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A Human-Centered Mixed Economy Model: The Institutional Sustainability of Middle-Class Welfare in the Age of Robotic Artificial Intelligence

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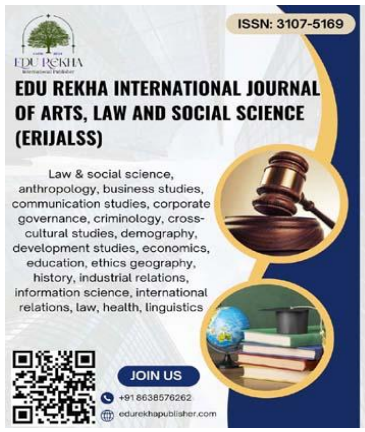

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Abstract

The age of robotic artificial intelligence, by raising for the first time the prospect of large-scale substitution of both physical and cognitive labor, structurally challenges the historical centrality of human labor upon which the modern economic order is built. This study aims to develop a holistic theoretical response to the question of how economic productivity, human dignity, middle-class sustainability, the social state, democratic legitimacy, and nation-state capacity can be preserved together in an era in which the economic centrality of labor is weakening. The study adopts a normative political-economy approach that combines historical-comparative analysis, transdisciplinary theoretical synthesis, comparative institutional model analysis, and scenario-based strategic foresight. Within this framework, it diagnoses the tendency of the robotic age to generate digital capitalism, technological feudalism, and a new class structure encompassing data elites and the cognitively precarious; it then analyzes the structural limits of classical liberal capitalism, the neoliberal paradigm, the traditional welfare state, and the unconditional universal basic income approach, and conceptually constructs a human-centered mixed economy model in response. The proposed model rests on complementary institutional pillars: a national robotic welfare fund, a fair tax architecture adapted to robotic productivity, participatory and cooperative ownership structures that broaden access to the means of production, the socialization of algorithmic rent through data cooperatives and a data dividend, a lifelong reskilling infrastructure, and a new framework of economic citizenship that makes the citizen a constitutive partner in the system. The model's robustness is further tested against major counter-theses and through a multi-scalar (national, regional, and global) governance dimension. The central claim is that, when equipped with appropriate institutional instruments, the robotic transformation can cease to render unemployment a structural fate in any nation-state, so that high productivity and broad-based welfare are no longer alternatives. The study's original contribution lies in offering a universally adaptable, human-dignity-centered institutional architecture that integrates scattered policy proposals around a single constitutive logic.

Keywords: Robotic artificial intelligence, human-centered mixed economy, middle-class welfare, post-labor society, robotic welfare state, economic citizenship.

JEL Sınıflaması: O33, J24, H53, P16, D63, E24.

1. Introduction

The first quarter of the twenty-first century should be read not merely as a period in which technological innovation has accelerated, but as a historical civilizational threshold that is simultaneously reconfiguring economic, social, political, and ethical structures. At certain junctures, human history has been shaped not by technical advances alone, but by structural ruptures that transform the constitutive operating logic of civilization itself: the agrarian revolution redefined humanity's relationship with nature and the fundamental forms of property; the industrial revolution radically altered the means of production and the structure of social class; Fordist mass production bound labor and consumption to a standardized order; and the digital revolution restructured the modes of access to information and of economic organization. Unlike these great ruptures—in which steam power transformed industrial society, electrification transformed mass production, and digitalization transformed the information economy—the transformation engendered by the age of robotic artificial intelligence directly calls into question the historical centrality of human labor within the economic system (Acemoglu & Johnson, 2023; Susskind, 2020; Harari, 2018). What is changing here is not merely the technical capacity of the means of production; it is the question of by which actors, through which institutional mechanisms, and with which social consequences economic value will be produced. In this respect, the present transformation is not an ordinary leap in productivity, but a structural transition that reopens the founding assumptions of modern civilization to renegotiation.

This historical comparison is not a superficial analogy, for every great technological transformation has also heralded the institutional order that followed it. The surplus generated by the agrarian revolution made possible the first cities, the state, and property law; the industrial revolution gave rise to the factory, wage labor, the trade union, labor law, and ultimately the welfare state; Fordism, by linking mass production to mass consumption, laid the material foundation of a broad middle class; and the digital revolution brought forth the information economy, platform markets, and data-based business models (Mokyr, Vickers, & Ziebarth, 2015; Aghion, Antonin, & Bunel, 2021). This historical pattern demonstrates that such leaps acquire meaning not through production techniques alone, but through the institutional innovations that succeed them. Consequently, the pressing question today is not merely what artificial intelligence is capable of doing, but whether new institutions commensurate with this capacity can be developed in time. Past experience teaches that in every period in which the institutional response has been delayed, the social cost has grown more severe.

The constitutive logic of the modern economic order rests largely upon human labor. Throughout the historical process extending from the rise of industrial capitalism to the institutionalization of welfare states, from the expansion of the middle class to the legitimation of mechanisms of democratic representation, the human being has been regarded as the fundamental productive subject of the economic system: one works, earns income, consumes, accumulates savings, pays taxes, and contributes to social security systems. For this reason, the economic centrality of human labor is not merely a matter of production, but at the same time the structural foundation of the modern social contract (Polanyi, 2001; Esping-Andersen, 1990). The modern regime of citizenship, too, has been constructed upon the assumption of the continuity of a wage-labor economy; hence, when this assumption is shaken, what is destabilized is not only the labor market, but the citizen's constitutive position within the economic order (Marshall, 1950; Standing, 2011). Work is not merely a means of subsistence; it is the constitutive form of the individual's economic belonging—an institution that produces status, meaning, and public visibility (Arendt, 1958).

Yet AI-supported cognitive automation, advanced robotic production systems, and autonomous decision-making mechanisms are, for the first time, raising in earnest the prospect of the large-scale substitutability of both physical and cognitive labor. Whereas in the past machines functioned as instruments that supported, accelerated, or assumed specific tasks of human labor, today's generative artificial intelligence systems are able to perform analysis, generate content, render legal assessments, develop software, and carry out cognitive functions requiring expertise. The robotic systems that accompany them are increasingly able to operate with ever-greater autonomy across production, logistics, healthcare, care work, and the service sectors. The convergence of these two trajectories—that is, of cognitive automation and physical automation—renders the historical position of human labor within the economic system questionable on an unprecedented scale (Acemoglu & Restrepo, 2020; Brynjolfsson, Li, & Raymond, 2023; Ford, 2021). Current empirical findings indicate that these systems carry the potential to directly affect a broad spectrum of occupations and that they have, within a short span, measurably altered the productivity of knowledge workers (Eloundou, Manning, Mishkin, & Rock, 2024; Noy & Zhang, 2023). For this reason, the present transformation is qualitatively more encompassing than the classical debates on automation; for the simultaneous and large-scale substitutability of both manual and mental labor is, for the first time in history, appearing on the horizon (Autor, 2022; Acemoglu & Restrepo, 2019).

At this point, the essential character of the historical threshold must be defined accurately: the issue is not merely the disappearance of certain jobs, but the possibility that economic value may become decoupled from human labor. The fundamental assumption of modern economic systems is that the individual earns income by participating in the labor market and thereby becomes integrated into the economic system. If the greater part of production becomes capable of being carried out by robotic systems and AI-based infrastructures, this will directly affect not only labor markets, but also income distribution, the tax system, social security regimes, and the mechanisms of social belonging (OECD, 2024; Cazzaniga et al., 2024; Pizzinelli et al., 2023). In other words, throughout history labor markets have changed in form; the present issue, however, is not a change in the form of labor, but the systemic erosion of its economic centrality. This distinction is critical, for whereas education and adjustment policies may suffice for labor that is merely changing in form, the labor whose centrality is being eroded requires the constitutive logic of the economic order itself to be redesigned (Susskind, 2020; Autor, 2022).

This change is not confined to job loss or to cross-sectoral occupational transformation either. If economic productivity meaningfully reduces its dependence on human labor, the income-generation logic upon which the modern system is built comes under strain: the tax base erodes, the financing of social security is strained, the consumption economy weakens, middle-class welfare grows fragile, and the social foundation of democratic legitimacy is shaken (OECD, 2024; International Monetary Fund, 2024). Moreover, the concentration of economic value around data, algorithms, computational infrastructure, and robotic capital within narrow groups of actors may give rise to a

deeper structural risk—one that signifies the renewed closure of access to the means of production and that has been discussed by some thinkers as the possibility of a new technological feudalism (Zuboff, 2019; Crawford, 2021; Piketty, 2020). Thus, a single technological development is transformed into a multilayered source of pressure capable of simultaneously affecting the labor market, public finances, the class structure, and political stability.

At this juncture, the fundamental distinction that constitutes the point of departure for this study comes into focus: the real issue of the age of robotic artificial intelligence is not technological progress in itself, but the kind of social order within which technological productivity will operate. Technology is not an independent variable that determines social destiny of its own accord; the same technological capacity may produce mass exclusion under one institutional order, while under another it may yield outcomes that reduce the compulsory burden of human labor, shorten working hours, and broaden welfare. If the transformation is left solely to existing market dynamics, gains in productivity may accelerate the concentration of wealth rather than broaden social welfare; yet when the appropriate institutional framework is developed, the same transformation may become the ground for a more inclusive welfare order (Rodrik, 2023; Korinek & Stiglitz, 2021; Acemoglu, Johnson, & Robinson, 2021). Here, technology is not an independent variable that single-handedly determines social destiny, but a field of force that acquires meaning through institutional choices. It is precisely this field of institutional choice that the present study aims to theorize systematically.

1.1. The Qualitative Specificity of the Robotic Threshold

Three fundamental features stand out in demonstrating that the robotic age differs from previous technological waves not merely by a difference of degree, but by a difference of kind. The first is speed: whereas the transition from agrarian to industrial society unfolded over centuries, and the transition from industrial to digital society over decades, the pace at which artificial intelligence capabilities are maturing tends to outstrip the pace at which institutions can adapt. This mismatch in speed narrows the temporal buffer that societies have historically possessed for preparing themselves for transformation (Brynjolfsson & McAfee, 2014). The second is the breadth of scope: the transformation affects not a single sector or type of skill, but a wide spectrum of both physical and cognitive labor simultaneously (Eloundou et al., 2024). The third is the logic of substitution: whereas previous leaps for the most part produced instruments that complemented human labor, the capacity of robotic artificial intelligence to substitute directly for labor in certain domains gives rise to the prospect of a qualitative break from the historical pattern (Acemoglu & Restrepo, 2020). When these three features are taken together, the mechanical application to the present of analogies grounded in past waves of automation becomes methodologically problematic; for in previous waves human labor could remain in the position of the machine's complement, whereas in an age in which cognitive tasks can be delegated on a large scale, the boundary between complementarity and substitution is far more fragile.

This qualitative break is not merely a theoretical projection; it is increasingly an empirically observable phenomenon. Experimental and field-based studies conducted on generative artificial intelligence reveal that these systems, while raising performance measurably and within a short span in domains such as software development, written content production, and consulting, are also transforming the very nature of tasks (Noy & Zhang, 2023; Brynjolfsson et al., 2023; Dell'Acqua et al., 2026; Filippucci, Gal, Jona-Lasinio, Leandro, & Nicoletti, 2024). Moreover, this transformation is not merely a matter of productivity; it also redefines the relationship between economic growth and structural risk. Certain theoretical models draw attention to the fact that transformative artificial intelligence harbors, alongside extraordinary growth potential, grave systemic risks as well (Jones, 2024; Trammell & Korinek, 2023). The issue, therefore, is not merely whether productivity will rise, but within which institutional framework, with which social consequences, and to whose benefit this rise will occur (Acemoglu, 2024).

Nevertheless, this diagnosis must not be turned into a reductive dystopian narrative. The most probable scenario of the robotic age is not an order in which the human being is rendered entirely obsolete, but a hybrid working order in which human capacities for judgment, ethical reasoning, creativity, and relationality are combined with the processing power of machines (Daugherty & Wilson, 2022; Autor, 2024). This hybrid perspective departs both from the pessimism of technological determinism and from the blind optimism placed in market spontaneity; for it acknowledges that the human being's position within the new order will be determined not by technology itself, but by the institutional framework to be established. In the same vein, the opposing view must also be given its due: some economists remind us that every great wave of automation has provoked similar anxieties, yet over the long term new fields of employment have emerged and aggregate employment has been preserved (Autor, 2022; Mokyr, Vickers, & Ziebarth, 2015). This study does not underestimate that view; however, by the principle of precaution, it emphasizes that under the optimistic scenario sound institutional design would cause no harm whatsoever, whereas under the pessimistic scenario the absence of such design would engender costs that are difficult to redress. This asymmetry renders early institutional design not merely desirable, but a prudent necessity.

1.2. Multilayered Systemic Pressure and the Strategic Fragility of the Middle Class

The robotic threshold gives rise to a series of mutually reinforcing systemic risks, and the cumulative effect of these risks constitutes the diagnostic plane of this study. The first risk is the concentration of wealth and power: as data, algorithms, computational infrastructure, and robotic systems become the new means of production, economic power tends to concentrate—beyond classical capital ownership—in a limited number of actors who control the technological infrastructure; the network effects and economies of scale of digital markets, moreover, may transform this tendency into oligopolistic structures of a winner-takes-almost-all character (Zuboff, 2019; Pasquale, 2015; Bessen, 2022). The second risk is precaritization: the digital platform economy transforms working relations away from secure employment toward fragmented, temporary, and often unprotected forms of work (Srnicek, 2017; Standing, 2011). The third risk is fiscal erosion: the value shifting from labor to machines weakens the wage-based tax and social security base, thereby placing the financing of welfare under strain (OECD, 2024; Cazzaniga et al., 2024). This threefold pressure demonstrates that high productivity may, paradoxically, narrow the very resource that finances public welfare.

These risks are accompanied by a fragmentation of labor markets that takes the form not of a uniform wave of unemployment, but of a multilayered polarization. At one pole there emerges a narrow segment of expertise that uses artificial intelligence in a complementary manner and whose value is rising; at the other, broad professional strata whose

tasks are being fragmented, whose autonomy is narrowing, and whose incomes are being suppressed. Thus, individuals may experience the loss of income, status, and professional autonomy even without losing their jobs entirely; this silent yet structural erosion points to a transformation deeper than the visible unemployment figures (Autor, 2022; Felten, Raj, & Seamans, 2021; Brynjolfsson et al., 2023). For a long time it was assumed that technological risk threatened chiefly low-skilled physical labor; yet the distinguishing feature of the present transformation is that artificial intelligence is placing under pressure white-collar and expertise-requiring cognitive domains as well—such as law, finance, media, education, consulting, and design (Autor, 2022; Eloundou et al., 2024; Pizzinelli et al., 2023). In this case the issue is not merely income loss, but the growing fragility of the principal load-bearing stratum of social stability.

For this reason, the deepest rupture of the robotic age is not unemployment as such, but the possibility of the dissolution of the middle class. The modern middle class has risen largely through education, specialization, and the generation of regular income, and it has constituted the historical ground of stability for modern democratic orders (Lipset, 1959; Sandel, 2020; Easterly, 2001). The erosion of a broad and secure middle class ceases to be a problem of economic indicators and turns directly into a problem of regime resilience; for when meritocratic legitimacy weakens, even individuals who have passed through intensive processes of education may face the risk of economic exclusion (OECD, 2021; Sandel, 2020). Furthermore, this fragility gives rise to a contradiction between production and consumption that is specific to the robotic age: while production becomes extraordinarily efficient thanks to robotic systems, the erosion of a broad consumer base possessing the income capacity to purchase that production creates a structural tension between supply and demand (Case & Deaton, 2020; Milanovic, 2023).

These material risks are accompanied by a psycho-social dimension that is often overlooked. The identity of the modern individual has been defined largely through occupation, productivity, and working relations; when the centrality of labor is eroded, the danger that arises is not merely material poverty, but the loss of status, the sense of purposelessness, and the feeling of worthlessness that broad strata who feel themselves to be superfluous will experience (Sennett, 2006; Han, 2015; Rosa, 2020). Comparative measurements of welfare show that gains in economic productivity do not always proceed in the same direction as levels of social happiness and social connectedness, and that loneliness and social disconnection are increasingly becoming a matter of public health (Helliwell et al., 2024; Holt-Lunstad, 2022; Office of the Surgeon General, 2023). This fragility grows especially acute for younger generations; employment uncertainty and the weakening of expectations for the future combine with mental-health findings indicating that young people are experiencing a rupture that is not merely economic but existential (Haidt, 2024; McGorry et al., 2024). Moreover, since the transformation also affects care labor, invisible domestic labor, and gender inequalities in distinctive ways, it cannot be assessed in isolation from the dimension of inclusiveness (Goldin, 2021; International Labour Organization, 2021).

Finally, this pressure also transcends national borders. Since the data, computational power, and expertise that nourish artificial intelligence and robotic capacity are distributed with extreme inequality across the world, the concentration of technological capacity in certain centers may lead to the reproduction, in a digital form, of the classical core-periphery relationship (United Nations Conference on Trade and Development, 2024; Korinek & Stiglitz, 2021). Actors that hold the nodal points of global economic networks are able to transform these networks into instruments of domination; in the robotic age, in which data and computational infrastructure are concentrated, this risk of weaponized interdependence grows still sharper (Farrell & Newman, 2023; Hillman, 2021). In this respect, the political economy of the robotic age is a multiscalar matter that transcends the boundaries of national social policy and possesses dimensions of digital sovereignty and global justice.

1.3. The Research Problem and the Gap in the Literature

The relevant literature has developed around two major axes. The first axis is the economic literature examining the effects of automation on employment and income distribution; these studies address, through task-based models, the dynamics of substitution and complementarity, the distribution of productivity gains, and the debates on technological unemployment (Acemoglu & Restrepo, 2019; Autor, 2015; Frey & Osborne, 2017; Acemoglu, 2024). The second axis is the political-economic and critical literature analyzing the power and property structures of digital capitalism; these studies pursue debates on surveillance capitalism, platform power, data ownership, and a possible technological feudalism (Zuboff, 2019; Srnicek, 2017; Pasquale, 2015; Bessen, 2022). These two axes are accompanied by the welfare and social-policy literature that pursues debates on security; here proposals such as universal basic income, the negative income tax, and universal basic services are discussed (Van Parijs & Vanderborght, 2017; Standing, 2017; Esping-Andersen, 1990).

These two axes, when taken together, render visible two major debates in contemporary political-economic thought. The first concerns whether the nature of capitalism is changing in the age of robotic artificial intelligence: according to one approach, this order is a surveillance capitalism in which individual behavior is commodified; according to another, the possibility emerges of a technological feudalism in which dependence on platforms and data once again closes off access to the means of production (Zuboff, 2019; Crawford, 2021; Pasquale, 2015). The second concerns whether this transformation is giving rise to new class structures; the possibility of new strata—such as data elites, owners of algorithmic capital, and a digital precariat—being added alongside the classical categories of the working class and the bourgeoisie brings onto the agenda a post-industrial class analysis defined not solely through income, but through access to data, models, and computational power (Piketty, 2020; Standing, 2011; Castells, 2010; Marx, 1976).

The common limitation of this rich literature is that its solutions for the most part remain one-dimensional. The diagnoses concerning the effects of automation are robust; yet analyses that connect the diagnosis to a holistic institutional response—that unite the economic, fiscal, property, legal, and democratic dimensions under a single constitutive logic—are comparatively scarce. Approaches focused on income transfer tend to neglect the dimensions of property, economic participation, and democratic belonging; analyses of property and power, for their part, often remain unconnected to any concrete institutional architecture (Stiglitz, 2024; Mazzucato, 2021; Rodrik, 2023; Couldry & Mejias, 2019). It is precisely here that the gap addressed by this study lies: in an age in which the economic centrality of labor is weakening, there is an absence of an integrated institutional model capable of preserving, in tandem, productivity, dignity, middle-class sustainability, the welfare state, democratic legitimacy, and the capacity of the nation-state.

From this arises the constitutive research question of the study: if, in the age of robotic artificial intelligence, economic productivity seriously reduces its dependence on human labor, how can economic efficiency, human dignity, middle-class sustainability, the welfare state, democratic legitimacy, and the capacity of the nation-state be preserved together? This question is not merely a problem of political economy; it is at the same time a matter of the rule of law, state capacity, social resilience, and a new social contract (Sen, 1999; Sandel, 2020; Levitsky & Ziblatt, 2023). For the historical link between economic insecurity and political radicalization is also supported by empirical studies; it is observed that the sense of economic exclusion nourishes anti-system mobilization and institutional distrust (Hacker & Pierson, 2020; Autor, Dorn, Hanson, & Majlesi, 2020).

1.4. The Aim, Thesis, and Contribution of the Study

The study adopts neither an anti-technology romantic stance nor the reductive approach of technological optimism that disregards institutional consequences. The aim is not to reject the productivity of the robotic age, but to develop theoretically a framework capable of transforming that productivity into social welfare within a human-centered institutional order. This framework is designated not as a superficial compromise between classical statism and the free market, but as a human-centered mixed economy model—a structural institutional response given to new historical conditions. The model is anchored upon three load-bearing pillars: a human-centered technology politics, a new-generation strategic mixed-economy order, and the institutional preservation of social stability in the robotic age. The constitutive norm that forms the ethical center of the model is clear and is positioned ahead of all institutional choices: technological efficiency cannot be substituted for human dignity (Sen, 1999; Nussbaum, 2011; Arendt, 1958).

The central thesis of the study is the following: robotic transformation, when equipped with appropriate institutional instruments, possesses the capacity to remove unemployment from being a structural fate in any nation-state. For the weakening of the economic centrality of labor turns into a regime of exclusion only when no compensatory mechanism is established. When a national welfare fund that ties the value of robotic productivity to social welfare, a tax architecture that distributes that value justly, cooperative property structures that broaden access to the means of production, data cooperatives that socialize algorithmic rent, security and lifelong-learning systems that cushion transitional shocks, and a new framework of economic citizenship that makes the citizen a constitutive partner of the economic order are established together, high productivity and broad-based welfare cease to be alternatives to one another (Stiglitz, 2024; Mazzucato, 2021; Rodrik, 2023; Keynes, 1930/1963). Moreover, if the human time freed up by robotic productivity can be channeled toward domains of high social value—such as care, education, culture, environmental restoration, and community-based production—then the declining demand for labor becomes not a process of exclusion, but one of redirection.

The original contribution of the study can be summarized at three levels. At the theoretical level, it integrates the economics of automation, the critique of digital capitalism, and the welfare literature under a single constitutive logic, thereby transforming scattered policy proposals into a systematic architecture. At the conceptual level, it proposes a three-tiered conceptual architecture composed of core concepts (the human-centered mixed economy, the robotic welfare state, the post-labor society), intermediate concepts (economic citizenship, algorithmic sovereignty, the architecture of distribution), and applied concepts (the national robotic welfare fund, digital citizenship income, the data dividend, participatory robotic ownership). At the normative-institutional level, it offers a universally adaptable design grounded not in the historical conditions of a particular country, but in the general institutional logic shared by any nation-state confronting robotic transformation. In this respect, the study lays claim to binding the constitutive norm that human dignity cannot be substituted by technological efficiency to a concrete institutional architecture, thereby lifting it out of being an abstract principle (Sen, 1999; Nussbaum, 2011; Mazzucato, 2021).

1.5. Theoretical-Normative Positioning: The Rejection of Two Erroneous Approaches

The theoretical positioning of the study deliberately rejects two erroneous approaches. The first is technological determinism; this approach views technological developments as inevitable forces that determine social consequences of their own accord. Yet historical experience demonstrates that the same technological capacity may produce entirely different social outcomes in different institutional contexts: the industrial revolution gave rise to different welfare models in different societies, and digitalization produced economic dynamism in some contexts while engendering new inequalities in others (Polanyi, 2001; Acemoglu, Johnson, & Robinson, 2021). The second is nostalgic defensiveness; this approach views technological transformation principally as a threat and seeks to preserve past relations of production as they are. The study does not adopt such a reflex either; for the reduction of the compulsory burden of human labor may, so long as productivity gains are shared within social legitimacy, also give rise to the possibility of shorter working hours and a more creative social life (Keynes, 1930/1963; Susskind, 2020).

This positioning situates the study within a particular theoretical tradition. Polanyi's theory that the market must be institutionally framed by society provides the model's fundamental intuition: markets do not operate independently of social institutions (Polanyi, 2001). Esping-Andersen's typology of welfare regimes offers an analytical foundation for the redesign of social protection in the robotic age (Esping-Andersen, 1990). The capability approach of Sen and Nussbaum introduces the normative framework that measures welfare not by income alone, but by people's freedom to lead the lives they have reason to value (Sen, 1999; Nussbaum, 2011). Acemoglu and Johnson's analysis of a thousand years of technological transformation, for its part, demonstrates that the diffusion of the gains of technological progress to broad masses has never occurred of its own accord, but always as the result of institutional struggles and political choices (Acemoglu & Johnson, 2023). Within this framework, the human being is positioned not as a passive object to be protected, but as the constitutive subject of the new economic order (Marshall, 1950). Thus, the study's real question is not whether human beings can compete with machines, but whether societies possessing high technological productivity can keep the human being at the center of the economic and social order.

1.6. The Roadmap of the Article

The study proceeds as follows. The second section establishes the theoretical and conceptual framework upon which the study rests and discusses the relevant literature; it addresses the political economy of technological transformation through three theoretical pillars and explains the three-tiered conceptual architecture. The third section

explains the adopted transdisciplinary, scenario-based normative method. The fourth section diagnoses the historical-threshold character of the robotic age and the dynamics of the erosion of middle-class welfare. The fifth section analyzes the structural limits of existing economic paradigms and constructs, pillar by pillar, the institutional architecture of the human-centered mixed economy model. The sixth section addresses the counter-theses that may be directed at the model, the comparative institutional implications, and the limitations of the model. The conclusion, for its part, integrates the findings and sets forth the theoretical and practical contribution of the study. This structural flow makes it possible for the article to be read not as a scattered aggregate of debates, but as an integrated analytical architecture that analyzes the different layers of a single constitutive problem.

2. Theoretical and Conceptual Framework

The theoretical horizon of this study requires that two major axes of contemporary political-economic debate be thought through in tandem. The first axis concerns the question of whether capitalism, in the age of artificial intelligence, is being transformed or is instead acquiring an altogether new form. Some analyses read this transformation as a surveillance-based digital capitalism in which human experience itself is reduced to a free raw material; others invoke the possibility of a technological feudalism in which dependence on data and platforms re-encloses access to the means of production, and in which the actors who own the infrastructure through which economic activity passes extract rent from it (Zuboff, 2019; Srnicek, 2017; Pasquale, 2015; Varoufakis, 2023). The second axis concerns whether this transformation gives rise to novel class structures; the prospect that strata such as data elites, owners of algorithmic capital, a platform aristocracy, and a digital precariat may be appended to the classical categories of working class and bourgeoisie places a post-industrial analysis of class firmly on the agenda (Piketty, 2020; Standing, 2011; Castells, 2010; Bourdieu, 1984). This study binds these two debates to a single constitutive question and contends that human-centered institutional design can serve as a structural safeguard against these incipient tendencies toward feudalization and class polarization.

The distinctiveness of this theoretical positioning lies in its treatment of three separate bodies of literature as complementary rather than antagonistic. The literature on the automation economy analyzes with considerable force the substitution and complementarity dynamics of technology vis-à-vis labor, yet it is frequently not connected to a holistic institutional response; the critical political-economy literature diagnoses in depth the concentration of power and ownership, yet it proposes no concrete institutional architecture; and the literature on welfare and social policy develops mechanisms of protection, yet it more often than not leaves the specific conditions of technological transformation exogenous to its account (Acemoglu & Restrepo, 2020; Zuboff, 2019; Esping-Andersen, 1990). By taking its diagnosis from the automation economy, its analysis of power from critical political economy, and its institutional response from the literatures on the strategic state and on welfare, this study aims to unify these dispersed insights under a single constitutive logic.

The fundamental intuition underlying this framework is plain: the societal outcome of the robotic age will be determined not by the technical properties of technology but by the institutional and political architecture that envelops it. The same technological capacity may, under one institutional order, lead to the dominion of a narrow digital aristocracy, and under another, to a broadly based common prosperity (Acemoglu & Johnson, 2023; Rodrik, 2023). The subsections that follow ground this intuition systematically—first through the three theoretical pillars that carry the political economy of technological transformation, then through the new class structure produced by the robotic age and the redefinition of the mixed-economy tradition, and finally through the study's three-tiered conceptual architecture and its theoretical positioning.

2.1. The Political Economy of Technological Transformation: Three Theoretical Pillars

The study's theoretical approach rests upon three pillars. The first is the premise that technology is not a neutral instrument but a constitutive social force that reshapes relations of production, class structures, and the distribution of power. Acemoglu and Johnson's analysis of a thousand years of technological transformation demonstrates that the diffusion of the gains of technological progress to broad populations has never occurred spontaneously; it has always been the outcome of institutional struggles, political choices, and balances of power (Acemoglu & Johnson, 2023). Technology is treated here not as an external force insulated from society but as a field of power that acquires meaning through the relations of ownership and the institutional choices within which it is embedded.

The second pillar is the thesis that gains in economic productivity do not translate spontaneously into social welfare, and that this translation becomes possible only through institutional mediation, distributive mechanisms, and political will (Mazzucato, 2021; Korinek & Stiglitz, 2021). Historical experience corroborates this thesis: the comparatively egalitarian welfare eras of the twentieth century were not outcomes the market produced of its own accord but the achievement of deliberate institutional design; as Polanyi showed, the market's operating on its own, detached from society, produces destructive consequences and activates society's reflex toward self-protection (Polanyi, 2001). Mazzucato's analysis of the entrepreneurial state, in turn, demonstrates that a significant portion of fundamental technological breakthroughs is the product of public investment, and that it is therefore legitimate for the returns on such investment to flow back into public welfare (Mazzucato, 2013, 2021).

The third pillar is the normative principle that, in the robotic age, the preservation of social stability can be secured not by growth rates alone but by an institutional architecture that places human dignity at its center (Sen, 1999; Sandel, 2020). These three pillars furnish a framework that also locates the relevant literature. Task-based models of automation show that technology does not merely substitute for labor but also relocates it by creating new tasks; yet they likewise reveal that this relocation does not spontaneously produce a balanced distribution of welfare (Acemoglu & Restrepo, 2019, 2020; Autor, 2015). The critical political-economy literature emphasizes that, in digital markets, the concentration of data and network effects may accelerate the accumulation of oligopolistic power and thereby weaken the mechanisms of democratic oversight (Zuboff, 2019; Crawford, 2021; Bessen, 2022). The literature on the directive role of the state, for its part, analyzes the institutional conditions of innovation and of the creation of public value (Mazzucato, 2018, 2021). By bringing these three pillars into joint operation, the study thinks technology, productivity, and dignity within a single analytical frame.

2.2. Digital Capitalism, Technological Feudalism, and a New Class Theory of the Robotic Age

The solutions the model proposes acquire meaning only once the structure of the problem it seeks to solve has been correctly diagnosed; for this reason, the new logic of accumulation and the class structure produced by the robotic age constitute a central component of the study's theoretical framework. The concept of digital capitalism designates an order that places data at the very center of economic accumulation. Whereas in classical industrial capitalism value was produced in physical processes of production and in the labor–capital relation, in digital capitalism value arises increasingly from processes of collecting, processing, and commodifying data. As Zuboff demonstrates in her analysis of surveillance capitalism, this model of accumulation treats human experience itself as a free raw material and produces value by converting individuals' behaviors into prediction products (Zuboff, 2019). Srnicek's analysis of platform capitalism, in turn, lays bare the institutional form of this transformation: digital platforms, by controlling the infrastructure through which economic activity passes, extract data and value from interaction and become structurally monopolistic owing to network effects (Srnicek, 2017; Fuchs, 2014).

A more radical reading of this transformation contends that the robotic age, in transcending capitalism, is evolving into a kind of technological feudalism. According to this concept, the power of digital platforms now operates not through the classical capitalist logic of profit but through a feudal logic of rent; the great platforms, by taking ownership of the digital domains through which economic activity passes, levy a kind of digital rent upon everyone who uses those domains (Varoufakis, 2023). On this reading, the place of the competitive market is taken by a hierarchical order in which a handful of digital seigneurs hold sway and all remaining actors are rendered dependent upon the infrastructure of these seigneurs. This thesis of feudalization must also confront a powerful counter-thesis directed against it: given that platforms still operate through the profit motive, the accumulation of capital, and the exploitation of labor, is what is at stake a new order that transcends capitalism, or merely a monopolistic phase of it? This objection deserves to be taken seriously; yet the practical upshot of the analysis is the same in either case: left unchecked, digital power produces a hierarchy that subjects broad strata to rules set by the owners of the infrastructure. This study treats the possibility in question not as a fate but as a risk that can be averted through institutional design—for feudalization is not a technical necessity but the consequence of the institutional re-enclosure of access to the means of production, and it can be reopened by those same means.

This new economic order produces social structures that cannot be grasped through classical class categories. Whereas in the classical analysis classes are defined by the relationship established with the means of production, in the robotic age the very concept of the means of production is itself being transformed; data, algorithms, and computational capacity are becoming the new means of production (Marx, 1976; Weber, 1978). This transformation gives rise to new class positions: at the apex, the data elites and owners of algorithmic capital who control vast pools of data, advanced artificial-intelligence models, and computational infrastructures; beneath them, a platform aristocracy that manages the platforms and possesses high cognitive capital; and beneath these strata, a broad and growing layer of digital precariat (Standing, 2011; Bourdieu, 1984). This stratification is shaped not by ownership alone but also by access to data, to models, and to computational power; Bourdieu's analysis of the forms of capital is illuminating at this juncture, for in the robotic age, cultural and cognitive capital increasingly and decisively determine one's economic position (Bourdieu, 1984).

The most original category of this new class map is the stratum of the cognitively precarious. Whereas the technological transformations of the past largely substituted for manual labor, the robotic age, for the first time, places highly educated mental labor directly under threat as well; professionals who in the past constituted the core of the middle class—jurists, accountants, translators, designers, and middle managers—now confront the threat of being substituted by artificial intelligence (Autor, 2022; Eloundou et al., 2024). To this is added the consumer mass of data producers, from whose data—generated by billions of people—value is produced but who receive no share of that value; this stratum, though it is the very source of economic value creation, is systematically excluded from its outcomes (Couldry & Mejias, 2019; Zuboff, 2019). This new class map demonstrates that the fundamental rupture of the robotic age is not unemployment alone but the systematic dissolution of the middle class, which is the load-bearing backbone of democratic stability; for when the middle class dissolves, the base of demand weakens, social trust erodes, and populist ruptures gain strength (Milanovic, 2016; Sandel, 2020).

That this tendency toward concentration operates more rapidly than in classical industrial capitalism can be explained by the structural properties of digital capital. The analysis according to which wealth becomes concentrated under conditions in which the return on capital persistently exceeds the rate of growth (Piketty, 2020) becomes sharper still where digital capital is concerned; for data and algorithmic assets, unlike physical capital, are infinitely scalable, can be reproduced at near-zero cost, and increase in value with the intensity of use owing to network effects. These properties render class polarization not the product of malevolent actors but the consequence of the natural operation of digital capital when left unchecked; this, in turn, reveals why institutional intervention is imperative. The theoretical contribution of this analysis is that it grounds the problem of class not in technology itself but in the question of in whose hands the productive assets are gathered and through which institutional channels the gains are conducted; thus class polarization ceases to be an inescapable destiny and becomes an institutional problem reversible through the democratization of ownership and a distributive architecture (Srnicek, 2017; Varoufakis, 2023).

2.3. Adapting the Mixed-Economy Tradition to the Robotic Age

The second mainstay of the study's theoretical framework is the historical evolution of mixed-economy thought. This tradition is not an abstract ideological preference but the accumulation of institutional wisdom that industrial civilization learned from its own crises: Bismarckian-era social insurance, post–Great Depression Keynesian public investment, and the postwar welfare state are all institutional responses that came into play at moments when the market proved unable to generate stability on its own (Polanyi, 2001; Keynes, 1936; Esping-Andersen, 1990). The lesson this accumulation holds for the robotic age is clear: just as the Industrial Revolution, by commodifying labor, rendered mechanisms of social protection imperative, the artificial-intelligence revolution, by removing labor from the center of the economic system, renders a new architecture of social protection imperative. The qualitative difference between them is this: whereas in the Bismarckian era protection aimed to collectivize the risks of the

working population, in the robotic age protection requires the wholesale redefinition of economic belonging in an environment in which labor income is structurally contracting (Standing, 2011).

This historical logic also requires that an objection that might be raised against classical social democracy be met: why should the existing social-democratic welfare state not suffice to answer the problems of the robotic age? The historical success of classical social democracy rested upon the existence of broad wage employment and, consequently, a stable base of labor taxation; the robotic age is eroding precisely this foundation. The problem, therefore, is not the values of social democracy but the unsustainability of its financing logic in the robotic age. The human-centered mixed-economy model upholds social democracy's values of solidarity and equality, but it aims to surmount the structural limit that classical social democracy could not overcome by shifting their financing from labor taxation to robotic productivity (Esping-Andersen, 1990; Streeck, 2014). In the same way, the model takes seriously the Marxist analysis's diagnosis of inequality and the concentration of ownership; yet it seeks the solution not in centralized ownership but—mindful also of Hayek's critique of the knowledge problem (Hayek, 1945)—in the broadly based ownership of productive assets and in the socialization of productivity gains through pluralistic institutional mechanisms.

Within this framework, the very concept of the mixed economy is also redefined. The existing literature tends largely to define the mixed economy as a matter of the ratio between state and market—that is, in terms of the share of the public sector in the economy. The approach developed in this study, by contrast, removes the mixed economy from being a quantitative matter of ratio and redefines it as a matter of the distributive architecture of productivity gains: the mixed character of an economy is measured not by the magnitude of public expenditure but by the strength of the institutional channels that diffuse the returns of robotic productivity to broad social strata (Mazzucato, 2021; Atkinson, 2015). This conceptual innovation is the fundamental difference that sets the mixed economy of the robotic age apart from that of the industrial age; for in an age in which labor income is contracting, the classical concept of the public–private ratio falls short of grasping the problem of distribution. The tension between the post-capitalist reading according to which the limitless reproducibility of productivity erodes the scarcity-based logic of price (Mason, 2015) and the feudalization reading according to which digital platforms produce a rent-based domination (Varoufakis, 2023) shows precisely why this redefinition is critical: the same technological capacity may, depending on the institutional framework, lead either to a broadly based common prosperity or to the dominion of a narrow digital aristocracy.

2.4. A Three-Tiered Conceptual Architecture

Powerful theoretical works do not merely explain phenomena; they also construct their own concepts and bind these concepts to one another within a single intellectual system. The conceptual architecture of this study is not an arbitrary aggregation of terms but an order built upon a three-tiered structure that carries a causal logic: the principal concepts define the historical diagnosis, the intermediate concepts the theoretical relations, and the applied concepts the institutional solution. Layering the concepts in this manner strengthens the work's theoretical clarity and academic coherence; for the consistent use of concepts along a single axis of meaning is a fundamental scholarly discipline that preserves the force of ideas without dissipating it.

2.4.1. Principal Concepts

The first tier comprises the principal concepts that bear the study as a whole. The human-centered mixed economy names the constitutive overarching paradigm of the age and denotes the conversion of technological productivity into social welfare within an institutional order centered on human dignity. The robotic welfare state forms the fiscal and institutional backbone of this paradigm and defines a structural redesign that shifts the basis of financing from labor taxes to the collective returns of robotic productivity. Digital sovereignty names national technological autonomy in the face of new forms of concentration of power and independence. The post-labor society, in turn, defines the new social plane on which the historical centrality of labor has been unsettled (Standing, 2011; Susskind, 2020; Zuboff, 2019).

2.4.2. Intermediate Concepts

The second tier contains the intermediate concepts that render concrete the workings of the principal concepts. Economic citizenship names the principle that removes the individual's legitimate standing within the system from being that of a mere recipient of income and constitutes the individual as a founding partner of the economic order; it expresses a new tier that must be appended, in the robotic age, to Marshall's analysis that stratifies citizenship into civil, political, and social rights—namely, the right to economic participation (Marshall, 1950; Bellamy, 2009). Algorithmic sovereignty expresses the manner in which decisions and power become concentrated through algorithmic systems (Pasquale, 2015). The distributive architecture defines the mechanisms by which productivity gains are returned to society; civilizational resilience, in turn, defines the capacity to absorb the psycho-social, cultural, and institutional shocks of the transformation (Sen, 1999; Putnam, 2000).

2.4.3. Applied Concepts

The third tier is occupied by the applied concepts that carry the framework into practice: the national robotic welfare fund, the digital citizenship income, the data dividend, and participatory robotic ownership. These concepts are not independent policy ideas but the logical consequences of the principal and intermediate concepts. Once the reader has acquired this conceptual map from the outset, every institutional proposal encountered in the chapters that follow can be read not as a scattered measure but as a natural part of the systematic architecture (Van Parijs & Vanderborght, 2017; Mazzucato, 2021). This three-tiered conceptual architecture is likewise a part of the study's methodological backbone, for it reframes ostensibly technical matters as institutional and political questions: unemployment here is not merely a labor-market problem but a problem of economic citizenship; the erosion of the tax base is not merely a fiscal problem but a problem of the sustainability of the welfare state; and the weakening of the middle class is not merely a problem of income distribution but a problem of democratic stability.

2.5. Theoretical Positioning: A Third Way Departing from Both Extremes

This conceptual architecture situates the study within a particular theoretical tradition. Polanyi's theory that the market must be institutionally framed by society supplies the model's fundamental intuition: markets do not operate independently of social institutions and are always constituted through particular institutional and political decisions (Polanyi, 2001). Esping-Andersen's typology of welfare regimes, by demonstrating that one and the same industrial capitalism can give rise to vastly different welfare models in different societies,

furnishes an analytical foundation for the redesign of social protection in the robotic age (Esping-Andersen, 1990). The capability approach of Sen and Nussbaum introduces the normative framework that measures welfare not by income alone but by the freedom of people to lead the lives they have reason to value (Sen, 1999; Nussbaum, 2011). The analyses of public value and inequality offered by Stiglitz and Mazzucato, in turn, nourish the fiscal and institutional pillars of the model (Stiglitz, 2024; Mazzucato, 2021).

This positioning deliberately proposes a third way that departs from both extremes. On one side lies the classical approach of central planning, which envisages governing the entire economy from a center; yet the knowledge problem to which Hayek pointed—by showing that dispersed and continually changing economic knowledge cannot be efficiently processed at a single center—reveals the structural limit of this path (Hayek, 1945). On the other side lies the neoliberal approach, in which the state is positioned merely as a minimal arbiter; yet in an age in which labor has lost its bargaining power and value is concentrated in narrow structures of ownership, the unchecked market tends to deepen inequality and precarity (Harvey, 2005; Stiglitz, 2024). The human-centered mixed-economy model departs from both of these extremes: it proposes an intermediate path that preserves the dynamism of the market but binds it to human-centered institutional oversight, uniting public and private capacity within a new synthesis (Rodrik, 2023).

This third way is directly connected to the study's central theoretical claim: the societal outcome of the robotic transformation is determined not in technology itself but in the ownership structure of productive assets and the distributive architecture of productivity gains. For this reason, the study carries the traditions in question into an original synthesis by adapting them to the specific conditions of the robotic transformation; it argues neither that classical capitalism can be sustained as it is nor that it must be rejected wholesale. The human-centered mixed-economy model is positioned precisely amid these post-capitalist debates, as an institutional synthesis that eschews ideological poles (Acemoglu & Johnson, 2023; Mazzucato, 2021; Rodrik, 2023). The chapter that follows sets out the transdisciplinary, scenario-based normative method upon which this theoretical framework rests.

3. Method

This study is premised on the assumption that the transformation arising in the age of robotic artificial intelligence cannot be accounted for solely by technical progress, gains in productive efficiency, or sectoral shifts within labor markets. The transformation in question is a multilayered, structural change that simultaneously affects the manner in which economic value is produced, the relations of property, the financing logic of social welfare, the capacity of the state, the foundations of democratic legitimacy, and the historical position of the human being within the economic system. A transformation of such magnitude cannot be apprehended through a single-discipline or narrowly technical framework of analysis; for the great transformations in human history have been defined not merely by the emergence of new instruments, but by the effects of those instruments upon labor, property, power, social hierarchy, and institutional legitimacy. For this reason, the study adopts a transdisciplinary, integrated perspective rather than a single-discipline technical analysis. This transdisciplinary orientation is a methodological necessity, for a matter that appears to be a problem of employment is, at the same time, a problem of the tax base, a problem of democratic legitimacy, and a problem of human dignity.

3.1. Research Design: A Normative Political-Economic Analysis

In terms of its genre, the study is a normative political-economic analysis; it is not a descriptive technology report, but a conceptual-theoretical inquiry that conjoins theoretical synthesis with strategic model construction. Research of this kind seeks not to generate empirical data but, rather, to develop an original conceptual contribution by reframing the existing theoretical and empirical body of knowledge (Jaakkola, 2020). This methodological genre possesses a deeply rooted tradition in the social sciences; for conceptual-theoretical studies, by uniting scattered empirical findings and theoretical insights under a single coherent framework, furnish the analytical ground upon which new empirical research may be built. The task of the study is to reorganize the existing body of knowledge concerning robotic transformation around a human-centered institutional architecture, and to demonstrate the internal coherence of this architecture in a systematic manner.

From an epistemological standpoint, the study is neither purely descriptive nor purely explanatory; it establishes a synthesis of description, explanation, and normative evaluation. That is, it addresses jointly what the present condition is, the causal dynamics underlying it, and how an order capable of safeguarding human dignity might be designed. This threefold epistemological posture distinguishes the study both from a purely technical public-policy report and from an abstract normative manifesto; for it aims to demonstrate, in conjunction, not only what is but what ought to be, and—more importantly still—why it ought to be so. Its ontological foundation, in turn, is relational: the human being, technology, the state, the market, and society are conceived not as essences independent of one another, but as wholes that take form within reciprocal interaction; technology is accordingly treated not as an external force isolated from society, but as a process that develops in intimate connection with social choices. This relational ontology likewise constitutes the theoretical foundation for the study's avoidance of technological determinism.

3.2. The Five Theoretical Axes of the Analysis

As a corollary of this epistemological posture, the theoretical framework of the study operates upon five mutually complementary theoretical axes. These axes are not disjointed theoretical instruments, but interconnected vantage points that illuminate different strata of the same constitutive problem. The first axis is political-economic analysis; for technological transformations are never realized as neutral processes of technical progress, but are invariably shaped by economic relations of power, structures of property, and institutional choices (Acemoglu & Johnson, 2023; Zuboff, 2019). The second axis is the theory of the social state and welfare; here, however, the classical conception of the industrial-society welfare state is not mechanically reiterated, for the classical financing logic grounded in the taxation of labor is being structurally eroded in the robotic age (Esping-Andersen, 1990).

The third axis is the state-capacity approach; here the state is treated neither as the absolute administrator of the classical centrally commanded economy nor as the minimal arbiter of the neoliberal approach, but is instead positioned as a strategic actor that sets institutional direction; this conception of a strong state, however, is

always conceived in conjunction with the guarantees of democratic oversight and the rule of law (Rodrik, 2023; Mazzucato, 2021). The fourth axis is the approach of democratic legitimacy and social stability; for economic systems become sustainable not by virtue of their productivity alone, but by virtue of their capacity to generate legitimate acceptance among broad segments of society (Levitsky & Ziblatt, 2023). The fifth axis is the approach of human dignity and normative institutionalization; for the evaluation of economic systems cannot be conducted by indicators of efficiency alone, and human dignity is treated not as an external ethical appendage to economic design but as its constitutive principle (Sen, 1999; Arendt, 1958). These five axes operate in concert throughout the entirety of the study and reframe ostensibly technical matters as institutional and political questions.

3.3. Four Methodological Instruments

This five-axis theoretical framework is operationalized through the joint employment of four methodological instruments. The first is the historical-comparative approach, which situates the contemporary technological transformation within a long historical process; for the significance of the robotic age becomes discernible only when it is placed in relation to the agricultural, industrial, and digital revolutions. Every great technological transformation has brought with it its own institutional response; this historical pattern indicates that the robotic age, too, requires its own institutional response (Aghion, Antonin, & Bunel, 2021; Mokyr et al., 2015). The second is transdisciplinary analysis, which treats the economic, social, political, and ethical dimensions as parts of an integral order whose elements affect one another; this approach aims, by transcending the sharp boundaries among economics, political science, law, and sociology, to apprehend the multilayered nature of robotic transformation.

The third is comparative institutional analysis, which compares different models of the state and of civilization according to specified institutional criteria and affords the opportunity to test abstract theoretical claims against concrete experience. The enterprise-oriented and market-centered technology ecosystem of the United States, China's state-directed strategic technology model, the rights-based regulatory approach of the European Union, Germany's tradition of industrial and social partnership, the developmentalist technology strategies of South Korea and Singapore, and the high-welfare-based inclusiveness models of the Scandinavian countries constitute the principal reference points of this comparative analysis (Esping-Andersen, 1990; Bradford, 2023; Hillman, 2021; Juhász, Lane, & Rodrik, 2024). This comparative perspective makes it possible to debate the question of which institutional arrangements might prove more sustainable, more inclusive, and more resilient not merely on normative grounds but on observable ones; thus the human-centered mixed economy model is grounded not as an abstract ideal, but as an institutional synthesis positioned in relation to existing governance alternatives.

The fourth is the scenario-based strategic-foresight method, which, rather than confining itself to a description of the present condition, discusses in a systematic manner alternative possibilities for the future and the institutional conditions attaching to them. This approach reinforces the non-fatalistic posture of the study: instead of foreseeing a single inevitable future, the work contemplates the divergent trajectories that robotic transformation might give rise to under differing institutional choices. The distinction between a digital-oligarchy scenario founded upon uncontrolled automation and the concentration of wealth, and a human-centered transformation scenario that binds productivity to social welfare, arises not from technology itself but from choices of institutional governance (Kissinger, Schmidt, & Huttenlocher, 2021; Bradford, 2023). This approach makes no claim to divine the future through prophecy; by demonstrating how discernible tendencies may diverge within different institutional contexts, it brings to light the importance of early institutional design (Rodrik, 2023; Korinek & Stiglitz, 2021). The work thus proceeds not as a prediction of the future, but as a deliberation upon the design of the future.

3.4. The Three Planes of the Analysis

These methodological instruments operationalize the analysis across three planes; these three planes demonstrate that the method is not merely descriptive but, at the same time, constitutive. The diagnostic plane lays bare the magnitude of the problem—namely, the erosion of the centrality of labor and the rendering-precarious of the middle class; the aim of this stage is not to produce a discourse of catastrophe, but to clarify, in theoretical terms, the map of risk. The model-construction plane develops an alternative institutional response—namely, the human-centered mixed economy model; this work is not merely an analysis that critiques the existing system, but at the same time a constitutive theoretical study that develops a functional institutional-design proposal with respect to economic citizenship, relations of property, the financing of welfare, and state capacity. The normative-orientation plane, in turn, elucidates the values in accordance with which this response takes form—namely, the principles of human dignity, social justice, and democratic legitimacy.

The operation of these three planes in concert enables the study to preserve both its analytical weight and its normative orientation; for an analysis that performs diagnosis alone may slide into pessimism, whereas an analysis that proposes a model alone may slide into a groundless optimism. This planar structure is, at the same time, the methodological safeguard for the study's avoidance of reductive technological determinism; for the diagnostic plane presents risks not as an inevitable fate, but as possibilities contingent upon institutional choices. Thus, unemployment is here reframed not merely as a labor-market problem but as a problem of economic citizenship; the erosion of the tax base, not merely as a fiscal problem but as a problem of the welfare state's sustainability; and the weakening of the middle class, not merely as a problem of income distribution but as a problem of democratic stability. This reframing constitutes the methodological backbone of the study.

3.5. The Data and Evidentiary Basis

So that the theoretical synthesis may cease to be an abstract construction, the study also rests upon a robust empirical foundation. Throughout the work, the data and reports produced by international organizations and research centers on artificial intelligence, labor, inequality, and welfare constitute the concrete underpinnings of the theoretical analysis (OECD, 2024; International Labour Organization, 2024; International Monetary Fund, 2024; World Economic Forum, 2024; Stanford Institute for Human-Centered Artificial Intelligence, 2024; United Nations Development Programme, 2024). Empirical studies concerning the task-level effects of artificial intelligence, field findings concerning the productivity effects of generative artificial intelligence, and current data concerning the transformation of the labor market relate the theoretical claims to observable tendencies (Acemoglu & Restrepo, 2020; Eloundou, Manning, Mishkin, & Rock,

2024; Brynjolfsson, Li, & Raymond, 2023; Felten, Raj, & Seamans, 2021; Pizzinelli et al., 2023).

This evidentiary basis ensures that the study is not merely a normative appeal, but an analysis grounded in observable reality. Nevertheless, the function of this empirical grounding is not to prove the theoretical claims, but to relate them to concrete tendencies and to demonstrate their plausibility; for, as a conceptual-theoretical study, the article does not undertake empirical hypothesis-testing. The work thus rests upon a multilayered source structure that employs the conceptual legacy of the classical theorists in conjunction with the contemporary literature on artificial intelligence, futures research, and comparative country studies. This multilayered use of sources is also the means by which a deliberate balance is observed between normative language and analytical language; for powerful ideas can produce a lasting impact only when they are set upon a sound analytical framework.

3.6. Scope, Validity, and Limitations

The scope of the study is deliberately universal: the dynamics analyzed pertain not to a particular country, but constitute structural tendencies belonging to any nation-state that enters the robotic age, whatever its level of development may be. This preference for universality arises from the fact that the fundamental logic of the model rests not upon a particular political geography but upon the shared structural logic of robotic transformation; whatever a country's level of development, political tradition, or economic magnitude may be, the principles of binding the value engendered by robotic productivity to a social share, of distributing that value equitably, and of rendering the citizen a partner in the economic order operate in the same manner. Consequently, the model developed is designed as a general institutional framework that any nation-state may adapt to its own conditions. This emphasis upon universal adaptability removes the model from being an abstract prescription and grounds it instead upon a general logic that is testable across differing contexts.

The limitations of this methodological choice must be openly acknowledged. First, as a conceptual-theoretical study, the article offers no direct empirical evidence concerning the effects of the model; the future empirical testing of the mechanisms it proposes remains an explicit research agenda. Second, scenario-based foresight, while discussing possibilities in a systematic manner, carries no claim to precise prediction; it aims to illuminate the field of institutional choice within which the future will be shaped, not to forecast it. Third, the emphasis upon universal adaptability does not exclude the fact that local institutional, cultural, and fiscal contexts will differentiate the model's implementation; this contextual variability does not invalidate the fundamental logic of the model, but conditions the manner of its implementation and is addressed separately in the study's Discussion section. Fourth, the measurement of robotic productivity and the computation of the value to be socialized may require new methodologies beyond the available instruments of economic measurement.

This methodological self-awareness aims to elevate the study from being a manifesto to the level of an academic analysis that openly declares its assumptions and its limits. The open declaration of limitations does not weaken the study's contribution; on the contrary, it opens a fruitful agenda concerning how a theoretical framework may be carried forward through empirical and comparative research. The following section, upon this methodological ground, analyzes at the diagnostic plane the historical-threshold character of the robotic age and the dynamics of the erosion of middle-class welfare.

4. The Historical Threshold and the Erosion of Middle-Class Welfare

This section constitutes the diagnostic plane of the study. It first establishes the threshold character of the robotic transformation—a quality that sets it qualitatively apart from earlier technological ruptures—and subsequently analyzes the multidimensional erosive dynamics this threshold exerts upon middle-class welfare, the systemic risks it engenders, and the psycho-social, democratic, and global ramifications of these risks. This diagnosis prepares the justification for the institutional response to be developed in the fifth section, for a model acquires meaning only once it has been clearly demonstrated why the existing institutional architecture may prove inadequate. The purpose of the diagnosis is not to generate a discourse of catastrophe, but to render the structure and magnitude of the risk with analytical clarity.

4.1. The Robotic Threshold as a Qualitative Rupture

In past great transformations, technology altered the nature of human labor yet did not expel it entirely from the economic system. Steam power transformed the structure of physical labor, automation mechanized particular work processes, and computerization reorganized cognitive labor; throughout all of these transformations, however, the human being remained the indispensable agent of the system of production (Mokyr, Vickers, & Ziebarth, 2015). In previous waves, as machines assumed first muscular and then computational functions, the human mind migrated toward new and more complex tasks; today, by contrast, the prospect that a significant portion of mental tasks may likewise become delegable sharpens, for the first time in history and to an unprecedented degree, the question of "where will the human being migrate next?" Three features render the age of robotic artificial intelligence a qualitative rupture. The first is *velocity*: whereas the transition from agrarian to industrial society unfolded over centuries, and that from industrial to digital society over decades, the pace at which artificial-intelligence capabilities are maturing tends to outstrip the adaptive capacity of institutions (Brynjolfsson & McAfee, 2014). The second is *breadth of scope*: the transformation affects not a single sector but a wide spectrum of both physical and cognitive labor simultaneously (Eloundou, Manning, Mishkin, & Rock, 2024). The third is the *logic of substitution*: whereas earlier leaps most often produced tools that complemented human labor, the capacity of robotic artificial intelligence to substitute for labor directly in certain domains gives rise to the possibility of a qualitative break from the historical pattern (Acemoglu & Restrepo, 2020).

The essential nature of this threshold must be correctly defined: the issue is not merely the disappearance of certain jobs, but the possibility that economic value may become decoupled from human labor. Throughout history, labor markets have changed form; the present issue, however, is not the changing form of labor but the systemic erosion of its economic centrality. This distinction is critical, for while education and adaptation policies may suffice for labor that is merely changing form, labor whose centrality is being eroded requires a redesign of the very constitutive logic of the economic order (Susskind, 2020; Ford, 2021). This transformation simultaneously reconfigures power relations: in the past, labor was able to confer a countervailing force upon the system through strikes, organization, and collective bargaining; yet as data, algorithms, computational infrastructure, and

robotic systems become the new means of production, economic power tends to concentrate in the limited number of actors who control the technological infrastructure (Zuboff, 2019; Pasquale, 2015). In an order in which labor has lost its countervailing power, the sole mechanism capable of preventing the unlimited conversion of economic power into political power is institutional design itself.

The opposing view, too, must be granted its due: certain economists remind us that every great wave of automation has provoked similar anxieties, yet that over the long run new fields of employment have emerged and aggregate employment has been preserved (Autor, 2022; Mokyr et al., 2015). According to this view, human creativity, adaptive capacity, and the emergence of new needs may open fields of employment that cannot be foreseen; moreover, artificial intelligence, if properly directed, may even contribute to the reconstruction of middle-class jobs (Autor, 2024). The present study does not underestimate this view; yet, in accordance with the precautionary principle, it emphasizes that sound institutional design would cause no harm under the optimistic scenario, whereas the absence of such design under the pessimistic scenario would generate costs that are difficult to redress. This asymmetry transforms early institutional design from something merely desirable into a prudential necessity. Furthermore, what is decisive is not only whether new jobs will emerge, but whether they will emerge in sufficient numbers, with sufficient security, and with sufficient inclusiveness—as well as how the losses arising during the transitional period are to be managed.

4.2. The Strategic Function of the Middle Class and Its Multidimensional Precaritization

The modern middle class is not merely a socioeconomic category situated within a particular income band; it is one of the load-bearing pillars of the equilibrium among production, consumption, fiscal contribution, social mobility, democratic legitimacy, and institutional trust. Since Aristotle, political thought has emphasized the stabilizing function of the middle stratum; modern political science, too, has argued that a broad and secure middle class supports democratic institutionalization, constrains extreme polarization, and strengthens the legitimacy of the political system (Lipset, 1959; Easterly, 2001; Sandel, 2020). For a long time it was assumed that technological risk threatened primarily low-skilled physical labor; yet the distinguishing feature of the present transformation is that artificial intelligence places under pressure not only routine physical tasks but also white-collar and expertise-intensive cognitive domains—that is, the professions constituting the very core of the middle class, such as law, finance, media, education, and consultancy (Autor, 2022; Eloundou et al., 2024; Pizzinelli et al., 2023). For this reason, the most profound rupture of the robotic age is not mere unemployment, but the possibility of the dissolution of the middle class, which is the load-bearing backbone of democratic stability.

This precarity is multidimensional. The first dimension is the erosion of income stability: the fundamental mainstay of the middle class is the predictable generation of income, yet AI-enabled automation, by generating transformative pressure even within white-collar professions, unsettles this narrative of security (Autor, 2022; Brynjolfsson, Li, & Raymond, 2023). The second dimension is the weakening of the capacity for future planning: the middle class subsists not on present income alone but on predictability regarding the future—that is, on the capacity for home ownership, the education of children, and the intergenerational transmission of welfare; when income becomes volatile, this capacity weakens (OECD, 2021). The third dimension is the dissolution of occupational identity: even where artificial intelligence does not eliminate particular professions entirely, it may redistribute their highest value-added functions; thus individuals may experience a loss of income, status, or occupational autonomy without losing their jobs altogether—an erosion that is quieter, yet more structural, than visible unemployment (Autor, 2022).

The fourth dimension is a paradox of consumption peculiar to the robotic age. Advanced capitalist economies rest in large measure upon broad-based middle-class consumption; should the middle class lose income and security, domestic demand weakens, and the risk of stagnation rises even amid periods of high productivity (Keynes, 1936). As production becomes extraordinarily efficient by virtue of robotic systems, the erosion of a broad consumer base possessing the income capacity to purchase that production engenders a structural tension between supply and demand; the intuition behind Henry Ford's decision to pay his workers a wage sufficient to purchase the very automobiles they produced re-emerges, in a new and sharper form, in the robotic age. The fifth dimension is the erosion of the meritocratic narrative: once even highly educated and specialized individuals begin to experience structural economic insecurity, the logic of "work, specialize, ascend" may forfeit not only its material but also its normative legitimacy; as Sandel emphasizes, the collapse of meritocracy is as much a question of justice as it is an erosion of social esteem and belonging (Sandel, 2020; Milanovic, 2023).

4.3. New Systemic Risks: Concentration, Precarity, and Fiscal Erosion

The robotic threshold gives rise to a series of mutually reinforcing systemic risks. The first is the concentration of wealth and power: as data, algorithms, computational infrastructure, and robotic systems become the new means of production, economic power tends to concentrate—beyond classical ownership of capital—in the limited number of actors who control the technological infrastructure (Zuboff, 2019; Pasquale, 2015). The network effects and economies of scale of digital markets render oligopolistic, winner-takes-almost-everything structures a natural tendency; the analysis according to which wealth concentrates under conditions in which the return on capital exceeds the rate of growth becomes all the more acute where digital capital is concerned (Bessen, 2022; Piketty, 2020; Chancel, Piketty, Saez, & Zucman, 2022). The second is precaritization: the digital platform economy transforms labor relations away from secure employment toward fragmented, temporary, and frequently unprotected forms of work (Srnicek, 2017; Standing, 2011).

The third risk is fiscal erosion: modern welfare states are financed largely through taxes derived from labor income and through a structure of waged employment; value migrating from labor to machines weakens the wage-based tax and social-security base, thereby placing welfare financing under pressure (OECD, 2024; Cazzaniga et al., 2024; International Monetary Fund, 2024). Thus, the technological transformation may turn not merely into a market issue but also into a crisis of public finance; unless the logic of taxation is redesigned, the very source that finances public welfare may contract even as economic value increases. The fourth risk is that labor markets fracture not in the form of a uniform wave of unemployment but in the form of a multilayered polarization: at one pole, a narrow segment of expertise that employs artificial intelligence in a complementary manner and whose value rises; at the other pole, broad professional strata whose tasks are fragmented, whose autonomy narrows, and whose income is suppressed (Autor, 2022; Felten, Raj, & Seamans,

2021). This fragmentation demonstrates that the employment effect of the robotic age must be read not through a simple unemployment rate but through the redistribution of the content of occupations and of value chains.

4.4. The Psycho-Social and Democratic Dimension: Meaning, Legitimacy, and Global Asymmetry

These material risks are accompanied by a profound psycho-social dimension that is frequently overlooked. The identity of the modern individual has been defined in large measure through occupation, productivity, and labor relations; when the centrality of labor is eroded, the danger that emerges is not material poverty alone, but the loss of status, the sense of purposelessness, and the feeling of worthlessness that broad strata who come to feel superfluous will experience (Sennett, 2006; Han, 2015; Rosa, 2020). Comparative measures of welfare demonstrate that increases in economic productivity do not always advance in the same direction as societal happiness and the level of social connectedness, and that loneliness and social disconnection are increasingly becoming a matter of public health (Helliwell et al., 2024; Holt-Lunstad, 2022; Office of the Surgeon General, 2023). This vulnerability is especially acute for younger generations; employment uncertainty and the weakening of future expectations combine with mental-health findings indicating that young people are experiencing a rupture that is not merely economic but existential (Haidt, 2024; McGorry et al., 2024). Since the transformation also affects care labor, invisible domestic labor, and gender inequalities in distinctive ways, it cannot be assessed in isolation from the dimension of inclusiveness (Goldin, 2021; International Labour Organization, 2021).

The cumulative effect of these risks translates directly into a risk to democratic legitimacy. When the economic system fails to offer opportunity to broad social strata, the legitimacy of the political system weakens; when citizens come to believe that technological progress benefits only narrow economic elites, trust in democratic institutions diminishes, populist reactions gain strength, and institutional polarization rises (Levitsky & Ziblatt, 2023). The historical link between economic insecurity and political radicalization is supported by empirical studies as well; it is observed that the sense of economic exclusion feeds anti-system mobilization and institutional distrust (Hacker & Pierson, 2020; Autor, Dorn, Hanson, & Majlesi, 2020). The anger reflected at the ballot box is, in many cases, the sense of economic exclusion transmuted into political preference; for this reason, the preservation of democracy in the robotic age is bound directly to the preservation of economic participation.

Finally, this pressure transcends national borders as well. Because the data, computational power, and expertise that fuel artificial-intelligence and robotic capacity are distributed across the globe with extreme inequality, the concentration of technological capacity in particular centers may lead to a digital reproduction of the classical core–periphery relationship—indeed, to a kind of digital colonization for those societies relegated to the position of data providers (Couldry & Mejias, 2019; Crawford, 2021; United Nations Development Programme, 2024). Actors that hold the nodal points of global economic networks are able to transform these networks into instruments of domination; in the robotic age, in which data and computational infrastructure are concentrated, this risk of weaponized interdependence becomes all the more acute (Farrell & Newman, 2023; Hillman, 2021). In this respect, the political economy of the robotic age is a multiscalar issue that exceeds the bounds of national social policy and possesses dimensions of digital sovereignty and global justice.

4.5. Interim Conclusion: The Imperative of an Institutional Response and Reversibility

The fundamental conclusion of the diagnostic plane is this: the most profound rupture of the robotic age is not mere unemployment, but the possibility of the dissolution of the middle class and, with it, the erosion of the load-bearing ground of social stability. This outcome, however, is not a technological fate. Comparative experiences demonstrate this plainly: in the face of the same technological pressure, different countries have produced different outcomes. In the United States, deindustrialization and employment polarization produced a concrete human cost in the form of the "deaths of despair" that led to declining life expectancy in particular regions (Case & Deaton, 2020; Acemoglu & Restrepo, 2020); whereas countries possessing strong vocational training, traditions of social partnership, and active labor-market policies were able to manage the disruptive effects of the transformation in a relatively gentler manner, and societies endowed with comprehensive welfare and reskilling systems were able to manage the transformation as a process of reintegration rather than exclusion. This comparison reveals that the consequences of the robotic transformation are determined not by technology but by the institutional order surrounding it.

For this reason, the diagnosis renders imperative a direct question of institutional design. The weakening of the economic centrality of labor turns into a regime of exclusion only when no compensatory mechanism is established; when the proper institutional framework is developed, the same transformation may turn into an opportunity for welfare that diminishes the obligatory burden of human labor (Rodrik, 2023; Susskind, 2020; Keynes, 1930/1963). To regard the middle class merely as a social group sustaining harm is therefore inadequate; the essential matter is to develop the institutional design that will reproduce the economic participation, security, and social role of the middle class in the robotic age. To reconstruct the middle class in the robotic age is not to restore past employment structures as they were; it is to carry the material foundation of the middle class into the new conditions by adding to labor both productive asset ownership and a legitimate share drawn from collective value. The answer given to this question is the human-centered mixed economy model to be developed in the section that follows (Acemoglu & Johnson, 2023; Stiglitz, 2024; Mazzucato, 2021).

5. The Institutional Architecture of the Human-Centered Mixed Economy Model

This section constitutes the model-construction plane of the study. It first analyzes the structural limits that prevailing economic paradigms encounter in the robotic age; it then systematically constructs, in response to these limits, the institutional pillars of the human-centered mixed economy model. The pillars of the model are not independent policy proposals but mutually complementary components of a single constitutive logic; each pillar is the direct institutional consequence of the structural transformation diagnosed in the preceding section—namely, the migration of economic value from labor toward algorithmic and robotic capital. For once the source of value is transformed, the institutional architecture that binds it to public welfare must likewise be transformed.

5.1. The Structural Limits of Prevailing Paradigms

Classical liberal capitalism rests on the assumption that prosperity will spontaneously diffuse to the broad base of society; yet in the robotic age the concentration of productivity gains within a narrow technology-capital stratum weakens this assumption (Piketty, 2020; Stiglitz, 2012). The classical market paradigm rests on the premise that the broad population is integrated into the economic system through the labor market; if technological transformation diminishes the economic significance of human labor, then the market's classical mechanism for incorporating individuals into the system is weakened, economic participation contracts even as productivity rises, and the historical nexus between market efficiency and social welfare is severed (Polanyi, 2001). The neoliberal paradigm foregrounds market flexibility and the retreat of the state; yet within an order in which labor has lost its bargaining power, the unregulated market tends to deepen inequality and precarity; a fiscal logic that leaves the tax burden upon labor while rendering the returns to technological capital largely untouchable may, in the robotic age, deepen inequality rather than offset it (Rodrik, 2023; Hope & Limberg, 2022).

The traditional welfare state grounds its financing largely upon taxes and contributions levied on waged labor; when value migrating from labor to machines erodes this base, the classical welfare model confronts a financing crisis (Esping-Andersen, 1990; OECD, 2024). The subtlety that must be underscored here is that the problem lies not in the values of social democracy but in its financing logic: the historical success of classical social democracy rested upon the existence of broad waged employment and a stable labor-tax base, whereas the robotic age erodes precisely this foundation (Streeck, 2014). Finally, although an unconditional universal basic income has opened an important debate, taken in isolation it does not resolve the problems of property, economic participation, democratic belonging, and the institutional sharing of productivity returns; it carries the risk of rendering individuals passive recipients rather than active partners of the economic system (Van Parijs & Vanderborght, 2017; Standing, 2017). When these four limits are assessed together, what emerges is the necessity not of a small-scale reform but of a new, integrated institutional synthesis.

5.2. The Constitutive Principle and the Three Load-Bearing Pillars of the Model

The human-centered mixed economy model is not a superficial compromise between classical statism and the free market, but a structural institutional response to the particular conditions of the robotic transformation. The model's constitutive principle is clear: technological efficiency cannot be substituted for human dignity. This principle functions as a norm that takes precedence over all institutional choices and serves as the fundamental criterion by which each institutional component is to be evaluated; an institution, however efficient, contradicts this principle if it reduces the human being to a passive object of the economic order, and, however modest it may appear, accords with this principle if it empowers the human being as a constitutive subject (Sen, 1999; Sandel, 2020; Kant, 1996). The model rises upon three load-bearing pillars: a human-centered politics of technology, a new-generation strategic mixed economy order, and the institutional preservation of social stability. The six institutional components set out below translate these three pillars into concrete mechanisms and, interlocking with one another, form a single integrated architecture.

5.3. The First Pillar: The National Robotic Welfare Fund

The fiscal backbone of the model is constituted by a national robotic welfare fund that gathers the value generated by robotic productivity into a social pool. The logic of the fund draws inspiration from the experience of sovereign wealth funds and resource dividends; yet its source is not natural resources but the surplus of robotic and algorithmic productivity. Throughout history, resource-rich countries have sought to carry the revenues of oil, natural gas, or minerals into the future by means of sovereign wealth funds; in the robotic age, however, the new strategic resource is data, the new mineral is artificial intelligence infrastructure, and the new energy is automation capacity (Mazzucato, 2021; Atkinson, 2015). Norway's model—accumulating its oil revenues in a permanent sovereign wealth fund for future generations rather than consuming them directly, and transforming this fund into an instrument of intergenerational justice—offers a proven example of such institutionalization; Atkinson's proposals for a national capital fund and a citizen's share, in turn, strengthen the theoretical foundations of this mechanism (Atkinson, 2015).

The success of the fund depends directly upon its institutional design; for a poorly designed public fund can readily become susceptible to political abuse, the squandering of resources, and inefficiency. For this reason the national robotic welfare fund must be designed as a long-term and strategic asset structure separate from the ordinary budget; it must not be turned into an instrument for closing day-to-day budget deficits, must be operated under a professional and independent management insulated from short-term political interference, and must be subjected to transparent reporting and robust auditing mechanisms. Ostrom's analysis—that common-pool resources can be governed sustainably only through well-designed institutional principles such as clearly defined boundaries, participatory rule-making, effective monitoring, and graduated sanctions—sets out the conditions under which such a fund can genuinely function (Ostrom, 1990). This point is critical: there are as many examples of countries that have squandered the same revenues through poor governance, favoritism, and short-term populism as there are of countries that have succeeded in converting natural-resource revenues into permanent wealth; what distinguishes the two outcomes is not the resource itself but the quality of the institutions that govern it. A poorly governed welfare fund can itself turn into a source of rent that feeds the very inequality it was intended to resolve.

One of the deeper functions of the fund is that it operates as a transitional buffer during the process of technological transformation; for robotization may generate sharp income fluctuations at the individual and regional levels. By financing educational support, reskilling programs, and income guarantees, the fund can render individuals partners in the transformation rather than its victims; through regional development programs it can narrow the gulf between the technological core and the periphery; and in periods of international crisis, strategic reserves accumulated in advance can serve as an economic insurance, enhancing social resilience. A further deep function of the fund concerns the dimension of intergenerational justice: since robotic infrastructure is built largely upon the knowledge, public investment, and social labor accumulated by past generations, the returns to this productivity ought to be regarded not as the exclusive gain of present-day capital owners but as the shared gain of all generations. Rawls's principle of just savings across generations demonstrates that such a fund ought to convert the wealth of the robotic

age into a permanent social patrimony rather than leaving it to the consumption of a transient generation (Rawls, 1971).

5.4. The Second Pillar: A Tax Architecture Adapted to Robotic Productivity

The mechanism that feeds the welfare fund is a fair tax architecture that re-taxes the value migrating from labor to machines. In an age in which the wage-based tax base is eroding, the preservation of fiscal sovereignty requires that the new forms of value creation—namely the returns to robotic capital, automation gains, and algorithmic rent—be brought within the scope of taxation (OECD, 2024; Stiglitz, 2024). This architecture aims not at a design that penalizes productivity, but at one that ensures productivity gains are shared equitably. The logic of this design bears an illuminating parallel to the logic of environmental taxation: just as the purpose of a carbon tax is not to penalize production but to internalize an externalized social cost into the price system, so too the purpose of a robotic productivity levy is not to suppress innovation but to return the social gains of automation to broad segments of society.

This architecture must confront a powerful counter-thesis: would not levies imposed on robotic production, data, or artificial intelligence deter innovation and thereby slow technological progress? This objection must be taken seriously; yet the point it overlooks is that the problem lies not in the existence of the tax but in its design. A progressive levy structure that, without deterring small-scale and nascent enterprises, targets only large-scale concentrations of robotic capital and the extraordinary returns derived from collectively produced data can balance the concentration of wealth without killing innovation; for the aim is not punishment but the democratization of productivity gains (Atkinson, 2015). The reconstruction of tax justice is not merely a matter of revenue collection but at the same time a matter of safeguarding the fiscal ground of democratic legitimacy; for a fiscal structure that cannot sustain the welfare of broad segments will in time erode political stability as well. The element that completes this architecture is the socialization of the extraordinary profits that large technology platforms derive not from the original value they produce but from the rent position created by the data and network effects they control—that is, the socialization of algorithmic rent; Mazzucato's distinction between value extraction and value creation demonstrates that the platform economy rests to a significant degree upon value extraction, and that this rent, much like land rent, can be socialized (Mazzucato, 2018).

5.5. The Third Pillar: Participatory and Cooperative Ownership

One of the distinctive pillars of the model is the participatory and cooperative ownership structures that broadly distribute access to the means of production. Income transfer alone leaves the source of inequality intact without altering ownership relations; the durable socialization of robotic productivity, by contrast, requires that citizens become partners in productive capital (Ackerman & Alstott, 1999; Mazzucato, 2021). If the new source of economic power is the robotic means of production, data, and algorithmic capacity, and if these resources are concentrated within a narrow stratum, then reversing class polarization likewise requires that ownership of these resources be diffused across broad segments of society. Citizen robot ownership, cooperative production enterprises, and communities' shared robotic pools aim to broaden the diffusion of productive capital and to balance the concentration of wealth; thereby the individual is carried from the position of a passive recipient of the economic order to that of a partner in productive assets, and may derive income not only from working but also from the ownership of productive assets. The issue here is not to nationalize property in a centralized manner; on the contrary, it is to establish a pluralistic ownership regime that avoids the concentration of property in either narrow private monopolies or an absolute state monopoly.

This proposal must confront a powerful counter-thesis: would not individual robot ownership lead to new debt crises, to the risks of technological obsolescence, and to the exploitation of small robot owners by large platform companies? This objection must be taken seriously; for a poorly designed model of robot ownership could leave citizens burdened by expensive yet dysfunctional technology investments and by debt. The point it overlooks, however, is that the model is not confined to individual ownership alone. Cooperative ownership models overcome the problem of high cost and risk through collective sharing; state-provided technical maintenance infrastructures, certification systems, and insurance mechanisms reduce the risks of technological obsolescence; and financing is structured not as a classical debt relation that places the entire burden of repayment upon the individual, but as a partnership and risk-sharing mechanism grounded in productive returns. Against the risk of platform dependency, open standards, anti-monopoly regulations, and national technological-sovereignty strategies are required. Thanks to these institutional safeguards, the model of robot ownership can become, rather than a source of new debt bondage, an instrument of economic subjectivation and broad-based welfare; and this constitutes the structural ground for the re-empowerment of the middle class.

5.6. The Fourth Pillar: Data Cooperatives and the Data Dividend

In the robotic age a significant portion of value arises from data and algorithmic capacity; yet while data is produced at the level of society, its ownership is gathered under the control of a limited number of actors (Zuboff, 2019; Birch, Cochrane, & Ward, 2021). The productivity of artificial intelligence systems is fed largely by the streams of data that millions of people produce through their everyday activities; yet the citizens who are the true producers of this data today receive almost no share of the value they create. Zuboff's analysis of surveillance capitalism shows that human experience is seized as a free raw material, while Couldry and Mejias's concept of data colonialism shows that this value extraction carries the resource-appropriation logic of historical colonialism into the digital domain of human life (Zuboff, 2019; Couldry & Mejias, 2019). To remedy this asymmetry, the model proposes the redefinition of data ownership, the establishment of data cooperatives, and the socialization of algorithmic rent by means of a data dividend. While a single citizen's data carries limited value individually, the aggregation of the data of millions of citizens under a common roof yields considerable economic and bargaining power; data cooperatives can negotiate on behalf of citizens with the companies that wish to use the data and can transfer the revenues thereby obtained to their members or to social welfare funds.

The success of this institutional architecture depends upon a critical distinction: the socialization of data must mean not the state's appropriation of the individual's data, but the strengthening of the individual's rights over his or her data. For if the aggregation of data at the national level is not balanced by robust democratic safeguards, it may reproduce, by the hand of the state, the very problem it set out to resolve—namely, the loss of the individual's control over his or her own data. The way to eliminate this risk is to design the data

partnership not as a centralized pool in which the state owns the data, but as a cooperative structure that strengthens the individual's rights over his or her data and converts these rights into a collective bargaining power (Ostrom, 1990; Han, 2015). Thereby, data ceases to be a source of rent for a narrow stratum and becomes a shared input of social welfare and a concrete institutional instrument of digital sovereignty; the socialization of data is emancipatory only when it means the strengthening of the individual's control, and oppressive when it means the expansion of the state's surveillance capacity. This distinction is the guarantee that the data cooperative will become an instrument of economic democratization rather than an apparatus of surveillance.

5.7. The Fifth Pillar: A Lifelong Skill-Building Infrastructure

In an age in which the period of validity of skills is shortening, education ceases to be a preparation completed within a particular phase of life and becomes a continuous process of renewal extending across the whole of working life. Yet when this burden of adaptation becomes a fate that the individual is expected to bear alone, it turns into a new source of precarity. The model proposes to remove reskilling from the domain of individual responsibility and to render it a right—publicly supported, accessible, and provided together with income support (Sen, 1999; Nussbaum, 2011; UNESCO, 2021). As Sen's capability approach demonstrates, true security consists not merely in providing income but in strengthening the individual's capacity to adapt to changing conditions and to direct his or her own life; for this reason lifelong learning is an integral component of the social-security architecture of the robotic age.

This approach aims at a model of a learning society that develops the human capacities that cannot be ceded to the machine—namely, critical thinking, creativity, ethical judgment, emotional intelligence, and complex problem-solving. What is critical here is the distinction between a narrow vocational training and a broad human development: a conception of education that shapes skills solely according to the market's momentary demand carries the risk of perpetually leaving the individual behind in the face of the pace of technological transformation, for a technical skill taught today may rapidly lose its value once automation takes it over; by contrast, a conception of human development that places critical thinking, ethical judgment, and learning-to-learn at its center prepares the individual not for a particular occupation but for continuous transformation. Learning thus becomes an infrastructure that distributes across society the burden of adaptation that transformation gives rise to and that turns into one of the most potent antidotes to the fear of unemployment; moreover, this investment, by strengthening the transformative capacity not only of the present generation but of future generations as well, constitutes a concrete expression of intergenerational justice.

5.8. The Sixth Pillar: Economic Citizenship and a Digital Citizenship Income

The pillar that qualitatively distinguishes the model from classical universal basic income is the framework of economic citizenship. Within this framework the citizen is not merely the recipient of a transfer; he or she is a partner in productive assets, a stakeholder in the data economy, and a constitutive member of the economic order (Marshall, 1950; Bellamy, 2009). Marshall's analysis, which stratifies citizenship into civil, political, and social rights, requires expansion in the robotic age by a new stratum—namely, the right to economic participation; just as the social rights of the twentieth-century democratically balanced industrial capitalism, so too economic citizenship can balance robotic capitalism in a human-centered manner (Marshall, 1950). The digital citizenship income defined upon this foundation treats an unconditional income floor and the universal services that prevent the commodification of basic human needs not as alternatives to one another but as two mutually complementary components (Van Parijs & Vanderborght, 2017; Esping-Andersen, 1990).

The deepest point at which the model diverges from unconditional basic income is that it transforms the human being from a passive recipient into an active partner; for although a mere cash transfer secures the individual's subsistence, it leaves him or her a passive aid-recipient outside the ownership of, and the decision-making processes of, the economic system. For this reason the proposed income guarantee rests upon a multi-layered architecture: the individual is at once a stakeholder in the common welfare fund, the owner of his or her data, and, where possible, a partner who shares in the returns of his or her own productive asset. The critical attribute of this multi-layeredness is that each layer provides protection against a different risk and that the layers compensate for one another's weaknesses; whereas an individual dependent upon a single source of income is left unprotected when that source is shaken, in a multi-source architecture, when one layer weakens, the others come into play. This distinction is vital, for whereas a culture of charity produces in time dependency and stigmatization, a security grounded in rights and partnership produces belonging and dignity; Kant's moral principle that the human being must always be regarded as an end constitutes the normative core of rendering the individual a dignified partner of the system (Kant, 1996; Marshall, 1950).

This income guarantee must also confront the widespread objection that it would weaken the incentive to work. Yet empirical basic-income experiments show that a guaranteed income does not markedly reduce labor-force participation but, on the contrary, enables individuals to seek higher-quality work and to turn toward socially valuable activities such as education and care (Van Parijs & Vanderborght, 2017; Standing, 2011). Moreover, because the model's financing is provided not from the ordinary budget but from robotic productivity levies, the returns of the data economy, and the revenues of the national welfare fund, the income guarantee becomes grounded not in debt but in productive wealth; when robotic productivity enormously increases supply capacity, rising demand can be met by rising supply, and thus it ceases to be necessary that the income guarantee be inflationary. When it is established together with the preceding pillars—namely the welfare fund, the tax architecture, participatory ownership, the data dividend, and the skill infrastructure—this income becomes not a benefaction but the material correlate of economic citizenship.

5.9. The Integrated Logic of the Pillars: The Structural Resolution of Unemployment

The strength of the model arises from the fact that the pillars operate not in isolation but by interlocking with one another. When the welfare fund that gathers the value of robotic productivity into a social pool, the fiscal architecture that re-taxes this value, the participatory ownership that broadly distributes access to the means of production, the data dividend that socializes algorithmic rent, the skill infrastructure that distributes the burden of adaptation, and the framework of economic citizenship that renders the citizen a constitutive partner are brought together, high productivity and broad-

based welfare cease to be alternatives to one another (Stiglitz, 2024; Mazzucato, 2021; Standing, 2017). This integrated logic grounds the central thesis of the study: in the robotic setting, the anxiety of unemployment is not a fate of technology but a choice of institutional design.

To see the operation of this mechanism in concrete terms, it is necessary to follow the logic of the process step by step. When robotic productivity diminishes the demand for human labor in particular tasks, two distinct flows arise: on the one hand, the human time and labor thereby released, and on the other, the increasing economic value produced by the machines. In the classical order, when these two flows are severed from one another—that is, when the released labor is directed to no new domain and the increasing value is gathered within narrow ownership structures—the result is mass unemployment and deepening inequality. The human-centered institutional architecture, by contrast, re-binds these two flows to one another: the value produced by the machines is partly channeled into public welfare through the national welfare fund and the robotic productivity levy; these resources finance the redirection of released human labor toward domains of high social value such as care, education, culture, environmental restoration, and community-based production. Thereby diminishing labor demand becomes a process not of exclusion but of redirection; shorter working hours, more meaningful domains of labor, and a broader welfare base become possible.

The second institutional line that completes this logic is the inclusion of the citizen as a partner in productive robotic capital. If robotic systems are becoming the principal producers of economic value, then the citizens' capacity to receive a legitimate share of the returns of these systems is decisive for both income security and economic belonging; through individual and collective robotic ownership funds, cooperative ownership structures, and citizen partnership mechanisms, every citizen can be bound to the economic system not only through his or her labor but also through the returns of productive robotic assets. The weakening of the economic centrality of labor turns into a regime of exclusion only when no compensatory mechanism is established; when, by contrast, an integrated architecture that binds the productivity surplus to society is established, the income precarity produced by automation can be structurally eliminated in any nation-state. From this, too, arises the universal adaptability of the model: the proposed framework rests not upon the historical conditions of a particular country but upon the general institutional logic shared by any nation-state confronting the robotic transformation. The concrete form of implementation will differ according to each country's institutional capacity, resources, and social structure; yet the fundamental logic of the model is adaptable and general.

6. Discussion

A robust scholarly thesis does not merely defend its own proposition; it also openly works through the most serious objections that might be raised against it. This section first discusses the principal counter-arguments that may be directed at the human-centered mixed economy model, together with the institutional safeguards developed in response to them; it then addresses the model's comparative institutional implications, its multi-scalar governance dimension, and its theoretical and political contributions; finally, it sets out the limitations of the study and the research agenda it opens up. Discussing the limits and risks of the model is a fundamental scholarly requirement that prevents the normative intensity of the study from degenerating into an ideological manifesto; for the strength of a theory lies not in evading criticism, but in becoming more resilient by absorbing it into itself (Acemoglu & Johnson, 2023; Stiglitz, 2012).

6.1. Counter-Arguments and Institutional Safeguards

The first objection holds that economic citizenship income and robotic welfare transfers may generate inflationary pressure and may transform individuals into passive recipients of the system. This objection must be taken seriously; for an income policy that is not underpinned by an increase in production and is reduced to mere monetary transfer may disrupt price stability and may foster a culture of dependence that generates no sense of belonging. The model's response is to conceive income not as an abstract monetary transfer but as a social dividend grounded in the supply of goods and services that robotic productivity has actually expanded in real terms; income is the sharing of the productivity surplus, not a printing of money severed from productivity. Because this logic ties the source of the distributed welfare not to borrowing but to the production base that automation has in fact enlarged, it structurally constrains inflationary risk (Van Parijs & Vanderborght, 2017). Against the critique of passivity, the model positions the individual as a constitutive partner in cooperative ownership, distributed entrepreneurship, and human–machine collaborative workspaces; here income security is not a dependency trap but a foundation of freedom that enables the individual to take risks, to be retrained, and to make creative contributions (Standing, 2017; Sen, 1999).

The second objection is that the model, by excessively expanding state capacity, may produce a cumbersome, inefficient bureaucratic structure that stifles innovation. This objection, too, is apposite; for the line between the strategic state and the cumbersome state is thin, and historical experience has shown that overly centralized models weaken dynamism. The model's response is to position the state not as the sole actor in production but as a strategic coordinator that preserves the innovative force of the market and shapes its direction toward social benefit; the state does not substitute for innovation but functions as a pioneering investor in risky domains and sets the course (Mazzucato, 2018; Acemoglu & Johnson, 2023). Even so, this critique clearly demonstrates that the model must incorporate mechanisms of transparency, accountability, performance auditing, and the distribution of authority into its institutional architecture from the outset. A sixth objection, which sharpens this point still further, is that the model implicitly presupposes a competent and honest state; whereas in many orders institutions are susceptible to corruption and to capture by narrow interest groups. The model's response is to treat institutional quality as a goal as much as a precondition; rather than taking good governance as given, it makes transparency, independent oversight, judicial guarantees, and the dispersion of power inseparable parts of the architecture (Fukuyama, 2014; Easterly, 2001).

The third objection holds that the democratization of robotic ownership may generate new relations of debt, and that digital welfare systems, by enhancing surveillance capacity, may turn into a control state. This warning is exceedingly important; for the same technological infrastructure that can serve as an instrument empowering the citizen can equally turn into a mechanism that continuously monitors them. The model's response is twofold: digital welfare and data systems must be designed together with robust data rights, algorithmic transparency, independent judicial oversight, and the individual's right of control over their own data; while cooperative and participatory ownership must be established not on a debt basis but

on the basis of the direct social sharing of the productivity surplus (Zuboff, 2019; Couldry & Mejias, 2019). The seventh and, from a philosophical standpoint, most fundamental objection is that the concept of human dignity on which the model rests is not a neutral fact but the choice of a particular ethical tradition. This objection is justified; for no institutional design is value-free. The model's response is, rather than concealing its normative commitment, to embrace it openly and to present its grounds in a manner open to reasoned scrutiny; moreover, the minimal intuition that the human being must not be reduced to a means rests upon a broad common ground that different traditions can endorse from within their own resources (Sandel, 2020; Nussbaum, 2011).

The fourth objection, and the most demanding from an implementation standpoint, concerns the difficulty of the model being implemented by individual nation-states within an environment of global technological competition; the cross-border mobility of capital may push a state acting alone into a competitive disadvantage and may fuel a downward race in regulation. This objection explains why the global governance dimension of the model is indispensable; yet the model's central claim retains its validity: the institutional architecture is implementable in any nation-state, and the implementing country, by socializing the surplus of robotic productivity and thereby strengthening domestic demand, social stability, and the quality of human capital, attains in the long run not a competitive disadvantage but a sustainable competitive advantage (Rodrik, 2023). The fifth objection is that the technological foresight on which the model rests may be exaggerated, and that automation will not entirely eliminate employment; yet the validity of the model is not contingent upon the materialization of mass unemployment: because the model advocates the fair sharing of productivity gains and the cushioning of the insecurity engendered by the transformation even if permanent unemployment does not materialize, it retains its meaning and is a flexible design adaptable to differing speeds of transformation (Brynjolfsson & McAfee, 2014; Ford, 2021).

What renders the model integral is that it also encompasses the eighth and ninth objections. The eighth objection is that the productivity surplus to be distributed may strike an ecological ceiling; that the energy consumption of data centers and the carbon footprint of digital infrastructure may be unsustainable. The model internalizes this objection by defining the productivity surplus not through quantitative growth but within ecological limits; because the human-centered mixed economy targets not boundless material growth but human development, it is structurally disposed to make energy efficiency, circular production, and sustainability part of the distributive logic (Jonas, 1984; Beck, 1992). The ninth objection is that the transformation may be obstructed by the powerful interest groups that stand to be most harmed by it, or that the institutions may be captured by being hollowed out of their content; this objection compels the model to be treated not merely as a technical design but at the same time as a matter of political strategy. Configuring reform in stages, ensuring that each step delivers concrete benefit to broad segments, and mobilizing the active support of the majority that will gain from the transformation constitute the fundamental means of weakening the coalition of resistance (Streeck, 2016; Rodrik, 2023). The tenth and most subtle objection is that economic security may prove insufficient to resolve the deeper crisis of meaning and identity engendered by the robotic age; the model's response is to treat the problem of meaning not as a defect but as a central part of its solution, and to redefine education not as mere preparation for employment but as the capacity to construct a meaningful life (Frankl, 1959; Sandel, 2020).

6.2. Comparative Institutional Implications

The robotic age produces not a single civilizational model but distinct, mutually competing models of technology governance; the originality of the present model becomes visible in its selective drawing upon all of these models. Anglo-American technology capitalism, while strong in terms of market dynamism and the pace of innovation, also brings with it the risks of income concentration and middle-class erosion (Acemoglu & Johnson, 2023). China's state-backed model, while offering capacity for strategic coordination and rapid scaling, raises serious questions with respect to surveillance and individual liberties. The European Union's ethical regulation model develops a pioneering normative framework in data rights and algorithmic transparency, yet may encounter difficulties in terms of the pace of innovation (Bradford, 2023). The strategic technocrat models of countries such as Singapore and South Korea are instructive with regard to the coordination of state capacity with technological investment; while the Scandinavian social-technology approach demonstrates that a strong social state and digital transformation can be conducted together (Esping-Andersen, 1990).

This comparison offers a critical theoretical lesson: no model is ideal on its own, because each one, while strengthening one dimension of the balance among state, market, and society, neglects the others. The originality of the human-centered mixed economy model lies in its aim to unite, along the axis of human dignity, the innovative dynamism of the Anglo-American model, the ethical regulatory capacity of the European model, the strategic coordination ability of the East Asian model, and the conception of social security of the Scandinavian model. The answer to the question of which model will prove sustainable lies not in mere technological superiority but in the ability to combine technological capacity with social stability and democratic legitimacy. This synthesis offers a flexible framework that any nation-state can adapt to its own historical and institutional conditions; for the model's fundamental principle rests not upon a particular political geography but upon the shared structural logic of the robotic transformation (Mazzucato, 2018; Bradford, 2023).

6.3. Multi-Scalar Governance and the Global Dimension of the Model

The national applicability of the model is strengthened when it is completed by its global dimension. The robotic transformation does not affect all countries with the same capacity; countries lacking technological infrastructure and data-processing capacity may, by largely ceding to external actors the data their own citizens generate and the value that this data produces, become the periphery countries of the digital age. This situation may lead to the reproduction of the classical core–periphery relationship in a digital form, indeed to a kind of digital colonization (Couldry & Mejias, 2019; Bradford, 2023). A concrete tension accompanying this is the problem of coordination in the international taxation of technological gains: because companies can shift their profits to the jurisdictions with the lowest taxation, a downward tax competition emerges among states, and all of them at once may be deprived of the public resources required for the sharing of technological welfare. Minimum corporate tax standards and international accords concerning the taxation of digital value at its source are the concrete instruments of this coordination (Piketty, 2020; Rodrik, 2023).

These implications demonstrate that governance must be established not at a single scale but in an architecture composed of interlocking layers. The nation-state continues to be the fundamental unit that protects the rights of its own citizens, socializes the productivity surplus, and invests in human capital; for democratic legitimacy and accountability can be organized most robustly at this scale. The layer of regional cooperation offers a complementary intermediate plane that, through common standards and common markets, augments the limited bargaining power of individual states in the face of global flows. The global level, in turn, encompasses the common frameworks that address problems no country can solve on its own—namely, cross-border data flows, digital taxation, and the climate–technology intersection (Held, 1995; Rodrik, 2023). An original theoretical emphasis is required here: these layers are not mutually competing but mutually reinforcing planes; when sovereignty and cooperation are conceived as complementary rather than mutually exclusive principles, the model can be implemented at the national level, strengthened through regional cooperation, and brought to integral wholeness through global frameworks. In this multi-scalar architecture, the nation-state is not inevitably condemned to dissolution; yet its survival is contingent upon its developing new capacities such as data sovereignty, public digital infrastructure, and strategic technological independence (Castells, 2010; Zuboff, 2019).

6.4. Theoretical and Political Implications

The theoretical contributions of the study may be gathered along seven axes. The first is the formulation, as an original paradigm, of the human-centered mixed economy model that unites the innovative force of the market with public responsibility. The second is a theory of a robotic welfare state, financed through the socialization of the robotic productivity surplus and moving beyond the assumption of full employment. The third is an approach to middle-class sustainability that treats the dissolution of the middle class as the central problem of democratic stability. The fourth is a synthesis of post-labor citizenship and digital citizenship that redefines economic citizenship beyond wage employment. The fifth is a contribution to a post-industrial class theory that analyzes data, algorithm, and digital capacity as the axes of a new social stratification. The sixth is an approach to an ethical technology state that subordinates technology to human dignity. The seventh, finally, is a paradigm of robotic civilization that unites all of these axes within a single integrated framework (Acemoglu & Johnson, 2023; Mazzucato, 2018; Sen, 2009).

The common feature of these contributions is that they unite the debate on automation and employment, the theory of the social state, the political philosophy of the digital age, and analyses of civilization within a single holistic framework. The study's most distinctive contribution to the literature is that it transforms the employment problem of the robotic age from a matter of technical unemployment into a problem of civilizational design; thus the problem is reframed as a matter to be addressed not solely through economic policies but through the whole of the institutional, ethical, and political architecture. At the political level, this requires thinking about the transformation together with the question not only of what must be done but also of with which coalition and in what sequence it can be realized; for even the most coherent institutional design remains on paper when it fails to take into account the strength of the political coalition that is to bring it to life (Streeck, 2016; Esping-Andersen, 1990). The model's combination of a normative vision of civilization with an implementable institutional design—by explicitly establishing the theoretical transitions between the two—rescues it from being either a merely abstract utopia or a theory-less bundle of policy proposals.

6.5. Limitations and the Future Research Agenda

The limitations of the study must be openly acknowledged. First, as a conceptual-theoretical work, the article offers no direct empirical evidence concerning the effects of the model; the future empirical testing of the mechanisms it proposes is an open research agenda. The measurement of robotic productivity, the calculation of the value to be socialized, and the modeling of the fair distribution of the data dividend may require new methodologies beyond existing economic measurement instruments (Brynjolfsson & McAfee, 2014). Second, the model's claim to universal adaptability does not exclude the fact that local institutional, cultural, and fiscal contexts will differentiate its implementation; how countries at differing levels of development might gradually bring the model to life is a domain awaiting deepening through comparative and country-based studies (Rodrik, 2023; Easterly, 2001). Third, the institutional quality, democratic oversight, and political-coalition conditions upon which the model's success depends call for a closer dialogue with the literatures of institutional economics and comparative politics.

These limitations point to a fruitful future research agenda. The governance design of the robotic welfare fund, the institutional architecture of data cooperatives, the non-inflationary financing conditions of a digital citizenship income, and the risk-sharing mechanisms of participatory ownership models each merit separate empirical and institutional research programs. Likewise, the global dimension of the model can be integrated with the literature of international relations and global governance in such areas as international tax coordination, digital sovereignty, and the global sharing of the benefits of technology (Held, 1995; Bradford, 2023; Milanovic, 2016). The open declaration of the limitations does not weaken the study's contribution; on the contrary, it opens up a fruitful agenda concerning how a theoretical framework can be carried forward through empirical and comparative research. The following section, in light of this discussion, presents the concluding assessment that integrates the study's findings and its central thesis.

7. Conclusion

This study has analyzed the multilayered structural transformation engendered by the incipient withdrawal of human labor from the center of economic value in the age of robotic artificial intelligence, and has developed a human-centered mixed economy model in response to this transformation. The central thesis sustained throughout the study is that the anxiety of unemployment and precarity in the robotic environment is not an inevitable destiny of technology but a choice of institutional design. Historical experience corroborates this thesis: in the transition from agrarian to industrial society, the mass deprivation initially produced by mechanization eventually gave way, through the construction of distributive institutions, to the emergence of a broad middle class—thereby demonstrating that the social outcome of technological transformation is determined not by technology itself but by the institutional architecture that surrounds it. The robotic age, too, stands before the same fork: productivity will either be concentrated within a narrow propertied elite or be diffused to broad segments of society through institutional channels.

7.1. An Integrated Synthesis of the Findings

The findings of this study are not mutually independent issues but rather distinct dimensions of one and the same historical

transformation. As demonstrated at the diagnostic level, the robotic threshold differs qualitatively from prior technological ruptures, for on this occasion the segment under threat is not solely those engaged in manual labor but the educated professionals who constitute the very core of the middle class; and what is at stake is not a transmutation in the form of labor but the systemic erosion of its economic centrality (Autor, 2022; Eloundou, Manning, Mishkin, & Rock, 2024). This erosion gives rise to mutually reinforcing systemic consequences in the form of income instability, fiscal-base erosion, wealth concentration, and the imperilment of democratic legitimacy (Zuboff, 2019; Milanovic, 2016). At the level of model construction, six institutional pillars stand against these risks—namely, a national robotic welfare fund, a tax architecture adapted to robotic productivity, participatory and cooperative ownership, data cooperatives and a data dividend, a lifelong skills infrastructure, and a digital citizenship income grounded in economic citizenship—which together constitute a single integrated architecture interlocking with one another (Mazzucato, 2021; Atkinson, 2015; Van Parijs & Vanderborght, 2017).

The integrated logic of these pillars furnishes the foundation of the study's central finding: when the labor demand diminished by robotic productivity and the augmented value produced by machines are severed from one another within the classical order, the result is mass unemployment and deepening inequality; the human-centered institutional architecture, by contrast, reconnects these two flows to one another. When the value produced by machines is partially channeled into public welfare by means of the welfare fund and the productivity contribution, the human labor thereby liberated can be redirected toward domains of high social value such as care, education, culture, environmental restoration, and community-based production. In this manner, diminishing labor demand is transformed not into a process of exclusion but into one of redirection—into shorter working hours, more meaningful spheres of labor, and a broader base of welfare (Keynes, 1930/1963; Arendt, 1958; Sen, 1999). This is the institutional correlate of the principle that constitutes the normative core of the study: technological efficiency cannot be substituted for human dignity.

7.2. The Central Thesis and Universal Adaptability

The central thesis of the study is that the social order to be produced by the robotic transformation will be determined not by technology itself but by the ownership structure of productive assets and the distributive architecture of productivity gains. If data, algorithms, and robotic means of production come to be concentrated within a narrow segment, the order that emerges may evolve toward a new hierarchy dominated by a handful of digital seigneurs, within which broad segments are rendered precarious; if, conversely, the ownership of these productive assets is diffused to broad segments and productivity gains are socialized through institutional mechanisms, the very same technological capacity may be transformed into the wellspring of a broad-based common welfare (Varoufakis, 2023; Standing, 2011). The human-centered mixed economy model is a theoretical choice that aims to institutionalize the second path at this bifurcation; and to demonstrate that this choice will be made not by technology but by the will of humanity is also to disclose where responsibility ultimately lies.

The scope of this thesis is universal. The dynamics here analyzed pertain not to any particular country but to the structural tendencies of any nation-state entering the robotic age, whatever its level of development, for the fundamental logic of the model rests not upon a specific political geography but upon the shared structural logic of the robotic transformation. Whereas technologically advanced countries are able to convert the vast surplus brought forth by robotic productivity into comprehensive welfare and social-dividend mechanisms, middle-income countries can transform the robotic transformation into an opportunity for a developmental leap rather than into a dependency by integrating the model's components of strategic public entrepreneurship, skill formation, and cooperative ownership with their own developmental priorities; countries of comparatively limited capacity, in turn, can sow the seeds of the model through such fundamental steps as safeguarding data sovereignty, investing in human capital, and organizing access to robotic technologies around the axis of social benefit (Rodrik, 2023; Easterly, 2001; Sen, 1999). What is decisive is that each country be able to implement the principles of the model in a graduated manner in accordance with its own conditions, for the model is not a uniform prescription but an adaptable architecture.

7.3. The Historical Threshold and the Horizon of the Future

Humanity stands at the threshold of a third great civilizational transformation, following the agrarian and industrial revolutions; yet, unlike the preceding thresholds, the direction of this transformation depends in large measure upon humanity's conscious institutional choices, for technology is not a destiny but a possibility whose meaning is determined by the values and institutions invested in it (Harari, 2018; Jonas, 1984). The stance adopted by this study is neither a prophecy that technology will inexorably drive humanity toward ruin nor a passive optimism that the market will spontaneously resolve every problem; departing from both extremes, it maintains that the future is not a predetermined destiny but a field of possibilities that can be shaped by the choices of humanity. The old labor-based social settlement is dissolving, while the new one has not yet been established; this interregnum is a fragile transitional phase in which uncertainty and social tension intensify, and the new settlement will be established not spontaneously but through conscious institutional design, normative choice, and social deliberation.

The successful traversal of this threshold is not merely a matter of policy design but, at the same time, a matter of social solidarity and common will, for even the most coherent institutional architecture cannot prove durable absent the social trust and the will to act in concert that would sustain it. For this reason, the ultimate promise of the robotic age lies not in rendering the human being unemployed and superfluous, but in its potential to deliver the human being into a freer, more dignified, and more meaningful existence beyond the realm of compulsory labor; an age in which work recedes may signify not the devaluation of the human being but the rediscovery of that human depth which machines cannot replace—namely, creativity, the generation of meaning, care, and social solidarity. The maturity of a civilization is revealed in its consciousness of being able to measure itself not solely by its present attainments but also by the world it will bequeath to coming generations.

In conclusion, artificial intelligence and robotic technologies represent an inevitable future for humanity; how this future will be shaped, however, is by no means predetermined. Humanity stands at a crossroads: on one side lies the prospect of a world in which technological power is governed by the logic of limitless competition, in which inequalities deepen, and in which the human being is subordinated to algorithmic systems; on the other side lies a more ethical model of civilization in which technological capacity is directed in accordance with the principles of human dignity, social justice, and sustainable life. This study has sought to demonstrate that

the second path is not only desirable but also institutionally constructible. Genuine progress in the robotic age will consist not in transforming the human being into the passive object of the economic system but in fortifying the human being's creativity, freedom, and capacity for social solidarity. For this reason, the ultimate question of the robotic age concerns not technology but humanity itself; and how this threshold will be crossed will be determined less by the power of technology than by the ethical maturity, institutional capacity, social solidarity, and will to safeguard human dignity that humanity is able to summon.

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