Stability without Reproduction: Artificial Intelligence and the Return of Marxian Questions

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Abstract

Recent advances in artificial intelligence have enabled sustained increases in productive capacity with diminishing reliance on human labor. While such developments generate efficiency gains at the firm level, their macroeconomic implications remain contested. This paper examines the structural relationship between AI-driven productivity growth, income formation, and aggregate demand.

We develop a stylized production–income framework in which technological progress is labor-saving, allowing output to expand while wage-based income contracts. Under limited profit redistribution, aggregate demand weakens despite rising productive capacity. The model identifies a structural divergence between production and purchasing power, generating an endogenous deflationary bias.

The analysis further distinguishes between stabilization and structural reproduction. Fiscal transfers can stabilize demand, but only by substituting for endogenous income generation. Long-run stability therefore becomes policy-dependent rather than self-reproducing.

1 Introduction

Recent advances in artificial intelligence have renewed long-standing debates in political economy concerning the relationship between productivity, labor, and aggregate demand. [Autor, 2015, Acemoglu and Restrepo, 2020, Brynjolfsson and McAfee, 2014] Unlike earlier waves of automation, contemporary AI technologies exhibit a qualitatively distinct feature: they enable sustained expansion of productive capacity with sharply diminishing reliance on human labor. As a result, output growth is increasingly decoupled from employment growth.

This development has been widely celebrated for its efficiency gains and cost reductions. From the perspective of individual firms and consumers, AI-driven automation lowers production costs, reduces prices, and expands access to goods and services. However, at the macroeconomic level, these gains raise a structural question that remains insufficiently addressed: how is aggregate demand sustained when income formation continues to depend primarily on labor compensation, while production no longer does? [Summers, 2014, Mian et al., 2021]

This paper argues that the tension between expanding productive capacity and weaken-

ing income generation constitutes a structural feature of a post-AI production regime rather than a temporary disruption. The core mechanism is not technological unemployment per se, but the erosion of the wage-based income channel that historically linked productivity growth to mass consumption. When labor ceases to function as the primary conduit between production and purchasing power, productivity gains alone are no longer sufficient to sustain aggregate demand.

Existing economic frameworks address aspects of this problem through redistribution, monetary expansion, or employment-oriented interventions. While such measures may stabilize outcomes, they often treat demand shortfalls as policy failures or cyclical anomalies. [Keynes, 1936, Minsky, 1986] By contrast, this paper adopts a structural perspective: it examines whether an economy characterized by labor-saving AI can reproduce its own demand endogenously, or whether stability increasingly depends on continuous external intervention.

The contribution of the paper is threefold. First, it formalizes a simple production-income framework that isolates the asymmetry between output expansion and income generation under labor-substituting technological change. Second, it distinguishes analytically between interventions that supplement household income while preserving the production regime and those that substitute for it by reasserting labor as a stabilizing mechanism. Third, it clarifies the implications of long-run reliance on state intervention for structural stability, without advancing normative claims regarding policy desirability.

The analysis does not assert that economic collapse is inevitable, nor does it claim that state intervention is ineffective. Rather, it highlights a conceptual boundary: when aggregate stability requires permanent external support, stability is maintained rather than self-reproduced. [Marx, 1885, Harvey, 2010] In this sense, the paper revisits classical concerns in political economy under contemporary technological conditions, offering a framework through which the relationship between AI, income formation, and macroeconomic stability can be examined with greater clarity.

2 Economic Environment and Production Regime

This section defines the stylized economic environment used throughout the analysis. The purpose of the framework is not descriptive completeness, but analytical discipline: to isolate the relationship between technological change, income formation, and aggregate demand under a production regime in which labor is no longer a binding constraint.

2.1 Agents

The economy consists of two representative agents:

- **Households**, who supply labor inelastically and derive income primarily from wages.
- **Firms**, who produce a homogeneous consumption good using labor and AI-augmented technology, and who maximize profits.

Government production, financial institutions, and capital markets are not explicitly modeled at this stage. Their potential roles are considered later as stabilizing or redistributive mechanisms rather than as determinants of the production structure itself.

2.2 Production Technology

Output is produced according to the reduced-form technology

$$Y = A \cdot f(L), \tag{1}$$

where Y denotes aggregate output, L labor input, and A a productivity parameter capturing the deployment of artificial intelligence. The function $f(\cdot)$ satisfies standard properties $f'(L) > 0$ and $f''(L) < 0$.

The defining feature of the production regime is that productivity growth is *labor-substituting*. Increases in A reduce the labor input required to produce a given level of output:

$$\frac{\partial L}{\partial A} < 0. \tag{2}$$

This assumption reflects a technological environment in which output expansion is increasingly decoupled from employment. [Acemoglu and Restrepo, 2020, Autor, 2015]

2.3 Income Formation

Household income is generated through wage earnings. Let w denote the real wage rate. Total wage income is therefore

$$W = wL. \tag{3}$$

Firms earn profits Π. To allow for partial redistribution of profits without imposing it as a defining feature of the system, a parameter $\theta \in [0, 1]$ is introduced, representing the fraction of profits transferred to households. In the baseline environment, θ is assumed to be small.

2.4 Aggregate Demand

Aggregate demand is driven by household consumption:

$$D = C = c(W + \theta\Pi + T), \tag{4}$$

where $c \in (0, 1]$ is the marginal propensity to consume and T denotes net transfers from the state.

Transfers are interpreted as exogenous additions to household purchasing power, such as lump-sum fiscal transfers or universal basic income schemes. They do not affect the production function or labor demand directly. [Keynes, 1936]

2.5 Core Asymmetry

Under labor-saving technological progress,

$$\frac{dY}{dA} > 0 \quad \text{and} \quad \frac{dW}{dA} < 0, \tag{5}$$

and, for sufficiently low θ,

$$\frac{dD}{dA} < 0. \tag{6}$$

Productive capacity expands as AI deployment increases, while aggregate demand weakens as labor income contracts.

2.6 Price Adjustment and Deflationary Bias

When aggregate demand persistently falls short of productive capacity, downward pressure on prices emerges. The framework therefore identifies a *deflationary bias* arising endogenously from the structure of income formation rather than from temporary shocks.

3 Intervention, Consistency, and Structural Stability

This section clarifies the role of state intervention within the analytical framework and delineates the boundaries of structural consistency. The objective is not to assess the desirability of particular policies, but to

distinguish between interventions that preserve the internal logic of the production regime and those that fundamentally alter it. [Keynes, 1936]

3.1 Intervention as Supplement versus Substitution

State interventions are considered *admissible* insofar as they stabilize aggregate demand without reintroducing labor as a binding constraint in production. Transfers such as T fall into this category. By construction,

$$\frac{\partial L}{\partial T} = 0. \tag{7}$$

Such interventions supplement household income while leaving the labor-saving nature of production unchanged. [Minsky, 1986]

By contrast, employment-centered interventions—such as large-scale job creation programs or policies explicitly designed to absorb labor—constitute a *substitution* of the production regime. These policies restore labor as a central stabilizing mechanism and therefore violate the maintained assumption that output expansion is weakly dependent on labor input.

This distinction is analytical rather than normative. Employment-based policies may be effective under alternative production regimes, but they fall outside the scope of a post-labor production environment.

3.2 Maintained Stability versus Structural Self-Reproduction

A central conceptual distinction in the analysis is between *maintained stability* and *structural self-reproduction*.

An economy may display stable macroeconomic outcomes through persistent external support. However, such stability differs qualitatively from a system in which income and aggregate demand are generated endogenously through the production process itself.

In the present framework, transfers can offset demand shortfalls, but only by replacing endogenous income formation with exogenous support. Aggregate demand thus becomes policy-dependent rather than production-dependent.

3.3 Monetary Sovereignty and Long-Run Intervention

The framework is compatible with perspectives emphasizing monetary sovereignty and the capacity of the state to sustain nominal demand. From this standpoint, fiscal expansion can prevent collapse even when private demand weakens.

However, sustained reliance on state intervention implies that macroeconomic balance is preserved through continuous external adjustment rather than through the internal reproduction of income. [Keynes, 1936, Skidelsky, 2009] As long as production remains weakly linked to labor compensation, stabilization requires transfers to scale with productivity growth:

$$\frac{dT}{dA} > 0. \tag{8}$$

Effectiveness in maintaining demand does not imply structural resolution of the underlying asymmetry.

3.4 Implications for Structural Stability

If long-run stability requires permanent intervention, stability is achieved through substitution rather than reproduction of the underlying income-generation mechanism. The economy remains operational, but its coherence depends on sustained exogenous support.

This observation does not constitute a critique of intervention itself. Rather, it highlights a structural condition: the decoupling of production from labor income transforms stabilization from an endogenous property of the system into an externally maintained outcome.

4 Model and Core Results

This section formalizes the structural mechanism described in Sections 2 and 3. The objective is to establish qualitative results regarding the relationship between AI-driven productivity growth, income formation, and aggregate demand, rather than to provide calibrated quantitative predictions.

4.1 Model Setup

Output is produced according to

$$Y = A \cdot f(L), \tag{9}$$

where A represents AI-driven productivity and $f'(L) > 0$, $f''(L) < 0$. Technological progress is assumed to be labor-saving:

$$\frac{\partial L}{\partial A} < 0. \tag{10}$$

Wage income is given by

$$W = wL, \tag{11}$$

and profits are defined residually as

$$\Pi = Y - W. \tag{12}$$

Aggregate demand is determined by household consumption:

$$D = c(W + \theta\Pi + T), \tag{13}$$

with $c \in (0, 1]$, $\theta \in [0, 1]$, and T denoting exogenous transfers.

4.2 Productivity Growth and Income Dynamics

Differentiating output with respect to productivity,

$$\frac{dY}{dA} = f(L) + Af'(L)\frac{dL}{dA}. \tag{14}$$

Given $f(L) > 0$ and $\frac{dL}{dA} < 0$, output increases as long as the direct productivity effect dominates the labor-reduction effect, a condition satisfied for a broad class of production functions.

By contrast, wage income evolves as

$$\frac{dW}{dA} = w\frac{dL}{dA} < 0. \tag{15}$$

Thus, productivity growth expands output while contracting wage-based income.

4.3 Aggregate Demand Response

Differentiating aggregate demand with respect to A yields

$$\frac{dD}{dA} = c\left(\frac{dW}{dA} + \theta\frac{d\Pi}{dA} + \frac{dT}{dA}\right). \tag{16}$$

Substituting $\Pi = Y - W$,

$$\frac{dD}{dA} = c\left((1-\theta)\frac{dW}{dA} + \theta\frac{dY}{dA} + \frac{dT}{dA}\right). \tag{17}$$

This expression highlights the central asymmetry between output expansion and income generation.

4.4 Core Result

Proposition 1 (Structural Demand Weakening).

If (i) productivity growth is sufficiently labor-saving, (ii) profit redistribution is limited (θ is small), and (iii) transfers do not

scale proportionally with productivity ($\frac{dT}{dA}$ bounded), then

$$\frac{dY}{dA} > 0 \quad \text{and} \quad \frac{dD}{dA} < 0. \tag{18}$$

Proof. Condition (i) implies $\frac{dW}{dA} < 0$. Under conditions (ii) and (iii), the positive contributions of profit income and transfers are insufficient to offset the contraction in wage income. Aggregate demand therefore declines despite expanding productive capacity.

Proposition 2 (Stabilization without Reproduction).

Consider the economy described above, where output grows through labor-saving technological change and household income is primarily wage-based. Suppose the government introduces an exogenous transfer T to households, financed independently of current production.

Then, for any target level of aggregate demand $\bar{D}$, there exists a transfer rule $T(\cdot)$ such that aggregate demand is stabilized at $\bar{D}$. However, this stabilization does not restore endogenous demand reproduction: the required transfer must scale with productivity growth and cannot converge to zero over time.

Proof. Aggregate demand is given by

$$D = wL + T.$$

As productivity increases while L weakly declines, wage income wL does not scale with output. To maintain $D = \bar{D}$, the transfer T must therefore increase to offset the growing gap between output and wage income. Since the underlying production-income asymmetry persists, the transfer does not become self-extinguishing.

4.5 Deflationary Bias

When aggregate demand persistently falls short of productive capacity, downward pressure on prices emerges. This generates a deflationary bias rooted in the structure of income formation rather than in temporary shocks or policy errors.

4.6 Transfers and Stabilization

Aggregate demand can be stabilized if transfers satisfy

$$\frac{dT}{dA} \geq -(1-\theta)\frac{dW}{dA} - \theta\frac{dY}{dA}. \tag{19}$$

However, this condition requires transfers to scale continuously with productivity growth. Stability is therefore maintained through exogenous policy adjustment rather than endogenous income reproduction.

4.7 Interpretation

The model demonstrates a structural divergence between productive capacity and purchasing power in a post-labor production regime. Output expansion alone is insufficient to sustain aggregate demand when income formation remains anchored in labor compensation.

5 Discussion: Reproduction, Demand, and the Limits of Stabilization

This section interprets the results obtained in Sections 2–4 through the lens of classical and post-Keynesian political economy. The objective is not to reassess historical debates, but to clarify how contemporary technological conditions alter the relationship between production, income formation, and macroeconomic stability.

5.1 From Exploitation to Reproduction

Marxian analysis is often associated primarily with questions of exploitation and class conflict. However, a central concern of Marx's political economy lies elsewhere: whether a system of production can reproduce the material and social conditions required for its own continuation. [Marx, 1885]

In this respect, the results of the model are not Marxian by assumption, but Marxian in implication. The divergence between expanding productive capacity and contracting wage-based income directly challenges the endogenous reproduction of aggregate demand. When income formation no longer scales with productivity, reproduction becomes contingent rather than automatic.

The framework therefore resonates with Marx's analysis of reproduction without invoking moral or distributive claims. The issue is not the fairness of outcomes, but the coherence of the system as a self-sustaining process.

5.2 Effective Demand without Labor

Keynesian economics provides a powerful account of demand insufficiency and macroeconomic instability. Its core insight—that output and employment are demand-constrained—has proven robust across a wide range of historical contexts. [Keynes, 1936, Skidelsky, 2009]

However, Keynesian stabilization mechanisms rely implicitly on a production regime in which labor remains a central adjustment margin. Fiscal expansion is effective not only because it raises demand, but because it induces employment and income generation that reinforce consumption.

In a post-labor production regime, this transmission mechanism weakens. Demand may be stabilized through transfers or public spending, yet employment need not respond proportionally. The effectiveness of demand management therefore does not imply the restoration of endogenous income generation. [Minsky, 1986]

The model's results do not contradict Keynesian logic; rather, they delimit its domain of applicability. Stabilization remains feasible, but it no longer guarantees structural reproduction.

5.3 State Intervention as Structural Maintenance

The analysis is compatible with frameworks emphasizing monetary sovereignty and the capacity of the state to sustain nominal demand. Persistent fiscal intervention can, in principle, prevent collapse even when private income formation deteriorates.

Yet sustained intervention alters the nature of macroeconomic stability. When aggregate demand depends on transfers that must scale with productivity growth, stability is achieved through continuous external adjustment. The system remains operational, but it does not reproduce its own demand-generating conditions internally.

This distinction between stabilization and reproduction is central. Long-run reliance on state intervention does not resolve the structural asymmetry identified in the model; it renders that asymmetry manageable. [Harvey, 2010]

5.4 Interpretive Boundaries

The framework developed here does not predict economic breakdown, nor does it prescribe specific policy responses. Its contribution is diagnostic rather than normative.

By formalizing the divergence between productive capacity and purchasing power under labor-saving technological change, the

model clarifies why stabilization policies may become increasingly permanent rather than countercyclical. In this sense, contemporary debates surrounding fiscal expansion and income transfers can be interpreted as responses to a structural transformation rather than as departures from historical norms.

The results suggest that advanced economies may be transitioning from systems that reproduce stability endogenously to systems whose stability is maintained through policy. Whether such arrangements are sustainable or desirable lies beyond the scope of the present analysis.

6 Conclusion

This paper examined the macroeconomic implications of labor-saving artificial intelligence through a structural lens. By formalizing a production regime in which output expansion is increasingly decoupled from labor input, the analysis highlighted a persistent asymmetry between productive capacity and income formation. When wage-based income contracts while productivity continues to rise, aggregate demand no longer reproduces itself endogenously.

Demand shortfalls under such conditions are not merely cyclical disturbances or policy failures, but structural features of a post-labor production environment. Stabilization through transfers remains feasible, yet increasingly permanent. Stability, in this context, is maintained rather than self-reproduced.

The contribution of the paper is diagnostic rather than prescriptive. It revisits classical concerns in political economy under contemporary technological conditions, offering a framework for understanding macroeconomic stability in a post-AI economy.

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