possibility of a provider to limit the SNS membership to certain groups (e.g. students) or to specific restrictions (e.g. full real name registration). If there are no restrictions on the SNS access the variable *Access Policy* is naturally zero and so is its influence on the adoption rate. The other governance variable in the SD core model is *Privacy Policy & Controls* standing for the imple-

mentation of a transparent privacy policy and privacy controls to enable users to handle the visibility and use of their data. Hence, *Privacy Policy & Controls* has direct negative influence on *Unintended Data Disclosure*. Further, the variable has positive influence on the user trust for the SNS represented by the variable *Trust* which itself has positive influence on the UGC [24]. Again, if no privacy policy and privacy controls are implemented by the provider the variable *Privacy Policy & Controls* is zero and so are its influences. The last variable we include into our core model is the *User Awareness* indicating how aware users are in average of the possible unintended date disclosure and the general privacy problem. *User Awareness* has a negative influence on UGC representing that privacy aware users use less SNS features and contribute less UGC to avoid unintended data disclosure [11].

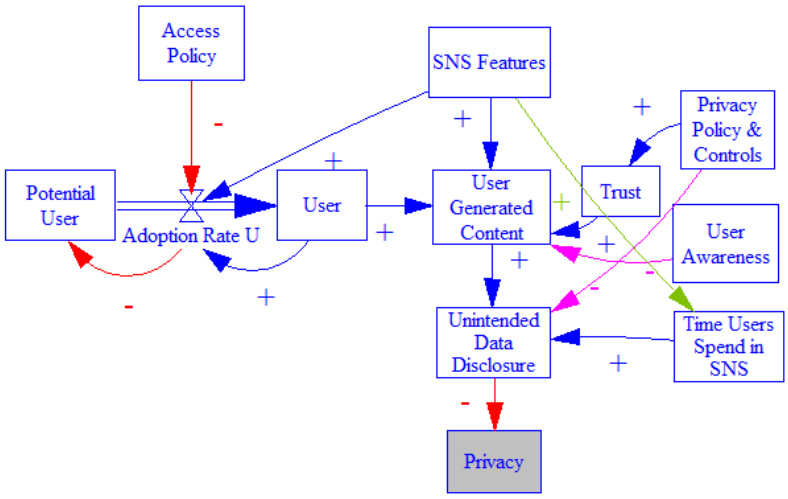

Fig. 2. SD SNS Core Model.

As one can see from our SD model (see Fig. 2) the main negative influence on user privacy for the SNS core (characterized by the positive influences on the variable *Unintended Data Disclosure*) is the pure quantity of UGC, itself caused by the number of SNS users and features and supported by users' trust in an SNS. Another source for *Unintended Data Disclosure* is simply the time users spend with the SNS. Otherwise, the only positive influence for user privacy seems to be the *User Awareness* and the implementation of *Privacy Policy & Controls*, at least for the SNS core.

3.2 The Periphery

Extending our core model for the periphery (see Fig. 3), we find three new platform participants. First the *Advertisers* and the *Potential Application Developers* both represented by the identically named variable. Further, similar to the *User* variable construct we also have adaption rates and *Potential Advertisers* or *Potential Application Developers* in this construct. The *Adoption Rate A* of the advertisers is positive

influenced by the quantity of users, same holds true for the *Adoption Rate AD* of the app developers, and the quantity of the *Application Developers* on the other hand increases the quantity of *SNS Features*. Moreover, the *Adoption Rate A* is positively influenced by the *Time Users Spend in SNS* and by the new variable *Profiling Capabilities*, which stands for the provider's capability to profile and target specific user groups for advertising and is thus logically fed by the quantity of UGC and *Unintended Data Disclosure*. Finally, the implementation of *Advertisers* has a positive effect on *User Awareness* because SNS users apprehend data transfer to third parties [43].

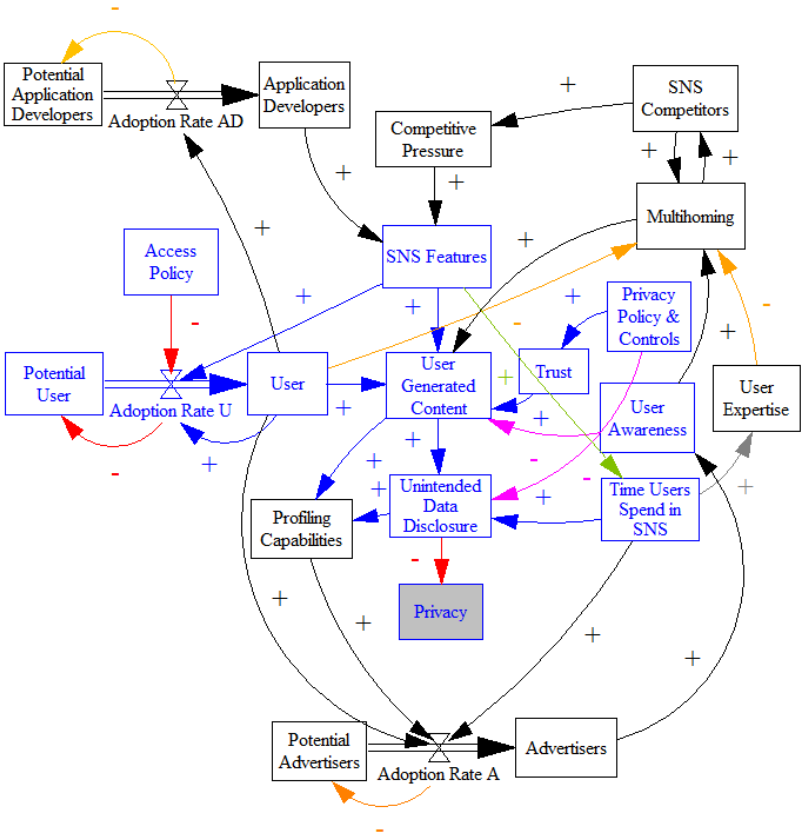

Fig. 3. SD SNS Core & Periphery Model

The last platform participant we include is the variable *SNS competitors* which represents other SNS competing for the same users, advertisers and app developers. Consequently, the variable has a positive influence on market's *Competitive Pressure*. Further, it also positively influences *Multihoming* and vice versa, while this variable stands for the multihoming behavior of SNS users. Higher *Competitive Pressure* itself indirectly increases the number of implemented *SNS Features* because the provider wants to get users to spend more time in the own SNS [28], which leads to an increase

in the last new variable for the periphery: the *User Experience*, representing how experienced users are in dealing with the SNS and, thus, also reflecting the switching costs in terms of effort to switch to another SNS or to use it parallel. Hence, the *User Experience* has a negative influence on *Multihoming*, which closes this feedback-loop. The positive effect from *User Awareness* on *Multihoming* [22] then completes our full SD SNS model (see Fig. 3). Due to contradictory findings concerning effects from advertising on SNS user behavior (cf. subchapter 2.5) we omitted to implement any of those. The same holds true for controversial impacts of multihoming.

Focusing again on *Privacy* respectively of its negative sources *User Generated Content* and *Unintended Data Disclosure* the periphery gives us several new insights. Firstly, the latter are both positive influences for the SNS *Profiling Capabilities* which are, especially in the face of strong *Competitive Pressure* needed by the provider to maintain and extend their market position for advertisers. Secondly, *Multihoming* has by its positive effect on UGC and its indirect positive effects on *Competitive Pressure* in the end a negative influence on privacy. Same holds true for the inclusion of *Application Developers* due to their positive effect on *SNS Features* and thereby on UGC.

4 Discussion

In the following we will discuss our results from our SD SNS model constructed from the findings of the literature review and match them with theoretical and empirical evidence. Further, we will argue the limitations of our review as well as of our model and will take an outlook on possible future research in the area of SNS privacy.

4.1 Core Model Results

As we derive from our core model (cf. subchapter 3.1) the only negative cause on user privacy in SNS is unintended data disclosure while contributing any kind of UGC to respectively using the network. This result assorts to earlier empirical and theoretical findings of Nolte et al. [11, 37] as well as to other research showing that users constantly underestimate the amount of data which is tracked and gathered by SNS during the direct or indirect usage of their services [21, 23, 28, 33, 46]. Further, it fits to the perception that SNS environments push user to reveal more personal data and thereby overcome user's initial privacy seeking behavior [21, 32, 34].

Besides the general user awareness and the with it connected user restraint in contributing UGC, the only source that seems to limit the unintended data disclosure is the implementation of transparent privacy policies and controls, this again matches with theoretical findings [37]. However, implementing privacy policies and controls seems also beneficial for the SNS provider because it increases the level of user' trust in the network and thus motivates them to contribute more content. This coherence is supported by the latest implementation of privacy controls by the leading platforms [47, 48]. Hence, the trust effect and therewith the increase in usage and UGC might be compensating the decrease of unintended data disclosure, a conjecture which is still open for research. However, undoubted is the influence of direct positive network

effects due to the user amount on the user adoption rate of SNS. Recent statistics that the largest SNS Facebook is still growing are supporting this coherence [41, 49].

4.2 Extended Model Results

Continuing with the full SD SNS model with the periphery included (cf. Fig. 3), we first find that the number of SNS users positive influences the adoption rate of external app developers and advertisers. While this result seems intuitive for both cases, it can only be confirmed indirectly for the advertisers with the Facebook case where the revenue from advertising increases with the number of users [49].

Furthermore, regarding advertising as main revenue source for SNS in competition for advertisers, the profiling capabilities and, thus, the ability to show target advertisement to a preferably exact target group becomes crucial for SNS providers. Hence, besides the capability to analyze data, the gathering of it via UGC and unintended data disclosure is an important factor. If the gained user trust and the therewith increase in UGC from implemented privacy policies and controls should not be able to compensate the by implanted privacy controls triggered decrease in unintended data disclosure SNS providers seem at least indifferent regarding the efficacy of those controls. The tendency of Facebooks default privacy settings from 2005 to 2010 supports this conjecture [50] as well as theoretical models and discussions from our literature review [18, 34, 37, 51]. However, recent trends in platform business seem to go in the opposite direction with better privacy by default preferences and hints on how to use implemented privacy controls [48, 52].

The probably most interesting insight of our model is the feedback-loop regarding the coherences between SNS competitors, the competitive market and user multihoming behavior. The outcome from the different results of our literature review (cf. chapter 2) shows that multihoming strengthens SNS competitors and, thus, competitive market pressure regarding the fight for users' time. This leads to providers including more features to their platform to get users to spend more time within. This has two positive outcomes for the provider: first, by spending more time in the SNS users disclose more data and, second, the user expertise for the specific network improves. The latter enhances switching costs in terms of practice efforts if users want to switch to or use another SNS, more clearly it weakens multihoming behavior.

Considering the current by far leading platform Facebook this coherences seem to fit: while multihoming behavior becomes more common [41] Facebook purchases and includes more and more external services (Instagram, WhatsApp) and also broadens self-developed features [53]. Hence, the revealed multihoming feedback-loop supports the findings of Zhang and Sarvary from 2011, who suggested that multihoming behavior leads to an overlap in content and, thus, on the long run to a winner-takes-it-all equilibrium where the biggest platform wins when there is no longer any difference in content [31]. Also, the results of Kwon, Oh et al. [19] Staykova and Damsgaard [7] from 2015 regarding platform stickiness by additional SNS features fit the mould. In contrast to the theoretical findings that multihoming in MSP should weaken competition by Doganglu and Wright in 2006 [44], which might hold true for the competition for users but miss the increase in competition for spent user time.

4.3 Limitations & Future Research

We first have to clarify that our literature review contains only a small part of all available works. Hence, further literature could be used to validate and refine our model and results. Further, not all of the included literature about multi-sided platforms fit entire to the SNS case. Some of the papers only address MSP theoretically, other analyzed nearby platforms, we transferred those findings to the SNS case. Concerning the theoretical models which had contradictory results to each other we have to clarify that these results led from different base assumptions. Nevertheless, those models were all built to describe the processes in and around MSP.

Future research should approach the trends of privacy policies and controls, especially regarding privacy by default. As we discussed, the evolution of these preferences is an indicator if the, by users trust for providers gained, increase in UGC can compensate for the loss of unintended disclosed data resulting from changed privacy controls (cf. subchapter 4.2). Further, another unsolved issue is the multihoming behavior of app developers and advertisers and its influence on the SNS market. Current MSP models for SNS as well as our own model assume that users are the multihoming side in SNS. However, while there exists reliable data for user multihoming behavior we lack numbers of it for application developers and advertisers to confirm this assumption. Finally, it would be a worthy attempt to pursue our qualitative system dynamics model into a quantitative one to comprehend SNS market processes.

5 Conclusion

The aim of this paper was to understand the coherences in social network services (SNS) and the ambient market structure influence user' privacy in SNS. Therefore, we firstly presented our literature review of 41 papers of the last 15 years concerning the topics of multi-sided platforms respectively two-sided markets and privacy in SNS. Analyzing those papers we followed a framework loosely based on the work of Staykova and Damsgaard [7] to identify the main elements and coherences of SNS. We separated this analysis in an SNS core, containing only the fundamental functions of the platform, and a broader concept of an SNS periphery including all important parts in the SNS market structure. In a second step we used the approach of system dynamics to develop a qualitative model out of the literature review's results. Again, we divided our procedure into main steps and first modeled the SNS core to extend this base afterwards with the findings of the SNS periphery.

From the core model we found that the negative influence on user' privacy is unintended data disclosure, itself caused by the amount of user generated content (UGC) users add to the SNS and the time users spend within the network. Further, UGC is naturally positive influenced by the number of users and by the available SNS features, while the time users spend in the SNS is also influenced by the amount of SNS features and by users' trust. Then again, the positive effects on privacy are implemented privacy policies and controls and general user awareness. The enhanced periphery model revealed that UGC and unintended data disclosure are positive factors for the profiling capability of the SNS provider which is sold in terms of targeted

advertising to customers. Moreover, the model showed that user multihoming behavior has positive influence on UGC and indirect on the market competitiveness and thereby secondary negative impacts on user privacy.

In the discussion we then analyzed those findings and matched them with empirical evidence and media reports. The most remarkable finding was the multihoming feedback-loop showing that user multihoming behavior strengthens SNS competitors and, thus, competitive market pressure, which leads to providers including more platform features and users spending more time in the network. Which in turn has two positive consequences for the provider: first, users disclose more data when they spend more time in the SNS. Second, thereby users' expertise for the SNS increases which increases users non-monetary switching costs and, thus, weakens multihoming. This might lead to a winner-takes-it-all outcome for the SNS market on the long run.

References

1. Seltzer, M.: The Surveillance State of Today. World Economic Forum Annual Meeting, Davos, Swiss, 22 January 2015. https://www.youtube.com/watch?v=l51S4dL6BHE. Accessed 3 May 2016
2. Vestager, M.: Competition in a Big Data World. DLD Conferences, Munich, Germany, 17 January 2016. https://ec.europa.eu/commission/2014-2019/vestager/announcements/competition-big-data-world_en. Accessed 3 May 2016
3. Evans, D.S., Schmalensee, R.: Markets with Two-Sided Platforms. Issues in Competition Law and Policy (ABA Section of Antitrust Law) **1** (2008)
4. Evans, D.S., Schmalensee, R.: Failure to Launch: Critical Mass in Platform Businesses. Review of Network Economics **9**(4) (2010)
5. Kane, G.C., Alavi, M., Labianca, G.J., Borgatti, S.: What's different about Social Media Networks? A Framework and Research Agenda. MIS Quarterly, forthcoming (2012)
6. Ellison, N.B.: Social Network Sites: Definition, History, and Scholarship. Journal of Computer - Mediated Communication **13**(1), 210–230 (2007)
7. Staykova, K.S., Damsgaard, J.: A Typology of Multi-Sided Platforms: The Core and the Periphery. In: European Conference on Information Systems, vol. 23, pp. 1–16 (2015)
8. Shapiro, C., Varian, H.R., Becker, W.E.: Information Rules: A Strategic Guide to the Network Economy. Journal of Economic Education **30**, 189–190 (1999)
9. Westin, A.F.: Privacy and Freedom. Atheneum, New York (1967)
10. Westin, A.F.: Social and Political Dimensions of Privacy. Journal of social issues **59**(2), 431–453 (2003)
11. Nolte, C.-G.: Personal Data as Payment Method in SNS and Users' concerning Price Sensitivity - A Survey. In: Business Information Systems Workshops, pp. 273–282 (2015)
12. Forrester, J.W.: Industrial Dynamics. MIT Press, Cambridge, Mass. (1961)
13. Armstrong, M.: Competition in two-sided markets. The RAND Journal of Economics **37**(3), 668–691 (2006)

14. Haucap, J., Heimeshoff, U.: Google, Facebook, Amazon, eBay: Is the Internet driving competition or market monopolization? International Economics and Economic Policy **11**(1-2), 49–61 (2014)
15. Rochet, J., Tirole, J.: Platform competition in two-sided markets. Journal of the European Economic Association **1**(4), 990–1029 (2003)
16. Beuscart, J.-S., Mellet, K.: Business Models of the web 2.0: Advertising or the Tale of Two Stories. Communications & Strategies, Special Issue (2008)
17. Knoll, J.: Advertising in social media: a review of empirical evidence. International Journal of Advertising **35**(2), 266–300 (2016)
18. Kox, H.L.M., Straathof, B., Zwart, G.: Targeted advertising, platform competition and privacy (2014)
19. Kwon, H.E., Oh, W., Kim, T.-H.: One-Sided Competition in Two-Sided Social Platform Markets? An Organizational Ecology Perspective (2015)
20. Lin, K.-Y., Lu, H.-P.: Why people use social networking sites: An empirical study integrating network externalities and motivation theory. Computers in Human Behavior **27**(3), 1152–1161 (2011)
21. Stutzman, F., Gross, R., Acquisti, A.: Silent listeners: The evolution of privacy and disclosure on facebook. Journal of privacy and confidentiality **4**(2), 2 (2013)
22. Tucker, C.E.: Social networks, personalized advertising, and privacy controls. Journal of Marketing Research **51**(5), 546–562 (2014)
23. Acquisti, A., Gross, R.: Imagined communities: Awareness, information sharing, and privacy on the Facebook. International workshop on privacy enhancing technologies, 36–58 (2006)
24. Lawani, O., Aïmeur, E., Dalkir, K.: Improving Users' Trust Through Friendly Privacy Policies: An Empirical Study. International Conference on Risks and Security of Internet and Systems, 55–70 (2015)
25. Schudy, S., Utikal, V.: 'You must not know about me': on the willingness to share personal data (2015)
26. Tucker, C.: Social advertising. Available at SSRN 1975897 (2012)
27. Tucker, C.: Economics of Privacy and User-Generated Content. Emerging Trends in the Social and Behavioral Sciences: An Interdisciplinary, Searchable, and Linkable Resource (2015)
28. Litt, E.: Understanding social network site users' privacy tool use. Computers in Human Behavior **29**(4), 1649–1656 (2013)
29. Ahn, D.-Y., Duan, J.A., Mela, C.F.: An equilibrium model of user generated content. Available at SSRN 1957989 (2011)
30. Eisenmann, T., Parker, G., van Alstyne, M.W.: Strategies for two-sided markets. Harvard business review **84**(10), 92 (2006)
31. Zhang, K., Sarvary, M.: Social media competition: Differentiation with user generated content. Marketing Scienc (2011)
32. Zittrain, J.: The future of the internet--and how to stop it. Yale University Press (2008)
33. Krasnova, H., Spiekermann, S., Koroleva, K., Hildebrand, T.: Online social networks: why we disclose. Journal of Information Technology **25**(2), 109–125 (2010)
34. Martin, K.E.: Transaction costs, privacy, and trust: The laudable goals and ultimate failure of notice and choice to respect privacy online. First Monday **18**(12-2) (2013)

35. Torres, A.M.: Social networking and online privacy: Facebook users' perceptions. Irish Journal of Management (2012)
36. Barary Savadkoohi, F.: Personalized online promotions: long-term Impacts on customer behavior, Massachusetts Institute of Technology (2012)
37. Zimmermann, C., Nolte, C.-G.: Towards Balancing Privacy and Efficiency. A Principal-Agent Model of Data-Centric Business. International Workshop on Security and Trust Management, 89–104 (2015)
38. Evans, D.S., Schmalensee, R.: The antitrust analysis of multi-sided platform businesses. National Bureau of Economic Research (2013)
39. Taylor, C.R.: Consumer privacy and the market for customer information. RAND Journal of Economics, 631–650 (2004)
40. Hyytinen, A., Takalo, T.: Multihoming in the market for payment media: evidence from young Finnish consumers. Bank of Finland Research Discussion Paper(25) (2004)
41. Duggan, M., Ellison, N.B., Lampe, C., Lenhart, A., Madden, M.: Social Media Update 2014 (2015)
42. Mital, M., Sarkar, S.: Multihoming behavior of users in social networking web sites: a theoretical model. Information Technology & People **24**(4), 378–392 (2011)
43. Choi, J.P.: Tying in two-sided markets with multi-homing. The Journal of Industrial Economics **58**(3), 607–626 (2010)
44. Doganoglu, T., Wright, J.: Multihoming and compatibility. International Journal of Industrial Organization **24**(1), 45–67 (2006)
45. Jerome, J.: Buying and selling privacy: Big data's different burdens and benefits. Stanford Law Review Online (Forthcoming) (2013)
46. Debatin, B., Lovejoy, J.P., Horn, A., Hughes, B.N.: Facebook and online privacy: Attitudes, behaviors, and unintended consequences. Journal of Computer-Mediated Communication **15**(1), 83–108 (2009)
47. Facebook introduces new privacy controls. The Irish Times, 18 March 2008. http://www.irishtimes.com/news/facebook-introduces-new-privacy-controls-1.820105. Accessed 21 July 2016
48. Prigg, M.: One more reason to Google yourself: Search giant to add privacy information letting users see what it knows about them. Dailymail.com, 1 June 2016. http://www.dailymail.co.uk/sciencetech/article-3619937/Googling-leads-personal-privacy-controls.html. Accessed 21 July 2016
49. Facebook, Inc.: Facebook Reports First Quarter 2016 Results, Menlo Park, California (2016)
50. McKeon, M.: The Evolution of Privacy on Facebook. Changes in default profile settings over time (2010)
51. Zhang, C., Sun, J., Zhu, X., Fang, Y.: Privacy and security for online social networks: challenges and opportunities. IEEE Network **24**(4), 13–18 (2010)
52. Gross, D.: Facebook privacy now defaults to friends only (2014)
53. Reckhow, M.: Introducing Instant Articles (2015)