# Platformization of Data Sharing: Multi-Party Computation (MPC) as Control Mechanism and its Effect on Firms' Participation in Data Sharing via Data Marketplaces

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**Abstract** Data sharing facilitated by data marketplaces enable companies to generate meaningful insights and discover new opportunities. However, enterprises are reluctant to share data over platforms due to lack of trust, fear of losing control over data and concerns regarding privacy violations. Multi-party computation (MPC) is a cryptographic technique that enables joint data analyses by multiple parties while retaining data secrecy. Despite the potential of MPC, its meaning in data marketplaces setting and how MPC change firms' behavior towards data sharing is not yet researched. This research aims to explain why and how MPC could enable platform control and affect firms' participation in data sharing via data marketplaces. To do so, we will employ a mixed-method research design by combining semi-structured interviews with actors in the mobility domain and quantitative experiments using a mockup of MPC-enabled data marketplaces. Our initial findings revealed various barriers and incentives for firms in sharing their data. We expect our research to become a foundation for future research in the emerging phenomenon of platformization of data sharing via data marketplaces and the key role of MPC in enabling the data economy.

# 1       Introduction

In this digital era, technological advancement makes it possible to generate an enormous amount of data via sensors and smart devices. As a result, data is viewed as one of the most important resources in the world (The Economist, 2017). However, most of the data collected by firms are left unused, which poses a significant challenge in realizing the so-called "data economy" vision (Green, 2015; Manyika, 2015).

Data marketplaces could bridge this gap by facilitating data sharing and trading between companies to generate meaningful insights and stimulate innovation (Koutroumpis, Leiponen, & Thomas, 2017; van den Broek & van Veenstra, 2018; Virkar, Pereira, & Vignoli, 2019). Such platforms enable its participants to store, maintain, access and trade data from various sources based on different licensing models (Schomm, Stahl, & Vossen, 2013; Stahl, Schomm, Vossen, & Vomfell, 2016). On top of that, data marketplaces also offer complementary applications and services such as data visualizations, data valuation, and data analytics (Schreieck, Hein, Wiesche, & Krcmar, 2018; Spiekermann, 2019; van den Broek & van Veenstra, 2018). However, there are various barriers for enterprises to share data with other actors, such as lack of trust (Arnaut, Pont, Scaria, Berghmans, & Leconte, 2018; Dahlberg & Nokkala, 2019; Kembro, Näslund, & Olhager, 2017), fear of losing control over sensitive data that could benefit competitors (Jarman, Luna-Reyes, & Zhang, 2016; Klein & Verhulst, 2017) and concerns over privacy violations (Khurana, Mishra, & Singh, 2011; Sayogo et al., 2014).

Novel privacy-preserving technologies may overcome risks of data sharing in data marketplaces. One class of these is multi-party computation (MPC), which enables multiple parties to jointly analyze data while retaining the secrecy of the data (Choi & Butler, 2019; Roman & Vu, 2018; Zhao et al., 2019). With MPC, the security and confidentiality of the data can be guaranteed since the computation results in an aggregated output while not disclosing the input provided by a single party (Bestavros, Lapets, & Varia, 2017; Zhao et al., 2019). However, real-life deployments of MPC are still lacking, and even more limited in data marketplaces context. Hence, there is still little knowledge regarding the meaning of MPC in the data marketplaces domain, as well as its influence on firms' willingness to share data.

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In the IS literature, data sharing between organizations has been studied prominently since the emergence of Electronic Data Interchange (EDI) and Inter-Organizational Systems (IOS), with the main focus on the antecedents of data sharing between two partners with a clear usage context (Elgarah et al., 2005; Narayanan, Marucheck, & Handfield, 2009; Praditya, Janssen, & Sulastri, 2017). Important factors in this setting include security (e.g. de Prieëlle, de Reuver, & Rezaei, 2020; Fu, Chang, Ku, Chang, & Huang, 2014; Lippert & Govindarajulu, 2006; Sun, Cegielski, Jia, & Hall, 2018) and trust (e.g. Asare, Brashear-Alejandro, & Kang, 2016; de Prieëlle et al., 2020; Pavlou & Gefen, 2004; Sila, 2013). However, the new phenomenon of data marketplaces is challenging the current understanding of data sharing. Specifically, data marketplaces allow data sharing in a complex ecosystem with an unbounded range of participants, which increases uncertainty and causes data providers to perceived a lack of control over their data (Spiekermann, 2019). Furthermore, the introduction of MPC also challenges the current understanding of why companies share data since it enables a new approach in the form of aggregated data sharing and the sharing of "data insights" (Bestavros et al., 2017; Elliott & Quest, 2020; Lapets et al., 2018). These differences thus require new studies on how governance aspects of data sharing through platforms, particularly platform control (e.g. Tiwana, Konsynski, & Bush, 2010), affect firms' participation in data sharing facilitated by data marketplaces.

This research aims to understand why and how MPC could realize platform control and affect firms' intention to share data in data marketplaces. Based on this objective, we propose our main research question as to the following:

*How does platform control, as realized through secure multi-party computation (MPC), incentivize companies to participate in data sharing activities facilitated by data marketplaces?*

We divide our main question into three sub-questions to guide our research further:

1. How does MPC enable platform control in the context of data marketplaces?
2. What are the effects of MPC, in which it enables platform control, on firms' willingness to share data via data marketplaces?

3.  What is the role of trust and perceived risk towards data consumers in the relationship between MPC as platform control and firms' willingness to share data via data marketplaces?

To answer these questions and ultimately fulfill the research objective, we will focus on the mobility sector as our domain under study and follow a mixed-method research design, combining qualitative and quantitative research approaches (Venkatesh, Brown, & Bala, 2013).

The remainder of this paper is structured as follows: In section 2, we elaborate on MPC, control mechanisms of digital platforms as well as trust and perceived risk as background knowledge for this research. Next, section 3 presents our approach to answer the main question and fulfill the research objective, followed by a brief discussion on preliminary findings in section 4. Finally, section 5 outlines the expected contributions of our research.

## 2 Background

### 2.1 Secure MPC

MPC is a cryptographic technique where two or more parties perform a joint computation that results in a meaningful output without disclosing the input provided by either party (Bestavros et al., 2017; Choi & Butler, 2019; Zhao et al., 2019). Conceptually, MPC makes it possible to balance the tension between sharing information to create value and protecting information as a competitive advantage, which often emerges in the context of cooperating competitors (e.g. Gast, Gundolf, Harms, & Collado, 2019). A typical example to illustrate MPC is the millionaire's problem (Yao, 1982), a secure comparison function to determine which one of two millionaires is richest without revealing the net worth to each other. While there are some real-life applications of MPC, such as auction-based pricing (Bogetoft et al., 2009) and gender wage gap analysis (Lapets et al., 2018), its application within the context of data marketplaces is lacking (exception: Roman & Vu (2018)).

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In this research, we conceptualize MPC as a means to exercise control in data marketplaces. With MPC, it is possible to (1) share data without having to store it centrally (i.e. distributed/decentralized data sharing); and (2) sharing aggregate data/data insights (i.e. not necessary to exchange individual data). In this way, data providers might be able to regain control over data, which could potentially increase trust and reduce perceived risks while exchanging data in a non-predefined scenario via data marketplaces. This approach is in line with previous research on data marketplaces that points out the importance of data providers to keep control over their data (Otto & Jarke, 2019). Therefore, MPC could serve as an appropriate solution for this matter because it might change the way data is stored and processed, which ultimately allows the securing of the data.

## 2.2     Control Mechanisms of Digital Platforms

Digital platforms are a unique type of digital artifacts that comprise of transaction and innovation capabilities (Cusumano, Gawer, & Yoffie, 2019; de Reuver, Sørensen, & Basole, 2018; Gawer, 2014). Transaction capabilities mean that digital platforms mediate different user groups (Hagiu & Wright, 2015), resulting in network effects (Katz & Shapiro, 1985). Meanwhile, innovation capabilities are related to the extensibility of digital platforms, in which they provide technological building blocks (e.g. Android or Apple iOS) that allow third-parties to develop complementary modules (e.g. mobile apps) (Tiwana et al., 2010).

Control mechanisms are one of the essential governance mechanisms for digital platforms to be successful in the market (Schreieck, Wiesche, & Krcmar, 2016). It is generally a set of approaches employed by a platform owner to ensure that participants behave as desired (Tiwana et al., 2010). By exercising platform control via rules, regulations, and incentives, platform participants are enforced to behave consistently with the objective of the platform owner (Goldbach, Benlian, & Buxmann, 2018; Tiwana, 2013).

Control mechanisms comprise two distinct types, namely formal and informal control (Goldbach et al., 2018; Mukhopadhyay, de Reuver, & Bouwman, 2016; Tiwana, 2013). To exercise formal control, platform owners may choose to establish selection criteria (i.e. input control), rules/procedures (i.e. process control) and/or

target performance (i.e. output control). Meanwhile, two categories of informal control can be identified: self-control (i.e. capacity building for self-regulation) and relation-al/clan control (i.e. shared norm and values) (Goldbach et al., 2018; Mukhopadhyay et al., 2016; Tiwana, 2013).

MPC offers a new approach to exercising control in the form of 'algorithmic control.' The computation will be performed automatically and resulted in aggregated insights that restrict the way data consumers utilize the data. In this way, MPC would allow automated process control without any human involvement. Nevertheless, we intend to explore MPC as complementary to existing control mechanisms in data marketplaces and not to replace human control with automation fully.

## 2.3     Trust and Perceived Risk

Trust plays a vital role as a prerequisite of data sharing and trading in data marketplaces (Richter & Slowinski, 2019; Spiekermann, 2019). Maintaining trust in this setting is challenging since the value of the data is difficult to understand without disclosing it, yet the value may decrease after that because of its non-rivalrous nature (Koutroumpis et al., 2017). Here, we focus on the trust of data providers' towards data consumers. In this way, we can explore possibilities to incentivize data providers so that they have more willingness to share data via data marketplaces.

Our emphasis is on trust at the inter-organizational level (Pavlou, 2002), which comprises two dimensions: credibility (i.e. trustor believes in the trustee in performing effective and reliable transaction) and benevolence (i.e. trustor believes that trustee's motives are beneficial to them). We also put specific attention on data providers' trust in a networked setting (one-to-many), where data providers interact with a wide range of data consumers in data marketplaces. Following Pavlou and Ge-fen (2004), we conceptualize trust as the subjective belief of data providers that online transactions with data consumers in data marketplaces will occur in a manner that consistent with data providers' expectations of trustworthy behavior.

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Trust is often associated with perceived risk, especially while transacting in online marketplaces (Nicolaou & McKnight, 2006; Pavlou, 2002; Pavlou & Gefen, 2004). An example of risk in the context of data sharing via data marketplaces includes a risk that competitors might gain an advantage from the data shared by data providers (Spiekermann, 2019). We look into perceived risk from the perspective of data providers and extending the definition by Pavlou and Gefen (2004) to the context of data marketplaces. Here, we describe data providers' perceived risk as data providers' perception that there is a likelihood of suffering a loss when performing transactions with data consumers in data marketplaces.

## 2.4.    Initial Research Model

Building on the theoretical background of MPC, platform control, trust, and perceived risk, we develop an initial research model of firms' behavior towards data sharing in data marketplaces. We illustrate this model in Figure 1.
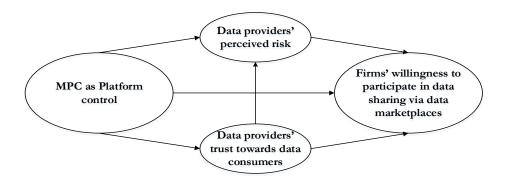


**Figure 1: Initial research model**

First, we conceptualize MPC as an instance of platform control that may affect firms' willingness to share data via data marketplaces. Then, we expect that this causality is mediated by trust and perceived risk of data providers in sharing data with data consumers in data marketplaces. Lastly, from data providers' perspective, higher trust towards data consumers may reduce the perceived risk of participation in data sharing via data marketplaces. It should be noted that we cannot establish clear hypotheses yet since the notion of MPC in data marketplaces is still very new. We

will specify each concept and refine our model during the qualitative study and test the model via quantitative study (see section 3).

## 3 Methodology

This research will adopt a mixed methods research design (Venkatesh et al., 2013), combining quantitative and qualitative research approaches. This approach is appropriate because (1) data marketplaces are hardly studied from platform perspectives, and (2) there is a lack of knowledge on the meaning of MPC in data marketplaces context. Therefore, we first need to conduct a qualitative study to contextualize MPC and platform control into data marketplaces setting. The exploratory nature of the research inquiry makes a qualitative approach suitable as a means to refine our preliminary research model based on empirical resources (Verschuren & Doorewaard, 2010). We follow the developmental rationale in adopting a mixed-method approach (Venkatesh et al., 2013): findings from the qualitative study will serve as a basis for a quantitative study, in which specified concepts and hypotheses would be tested via experiments.

We will scope our research into the mobility sector due to the sensitive nature of the data in this domain, resulting in a high reluctance to participate in data sharing (e.g. Docherty, Marsden, & Anable, 2018). We will start by conducting a literature review on the core concepts (i.e. B2B data sharing, IOS adoption, digital platforms, and platform control) as well as our research domain (i.e. data marketplaces and MPC). Insights derived from the literature study resulted in an initial research model on how platform control, as realized through MPC, influences firms' intention to share data via data marketplaces. Then, we will conduct a qualitative study in the form of semi-structured interviews with key business actors in the mobility sector. The purposes are twofold: (1) to specify concepts into testable hypotheses and (2) to better understand the causality in the conceptual model. The refined model from the qualitative study will then be tested in the quantitative study via experiments using the mockup of MPC-enabled data marketplaces, which will be conducted via an online crowdsourcing platform. Finally, findings resulted from the quantitative study will then be compared and analyzed with the core concepts of our research as well as insights from the qualitative study. In this way, we can explore explanations on why and how MPC enables platform control, which in turn influences firms'

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willingness to share data in data marketplaces. In the end, we will be able to draw conclusions and recommendations from our research.

The mixed-method approach allows us to complement the strength of both qualitative and quantitative research methods (Gable, 1994; Venkatesh et al., 2013). On the one hand, the qualitative meth-od enables us to understand the causality in more detail while maintaining the possibility to discover alternative explanations. On the other hand, the quantitative method allows us to identify the correlation in our findings. In other words, the mixed-method approach will generate a richer understanding of the phenomena under study (Venkatesh et al., 2013).

## 4     Preliminary Findings

We conducted a workshop with business actors as an exploratory to better understand the barriers and incentives of business-to-business data sharing from the firms' perspective. Understanding barriers and incentives are beneficial to clarify what kind of risks and trust issues that exists, why they affect intention to share data and exploring alternative explanations that are needed to control for in the experiment.

The workshop was conducted in Graz, Austria, in November 2019 as a part of a larger European project. In total, 27 experts and representatives of firms that are interested in the data economy took part in this workshop. Overall, we found barriers that are consistent with our preliminary literature review (see Section 1). Participants were afraid that sharing data with other parties would create knowledge spillovers resulting in competitive disadvantages over rivals. Legal concerns were also dominantly discussed since there is a lack of clarity in terms of process and consequences. Other barriers discussed include the absence of an internal process to support data sharing and the difficulty in quantifying the value of the data.

In terms of incentives for data sharing, participant suggestions are rather straightforward. They demand a clear benefit, either tangible (e.g. money/revenue stream) or intangible (e.g. benchmarking, value-added services). Other participants suggest a clear and established regulation in data sharing as an important incentive

for them. Finally, there is a need for a guarantee and protection of the data to make sure that firms that provide data will maintain their competitive advantage.

## 5 Expected Contributions

We expect this research to contribute to IS literature, especially on digital platforms and data sharing. Our research will provide a fundamental basis to IS scholars in understanding the "platformization" phenomenon in data sharing. Since data sharing in data marketplaces is substantially different from existing research in the IOS literature, our research will provide a foundation regarding why and how it is different from what we already know about data sharing.

We will also contribute to platform theory by looking into data marketplaces as one specific case study. Even though data marketplaces possess the characteristics of digital platforms, there is hardly any research that uses platform theory as an analytical lens to investigate data marketplaces. Our research will contribute to this gap by attempting to understand how data marketplaces can be viewed as digital platforms and how its governance aspect (i.e. platform control) is essential in driving its adoption.

Concerning adoption studies of digital platforms, this research will attempt to look into end-users' perspectives (e.g. data providers), which is often overlooked in previous research. This research will also become one of the first studies to incorporate platform governance (i.e. platform control) as antecedents of digital platform adoption (i.e. intention to share data in data marketplaces) in a business-to-business setting.

Finally, this research will also provide practical insights into business actors regarding business-to-business data sharing. In particular, providers of data marketplaces may get benefit from this research by considering various strategies in governing data marketplaces to incentivize participation in the platform. They can also consider implementing security technology like MPC to give assurance on data providers so that there is more than enough supply data available to achieve critical mass. Indirectly, this research can also contribute to achieving the vision of the data economy by looking at data marketplaces as one specific case study.

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## 6        Future Development

The next step is to conduct a study on the research domain. The study will provide an overview of data marketplaces in general (e.g., definitions, roles, taxonomy, control mechanisms, challenges, and opportunities) as well as data marketplaces in the mobility industry (e.g., examples, types of data, incentives for data sharing, control mechanisms). Additionally, the study will also provide an overview of MPC (e.g., concepts, comparisons with other cryptographic technique, architecture) and its relation with data marketplaces and control theory (e.g., use case of MPC in data marketplaces, applying control theory to MPC within the context of data marketplaces).

In parallel with the study on the research domain, preparation for the qualitative study will also commence. The preparation for this phase includes the development of interview protocol and identifying potential informants, which will be based on findings of the research domain. Informants will be companies, data marketplaces providers, experts, and consultants in the mobility sector as well as MPC developers/providers. Interviewees will be senior employees with decision making authorities within the organization that has a high-level knowledge of business and technical issues. Interviews will be conducted face-to-face and video calls if necessary. Since this research is part of the larger European project[1], we will interview relevant people from the project as well. We will follow the snowball sampling approach, and we will stop the interviews once there are no new insights or information presented. Interviews will be recorded, and all interviewees will be asked to read the transcript for validation.

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[1] Safe-DEED project (https://safe-deed.eu/). There is also a 'sister-project' TRUSTS (https://www.trusts-data.eu/) which is highly relevant with this research.

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