BEYOND EFFICIENCY: ECONOMICS AS A HUMAN-CENTERED PRACTICE IN THE DIGITAL ERA

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Abstract: This paper explores the transformation of economics in the context of digitalization and the paradigm shift from Industry 4.0 to Industry 5.0. It argues that the conventional neoclassical economic models, based on rational behavior and efficiency maximization, are increasingly inadequate in a world shaped by artificial intelligence, platform economies, and algorithmic governance. The article proposes a human-centered, interdisciplinary economic framework that integrates ethical, institutional, and technological considerations. The economist's role is redefined from a neutral analyst to a strategic mediator capable of designing sustainable and inclusive socio-technical systems. By analyzing shifts in agricultural economics, finance, and macroeconomics, the paper illustrates how digital infrastructures challenge traditional economic categories like value, trust, and sovereignty. Moreover, it calls for a radical transformation of economic education- moving beyond abstract modeling to include critical thinking, system dynamics, and moral reasoning. Economic knowledge must now serve as a tool not only for optimization but for envisioning and implementing just and adaptive institutional arrangements. In the digital era, economics is no longer a detached discipline but a transformative practice with the potential to shape futures. If economists fail to embrace this new ethical and visionary role, economic governance may be overtaken by opaque technological systems that erode democratic accountability and social cohesion.

Keywords: industry 5.0, digital economy, institutional economics, economic education, algorithmic governance

I. Introduction: Economics in the Age of Digital Transition

When understood in the context of the radical changes driven by digital transformation, economics can no longer be treated as a closed and neutral discipline, subordinated solely to the logic of mathematical modeling and optimization. Instead, it is emerging as a dynamic social science whose foundational categories are being reshaped by new technological conditions, institutional tensions, and moral imperatives. Within the framework of Industry 5.0 - conceptualized by the European Commission (2021) as an era of human-centric technological evolution - the necessity for economic theory to diverge from dominant neoclassical models and integrate new approaches that reflect the complexity, uncertainty, and asymmetry of contemporary market processes is becoming increasingly urgent. Critiques of the outdated rational behavior model embodied in the figure of homo economicus have been extensively articulated by authors such as Joseph Stiglitz (2010), who argues that assumptions of perfect information, stable preferences, and equilibrium are empirically unsustainable, especially in the context of systemic information asymmetry. In today's digital environment, where data becomes a primary economic resource and algorithms act as intermediaries of decisions, economic rationality is no longer autonomous - it is technologically mediated, fragmented, and often opaque. As Zuboff (2019) emphasizes, digital capitalism has established new forms of surveillance-based power in which economic value is extracted from behavior and attention, not merely from labor and capital - an insight that undermines the foundations of classical labor value theory and demands a reformulation of economic analysis. From this perspective, digitalization is not merely a technological phenomenon, but a transformative force that reshapes the methodology, norms, and legitimacy of the economic discipline itself. Institutional economics and the theory of sociotechnical imaginaries (Jasanoff and Kim, 2009) offer crucial frameworks for understanding this transition, highlighting how every technological infrastructure simultaneously projects a particular social order - a system of legitimized values, power relations, and cognitive matrices. In this context, the economist cannot be viewed as a neutral observer or technical analyst but must be reconceptualized as an institutional architect - mediating between society's normative demands and the operational logic of technology. The shift from Industry 4.0 to 5.0 is not merely about replacing machines and algorithms; it is a transformation of goals - from productivity to

sustainability, from scale to inclusion, and from economic efficiency to ethical legitimacy. This necessitates a new methodological and pedagogical framework in which economic knowledge is built not through reduction, but through synthesis - bridging quantitative and qualitative approaches, economics and sociology, data and ethics. For this reason, key thinkers in educational innovation such as Nussbaum (2010) argue that universities must focus on developing citizens rather than just experts - individuals who understand the societal implications of their expertise and can apply it in the service of the common good. This leads to the conclusion that digital transformation presents economics with an existential choice: either it evolves into an interdisciplinary, critical, and morally engaged science, or it becomes marginalized by technical systems whose legitimacy rests not on democratic accountability, but on algorithmic efficiency. It is within this choice that the significance of the new economist emerges - not as a specialist in optimization, but as a strategist, mediator, and visionary capable of designing institutions resilient not only to market fluctuations but also to social ruptures and technological risks.

II. The Transition from Industry 4.0 to Industry 5.0

The shift from Industry 4.0 to Industry 5.0 marks a fundamental change in the logic of economic development, in which technologies are no longer seen as neutral tools for enhancing productivity, but as carriers of social and ethical choices. While Industry 4.0 was dominated by a paradigm of automation, cyber-physical systems, the Internet of Things, and machine learning, the new framework of Industry 5.0 introduces the human being at the center of the technological process, emphasizing the need for co-creation, sustainability, and inclusiveness (European Commission, 2021). This pivot from technocratic to humanitarian logic in innovation has profound implications for economic theory, which for a long time treated technical progress as an exogenous, quantitative variable subordinated to the production function or the Solow growth model. In today's conditions, however, technologies acquire an institutional dimension - they not only increase efficiency, but restructure the very forms of labor, coordination, value assessment, and governance. As Schwab (2017) points out, the Fourth Industrial Revolution changes not only what we do, but who we are - our identity as workers, consumers, and citizens. With Industry 5.0, this transformation deepens through a new focus on the ethical consequences of technological choice: which groups are included or excluded from the digital economy, what are the ecological and psychosocial costs of automation, and what institutional responsibility do developers and

economic architects bear. In this sense, the economist's role undergoes a qualitative metamorphosis - from a neutral cost-benefit analyst to a strategic mediator between economic rationality and social justice. As Dosi (1988) argues, technologies follow trajectories that are not fully determined by the market, but are shaped by institutional, cultural, and cognitive factors - a reality that places economists at the heart of their design process. Thus, Industry 5.0 is not simply a stage in industrial evolution, but a normative framework in which economic efficiency is reinterpreted through the lens of sustainability, accessibility, and humanism. This demands a shift from reductionist models to systems thinking, where production functions are replaced by platforms for co-created value, linear dependencies by nonlinear dynamics, and individual utility by collective goods. The new business architectures, saturated with algorithms, artificial intelligence, and predictive systems, require not just technical analytical skills, but also the capacity for ethical judgment, strategic vision, and institutional design - competencies that classical economics training often neglects. As Brynjolfsson and McAfee (2014) note, the ability to effectively interact between people and machines becomes the most valuable economic resource, but this interaction must be oriented not only toward growth, but toward meaning and human development. In this context, the profession of the economist should not be viewed as a specialization in technical rationalism, but as a discipline of moral imagination (Nussbaum, 2010), capable of projecting alternative futures in which technological progress is not an end in itself, but a means for just resource distribution, participation, and dignity. This calls for a rejection of the notion of economic models as neutral representations and an embrace of their role as social constructs - frameworks that not only describe the world but actively shape and guide it. In this sense, Industry 5.0 not only deconstructs the classical paradigm of production efficiency but also introduces new standards for what it means to be an economist in the 21st century - not a master of mathematical abstraction, but a visionary capable of integrating technologies, ethics, and systemic thought in service of a more just, adaptive, and sustainable society.

III . Economic Education in the Context of the Digital Revolution

The transformations induced by the digital era require not just an adaptation of economic education, but a comprehensive reconfiguration of its philosophy, structure, and pedagogical tools, as the prevailing neoclassical canon - dominated by axioms of rational behavior, linear dependencies, and universality of market mechanisms - is increasingly incompatible with the

realities of a data-driven, platform-based, and AI-mediated economy. In this context, the teaching of economics as practiced in most academic institutions suffers from the inertia of abstract formalization, focused on models with limited applicability, neglecting the social, institutional, and ethical dimensions of economic processes - a problem sharply outlined by authors such as Colander (2009), who calls for a rethinking of the economist's toolbox in the 21st century. Research by Akerlof and Shiller (2009) also demonstrates that economic theory, when stripped of behavioral and psychological components, is incapable of explaining mass economic phenomena such as speculative bubbles, financial crises, and irrational market behavior - phenomena that are now amplified and accelerated through the algorithmic logic of the digital economy. Economic education must reflect this complexity by integrating behavioral economics, critical data theory, institutional analysis, systems dynamics, and the ethics of technology - domains traditionally marginalized in standard curricula. As evidenced by pilot programs in countries like the Netherlands, Finland, and Estonia, the introduction of interdisciplinary programs, simulations with real data, project-based learning, and experimentation with open-ended case studies enables students not only to acquire technical knowledge but also to develop the capacity for critical thinking, collaboration, and social engagement (Van der Zwaan, 2017). Universities, in this context, should no longer be seen as repositories of theoretical knowledge but as innovation ecosystems where teaching occurs through co-creation, reflection-in-action, and integration of diverse perspectives - an approach inspired by Schön's (1983) theory of the reflective practitioner. Importantly, the digital economy does not merely require more courses in programming, machine learning, or data analysis, but a new culture of teaching in which students are trained to understand the broader implications of technological decisions on markets, institutions, and human relationships. For instance, economists working in agriculture can no longer be trained solely with statistical models of yield and productivity but must develop an understanding of agroecological systems, land rights, cultural identities of rural communities, and sustainable resource governance - themes that can only be effectively taught within a transdisciplinary framework encompassing sociology, anthropology, political science, and ecology. This is why an increasing number of researchers such as Raworth (2017) advocate for 21st-century economic literacy, where students do not simply solve equations but critically assess how economic models create, justify, and stabilize particular social orders. Consequently, economics education cannot remain a mere instructional process - it must evolve into a laboratory for moral judgment, political imagination,

and strategic modeling of the future, forming not just experts but democratic citizens who are attuned to the ethical, social, and ecological consequences of economic decisions. Otherwise, economists risk being replaced by algorithms that predict more accurately but understand less deeply, systems that optimize processes but disregard human consequences - a scenario that would leave society without a critical mediator between technology and value.

IV. New Business Architectures and Digital Economies

The unfolding of the digital economy is leading to a radical reorganization of business architectures, where economic activity is no longer structured around classical production functions, transaction costs, or firm boundaries, but rather around dynamic, networked, and algorithmically governed ecosystems in which value is created through interaction, data, and continuous technological iteration. This transition challenges traditional economic theories, including Coase's (1937) theory of the firm, which interprets organizational structures through the lens of transaction costs - an assumption that becomes increasingly irrelevant in platforms like Amazon, Alibaba, or Uber, where market and firm converge into algorithmically managed hybrids, and the coordination of millions of participants is achieved through automated rules, rating systems, and predictive logics. As noted by Parker, Van Alstyne, and Choudary (2016), in these platforms, value is no longer derived from ownership of assets but from the ability to orchestrate network effects - creating conditions for scalable, self-reinforcing interaction among multiple agents, where users are simultaneously providers, customers, and producers of value. In this new context, the economist ceases to be merely an analyst of cash flows and production functions and becomes a mediator of processes in which algorithms structure not only transactions but also forms of rationality, reshaping choice, temporal logic, and the social accountability of economic actions. As Pasquale (2015) highlights, digital architectures often operate under conditions of "black box" opacity, where regulation, transparency, and accountability are replaced by corporate secrecy and technical complexity, creating asymmetries of knowledge, control, and power that challenge the core assumptions of competitive markets and informational equality. Platform-based business models also embody a new type of institutionality, where private actors exercise quasi-regulatory functions - determining market access, competitive conditions, pricing rules, and behavioral norms - turning into informal institutions with global reach that often operate beyond the sovereign jurisdiction of the state (Srnicek, 2017). As a result, economists face the necessity of mastering

new theoretical and analytical tools: institutional evolution theory, political economy of data, algorithmic governance theory, and regulatory ecosystem design - approaches that allow for a critical analysis of digital dominance and the creation of normatively sustainable frameworks. In this process, the economist is not a passive observer but an active participant in the design of future digital institutions: it becomes essential to understand the logic of smart contracts, blockchain architecture, data governance regulations, ethical AI protocols, and the potential for co-creation of digital value through open platforms. This implies that economic expertise must open itself to computer science, law, sociology, and ethics, not only to interpret but also to shape the digital economy as a space for innovation, democracy, and sustainability. While in the industrial age the economist was needed to optimize production processes, in the digital age they are needed to design rules that balance efficiency with legitimacy, speed with accountability, and scale with human rights - a task that requires not only new knowledge but a new professional identity based on critical understanding of value, power, and the long-term effects of technological transformation.

V. Case Study: Agricultural Economics and Artificial Intelligence

Agricultural economics, traditionally focused on resource management, productivity, and market access, is undergoing a fundamental transformation driven by artificial intelligence, sensor technologies, precision farming, and algorithmic modeling - tools that not only increase technical efficiency but also reshape the foundations of economic rationality in agriculture. In this new reality, agricultural value is no longer determined solely by productivity or pricing, but by the capacity to manage climate risks, balance automation with the social sustainability of rural communities, and build systems sensitive to local culture and ecological context - capabilities that require not only technical competence but deep institutional and political awareness. As Lobao and Meyer (2001) emphasize, agricultural development is not merely an economic process but a socio-institutional phenomenon, where decisions related to land use, market access, and technological adoption are closely tied to questions of power, identity, and inequality. In this sense, the use of AI in farming is far from technologically neutral - it holds the capacity to improve yields and resource optimization, but also to deepen social disparities through ownership concentration, marginalization of smallholders, and the algorithmic elimination of non-standardized practices. Research by Rotz et al. (2019) shows that the platformization of agricultural supply chains -

through agro-platforms that collect soil, yield, and meteorological data - often leads to power asymmetries in which large agritech corporations gain control over strategic data without corresponding mechanisms for accountability or value sharing with local producers. Here, the economist plays a critical role as a mediator between the algorithmic and the social, between global technological infrastructures and local institutional realities - a role that requires interdisciplinary expertise encompassing economics, sociology, land law, political ecology, and the ethics of innovation. In conditions of climate uncertainty, soil degradation, and demographic pressure on rural regions, classical models of agricultural efficiency are insufficient to capture real-world complexity - what is needed are systemic approaches based on scenarios, simulations, and co-modeling with stakeholder participation. As Pretty et al. (2018) argue, sustainable agricultural development requires new forms of knowledge that include local practices, traditional ecological expertise, and institutional diversity, which means that the economist must not only calculate but also listen, facilitate, and align interests in heterogeneous social environments. The challenge is not just which technologies are introduced, but who controls them, how their impacts are distributed, and what cultural transformations they trigger within rural communities. Therefore, agricultural economics must be reconceptualized not as a technical sub-discipline, but as a platform for social innovation and sustainable institutional design, where technologies are subordinated to goals defined through dialogue, participation, and long-term ecological rationality. This demands a new type of economic agent - neutral neither in instrumental nor ethical terms - who can mediate between technological innovation and social justice, between global data networks and local knowledge ecosystems, thereby transforming economic expertise from quantitative to qualitative capacity for adaptive institutional design.

VI. Finance and Macroeconomics in the Digital Era

The financial system and macroeconomic theory are undergoing a profound transformation under the pressure of digital technologies, as the rise of decentralized finance (DeFi), smart contracts, algorithmic trading, and central bank digital currencies (CBDCs) not only reshapes the toolkit of monetary policy but also calls into question the foundational categories of money, liquidity, trust, and sovereignty. In the context of automated platforms and blockchain protocols, where transactions are executed through self-executing contracts, the issue of institutional legitimacy in regulation becomes paramount - particularly when many of these systems operate in

parallel jurisdictions, beyond the control of central authorities. As Eichengreen (2019) notes, the proliferation of private digital currencies and stablecoins, especially in countries with weak financial institutions, undermines the state's ability to exercise monetary autonomy, transforming monetary policy into a space of technological competition rather than national consensus. This competition places economists before the challenge not only of analyzing interest rates and monetary aggregates but of understanding the deep architectural changes in the monetary economy - changes that include not only technical innovations but also a radical redefinition of trust and the social contract underpinning the modern financial system. DeFi systems, for instance, which promise financial inclusion and transparency, often turn out to be opaque to ordinary users, vulnerable to volatility, and exposed to new types of systemic risk - not through banks, but through code vulnerabilities, oracle attacks, and algorithmically amplified speculation, as seen in the crashes of the Terra-Luna ecosystem and other DeFi platforms (Gudgeon et al., 2020). This generates new demands on economic knowledge, which must now include cybersecurity awareness, understanding of decentralized consensus protocols, and the dynamics of network dependencies - elements that do not fit within the frameworks of classical DSGE models or IS-LM analytics. Simultaneously, at the macroeconomic policy level, algorithmic rationality is entering central banks, where machine learning is used to forecast inflation expectations, analyze consumer behavior, and manage financial flows - a development that, while increasing analytical precision, raises questions about transparency, accountability, and the normative direction of these predictive mechanisms (Carney, 2021). Who defines the parameters of these algorithms? How are the morally charged consequences of automated decisions with systemic effects on employment, prices, and investment interpreted? These questions require a new kind of economic literacy in which finance professionals must master not only the language of numbers but also the language of ethics, institutions, and systemic sensitivity. Financial analysis can no longer be reduced to maximizing returns - it must include the assessment of algorithmically generated inequalities, manipulative speculation, and social exclusion, which arise not despite but because of the logic of digital financial architecture. As Ghosh (2020) emphasizes, a sustainable financial system is not only stable but also just - a quality that cannot be achieved through technical optimization alone, but through political choices and normative commitments that economists must be prepared to engage with. Otherwise, financial innovation may erode the social fabric, creating systems that

work efficiently for capital but undermine trust, inclusion, and the long-term sustainability of economic life.

VII. Economics as a Transformative Practice

The gradual shift of economics from a neutral science to a transformative practice marks a pivotal moment in the redefinition of its societal role and methodological essence, in which economic models are no longer viewed simply as tools for describing reality, but as normative constructs that actively shape, guide, and legitimize it. In line with the constructivist approach articulated by scholars like Morgan (2012), economic theories are not passive reflections of objective laws but performative forces - they determine not only what is considered 'rational', 'efficient', or 'normal' but also which futures are economically imaginable and politically legitimate. This idea gains growing support in the context of the digital economy, where economic action is mediated by algorithms, data architectures, and standardized interfaces that filter perceptions and reduce the multiplicity of potential scenarios to a few operationally permissible options. As Callon (2007) argues, markets are not givens but 'calculated environments' in which economists and their models act as engineers of reality rather than mere observers. This creates the necessity for the 21st-century economist to master the capacity for strategic stochasticity - not simply evaluating probabilities, but designing plausible futures in which uncertainty is not avoided but harnessed as a productive force. This becomes especially important in digital contexts, where algorithms do not merely support decision-making but actively shape the conditions of choice - organizing information, filtering risks, and setting parameters for permissible behavior. From this perspective, the economist's role expands to that of an institutional designer capable of assessing not only the efficiency of a given algorithm or market mechanism but also its social, ecological, and moral implications - dimensions that require new forms of interdisciplinary sensitivity. As Mazzucato (2018) emphasizes, economists must engage in 'mission-oriented thinking' - neutrality is not merely insufficient, it is dangerous in a world facing crises that require active projection of collective goals, strategic investment, and morally grounded governance. In this paradigm, efficiency cannot be evaluated separately from the question 'efficiency for whom?', and value cannot be divorced from the frame 'value at what cost and for what purpose?'. Therefore, economic theory must be reconceptualized not as a natural science with objective laws but as a societal project with moral responsibilities, where different rationalities collide, and the economist's role

is to facilitate their negotiated alignment rather than impose optimal solutions. This demands that academic institutions become spaces for experimentation with social imagination, and that economics education cultivates not only analytical but also reflexive, ethically engaged individuals capable of acting under uncertainty and normative pluralism. If economics is to remain relevant in the digital age, it must see itself not as a technical sub-discipline but as an 'art of the possible' (Sen, 1999) - a discipline that does not merely measure but creates social worlds, that does not only describe realities but designs those aligned with the values of democracy, sustainability, and human dignity.

VIII. Conclusion: Toward an Ethics of the Possible

The conclusion of this analytical exploration leads to the recognition that digital transformation is not merely another stage in the technological advancement of economics but a fundamental civilizational shift that demands a radical rethinking of what constitutes economic knowledge, who has the authority to exercise it, and for what purposes it is applied. Industry 5.0 - with its emphasis on human-centricity, sustainability, and ethical responsibility - introduces new standards for the professional role of the economist, who can no longer suffice as a master of models and numerical forecasts, but must evolve into an institutional architect, ethical facilitator, and strategic visionary capable of integrating technologies with values and efficiency with legitimacy. As Zuboff (2019) underscores, in the age of platforms that monetize behavior, attention, and prediction without clearly defined regulatory mechanisms, value is extracted in ways that often undermine autonomy, democracy, and even social cohesion - a warning that places moral responsibility on economic professionals to design frameworks for fairness, accountability, and sustainability. In this context, the failure to transform economics education does not simply result in the loss of market competitiveness, but in the erosion of economists' societal role as legitimate participants in the democratic governance of economic life. As institutional theory (North, 1990; Ostrom, 2005) emphasizes, sustainable economic systems are not built on technical rationality alone but on shared norms, collective engagement, and social legitimacy - elements that require economists to act not only as experts but as democratic agents. This demands integration between technical expertise and moral competence, between predictive accuracy and political sensitivity, between technological adaptability and normative vision - a synthesis that must take place both in academic training and in the professional practice of economists. As Sen (2009) argues, economics

must be oriented not only toward what is, but also toward what could and ought to be - a space where efficiency is conceived through the lens of freedom, justice, and human dignity. Therefore, the most important insight from this transformative dynamic is that economics can no longer be regarded as a neutral technical science, but must be understood as an engaged practice through which societies define their goals, allocate their possibilities, and shape their futures. If economists take responsibility for their role in this process - not as technocrats, but as visionaries with a moral standpoint - then economics can once again become what it has been at its finest moments: an instrument of collective imagination, social justice, and sustainable development. But if this role is neglected, economic processes will be colonized by algorithms and interests devoid of ethical reflection - a scenario in which the human is replaced by the technical and society by system. It is for this reason that the current historical moment should not be seen merely as a technological epoch but as a moral-economic test - an opportunity to reclaim economics as a discipline of the possible, the desirable, and the just.

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