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Digital Labour Markets Within Sectoral Innovation Systems: Implications for the Dynamics of International Competitiveness

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Abstract: Digital labour markets have became central components in the modern digital economy,fundamentally alter how work is structured, delivered, and governed. Nevertheless, the existing literature is often tend to analyze these platforms as firm-level competition, labour precarity, or algorithm management without references to the fact that the latter is embedded within broader sectoral structuresmore macro-level sectoral patterns. This study applies the Sectoral Innovation Systems (SIS) framework to examine how technological capabilities, actor-network configurations, and institutional arrangements intersect to shape the international competitiveness of digital labour platforms. Drawing on twelve semi-structured interviews，policymakers, and practitioners, the findings reveal three core determinants of cross-border competitiveness: (1) highly developed technological and knowledge resources, specifically AI, machine learning, and data-oriented optimisation; (2) embedded network and ecosystem connections that create strong network effects and provide market scalability; and (3) institutional alignment, as reflected by regulatory legitimacy and broad societal acceptance of the new model which facilitates or limits international expansion. The analysis demonstrates that competitiveness is created not only out of their individual firm-specific benefits but the co-development of technologies, networks, and institutions within the industry. This paper combines SIS theory and qualitative implications, which contributes to a more systemic view of digital labour markets and offer a conceptual ground on how the concept of platform internationalisation and governance to be researchable in future.

Keywords: Digital labour markets; Sectoral innovation systems (SIS); Platform competitiveness; Network effects; Institutional alignment; Artificial intelligence (AI)

Introduction

Digital transformation has emerged as a profound systemic transformation innovation, production, and competition across virtually all sectors of the contemporary economy (Berman & Marshall, 2014). Advances in digital technologies most notably artificial intelligence (AI), machine learning, and data-driven infrastructures,

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have enabled the creation of entirely new digital products and services while simultaneously redefining the nature and performance of traditional ones (Zohuri & Rahmani, 2019 These innovations have led to the acceleration of the reorganization of the economic process, the promotion of new types of entrepreneurship, and the increase in the role of platform-based systems in the world markets (Acs et al., 2021). With the change in digital infrastructures, change in organizational logics and coordination processes in which firms create value also change (Henfridsson & Bygstad, 2013).

Within this broader transformation, digital labour markets represent one of the most significant institutional innovations (Hinings, Gegenhuber, & Greenwood, 2018). Enabled by platform technologies, they facilitate new modes of labour exchange, such as location-based ride-hailing and remote microtasking, and have become central to the organization of work in many industries (Zvavahera, Chigora, & Aquino, 2024). Their fast growth demonstrates how digital platforms have the ability to overcome traditional sectoral limits and develop new kinds of competitive advantage based on data volume, algorithmic coordination and network dependencies (Subramaniam, 2022).

Despite the growing volume of research on digital platforms, the available literature tends to view digital labour markets through a lens that focuses on labour precarity, algorithmic control, or firm-level platform competitive pressures (Graham, Hjorth, & Lehdonvirta, 2017). These analyses offer valuable information, but what remains unexplored through them is how digital labour platforms perform within and co-develop with larger sectoral mechanisms. Specifically, the sectoral innovation systems (SIS) lens that focuses on the interaction between knowledge base, technological regime, actor networks, and institutions has rarely been used to know how digital labour market gains and maintains international competitiveness (Tay & Wahab, 2025). As a result, current literature does not sufficiently explain why certain platform firms are able to consolidate leadership across multiple national markets, overcome heterogeneous regulatory environments, and establish durable global positions while others remain locally constrained (Nambisan, Zahra, & Luo, 2019).

Addressing this conceptual gap requires a framework capable of capturing the systemic and evolutionary characteristics of the digital labour market sector. Such an analytical basis is provided by the SIS perspective that emphasizes the role of technological accumulation, the network between organizations, and institutional dynamics in creating the competitive streams (Schumm & Hanelt, 2021). By examining digital labour markets through this lens, it becomes possible to illuminate the mechanisms through which platform-based firms develop and leverage their technological capabilities, orchestrate multi-sided networks, negotiate institutional environments, and ultimately establish international leadership.

Research Questions

RQ1: How do firms understand and develop technological and knowledge capabilities within the digital labour market?

RQ2: How do different types of industry actors—such as drivers, consumers, governments, and partners enhance platform competitiveness through network relationships?

RQ3: How do institutional environments, including regulations, policies, and public perceptions, shape the internationalization and competitiveness of digital labour platforms?

This essay adopts the sectoral innovation systems framework to analyze the digital labour market sector, with a particular focus on how the configuration of knowledge and technologies, actors and networks, and institutional arrangements influences the emergence and sustainability of international competitiveness. Through

this approach, the analysis reaches a further development of a more comprehensive account of digital labour at work platforms as embodied in the changing sectoral formation as opposed to the technological or organizational phenomena. It also provides a conceptual basis of the interpretation of how companies like Uber build global competitive roles in more competitive digital markets.

Literature Review

The Sectoral innovation systems (SIS) model provides framework that is comprehensive in terms of analysis of the nature of technological change, industrial development and competitive advantage within particular sectors (Malerba, 2005). Originally advanced by Malerba (2002; 2004), the SIS perspective conceptualizes sectors as configurations of specialized knowledge bases, technological regimes, heterogeneous actors and networks, and institutional arrangements that jointly shape patterns of innovation and market development. In contrast to firm-level or industry-level approaches, SIS emphasizes the co-evolution among these components and how such co-evolution determines the capacity of firms to compete, scale, and sustain leadership (Volberda & Lewin, 2003).

The algorithmic systems that mediated the supply and demand in digital labour markets are particularly applicable to the context of the SIS framework (Dedema& Rosenbaum, 2024). The characteristics of digital labour markets are fast technical development, high network externalities, and institutional conflicts as such, understanding their international competitiveness requires a system-level perspective that integrates technological trajectories, actor-network configurations, and institutional governance (Coenen & López, 2010). The following subsections review the key literature related to each dimension of the SIS approach.

Knowledge and Technologies

The basic dimension of sectoral innovation systems is knowledge and technologies. According to Malerba (2004), sectoral knowledge bases are cumulative, path dependent, and often highly specialized and influence the way firms create and internalize technological innovation. This opinion is supported by the literature on digital innovation: Digital technologies like artificial intelligence, machine learning, and data-driven architectures provide new possibilities of experimentation and reconfiguration (Nambisan, Wright, and Feldman, 2019). Their combinatorial quality enables firms to accumulate on the existing capability, with successive returns and technological lock-in.

Platform firms within digital labour markets are competitive because of the systems of algorithmic governance, routines of data-intensive operations, and optimization through learning. According to research on platform algorithms, they play a central role in pricing, efficiency in matching, route, and stability of the services (Yeung, 2018; Gillespie, 2014). With such technological infrastructures, there is learning benefits that can be built and enhanced over time giving it an advantage that late entrants would find hard to match.

From a sectoral perspective, these knowledge and technological assets form a distinctive technological regime one characterized by low marginal cost of reproduction, scalability across regions, and the ability to continuously integrate new data to refine decision-making. The literature also highlights that knowledge in the digital platforms is application-specific, as opposed to general-purpose (Malerba, 2002). Technologies optimized for ride-hailing, for example, may not be transferable to other labour sectors without major adaptation. This specialization strengthens the companies in their technological course in the industry, which leads to global scalability and competitive advantage.

Actors and Networks

Actors and networks represent the second key dimension in SIS scholarship. According to Malerba (2004), sectors comprise a heterogeneous set of organizations, firms, suppliers, universities, users, and regulators, engaged in both market and non-market interactions. Their interdependencies determine the knowledge flows, development of capabilities and the competitive rivalry organization.

Another significant addition to SIS theory is the literature on platform ecosystems. Platforms are not independent firms but ecosystems coordinators (Jacobides, Cennamo, and Gawer, 2018), which organize multi-sided marketplaces and organize complementary parties. The digital labour platforms, including ride-hailing service providers, are dependent on a high density of interaction networks between drivers, riders, data partners, logistics providers, and local governments. These ecosystems permit uninterrupted feedback mechanisms, diffusion of knowledge and co-development of complementary services.

Network effects are a central mechanism highlighted in economic and information systems research. As participation on one side of the platform grows, value increases for the other side (Gawer & Cusumano, 2014). These impacts are known as positive feedback loops that enhance market concentration and allow some of the firms to accelerate towards the winner-takes-all dominance. Moreover, the internationalization of networks through cross-border expansion enables leadership at the international scale by reducing entry barriers, capitalizing on global data and applying established algorithms in new geographical markets.

The literature also shows that actor networks extend beyond economic relationships to include symbolic, cognitive, and political alliances. Collabourations with higher education institutions, business clients, or local governments allow platforms to co-create new services, become valid, and overcome regulatory unpredictability. Such actor-network arrangements play a crucial role in understanding the reason some platforms do better in the global arena compared to others languishing in the local markets.

Institutions

Institutions the regulative, normative, and cognitive structures that shape behavior, constitute the third dimension of the SIS framework (Scott, 2001; Malerba, 2004). According to the institutional literature on the presence of digital platforms, digital labour markets are usually faced with grey or incompatible regulatory backgrounds, especially in labour classification, competition policy, passenger safety, and data governance (Ranchordas, 2018).

The international expansion strategy of a firm is determined by differentiated institutional heterogeneity between countries. Liberal market economies (e.g. United States) tend to be more laissez fair to the experiment of platforms, whereas coordinated market economies (e.g. Germany, the Netherlands) are highly regulatory as demonstrated in comparative capitalism studies (Hall and Soskice, 2001). This institutional diversity explains why some platforms achieve rapid penetration in certain markets but face prohibitions or withdrawals in others.

The institutional entrepreneurship literature also indicates how firms strategically shape up their regulatory environments. The digital platforms are more likely to employ multi-aspect solutions like the mobilization of the population, the local cooperation, the data-inspired advocacy, and the targeted communication to gain legitimacy (Garud, Kumaraswamy, Roberts, and Xu, 2022). In such a way, these actions lead to not only being adjusted to the institutions but also influencing them, enhancing the competitive advantage of firms in the global digital labour market.

Collectively, the literature suggests that institutional arrangements do not passively constrain the technological and organizational courses; quite on the contrary, they co-evolve with them. Understanding

institutional dynamics is thus essential for analyzing international competitiveness within digital labour markets.

H1: The capabilities of developing high-technological and knowledge levels are more likely to reinforce the presence of a platform in the international digital labour market.

H2: The more embedded platforms are in various and well-structured actor networks like user communities, partner organizations and complementary institutions, the higher competitive advantages are likely to develop in international environments.

H3: The capability of a platform to fit within institutional settings, such as regulatory frameworks, legitimacy norms, and expectations of the people does help in the capacity of the platform to create and maintain international leadership.

Methodology: Qualitative Research Design

Research Approach

To examine how sectoral innovation system (SIS) configurations shape the international competitiveness of digital labour platforms, this study adopts a qualitative research design grounded in semi-structured interviews. A qualitative approach is particularly suitable for emerging digital sectors where technological, institutional, and organizational dynamics evolve rapidly and where empirical observations are necessary to complement conceptual frameworks. This approach allows understanding the interpretations of technological capabilities, actor networks, and institutional environments by the practitioners, policymakers and industry professionals in the digital labour market in detail.

This method is also consistent with the previous studies that have highlighted the value of context-dependent experience-based insights in the study of innovation systems and platform ecosystems.

Sampling and Participants

A purposive sampling approach was used to select the respondents who have had a first-hand experience with digital labour markets, or are part of relevant innovation ecosystems.

A total of 12 interviews within the recommended scope of qualitative exploratory research and allows saturating the themes. The duration of interviews was between 30 and 50 minutes, depending on experience and time of availability of the participants.

Data Collection Procedure

The semi-structured interviews were used as a method of data collection in face-to-face or video conferencing programs, including Zoom or Microsoft Teams. Both interviews were conducted according to a loose protocol that was aimed at eliciting free discussion, which was sufficient to address the major themes of the SIS framework.

The questions posed in the interviews were based on three areas technological and knowledge capabilities (e.g. role of AI, data infrastructures, algorithmic efficiency), actor networks and ecosystem interactions (e.g. user base, partnerships, supply-side interactions, network effects), institutional and regulatory environments (e.g. regulatory constraints, legitimacy, compliance challenges, public acceptance).

All interviews were transcribed and audio-recorded with permission to analyze. Anonymity and confidentiality were guaranteed to the participants.

Data Analysis

The study employed thematic analysis, following the widely adopted procedure proposed by Braun and

Clarke (2006). This method is s suitable in defining trends on meaning across qualitative data sets and is consistent with the exploratory studies on innovation systems. The against the proposed hypotheses were the themes that were compared to determine consistent themes, divergent themes, or emergent ones. NVivo or similar software was not required; manual coding ensured close engagement with the data.

Results

A thematic analysis of the 12 interviews revealed three core themes. These themes relate to the three sectors of sectoral innovation systems (SIS) framework which are knowledge and technologies, actors and networks, and institutions. The following subsections present each theme alongside illustrative participant quotations.

Theme 1: Technological and Knowledge Capabilities as Primary Drivers of Competitiveness

Participants consistently emphasized that a platform's technological and knowledge capabilities form the central foundation of its international competitiveness. Advanced algorithmic systems, data-driven optimization, AI-enabled automation, and predictive analytics were frequently described as essential for delivering efficient services, reducing operational costs, and supporting large-scale expansion across markets.

Participants reported that as a platform builds up significant amounts of operational data, its algorithms become more precise and flexible to better establish a cumulative learning effect, which is hard to imitate by new entrants. Technological sophistication was considered as a mechanism that could allow platforms to grow across borders with comparatively low marginal costs, in addition to being a differentiator.

Illustrative quotes:

"When a platform has strong AI-driven matching or routing systems, it can scale globally much faster than competitors". (P3, Platform Specialist)

"The real competitive edge is not the app interface, but the data models and algorithms behind it". (P7, Industry Consultant)

"Once a platform accumulates large-scale operational data, its predictions improve in ways that new entrants cannot easily catch up with". (P2, Technical Manager)

These insights support Hypothesis 1 (H1): Platforms with stronger technological capabilities are perceived as more internationally competitive.

Theme 2: Network Embeddedness and Ecosystem Relationships Strengthen Market Expansion

The second theme is the significance of actor networks and relationships in the ecosystem. The participants observed that platforms with huge user bases, thick networks of drivers and that have robust relationships with external stakeholders like businesses, universities, logistical participants and governments significantly enhance the platform competitiveness.

The network effects were often cited as an important mechanism: The more people join the service as riders and drivers, the more reliable the services they will offer, which will attract more people to the platform. Another focus of the participants was that ecosystem partnerships will help to promote local adaptation, improve the legitimacy, and minimize the difficulties with expansion into new geographical markets.

Illustrative quotes:

"Without a strong driver and rider network, no platform can survive in the long term, let alone expand internationally". (P4, Urban Mobility Expert)

"What really boosts competitiveness is not just technology, but partnerships—municipalities, universities,

even airports". (P9, Industry Analyst)

"Platforms that coordinate their ecosystem well can enter new markets almost like plugging into an existing infrastructure". (P6, Operations Manager)

These findings support Hypothesis 2 (H2): Platforms with stronger network embeddedness are perceived as more competitive in international markets.

Theme 3: Institutional Alignment Shapes Legitimacy and Cross-Border Scalability

The third theme is that of institution alignment-regulatory support, legal recognition, and acceptance of the public in the process of developing cross-border competitiveness. As noted by the participants, even highly innovative platforms cannot penetrate or remain in a market with a restrictive or misaligned regulatory environment to their business models of platforms.

Heterogeneity of institutions between nations was observed many times. The supportive structures of environment exist in some environments that support integrating platforms, and legal restrictions, licensing, or opposition by existing industries exist in others.

Illustrative quotes:

"If regulators do not recognize the business model, no amount of innovation can help the platform expand internationally". (P1, Legal Researcher)

"Institutional support gives platforms legitimacy, and legitimacy is what turns a local service into an international one". (P10, Policy Advisor)

"Some markets welcome digital labour platforms, while others create so many barriers that expansion becomes impossible". (P8, Government Consultant)

These findings support Hypothesis 3 (H3): Platforms that are institutionally aligned enjoy stronger international leadership potential.

Table 1

Key Determinants of International Competitiveness in Digital Labour Platforms

Theme	Description	Illustrative quotes
Theme 1: Technological and knowledge capabilities	Technological sophistication: such as AI, machine learning, and data-driven optimization are considered the major contributor to international competitiveness in digital labour platforms.	"When a platform has strong AI-driven matching or routing systems, it can scale globally much faster than competitors". (P3) "The real competitive edge is not the app interface, but the data models and algorithms behind it". (P7)
Theme 2: Network embeddedness and ecosystem relationships	Extensive user bases, well-developed networks of drivers and collabourations with companies, cities, and institutions drive scalability and competitiveness on network effects and ecosystem complements.	"Without a strong driver and rider network, no platform can survive in the long term, let alone expand internationally". (P4) "Platforms that coordinate their ecosystem well can enter new markets almost like plugging into an existing infrastructure". (P6)
Theme 3: Institutional alignment and legitimacy	Favorable regulatory climates and social endorsement define legitimacy and dictate the ability of platforms to continue their operations and expand to different markets.	"If regulators do not recognize the business model, no amount of innovation can help the platform expand internationally". (P1) "Institutional support gives platforms legitimacy, and legitimacy is what turns a local service into an international one". (P10)

Conclusion

This study offers a more integrated perspective on how international competitiveness develops in the digital labour market by analyzing the sector through the sectoral innovation systems (SIS) framework. Evidence

discussed in this paper demonstrates that the competitive advantage of a platform is not determined by one source, but as a result of the interplay between the technological capabilities, network structure within which the platform operates, and how well it fits or can fit the institutional environments of various markets.

The analysis highlights that knowledge and technological resources are the backbone of competitive differentiation which enables the digital platforms to optimize their activities, capitalize on their previous learning, and customize their services to suit various regional requirements. The competitive strength is also enabled by wide and intertwined networks of actors, which aid in coordination across the ecosystem, aid in the quality of services and assist in scaling among the platforms efficiently. Meanwhile, institutional factors are also important. Acceptance by the regulators as well as societal acceptance play a major role in determining the ability of digital labour platforms to build legitimacy and continue their operations in the long term, particularly where the expansion is across country borders.

On the whole, the data demonstrate that technological preconditions, network ties, and the compatibility of the institutions make up the competitiveness in the digital labour market. The SIS framework, therefore serves as a useful analytical tool for understanding how these elements interact and how digital platforms gradually consolidate global leadership.

Beyond offering a conceptual contribution, this research also contributes to the existing debates on a digital innovation and platform governance in the form of empirical evidence. Through the processes of creating competitiveness advantage, the study offers a point of departure to the future research that focuses on the distinction of institutional reaction in different countries, how platforms accumulate and remodel technological skills over time, or the comparative performances of different types of digital labour platforms in the internationalisation process.

Table 2

Participants information

Participant	Role/position	Organization type	Experience in digital labour markets	Interview duration
P1	Legal researcher	Public Policy Research Institute	6 years (platform regulation, mobility policy)	45 min
P2	Senior data engineer	Ride-Hailing Platform A	8 years (AI/ML system design, routing algorithm development)	40 min
P3	Platform operations specialist	Global Digital Labour Platform	5 years (market expansion, service optimisation)	38 min
P4	Urban mobility expert	Municipal Transport Authority	10 years (urban transportation, digital mobility governance)	50 min
P5	Policy analyst	National Digital Economy Office	7 years (platform legislation, innovation policy)	42 min
P6	Operations manager	Food-Delivery & Ride-Hailing Platform B	6 years (ecosystem coordination, partner management)	35 min
P7	Industry consultant	Private Consulting Firm	12 years (platform competitiveness, innovation strategy)	48 min
P8	Government advisor	Ministry of Transport	9 years (regulatory frameworks, cross-border mobility)	52 min
P9	Industry analyst	Market Intelligence Company	5 years (platform competition, market analytics)	33 min
P10	Policy advisor	City Government Innovation Unit	7 years (regulatory sandboxes, legitimacy processes)	47 min
P11	Senior product designer	Digital Logistics Platform	8 years (user experience, service design)	39 min
P12	Academic researcher	University	11 years	45 min

		(Digital Economy Lab)	(platform ecosystems, SIS research)	

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