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Artificial intelligence (AI) and macroeconomics: Theoretical reconstruction, mechanism analysis and policy framework

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Abstract
The Fourth Industrial Revolution uses artificial intelligence as its fundamental core technology which transforms how the macroeconomy functions through its operational system. The paper explains how AI transforms household behavior and business operations and government operations and foreign sector activities through the traditional four-sector macroeconomic analysis. The paper argues that AI functions as an independent factor which should join the classical four factors of production system. The research develops an extended production function which integrates AI capital as a vital element. The research demonstrates that AI enables macroeconomics to shift from human-only decision systems toward human-machine collaborative decision systems through its impact on total factor productivity and its ability to modify how income from factors is distributed and its effects on the structure of aggregate supply and demand and its role in monetary and fiscal policy transmission systems. The research paper explores multiple critical elements which include the AI era defects of GDP accounting system and the labor market structural transformations and the financial system stability and the worldwide economic system changes. The research combines SSCI literature evidence with policy optimization methods that create a balanced system between operational efficiency and social fairness and economic stability. The research provides academic evidence which supports the development of new economic theories and their practical application through policy implementation.

Keywords: Artificial intelligence, macroeconomics, the fifth factor of production, gdp accounting, income distribution, monetary policy, fiscal policy

Introduction

The Keynesian Revolution of the 20th century established macroeconomics as the study of four fundamental units which include households and firms and the government and the foreign sector. The classical analytical framework of equilibrium in the commodity market and factor market and loan market operates through four core variables which include national income and employment and price and economic growth (Keynes, 1936) [20]. The implementation of generative AI technologies together with large-scale machine learning systems has produced fundamental changes which affect how production works and how decisions are made and how factors operate and how markets function. The first three industrial revolutions introduced the steam engine and electricity and information technology which focused on changing physical work and basic mental tasks but AI operates as a fundamental system which learns independently and duplicates itself without competition while using data to enhance its performance across all economic sectors (Acemoglu, 2024; Brynjolfsson *et al*., 2023) [1, 8]. Three fundamental issues challenge modern macroeconomic theory because its traditional factor framework fails to explain AI-induced increasing returns to scale and intangible asset value generation. The GDP accounting system excludes free digital services together with data assets and quality enhancements which results in an inaccurate measurement of the digital economy (Aldasoro *et al*., 2024) [13]. The traditional factor distribution theory together with social stability foundations face challenges because of three major economic changes which involve labor market erosion and superstar firm dominance and rising income gaps. The technical tools of AI enable precise monetary policy predictions which help fiscal policies become more effective while creating an optimized green economy system that transforms macro-control into an active system which predicts future events.

The paper establishes its main argument that AI transforms macroeconomics through a research process which starts with theoretical reconstruction before moving to mechanism analysis and then policy optimization. The research establishes its boundary by studying how AI systems affect macroeconomic variables and policy frameworks through the analysis of micro-subject behavior and macro-equilibrium results. The research method primarily uses theoretical deduction which researchers support through empirical evidence obtained from SSCI journals. The research presents a new analytical system which unites macroeconomic theory with AI applications to solve the academic separation between theoretical knowledge and actual practice while creating an academic foundation for policy development.

Literature Review

Three separate research streams about AI macroeconomic effects have emerged among international scholars. The task-based model of Acemoglu & Restrepo (2020) [2] demonstrates that AI produces two opposing effects on production efficiency through its ability to replace human work and its ability to generate new work tasks. The production function shows diminishing returns when AI functions as a separate production element which operates independently from other factors. The research of Korinek & Stiglitz (2025) [21] demonstrated that AI and data establish an interdependent system which follows the knowledge diffusion patterns found in endogenous growth theory because they possess non-competitive qualities and their

value grows over time. The OECD (2025) [26] conducted an empirical study using G7 country data which demonstrated that AI investment produces an annual increase of 0.8 to 1.5 percentage points in total factor productivity growth while showing different effects across various industrial sectors. Melina & Villa (2025) [24] confirmed through DSGE models that AI-driven ICT capital deepening modifies the natural interest rate while simultaneously changing how monetary policy affects economic systems. The labor market together with distribution systems stand as the third perspective which Athey & Scott Morton (2025) [4] used to demonstrate how AI creates higher market dominance which allows top-performing companies to generate additional profits while their employees receive lower wages which produces larger wealth differences between people. Moosa (2025) [26] created a detailed classification system which shows how AI produces both positive and negative effects on inflation rates and employment levels and financial system stability while showing how institutional rules affect these outcomes.

Researchers in China study how artificial intelligence technology connects with the country's economic development structure at a national scale. The research of Jiang Wei and his team (2025) [18] used international data to prove that AI technology enables middle-income nations to overcome the middle-income trap through their industrial development but simultaneously creates greater job market segregation. Huang Yiping (2023) [15] studied how digital economy accounting methods based on GDP failed to work properly so he suggested creating a separate account for data assets. Liu Shangxi (2024) [23] analyzed digital tax system advancement through fiscal policy evaluation of AI tax implementation. The current domestic research environment concentrates on individual topics but it fails to build a complete system which unites macroeconomic structures with worldwide economic research through its insufficient empirical studies.

Research studies have identified three major gaps in current AI macroeconomic research which shows how AI disrupts the macroeconomy. Research fails to provide an all-encompassing macroeconomic framework which includes AI elements. The research on GDP accounting together with policy tools and international coordination remains scattered across different studies. The research field has no organized studies which connect theoretical development with empirical data and policy application. The traditional four-sector framework serves as the foundation for this research which adds a fifth production factor and includes 15 fundamental components while adding SSCI-based empirical data to connect theoretical development with practical policy applications.

The Reshaping Mechanism of AI on the Traditional Four-Sector Framework

The core sectors of traditional macroeconomics consist of households and firms together with the government and foreign trade activities. Every sector in the decision-making process experiences AI penetration which creates new behavioral patterns that produce different equilibrium results. Households which function as both workers and consumers base their choices on their desire to maximize happiness and their available financial resources. The AI era brought three major changes to how people behave at home which include algorithmic decision systems for consumption and intelligent recommendation systems that help people find things better while shaping their choices through information bubbles which determine how people spend their money based on algorithm spread (Mehrotra, 2024) [13]. The labor market now operates through flexible work arrangements which enable people to work remotely and use gig economy platforms while task-based contracting has become the dominant employment method which allows workers to choose their work schedule and location and employment type. The professional savings and investment sector experiences change because robo-advisors have made their services available to more people while they create better asset distribution methods which reduce the need for safety funds and rewrite how families plan their financial future between present and future needs (Melina & Villa, 2025) [24]. The utility function requires addition of algorithm recommendation variables during this period while the labor supply function needs platform participation indicators as part of its structure.

The traditional production system which used capital and labor now includes data and AI components to form a new production system. Machine learning enables intelligent production decision-making through its ability to achieve complete autonomy in demand forecasting and dynamic pricing and supply chain optimization operations (Acemoglu, 2024) [1]. The core business strength now depends on intangible core assets together with algorithms and AI models and data systems while companies maximize their profits through data size and algorithm efficiency and speed of testing changes instead of relying on conventional resource distribution methods. The combination of increasing returns to scale and free AI model duplication and network effects allows companies to overcome the rising cost of production and dominate their markets through a winner-takes-all system (Athey & Scott Morton, 2025) [4]. The production function requires an update which should include AI capital because marginal returns no longer follow the typical pattern of decreasing returns.

The government now focuses on creating institutions and exact rules instead of fixing markets after they have already failed. AI technology enables intelligent public services which use the system to perform tax audits and distribute welfare benefits and control traffic operations while achieving better administrative performance and cost reduction. The government needs to develop digital competition rules and tax systems because institutionalized regulatory challenges now exist alongside new problems which include algorithmic discrimination and data monopoly and cross-border profit shifting (Korinek & Stiglitz, 2025) [21]. The system achieves precise macro-control through AI which enables economic forecasting and policy simulation and risk monitoring to transform from manual decision-making into automated rule-based systems with intelligent capabilities. The government sector has experienced two major transformations because AI technology now operates through new production functions and different policy tools.

The foreign sector functions as a boundary which open macroeconomics defines to control international trade of goods and financial capital movements and currency value changes and global economic policy synchronization. The analytical framework of open macroeconomics uses comparative advantage together with factor endowments and tariff barriers and the permanent establishment principle and traditional balance of payments statements to study the foreign sector (Krugman & Obstfeld, 2009) [22]. The system bases international labor division on physical commodity

manufacturing and standardized service delivery and tangible capital movement which produces an overall connection through GDP and trade numbers and currency exchange values and financial market interest rates and foreign currency holdings. The foreign sector experiences a complete transformation because foreign sector behavior along with decision-making processes and equilibrium results undergo fundamental changes due to artificial intelligence which functions as a digital production factor and general-purpose technology. The foreign sector experiences a total transformation of its foreign sector behavior because artificial intelligence operates as a general-purpose technology together with digital production factors to transform foreign sector decision processes and foreign sector behavior and foreign sector equilibrium points across six core aspects which include trade structure and capital flow pattern and global value chain division of labor and international tax system and data sovereignty and monetary power. The development of modern AI technology has created a complete transformation of international trade because AI now functions as a fundamental economic element which determines how nations achieve their competitive advantages and which controls international business expenses and transforms national economic strength and establishes new international governance protocols (Korinek & Stiglitz, 2025; Aldasoro *et al*., 2024) [3, 21]. The foreign sector now follows an AI-driven behavioral pattern which transforms from "physical factor-based" to "data-algorithm-computing integrated-based" system. The modern global economy needs an updated macro open economy model which includes digital factor flows and algorithm service trade and AI capital deepening and cross-border data governance to understand its actual operational system.

1. Transformation of Trade Structure

Artificial intelligence creates its main impact by speeding up the transition of global trade activities from physical goods trade toward digital service trade which also produces incorrect trade statistics in conventional trade data systems. The initial phase of AI development focuses on creating export products which include algorithm licensing services and cloud computing power and model invocation and data labeling and intelligent customer service and automated design systems. The services operate outside customs control because they do not require physical movement of goods and they maintain operational expenses which approach zero and they provide worldwide immediate access without competition between users (Brynjolfsson *et al*., 2023) [8]. A general large model which one country developed provides global enterprises with API-based inference services but its revenue stream comes from service exports which BOP statistics group under "other business services" and these services remain difficult to track at a detailed level. The OECD (2025) [26] report shows that AI-related digital service trade has increased its share of worldwide service trade from 12.3% in 2019 to 21.7% in 2025[30]. The trade sector experiences an average yearly expansion which exceeds 15% to produce this growth rate. The trade sector experiences an average yearly expansion which exceeds 15% to produce this growth rate. The trade sector experiences an average yearly expansion which exceeds 15% to produce this growth rate.

The second point explains how AI technology operates through various international business sectors which include cross-border e-commerce and global supply chains and international logistics and cross-border payments to decrease operational expenses while expanding digital trade volume. Small businesses and medium enterprises and micro-enterprises can access global markets through AI technology which enables demand forecasting and production scheduling optimization and path optimization for international shipping and price adjustment systems. The new system enables trade subjects to operate through multiple small and medium business platforms which stand in contrast to traditional multinational corporation operations (Gomez-Herrera & Martìnez-Zarzoso, 2024) [13].

The export function for traditional businesses undergoes a transformation because exports now depend on foreign income and real exchange rate and trade barriers and platform penetration and algorithm matching efficiency and data availability and cross-border digital regulatory intensity.

The third problem emerges because traditional trade numbers fail to show how AI technology enhances product quality and expands product selection options. The US dollar-based statistical system fails to show how export product quality improvement leads to actual economic growth because it ignores the full value of technological progress in manufacturing processes and design methods and quality inspection and marketing operations (Aldasoro *et al*., 2024) [3].The US dollar-focused statistical system fails to show the actual economic impact which quality improvement activities create in terms of national economic growth. Traditional methods for calculating real exports and terms of trade and current accounts contain built-in inaccuracies which lead to wrong assessments about a nation's international financial position and its ability to control its economy.

AI technology enables trade structure digital transformation which simultaneously reduces export and import response to exchange rates and foreign market demand but increases their reaction to digital infrastructure and data openness and algorithm competitiveness and regulatory mutual recognition systems. The Mundell-Fleming model from traditional times shows that net exports depend primarily on real exchange rates and foreign income yet digital factor endowments now serve as the main determinant of trade performance during the AI era.

2. Restructuring of Cross-Border Capital Flows

The way artificial intelligence transforms international capital flow patterns through its influence on five distinct aspects which include speed of capital movement and types of assets moved and market stability and basic motivators and control requirements for regulations. The world now experiences rapid international capital flows which operate through complex digital systems that produce fast algorithmic trading results. The primary capital movement system now operates through investments which include AI technology and data assets and digital platform shares and computing system power. Multinational companies now use global expansion strategies which go beyond traditional factory building and acquisition-based growth to include algorithmic production and data sharing and platform integration and shared modeling and power rental services (Korinek & Stiglitz, 2025) [21]. Foreign direct investment (FDI) through this investment approach does not create fixed capital assets which follow conventional patterns yet it enables businesses to maintain their profit return and

technology ownership which appears as service or investment revenue in balance of payments statements. The actual amount of international capital control power which countries possess does not show up in FDI statistics because of this situation. The second major factor involves AI-based high-frequency trading along with algorithmic arbitrage and cross-market hedging which enables capital to move at millisecond speeds while producing strong market impacts that spread rapidly through short-term financial systems. Traditional capital flows adjust on a daily, weekly or monthly frequency, while AI trading systems can monitor global foreign exchange, stock, bond and derivative markets simultaneously, and withdraw instantly once risk signals appear, triggering "sudden stop" and currency panic (Jeanne & Korinek, 2025) [17]. The uniform algorithmic systems which control market activities create conditions that make emerging markets more likely to experience severe capital flow changes while capital control systems fail to establish efficient monitoring systems.

Third, AI revolutionizes the decision-making process for cross-border investment because it transforms the way rules operate and how expectations develop. The investment models now include high-dimensional data which contains machine-readable news and public opinion analysis and satellite images and credit card transactions to replace institutional subjective judgment with algorithmic data-driven systems. Mainstream global funds which operate with identical AI models will produce synchronized expectations and identical transactions which will create higher market volatility thus resulting in cross-border capital flow patterns known as "procyclical overshooting" (Melina & Villa, 2025) [24]. The traditional interest rate parity and risk premium and portfolio theory models show reduced explanatory ability so the cross-border capital flow function needs three additional variables which include algorithm strategies and data availability and model consistency. The fourth solution enables digital assets and stablecoins to transfer international money through unregulated channels which avoid regulatory detection. The combination of AI and distributed ledger technology enables value transfer to bypass the traditional banking system, making it difficult for regulators to track the source and destination of funds. The effectiveness of capital controls will decrease for emerging economies while their monetary policy control over exchange rates will create an escalating conflict between these two economic policies (IMF, 2025) [26]. AI has completely changed how international funds travel between countries because it now operates at breakneck speeds through multiple channels with algorithmic trading and parallel processing which makes external systems more defenseless while reshaping all balance of payment relationships.

3. Restructuring of Global Value Chains

The reshaping of global value chains (GVCs) by artificial intelligence is reflected in a comprehensive shift in division of labor logic, power structure, income distribution and geographical layout. The worldwide production network follows the sequence of R&D operations and manufacturing and assembly and marketing activities according to its established structure. The research and development operations together with brand management functions operate from developed nations although processing and assembly activities take place in developing countries. The division of work between countries depends on their workforce expenses and their available natural resources and their state industrial development programs (Gereffi *et al*., 2005) [11]. The value chain has shifted from production links to data control and algorithm management and platform ecosystem maintenance and standard development which created a global value chain based on the "data chain" (Acemoglu, 2024) [1].

AI technology establishes stronger control over the initial market segments which leads to total domination of all market segments by a single market leader. The ability of tech giants to control major models and computing resources and user information enables them to deliver worldwide services through minimal additional costs which creates pressure on domestic platforms and algorithm-based businesses throughout different nations. The pattern of oligopoly emerges because these companies take the position of "chain leader" in the market. Value chain income is highly concentrated in a few enterprises mastering AI technology, the income of processing and manufacturing links is further compressed, and the path for developing countries to upgrade by embedding traditional GVCs narrows (Athey & Scott Morton, 2025) [4]. AI technology leads businesses to create shorter supply networks which they establish within their local regions. Smart factories along with automated production systems and demand forecasting technology enable companies to reduce their need for cheap labor while multinational corporations choose to relocate their operations closer to home through nearshoring and friendshoring strategies to protect their supply networks and lower their transportation expenses and avoid political conflicts. The transformation of global value chains led to a shift from "globalized lengthening" toward "regionalized shortening" which impacts how countries export their foreign value-added content and trade their products (Bonadio *et al*., 2024) [13].

The implementation of data localization policies together with digital sovereignty regulations establishes new value chain distribution patterns which determine how value chains operate across different regions. Multiple countries have adopted data localization and algorithm filing requirements and cross-border data review procedures to defend their data security and tax rights and algorithmic decision systems which forces international AI companies to create computing facilities and data storage centers and service operations within each country they enter. The institutional segmentation process creates distinct regional digital markets which replace the previous global market unity to establish new patterns for foreign sector transaction costs and business location decisions (Goldfarb & Tucker, 2023) [12]. The digital transformation of worldwide value networks creates three main effects on the macroeconomic environment because TiVA accounts don't show digital factor income correctly and exchange rate changes no longer affect export competitiveness and industrial policy now supports data and algorithm development and computing power and talent acquisition. International spillover effects shift from "demand spillover" to "technology spillover, data spillover and regulatory spillover".

4. Impact on the International Tax System

The world of international taxation faces three main crises because of artificial intelligence together with the digital economy which have caused tax base erosion and profit shifting and broken the territorial principle. The foreign

sector has seen its government actions change because of these three major crises which have transformed international taxation. First, AI enterprises can provide services and obtain profits across borders through the cloud, APIs and cross-border data without setting up physical premises in host countries. The permanent establishment rule fails to tax digital platform operations and AI model operations because it depends on physical presence which digital businesses do not require. Organizations use this method to move their earnings to countries that have lower tax rates (Auerbach *et al*., 2025) [26].The International Monetary Fund predicts that digital businesses lose over 300 billion US dollars every year because of their cross-border profit shifting activities during 2025[26]. The proportion of AI-related businesses has increased during this time.

Second, data, algorithms, intellectual property rights and user value become the core sources of profit creation, but it is difficult to reasonably allocate taxation rights between countries. AI enterprises tend to store their most valuable algorithms and data assets in tax havens while operating their less profitable business activities within market nations which prevents these countries from taxing their value creation activities (Devereux & Vella, 2024) [9].The system operates against established principles which support fair taxation while it reduces the amount of money host nations can collect through taxes and their ability to distribute public resources. Third, AI supports worldwide discussions about three main tax rules which include the global minimum tax and digital service tax and data tax regulations. The OECD/G20 Base Erosion and Profit Shifting (BEPS) 2.0 framework solves tax base erosion through a global minimum tax set at 15% but continues to face multiple disputes about how to value intangible assets and how to distribute costs and assign profits in AI businesses (OECD, 2024) [10]. Multiple nations have established digital service taxes which have resulted in trade wars between countries and created conflicts throughout the international system. International tax coordination has developed a new focus to decide if separate taxes should exist for AI services which cross borders and for data movement and algorithm-generated earnings.

The restructuring of international tax rules directly shapes macro equilibrium through four main channels which determine enterprise cross-border investment location and multinational corporation profit repatriation and current account performance and government tax revenue generation and fiscal sustainability and the likelihood of international policy coordination and trade disputes. The international strategic value of taxation has been established through AI which transformed domestic policy into a global operational system. Foreign sector governments have shifted their approach to digital tax rules because they now actively create these rules instead of following established regulations.

5. Data Sovereignty and Cross-Border Governance

The development of artificial intelligence technology has established data as the main operational asset which organizations now consider their most essential resource. The foreign sector faces three main areas of competition which include international data transmission and information protection and algorithm evaluation and personal data security. Data exists as a dual-natured entity because it functions as an economic resource while serving as a vital element for national security. AI models produce their best results when they receive large amounts of diverse data because the organization which accesses more valuable international data will achieve better AI development and market leadership (Jones, 2026) [19].The protection of data and its availability to the public now forms a strategic concern which extends past economic considerations because it affects technological competition and industrial security and geopolitical matters.

The world currently operates with three different systems which govern data management through their distinct approaches to data governance. Different models face mutual recognition barriers which function as a digital trade barrier that blocks international AI service delivery and data sharing and collaborative research and development activities (Ferracane *et al*., 2024) [10]. Data sovereignty conflicts produce institutional changes which affect how the foreign sector operates. The international economic system depends on trade and investment and finance to operate. The AI era introduced four new institutional elements which consist of data governance systems and algorithm regulation systems and computing power protection measures and AI ethical standards. International organizations along with regional agreements and bilateral negotiations now focus their efforts on developing cross-border data regulations and AI risk management systems and algorithm transparency standards and secure computing power networks (WTO, 2025). The foreign sector produces the following effects on domestic economy through cross-border data systems which determine AI factor accessibility and total factor productivity international spillover and digital service trade expenses and foreign sector economic impact levels. The open economy model establishes data liquidity as a national economic measure which holds the same significance as capital liquidity and trade openness.

6. Transformation of the International Monetary System

The current international monetary system faces four major effects from Artificial Intelligence which affect payment systems and exchange rate development and monetary trust and international payment processing systems which drive foreign sector monetary behavior evolution. AI technology improves international payment systems through enhanced speed and it cuts down on foreign exchange transaction expenses. Smart contracts work through algorithm matching and real-time risk control to transform international payments from their current state of multiple connections and extended processing times and expensive fees into direct transactions which complete within seconds at affordable prices while diminishing the dominance of established payment networks and creating new patterns for currency usage and US dollar adoption (He *et al*., 2025).

AI and Central Bank Digital Currency (CBDC) work together to create new methods which banks use to settle their accounts while they fight to control national currency systems. The implementation of AI risk control and identity authentication systems will boost system performance through CBDCs which enable programmable payment functions and smart compliance operations and instant international transaction processing. The first countries which launch CBDCs and build international payment networks will achieve greater market control for their national currencies which will reduce US dollar dominance (BIS,2025) [26]. AI systems create two separate systems which control how exchange rates develop and how people

develop their exchange rate expectations. Machine learning models analyze large amounts of high-frequency data to forecast exchange rate patterns which produces steady market expectations while algorithms control brief exchange rate changes instead of using economic indicators (Melina & Villa, 2025) [24]. The explanatory strength of conventional exchange rate determination models which include purchasing power parity and interest rate parity and monetary approach has decreased. Economic forces now trigger exchange rate shifts which create unexpected extreme market movements and intricate market behavior.

The foundation of monetary confidence depends on AI competitiveness. The investment community selects nations for their long-term economic expansion and currency stability through their AI technological capabilities and their secure computing systems and their digital industrial market position. International capital tends to prefer currencies from AI-progressive nations while backward nations must endure ongoing currency depreciation and capital deterioration (Korinek & Stiglitz, 2025) [21]. The international monetary system has evolved because AI technology transformed its support structure which used to depend on "economic scale-financial depth-military strength" into a system that receives backing from "economy + technology + data + algorithm + CBDC". The international monetary system now distributes monetary power through an organized system which operates automatically. The complete adoption of AI requires the existing open macro model to include additional elements which will enable it to describe foreign sector equilibrium through expanded factor analysis and institutional and behavioral components. The transnational production function needs to include cross-border data and algorithm services and AI capital which operate as digital factors that expand production capabilities through their non-rivalrous nature and their ability to generate increasing returns to scale. The trade function requires expansion because exports and imports depend on foreign income and real exchange rate and digital infrastructure and data openness and algorithm competitiveness and platform ecology systems.

The explanation of high-frequency capital movements which follow economic cycles and maintain their direction requires the addition of algorithmic trading intensity and data asset return rate and AI regulatory risk and CBDC availability to the capital flow model. The balance of payments needs additional categories for digital service trade and data rent and algorithm licensing income and computing power import and export because these items generate statistical differences between current and capital accounts. The government now pursues international policy goals which include data protection and algorithm self-determination and fair taxation and technological market strength and national digital control in addition to their standard goals for external balance and currency value maintenance. The research expansion brings vital theoretical value because it establishes new principles which identify comparative advantage through data and algorithms and computing power and digital systems and AI professional skills. The transmission channels of external shocks experience a complete transformation because they now operate through trade and financial channels which have evolved into data channels and algorithm channels and platform channels. The global digital network facilitates rapid spread of macro policy effects because countries' AI regulations and data policies and tax rules and CBDC designs produce immediate effects on other nations' macroeconomic stability. International coordination between countries becomes increasingly important because AI technology produces extensive international impacts which single-country policies cannot effectively control without causing negative global consequences.

Theoretical Justification of AI as the Fifth Factor of Production

The established production system consists of four main elements which are labor and capital and land and the abilities of entrepreneurs. AI stands apart from these categories because it possesses unique factor characteristics which exist independently. AI operates differently from conventional capital depreciation and workforce training because it performs self-optimization through autonomous systems which generate continuous performance improvement without requiring human input (Acemoglu, 2024) [1]. AI models show non-rivalry and replicability because their trained versions become free to duplicate at infinite scale while they support various applications at the same time. The models demonstrate increasing returns to scale because they eliminate the typical declining returns which occur with conventional production resources (Korinek & Stiglitz, 2025) [21]. Companies require particular data types to achieve satisfactory results from their AI implementations through data complementarity. Organizations build value through AI adoption by using their data resources which create an expanding feedback system that connects data collection with AI development and user engagement to produce additional data for value creation (Brynjolfsson *et al*., 2023) [8].

The aggregate production function which includes AI capital emerged from endogenous growth theory to explain its development:

Y=F(L,K,N,E,A)

The function shows that “L” represents labor while “K” stands for conventional capital and “N” represents land resources and “E” shows entrepreneurial abilities and “A” represents AI capital resources. The combination of AI with human capital and data produces a function which shows growing returns to scale that creates a fresh economic growth driver for sustainable development (Jones, 2026). The OECD (2025) [19, 26] research shows that AI capital expansion by 1% results in 0.3 to 0.6% GDP growth which exceeds the response rate of conventional capital investments. The Fourth Industrial Revolution known as the AI Revolution brought a new type of industrial revolution which used to depend on three previous ones. The steam engine broke through physical limitations and electricity achieved economies of scale and information technology reduced information costs. AI technology started to substitute creative and decision-based mental work which resulted in the fast movement of the production possibility curve into new areas while it transformed how resources get allocated and it created essential changes to the policy system (Moosa, 2025) [26]. AI functions as a production subject which possesses decision-making capabilities instead of serving as a mere tool.

Disruptive Challenges of AI to GDP Accounting and Economic Measurement

The macroeconomic indicator GDP experiences major data inaccuracies because of artificial intelligence operations.

1. Connotation Changes of the Traditional GDP Formula (C+I+G+X−M)

1.1 Free AI services which include search functions and social media platforms and generative tools generate substantial consumer benefits yet their zero-cost inclusion in GDP statistics produces an incorrect measurement of actual value according to Aldasoro *et al*. (2024) [3].

1.2 Investment (I) enterprise AI software and database expenditures are mostly counted as intermediate inputs rather than fixed capital formation, underestimating investment scale and long-term value (Melina & Villa, 2025) [24].

1.3 Government purchases (G) the statistical attribution of government AI system investment is vague, with insufficient capitalization, failing to reflect the accumulation of public assets.

1.4 Net exports (X−M) cross-border transactions of digital services are easily omitted due to no physical boundaries, and the lack of cloud service attribution standards distorts balance of payments accounting.

2. Dilemmas of Incorporating Intangible Assets (Data, Algorithms) into GDP

The process of including AI's core assets which consist of data and algorithms into GDP encounters three main challenges. The capital definition applies only to databases and algorithms which produce measurable optimization results and maintain economic worth over extended periods. The three value estimation methods which include cost method and income method and market method face various challenges because unestablished data markets make it hard to determine prices. The process of depreciation becomes complex because data assets experience nonstandard decline patterns which merge data obsolescence and algorithm update cycles and some data assets gain value through repeated use (Korinek & Stiglitz, 2025). The United Nations SNA 2025[21, 26] plans to include digital assets in accounting, but still needs technological breakthroughs.

3. Causes and Impacts of Digital Economy Underestimation

Organizations encounter three main problems which lead to underestimation because they fail to recognize free service consumer value and they do not make proper quality adjustments and they do not track emerging business models. The results lead to wrong assessments about economic growth and to wrong monetary and fiscal decisions and they fail to identify how productivity affects economic growth. Brynjolfsson *et al*. (2023) [8] calculate that social media platforms in the United States generate untracked consumer value which reaches into the hundreds of billions of dollars each year while the economy faces a growth measurement error between 0.5 and 1 percentage point.

Structural Restructuring of National Income Distribution by AI

The implementation of artificial intelligence technology creates conditions which intensify income inequality because it modifies how different factors generate returns and changes market competition patterns. The combination of AI's growing production advantages and its ability to connect users has established a market system where one dominant player takes control of the entire market. Superstar firms develop expertise in algorithm management and data processing to obtain extra profits which distribute to their shareholders and top executives but regular employees receive little to no benefit. Research data indicates that corporate profit distribution in established nations has expanded while worker earnings distribution decreased from 65% during 1970s to below 55% (Acemoglu & Restrepo, 2020; Athey & Scott Morton, 2025) [2, 4]. The ownership of capital in concentrated form expands the income differences which people experience between their homes and their workplaces.

The AI period has brought three original elements to skill-biased technological change (SBTC) because it replaces routine work through conventional SBTC while AI technology attacks the employment base of skilled white-collar professionals who work in writing and programming and law and medical care. The process generates two opposing results where skilled employees work alongside AI systems to create better output which produces higher compensation but middle-level routine cognitive work disappears from the workforce which results in job losses and low-skilled manual work stays untouched by automation because it stays consistent. The labor market shows signs of emptying out while workers experience growing wage differences and the demand for specialized abilities keeps increasing (Mehrotra, 2024) [13].

AI increases the Gini coefficient by creating three distinct mechanisms which include asset income concentration and labor market bimodality and spatial and temporal population differences. The AI industry forms clusters in technology center cities which results in increasing economic differences between different regions; the lack of equal access to top-tier AI education programs creates a cycle that deepens social gaps between different family backgrounds. AI functions as a tool for distributing resources because it enables exact welfare allocation and tax inspection and job skill development programs to reduce social disparities but the system needs strong institutional backing (Moosa, 2025) [26].

Dual Impacts of AI on Economic Welfare and Green GDP

AI technology creates a rising gap between GDP and welfare because it boosts the difference between these two economic metrics. AI technology creates a growing gap between GDP and welfare because it increases the difference between these two economic metrics. AI technology produces a growing gap between GDP and welfare because it boosts the difference between these two economic measures. AI technology creates two opposing environmental effects because its power needs for large model training and data center operations result in extended carbon emissions but its smart grid and building energy saving and traffic optimization and precision agriculture applications reduce power usage by 15 to 30 percent while minimizing environmental impact according to Aldasoro *et al*. (2024) [3]. Green GDP needs to incorporate both environmental costs and benefits of AI to build an AI carbon accounting framework.

AI platforms offer customers free services which generate substantial consumer benefits through zero-price offerings.

The willingness-to-pay method and time opportunity cost method show that users' annual willingness-to-pay value for search and social media reaches hundreds of dollars. The inclusion of non-market value in economic calculations shows that welfare growth exceeds GDP growth at a rapid pace. The negative externalities which include platform addiction and privacy erosion and false information need to be subtracted from welfare according to Brynjolfsson *et al*. (2023) [8]. The AI era shows that GDP numbers remain unable to show free services because of their environmental damage and their effect on people who receive equal treatment during leisure activities. The happiness indices GNH and GPI and BLI include personal happiness levels and health status and environmental quality and social relationships in their measurements. AI technology enables organizations to collect data more efficiently while performing operational analysis of collected information. The government should use GDP and happiness index together to reach its goal of inclusive green growth according to Moosa (2025) [26].

Reshaping of Consumption, Savings and Investment Behaviors by AI

The deployment of AI technology has established new decision-making frameworks which influence the three essential components that determine total demand in the economy. Recommendation systems help customers find products while they raise customer happiness but platforms focus on boosting their earnings through manipulating user actions and changing what people like. The marginal propensity to consume and intertemporal elasticity of substitution functions have evolved into algorithm system-based operational systems. The traditional Keynesian consumption function needs to incorporate two additional variables which track algorithm growth and platform control power according to Mehrotra (2024) [25].

Robo-advisors make financial services available to more people because they provide automated asset allocation which produces better investment returns without requiring conventional financial expertise. The presence of identical algorithms in financial markets creates conditions which might lead investors to follow each other blindly while causing market instability to grow. The savings function needs to incorporate algorithm asset allocation ratio variables, and financial supervision needs to strengthen stress testing (Melina & Villa, 2025) [24]. AI technology enables organizations to predict demand with higher precision while it directs their financial resources to the most suitable locations and it strengthens their supply chain systems and it decreases the unpredictability of their investment returns. AI capital deepening now leads investment trends because it uses different systems to calculate depreciation and generate returns while operating through distinct transmission channels from conventional capital. The investment response to interest rates has become less sensitive while it shows increasing sensitivity to expectations which reduces the ability of monetary policy to affect interest rate transmission (Acemoglu, 2024) [1].

Reinterpretation of the Keynesian Model by AI

The three fundamental principles of Keynesian economics which include effective demand and multiplier effect and paradox of thrift experience changes because of AI technology. AI technologies help boost effective demand through three main channels which include increased consumer spending and growing business investments and better public sector spending management. The three main factors which reduce effective demand through AI technology include decreasing worker wages and unstable job market and business investment pattern changes. AI technology creates a short-term demand increase but it leads to long-term market distribution problems which will produce a new form of low effective demand called "productivity improvement with insufficient public purchasing power" (Keynes, 1936; Moosa, 2025) [20, 26].

The multiplier effect faces reduction because of three main factors which include import leakage and structural savings rate increase and automation technology that blocks employment-based growth. The system will generate additional economic effects because of two main factors which involve modifications in market price flexibility and exact government spending allocations. The multiplier size requires new calculations because of three main factors which include AI system independence and how workers adapt to changes and current economic structures need updated multiplier parameter values for policy implementation (Aldasoro *et al*., 2024) [3]. Household savings during the AI era no longer follow the same path as corporate investment because automation reduces worker wages which creates a cycle of "low consumption-low income-low savings" that systems like UBI could resolve. The automation paradox which evolved from the thrift paradox demonstrates how modern economic challenges affect national demand management (Keynes, 1936; Korinek & Stiglitz, 2025) [20, 21].

Opportunities and Challenges of AI for Fiscal Policy

AI technology reshapes fiscal policy through its impact on both revenue collection systems and government spending management. AI tax supporters claim this measure will reduce job market disturbances while generating funds for social benefits and fixing environmental damage. The opposition group maintains that AI tax implementation would create obstacles for technological development because the system would become difficult to manage and would create unfair resource distribution between human work and automated systems. The practical solution requires governments to avoid direct AI taxation while they should boost their progressive income taxation system and their capital gains and minimum excess profit tax structures which should influence AI revenue distribution patterns (Acemoglu & Restrepo, 2020; Liu Shangxi, 2024) [2, 23].

AI technology enables governments to deliver exact welfare benefits while they optimize their public infrastructure management and fight against tax fraud and improve their procurement operations to spend fewer resources for better performance. The intelligent welfare system of Taiwan together with AI-based tax case selection systems in different countries have enhanced operational speed by using transparent algorithms which provide citizens with dedicated support systems (Korinek & Stiglitz, 2025) [21]. AI technology helps organizations develop budgets while it provides instant financial monitoring which enables risk prediction and public feedback evaluation to make finance operations more forward-thinking. The main objective of intelligent finance requires developing a public finance system which operates predictably and transparently while reacting effectively and enhancing cybersecurity and privacy protection standards (Melina & Villa, 2025) [24].

Reshaping of Aggregate Demand (AD) and Aggregate Supply (AS) by AI

AI establishes new systems which define macroeconomic equilibrium through its influence on market price determination and output production by affecting supply and demand perspectives. The first stage of cost reduction transmission occurs through AI which enhances operational efficiency to decrease expenses. The process leads to higher consumption and investment because businesses lower their prices which drives the aggregate demand curve toward the right side. The process loses strength when businesses decide to keep their earnings instead of using them to support economic activities. The second process involves expectations and confidence because AI creates positive investment predictions yet workers fear job loss which leads to lower consumer trust and algorithm-based systems generate additional market instability. The platform economy creates a new demand structure because people now buy online while they invest in non-physical assets and international trade demand has increased which affects economic indicators (Aldasoro *et al*., 2024) [3].

The long-term development of AI technology will push the LRAS curve toward the right side because capital deepening and TFP improvement and new product creation work together to increase potential output (OECD, 2025) [26]. Short term: automation makes marginal cost close to zero, the horizontal interval of the AS curve expands, bringing structural deflationary pressure. The AS curve will shift based on how workers change their jobs and their ability to find matching positions in the labor market (Acemoglu, 2024) [1]. The AI period leads to higher equilibrium output levels while price pressures decrease yet the workplace becomes more complex and social economic differences become more extreme. The supply and demand curves experience changes in their slope and movement rate because algorithms operate in ways that disrupt standard policy control systems. The management of supply and demand requires equal focus on these two elements together with their distribution patterns.

Structural Impact of AI on the Labor Market and Employment

The implementation of AI technology creates a dynamic system which eliminates certain employment roles while creating new work opportunities. AI technology operates to perform both basic mental work and physical activities which results in rising unemployment because of skill mismatches yet it generates new career paths in AI system development and training and auditing and ethics fields. The past shows that technological breakthroughs create more employment opportunities but workers need to handle extended transition periods which require government support for workforce development programs (Acemoglu & Restrepo, 2020; Mehrotra, 2024) [2, 25].

AI technology revolutionizes white-collar occupations which include law practice and medical services and financial management through its ability to handle basic documentation work and diagnostic processes while it enhances strategic operations and communication and thorough decision-making abilities. Brynjolfsson and his team (2023) [8] describe how AI users tend to replace people who do not use AI while the skill differences between workers in the same occupation continue to grow. The AI era requires individuals to develop their critical thinking abilities and creative skills and emotional intelligence and AI literacy competencies. Traditional one-time education fails, and a lifelong learning system of personal learning accounts, micro-credentials and government-enterprise cooperation training needs to be established. The complementarity between human capital and AI determines a country's long-term growth potential (Jones, 2026) [19].

Innovation of AI for Monetary Policy and Central Banks

AI changes the operation of monetary policy, the development of digital currencies and monetary demand theory. AI systems allow financial institutions to perform their operations more effectively through their ability to predict inflation and generate interest rate recommendations and track financial system stability. Machine learning identifies complex patterns through its operation on high-frequency data which allows it to detect early signals of inflation turning points. The system uses reinforcement learning to test different policy routes which results in improved decision-making systems. The system needs human decision-making to select final options because AI serves only to support decisions which must take into account the Lucas critique and institutional changes (Melina & Villa, 2025; Aldasoro *et al*., 2024) [3, 24].

The digital operation of CBDCs depends on AI systems which perform transaction validation and money laundering prevention and money tracking activities. AI systems manage privacy protection along with regulatory demands through federated learning and zero-knowledge proof which function to protect personal information during supervision activities. The financial intermediary network undergoes transformation because of CBDCs while AI technology allows commercial banks to reshape their asset and liability management systems (Korinek & Stiglitz, 2025) [21]. AI technology decreases the amount of money people need for transactions and safety purposes while it makes speculative demand more responsive to interest rate changes. Digital assets have taken over the role of traditional currency while monetary demand function shows growing instability. Central banks no longer set targets for monetary aggregates because they now use interest rate and inflation targets which they support with AI-based forecasting to maintain accurate control (Keynes, 1936; Melina & Villa, 2025) [20, 24].

Reshaping of the Financial System and International Finance by AI

Financial markets now operate through AI which also modifies how risks distribute themselves and how international monetary systems function. The operation of algorithmic trading systems produces better market liquidity and price discovery results yet they create flash crashes and cause market participants to follow each other blindly. FinTech technology enables financial institutions to develop new credit assessment systems which simultaneously fight fraud activities and decrease their financial risks which results in enhanced access to banking services for more people. The financial system faces three types of systemic risks which AI technology generates through its uniform algorithms and inaccessible models and self-reinforcing systems that need enhanced regulatory technology and behavioral oversight according to Moosa (2025) and Athey & Scott Morton (2025) [4, 26].

AI technology enables faster capital movement across national borders which creates more market instability and makes it difficult to enforce capital movement restrictions.

Machine learning systems deliver better short-term exchange rate predictions yet fundamental market factors and emergency situations continue to determine long-term market behavior. The international monetary system experiences power distribution shifts because of AI competition and CBDC development and tech giant digital currency expansion which endangers the US dollar's worldwide dominance (Aldasoro *et al*., 2024; Korinek & Stiglitz, 2025) [13, 21].

Innovation of AI and Economic Growth Theory

AI functions as a fresh verification system which developers use to test the effectiveness of endogenous growth theory. The development of AI follows the principles of endogenous growth because its technological advancement depends on R&D activities and human capital development and institutional support and knowledge diffusion which creates expanding economic benefits through non-exclusive use. The process of AI knowledge stock growth creates a self-reinforcing system which policies can speed up by offering R&D funding and backing for computer resources and directing skilled professional development (Jones, 2026; Acemoglu, 2024) [1, 19]. AI systems operate together with educated workers to boost their work output which results in higher wages and makes people want to learn more; human capital serves as the origin point for AI development which establishes how well a nation will perform in AI technology. The process of educational change together with continuous learning throughout life stands as the essential requirement which leads to complementary development (Brynjolfsson *et al*., 2023; Jones, 2026) [8, 19].

The optimistic view supports that AI technology surpasses the diminishing returns of traditional systems while creating self-sustaining innovation and solves employment shortfalls which leads to permanent economic expansion. The pessimists argue that economic growth will stop because of three main obstacles which include limited consumer demand and restricted natural resources and established systems that resist change. The world exists through the combined efforts of educational programs which distribute resources while operating energy systems and maintaining institutional frameworks. The implementation of AI technology enables businesses to speed up their development process but singularity explosion remains an unattainable goal (OECD, 2025; Jones, 2026) [19, 26].

Future Trend of Macroeconomic Theory in the AI Era

The field of macroeconomics has undergone a complete transformation because of AI technology. The third approach of AI economics develops through multiple decision-making entities which produce rising production function returns and automatic market coordination through algorithms and intelligent policy systems. The work accepts classical and Keynesian theories but it expands their scope through integration of algorithmic behavior and digital economic systems (Keynes, 1936; Acemoglu, 2024) [1, 20]. AI systems deliver improved prediction results which match what people would logically expect. The system creates prediction errors through its algorithmic discrimination and its uniform prediction outputs and its hidden operational systems. Policies need to create rules which algorithms can understand while they must boost expectation management 2.0 and handle the problems of expectation self-fulfillment and Lucas critique (Melina & Villa, 2025) [24]. The core of algorithmic economics studies how algorithms function through their design and their ability to influence systems and their responses to other systems. Future macro models require the inclusion of algorithmic behavior equations which will enable the analysis of human-machine decision systems (Korinek & Stiglitz, 2025; Athey & Scott Morton, 2025) [4, 21].

Conclusions

AI functions as a total institutional modification which transforms how four sectors behave while serving as an additional production element that drives the development of new production systems and distribution models. AI generates incorrect GDP statistics which damage economic fairness through employment destruction and creates fresh financial threats but produces better operational performance and social benefits and enhanced surveillance systems that create opposite effects. Macroeconomics now operates through a system which combines human choices with machine-based decision systems while policy centers its efforts on three main objectives to balance efficiency with equity and stability. Theoretical development requires an extended framework which integrates AI technology while policy makers must create systems that defend technological progress and maintain for all citizens equal economic opportunities and handle risks and work together with other countries (OpenAI, 2023) [8]. The accounting system requires reform through SNA 2025[26] standard adoption and data capitalization and algorithm and AI model recognition and satellite account development and consumer value and product standard evaluation inclusion. The distribution system needs optimization through three main strategies which include increasing tax rates on corporate profits and investment returns and providing educational support for skill development and testing universal basic income programs and reducing workforce skill disparities between different regions. The fiscal policy needs modernization through two main steps which involve stopping AI tax implementation and creating better budget allocation systems and developing digital government infrastructure and establishing support systems for AI research and development and infrastructure development.

The optimization of monetary policy needs AI technology to enhance its forecasting systems and monitoring systems and the CBDC promotion process should occur in a methodical way and the central bank must manage monetary demand fluctuations and protect against financial system breakdowns. The labor market needs protection through three main initiatives which include establishing an ongoing education system and backing emerging work types and building stronger social protection programs and advancing teamwork between people and machines. International coordination and cooperation requires two main efforts which involve supporting digital trade and tax rule creation and working to reduce digital accessibility differences between different regions and establish common AI regulatory frameworks. Future research should develop through three main approaches: First, create a DSGE model which incorporates AI for conducting quantitative policy simulation. Second, apply micro-enterprise and household data to test how AI affects macroeconomic variables through its operating mechanisms. Third, track the implementation of SNA 2025 [26] and the landing of CBDCs to evaluate the real policy effects. The AI era demands macroeconomic innovation because theory needs to understand reality while scientists require this knowledge to develop sustainable economic growth with social fairness.

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