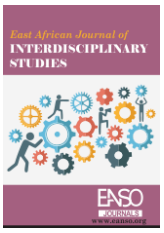

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*Original Article*

# The Matrix as an Economic Network Model: Structures, Incentives and Practical Implications for Platform Economy and Governance

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## ABSTRACT

Platform markets unfold their dynamics in a network of decentralised distributed knowledge and centrally controlled access. This paper develops a matrix model that brings together economic, institutional and informational perspectives to reveal the hidden structures and incentive mechanisms of digital networks. A mixed-methods approach combines theoretical foundations with practical case studies and shows how platform operators influence competition and behaviour via interfaces, data flows and algorithmic rules. The results emphasise that platform markets only remain resilient where institutional frameworks create trust, limit concentration processes and clearly manage incentives. This results in recommendations for operators, user groups and regulatory bodies on how incentive systems must be designed to ensure fairness, transparency and resilience. The work thus contributes not only to the analytical description of platform markets but also to their practical and regulatory design.

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## INTRODUCTION

Digital markets do not emerge from rigid equilibria, but in mobile structures in which knowledge is unequally distributed. Platforms such as Amazon or Uber show that networks expand familiar market mechanisms and create new dependencies in the process (Kenney & Zysman, 2016). Information does not circulate freely there, but follows access restrictions that secure competitive advantages (Stiglitz, 2000).

The idea of a matrix describes platform markets as a network of nodes, connections and rules. Some actors control interfaces that give them power. Others remain restricted to partial access (Granovetter, 1985; Castells, 1996). Such structures are neither purely decentralised nor strictly hierarchical. Institutions provide stability and orientation but can also foster the concentration of power in certain areas (North, 1990; Ostrom, 1990). This paper develops the matrix as a model for analysing information flows, incentives and institutional rules in context. It asks how power asymmetries can be explained when network economics, institutional economics and information economics are combined (Stiglitz, 2000). Precisely because platform markets raise regulatory questions at many points, neither spontaneous market processes nor rigid rules alone are sufficient to offer viable answers (Kenney & Zysman, 2016).

The methodological approach is based on the integration of a systematic literature review and qualitative case studies. This design is intended to ensure a robust linkage between theoretical foundations and empirical findings (Creswell & Plano Clark, 2018; Flick, 2020). All sources have been systematically compiled and verified as of May 2025 and are publicly accessible for independent validation (Tranfield, Denyer & Smart, 2003).

The structural composition of the work follows a coherent sequence: after the introduction, the theoretical framework, methodological procedures, analysis and discussion are presented, concluding with the final remarks and a critical reflection of the study's limitations.

Its value does not lie in providing definitive answers, but in reading platform markets as a matrix to make room for manoeuvre visible.

## THEORETICAL BACKGROUND / STATE OF RESEARCH

Since the contributions of Granovetter and Castells, the analysis of economic networks has found a firm place in economics (Granovetter, 1985; Castells, 1996). Granovetter shows that economic activity remains embedded in social relationships. Markets do not emerge in isolation, but within social structures. Information, power and resources circulate unequally there. Castells emphasises that digital networks change these structures. Communication and exchange gain reach through technical connections. Kenney and Zysman emphasise that platforms expand this framework. Digital infrastructures link interactions in real time. Data is bundled and processed on a massive scale.

Network economics describes how connections between actors lead to network effects that increase the value of individual positions within the structure. Rochet and Tirole (2003) have worked out that platform operators can realise strategic advantages through two-sided markets, as they orchestrate supply and demand simultaneously. However, it is clear from the literature that many studies only superficially address the associated aspects of power. The matrix model picks up here by visualising nodes, their steering effect and the circulation of resources.

 

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With North and Ostrom, institutional economics has sensitised us to the fact that formal rules and informal norms organise the scope for action and, at the same time, enable trust. Research indicates that stable institutions promote a willingness to cooperate, but can also reinforce path dependencies and concentration processes. In this context, platforms illustrate that informal practices such as algorithmic control often remain opaque and pose new challenges for established regulatory instruments.

In information economics, Stiglitz (2000) emphasised the relevance of asymmetrically distributed information and showed how strongly access to data influences competitive advantages. Current literature shows that data is not just a technical resource, but that markets can be actively shaped. This means that platforms are no longer neutral intermediaries, but act as market players in their own right. The current state of research provides a great deal of empirical evidence in this regard, but a consistent model that integrates information flows, institutional rules and individual incentive structures has yet to be developed.

The Austrian School, above all Hayek (1945), has always emphasised that knowledge is decentralised and that markets serve as a coordination mechanism. Research shows that this approach has rarely been systematically linked to network and institutional theory. The matrix model addresses this gap by bringing together decentralised knowledge transfer, formal and informal institutions and incentives in a uniform regulatory framework.

The literature search was conducted until May 2025 and only took into account scientifically peer-reviewed, publicly accessible works whose relevance with regard to the research question is clearly recognisable. The selection follows established standards of systematic literature review. Conference papers and preprints were not considered in order to ensure the robustness of the theoretical basis. This results in a framework that reflects the current state of research, bundles the central theoretical lines and at the same time makes existing gaps visible.

## METHODOLOGY

The work follows a mixed-methods approach by Creswell & Plano Clark (2018). It combines a literature-based analysis with a qualitative case study. This approach was chosen because digital networks cannot be described purely theoretically or only empirically (Creswell & Plano Clark, 2018). Only the combination of both approaches creates a robust model. This allows hypotheses to be tested and practical tips to be derived.

The first pillar is the systematic literature review. This is based on publications from network, institutional and information economics and the Austrian School of Hayek (1945) (Ostrom, 1990; North, 1990). Only sources that are publicly accessible, peer-reviewed and recognised are taken into account. The aim is to clarify terms, examine existing approaches and make open questions visible. A grid is created from this basis. It makes the matrix tangible as an organising metaphor. The literature review does not stop at descriptions, but develops hypotheses. These focus on how information asymmetries and rules shape behaviour on platforms (Stiglitz, 2000).

The second pillar is a qualitative case study. It looks at companies such as Airbnb, Uber and Amazon (Kenney & Zysman, 2016). These platforms stand for network effects and the bundling of power. The cases show similarities and differences. The data is based on annual reports, market analyses and academic studies. The study is open and exploratory in nature (Yin, 2018). The focus is on questions about nodes, gatekeeper positions and the effects of formal or informal rules (Ostrom, 1990). This makes it possible to recognise whether patterns support or restrict the hypotheses. The results help to check whether the model can be transferred to other platforms.

 

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The mixed methods approach is intended to bring theory and practice together (Creswell & Plano Clark, 2018). The work emphasises traceability. All data is freely accessible. Where uncertainties exist, they are disclosed and named in the limitations. The matrix is not treated as a rigid structure. It remains an instrument that can be adapted to new contexts. The aim is to make a contribution that goes beyond pure theory and offers stakeholders concrete pointers for platform regulation.

## ANALYSIS

Applying the matrix model to specific platform examples illustrates how networks organise power, incentives and information flows. The results support the hypothesis that platform operators gain privileged access to data via central nodes and thereby secure competitive advantages (Stiglitz, 2000). The example of Amazon shows that marketplace operators can influence the visibility of offers through algorithmic control. Platforms, therefore, do not act as neutral intermediaries, but actively shape market structures (Kenney & Zysman, 2016).

Airbnb shows how informal rules and formal institutions intertwine. The case analysis makes it clear that local attempts at regulation can be circumvented if hosts and platforms make targeted use of incentive structures. Ostrom (1990) shows that common rules are necessary in order to manage collective resources in a sustainable way. North (1990) adds that institutions create trust, but at the same time can also favour path dependencies and concentrations of power.

Uber extends the perspective to asymmetric information distribution. The platform controls supply and demand via real-time data, which is only visible to riders to a limited extent. The analysis supports Stiglitz' (2000) finding that information advantages promote strategic behaviour. Travellers thus remain dependent on a platform that controls prices and customer allocation.

The following schematic diagram summarises the central elements of the matrix model and shows how nodes, information flows and institutional rules interact in platform networks. To ensure methodological transparency, the qualitative case studies were analysed through a structured thematic coding approach (Flick, 2020; Yin, 2018). Key elements such as node positions, access points, algorithmic control mechanisms and regulatory frameworks were identified and clustered according to recurring patterns. No dedicated software was used; instead, a manual coding grid was developed to maintain close alignment with the conceptual matrix model. This allowed for constant comparison between the cases, ensuring that patterns and deviations were systematically traced back to the hypotheses derived from the literature review (Creswell & Plano Clark, 2018). Cross-case synthesis was employed to highlight similarities and differences between platforms such as Amazon, Uber and Airbnb, and to link practical observations to theoretical assumptions. The results were then consolidated into a schematic representation (see Figure 1) to illustrate how nodes, information flows and institutional rules interact within digital platform markets.

 

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**Figure 1: Matrix Model as a Schematic Network Structure of Digital Platform Markets**

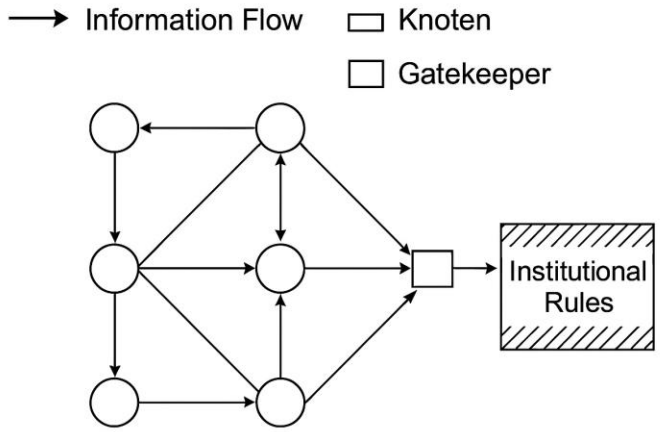


Figure 1 illustrates how the thematic coding of the case studies revealed that platform operators can secure strategic advantages through gatekeeper positions and controlled interfaces. It also shows how institutional rules act as a regulatory framework that shapes incentives and channels data flows. By mapping these elements within the matrix, the figure makes the interactions between nodes, information streams and governance structures more transparent and comparable across cases.

In all examples, it becomes clear that the matrix is more than just a theoretical grid. It serves as an instrument to make centers of power in networks visible. The combination of network economics, institutional economics and information economics shows that platform markets are not purely decentralised structures. Rather, hybrid orders emerge in which spontaneous processes and conscious control coexist (Castells, 1996).

The analysis shows that platform operators can secure competitive advantages and utilize regulatory deficits through control over nodes (Kenney & Zysman, 2016). Hayek (1945) points out that knowledge is distributed in a decentralized manner, but this shows that access is often bundled centrally. This tension makes it clear why governance issues must become more important in the future.

The model shows that the matrix is suitable for revealing interfaces between regulation, informal rules and incentives. Companies recognise dependencies. Authorities can assess concentrations of power. The results suggest that platform markets only remain viable if emergent structures and institutional rules are in balance (North, 1990).

## RESULTS

The cross-case analysis confirms three key findings. First, platform operators consolidate market power by controlling access nodes and interfaces, which secures competitive advantages. Second, informal rules and formal institutions interact in ways that may undermine local regulatory attempts if incentive structures remain opaque. Third, asymmetrically distributed information enables strategic behaviour and strengthens dependencies within the network. Together, these results highlight the matrix's value in visualising how power, incentives and institutional rules intersect across different platform contexts.

 

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## DISCUSSION

The analysis shows that platform markets must be thought of as networks in which formal rules, informal practices and individual incentives are intertwined. The matrix model makes these interdependencies visible and poses the question of whether it also offers practical control impulses beyond the analytical level. Therein lies the tension between decentralised order and institutional design (Ostrom, 1990).

The perspective of the Austrian School emphasises that knowledge is decentralised. Hayek describes how market participants base decisions on partial information, which results in emergent orders. However, the case studies make it clear that platform operators specifically shape these orders through algorithmic control. This shows that, contrary to Hayek's idea of spontaneous and self-organising market dynamics, algorithmic governance can systematically limit decentralisation and reinforce new hierarchies. This asymmetry supports the insight that information inequality favours strategic behaviour (Stiglitz, 2000). Hildebrandt (2016) points out that the use of smart technologies often overwhelms the existing legal framework and makes new control instruments necessary. It follows that platform markets need a balance between dynamism and binding rules.

North (1990) points out that stable markets require an institutional framework in order to build trust and reduce transaction costs. Ostrom (1990) adds that collective resources can only be utilised sustainably if actors negotiate common rules. For platforms, this means that governance models must create cooperative incentives without stifling spontaneous organisation.

The matrix reveals that market power does not only arise from market shares, but also from control over nodes and data. Zarsky points out that the GDPR reaches its limits in big data contexts when platform operators bundle data streams and use them for strategic behaviour (Zarsky, 2017). Castells (1996) makes it clear that networks can be organised hierarchically, even if they appear open to the outside world. Practice shows that actors with privileged access control information flows and interpret rules in their favour. As a result, governance in platform markets must be hybrid: self-regulation, reliable framework conditions and collective negotiation work together. Companies can derive from the matrix where their dependencies lie and at which nodes knowledge and resources circulate (Kenney & Zysman, 2016). Regulatory authorities use them to recognise power asymmetries and limit information advantages. Institutional solutions must remain open in order to avoid blocking dynamic developments with rigid guidelines.

The literature shows that regulatory approaches are only effective if formal rules and informal practices are taken into account at the same time. The matrix model makes it clear where these interfaces run. It shows that platform markets cannot remain stable through market mechanisms or state control alone, but that a flexible regulatory framework is required that combines institutional stability with decentralised dynamics. In practice, this entails organising complexity, reducing interdependencies, and establishing fair incentive structures. In this way, the matrix is not merely employed as an analytical tool but is transformed into a framework of orientation for the design of digital markets. From this, concrete measures can be derived to address the identified challenges. Beyond commercial platforms, the matrix is equally applicable to other sectors. For instance, Learning Management Systems (LMS) in the education sector demonstrate how providers control access points and data flows. Teachers, students, and administrators are embedded as nodes within the network, while institutional rules and incentive mechanisms determine how information circulates and who gains access. This exemplifies how the matrix may facilitate the analysis of dependencies

 

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and governance challenges beyond conventional platform markets.

## RECOMMENDATIONS FOR ACTION FOR EDUCATIONAL INSTITUTIONS AND PLATFORM PROVIDERS

Data protection in digital learning environments is not an isolated legal requirement, but combines technical security, institutional reliability and pedagogical room for manoeuvre. Platforms must show that they understand data protection as a structural principle, not as a formal obligation (BfDI, 2023). Risk analyses in accordance with Art. 32 GDPR and complete documentation form the basis for this, but are not sufficient as long as technical and organisational safeguards are not consistently interlinked (Gola & Heckmann, 2022).

Privacy by design and privacy by default require data avoidance and deletion to be written into the system structure from the outset. Solove (2009) makes it clear that privacy should not be viewed solely as an individual sphere of protection, but as a social organising principle. Without clear limits on the volume of data, there is a risk of unnecessary risks for learners, teachers and providers alike (ENISA, 2022). Experience from the protection of critical infrastructures makes it clear that a robust level of security is also essential in educational contexts in order to prevent sabotage or misuse (Ritter & Barenkamp, 2024). The BSI recommends adhering to proven basic protection standards when securing digital learning environments in order to effectively ward off cyberattacks (Federal Office for Information Security, 2024).

Data protection is also an organisational task. Responsibilities must be clearly defined. Data protection officers need support. All those involved should receive training that combines technology, law and practice (BfDI, 2023). Trust can only be created if data flows are explained in a comprehensible manner and consent is understandable. The Article 29 Working Party emphasises that users must be clearly informed about cookies and behaviour-based advertising. Only then is consent effective (Article 29 Data Protection Working Party, 2010).

Platform operators have a responsibility to create modular architectures. These should ensure interoperability without storing data unnecessarily. The European Data Protection Board makes it clear that platforms often act as both controller and processor. Responsibilities must therefore be clearly defined (European Data Protection Board, 2020). ISO/IEC 27701 provides a recognised framework for this (ISO, 2019). Voluntary data protection certificates can create trust. This also makes high standards visible to third parties (Gürses & Berendt, 2012). North emphasises that stable rules reduce transaction costs and promote trust (North, 1990).

Regulatory authorities should actively support these developments. Pure formal checks are not enough. The OECD and ENISA are in favour of governance models that combine binding requirements with flexible standards (OECD, 2021; ENISA, 2022). Data protection is only effective if technology, organisation and institutions are understood as a networked system. Simitis, Hornung and Spiecker gen. Döhmann (2024) emphasises that data protection law must be thought of as an open control instrument that combines technical and organisational issues.

### Relevance for Educational Institutions

For schools, universities and further education providers, the matrix approach shows that digital platforms are not neutral (Kenney & Zysman, 2016; Stiglitz, 2000). Anyone using such systems should know at which points control and data access converge. This applies not only to the choice of provider, but also to the question of how access rights, interfaces and data flows are regulated (North, 1990; Ostrom, 1990). Where responsibilities remain unclear, trust suffers. It is therefore important to regularly check which structures are really necessary, who has access to

 

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sensitive data and how openly information about this is provided. Teachers, students and parents must be able to understand what information is being collected and processed. In this way, data protection becomes part of everyday life not only as a duty, but as the basis for reliable educational programs (Gola & Heckmann, 2022; BfDI, 2023).

**Relevance for Platform Operators**

Platform operators recognise from the matrix model how important it is to handle interfaces and data flows responsibly (Rochet & Tirole, 2003; Stiglitz, 2000). Those who control market access and user relationships via centralised nodes take on more than just a technical role (Kenney & Zysman, 2016). This means that processes must be transparent and information asymmetries should be limited. Companies should clearly regulate how data is collected, stored and used and disclose these rules (Zarsky, 2017). Those who control interfaces can set targeted incentives to strengthen competition and trust (North, 1990). The matrix model helps platform operators to consciously shape their position strategically and responsibly towards users and regulators.

**Relevance for Regulatory Authorities**

Regulatory authorities need to shape platform markets in ways that prevent market power from concentrating at a handful of strategic points. The matrix model helps to pinpoint where providers can steer data flows and determine access rights (Stiglitz, 2000; Kenney & Zysman, 2016). Information advantages at these nodes can easily restrict participation and weaken competition. This is why focusing on formal laws alone falls short. Informal arrangements and concealed structures also deserve attention and must be kept under ongoing review (Zarsky, 2017). At the same time, regulatory frameworks should not become so rigid that they stifle technical progress. As North and Ostrom (1990) argue, trust grows when formal and informal rules reinforce each other in practice. In this perspective, the matrix approach supports regulators in balancing interests, monitoring critical interfaces and building conditions that secure stability while allowing room for innovation (OECD, 2021). This extends previous models by showing that without conscious governance design, platform structures risk amplifying the very power asymmetries that decentralised theories have historically underestimated.

## CONCLUSION

The analysis shows that the matrix model provides not only a theoretical framework but also a practical orientation for different actors. It illustrates that platform markets function as networked systems shaped by network effects, unequal knowledge distribution, and institutional rules, resulting in structures that are neither fully decentralised nor entirely hierarchical (Castells, 1996; Stiglitz, 2000). The findings confirm that platform operators use their control over central nodes to secure structural advantages. In this way, Hayek's idea of decentralised knowledge is extended: access remains uneven and is deliberately regulated (Hayek, 1945; North, 1990).

This leads to a twofold perspective for practice. Companies can use the model to identify dependencies and assess their strategic position within platform structures. Regulatory bodies gain a tool to recognize power asymmetries and design hybrid governance solutions that combine flexibility with stability (Ostrom, 1990). The matrix highlights where formal rules and informal practices intersect and where incentives can support effective governance.

In response to the research question, it becomes clear that platform markets can only be stable and fair when spontaneous market processes are combined with reliable institutional frameworks. The examples of Amazon, Uber, and Airbnb show that self-organising dynamics and targeted governance go hand in hand and that flexibility must be maintained. Future research should refine the model further and adapt it to specific sectors

 

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(Kenney & Zysman, 2016; Srnicek, 2017). This approach ensures that the study goes beyond theory and offers decision-makers a practical framework for viewing platform markets as open yet institutionally anchored systems. Its practical value lies in addressing information asymmetries more consciously, distributing resources more fairly, and designing incentives that strengthen competition and trust (North, 1990; Ostrom, 1990).

## LIMITATION

This paper does not claim to cover all the details of digital platform markets. It deliberately relies on publicly available data to ensure traceability and transparency (Creswell & Plano Clark, 2018). Internal company information, which could show some patterns more clearly, was left out so as not to jeopardise verifiability.

Another limiting point is the selection of case studies. Amazon, Uber and Airbnb are examples of central structures of the platform economy. They illustrate network effects and power asymmetries and offer a practical approach to testing the matrix model (Kenney & Zysman, 2016). At the same time, it remains unclear what similar patterns look like in other sectors.

The study comes to the conclusion that the research questions listed cannot be answered conclusively, but can rather be closed by further research projects (Srnicek, 2017). It should therefore be noted that this study takes into account a systematic literature analysis up to and including May 2025. The quality of the literature analysis was ensured by selecting peer-reviewed sources (Tranfield, Denyer & Smart, 2003). Interdisciplinary sources from the field of network and information economics were also included in the research, as were studies on platform dynamics (Castells, 1996; Rochet & Tirole, 2003). The scientific standard was ensured by deliberately avoiding the selection of preprints and non-peer-reviewed articles (Gola & Heckmann, 2022).

The findings of Hayek, North and Stiglitz were taken into account in this study, as they have established decisive arguments in the research field of platform and network economies (Hayek, 1945; North, 1990; Stiglitz, 2000). The findings of this research can be reconstructed based on the clear documentation of the selection process (Flick, 2020). All these measures ensure that the study remains structured and comprehensible in order to further develop the matrix model in future research.

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