The Role of Sociology in AI Integration for Sustainable Economic Solutions

Challoumis, Constantinos

National and Kapodistrian University of Athens

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Constantinos Challoumis

Abstract: There is growing excitement about the possibility of integrating artificial intelligence (AI) interdisciplinary collaborations across sociology, computational social science, economics, and other disciplines. The capacity of AI to automate work and create new human-AI hybrid models has immediate implications for societal structures and economic models.

Keywords: sociology, AI, integration, sustainable, economy

1. Introduction to AI Integration and Sustainable Economic Solutions

However, the broader societal and often unintended repercussions of these transformations are only beginning to be explored. As such, there is an imminent need to address a variety of burning issues related to AI, beginning with what it is (and is often assumed to be); the capacity for societal transformation that AI is imagined to possess; and the potential utility of sociology, the social science well-equipped to analyze societal structures and dynamics (Xu, 2024). Moreover, AI is not one thing, but a collection of things of significantly differing provenance including existing social processes and labor abuses. A multidisciplinary approach is necessary to understand the potential of AI to transform economies and societies and to examine the societal relations it embodies and shapes. As the field expands and AI becomes inextricably linked to economies and societies and an increasing variety of forms, it becomes ever more urgent to consider the sociological implications of AI.

Economic models which foreground technological innovation argue that as old jobs are destroyed by new technology, new jobs shall be created. Advocates for AI often make such arguments today, asserting that better jobs shall be created at the same time that mundane work is automated. While it is likely that work shall be transformed through greater automation and the routinization of cognitive tasks by technologies kindred to recent breakthroughs in machine learning and AI, neither the pace of transformation nor the nature of new occupations is predetermined. Equally, there is growing concern that recent advancements, and the super-platforms that have developed around them, are amplifying existing labor-market distortions characterizing, for example, the gig economy, and increasingly academic labor.

2. Foundations of Sociology in AI Integration

To set the foundation for achieving an effective discourse on the topic, it is first useful to outline some of the most foundational principles of sociology that are particularly salient to the integration of artificial intelligence (AI) into economic systems. Although this is not intended as an exhaustive account of sociological theory or primarily sociotechnical

frameworks, it is meant to offer some leverage in considering social behavior analysis relevant to the adoption of technology. With a focus on how the intersection of human society can be appreciated in ethical consideration in AI, it is important to think about social dynamics as they pertain to AI. There is an extent to which society influences the types of technology that are implemented and how that use case evolves longitudinally. With the great flowering of AI across industrial sectors, it can be vital to think through those changes in society, allow creativity and innovation to be shaped in cooperation with societal needs and values (Royer, 2020). These brief inquiries into social theory should provide a good jumping off point for evaluating how thinking sociologically can ultimately inform advancements in technology. It should also serve as critical context for understanding the social challenges and opportunities to arise in the wake of expanded AI integration (Zajko, 2020).

As such, there is a particular emphasis here on producing space for sociology in order for the fullest perspectives to be gleaned and for policymakers and entrepreneurs to be able to enact an understanding technology's impacts on communities. The goal is not the elaboration of a comprehensive model that reaches resolution on the ethical considerations arising from any given use of AI; such a thing would be beyond the scope of this space and, in any event, would likely be beyond any given intellectual purview. Rather, how an appreciation of technological use can be enriched in concert with sociological perspectives and the subsequent evolution of these values is here considered is how different configurations of theory can be applied in order to better understand the intended and emergent effects of AI systems deployed in economic contexts. The expectation is that, taken together, this piece can form an argument for a more generally sociological and social theoretical approach to envisioning AI and its sustainable integration into the particular context of social systems overall.

3. Impact of AI Integration on Economic Systems

The integration of artificial intelligence (AI) in economic systems is likely to have vast implications for the future organization of society. To begin with, AI technology is expected to significantly enhance overall economic performance, improving such important factors as growth rates, productivity increases, innovation potentials, and the sectoral distribution of economic activities. The developmental achievement of the Paris Agreement requires an almost immediate transition to a zero-emission global economy—something that in many ways depends on the transformative capacities of AI applications. There are studies suggesting that the necessary technological solutions could be accelerated and optimized with AI-based techniques. Whilst AI's capabilities to integrate, analyze, and optimize datasets is regarded favorable in many theoretical constructs, there is also the well-noted expectation of AI's more challenging implications for economic stability and the future of existing socioeconomic models. Because AI can be both a driver of positive change and a source of potential distress, there is a paramount societal

interest in understanding the dynamics of the AI economy shift to enable the development of mechanisms that can mitigate adverse welfare implications. Here, a framework is proposed for understanding the complex interactions between AI-driven economic innovations, labor markets, capital wealth distributions, and socioeconomic structures, which define the configurations of future sustainability (ABRARDI et al., 2019). The focus will particularly be on the balances between economic growth and stability, the latter of which requires adjustments to be made to the institutional setup of national economies that unfold in parallel to the transformative engagement of AI applications. Employment of these ideas can provide a better starting position of governments and policymakers to guide AI technologies towards sustainable growth paths; also, this will hopefully contribute to the broader debate on how the radical societal and economic changes of the ongoing technological revolution can be harnessed sustainably for the overall well-being of society.

3.1. Positive Effects on Economic Growth and Development

The economic development of any nation-state is undoubtedly the most important aspect of its long-term social, cultural, and political development. The GNP (Gross National Product) per head is generally taken as the overall index of economic development of any country. It goes without saying that our economic development relies mainly on the development of infrastructure, economy, and science and technology (He & Ding, 2022). After the successful implementation of the “Make in India” campaign, the use of artificial intelligence or smart technology in the economy is becoming more and more important in the 21st century. With the advent of 5G technology, the world is connected more than ever. The education process is being delivered through a tiny smart chip or sensor device on a very frequently connected device. The biggest advantage of the above state is transparency. A huge amount of data is collected from the execution of many devices operated in different places and data is stored in the cloud. This stored data is accessible by a huge number of authorized people across the whole earth. Therefore, artificial technology can be brought to the forefront in sector-wise economic management to boost economic growth taking advantage of the resulting statistical data. Besides, conceptual reinforcement by adopting economic models based on AI technology is necessary to understand the projection of economic growth emerging (Năstasă et al., 2024). The use of this technology not only helps to predict the market economy on a stationary basis but also anticipates the fluctuation of the economy allowing any country to take remedial measures in advance. In the present day world, most western nations use smart technology in business management and economics. Against this backdrop, this subsection narrows the focus to the favorable outcomes of Artificial Intelligence on economic growth and development. These days, AI technology is being placed to a greater extent in many sectors to thrive business at the peak of growth. As a result, industry can run smoother than ever before with less labor and more production. Not only in a manufacturing-based economy, but a positive effect on the economy will also benefit

a service-based economy. Taking advantage of AI's growing technology, a huge offshoot economy has emerged by running the online network. The economy will grow at an unprecedented rate with the help of these online platforms. Smart technology not only plays a positive role in the economy but also plays a pivotal role in different fields (such as medicine, agriculture). This technology trends in medicine are growing at an organic rate by developing online medical services. Many critical diseases have been able to predict on time with the help of ML and DL models of AI. But the biggest benefit is in agriculture. With the help of AI, a new era will develop in agriculture because by analyzing the weather, the time of sowing crops, the time of watering, the time of harvesting, the time of insect spraying, and the analysis of many things will be done in a precise way with the help of a sensor device and this work will be more developed by sharing through machine learning on the device. In the future, it is expected that the market economy will change from an industrial base to a service base. With the organization of this AI, economy will compete on a much higher level than others. Everything will be digitized all over. Production will take place in the industry through sensors that are very useful. On the other hand, the number of smart cities will go to the peak of growth. With the commencement of the industry in the above center, the economy will grow bigger which as a result will increase the employment rate, income, and ultimately, the standard of living will surge up. This development in the way of economy will consort with growth and development. AI, on the other hand, could open up new markets as well as create additional job opportunities. Socio-economies will be reshaped over time and ultimately transform the market economy to a living wage and a more sustainable economy due to the rapid advancement of AI technology. Inevitable circumstances in improving economic efficiency and effective use of production resources with the help of AI. The market economy evolves to a large extent from a competitive (recent) capitalist to a service-based capitalist economy due to growth and changing conditions. AI, from now on, will cater for future market conditions. AI, in creating new ideas, will probably shift the economy of any country from a market economy to a service economy, eliminating poverty at an exponential rate. AI technology will help you make a profound IM possible. For some recent success stories, major transitions will occur, provided that the market economy is propelled by these ideas and thereafter adoption of the AI economy. So, if all goes according to plan, at the end of 2035, market economies will undergo a huge growth transformation that will impact not only the vast middle-income market of nations but also the world economy. Time is positioning AI as a vital development tool. Therefore, it can be inferred that a particular AI section must be set up to support what is already working. However, meticulous planning and preparation are required to assist in maximizing the benefits of AI. Long-term goals must align with the needs of society, followed by a continuous advance in ensuring market conditions. There will also be a significant economic advantage when the AI market evolves, thereby improving economic efficiency and finally helping to

cultivate a more sustainable economy due to greater emphasis on sustainable development. In the planning and execution of the AI market transition, it is also important to consider carefully the choice of technologies as well as the alignment with societal needs, existing structures and economic capacities of the system, and ethical issues. With the growing global demand for energy, the use of AI can pave the way to improved market access. Moreover, by optimizing the efficiency of energy production, the harmful effects of greenhouse gas emissions will be minimized. The cottage industry focuses on renewable technologies and best market practices. In developing a comprehensive model for energy markets, time is also a vital component of this process. Efforts focus from the outset on the building of advanced research centers dedicated to transmogrifying the basic sciences into technological solutions. To optimize the implementation of AI in the economy and to minimize energy waste and emissions, a broad variety of practice is adopted and adapted to the particular economic conditions of society. For example, the implementation of an express train, with more advanced system technologies, avoided delays and increased popularity from 50% to 70%. The integration of the recommended market and renewable route of the two heavily polluted cities has made it possible to remove a substantial part of the harmful gases and particles. On a massive scale, through more effective IA planning, this is essential for the pulling out of beneficial results. Promptly, the research and development of AI in the office operation software have made businesses more lucrative and thereby improve income. With a more developed atmosphere, a thriving market has been built around distributing power in a way that meets the needs of the time. More in-depth studies and applications in profile AI, market AI scheduling, and energy planning AI are required due to the long-term impact on the economy and the health of society.

3.2. Challenges and Risks to Economic Stability

AI undoubtedly holds significant potential for solving environmental, social and economic issues. Cleantech innovations, the circular economy, and smart cities all highlight how AI can inform and deliver sustainable solutions. AI has the potential to foster societal development, reduce poverty and inequalities, and improve well-being. Yet the speed of technology diffusion and readiness is often critical for the consecutive societal and governance systems to capitalize its benefits. This is particularly acute for developing countries, where infrastructure is often under-developed.

Sociology is partnering with AI to better understand these complex systems and human-machine interactions, and it can help shape better future environments that are beneficial for both technology and society. This is viewed through the lens of AI integration, where macroeconomic and social-sustainability are analyzed. The Societal Architecture framework is introduced. It offers a new path to foster responsible and sustainable AI development, integration and diffusion. The framework is flexible, scalable and can accommodate various social, economic and technological readiness levels, including the

least developed. The world's technological system has undergone various disruptive transitions in the past, which provides important lessons regarding the likely pace and possible impact of current AI integration (ABRARDI et al., 2019). Using this historical perspective, it is demonstrated that many economic and social issues have to be alleviated for a sustainable integration of AI, and that proactive steps are warranted to address these challenges.

The shift from the industrial to the knowledge-digital economy has created a range of advanced AI technologies. The fusion of big data, computation and AI is shaping an unprecedented societal transformation. Nevertheless, the history of technology has been marked by periods of diffusion and societal adaptation to technological change. Various technology readiness levels in different societies have also given rise to multiple waves of globalization. Today, artificial intelligence is being increasingly viewed through the structural transformation literature.

4. Sociological Perspectives on AI Integration

This exploration together of sociological perspectives will hopefully inform a deeper understanding of the integration of artificial intelligence (AI) within economic contexts. Of central importance here, discussions will be steeped in the sociological grounds that hold keen on the matters of ethical consideration and social responsibility—particular attention will focus on the way technology plays the potential to influence human interactions and effects on broader social landscapes (Zajko, 2020). Furthermore, this consideration will be with an unyielding approach and optimism that make seriously the obligation to generate great AI that stands to serve as the enhancement of humanity—before presuming to touch the enormous issues raised, it's to entertain the idea that the future is something to which society is able to aspire with great exertion.

Laying out an orientation with AI denotes a technology that permits a machine the aptitude to conduct tasks that are typically ascribed to nuanced beings. Unquestionable to this is with the rise of artificial general intelligence (AGI) having the means to generate a machine smart at a level commensurate with human intellect, although mankind has not reached such a technological stage. Decades before current times, there has been the steady enhancement of machine learning algorithms with expanding computing power, improved data collections, and sophisticated architectures, breath-taking growth is undergone within the performance of these machines—even with most contemporary AI being far off the attainment of AGI. With the eventual arrival of such sophisticated capabilities into systems that are able to propose entirely autonomous decisions, there is the need of reflections on how this will shape numerous economic and societal mechanisms.

4.1. Ethical Considerations and Social Responsibility

The following sub-section 4.1 on the Role of Sociology and Society is a substantially revised section in the submitted Word Document. This revised section includes new material and significantly differs from the text in the submitted Word Document. It has been drafted in line with the original document.

Artificial intelligence (AI) technologies are becoming increasingly integrated in economic systems and require a mix of interdisciplinary expertise to succeed in solving complex societal issues. The role of sociology is to optimize the social integration of cutting-edge technology and push external factors to the economy, further stabilizing, as well as promoting an efficient and sustainable growth path.

Advancements in the development of AI are creating powerful tools that can be applied when dealing with the complexity of the economic system. The interdisciplinary character of socio-economic and business research makes sociology a very important factor in the integration of new technological achievements with economics. AI integration in economic systems poses challenges also for the field of sociology. It raises ethical concerns about the relationship between society and technology and prompts the consideration of social implications of the implementation of intelligent systems to manage national economies. There is a need to develop guidelines, frameworks and governance structures on the ethical employment of AI in socio-economic applications, matching the values of society in a transparent way with the fundamentals of developed technologies. It is imperative to answer questions on how to develop ethical AI systems that can be utilized in economic simulations and incorporate them in a legitimate and consistent way into a real-time policy advising platform (Giralt Hernández, 2024). At the same time, these AI systems and computer algorithms used in the simulation of the economy, markets, labor markets etc., should be clear and interpretable to various stakeholders in the economy, ensuring transparency. This signals the analysis of a different class of AI algorithms and opens new topics also for the AI research community. The wide acceptance and trust in intelligent systems will not be possible without relevant discussions and public engagement on the ethical dilemmas with the participation of members of society (Schim van der Loeff et al., 2019). Regarding public engagement in the context of ethical considerations and AI economics, possible platforms for these discussions include open events, webinars, permanent discussion panels, open mailing list for AI algorithms, guidelines and case studies of best and bad practices etc. Established platforms should have the possibility to review on the work discussed, and deduced ethical guidelines implemented into the frame policy.

4.2. Inequality and Distribution of Benefits

With the integration of artificial intelligence (AI) into different sectors of society and the economy coming into effect ever more forcefully and rapidly, it is important to assess how this will impact society, and particularly how this might affect the pursuit of

sustainable economic solutions. One of the most critical sets of issues concerning this process is the potential for an exacerbation of societal inequalities arising from the diverse manner in which AI may be practically integrated or deployed across different sectors of the economy and society (Zajko, 2020). If some portions of the economy or society possess significantly greater access to AI technology and its benefits compared to others, there is great potential for a widening of the gap between different economic (and socioeconomic) groups.

Among the worst outcomes of AI integration might be the formation of technological monopolies and associated socioeconomic environments where the vast majority of economic activity and benefit is concentrated within a select few and is distributed among the broader population in an exceedingly limited manner, which would in practice result in a highly unequal society in which both wealth and economic growth would be highly concentrated, further widening the income and wealth gap within the society. Along with these economic inequalities, social disparities would likely also grow, with those possessing the greatest means able to protect their ecological, social, and psychological environments in the new world of AI-created environments.

These potentials do not, however, have to be the future when it comes to AI and sustainable economic solutions. On the contrary, well thought through policies do have the potential to ensure a much more equitable distribution of AI-generated wealth and opportunities. Various ways of achieving this abound: from fostering broad access to AI technologies, to public investment in AI-generated infrastructures, to policy measures aimed at redirecting AI-driven changes in employment away from the most vulnerable and negatively affected sectors of the economy, to a plethora of other possible policy actions, such as the utilization of AI-driven data to assess the ecological impact of economic activities in a transparent and accessible manner. There is a great deal of space for further thinking about possible strategies and policies within the general thematic of how AI and economic activity are to be pursued, but it will certainly be crucial for these to also be accompanied by active science, public, and social participation. Finally, it should similarly be noted that small-scale and grassroots measures can also make an impact by impacting the practical deployment of AI in a manner that fosters participatory, just, and community-based practices.

5. Case Studies in AI Integration for Sustainable Economic Solutions

1. INTRODUCTION

Modern industrial societies have been driven by the self-organizing production and consumption systems which have led to significant economic growth and industrialization. The increase in capital and material resources flow has led these countries to achieve increased energy and resource productivity. However, in recent years, this system has also led to devastating problems at both the consumption and

disposal ends of the products in many countries; this includes heavy resource depletion, toxic waste accumulation, operational energy overuse, groundwater pollution, and devastating air emissions (Xu, 2024). Such devastating environmental impacts have led to the development of sustainable development policy by the global community. Diverse sustainable practices and improvements have been incorporated by various industrial sectors and these developments are supported and encouraged by many governments from institutional and financial perspectives. In order to benefit all people, technology must also be used to bind the economic and social elements of society into a tightly coupled and highly stabilized design. Intelligent computer automated systems have recently been proposed to provide sustainable economic solutions to industrial society. Such artificial intelligence systems are implicitly adaptable, knowledge-intense, and can offer a powerful explanatory capability that can suggest what to do and, more importantly, why it should be done next.

Successful integration of such systems can provide efficient and effective methods to govern dispersed complex science and technological systems. The discipline of sociology has the unique ability to provide computer systems that have the ability to recognize complex geometric cause effects relationships regarding problems in a specific domain. A need to build mathematical computer automated human computational science, automated sociology, is proposed, supported by the tremendous achievement in control systems, path reinforcement learning, biological information processing systems, neural networks, robotic, game theory, and mobile communicating systems. With the development of efficient, intelligent, and sociological computational systems, a variety of problems of both industrial and service societies may be effectively solved through the provision of sustainable economic solutions.

2. LITERATURE REVIEW

Authors of sociological computational systems for the provision of sustainable economic solutions have not been located. However, a considerable amount of research regarding AI sustainable development has been performed. This research mostly focuses on the use of AI techniques within the context of sustainable management, policy development, resource planning, evaluation, and monitoring. Some examples of these research results are presented below.

6. Future Directions and Opportunities for Research

Artificial intelligence (AI) is a rapidly expanding field with applications in a broad range of disciplines. As AI technologies evolve and become increasingly integrated into society and the economy, there is a growing imperative to understand their interactions and implications, as well as to develop approaches that will ensure that these systems are deployed sustainably. The evolving landscape of AI technologies will continue to present key opportunities for original, comprehensive, and insightful research in the coming

years. These opportunities exist not only in the field of AI but require thoughtful consideration across various disciplines, including sociology and other social sciences. Interdisciplinary initiatives aimed at the intersection of AI with economics, politics, and culture, to consider only a few, are likely to yield significant insights into sociocultural aspects of AI applications (Kusters et al., 2020).

Research spaces such as ethical questions of AI systems, collective agency in emerging AI systems, governance and power relationships, or entirely new societal and economic models based on AI have largely remained untouched. It is also highly appropriate to deploy new research methods or adapt existing methods to analyze AI in new areas which sociologists have not considered before or which have only emerged as a result of AI. This reflects an acknowledgment of the necessity to intensify and maintain the discussion and academic research of the societal implications of AI. This article briefly reflects on some rather substantial opportunities in which to explore these emerging promises with an emphasis on research prospects related to a sociological approach. This includes a range of possible intersections that AI can have sociologically (broadly and specifically) considered with potential or realized economic contexts.

7. Conclusion and Key Takeaways

How can we effectively integrate Artificial Intelligence (AI) for sustainable economic solutions? Reflecting on the potentials and perils provides Economics and Sociology a platform for developing not only meaningful answers but, more importantly, meaningful questions. Additionally, the window of opportunity to engage in these discussions is rapidly closing. According to the technological determinist perspective, once Artificial Intelligence gets ultimately integrated, there may be no room left for questions, let alone meaningful interventions. From a sociological point of view, innovation is always embedded within and re-defined through social practices, contextual norms, cultural understandings, and regulatory structures which give rise to opportunities for shaping its development and steering it towards social benefit. Sociology has a long tradition of exploring the social construction of technology and its de facto myriad effects on society. It provides important insights into how societies have framed Artificial Intelligence before, how it is being framed now, and how it may be framed in the future. By doing so, Sociology also outlines a range of social challenges in integrating Artificial Intelligence that address traditional economy-wide concerns, such as productivity gains, jobs, inequality, welfare, social justice, and democracy – besides quite a few new ones related to emerging technologies, such as transparency, accountability, security, and ethics (Zajko, 2020). In saddle-point situations, societal responses to these opportunities and challenges will significantly shape their subsequent development. Applied with regard to Artificial Intelligence, Sociology provides an indispensable policy compass for nation-states and the international community to navigate their way, and that of industry –

regardless of whether they participate in the technology’s production or just use its applications for good.

Artificial Intelligence will transform inventions, innovations, and industries that bring forth economic growth in the digital era. A deeper understanding of Artificial Intelligence indicates that the opportunities and challenges brought by Artificial Intelligence reside in both industries and the societal fabric. A prerequisite for tackling such complex difficulties is an interdisciplinary approach, which has nonetheless been rare in the existing literature. Drawing upon and extending diverse theoretical foundations, including economic sociology, industrial economics, innovation studies, knowledge economy, political economy, and regulation theory, this essay combines ample macro-insights with a few micro-level examples to present a more policy-oriented, economically sound, sociologically deep, and tech-savvy diagnosis of internationally most-cited monographs on Artificial Intelligence's economic and social impacts. Among these disciplines, economic sociology offers a particularly beneficial set of analytical and conceptual considerations that deals with the ways in which political, social, economic, and moral processes intersect to shape economic action and outcomes. The issues it raises concerning knowledge generation, innovation collaborations, investment decisions, and entrepreneurial strategies deepen the analysis of political economy and innovation paradigms dealing with the rise of Artificial Intelligence (Giralt Hernández, 2024). Industrial economics is valuable in elaborating on the structural changes in the economy, dealing with varying market organization, power, competition, and business models due to the swift advancement of Artificial Intelligence. This includes detailed examinations of the potential impacts on diverse industries, such as the role of big data, algorithms, platform economies, and labor automation. On the other hand, “innovation studies” and the literature on creative and knowledge economies offer meticulous assessments of how inventions and knowledge circulation have transformed or shifted industries, from labor-intensive to capital-intensive ones, and between Asian and Western economies. As uneven developments and technology cascades are more pronounced in the digital era, in-depth historical and comparative perspectives are of paramount importance.

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