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Entropy and Economics: A Bioeconomic Perspective on Economic Development and Sustainability

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Abstract
This paper investigates the integration of the thermodynamic concept of entropy into economic theory, with a particular focus on the development of bioeconomics. After introducing the physical foundations of entropy, we explore how these principles have been adapted into economic thought to address key challenges related to resource scarcity, ecological constraints, and the irreversible nature of economic processes. Among others, we highlight Georgescu-Roegen's bioeconomic approach, grounded in the Second Law of Thermodynamics, and discuss how it contrasts with the assumption of neoclassical economics, which traditionally focuses on equilibrium and efficiency without fully accounting for the physical and thermodynamic constraint of resource use. In addition, we review specific applications of entropy-based techniques into the economic field, including production, growth theories, and policy evaluation. While entropy provides valuable insights for sustainable economic modelling, we also highlight its limitations; particularly, in addressing the complexities of socio-economic systems, accounting for technological change, and applying entropy-based concepts in empirical economics, where their integration into measurable models remains methodologically and computationally challenging. Finally, we propose possible directions for future research, particularly concerning the integration of entropy into post-growth frameworks, to develop a more comprehensive understanding of sustainable economic development.

JEL classification: A12, B4, B20, E61, Q32, Q4
Keywords: entropy in economics, circular economy, energy efficiency, bio economics, policy implication

Outline

1. Introduction

Entropy is a fundamental concept in physics that reflects how energy is spread out in a system and how many microscopic configurations a system can have. It captures the natural tendency of isolated systems to evolve toward thermodynamic equilibrium, where energy becomes more evenly distributed and less available to perform useful work. As concentrated, usable energy (such as heat or chemical energy) transforms into diffuse, less useful forms, many physical processes become irreversible unless external energy is introduced to restore order. The term itself derives from the Ancient Greek word *entropía,* meaning "a turning toward" or "transformation," thus reflecting the concept of change and the evolution of energy. The notion was later formalized in thermodynamics, where entropy quantifies irreversible energy transformations in a closed system.

The scientific understanding of entropy is grounded in the two fundamental laws of thermodynamics, which together provide its conceptual framework and scientific derivation. The First Law of Thermodynamics - also known as the law of energy conservation - states that energy within a closed system remains constant; it can change form, but it cannot be created nor destroyed (Clausius, 1850; Atkins, 2010). This principle therefore implies that, while energy transformations occur, the total quantity of energy remains unchanged. The Second Law introduces the concept of entropy by emphasizing the directionality and irreversibility of these energy transformations. It states that in any isolated system, entropy tends to increase over time, reflecting the system's natural progression towards thermodynamic equilibrium (Clausius, 1867; Boltzmann, 1872; Prigogine, 1977). Thermodynamic equilibrium is reached when a closed system exhibits no net macroscopic flows of energy or matter and when temperature and chemical potential are uniformly distributed throughout. At this point, entropy reaches its maximum value, indicating a state in which energy and matter are spread out as evenly as possible given the constraints[1]. For a fixed total energy, the system is in equilibrium, and no further spontaneous changes or internally useful work can occur. Entropy captures the irreversibility and inherent wastefulness of physical transformations. When energy is converted from one form to another — for instance, in the operation of an engine or in metabolic processes — part of it becomes unavailable for further work, resulting in irreversible dissipation, often in the form of heat or material waste (Kamiński, 2020). As usable energy is progressively converted into a less concentrated form of energy, it spontaneously disperses throughout the system. Such a diffusion leads to a more homogeneous temperature distribution, increasing entropy. As thermal gradients vanish, the system loses its ability to perform useful work, illustrating how rising entropy fundamentally constrains the efficiency and reversibility of physical processes (Georgescu-Roegen, 1971; Jakimowicz, 2020).

Over time, the concept of entropy has been applied beyond physics, offering valuable insights across a variety of disciplines such as information theory, biology, economics, and social sciences (Shannon, 1948; Nicolis & Prigogine, 1977; Georgescu-Roegen, 1971; Ulanowicz, 1986; Martyushev & Seleznev, 2006). This paper explores its relevance through the lenses of bioeconomics, which emphasizes the connection between biological systems and the economic modeling of growth. This link assumes that economic models are governed by the same laws as biological and physical systems. Therefore, the dynamics of economic processes can be described using principles such as energy flows, system equilibrium, and entropy. Since entropy governs the degradation of energy and matter in all physical

[1] In classical physics, mass and energy are treated as distinct and separately conserved quantities. In relativistic physics, however, mass is understood as a form of energy (as expressed by Einstein's equation $E = mc^2$), and total energy is conserved as a single entity (Einstein, 1905). This total energy represents all its possible forms - kinetic, potential, rest mass energy - and remains constant within a closed system according to the constraints given by the system's boundary conditions and conservation laws (Gibbs, 1982).

and biological processes, the economy - like any living system - must operate within the constraints of finite energy and material resources. Rather than presenting new empirical results or applied modeling, our aim is to examine how entropy has been interpreted and employed within this interdisciplinary field. We have therefore chosen to review the existing literature, by concentrating on those contributions that explicitly ground the notion of entropy in its thermodynamic roots, and thus leaving aside other domains — such as finance, game theory, or social sciences — where the concept is often used in a more analogical or metaphorical sense, frequently without a clear physical or measurable basis. This decision reflects the goal of our work, which seeks to contribute conceptually to the understanding of entropy as a constraint on economic processes, especially in relation to the limits of resource use and the sustainability of growth patterns.

It is worth noting that entropy - as originally defined in physics - possesses well-defined mathematical properties, such as scalability and differentiability. The concept of scalability means that entropy scales proportionally with the irreversibility of the system, allowing us to assume that the principles observed at the micro level might inform dynamics at the macro level. Differentiability, meaning that partial derivatives of entropy with respect to state variables such as energy and volume exist, enables us to isolate individual factors to understand its influence on a system's disorder or complexity. By borrowing this conceptual framework, fields like biology, economics, and the social sciences employ entropy as an analytical metaphor. In these contexts, related ideas like disorder, dissipation, and complexity are used to capture emergent patterns or hidden instabilities. While these applications may not adhere to a strict quantitative framework, they provide an invaluable conceptual toolkit. In the context of economics, its interpretation through the lens of thermodynamics enables us to look at the production and consumption processes as the transformation of ordered, low entropy resources into goods designed to satisfy human needs (Kamiński, 2020). However, as free energy becomes bound and less available, economic activity faces inevitable thermodynamic limits. These constraints have gained renewed relevance today in light of escalating ecological degradation and resource depletion.

Nevertheless, entropic reasoning alone cannot provide complete knowledge about economic systems. At this point, the adoption of a bioeconomic perspective offers a natural extension of the framework. For instance, biological systems, governed by biophysical limits, demonstrate that maximization — whether of growth, resource extraction, or population spread — does not always lead to optimal or stable outcomes. In fact, pushing systems toward their maximum capacity can result in instability, collapse, or irreversible degradation, challenging the traditional economic assumption that more is always better. Instead, they demonstrate that stability is often a goal for living systems. A clear example is the regulation of oxygen, where extremely high or low values can be harmful. From this angle, the pursuit of unchecked profit or output maximization appears not only questionable but potentially maladaptive. This rethinking also extends to classical economic competition, often justified by Darwin's principle of the "survival of the fittest" (Darwin, 1869). Recent biological research has emphasized the role of cooperation, not only competition, as vital to the survival of species. Recognizing these dynamics invites economists to rethink assumptions about efficiency, competition, and growth in light of the cooperative and adaptive strategies observed in nature — all of which are ultimately governed by entropic constraints.

The literature reviewed in this paper was selected through a reconstructive and theoretically grounded approach, aimed at ensuring both coherence and conceptual relevance. Rather than conducting a systematic review based solely on keyword searches, we focused on genealogical and thematic connections, prioritizing contributions that engage with the thermodynamic foundations of economic processes. Specifically, we included works that address the application of entropy within economic systems, with particular attention to resource scarcity, limits to growth, and sustainability challenges.

Foundational works from both classical economic thought (such as Georgescu-Roegen, Daly, Robbins, and Latouche) and the physical sciences (including Clausius and Boltzmann) were considered essential for framing the theoretical background. At the same time, we integrated more recent empirical studies and methodological innovations, including entropy-based approaches to sustainability assessment (such as the Entropy Weight Method), as well as emerging perspectives from fields like econophysics, complexity economics, and microeconomic models.

The paper is structured as follows. *Section 2* introduces the concept of entropy as defined in physics, emphasizing the aspects that are most relevant for its economic application. *Section 3* retraces the historical and conceptual transfer of physical and biological principles into economic theory, with a particular focus on Georgescu-Roegen's pioneering integration of entropy into economics and the resulting development of bioeconomics. *Section 4* then presents the direct applications of entropy in economics, including its use in economic models of production, growth, and policy evaluation. Finally, *Section 5* provides concluding remarks, synthesizing the key insights and proposing directions for future research.

2. Entropy in Physics

The concept of entropy originates from the study of heat engines, which played a fundamental role in the development of thermodynamics in the 19th century. One of the earliest key insights came from Carnot's Principle (1824), which showed that the efficiency of a reversible engine depends only on the temperatures of the heat reservoirs, not on the working substance. This principle was refined by Lord Kelvin (1851), who demonstrated that no cyclic process can fully convert heat into work without energy dissipation. These insights led to the formulation of the Second Law of Thermodynamics. As discussed earlier, the First Law of Thermodynamics ensures energy conservation, while the Second Law addresses the directionality and irreversibility of energy transformations. To quantify this irreversibility, Clausius (1854) developed the mathematical concept later termed "entropy", which he initially referred to as "transformational content" (Jakimowicz, 2020). In 1865, he formally used the term *entropy*, which serves as a measure of the thermal energy that is unavailable to perform useful work, thus quantifying the system's energy dissipation (1).

$$\Delta S = \frac{1}{T} \Delta Q, \tag{1}$$

where ΔQ represents the amount of heat transferred reversibly divided by absolute temperature T at that moment, and ΔS stands for the change in entropy (Fermi, 1956). This concept can also be applied to a closed and isolated system, such as the universe in order to describe fundamental properties of its behaviour: directionality and irreversibility of the processes. When heat Q flows from a hotter body at temperature $T1$ to a colder one at $T2$, the total entropy change can be described as:

$$\Delta S = \left(\frac{1}{T2} - \frac{1}{T1}\right) Q \tag{2}$$

Since heat naturally flows from hot to cold, we know that $T1 > T2$, which means $\frac{1}{T2} > \frac{1}{T1}$. Therefore, the change in entropy is always positive, leading to an increase of the total entropy. This expresses the irreversibility of spontaneous processes. Clausius formalised previously described properties into what became known as the Second Law of Thermodynamics, which encapsulates the tendency of isolated systems to evolve irreversibly toward states of higher entropy (Truesdell, 1980).

In other words, a spontaneous transfer of heat from a cold body to a hot one violates the Second Law of Thermodynamics, because this would lead to the decrease of the system's entropy. However, such a transfer is possible if we are no longer acting in a closed and isolated system; in that case, external work is required. Yet performing this work leads to energy dissipation, as some energy is inevitably lost as unusable heat in the surroundings (Jakimowicz, 2020).

This irreversible dissipation of energy is closely linked to the statistical behaviour of the system at the microscopic level. In thermodynamic, what appears in a single macroscopic state — defined by variables such as temperature, pressure, volume and density — corresponds to a vast number of microscopic configurations (microstates), each representing a different arrangement of the system's particles (in terms of position and momentum). The macrostate is thus a statistical summary of these possibilities. The Second Law reflects the statistical tendency of isolated systems to evolve toward macrostates with the largest number of microstates — the most probable configurations. This explains the macroscopic irreversibility of processes such as heat transfer. In this sense, entropy quantifies the number of microstates within a macroscopic state. The greater the number of such configurations, the higher the entropy. Figure 1 schematically illustrates particle microconfigurations corresponding to low and high-entropy macrostates.

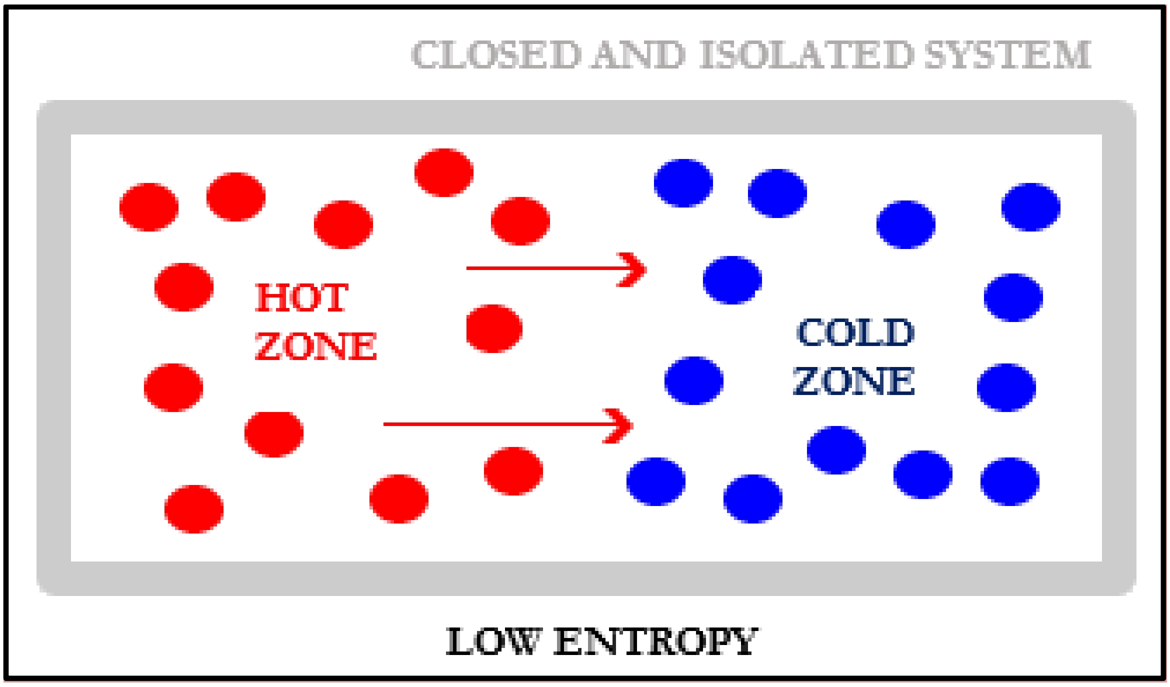

Figure 1. In the low-entropy case, particles are concentrated and heat flows from hot (red) to cold (blue) regions, as shown by directional arrows. In the high-entropy case, particles are more disordered and uniformly distributed, indicating thermal equilibrium where no net heat flow occurs. *Source*: authors' own development.

From the perspective of classical physics, however, such a probabilistic behavior emerges from underlying deterministic rules: although gas molecules may appear to move chaotically within a volume, each molecule still follows Newton's Laws of Motion. The apparent randomness at the microscopic level arises only from our inability to track all particles simultaneously. The behavior of a collection of gases thus can be described by macro magnitudes, which represent average properties derived from the probability distributions of the motions, such as velocities and the average time between collisions. In this classical physics framework, randomness is not inherent, but rather reflects our limited knowledge of initial conditions, which entirely determines the future behavior of the system.

In contrast, quantum physics introduced a fundamentally different perspective: at the microscopic level, particles do not follow deterministic trajectories but are instead governed by probability amplitudes and principles of randomness. Here, uncertainty is intrinsic to the system itself, and physical quantities can only be predicted probabilistically, even with complete knowledge of the system's wavefunction, which describes the probabilities of all possible outcomes.

Despite these differences, both classical and quantum perspectives agree that the organization of gases in a closed system tends to evolve from less probable distributions to more probable ones, allowing the change to be measured. This statistical evolution, from fewer to more numerous microstates, is what entropy quantitatively captures. Although entropy is often described as a measure of 'disorder,' this term can be conceptually ambiguous, as it lacks a precise physical definition. A more accurate interpretation, pioneered by Boltzmann (1872), defines entropy as the number of microscopic configurations — or microstates — compatible with a given macroscopic state. In this sense, entropy measures the degree of multiplicity or statistical likelihood of that state, rather than any subjective notion of chaos or randomness. Boltzmann demonstrated that the probability distribution of the microstates resulting from the thermal motion of gas molecules can be used to characterize each thermodynamic macrostate of a gas (Brătianu, 2020). He later showed that such a process has a stochastic nature rather than a deterministic one (Kamiński, 2020). Thus, he provided a statistical formulation for entropy, defining it as the logarithm of the total number of microstates required to determine a specific macrostate for the gas contained within a given space (Brătianu, 2020). Even though it was initially underestimated, his statistical approach gradually gained such notoriety that many researchers attempted to apply it to other fields of study.

The formulation is rather simple but effective. Boltzmann formula expresses entropy S as:

$$S = k_B lnW \tag{3}$$

where k_B is the Boltzmann constant, a proportionality coefficient, and W represents the number of distinct microstates corresponding to a given macrostate. The value W depends on the macroscopic properties defined by such parameters as the number of molecules, volume, energy, and pressure. This formulation is utilized in statistical mechanics to connect the macroscopic property of entropy with the microscopic behavior of particles through probability.

In classical mechanics, the thermodynamic probability W in the Boltzmann entropy formula is treated as an integer (Jakimowicz, 2020). Nevertheless, Boltzmann's formulation can be generalized by incorporating probability distributions. More specifically, the total number of microscopic states of the system W can be represented combinatorially by calculating how N molecules within an isolated system are distributed among n energy levels. This calculation assumes a constant number of molecules and a fixed value for the total energy (Jakimowicz, 2020):

$$W = \frac{N!}{\prod_{i=1}^{n} Ni!} \tag{4}$$

Substituting it in the previous formula we obtain Boltzmann's entropy in the form, which is known as the Gibbs entropy formula (Gibbs, 1982):

$$S = k_B \ln \frac{N!}{\prod_{i=1}^{n} N_i!} \approx -k_B\, N \sum_{i=1}^{n} p_i \ln p_i \tag{5}$$

where $p_i = N_i / N$ is the probability of a molecule to be in the i-th energy state. For large N the system's behaviour becomes well-described by a probability distribution over microstates. Entropy is therefore associated with the degree of dispersion of a system's components: it increases as the system transitions from a concentrated configuration to a more evenly distributed one. Boltzmann (1877) argued that the tendency of any structure toward greater dispersion, or higher entropy, reflects a fundamental drive to increase its stability. When all microstates are equally probable, entropy reaches its maximum value, corresponding to thermodynamic equilibrium (Brătianu, 2020).

Extrapolated to the universe as a whole, this principle gave rise to the theory of heat death. When treating the universe as an isolated thermodynamic system, the implication is that, over time, it will evolve toward a state of maximum entropy and of thermodynamic equilibrium (Thomson, 1852; Von Helmholtz, 1854; Planck, 1900). In other words, the universe will reach a state of uniform temperature and evenly distributed energy, making it impossible to perform any mechanical work and thus becoming lifeless. For decades, this scenario concerned both scientists and philosophers. However, the advent of modern Big Bang cosmology, which frames the evolution of the universe in terms of perpetual space-time expansion, has shifted the perspective on this issue (Adams & Laughlin, 1997). Unlike in classical thermodynamics, this modern theory claims that the temperature of an expanding universe never stabilizes and never reaches complete thermodynamic equilibrium (Barrow & Tipler, 1978; 1986; Frautschi, 1982). Because of this continuous evolution, classical heat death is avoided. Yet, if the universe's expansion eventually becomes fully adiabatic (meaning no heat is exchanged), then the entropy within any given comoving volume may approach a constant value. In this case classical heat death may not occur; nevertheless, the universe could still become a lifeless and stagnant place with its temperature approaching zero. This is because the endless expansion of space will cause matter and energy to become so spread out that no useful energy transformations would be possible. This alternative fate is known as cosmological heat death (Adams & Laughlin, 1997).

3. Entropy in economics: a theoretical framework

The concept of entropy in physics has significant applications in economics, particularly bioeconomics, in relation to irreversibility, energy degradation, and systemic constraints. The adaptation of physical concepts to economics is nothing new (Baumgartner, 2019). The idea of aligning human activity with natural limits has deep historical roots, dating back to Ancient Greece. Philosophers such as Plato (Laws, 740–41; Republic, 424, 546) and Aristotle (Politics, 11.2; V.3, 6–7; VII.14) already argued that a society must maintain demographic and material balance to ensure its survival. These early reflections anticipate the modern idea of a steady-state economy, emphasizing the necessity of respecting natural limits. Building upon these foundations, economic thought has long attempted to connect economics with physical sciences, using different approaches over time. While early classical economists such as Adam Smith (1776) and Jean-Baptiste Say (1803) viewed the economy as a closed self-regulating system, John Stuart Mill (1848) offered a markedly different vision, introducing a more explicit interpretation of growth limits. He developed a vision of economic stationarity in which neither capital accumulation nor population growth would continue indefinitely. He argued that prosperity does not require endless expansion and that, beyond the satisfaction of basic material needs, further increases in production contribute little to human happiness. Rather than viewing a stationary state as a condition of stagnation or misery, Mill (1848) regarded it as an opportunity for society to redirect its focus toward cultural, intellectual, and moral advancement. His vision emphasized sustainable resource use, social justice, and a fairer distribution of wealth — themes that would later become central to ecological economics and bioeconomics (Daly & Farley, 2011). Building on Mill's

(1848) pioneering work, Robbins (1930) introduced a key distinction between two interpretations of the stationary state: one in which stationarity represents a final equilibrium achieved through an evolutionary process, and another in which a system is deemed stationary simply because its internal elements remain unchanged over time. This concept can also be extended to ecology, where stationarity implies that ecosystems remain stable as long as matter and energy resources remain equally available. However, this equilibrium relies on the assumption of a materially closed Earth — a condition that, as we will argue later, does not guarantee long-term stability. As previously discussed, not all energy or matter can be fully converted into useful work; part of it is inevitably dissipated as unusable thermal energy due to friction and other irreversible processes. This implies that true stationarity is not achievable in the long term, as the continuous increase in entropy, used here by analogy with physics, progressively degrades the availability of useful energy and matter. In other words, even in a materially closed system, the impossibility of fully recycling degraded materials and the irreversible dissipation of energy prevent a perfectly steady state from being maintained indefinitely without external inputs or compensatory mechanisms. This convergence between biological and economic thought was further strengthened by Alfred Marshall (1961), who proposed moving beyond the mechanistic and descriptive economics of his time, in favor of a biological approach. He argued that the economic process should be understood in evolutionary and organic terms — capable of explaining qualitative changes that classical mechanics could not address. In this sense, his perspective supports a conception of the economy as a living and adaptable system, governed by physical and biological laws. This approach thus makes it possible to integrate physical concepts such as entropy into economic analysis. In contrast, neoclassical economics, rooted in mechanical equilibrium concepts dating back to the physiocrats, assumes that markets operate like closed, isolated systems that naturally return to equilibrium after external shocks (Jakimowicz, 2020; McMahon & Mrozek, 1997). Within this framework, economic models focus on rational behavior and the allocation of land, labor, and capital, while largely neglecting energy as a production factor (Kümmel & Lindenberger, 2020). Production functions within this framework generally omit environmental inputs and fail to account for interactions with other systems, particularly the natural environment (McMahon & Mrozek, 1997). As a result, neoclassical models tend to ignore physical deterioration and the concept of entropy as the irreversible degradation of energy and the consequent loss of system order over time. This view has profound implications, as it suggests an economic system that can continue functioning smoothly without considering the degradation of the biophysical resources it depends upon. Influenced by this conceptualisation, many economists in the early to mid-twentieth century – particularly in the context of recovery from the Great Depression – focused on developing models of long-term growth linked to continuous, smooth economic operation (Vozna, 2016). Despite methodological differences, these various growth models shared the common goal of identifying a "golden" formula that would ensure the constant expansion of a mature capitalist economy. For example, the Harrod-Domar model introduced the concept of a justified growth rate required to maintain full employment, while Solow's neoclassical growth model defined the "golden rule" of capital accumulation, which maximises steady-state consumption per worker (Harrod 1939; Domar 1946; Solow 1956). Both frameworks attempted to mathematically determine the ideal proportion of savings, investment, and capital to achieve stable and non-inflationary growth trajectories, effectively preventing recessions and economic instability (Vozna, 2016). However, these theories are based on a closed-system perspective that abstracts from the biophysical foundations of economic activity, thereby ignoring the thermodynamic constraints of real-world processes. They overlook the Second Law of Thermodynamics, focusing solely on the conservation of energy (First Law), which fails to account for the inevitable degradation of energy and the associated increase in entropy (McMahon & Mrozek, 1997). This conceptual omission has drawn strong criticism from scholars in ecological economics, who argue that neoclassical growth models, including those employing the golden rule, fail to account for the physical limits imposed by resource depletion, energy degradation, and environmental deterioration (Georgescu-Roegen, 1971; Ayres, 1999). Additionally, neoclassical economics has been criticised for its monetary reductionism, as it tends to reduce complex ecological and social phenomena into purely financial metrics, ignoring systemic complexity, material flows, and irreversible processes (Daly & Farley, 2011). In contrast, entropy economics challenges this framework by integrating ecological, social, and political dimensions into economic rationality, emphasizing that long-term growth models cannot be decoupled from the biophysical constraints imposed by the laws of thermodynamics (Kamiński, 2020).

This critique represents a fundamental departure from the classical equilibrium models first developed in the late 19th and early 20th centuries by economists such as Léon Walras (1874) and Irving Fisher (1892). These pioneers developed equilibrium models inspired by mechanics and mathematical formalism. At the same time, Marx (1867) and early political economists started to recognize capitalism's entropic tendencies, acknowledging resource depletion during industrial expansion. While their observations did not explicitly rely on thermodynamic laws, they anticipated some of the consequences that would later be formalized through the concept of entropy in bioeconomics[2]. The mid-twentieth century marked a pivotal shift in economic and scientific thinking, moving beyond classical equilibrium models toward a systemic perspective that better captures complexity and irreversibility. Norbert Wiener's cybernetics introduced the concepts of feedback loops and adaptive regulation into economic thinking, while Claude Shannon's information theory provided a rigorous way to measure communication, uncertainty, and systemic complexity (Wiener, 1948; Shannon, 1948).

Building on these advances, Kenneth Boulding (1966) also contributed significantly to legitimizing the extension of physical concepts to socio-economic systems. Through his well-known distinction between "cowboy economics" – based on the idea of unlimited resources – and "spaceship economics", which acknowledges ecological limits and the finiteness of the planet, Boulding (1966) proposed a systemic vision of the economy as a subsystem of the global ecological system. This perspective entails the need to incorporate entropic constraints, even if treated in a more qualitative form, as an essential framework for a sustainable economic theory.

These interdisciplinary perspectives set the stage for the work of Nicholas Georgescu-Roegen (1906-1994), who was the first economist to formally integrate entropy into economic theory. In his seminal work, *The Entropy Law and the Economic Process* (1971), he argued that economic activity involves the irreversible transformation of low-entropy (high-quality) resources into high-entropy (less useful) waste, consistent with the Second Law of Thermodynamics (Jakimowicz, 2020). This challenged the conventional assumption of economic processes as circular and endlessly recyclable, highlighting that human systems cannot be explained solely by deterministic cause-and-effect models due to their anticipatory and adaptive behaviors. For instance, while a stone kicked by a person follows predictable mechanical laws, humans and biological systems display anticipatory and adaptive behavior (Bateson, 1972). These cybernetic interactions suggest that living systems pose challenges that often go beyond the scope of traditional deterministic models as used in classical physics. To better understand these phenomena, concepts from chaos theory[3] and non-linear dynamics can be helpful. Chaos theory shows that small changes in initial conditions can lead to radically different outcomes over time — a

[2] Many scholars have debated whether Marx fully grasped the significance of the Second Law of Thermodynamics. The controversy concerns not the existence of entropic limits as such, but whether Marx can be considered a precursor of ecological economics in a strict sense. In particular, the debate focuses on his interpretation of material limits and resource depletion, rather than on a direct adoption of thermodynamic principles (Burkett & Foster, 2008).

[3] Chaos theory is a branch of mathematics and physics that studies complex dynamic systems characterized by sensitivity to initial conditions. Small differences in the initial state may lead to large divergences in future outcomes, making long-term prediction difficult even when the system is deterministic. A classic example is the "butterfly effect" (Lorenz, 1963).

characteristic often observed in ecological, biological, and economic systems. These insights reinforce Georgescu-Roegen's argument that conventional economic models, which rely on linear assumptions and mechanical equilibrium, are inadequate to describe the real-world complexity of socio-economic interactions. By highlighting the sensitivity and dynamic instability of complex systems, chaos theory provides a valuable framework for exploring the adaptive and emergent behaviours characteristic of living organisms, which would be overly complex to account for in purely deterministic models.

Georgescu-Roegen's contribution laid the foundation for ecological economics and bioeconomics. Mansour (2000) described the discipline of bioeconomics as a paradigmatic shift addressing the environmental impacts of socio-economic activities. The Earth, in fact, can be considered a materially closed system, as it exchanges energy with its surroundings – by receiving solar radiation and emitting heat – but absorbs only minimal amounts of matter from the external environment (McMahon & Mrozek, 1997). Within this closed planetary system, the economy operates as an open subsystem that interacts continuously with the environment through the extraction of low-entropy resources — materials and energy that are concentrated, organised, and thus capable of performing work — and the emission of high-entropy waste, which is disordered, dispersed, and no longer usable. This openness enables socioeconomic systems to maintain their internal structure and functionality. In thermodynamic terms, order refers to the organised and concentrated state of energy or matter, whereas disorder indicates their random, diffuse distribution which inhibits any further productive use. For example, fossil fuels are low-entropy resources because their chemical energy is highly ordered and concentrated, whereas the CO_2 released by combustion represents high entropy: its energy has been dissipated as heat into the environment, making it unavailable for further work. This systemic transformation is visually summarised in Figure 2, which shows how the economic system receives solar energy and natural resources, and outputs waste heat and degraded materials, reflecting the entropic nature of production and consumption.

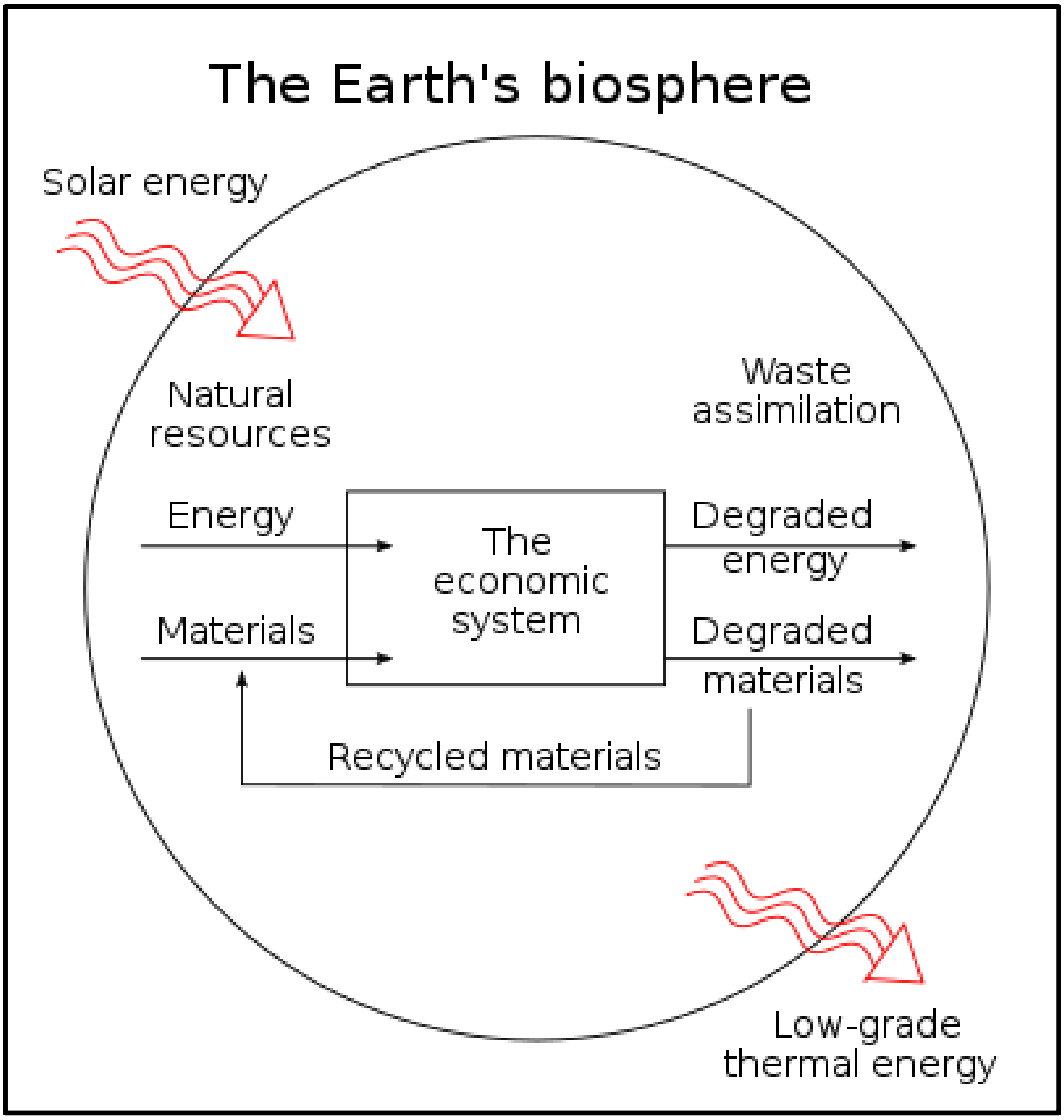

Figure 2. Diagram of natural resource flows within the Earth's biosphere. The figure illustrates the inputs of solar energy and natural resources into the economic system, and the resulting output of degraded materials and low-grade thermal energy. *Source*: Gu and Chen, 2021.

Georgescu-Roegen (1971) emphasised that economic processes are inherently entropic transformations, as they convert ordered, valuable resources into disordered waste, thus increasing the entropy of the overall system. A continuous inflow of low-entropy inputs is necessary for maintaining order and functionality within socioeconomic systems, which would otherwise experience increasing disorder (Kamiński, 2020; Ruth, 2007). He argued that the law of entropy applies not only to biological processes but also to all economic processes, even though different production methods may follow distinct economic rules (Georgescu-Roegen, 1971; Kamiński, 2020). Building on these insights about entropy and disorder, Ilya Prigogine (2015) contributed a fundamental perspective on how irreversible processes — typically associated with increased disorder — can paradoxically generate new forms of order in systems far from equilibrium. His theory of dissipative structures provided a theoretical framework to understand how complexity and organisation emerge from thermodynamic disequilibrium, a concept applied in biological and socio-economic contexts. Georgescu-Roegen (1971) also defined this fundamental and irreversible degradation as the "Fourth

Law of Thermodynamics”, underlining that degraded matter and energy cannot be fully recycled or restored to their original low-entropy state. Recognizing the entropic nature of economic activity challenges the core assumptions of neoclassical models and underscores the need to integrate ecological perspectives into economics to address sustainability within the biophysical limits of our finite planet. This view would later resonate in more popular and critical discourses, most notably in the work of Jeremy Rifkin (1980), who expanded on similar entropic principles to propose a critical reading of industrial civilization through the lens of the Second Law of Thermodynamics. Rifkin interprets entropy as a tool to describe the inevitable degradation of resources and the structural instability of modern economic and social systems. While less formal than Georgescu-Roegen’s framework, Rifkin’s interpretation helped disseminate the implications of the Second Law of Thermodynamics to broader audiences, strengthening the argument for a fundamental rethinking of modern economic paradigms.

The implications of Georgescu-Roegen’s work challenged classical growth theories. He aimed to demonstrate that unrestricted expansion is impossible, as it inevitably leads to the depletion of Earth's resources, thus highlighting the unsustainability of current development models. In fact, while knowledge and technology may enhance resource efficiency, they cannot eliminate waste or bypass thermodynamic constraints (Ruth, 2007).

However, such a principle is critically re-examined by Ayres (1999), who, while acknowledging the constraints imposed by the Second Law of Thermodynamics on process efficiency, challenges the necessity of introducing a so-called "Fourth Law" that would categorically prohibit complete recycling. He argues that, under certain thermodynamically ideal conditions — specifically in the absence of dispersion, contamination, or loss — materials could theoretically be recycled indefinitely, as the Second Law applies strictly to energy transformations, not to matter itself. His model suggests that a steady-state economy might be sustained despite entropy buildup, provided there is access to a large inert waste reservoir and a continuous external energy input — for example, from solar energy. By shifting the focus from absolute entropic limits to more pragmatic concerns — such as environmental degradation and the social and technical capacity for material recovery — Ayres redefines the terms of the debate. Rather than viewing entropy as an insurmountable barrier to growth, his perspective suggests it can be managed through effective control of energy inputs and waste reservoirs. In doing so, he offers a more flexible interpretation that challenges the deterministic pessimism often linked to thermodynamic constraints. In ecological economics, his study highlights the importance of trash stockpiles and energy availability in maintaining circular material flows. By rephrasing policy implications from inexorable decline towards regulating energy inputs and waste reservoirs to ensure systemic viability, Ayres' contribution therefore emphasises how entropy constrains economic processes but does not prevent long-term sustainability and stationarity. Furthermore, a few years earlier Smulders (1995) offered a crucial theoretical link between endogenous growth theories and biophysical constraints, contending that although the laws of thermodynamics naturally limit the accumulation of physical resources, economic value can increase through the advancement of technology and knowledge. His approach distinguished between the economic dimension of value creation, which depends on repeatable and non-rival inputs like knowledge, and the physical component of growth, which is limited by entropy and resource depletion. According to his theory, if natural resources are managed within ecological bounds and investments in human capital and technical innovation consistently increase resource productivity, sustainable growth is achievable. He highlighted that in order to match financial incentives with environmental sustainability, public policies should encourage resource conservation and pollution reduction in addition to knowledge development. His approach advanced ecological economics by demonstrating that thermodynamic restrictions do not necessarily prohibit economic development in and of itself; rather, they influence the institutional framework and routes that allow for it to continue.

Another significant contribution to growth alternatives comes from Serge Latouche (2004), who emphasised the need for alternative metrics such as circular economy indicators to assess economic performance beyond GDP. He argued that economic growth primarily generates non-recyclable, high-entropy waste and energy, thereby accelerating resource depletion and environmental degradation. The liberal paradigm prioritises profit maximisation, which is however an objective that does not necessarily lead to optimal social or ecological outcomes. Contrarily, in his view, Latouche (2004) argued for a more rational strategy for economic agents, which would involve minimising regret and cultivating greater awareness of the consequences of their actions and production choices. This critique laid the foundation for the development of degrowth theories. Degrowth is not merely an economic strategy but a broader philosophical and political approach that advocates for a deliberate reduction of economic activity to realign human needs with the planet's ecological limits (Charonis, 2021). It promotes a shift in focus from material accumulation toward enhancing public and social wealth, including ecosystem health, justice, social cohesion, equality, democratic institutions, and welfare systems. These dimensions constitute essential outcomes generated by economic processes, yet they remain largely invisible within conventional monetary statistics, which measure development solely in material and financial terms. However, the degrowth paradigm has faced significant criticism, particularly from Neoclassical and Marxist schools of thought. While Neoclassical economists question its feasibility in sustaining welfare, Marxist theorists often argue that it risks neglecting structural inequalities inherent in capitalist modes of production (Van den Bergh, 2011; Huber, 2022). Despite such critiques, degrowth perspectives continue to emphasise that a paradigm shift away from perpetual growth is necessary to achieve long-term ecological sustainability and social well-being. In response to the challenges and political resistance associated with degrowth implementation, an alternative perspective has emerged in the debate: a-growth. It is an approach that may prove more politically pragmatic, as it allows for targeted interventions to reduce environmental impact and improve social well-being without necessarily rejecting any form of conventionally measured economic growth - especially in contexts of greater poverty (Haddad & Solomon, 2024). From this viewpoint, any technical or economic regulations aimed at safeguarding the local or global climate and environment should be realistically evaluated, not only in terms of their ecological effects and financial costs to the stakeholders, but also regarding their effects on energy production and cycling, entropy production, and other relevant factors (Van den Berg, 2011). The entropy production factor may thus serve as a stand-in for unanticipated political and economic factors (Jenkins, 2005).

Given today's global challenges, revisiting traditional economic frameworks has become more critical than ever. Issues such as fossil fuel dependence and climate change dominate the international agenda, underscoring how governments have long overlooked the consequences of resource exploitation for future generations and developing nations (Stern, 2007).

It is important to further distinguish between bioeconomics and bioeconomy, two concepts that are often used interchangeably but refer to different analytical frameworks. Bioeconomics, as developed by Georgescu-Roegen, is a theoretical approach grounded in thermodynamic principles, emphasizing entropy, irreversibility, and the biophysical limits of economic processes. By contrast, the bioeconomy refers to a policy-oriented framework that focuses on economic activities based on renewable biological resources, including agriculture, forestry, and bio-based industries. While the bioeconomy provides practical strategies for resource use and sustainable production, bioeconomics offers the underlying theoretical foundation by highlighting the physical constraints within which such activities must operate. In this sense, the two perspectives are complementary.

In this context, bioeconomy offers a comprehensive perspective by examining all economic activities that rely on renewable bioresources from both land and sea — including agricultural crops, forests, animals, and microorganisms — to produce essential goods, services, and energy (McMahon & Mrozek, 1997; Lucia and Grisolia, 2021). Rather than focusing solely on GDP growth, bioeconomics emphasises human development in terms of enhanced well-being and reduced environmental impact. Central to this approach, alongside rethinking growth theories, is the development of policies that promote lower entropy (lower-waste) activities, minimising resource degradation. This perspective provides a crucial foundation for rethinking resource management theories to achieve sustainability within the planet's ecological limits.

For instance, the law of entropy has been widely applied to economic theories concerning resource management. In thermodynamic terms, human activities are irreversible processes, as they involve energy dissipation that increases the overall entropy of the system (Kamiński, 2020). Technologies that raise energy demand further exacerbate this trend (Georgescu-Roegen, 1971; Ruth, 2007). However, in the late 19th century, Podolinsky argued that human labour plays a unique role by capturing solar energy and preventing its immediate dissipation, thus facilitating the accumulation of additional usable energy on Earth (Vozna, 2016). Despite this, the long-term viability of economic systems depends on the availability of low-entropy energy and materials, as well as the capacity to harness solar energy for productive purposes. While solar energy flows remain abundant, the finite supply of material resources needed to convert this energy into usable goods is becoming a pressing issue, raising concerns about how long Earth's natural capital can sustain current or higher levels of resource consumption (McMahon & Mrozek, 1997).

As we already stated, scholars argue that entropy imposes an absolute physical limit on economic growth, because **e**ven if resources are used efficiently, waste and dissipation inevitably increase. Although specific resources can sometimes be substituted — such as replacing one fuel with another — this does not eliminate thermodynamic constraints. As Daly (1991) notes: "*Substitutability among different varieties of low entropy does not suggest that there can be a substitute for low entropy itself*." In other words, while particular materials can be replaced, the fundamental principle that all energy transformations increase entropy remains unavoidable (McMahon & Mrozek, 1997).

In ecological economics, Daly's (1991) concept of sustainable scale is central: it refers to the physical volume of throughput — the flow of matter and energy extracted, transformed, and returned as high-entropy waste — that can be maintained without compromising essential ecosystem functions. Achieving a sustainable scale requires respecting the regenerative capacity of renewable resources and the assimilative capacity of ecosystems to absorb waste (Haddad & Solomon, 2024). Nevertheless, awareness is growing that natural resource scarcity is not always accurately perceived or valued in markets (McMahon & Mrozek, 1997). The intrinsic value of environmental elements is often overlooked, while market systems that misjudge scarcity tend to promote technologies that foster economic growth at the cost of environmental degradation.

As Carpenter (1995) highlights, the strong sustainability approach rejects the Axioms of Material Value, Abundance, and Technological Abundance, which underpin conventional economic thinking. Norton (1989) further clarifies these axioms. The Axiom of Material Value assumes that resources have no intrinsic value beyond market price, leading to the undervaluation of essential environmental services. The Axiom of Abundance presumes that Earth's vastness prevents resource depletion within human timescales. The Axiom of Technological Abundance claims that technological innovation will always enable substitution between natural and man-made capital, making entropy constraints irrelevant

(Kamiński, 2020). In contrast to these optimistic assumptions, Georgescu-Roegen (1971) adopted a more cautious stance, arguing that the technological solution is only viable if it can sustain the material structures that support resource flows and essential ecosystem functions (Vozna, 2016). Therefore, sustaining economic expansion requires continuously absorbing low-entropy resources from Earth's surface and interior (e.g. fossil fuels, minerals) and relying on the constant flow of solar energy that fuels biological and ecological processes.

Finally, economists have debated whether the Second Law of Thermodynamics applies exclusively to energy or also to material resources. From a physical standpoint, this distinction is often considered artificial, as entropy governs both energy and material processes. It influences fields ranging from thermodynamics and quantum mechanics to information theory, biology, and cosmology. As such, entropy is a central factor in both energy and material constraints, and understanding its implications is crucial for achieving long-term economic sustainability (McMahon & Mrozek, 1997).

4. The application of entropy in economics: prospects, models and policies

The recognition of entropy as a structural and unavoidable constraint on socio-economic systems opens the way to significant applications across various economic domains. In this section, we aim at reviewing some applications of the entropy law in micro and macroeconomic modelling, resource management and policy evaluation. In terms of public policy, it calls for a reformulation of development strategies, which can no longer pursue unlimited linear expansion but must instead focus on resource regeneration, systemic resilience, and the optimal management of energy and informational dissipation. On a theoretical and modeling level, the entropic approach encourages the integration of thermodynamic limits into traditional macroeconomic models, in line with the principles of bioeconomics and ecological economics — through tools such as entropy-constrained input-output models and dissipative efficiency curves (Smulders, 1995). Finally, in the realm of environmental initiatives, this perspective provides a solid conceptual foundation to strengthen frameworks like the circular economy, the energy transition, and selective degrowth practices, steering design toward systems with low internal entropy and high systemic efficiency. In this sense, entropy is not only a physical limit but also a guiding principle for rethinking economic and ecological sustainability in structural terms (Lucia & Grisolia, 2021).

Entropy has been widely applied in economics, especially in resource management and sustainability assessment. One of the most straightforward applications is the Entropy Weight Method (EWM), a quantitative tool that assesses sustainability based on multiple indicators. The core idea of this method is to assign weights to each indicator based on its variability: those that vary more across regions or time are considered to carry more information and are given more weight in the analysis. The process begins with the construction of a decision matrix, which contains the values of various sustainability indicators for different regions, sectors, or time periods. This matrix is then normalized to ensure comparability. Next, the entropy of each indicator is calculated: this statistical measure reflects how uniformly an indicator's values are distributed. An indicator with high variability has higher entropy and thus provides more discriminating power. Such indicators are assigned greater weight in the composite index. Once the weights are determined, they are used to compute scores for specific subsystems and eventually to derive an overall sustainability index. This method ensures that the indicators contributing most to differences in sustainability performance are given more importance, making the evaluation more objective and data-driven.

For example, Cunha-Zeri et al. (2022) apply the EWM method to assess nitrogen management in Brazil. The analysis revealed that, economically, investment in water and sanitation was the most relevant factor, peaking in 2012 due to the Growth Acceleration Program, but subsequently declining and reducing sustainability. Socially, population growth emerged as a critical factor, as social dynamics are closely linked to consumption needs and environmental pressures. Lastly, from an institutional perspective, the country's political instability appeared as a key obstacle to sustainable action. Overall, by integrating these subsystems, EWM allowed for a comprehensive understanding of their impact on sustainability outcomes and guided policy priorities. Similarly, Wang et al. (2020) applied the EWM to assess the sustainability performance of the Fujian Province in China. Using 59 indicators derived from the Sustainable Development Goals, grouped into social, economic, and environmental dimensions, they calculated entropy-based weights to objectively capture the variability and significance of each indicator. While Fujian's overall development index improved, their analysis highlighted that low performance in certain social indicators - related to health and governance - significantly hindered sustainable development. Additionally, greater variability in environmental indicators resulted in higher entropy weights, highlighting imbalanced progress.

Beyond its use in sustainability assessment, entropy has also been applied to microeconomic modelling. Tsirlin and Gagarina (2020) developed a model exploring parallels between thermodynamics and economic behaviour. In thermodynamics, energy transfer occurs through heat and work; in economics, resources are exchanged through trade, production, and consumption. The authors introduce an economic indicator of irreversibility, demonstrating its maximum for a loan system in equilibrium. Their analysis defines economic agents as entities that engage in resource exchange and consumption, establishing wealth and capital dissipation functions. This reflects the principle that it is impossible to indefinitely generate profits from a transaction with an agent, akin to entropy constraints in physics. They argue that the Second Law of Thermodynamics translates into economics as follows: without external adjustments, resource flows do not move from agents with higher valuation to those with lower valuation, and profit generation is ultimately limited. Equilibrium in economic systems, like in thermodynamics, corresponds to maximum entropy, or in economic terms, to maximum net capitalization of agents. At this point, profitability declines to zero. The highest level of capitalization matches the highest invested capital, since total capital remains constant in an isolated system. Accordingly, thermodynamic balance equations find analogies in economics through capital, resource, and welfare balance equations, where non-negative welfare growth must be maintained across subsystems within systemic limits.

At the macroeconomic level, entropy has inspired the Maximum Entropy Production (MEP) hypothesis. According to Jenkins (2005), economic and political behaviours do not necessarily aim to maximize individual utility, but rather tend to optimize entropy production systemically. This implies that political power depends not only on financial resources but also on control over energy and material resources, which produce entropy. Thus, companies controlling energy sources and governments managing their distribution hold greater economic and political influence. However, maximising entropy production does not always yield positive outcomes. Its impacts depend on natural and economic constraints. Under abundant fossil fuel availability, the tendency towards maximum entropy production becomes evident. Policy interventions, such as CO_2 taxes or R&D incentives, influence this differently. Studies show that targeted R&D policies act as "catalysts", altering system dynamics more effectively than direct taxation (Huang et al, 2016).

The MEP hypothesis also has significant implications, especially concerning policymaking and macroeconomic growth (Huang et al., 2016). Rigid planning may unintentionally slow growth by limiting entropy production. As a result, economic systems tend to grow more efficiently when disruption is minimized. Governments play a key role in guiding entropy production through economic regulations and environmental policies, as they can direct or control businesses to operate in areas with greater stability and assimilative capacity, impose quotas or capital taxes to keep factor choices stable, and promote technologies that increase the productivity of natural capital rather than merely accumulating more of it (Goerner et al., 2009). Recognising entropy and assimilative capacity enables new frameworks for factor use, which has major implications for policy design—especially regarding trade-offs between income growth and ecosystem vulnerability. In this context, policy measures to reduce environmental capital degradation become essential. Examples include the promotion of creative closed-loop production systems that recycle waste and emissions, as well as the development of renewable and low-GHG emission technologies as alternatives to continued reliance on fossil fuels (Goerner et al., 2009). The pursuit of technologies focused on natural capital would also be encouraged by a deeper conceptualization (Thampapillai, 2014).

The MEP principle is also relevant in global environmental agreements. An MEP-driven agreement can be found in the Montreal Protocol (Murdoch & Sandler, 1997), which successfully limited the production of chlorofluorocarbons (CFC) and other compounds that deplete the stratospheric ozone layer. The success was made possible by the potential decline in economic activity (entropy production) in certain industries (Jenkins, 2005). However, as a result of the decline in global entropy production, the suggested reduction in CO2 emissions envisioned in the Kyoto Protocol (Babiker et al., 2002) can be considered much more challenging to achieve. Modeling studies have examined the effects of various carbon-reduction incentives on industrial processes, showing that different types of policies affect sectors in different ways. Environmental impacts arising from the exhaustion of natural resources not only represent a risk, but also amplify other vulnerabilities. Environmental risk, in particular, is increasingly acting as a trigger for other forms of harm - economic, social, geopolitical - which mutually reinforce one another, contributing to greater systemic disorder. Therefore, entropy, disorder and irreversibility, combined with rising complexity, are contributing to a polycrisis situation (The Global Risks Report, 2023).[4] In the coming years, as ongoing, parallel crises deepen fundamental changes in the economic and geopolitical environment, the various threats we face are expected to intensify.

Adopting an entropy approach requires accounting for ecological limits and resource scarcity. Accordingly, it proves particularly useful also when dealing with policy evaluations. A prominent example of how entropic and ecological constraints are being addressed at the institutional level is the adoption of the Sustainable Development Goals, or SDG (SDGs, 2015) established by the United Nations — a set of 17 objectives aimed at promoting a more sustainable global economic model. At the heart of this agenda lies a recognition of physical and biological limits to growth. Within this context, the concept of entropy becomes particularly relevant — not as a mere metaphor, but as a physical constraint: it defines the limits to energy efficiency, resource renewability, and waste absorption that economies must face in the long run (McMahon & Mrozek, 1997). We provide two examples of applications of a bioeconomic approach to policy evaluation, referring to the works of Jin et al (2020) and Stanujkic et al (2020). Both studies apply entropy to assess sustainable development performance, ensuring that policies are based on data-driven insights rather than arbitrary weighting.

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[4] Concurrent shocks, profoundly interrelated risks, and deteriorating resilience are raising the prospect of polycrises. Over the medium term, deteriorating geopolitical cooperation will have repercussions throughout the global risk landscape, including contributing to a potential polycrisis of interconnected environmental, geopolitical, and socioeconomic risks pertaining to the availability and demand for natural resources. There are four possible futures centered on food, water, metals and minerals scarcity, all of which could spark a humanitarian as well as an ecological crisis, ranging from water wars and famines to continued overexploitation of natural resources and a slowdown in climate mitigation and adaptation. Given the unpredictability of global risk interactions, comparable foresight exercises might assist in identifying future links, guiding preparatory steps toward reducing the scale and scope of polycrisis before they arise (The Global Risks Report, 2023).

Stanujkic et al. (2020) employ entropy to evaluate the progress of EU countries toward SDGs, while Jin et al (2020) refine the National Sustainable Development Index (NSDI) by incorporating economic, social, and environmental dimensions. By applying entropy-based approaches that emphasize biological constraints, policymakers can prioritize investments in high-impact areas, such as renewable energy adoption, social welfare programs, and circular economy initiatives, instead of relying solely on economic growth as a measure of progress. Furthermore, entropy-based assessments uncover hidden imbalances by identifying countries that may appear economically strong yet perform poorly in terms of environmental and social sustainability. As stressed in both studies, this methodology provides a systematic framework for decision-making, thereby guiding governments toward more holistic and effective sustainability strategies that balance economic development with social and environmental responsibility.

From a policy perspective, acknowledging entropic constraints requires a shift from traditional growth-centric paradigms toward models that explicitly incorporate biophysical limits (Georgescu-Roegen, 1971; Daly, 1991; Romeiro & Sa Earp, 2013). This entails promoting circular economy frameworks that prioritize resource efficiency and waste minimization (Haddad & Solomon, 2024), as well as ecological fiscal reforms that internalize environmental externalities (Thampapillai, 2014). It also involves targeted public investments in technologies that enhance the resilience and productivity of natural capital while reducing systemic vulnerabilities (Kamiński, 2020; McMahon & Mrozek, 1997). Incorporating entropy into macroeconomic modeling also allows for a more integrated assessment of long-term systemic risks, capturing the complex feedback loops between economic activity, resource depletion, and environmental degradation (Jakimowicz, 2020; Ruth, 2007). This is particularly relevant in the context of mounting global challenges, where climate change, biodiversity loss, social inequality, and geopolitical instability increasingly interact and reinforce one another (The Global Risks Report, 2023). Moreover, the entropic perspective highlights the importance of accounting for energy flows, material throughput, and ecosystem services as fundamental inputs into production and welfare models, offering a richer framework for evaluating trade-offs between short-term economic gains and long-term ecological sustainability (Georgescu-Roegen, 1971; Daly, 1991; Jenkins, 2005). As such, entropy-based frameworks provide not only a diagnostic tool for assessing current trajectories but also a normative foundation for designing transition pathways that align economic systems with the carrying capacity of the biosphere (Haddad & Solomon, 2024; McMahon & Mrozek, 1997).

5. Conclusion

In this paper, we traced the adaptation of the concept of entropy into economic thought, with a particular focus on ecological economics. The growing applications of entropy in economics suggest that this field of study will further expand in the coming years. The ever-growing attention to the finiteness of resources, increasing awareness of planetary limits, and the study of alternative development and growth models - including degrowth, post-growth and a-growth - make the application of the Second Law of Thermodynamics in economic models both interesting and useful, as Georgescu-Roegen argued. The Law of Entropy is indeed essential in this context, as the harsh conditions of life-supporting structures arise from their absolute dependence on available energy, coupled with continuous and irreversible entropic degradation. While this is not the first study to explore this intersection, we believe the originality of our contribution lies in adopting a bioeconomic approach. Considering this, we reviewed the application of physics - more specifically, entropy - to various economic theories, highlighting differences in methodologies and implications. Since our goal is to deepen the understanding of entropy as a resource constraint on economic processes, our contribution builds upon the concept as strictly defined in thermodynamics. Nonetheless, future work should explore other applications - such as in finance or income distribution theory - in greater detail.

We distinguished classical theories, which apply classical mechanical concepts, from more innovative approaches that incorporate the Second Law of Thermodynamics and focus on ecological scarcity and resource finiteness. Specifically, our discussion is grounded in the contributions of Georgescu-Roegen (1971), the father of bioeconomics. The adoption of a bioeconomic approach was suitable to select some of the numerous applications of entropy economics, shifting our focus to micro and macroeconomic applications that take ecological constraints into account. We also discussed the policy implications of this approach, as it is highly useful for both policy making and evaluation. From an ecological economics perspective, governments can implement tools such as quotas or capital taxes to stabilize output and reduce entropy. These measures help shift incentives from capital accumulation toward technologies that enhance natural capital efficiency. The MEP hypothesis offers an alternative view of economic behavior, suggesting that systems may evolve to maximize entropy production rather than utility. However, this tendency is not always compatible with sustainability and is constrained by ecological and systemic limits (Jenkins, 2005). Introducing an entropic constraint in economic modelling, even if it provides a more representative picture of reality, comes with some limitations. In fact, it overlooks the fact that economic systems, while subject to thermodynamic laws, cannot be treated as purely physical systems. Given the fact that they also involve social interactions and human activities, entropy alone is not sufficient to provide a complete framework. Moreover, entropy-based models tend to overlook the role of technological progress which - although insufficient on its own to counteract long-term resource depletion - remains a key and unavoidable component of economic evolution (Romeiro, Sa Earp, 2013). Furthermore, while entropy represents a necessary constraint, it must be acknowledged that it presents computational challenges, as its measurement in economics is more abstract than in physics and quite complex to integrate into economic modelling (Herbert et al, 2023). Issues such as the complexity of required data, the need for standardized indicators, and the integration of these tools into existing institutional frameworks remain significant barriers to widespread adoption. This approach could, in fact, provide an effective framework for analyzing the challenges faced by implementing economic programs in addressing economic inequality among social classes and nations. Indeed, the human species is the only one in the biological world to exhibit, alongside biological differences, social inequalities, which can cause major upheavals in history, as emphasized by early social philosophers such as Plato and Aristotle. However, we emphasize that our intention is not to apply the physical laws of thermodynamics mechanically to social realities. Rather, we adopt entropy as a guiding metaphor and analytical framework to explore how resource depletion, energy dissipation, and systemic constraints manifest in economic systems. As with any interdisciplinary borrowing, this transfer entails epistemological trade-offs: while it opens promising paths for integrated analysis, it also requires critical awareness to avoid oversimplification. Recognizing these boundaries, our approach aligns with a bioeconomic tradition that values both scientific rigor and conceptual flexibility. This alignment enables a richer understanding of sustainability challenges, grounded not only in material flows but also in broader structures—social, institutional, and ecological—that shape them. As noted by Romeiro and Sà Earp (2013), modeling and quantifying ecosystem resilience thresholds is extremely challenging, which complicates accurate forecasting due to the behaviour of ecosystems. This set of inputs represents a new research trajectory that could be further explored in future studies. In particular, a more in-depth analysis of the applicability of entropy to post-growth theoretical models might represent a fruitful avenue. Such an inquiry may help overcome current limitations and foster a more robust and comprehensive theoretical framework within this field.

Declarations

Ethical Approval: this article does not contain any studies with human participants performed by the author.

Consent to Participate: Not applicable as this study did not involve human participants.
Consent to Publish: Not applicable as this study did not involve human participants.

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Appendix

Key Terms and Concepts

This glossary provides a conceptual reference to enhance accessibility and clarity for readers from different disciplinary backgrounds.

1. Thermodynamics and physical foundation of entropy

- **Entropy:** A thermodynamic measure of the dispersion of energy within a system. In isolated systems, entropy tends to increase, driving the system toward equilibrium.
- **First Law of Thermodynamics (Energy Conservation):** Energy cannot be created or destroyed, but only transformed or transferred between forms, so that the total amount of energy remains constant in a closed system.
- **Second Law of Thermodynamics (Entropy Increase):** In closed systems, entropy tends to increase over time, reflecting the irreversible dispersion of energy as systems evolve toward thermodynamic equilibrium.
- **Thermodynamic Equilibrium:** The state at which entropy is maximized and no further spontaneous macroscopic energy transformations occur.
- **Heat Death:** A hypothetical final state in which no useful work can be performed because no energy gradients remain. In classical thermodynamics, this corresponds to maximum entropy and uniform temperature.
- **Isolated system:** A system that cannot exchange energy or matter with its surroundings. In such systems, maximum entropy is achieved at the thermodynamic equilibrium of the system.

2. Entropy in Economic Thought

- **Bioeconomics:** An economic approach that incorporates biophysical constraints, recognizing that economic processes are embedded in ecological systems governed by the laws of thermodynamics (Georgescu-Roegen, 1971).
- **Ecological Economics:** An interdisciplinary field emphasizing sustainable economic development within the carrying capacity of ecosystems, integrating ecological and economic principles.
- **Neoclassical Economics:** A school of economic thought based on rational agents, market equilibrium, and closed-system assumptions that largely disregard physical and ecological constraints.
- **Technological Abundance:** The belief that ongoing technological innovation will indefinitely substitute for resource shortages, enabling continuous economic growth.
- **Axiom of Material Value:** The notion that natural resources have no intrinsic value unless assigned a price through market exchange.
- **Axiom of Abundance:** The view that Earth's vast size renders resource depletion irrelevant for long-term economic growth.
- **Degrowth:** An alternative economic paradigm promoting reduced production and consumption to ensure environmental sustainability, social equity, and long-term well-being.
- **Stationary State:** An economic condition where production and consumption stabilize over time, maintaining a steady equilibrium without further growth.
- **Fourth Law of Thermodynamics (Georgescu-Roegen's Formulation):** An extension of thermodynamic principles applied to economics, emphasizing that resource degradation is irreversible, making infinite growth impossible.
- **Open Economic System:** An economic system that constantly exchanges energy and materials with its environment, in contrast to the closed-system models used in much of neoclassical economics.
- **Maximum Entropy Production (MEP) Hypothesis:** The tendency for complex systems to evolve toward states that maximize entropy production, within the constraints imposed by their environments.
- **Sustainable Scale:** The maximum physical volume of economic activity that can be maintained over time without compromising essential ecological functions.
- **Resource Scarcity:** The limited availability of natural resources required for production and consumption, which imposes physical limits on economic activity.
- **Energy Quality (Low vs. High Entropy):** Low-entropy energy is highly concentrated and capable of performing work; high-entropy energy is dispersed and no longer useful for economic processes.
- **Ecosystem Resilience Thresholds:** Critical tipping points beyond which ecosystems may undergo irreversible change or collapse, often unpredictably.
- **Technological Progress (in Entropic Context):** Advancements that may improve resource efficiency and delay resource depletion but cannot eliminate the fundamental thermodynamic constraints on economic activity.
- **Co-evolutionary Dynamics:** The mutual and interdependent evolution of economic systems and ecosystems, characterized by feedback loops and non-linear interactions.
- **Throughput:** The flow of energy and materials extracted from nature, processed by the economy, and returned to the environment as waste.

3. Applications of Entropy in Economics Models and Policy

- **Econophysics:** An interdisciplinary field where physicists apply statistical physics and thermodynamic principles to analyze complex economic systems, using methods such as probability distributions, scaling laws, and stochastic models (Scharfenaker & Yang, 2020).
- **Complexity Economics:** An approach that studies economies as complex adaptive systems characterized by nonlinear dynamics, feedback loops, and emergent behavior, incorporating tools from physics, biology, and information theory.
- **Self-Referential Economic Systems:** A feature of economic models where theories and expectations influence the behavior of economic agents, making economic systems reflexive and socially constructed, unlike purely deterministic physical systems (Castoriadis, 1975).
- **Entropy Weight Method (EWM):** A multi-criteria decision-making tool that applies entropy to determine the relative importance of sustainability indicators based on their variability across regions or time, enhancing the objectivity of sustainability assessments (Cunha-Zeri et al., 2022).
- **Microeconomic Entropy Models:** Approaches that apply thermodynamic principles to individual agents' behavior, where resource exchanges, capital dissipation, and profit generation mimic energy transfer and irreversibility found in physics (Tsirlin & Gagarina, 2020).
- **Irreversibility (Economic Context):** A principle emphasizing that once resources are transformed or consumed, they cannot be fully recovered or restored to their original state, echoing the Second Law of Thermodynamics.
- **Wealth Dissipation Function:** A microeconomic analogy to entropy, describing how the capacity to generate additional wealth diminishes over time as systems approach resource or profit equilibrium (Tsirlin & Gagarina, 2020).
- **Catalytic Policies:** Policy interventions that indirectly influence the systemic dynamics of entropy production, such as promoting research and development, circular economy models, or innovation rather than directly targeting static growth goals (Jenkins, 2005).
- **Assimilative Capacity:** The ability of natural ecosystems to absorb and neutralize waste outputs from economic activities without suffering degradation or loss of functionality.
- **Polycrisis:** A situation in which multiple interconnected global risks (economic, environmental, geopolitical, social) reinforce each other, leading to amplified instability and systemic disorder (The Global Risks Report, 2023).
- **A-Growth:** An emerging alternative to growth and degrowth paradigms, suggesting a pragmatic focus on improving well-being and reducing environmental impact without rigidly opposing GDP growth, especially in developing economies (Haddad & Solomon, 2024).
- **Natural Capital:** The stock of renewable and non-renewable natural resources—such as air, water, soil, and biodiversity—that provide essential ecosystem services and serve as a foundation for economic activity (Thampapillai, 2014).

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Do we need our needs?

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Abstract
This article challenges the foundational assumption of mainstream economics that human wants are unlimited and unchanging. Drawing on the distinction between fundamental human needs and the culturally and historically variable satisfiers used to meet them, it argues that needs are finite, universal, and oriented toward balance rather than accumulation. By conflating ends (needs) with means (commodities), modern economics obscures the true nature of wealth, wellbeing, and poverty, and legitimizes perpetual economic growth. The paper shows how contemporary development models actively reproduce poverty by promoting pseudo-satisfiers and by reshaping social and technological environments in ways that generate new dependencies. Reframing wealth in terms of need satisfaction rather than consumption, the article concludes that sufficiency, balance, and frugality—rather than growth—are central to overcoming poverty and restoring wellbeing.

Introduction

Economics is commonly defined as the study of ‘how people allocate scarce resources to satisfy unlimited wants’. Yet, although a lot has been said about the allocation part of the definition, little if anything has been said about the second – and maybe more crucial part, namely human wants and the assumption of them being unlimited. Why do we want what we want, and are our needs infinite, thus supporting the need for never-ending economic growth as assumed by standard economics? Can we take human needs for granted and treat them as unchanging, or are they historically and culturally changing in both space and time, thereby making them hardly manageable as parameters for mathematical models? Can we distinguish between needs and the products and strategies that different people and cultures use to address them? Or can we simply mix the means and the ends into one single concept, ignoring the difference between what we need and how we try to meet this need? As I will try to show in this article, the answers to these questions lead us to reconsider the common assumptions underlying contemporary development processes and strategies, and even what it means to be ‘rich’ or ‘poor’ in the first place. Moreover, they question the practice and models of standard economics, which assume that consumers' preferences can be treated as parameters shaping consumer behavior without examining their true nature or asking what the human needs manifested in these preferences are. This lack is particularly worrisome, not just because standard economics fails to inquiry into a central aspect of its own purported objectives but because the idea of unlimited wants happens to be a wrong one; nor can they be seen as unchanging and mathematised as parameters of equations, thus questioning the epistemological foundations of mainstream economics based on a misplaced methodological choice, namely mechanics, to study a complex, historically changing social phenomenon like the economic process and our human needs driving it.[1]

About needs and satisfiers

Any discussion about wellbeing or poverty, indeed the essence of the economic and sustainability discourse, requires an understanding of human nature and the 'needs' to be satisfied for us to 'live and live well'. This requires an understanding of how these needs are, or are not, satisfied by our economic behavior and development. And this is something neither the standard economists nor the proponents of sustainable development attempted to do. Although the Brundtland Report stated that "sustainable development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs,"[2] no further thoughts were given to what constitutes these needs in the first place. Nor do our standard definitions of poverty consider the qualitative, systemic and relational nature of satisfiers, whether satisfying or not the fundamental needs of people. Although needs as such may be unchanging, or change very little and slowly both in space and in time, the preferences for concrete satisfiers to meet them are very volatile and diverse, and cannot, thereby, simply be assumed as given and immutable as mainstream economists do by invoking the ceteris paribus assumption in their models.

Indeed, as we will see, the whole mathematical edifice on which standard economics is built relies on failing to distinguish between needs and the ways in which different individuals and societies choose varying satisfiers to address them. Max-Neef and others, already in the 1980s, argued that there is a fundamental difference between *needs* and the way these needs are satisfied or not by particular *satisfiers*.[3] While needs may be common to us humans by virtue of our intrinsic human nature, satisfiers are not; they vary according to different ways of *being*, *having*, *doing,* and *interacting*. For instance, *living* and *interacting* in a rural environment in which plentiful food is *being* grown requires you to *have* access to this grown food in the first place for it to satisfy your subsistence needs. You may *have* access as a producer who *produces* self-sufficiently or as a consumer who, *having* enough money to spend, *goes* to the local market. Or, being part of a larger community based on reciprocity, we may rely on food *given* freely by others, as was and still is the praxis in some religious communities that

[1] Elsewhere, I have discussed these aspects in more detail, showing how the use of the mathematical approach and the assumptions required to do so place economics, as such, outside the realm of science and into the realm of ideological justification, and how an alternative, phenomenological approach is required to address it. May this article serve as an example of how different our economic reality appears to us if approached phenomenologically. Stahel, Andri W. (2020) "Is economics a science?" Real-World Economics Review, issue no. 94, 9 December, pp. 61-82, http://www.paecon.net/PAEReview/issue94/Stahel94.pdf; Stahel, Andri W. (2021) "Has economics become a new theology? Some comments about the practice of modern economists and medieval theologians" real-world economics review, issue no. 97, 22 September, pp. 2-19, http://www.paecon.net/PAEReview/issue97/Stahel97.pdf and Stahel, Andri W. (2021) "Oikonomics: towards a new paradigm in economics." real-world economics review, issue no. 96, 22 July, pp. 217-238, http://www.paecon.net/PAEReview/issue96/Stahel96.pdf.

[2] World Commission on Environment and Development (1987).Our Common Future. Oxford: Oxford University Press. Available online http://www.un-documents.net/wced-ocf.htm.

[3] Max-Neef, Manfred; Elizalde, Antonio & Hopenhayn, Martin (1989). Human Scale Development. In Development Dialogue, 1989 (1). Uppsala: Dag Hammarskjöld Foundation. Elsewhere, we have proposed some methodological extensions to the original proposal, aiming to enlarge its application as an evaluation tool for different development models and wellbeing. See Cruz, Ivonne; Stahel, Andri & Max-Neef, Manfred (2009). Towards a systemic development approach: Building on the Human-Scale Development paradigm. In Ecological Economics (68): 2021-2030.

rely on donated food. Or, according to one's position and *interactions* in a larger redistribution scheme, *getting* food stamps from the government or food provided by the employer in other cases. Moreover, *having* food will not be enough to appease your hunger if you do not *eat* and do not *digest* the food adequately due to your biological way of *being*. Wheat bread may not be an adequate satisfier for those suffering from celiac disease, in the same way as a vegan may reject meat as a satisfier for their hunger, as it may negatively affect their identity needs. There are virtually infinite ways of *being*, *having*, *doing,* and *interacting* whereby different people at different times attempt to satisfy their needs through different satisfiers which, moreover, depend on others to satisfy one's needs.

Different satisfiers at different ontological levels may complement, contradict, reinforce or dampen each other. Conversely, satisfiers do not just affect a single need linearly, but simultaneously affect different needs at different levels and in different ways. Going to the cinema may be a way of attending a need of idleness, but it may relate and affect as well your identity (depending on the kind of movie you are choosing), affection (depending on whether you go alone or with someone else), understanding (as long as the movie helps you to deepen in the understanding of given realities or human relations and feelings) and participation, insofar as having seen certain movies is part of your ways of socializing with like-minded.

There are potentially infinite ways in which people and cultures attempt to satisfy their needs, with varying concrete satisfiers. Something completely different happens with our fundamental needs, which we share with all other human beings according to our common human nature. Indeed, fundamental human needs are the same across cultures and historical periods, changing only very slowly as our species evolves. Those proposed by the Human Scale Development approach are, at the axiological level (i.e., referring to the things we value and need): subsistence, protection, affection, understanding, participation, idleness, creation, identity, and freedom. The need for transcendence is sometimes included as well. Other authors may have slightly different lists and names, although as long as a clear distinction between needs and satisfiers is made (not taking satisfiers as needs, for instance), they always end up being few and limited. As for other living beings, these needs are the driving force of human behavior, particularly economic behavior, as we try to meet them with the scarce resources available to us.

Needs are an abstract, generic category, like the need to survive or the need to understand. Satisfiers, by contrast, are the concrete means and strategies used to address these needs. Unmet needs are perceived as a lack or want, which drives our behavior to fill that need, such as feeling hungry or feeling insecure. Satisfiers are the means by which individuals and communities address these needs.

When the right satisfier is obtained and consumed, the corresponding lack ends, and the pursuit of that need stops. After eating enough, there is no incentive to eat more. Like other living beings, once we had enough, we tend to rest rather than seek more, even if food is available. Health and wellbeing rely on proper scale and balance: too little causes need and discomfort; too much leads to illness. Living well means finding this balance.

In the same way, lack of security may manifest as insecurity and fear. Overprotection may again lead to feelings of insecurity, tightness, and a lack of freedom. It is only in between, neither too little nor too much, that a pleasant sense of satiation and wellbeing may calm us, providing peace and no further need to act. No living being, humans included, has infinite needs. Living beings are finite, and so are their needs. Health and wellbeing are not associated with ongoing desires, consumption and accumulation but are balanced within narrow frames. We eat healthily until we are satiated. A lack or imbalance in nutrient intake is associated with hunger and eventual starvation. Conversely, too much brings indigestion and obesity. Health is associated with balance, not with accumulation. As Paracelsus famously stated, 'the dose makes the poison'. Any excess represents a health threat. Too little security may put our lives at risk, while too much hampers our freedom and actions.

It should be obvious that there is a crucial difference between what we need and how we attempt to meet this need. Yet in standard economics, this distinction is simply ignored, as it is in our daily lives when we see ourselves in need of a new car or new clothes. These are satisfiers, not the need they may, eventually, meet.

Where it all started

This failure to reflect on what human needs actually are is not new. It was already introduced into modern economic thinking by the economics' founding father, Adam Smith, who proposed conducting an 'inquiry into the origins and causes of wealth'. Following Aristotle who in his *Politics* already made this point, Smith distinguished between use-value (that which may be gained by the use of something) and exchange-value (that which may be gained in exchange for it) and defined that "every man is rich or poor according to the degree in which he can afford to enjoy the necessaries, conveniencies, and amusements of human life."[4] Thereby, Smith, as Aristotle had done before, defined wealth in terms of use-value. Furthermore, reflecting on the relation between use- and exchange-values, Smith observed that "the things which have the greatest value in use have frequently little or no value in exchange; and on the contrary, those which have the greatest value in exchange have frequently little or no value in use. Nothing is more useful than water, but it will purchase scarce any thing; scarce any thing can be had in exchange for it. A diamond, on the contrary, has scarce any value in use; but a very great quantity of other goods may frequently be had in exchange for it."[5] He could certainly have extended his examples to a myriad of other freely available use-values, like the fresh air he breathed, the stable climate he lived in, the social and familiar networks that sustained him or even the academic relations and friendships that nurtured both his emotional and intellectual needs, and his professional career. They clearly represented a very high use-value and a great deal of the 'necessaries and conveniences' of his life, although they were absolutely free and had no exchange-value at all. Thereby, according to his own reasoning, there is no direct correlation between use- and exchange-values, and, thereby, to inquire into the origin and cause of wealth, he would have to inquire into the nature of use-values and not that much into the exchange-value of things – something he ended up not doing.

Indeed, right after having defined wealth in use-value terms, he reduced his inquiry to the quantitative market dimension of the economic process rather than to its qualitative relational dimension. This was justified by Smith, and accepted by those economists of all colors and orientations who came after him, by means of the argument that "when the division of labor has been once thoroughly established, it is but a very small part of man's wants which the produce of his own labor can supply. He supplies the far greater part of them by exchanging that surplus part of the produce of his own labor, which is over and above his own consumption, for such part of the produce of other men's labor as he has occasion for. Every man thus lives by exchanging, or becomes in some measure a merchant, and the society itself grows to be what is properly a commercial society."[6]

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[4] Smith, Adam (1776/1937). *An Inquiry into the Nature and Causes of The Wealth of Nations*. New York: Random House, p. 30.
[5] Ibid. p. 28.
[6] Ibid. p. 22

Thereby, Smith and those economists who followed him simply ignored other forms whereby wealth and use-value are reproduced both by humans and by the free functioning of natural processes. Indeed, he ignored the bulk of what keeps us alive. Moreover, he did not bother to examine the relational and context-dependent systemic factors needed to 'afford to enjoy the necessaries, conveniencies, and amusements of human life'.

By not inquiring into the nature of human's wants, by ignoring the ways of being, having, doing and interacting whereby we sustain our lives and attain our wellbeing, Smith, as did those who followed him, failed to see that inquiring into our needs and how they are shaped and manifest should be at the center of any inquiry into the nature of wealth and economics.

Are we in need of our needs?

This small assumption which allowed Smith to divert from his stated aims of inquiring into wealth, namely that only 'a very small part of man's wants which the produce of his own labor can supply' went unchecked since then. Yet, it happens to be wrong. Indeed, a quick look at all the non-commercial and non-treaded satisfiers, like the air we breathe, the natural processes that keep our Earth alive, and the family and social relations in which we live and grow up, shows that it is rather the other way around. Even today, without them, we would not even survive. Moreover, as Smith saw, our needs are satisfied not by the exchange-value of goods and services, but by the very nature of use-values and the way we relate to them, satisfying or not our needs.

By confounding our ends (the satisfaction of our fundamental need to survive and stay healthy) with the means to achieve it, modern economics inaugurated by Smith left unanalyzed how actually the chosen satisfiers for our 'needs' are socially and historically changing according to the prevalent cultural values and narratives, and how, each different development model producing, distributing and consuming a different set of satisfiers in different and varying ways, actually generates more or less wealth and wellbeing. Indeed, economics fails to inquire into the very essence of the economic process, namely, how we humans aim to satisfy our needs through our economic behavior making use of the limited set of satisfiers we have at our disposal.

Therefore, if we want to go beyond this vision, we must, from the outset, understand that the human being, as a being endowed with reflective consciousness and—socially—with a symbolic culture, does not have his behavior given in a purely biological, instinctive way. Human behavior is always inscribed in a specific cultural context given by the history of each social group, by the web of social relationships that characterize it and—on a broader level—by the reproduction of the cultural and symbolic values that distinguish it. Thereby, although our needs may be common to us all and unchanging, our preferences and choices are not.

Each individual and each society adopts different methods for satisfying the same fundamental human needs. These are satisfied (or not) in each case through different satisfiers. We can even say that one aspect that defines a culture is its choice of satisfiers. Cultural changes are, among other things, the consequence of abandoning traditional satisfiers in favor of new or different satisfiers. By abandoning meeting rooms and direct contact in favor of Zoom meetings and working from home, we are not changing our fundamental needs as social creatures, but only the way we satisfy them. Moreover, they change from individual to individual and in each individual over time. For instance, some individuals may, at certain times, choose to eat bread or a sandwich to satisfy their subsistence needs. Others, or the same individual at a different time, may choose to eat a fruit or invite their partner or friends to a fancy dinner.

Moreover, as Baudrillard already analyzed in the 60s/70s, what we buy and consume are not objects, but rather objects/signs. We, humans, have our preferences shaped by the narratives that inform our cultures, the particular social groups we belong to, and the different levels of consciousness and belief systems we possess at every moment. Commodities, although presented to the consumer as a heteroclite collection of objects destined to satisfy this or that need, nevertheless form, as a whole, a coherent system of cultural signs, a social language that structures the relationship of humans not only with the object, but also with the community, with the world, and with themselves. By adopting certain satisfiers to meet a certain need, by choosing a certain product—such as a particular brand of cigarette, clothing, or car, spending holidays in certain places or hotels, etc.—we are no longer just satisfying immediate needs (of eating, leisure, mobility, etc.), but we are structuring our own identity, adhering to certain social values, and situating ourselves within the symbolic universe shared by certain social groups. In this way, not only each social group, but the individual identity of each person, is characterized—among other things—by the adoption of certain satisfiers that act, at the same time, as cultural signs.

It is this cultural and symbolic character of objects that allowed André Gorz to establish a fundamental distinction between poverty and misery. While he defined misery in absolute terms as resulting from not having our fundamental human needs adequately satisfied, representing a lack of conditions leading to inadequate physical and mental conditions, or even death, poverty always refers to a subjective dimension, to a lack in relation to a satisfier one would like to have rather than the ones available. While the former is an objective, measurable fact, the latter concerns a subjective perception: it is a difference, an inequity, an inability to access what the individual, on a subjective level, defines as 'good' and 'desirable'. What makes one poor is having less than one expects or desires, which, in turn, is shaped by the prevailing socio-cultural norms and narratives that guide and stimulate desire. And these change continuously as the society and the individual progress. As Gorz put it for the early 1970s, "someone is poor in Peru if he walks barefoot. In China, by not having a bicycle, and in France, by not being able to have a car. In the 1930s, someone was poor by not being able to buy a radio, in the 60s, by not having a television and in the 70s, you became poor by not possessing a color TV."[7] In the 1930s, one was poor if one could not afford a radio; nowadays, in our affluent societies, people may feel poor if they cannot afford top-branded goods or a new car, or the latest iPhone.

As Baudrillard showed, people feel poor as long as they do not manage to acquire the sign values needed to affirm their identity and belonging within a given group or community. Thereby, poverty relates to not having access to those satisfiers individuals, on a subjective level, deem as constituting 'the necessaries, conveniences, and amusements of human life' – something very well understood by advertisers and publicity but ignored by economists at large.

Modern development and the (re)production of poverty

It is this same logic of poverty that allowed Illich to speak of the modernization of poverty. As he put it, "The most effective way to open a market is to identify the use of what is new as an important privilege. If this identification succeeds, the old model is devalued and the self-interest of the consumer is wedded to the ideology of never-ending and progressive consumption. Individuals are socially graded according to the number of years their bill of goods is out of date. Some people can afford to keep up

[7] Gorz, André (1978). *Ecologie et Politique*. Paris: Seuil, p. 65.

with the Joneses who buy the latest model, while others still use cars, stoves, and radios that are five to ten years old-and probably spend their vacations in places that are just as many years out of style. They know where they fit on the social ladder. (…)

Periodic innovations in goods or tools foster the belief that anything new will be proven better. This belief has become an integral part of the modern world view. It is forgotten that whenever a society lives by this delusion, each marketed unit generates more wants than it satisfies. If new things are made because they are better, then the things most people use are not quite good. New models constantly renovate poverty. The consumer feels the lag between what he has and what he ought to get. He believes that products can be made measurably more valuable and allows himself to be constantly re-educated for their consumption. The 'better' replaces the 'good' as the fundamental normative concept."[8]

Thus, contrary to all the dominant discourse, modern development is not characterized by a search for how to alleviate poverty but, on the contrary, it feeds on poverty and unmet needs once consumers are led to consume mostly what the human scale development classifies as pseudo-satisfiers – when not destructive satisfiers – that is, satisfiers that, although supposedly aimed at satisfying a given need, do so only in a very limited way or time-span.[9] Indeed, this continuously renewed lack, by not providing a lasting satisfaction of a need, is the engine that keeps the capitalist system turning, eternally oriented towards the future. It is this (re)production of poverty that feeds—and legitimizes—the expanded reproduction of the production of goods and, thus, of capital.

Moreover, we can affirm that modern society is the first society that has created a specialized technical body, whose function is precisely to create and (re)produce poverty: advertising and marketing professionals who, through the manipulation of symbolic language and by acting on the unconscious psychological lacks and desires of people, manage to foster the desire for consumption and the subjectivity of poverty. Nowadays, in the age of the internet, where we, as consumers, have become the product, companies make their profits by keeping us glued to their screens. The use of algorithms and instant dopamine satisfaction has brought this ongoing reproduction of pseudo-satisfiers or even destructive satisfiers (once trying to satisfy one need, others are neglected or impaired) to another

[8] Illich (1975), Illich, Ivan (1975). *Tools for conviviality*. Glasgow: Fontana/Collins, pp. 89 and 90.

[9] While unlimited in forms and possibilities, within the Human Scale-Development approach, satisfiers may be classified according to how they satisfy particular needs, depending on how they relate to other fundamental needs and satisfiers in systemic ways. Within the human-scale development approach, they are broadly classified into five categories according to their attributes. Namely: synergic, singular, pseudo, inhibiting, violators or destroyers. Synergic are those satisfiers that simultaneously satisfy different needs, such as breastfeeding, meeting the baby's subsistence needs, and others like affection, security, and even identity. By contrast, bottle-feeding is singular in nature, attending to one need at a time without affecting others. Then, there are those like the pseudo-satisfiers, apparently attending to a fundamental need but doing so in a limited and short-lived way, as when we take a pill to get rid of a headache or take a drug to feel good or, nowadays, keep clicking on the feed bottom of Instagram or TikTok. Inhibiting satisfiers are those that, while satisfying a given need (generally over-satisfying it), seriously impair the possibility of satisfying other needs. Paternalistic ways of being and many redistribution schemes, while attending, for instance, to the need for subsistence or security of those who receive them, may create dependencies and a lack of initiative, thus inhibiting individual freedom and creativity, among other things. Finally, there are the violators or destroyers, which are satisfiers that, while chosen or presented as a way of satisfying a particular need, not only fail to fulfil this need but also impair the satisfaction of others. Many strategies that provide individual and collective security often fall into this category: 'Building the Wall' or waging a war against a perceived enemy often not only achieves lasting or even greater security but impairs other fundamental needs like freedom, understanding or subsistence. The very fact that satisfiers differ so much in their capacity to satisfy or not our needs already points to the importance of taking a closer look at those we choose rather than just ignoring the issue, putting it all into a black box as economists do.

level. Consequently, so-called development aid or the purported need to innovate and create new technologies – legitimized under the banner of 'the fight against poverty' – is, in fact, the way by which poverty is introduced and reproduced in the first place.

Traditional societies orbited around a socio-cultural logic that did not incessantly seek the new, but cultivated the preservation of past values and balances. They were based on the principle of satiety and not on the typically modern conception that the human being is characterized by having unlimited needs, that is, the argument of the logic of lack, of want. Moreover, these were social organizations in which the market played a secondary role, precisely the opposite of modern society, whose social organization is articulated around market relations and which has chosen mercantile satisfiers (commodities) as the most important satisfiers, thus prioritizing—as Fromm already analyzed—Having over being. Under this conception, not having money to access the privileged mercantile satisfiers of modern societies is, and feels, poor almost by definition.

And it is this mercantile conception of poverty that overshadows all other types of 'poverties', such as spiritual poverty, affective/emotional poverty, poverty of relationships—both social and with a harmonious physical environment—etc., under whose prism, in fact, we would have to invert the dominant conception of rich and poor societies, since it is precisely in the most developed countries where these types of poverty are most suffered, as the high rates of suicide and depressive illnesses that characterize them seem to confirm.

Thereby, "Contrary to all appearances, ours is not a society of abundance. By abandoning the primitive rule according to which needs, 'wealth' or 'poverty' are based on human relations and are manifested in the concrete and symbolic sharing of goods; and by replacing it with the modern principle of insatiability of individual wants and the ideal of accumulation of goods, industrial societies condemned themselves to a struggle, properly infinite, against scarcity: «it is necessary», wrote Jean Baudrillard in 1970, «to abandon the preconceived idea that we have of a society of abundance as being a society in which all material (and cultural) needs are largely satisfied. Such an idea eliminates social logic. And we must share the idea, taken up by Marshall Sahlins, according to which our industrial and productivist societies are, unlike certain primitive societies, dominated by scarcity, by the obsession of scarcity, characteristic of the market economy. The more that is produced, the more the irremediable departure from the final point that is abundance – defined as the balance of human production and human ends – stands out in the heart of profusion. Since what is satisfied in a growth society, and more and more satisfied as productivity grows, are the needs of the production order itself, and not the 'needs' of man, in the ignorance of which, on the contrary, the whole system rests, it is clear that abundance recedes indefinitely: better than that – it is irremediably denied for the benefit of the organized kingdom of scarcity (...). It is not, therefore, paradoxical to maintain that in our 'affluent' societies, abundance is lost, and that it will not be returned by an increase in productivity as far as the eye can see, by the release of new productive forces. (...) It is the social logic that made known to the primitives the 'first' (and only) society of abundance. It is our social logic that condemns us to a luxurious and spectacular shortage."[10]

Besides creating poverty at the level of subjectivities and their culturally determined conception of needs, there is also a concrete field in which the process of modernization, far from alleviating poverty, (re)generates it. Every new product, every new technology, once created, becomes part of the environment in which social and ecological relationships occur, altering them. By changing reality, the

[10] Alphandéry Alphandéry, Pierre; Bitoun, Pierre and Dupont, Yves (1992). *O Equívoco Ecológico - Riscos Políticos*. São Paulo: Brasiliense, pp. 109-110, quoting Baudrillard, Jean (1974). *La Société de Consommation*. Gallimard: Paris, pp. 90 and 92.

satisfiers needed to attend to our fundamental needs change, too. Thus, for example, the invention and generalization of the automobile as a means of transport and mobility enable and provoke a new geographical distribution of economic and social activities. It thus determines a new urbanization and a new economic distribution/concentration at the level of the territory as a whole. In doing so, it creates the need for everyone to own a car to meet their mobility needs, not to enjoy greater freedom of movement, but simply to cope with the new demands of social life in the environmental context created by the car itself.

Similarly, continually updating one's computer or smartphone by acquiring new models increasing both the power/speed of hardware and the degree of software updating, is no longer just a matter of where one is on the social scale according to the 'novelty' of the possessed equipment, but—increasingly in very concrete ways—simply a matter of being situated in society, since, after a few years, old systems are already unable to communicate with the new ones. This turns old equipment into relics, doomed to a solitary monologue or directly to the rubbish, thus contributing to the acceleration of the planet's entropic degradation. Thereby, forced obsolescence occurs not only at the subjective level of desires but also at the concrete level of satisfiers needed to meet fundamental needs, which could previously or in other contexts be satisfied otherwise.

These changes do not necessarily represent an increase in wealth, understood as the satisfaction of one's fundamental needs. Often, rather the other way around. New satisfiers due to technological lock-in lead to forced consumption at both a concrete, physical level and a subjective, cognitive level. Thereby, instead of liberating our mobility needs, cars became an everyday necessity in our jammed metropolis, while smartphones, once luxuries, are now required for banking, communication, and work, forcing even those already struggling to pay their bill to have updated models and to pay a telecom to provide for their needed internet connection.

Yet, for the affluent part of the population, too, from a needs perspective, people are not necessarily better off by becoming more affluent. As Wolfgang Sachs reminds us, "indeed for many, in particular the well-to-do, it is not money that is in short supply, but time. (…) Beyond a certain income level, the marginal utility of more available time is higher than the marginal utility of more available income. (…)

Beyond a certain number, things can become the thieves of time. Goods must be chosen, bought, set up, used, experienced, maintained, tidied away, dusted, repaired, stored and disposed of. Even the most beautiful and valuable objects unavoidably gnaw away at the most restricted of all resources: time. (…) Scarcity of time has therefore become the nemesis of affluence.

In fact, in a multi-option society people suffer not from a lack but from an excess of opportunities. While well-being is threatened by a shortage of means in the first case, it is threatened by a confusion about goals in the second. The proliferation of options make it increasingly difficult to know what one wants, to decide what one does not want, and to cherish what one has. (…)

Viewed up close, one can say that well-being has two dimensions: the material and the non-material. Material satisfaction is obtained by acquiring and utilizing certain objects or materials – for example, buying food and eating a multi-course meal will satisfy the need to fill the stomach. Immaterial satisfaction stems from the way in which the object and materials are used – enjoying Italian cooking and convivial company over dinner gives another dimension of pleasure. Similarly, many objects achieve their full value only when they are put to use, enjoyed and cultivated. However, and this is the dilemma, obtaining immaterial satisfaction calls for attention, demands involvement, requires time. (…) The conclusion is obvious. Having too many things makes time for non-material pleasure shrink; an overabundance of options can easily diminish full satisfaction. So, poverty of time degrades the utility of a wealth of goods. (…) As it turns out, having much contradicts living well. Frugality, therefore, is a key to well-being."[11]

Conclusions

From all that has been said above, we can conclude with Sachs that "Up until the present day, development politicians have viewed 'poverty' as the problem and 'growth' as the solution. They have not yet admitted that they have been largely working with a concept of poverty fashioned by the experience of commodity-based need in the northern hemisphere. With the less well-off *homo economicus* in mind, they have encouraged growth and often produced destitution by bringing multifarious cultures of frugality to ruin. For the culture of growth can only be erected on the ruins of frugality, and so destitution and dependence on commodities are its price. (…)

Destitution (…) becomes rampant as soon as frugality is deprived of its foundations. Along with community ties, land, forests and water are the most important prerequisites for subsistence without money. As soon as they are taken or destroyed, destitution lurks. Again and again, peasants, nomads, and tribals have fallen into misery after being driven from their land, savannas and forests. Indeed the first state policies on poverty, in sixteenth-century Europe, were a response to the sudden appearance of vagabonds and mendicancy provoked by enclosures of the land. (…) Scarcity derives from modernized poverty. It affects mostly urban groups caught up in the money economy as workers and consumers whose spending power is so low that they fall by the wayside. (…) Their capacity to achieve through their own efforts gradually fades, while at the same time their desires, fuelled by glimpses of high society, spiral towards infinity. (…)
Is it not time after 40 years to draw an obvious conclusion? Whoever wishes to banish poverty must build on sufficiency; a cautious use handling of growth is the most important way of fighting poverty."[12]

And this is something we can only do if we manage to see and understand the difference between 'satisfiers' and 'needs', between means and ends, and we start to inquire into the true origin and cause of wealth in real-world terms. It is by doing so that we can start looking into the right means to satisfy our fundamental needs, we can start choosing the right satisfiers amid the scarce resources of a finite world we have at our disposal instead of looking elsewhere while we keep increasing poverty through our 'fight against poverty'.

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[11] Sachs (Sachs, Wolfgang (1999). *Planet Dialectics: Explorations in Environment and Development*. New York: Zed Books, pp. 208 and 211-212, quoting Hörning, K. H. et al (1990). *Zeitpioniere. Flexible Arbeitszeiten - neuer Lebensstil*, Frankfurt: Suhrkamp; and Scherhorn, G. (1995). *Zeitwohlstand versus Güterwohlstand - über die Unvereinbarkeit des materiellen und imateriellen Produktivitätsbegriffs; in B. Bievertrand, Bernd and Held, Martin (Editors)(1995). Zeit in der Ökonomik*. Frankfurt: Campus Fachbuch, pp. 147-168, for the distinction between material and immaterial satisfaction.

[12] Ibid., p. 11-12, with the order of the paragraphs slightly changed.

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How Invisible Capital Gains Drive Extreme U.S Wealth Concentration: Evidence from Balance-Sheet-Complete Haig-Simons Accounting

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Abstract
Researchers of income, wealth and inequality have long called for data series of total "Haig-Simons" (H-S) income, which includes accrued capital gains, but a data set of that measure has not been available. We integrate NIPA income and saving measures with Integrated Macroeconomic Accounts (IMAs) data to derive an open-access, balance-sheet-complete data set for use by researchers, of 1960-2023 "Total U.S. Haig-Simons Household Income Accounts" (THIAs) for U.S. households, with distributional estimates covering 2000-2023. We also calculate Total H-S Saving (deducting outlays/uses from H-S Income), which equals change in balance-sheet net worth. We highlight five trends in this data that all contribute to the increased U.S. wealth concentration since the late 1970s. For instance, 91% of Haig-Simons saving/wealth accumulation since 2000 accrued to the top 20% of households (by income), driven heavily by asset-price increases, plus top households' lower and declining propensities to consume out of income, and especially out of wealth.

Keywords: income, wealth, Haig-Simons, equality, distribution, consumption, spending, saving

JEL subject codes: D31 - Personal Income, Wealth, and Their Distributions, B41 - Economic Methodology, O11 - Macroeconomic Analyses of Economic Development

Abbreviations: CEX: Consumer Expenditure Survey. DFA: Distributional Financial Accounts. DINA: Distributional National Accounts. DPCEA: Distribution of Personal Consumption Expenditure Accounts. DPIA: Distribution of Personal Income accounts. FA: Federal Reserve Financial Accounts (F, L, and B tables). IMA: Integrated Macroeconomic Accounts. NIPA: National Income and Product Accounts. OECD: Organization for Economic Cooperation and Development. SCF: Survey of Consumer Finances. SNA: System of National Accounts. WID: World Inequality Database.

"*The greatest trick capital-gains income ever managed was convincing the world that it doesn't exist.*" —Carlos Mucha (inventor of the Platinum Coin)

This paper makes two contributions. It offers in the accompanying Excel workbook, an open-access data set constructed from the U.S. national accounts, of household-sector Haig-Simons Income, its derivatives, and their analytical import — data series which economists have been expressing a desire for over many years. The data set is here dubbed the Total Household Income Accounts, or THIAs. Second, we provide five key insights into the data set's analytical import. Compared to series based only on NIPA income and saving, these data series provide a balance-sheet-complete and often surprising analysis of recent decades' increased wealth concentration and its sources, notably the major significance of accrued capital-gains property income in that trend.

The Introduction in Section One (p.40) presents a simplified explanation of the issues involved, and the data series provided. Section Two (43) explores the history of Haig-Simons income accounting and literature, and its relationship to recent calls for integrated "3D" measures of income, consumption spending, saving, and wealth. Section Three (46) presents the THIAs, and explains their key departures from NIPA-only accounting treatments. Section Four (51) presents the THIAs' distributional breakouts of all measures, by income quintiles. Section Five (54) displays the very different "story" of wealth concentration over recent decades that's made visible by the THIAs' balance-sheet-complete construction. Section Six (59) concludes and makes suggestions for further research. The appendices (60 ff) address Haig-Simons income theory more deeply, provide a detailed explanation of the THIAs' construction and derivations, and offer insights and suggestions for improving the THIAs' distributional measures.

Section 1: Introduction

A dominant economic fact of the past half century is the extreme and increasing concentration of U.S. wealth into the hands of ever-fewer people, families, and dynasties, and the corporations (including banks, insurers, major media companies, etc.) that they own as shareholders — with the accompanying concentration of economic, political, and cultural power, influence, and control. The post-1980 era has been a complete reversal of the unprecedented and epochal six-decade wealth dispersal from the 1930s to the late 1970s.[1]

The economics literature offers many explanations for that U-shaped development of wealth concentration, with many focusing on changes in income inequality (or often just wage inequality), as variously measured and conceptualized. But with some rare exceptions (*e.g.* Eisner 1989, Robbins 2018, Bricker et. al. 2020, Larrimore et. al, 2021), they all share one thing. They rest on a definition of "income" (in the NIPAs) that does not include households' total property income, return on assets. In addition to the "yield" (interest and dividend) returns on assets tallied in the NIPAs, the Total Return measure necessarily includes holding (or "capital," or revaluation) gains accrued and accumulated by households as wealth across years, decades, lifetimes, generations, and dynasties. (Auten/Splinter incorporates realized gains only, in their measures.) The national accounts don't provide measures of

[1] Recent updates of that century-long "U-shaped" trend include Wolff 2024 and Kuhn 2025. The authors offer an update of Saez and Zucman 2020 Figure 26 (which updates from 2016), with coverage 1917-2023: wealth-economics.com/S_Zucman_JEP_2000_rti_thru_2023.xlsx. See tabs Figure F1b and DataF1-F2(Wealth). Updated using data from Blanchet, Saez, and Zucman's realtimeinequality.org. Note that all three plotted wealth measures in this figure exclude durables holdings and federal-employee pension entitlements, so are comparable. (The unadjusted "raw" DFA wealth series, also provided in the SZ spreadsheet and updated in the linked spreadsheet here, includes those additional measures, and results in a notably smaller top-1% share.)

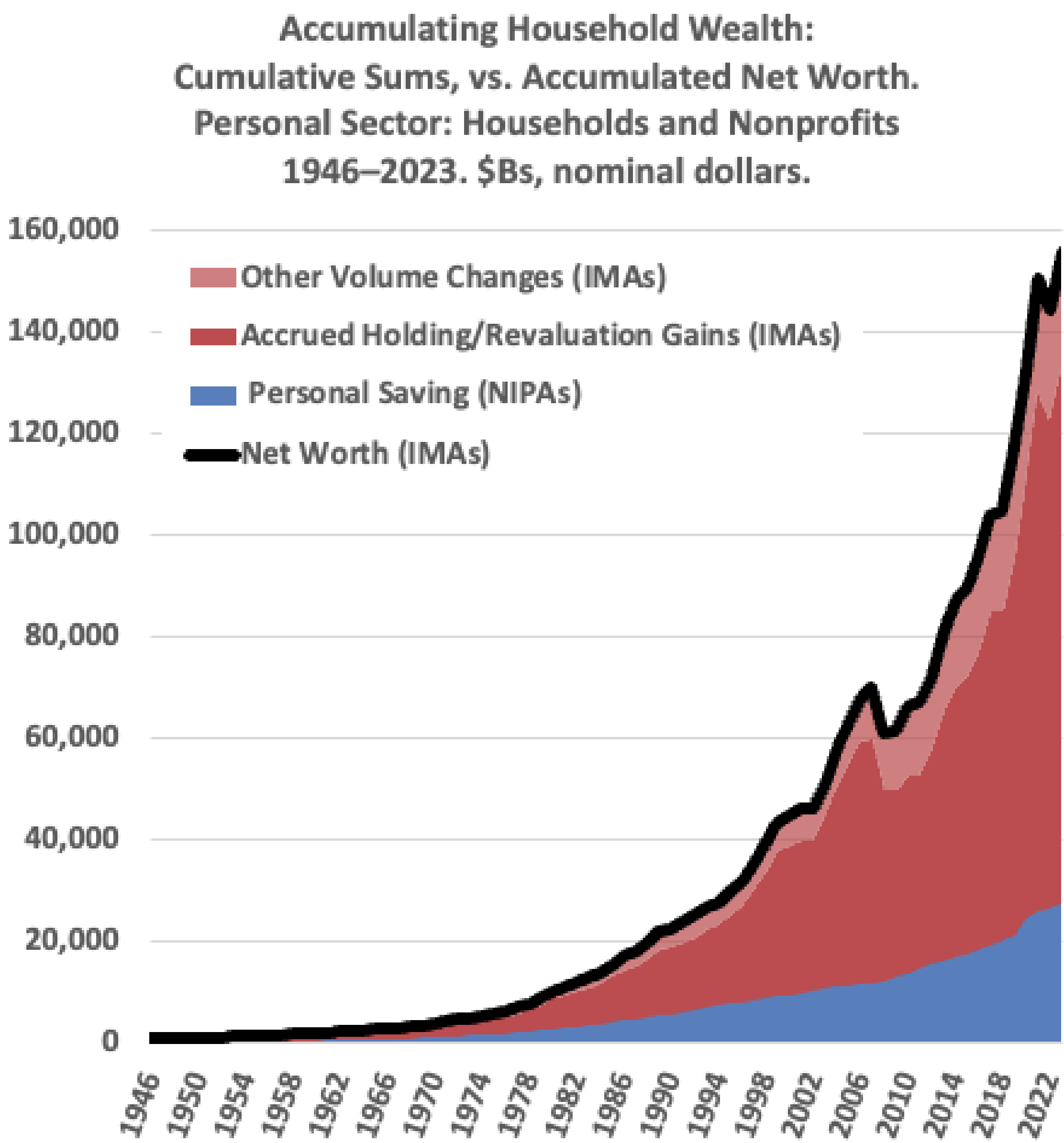
such inclusive, comprehensive “Haig-Simons” income[2] — which economists have referred to for many decades as the “preferred” income measure.

So, likewise, the NIPA household “saving” measure (the residual or remainder from NIPA income after subtracting taxes, consumption spending and non-mortgage interest payments) fails to explain household wealth accumulation. Figure 1 shows that over time; cumulative NIPA “household” or “personal” saving is much smaller than change in net worth. If cumulative NIPA saving did represent households’ total wealth accumulation (and their resulting stock of “savings”[3]), households’ 2023 net worth would be $29T — the blue area in Figure 1 — versus the observed measure of $155T (the black line).

[2] Haig-Simons income is typically defined as consumption spending plus change in net worth. As displayed in Figure 1 and discussed throughout this paper, that measure is equal to NIPA income plus accrued holding gains (and other volume changes). It is referred to as “Total income” herein.

[3] This plural “savings” usage, implying a stock measure as in the vernacular “your retirement savings,” is widely used but is not a technical economic term of art. There is no stock measure labeled “savings” in any national accounts — only assets and net worth.

Figure 1: Sources of U.S. household net worth accumulation. The red and pink sections comprise property income, return on asset holdings, that's not included in NIPA measures and that is necessary to explain total asset/net-worth accumulation.



Sources. Personal Saving: NIPAs Table 2.9. or 2.1. Holding gains and Other changes: IMAs Table S.3.a. Net worth: IMAs S.3.a or Fed Financial Accounts balance-sheet table B.101.

All of the income in the red and pink slices of Figure 1 is property income (*i.e.* not labor or transfer income), which is added to the yield-only property income tallied in the NIPAs. By these balance-sheet-complete measures, Total property income is a far larger and more powerful component of wealth accumulation (and concentration). This suggests that policy focus, at least if it emphasizes wealth concentration as a key metric and priority, needs to give greater attention to addressing these very large and somewhat accounting-invisible mechanisms of wealth accumulation.

The additional measures/data series necessary to assemble this complete accounting (the pink and especially the red area in Figure 1) have been available to researchers since the 2006 release of the Fed/BEA (SNA-based) Integrated Macroeconomic Accounts, or IMAs.[4] They make it possible to assemble Haig-Simons income series, which in turn are necessary to calculate balance-sheet-complete wealth accumulation or "Haig-Simons Saving" (all three colored areas in Figure 1, combined). Those, in turn, are necessary to explain observed changes in wealth concentration (Figure 10).

US Household wealth-*distribution* tables were released in 2019 (the Fed's Distributional Financial Accounts or DFAs). These make it straightforward to allocate holding *gains* to different groups (broken out by wealth, income, etc.), based on each group's asset *holdings* — providing a key necessary component for distributional Haig-Simons income series. The development of distributional household (NIPA) income accounts (the DPIAs), plus long-standing consumption series from CEX, also make it possible to assemble distributional Haig-Simons saving series explaining different income groups' relative and absolute changes in wealth.

The THIAs thus provide aggregate household-sector Haig-Simons income, saving, and wealth-accumulation measures 1960–2023, as well as distributional Haig-Simons measures 2000–2023. See Figures 2 and 5. For reasons discussed below, the distributional measures must be considered as prototypes and proof of concept, but the top-20% and bottom-80% breakouts are quite solid; they closely match *observed* balance sheet changes for the groups.

All THIA measures are in nominal dollars ($Bs). Inflation-adjusted series are easily derived from these. These nominal series are of course not the only or final word on the issues addressed here. Household-size-equivalized income measures, for instance, offer a different and important analytical view. But the THIAs' nominal-dollar series provide a stock-flow-consistent or -coherent (SFC) empirical accounting foundation that has previously been unavailable, and that other researchers may find valuable. The nominal-dollar series also allow for examination of long-term ratios, without the challenges that are inherent to inflation accounting.

Section 2: Haig-Simons Income, Integration, and "Inequality in 3D"

Haig-Simons Income has a long history.[5] For decades, economists studying income, wealth and inequality have referred to it as the "preferred" income measure, and expressed wishes for a published Haig-Simons data series, as two recent research teams note:

[4] Despite the unique and important measures introduced in the IMAs, they have been little-used in research and are rarely mentioned over the past decade. An IDEAS/RePEc search for the term since 2015, for instance, yields only eleven results. The BEA has stopped publishing the IMAs on its site "due to budget constraints," though the tables and data series are still published at the end of the Fed's quarterly Z.1 report (as the "S" tables, for SNA) and are still available on FRED. Even there, though, some aggregate IMA series have recently been labeled "discontinued" and are not updated on FRED (e.g. total nonfinancial assets), even though their component sub-measures (real-estate assets, durables, etc.) continue to be published and are easily summed to the aggregate measure. Perplexingly, these measures *are* still published in the Z.1 report's "S" tables.

[5] Robbins' footnote 7 nicely encapsulates Haig and Simons' definitions: "Haig (1921) wrote that income is 'the money value of the net accretion to one's economic power between two points of time', and Simons (1938) wrote that income is 'the algebraic sum of (1) the market value of the rights exercised in consumption and (2) the change in the value of the store of property rights between the beginning and end of the period in question.'"

> "The most comprehensive concept of income and consumption is drawn from the suggestions of Haig and Simons, where income represents the capacity to consume without drawing down net worth. Economists have used the following equation as the working definition of Haig-Simons: Income (Y) equals consumption (C) plus the change in net worth (ΔNW). No studies use this definition to the fullest extent, because no household survey has the necessary variables to create a full measure of Haig-Simons income. (Fisher et. al. 2020 p. 7)

> "A long-standing preferred measure of economists is the Haig-Simons concept of economic income, sometimes described as equaling consumption plus the change in net worth and including these income sources. A key feature of this definition of income is the inclusion of annual accrued capital gains or losses. ... While the Haig-Simons approach is often considered the preferred measure by economists, actually estimating the distribution of accrued gains is necessarily imprecise because micro data rarely have all the information needed. (Auten 2022 p. 2)

Atkinson, Piketty, and Saez 2011 p. 34 likewise refers to "a 'preferred' definition of income, such as the Haig-Simons comprehensive definition, which includes such items as…accruing capital gains and losses." Saez and Zucman 2019 focuses on this measure as well, though not by that name; they call it "true economic income."[6]

Earlier research on the topic is extensive and longstanding. Hicks 1946 (*Value and Capital*) is an important touchstone. It devotes a chapter to H-S income, though again not by that name (Chapter 14, "Income"). H-S income is necessary and inherent to Hicks' sustainable-consumption constraint (and Hyman Minsky's "survival constraint"): "the amount which [households] can consume without impoverishing themselves."[7] (Without running out of assets to spend, that is.) The 2008 SNA guide (p. 160) echoes Hicks' words almost verbatim. Haig-Simons income is also fundamental to and is discussed and employed throughout Godley and Lavoie's *Monetary Economics*. (For a summary see Roth 2021a p. 17.)

The OECD (a) handbook (p. 29) discusses H-S income and concludes, "Although it is not part of the income definition as defined by the SNA, it would provide more insight into the economic situation of various household groups." As the THIAs demonstrate, it also provides a complete accounting explanation of household wealth accumulation, which in turn makes possible an accounting-complete understanding of differential, concentrated wealth accumulation (Section Five).

Previous efforts to assemble H-S income series include Eisner 1989, Robbins 2018, Bricker et. al. 2020, and Larrimore et. al, 2021. They use different methodologies and data sources so are difficult to compare or re-create, especially absent downloadable data sets, replication files, and detailed accounting derivations.

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[6] Eight usages in the paper. One example, emphasis added: "As long as Bezos, Buffett, and Zuckerberg do not sell their stock, their realized income is going to be minuscule relative to their wealth and *true economic income*."

[7] Minsky/Simons: See Mehrling 1999, p. 139: "the most basic constraint on the behavior of every economic agent is the 'survival constraint' (Minsky, 1954, p.157) which requires that cash outflow not exceed cash inflow." The THIAs consider all assets, not just households' quite small (~10%) proportion of "cash" assets. See also Bezemer, 2021, p 391 ff, and Neilson, 2019, pp 45–49.

Economists' desire for such an integrated understanding, and acknowledgment of its ongoing absence or incompleteness, is epitomized most recently in the title of a 2024 report from The U.S. National Academies' Committee on National Statistics: *Creating an Integrated System of Data and Statistics on Household Income, Consumption, and Wealth: Time to Build* (Smeeding et. al. 2024). The envisioned system is rooted in a fundamental accounting identity (here simplified): Income minus Consumption Spending = Wealth Accumulation. $I - C = \Delta W$. (Smeeding 2024, "Conclusion 2-1," p. 3, and pp. 65-66.) It's the "ICW" approach, nicely characterized in the title of Fisher 2021: "Inequality in 3D."[8]

The report's subtitle, "Time to build," is appropriate in view of the long buildout of fully accounting-integrated U.S. national accounts. In the late 1980s/early 1990s the Federal Reserve started developing annual balance sheets for the households & nonprofits (personal) sector and two other "real" sectors (not including financial institutions, government, or rest-of-world). Integrated SFC accounting (and understanding) is impossible without these balance sheets; they *are* the stock measures. The NIPAs, for instance, don't have balance sheets. The accounting identities for their flow measures terminate at Saving, a "dangling" measure; the NIPAs provide no accounting-identity relationship between that measure and (changes in) balance-sheet assets/net worth.[9] And as displayed in Figure 1, NIPA Saving does not equal the change in assets or net worth: $I - C = S \neq \Delta W$.

The major "integration" breakthrough came in 2006, when the Federal Reserve and the Bureau of Economic Analysis jointly started publishing the aptly titled *Integrated* Macroeconomic Accounts — the IMAs, based on and largely conforming to the U.N. System of National Accounts' (SNA 2008, updated 2025) framework and requirements. The IMAs provide a fully integrated flows-and-stocks accounting table including balance sheets, for each domestic sector (notably the Personal sector, households plus nonprofits), plus rest-of-world.[10] They also include clearly presented measures of sectors' accrued holding or (re)valuation gains broken out by asset class, and Other Volume changes, that are absent in the NIPAs. These additional measures and balance sheets make it possible to assemble total Haig-Simons income series as displayed in Figure 2.

The Smeeding report addresses the history and import of Haig-Simons income at multiple points, notably including (p. 33):

> "The critical factor in comparing trends in inequality across all three dimensions in a balanced way is to use the Haig-Simons budget identity to ensure that the definitions are consistent."

The report also mentions the IMAs (once, on p. 52): "Changes in wealth enter the national accounting via the Integrated Macroeconomic Accounts."

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[8] Garner et al (August 2023) Appendix B provides an excellent historical and international overview of that emerging "3D" approach, and the literature and research institutions engaging it.

[9] The Fed's Flow of Funds (FOF) Table F.6, "Derivation of Measures of Personal Saving," provides reconciliation of the measures of "Personal saving, FOF concept (FOF)," "Personal saving, NIPA concept (FOF)," and "Personal saving, NIPA concept (NIPA)," but it is a challenging construction even for national-accounting adepts. And it still does not consider or include the "missing" income and saving represented in the red and pink sections of Figure 1 or the "red box" highlighted in Figure 2.

[10] Annual releases, with coverage from 1960. Quarterly tables, also back to 1960, were released in 2012. Coverage of Financial sub-sectors was also added in 2012, with balance sheet and revaluation measures back to 1960; coverage of financial subsector flow or "transaction" measures extends back to 2001.

The THIAs incorporate both of these insights: they integrate the standard NIPA income accounting with the additional "changes in wealth" measures from the IMAs, to derive total Haig-Simons income. They then subtract "uses" (taxes, consumption spending, interest payments) to derive Haig-Simons saving, which equals ∆NW.

Section 3: Total Household Income and Wealth Data, 1960-2023

The main contribution of this paper and the accompanying Excel workbook[11] is to provide an open-access data set based on Haig-Simons income (and saving) and its constituent components and derivations, for use by other researchers (Figure 2). It currently covers 64 years, 1960-2023. All THIA measures are for the households-only sector, excluding nonprofit institutions serving households (NPISHes).[12] All measures are in nominal dollars ($Bs); inflation-adjusted series are easily derived from these (see footnote 15).

[11] http://wealth-economics.com/THIAs_5.2.xlsx

[12] In 2019, national accountants "de-consolidated" the consolidated personal sector (often referred to in shorthand as the household sector) into its component sectors, households and NPISHes. See NIPA Table 2.9's separate measures: personal, household, and nonprofits (coverage back to 1992), the DPIAs (coverage from 2000), plus the FA balance-sheet tables B.101h and B.101.n and the households-only DFAs (coverage from 1989). Measures for earlier years are adjusted in the THIAs from the available personal-sector measures to households-only estimates as necessary, as explained in Appendix A and displayed in the spreadsheet itself. The choice of sector for the THIAs was driven by the DFAs' distributional-wealth tables, which only provide household (not personal-sector) measures. The THIAs' distributional results, discussed below, rely heavily on the DFAs' distributional balance-sheet measures, so the THIAs cannot currently be assembled for the personal sector.

Figure 2: The Total Household Income Accounts, detail displaying 2021-2023. Columns extend back to 1960. The red box highlights this paper's focus: income not included in NIPA measures of income or saving.

Total Household Income Accounts, Sources and Uses	**2021**	**2022**	**2023**	**Sum 2000–23**	**% of Total income**
Billions, nominal dollars. Household-only measures, ex-NPISH					
Start-of-period net worth	124,574	142,948	136,967		
Start-of-period assets	140,542	160,474	155,613		
Start-of-period liabilities	15,968	17,526	18,647		
Sources: Total income. Labor + total property + transfers	**37,312**	**15,021**	**32,657**	**424,357**	**100%**
Labor Compensation (earned income)	**12,557**	**13,437**	**14,190**	**216,412**	**51%**
Plus: Primary property income, return on assets ("yield")	**5,695**	**6,139**	**6,675**	**93,505**	**22%**
Proprietors' net income (profits)	1,815	1,874	1,949	30,006	7%
Rental net income (profits) including imputed owner-occupier rental profits	762	859	977	11,357	3%
Interest	1,458	1,611	1,864	30,827	7%
Dividends	1,660	1,795	1,885	21,316	5%
Equals: IMAs' "Primary" (market) income. Labor + primary property	18,252	19,575	20,865	309,918	73%
Plus: Additional property/ownership Income, return on assets	**15,940**	**-7,030**	**9,266**	**81,091**	**19%**
Other Changes in Volume	**18**	**-850**	**448**	**9,436**	**2.2%**
Accumulation of durable goods (net of consumption of fixed capital, durables)	475	368	330	5,285	1.2%
Disaster losses	-6	-16	14	27	0.0%
Other (other) volume changes	-450	-1,202	104	4,124	1.0%
Accrued holding or "capital" gains/asset (re)valuation	**15,922**	**-6,180**	**8,819**	**71,655**	**17%**
On financial assets	9607	-9605	7281	42,690	10%
On nonfinancial assets	6,315	3,425	1,537	28,965	7%
Memo: Total property income, Primary + Additional. Total return on assets	21,635	-891	15,941	174,596	41%
Equals: Total market income. Earned labor income + total property income.	**34,193**	**12,545**	**30,131**	**391,008**	**92%**
Plus: Net transfer income	**3,120**	**2,475**	**2,526**	**33,348**	**8%**
Gross social benefits and other transfers received	4,679	4,180	4,342	60,026	14%
Government social benefits	4,490	3,956	4,116	57,173	13%
From business (net)	58	89	85	739	0.2%
From nonprofits	132	135	141	2,113	0.5%
(Less) Household contributions for gov. social insurance	1,560	1,705	1,817	26,677	6%
Memo: Household income (labor + primary property + net transfers)	21,372	22,051	23,390	343,266	81%
Less: Uses	**18,939**	**21,002**	**21,875**	**317,863**	**75%**
Household Taxes	2,705	3,245	2,856	41,238	10%
Household Outlays	16,233	17,757	19,019	276,625	65%
Consumption expenditures	15,673	17,154	18,269	265,835	63%
Consumer (non-mortgage) Interest paid	278	334	493	6,425	1.5%
Adjustment for personal vs HH: net HH transfers to nonprofits	283	268	257	4,365	1.0%
Equals: Total saving. Change in net worth. Sources - uses.	**18,374**	**-5,981**	**10,782**	**106,494**	**25%**
Memo: Household saving (Household income - taxes - outlays)	2,434	1,049	1,516	25,403	6%
Plus: Assets accumulated from net new borrowing	1,557	1,121	501	12,726	3%
Equals: Change in assets	**19,931**	**-4,860**	**11,283**	**119,220**	**28%**
Minus: Liabilities accumulated from net new borrowing	1,557	1,121	501	12,726	**3%**
Equals: Change in net worth	**18,374**	**-5,981**	**10,782**	**106,494**	**25%**
End-of-period net worth	142,948	136,967	147,749		
End-of-period assets	160,474	155,613	166,896		
End-of-period liabilities	17,526	18,647	19,147		

81% of Total Income in the THIAs is NIPA Household Income. The red box in Figure 2 highlights Additional Property Income tallied from the IMAs (19%). That measure is dominated by accrued holding gains accumulated by households (17%), redounding to their balance sheets over years, decades, lifetimes, generations, and dynasties. (A very similar table could be assembled for any *individual's* total Lifetime Income and ending assets/net worth at death, which would be quite pertinent in the context of Modigliani/Friedman's so-named hypothesis.)

The THIAs' table structure is derived from and based on the IMAs' structure, with reorganization and re-labeling of measures in an effort to make the "integrated" sources, uses, and level changes, and their accounting-identity relationships, straightforwardly understandable to the general public or a typical businessperson, as well as academic researchers. The THIAs depart from the IMAs' structure by including Additional Property Income in Total Property Income (and hence in Total income), consistent with the income definition in the academic literature on Haig-Simons income.

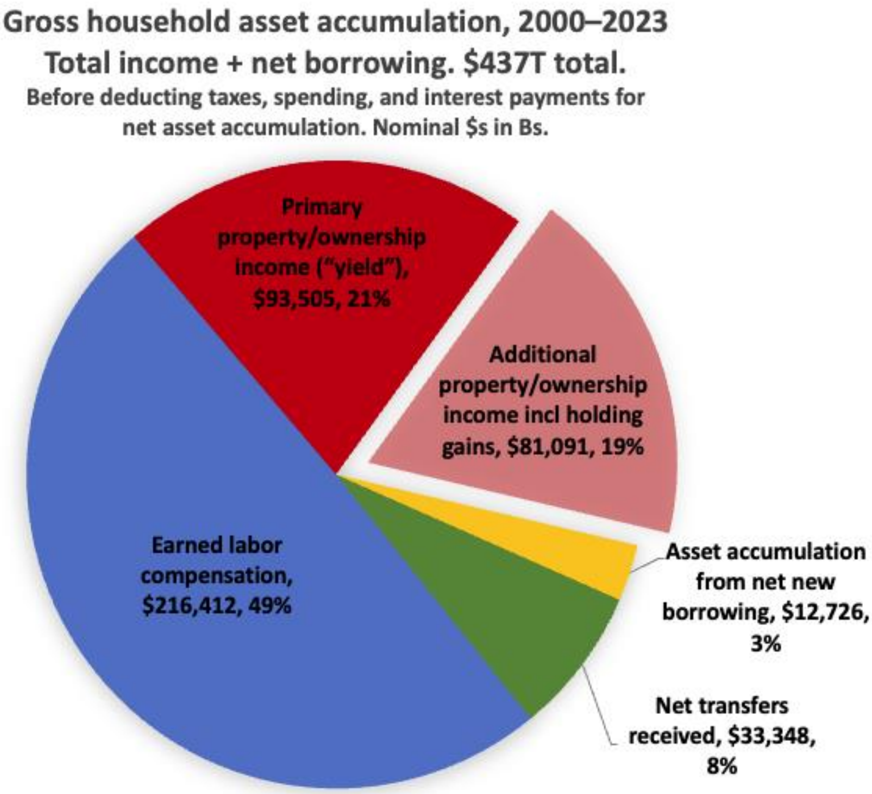
Total Property Income represents asset-holders' *total* returns on assets including holding gains — not just the "yield" from interest, dividends, etc. tallied in NIPA income. From 2000–2023, Additional Property Income comprises 46% of Total Property Income, return on assets, (of which holding gains are 41%) — vs. 54% from yield. With the inclusion of taxes, outlays (consumption spending and consumer-interest payments), and borrowing, the THIAs are balance-sheet-complete.

That feature makes it possible to cross-check and validate the THIAs' calculated, year-by-ensuing-year wealth changes and ending balance sheets (which are the starting balance sheets for the next year) against *observed* balance sheets from the Fed's Table B.101.h (which matches the DFA balance-sheet measures). Despite necessary THIA adjustments to account for household- vs personal-sector measures, the THIAs' end-of-2023 assets, calculated year by year over 64 years, match observed end-of-2023 household balance-sheet assets with a discrepancy of only 0.7%.

Figure 3 illustrates the sources of new household assets over 24 years. (It includes the relatively small quantity of new assets accumulated through borrowing, even though borrowing is not part of income.[13]) The detached pink pie-slice highlights the magnitude of Additional Property income that is not included in NIPA income or saving.

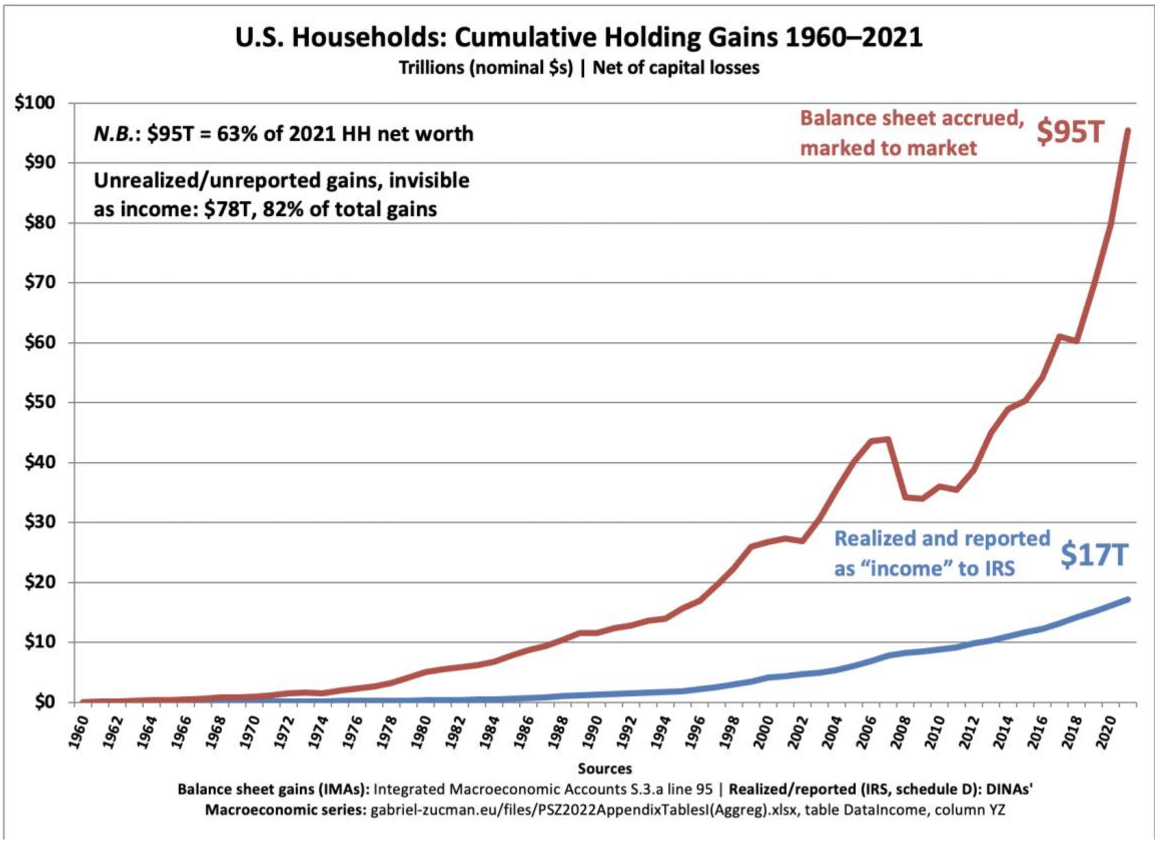
[13] The bottom rows of the THIA table in Figure 2, below Total Saving, tally households' balance-sheet changes due to net new borrowing — new borrowing minus loan payoffs. New borrowing adds assets and liabilities in equal measure, so it increases household assets but has no effect on net worth. It's "balance-sheet expansion," on both sides of the balance sheet.

Figure 3: Household-sector income and borrowing, including Additional Property/Ownership Income. The red and pink slices combined are total return on owners' assets, total property income.



Some widely-used data sets provide alternate measures of income that do include households' *realized* holding gains. (See discussion in Appendix A.) These measures cannot account for households' observed wealth accumulation because a large percentage of accrued holding gains are never "realized" or reported for tax purposes. (They don't appear in the tax "administrative data" that constitutes an important basis for those data sets.) Figure 4 illustrates the magnitude of the gap between realized/reported gains and the accrued holding gains tallied in the IMAs. 82% of accrued holding gains are never realized and reported.

Figure 4: Household holding gains: realized and reported, versus accrued.



Accrued gains which are not realized nevertheless redound to household balance sheets as asset accumulation. Significantly, given holding gains' volatility (and thus their frequent treatment as "not real wealth" or "windfall" gains), over 62 years there has been only one significant drawdown in Figure 4's cumulative accrued series (red line), in 2008: down $9.7T, a 13.7% decline.[14] Asset-holders recovered from that drawdown in only five years (in nominal terms).[15] Accrued holding gains are not just temporary up-and-down fluctuations.

[14] Given this rather large reality, it is worth revisiting the BEA FAQ, "Why do the NIPAs exclude capital gains from income and saving?" bea.gov/help/faq/67 Because asset prices are so volatile, the THIAs' total-income measures are not a useful measure of current, "this-period" production — the *ultima thule* of the GDP accounting construct. But they're arguably a valid market correction of firms' past production measures. In this logic, current asset markets think the country's unconsumed long-lived (productive) goods/"fixed capital" produced in the past (tangible and non-), are worth more, relative to their sales prices when they were produced, purchased, and posted as assets to balance sheets.

[15] To touch on inflation-adjustment: the CPI index level increased by 82% from 2000 through 2023. (PCE index: by 67%.) Market-price changes for households' assets, calculable in the THIAs, grew much faster. Nominal revaluation/holding gains over the same period were 129% of 2000 holdings for financial assets, 181% for nonfinancial assets, 146% for all assets combined. BEA Table 5.10 lines 54 ff (covering produced assets only: fixed assets and inventories), labels the first — nominal gains *attributable* to general inflation — as "neutral" nominal gains, and the remainder as "real" nominal gains. Table footnote 12: "Neutral holding gains are the gains derived from holding an asset if the price of an asset changed in the same proportion as the general price level. The chain-type price index for gross domestic purchases is used as a measure for the general price level."

Section 4: Distributional Wealth and Income Measures, 2000-2023

The THIAs also provide distributional breakouts for all of its income and outlay categories and subcategories, by income quintile, 2000-2023 (Figure 5).[16] These measures must be considered as prototypes and proofs of concept. The top-20% and bottom-80% breakouts cross-check very well against observed distributional balance sheets (DFAs), so this paper focuses on those measures. The lower quintiles are more problematic. The 24-year period 2000-2023 is also used frequently in this paper as a convenient sample of recent decades' aggregate and average measures and ratios.

Figure 5: A detail from the top of the THIA table (displayed columns are for 2019–2023) with Proprietors' and Rental income measures "expanded" to display the distributional breakouts by income quintile provided for all measures in the table. The "All HHs (cross check)" rows are an error-checking convenience for users who are revising or updating the table.

9	**Sources: Total income. Labor + Total return on assets + transfers**	**28,229**	**30,122**	**37,312**	**15,021**	**32,657**
17	**Labor Compensation (earned income)**	**11,447**	**11,596**	**12,557**	**13,437**	**14,190**
25	**Plus: Primary property income, return on assets ("yield")**	**5,127**	**5,179**	**5,695**	**6,139**	**6,675**
33	Proprietors' net income (profits)	1,556	1,594	1,815	1,874	1,949
34	*All HHs (cross check)*	*1,556*	*1,592*	*1,817*	*1,874*	*1,951*
35	Top 20%	1,379	1,439	1,653	1,685	1,729
36	60-80%	112	108	109	126	138
37	40-60%	47	37	40	47	57
38	20-40%	16	13	16	17	21
39	Bottom 20%	3	-5	-2	0	6
40	Bottom 80%	177	153	163	189	222
41	Rental net income (profits) including imputed owner-occupier rental profits	679	728	762	859	977
42	*All HHs (cross check)*	*679*	*727*	*763*	*859*	*977*
43	Top 20%	309	325	350	395	440
44	60-80%	136	152	156	171	197
45	40-60%	106	114	117	133	156
46	20-40%	85	89	90	105	123
47	Bottom 20%	43	47	50	55	61
48	Bottom 80%	370	403	413	464	537
49	Interest	1,578	1,487	1,458	1,611	1,864
57	Dividends	1,314	1,370	1,660	1,795	1,885
65	**Equals: Primary market income. Labor + primary property**	16,573	16,775	18,252	19,575	20,865

The THIAs' distributional breakouts are only possible because of major BEA and Fed data releases since 2019. In that year the Federal Reserve released the quarterly Distributional Financial Accounts (balance-sheet measures), with coverage back to 1989.[17] They provide distributional breakouts by income quintiles, and by wealth percentiles, plus age, generation, education, and race. The DFAs' income-quintile breakouts are what make it possible to allocate the IMA holding-gain measures across quintiles, and cross-check and validate the THIAs' distributional results against distributional balance sheets.

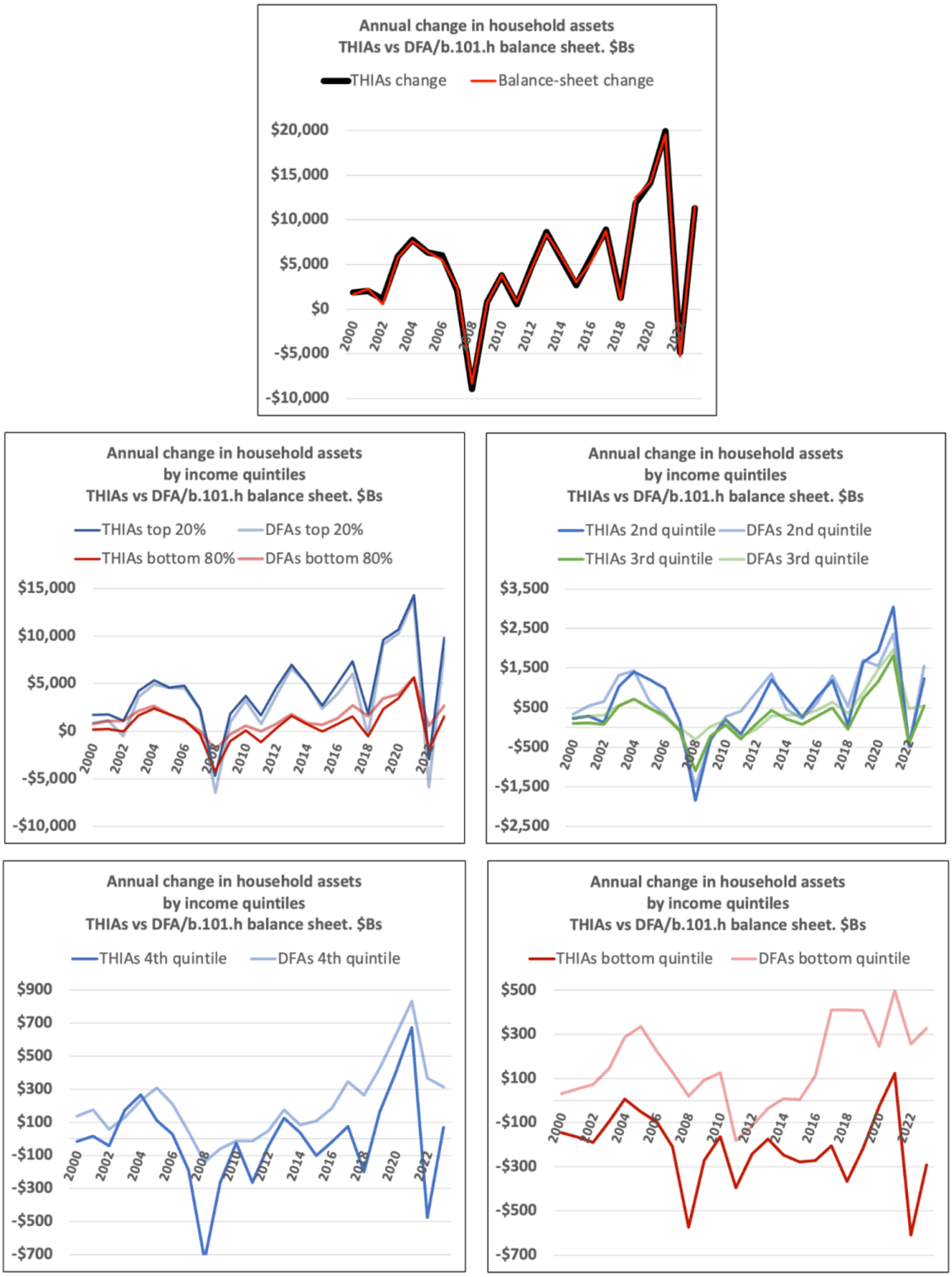
[16] Income quintiles are used because they are directly provided by all the source data sets. They provide both a broader and more granular bottom-to-top view than in the DINAs, where both income- and wealth-percentile breakouts are given for the bottom 50%, next 40%, and above. The DFAs' wealth-percentile breakouts also use that form, but their income-percentile breakouts are by quintiles (plus top 1%). Both the DPIAs and CEX provide income decile/quintile breakouts. See Appendix C for discussion of income quintiles' comparability across sources. It might appear preferable to analyze all of these breakouts by quintiles of Total Income instead, but 1. as Campbell et. al. 2024 (p. 8) points out, in years with negative holding gains this would include rich people in the bottom quintile, and 2. the necessary quintile breakouts (household income and spending by Total Income quintiles) are not available from national agencies or private researchers.

[17] The DFAs are household-sector accounts, excluding NPISHes. So in the same year, deconsolidated balance sheets were launched — FA Tables B.101.h and B.101.n — along with deconsolidated flow/transaction tables for the household and nonprofit sectors (NIPA Table 2.9). All these tables stand out for being very well integrated across agencies and approaches.

Given economists' longtime focus on income as opposed to wealth measures, it's surprising to find that the BEA's Distribution of Personal [and Household] Income Accounts were developed much later. The first prototype efforts covering a few years were released in December 2020, with annual improved and expanded December releases through 2024 (coverage through 2023). Since 81% of the THIAs' Total income consists of NIPA household income, these DPIA breakouts are necessary to derive the THIAs' distributional results.

The THIA's balance-sheet-complete accounting again offers an important advantage: the calculated wealth changes *for each income quintile* can be cross-checked and validated against the DFAs' observed balance-sheet changes for each quintile (Figure 6).

Figure 6: The THIAs' calculated changes in quintiles' assets versus balance-sheet asset changes in the DFAs. Note graphs' Y-axis differences.



The THIAs' aggregate all-households measures match DFA measures quite closely. Lower quintiles show (much) greater discrepancies. The bottom-80% and top-20% series are quite solid, and thus are the main distributional measures examined in Section Five. Lower quintiles display larger discrepancies. The bottom-20% series, especially, shows large *qualitative* discrepancies, including persistent differences in sign. It's worth noting, however, that the bottom quintile's percentage discrepancies are quite small in dollar terms (note the Y axis), relative to aggregates.

Even for the more-solid bottom-80 and top-20 series, some particular years show notable percentage discrepancies between the THIAs' calculated asset changes, and observed balance-sheet changes. These are especially notable in 2002, 2008, 2018 — years with large equity-market drawdowns, especially end-of-year, and in adjacent years.[18] One possible explanation for those discrepancies is the DFAs' necessary interpolation of SCF measures for years (and quarters) between the triennial SCF surveys, and extrapolation in recent years. Whatever the causes, the THIA (and DFA) series require careful use when examining periods shorter than five or ten years.

The THIAs' construction makes it possible for researchers to improve this prototype distributional effort by adding to or replacing any of the underlying data series with alternative series constructed from other data sources, or the same sources with alternative adjustments and/or quintile allocations. Some suggestions are discussed in Appendixes C and D.

Section 5: The Wealth-Concentration Story: Key Takeaways from the THIAs

The Total Haig-Simons income and saving measures in the THIAs paint a more integrated, complete, and sometimes quite surprising picture of U.S. inequality, and past decades' wealth accumulation and concentration. Total property income including holding gains figures much more prominently, with less focus on (smaller) changes in labor income. The focus in this section is on household *asset* accumulation. Liabilities only equal about 15% of household assets, and they change very slowly with net new borrowing. Over the period 2000 through 2023, borrowing has explained only 3% of gross asset accumulation (Figure 3).

Five key insights are highlighted here. First, the labor-income share of Total income is much smaller and has been declining faster than the labor share of Household income. Second, total income is much larger and total-income *growth* is much faster for the top 20% than for the bottom 80% — much more so than is true for household income growth. Third, the top quintile is turning over/depleting less of its income and assets in spending each year, compared to the bottom 80%. Fourth, the bottom-80's household saving is persistently negative, but its total saving is positive due to additional asset accumulation from holding gains (plus borrowing, to a much lesser extent). Fifth, as a result of the preceding, 91% of the Total saving since 2000 redounded to the top 20%, and that quintile's share of total assets — wealth concentration — increased accordingly.

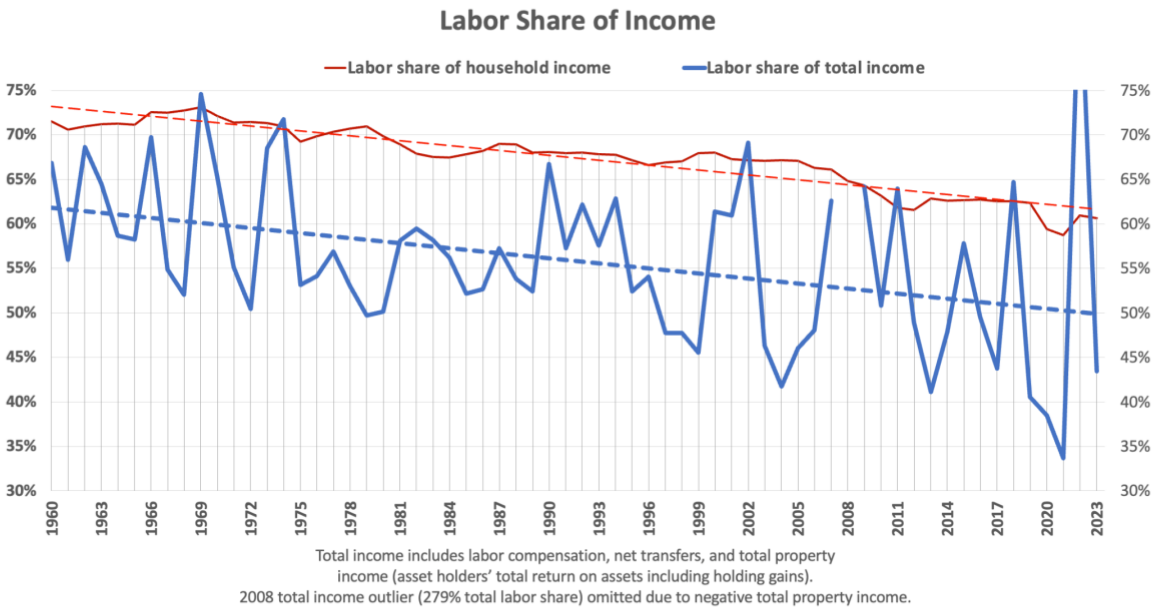
Labor shares of income. Labor's share of Total income is much smaller than its traditionally-measured share of Household income (Figure 7).[19] The labor share of Total income also shows

[18] Given the large equity drawdown in December 2018, this suggests inaccurate allocation of holding losses from that event to income quintiles. Late-2008 drawdowns were also largely in equity markets; real-estate declines spanned the period 2007 to 2011.

[19] Various accounting treatments quite reasonably try to re-allocate a portion of "mixed income" of "active" property owners and "proprietors" (variously defined) from property to labor income. See e.g. Saez and Zucman 2020: "We allocate 50% of partnership mixed income to capital (vs. 50% to labor) and 20% of sole proprietorship income to capital." These re-allocations to the labor income of owners *qua* working "entrepreneurs" only shift the aggregate labor share by one or two percentage points. The THIAs don't essay such adjustments, just relying on the NIPA labor-compensation measure and leaving adjustments to the discretion of individual researchers.

somewhat faster decline, from ~63% to ~50% over 64 years. During covid, labor's share of Total income dropped to as low as 34% (2021). But even in 2019 it had dropped to a record low of 40%.

Figure 7: Labor compensation as a percent of Household and Total income.[20]



Workers are capturing an ever-smaller share of the Total household-sector wealth-accumulation "pie" over time, while asset holders are capturing bigger slices. The total income approach provides a much more complete and comprehensive answer to the question posed, for instance, in the title of Fixler (2019): "How households share in an economy's growth" — which addresses Personal income only.

Unearned income. The obverse of earned labor income is unearned income, from property/ownership plus transfers. Unearned Household income is split 74%/26% between asset holders and transfer recipients. For unearned Total income, the split is 85%/15%.

Income growth and distribution. Turning to distributional measures by income quintiles, total income is much greater than household income for all quintiles (Figure 8).[21] Household income *growth* was about the same for the top 20% and bottom 80%. Total income growth has been faster than for the Household measure, for both groups — but *much* more so for the top 20% (Table 1). The holding-gains portion of Total income has redounded to all quintiles, but especially to the top quintile that owns 85% of equity shares, 75% of financial assets, 54% of nonfinancial assets, and 68% of total assets.

[20] For comparison, The BLS "labor share of nonfarm business output" measure averages 59% over the period. The Penn World Tables' U.S. labor share of GDP averages 60%. These both reflect NIPA-style "national income"-based accounting, ex-holding gains.

[21] Even the bottom quintile's total income is significantly higher than its household income, and the DFAs show even greater bottom-quintile net asset accumulation than the THIAs (Figure 6). So this result does not appear to be just an artifact of the THIAs' calculations.

Figure 8: Income quintiles' Total and Household income.

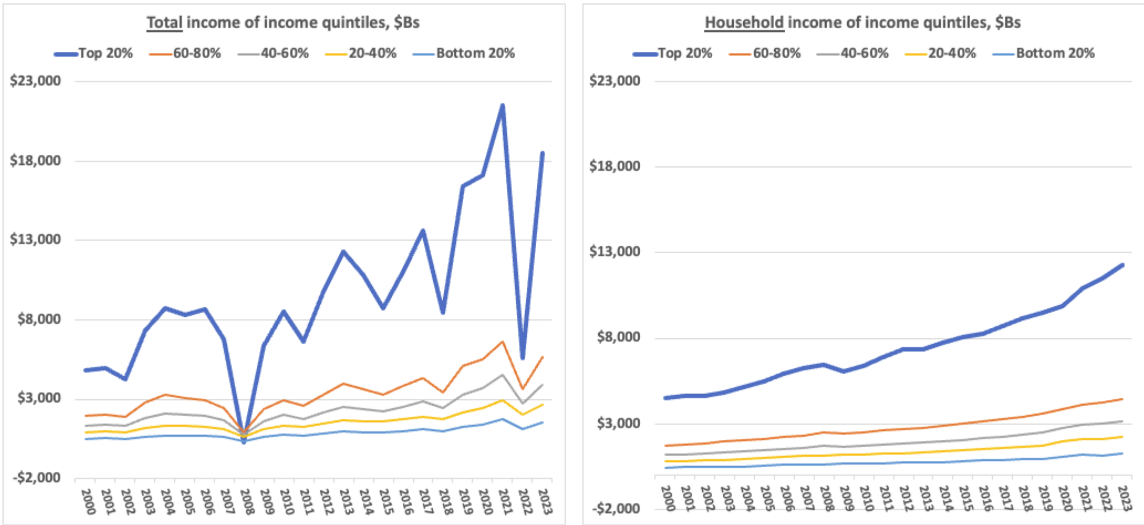


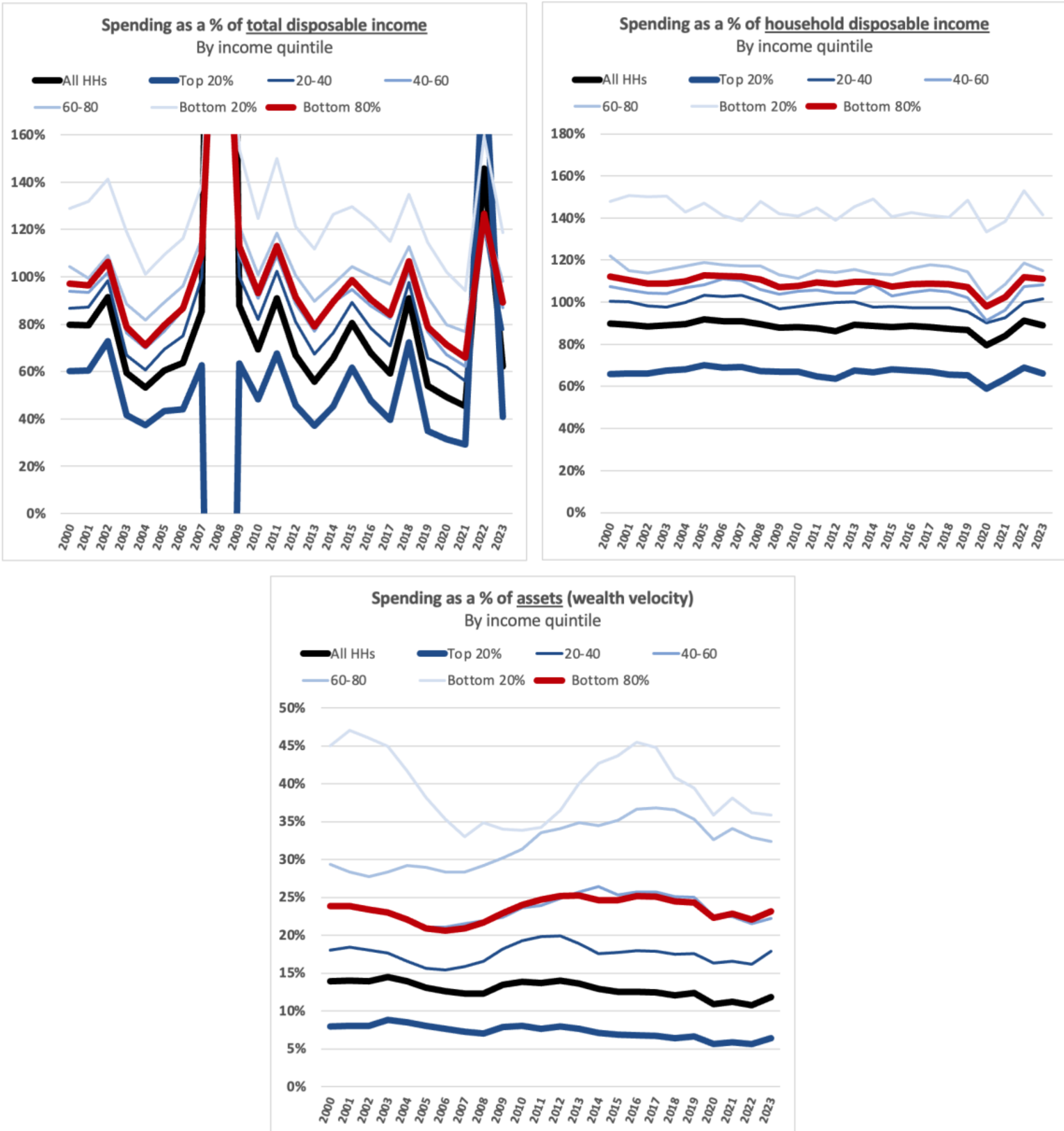
Table 1: The distribution of 2000-2023 income growth: Total income versus Household income. The red outlined cell highlights the most significant outlier in the table.

	Top 20%	Bottom 80%
Household income growth	+146%	+152%
Total income growth	+350%	+230%

Spending propensities: The THIAs' distributional spending breakouts also provide novel pictures of annual propensity-to-spend ratios (the inverse of propensity to save) relative to Household income, Total income, and total assets (Figure 9). While *marginal*-propensity equations and curves have been widely studied, the THIAs' annual distributional propensity-to-spend ratio data series have previously required bespoke construction by researchers.[22]

[22] Fisher et. al. 2020 Table 1, for instance, constructed from the Panel Study of Income Dynamics (PSID) *en route* to calculating marginal propensities, derives annual propensities to consume/spend out of income in 1999 and 2013, for all income and wealth quintiles.

Figure 9: Income quintiles' propensity to spend: annual spending relative to income and wealth.



Households show declining propensities to spend over the period in all three ratios, especially relative to total income. Examining spending as a percent of assets ("wealth velocity"), the top 20% especially stands out; it only turned over 6% of its assets in spending in 2023, down from a series high of 9% in 2003/2004 — a 33% decline in that ratio. By contrast, the bottom-80% ratio was basically unchanged:

about 23% for the period, 4–6 times greater than the top 20% ratio.[23] Even as the top-20%'s total income and wealth shares increased, it has been depleting its assets more slowly via spending.[24]

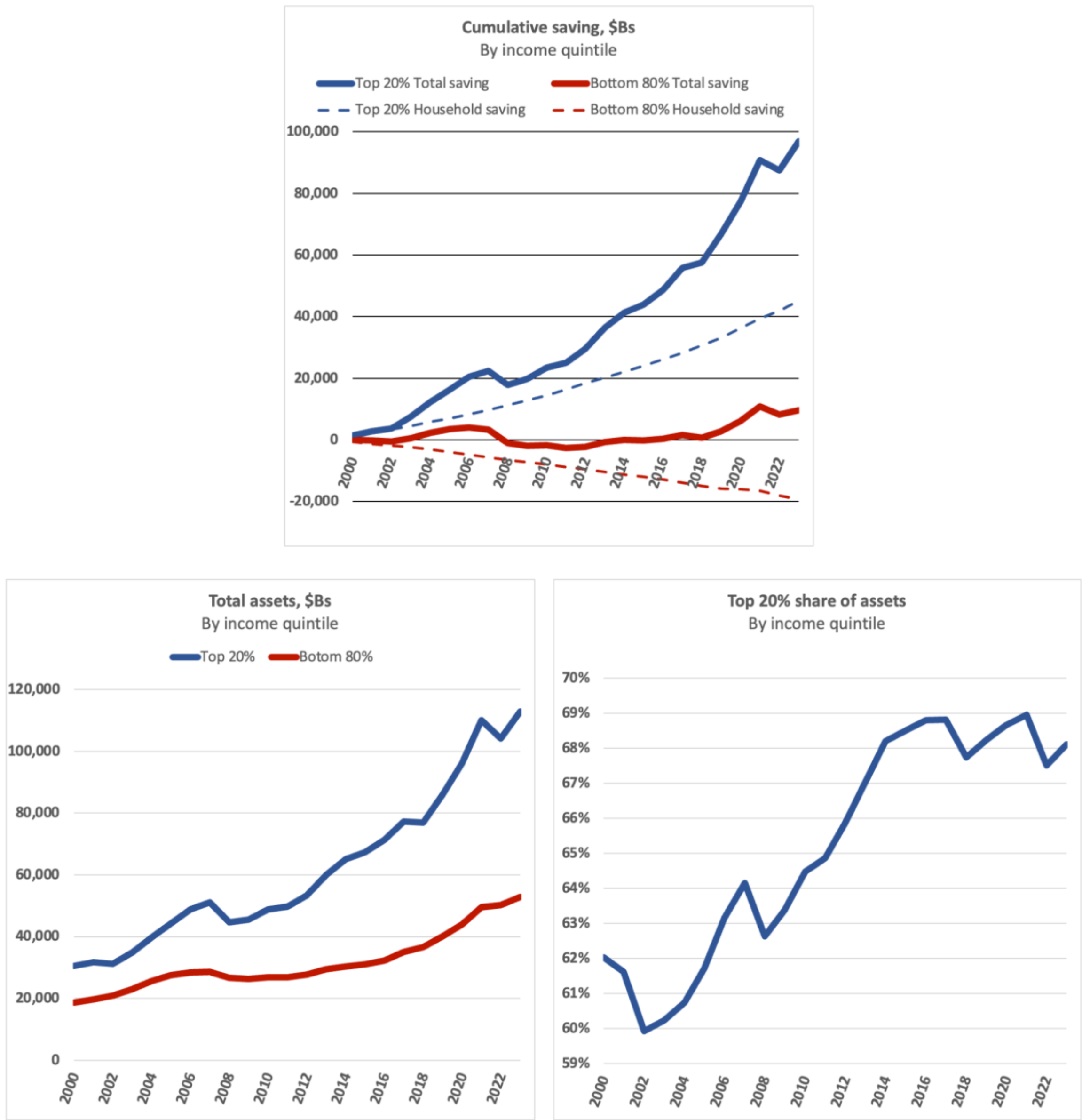
Saving and wealth accumulation. The increased total-income concentration detailed above, into more-concentrated property vs. labor income and into the top quintile, combined with declining top-20% spending propensity, explains the dominant stylized economic fact in the U.S. over recent decades that's highlighted in the first paragraph of the Introduction: extreme and increasing concentration of wealth into the top income (and wealth) percentiles (Figure 10).[25]

[23] Wealth velocity is the conceptual inverse of Piketty's wealth:national-income ratio, β. The fairly consistent wealth-velocity ratios across the period, with some trending, suggest that predictive growth models might benefit from including a wealth term in their consumption functions, combined with the traditional Keynesian income term. Roth 2021b presents a long-term economic growth model calibrated based on income quintiles' historical wealth-velocity measures. (Wealth velocity is distinct from monetarists' "velocity of 'money,'" which only encompasses "M2": currency and deposit assets that comprise about 10% of household assets, 13% of financial assets.)

[24] Perhaps the most surprising result in dollar terms: the bottom 80% persistently spends more than its household disposable income, with a -8% average household saving rate. By that standard measure, the bottom 80% perennially dissaves; the top 20% does all the saving (see Figure 10). It seems these spending deficits should very quickly encounter a straightforward version of Minsky's survival constraint or Hicks' sustainable-consumption constraint: If a household spends down all its assets (so it has none), it can't spend (see footnote 7). By contrast, the bottom 80% does not spend all of its total income; the household-saving deficit is "funded" primarily by lower quintiles' own holding gains. Borrowing provides additional funding, but the funding from gains is an order of magnitude larger (Roth 2023).

[25] There has been much discussion and debate about "upper tail" income concentration, into the top 1% and above, notably of late between, Auten/Splinter, Smith et. al., and Piketty/Saez/Zucman. Auten/Splinter, for instance, incorporates realized gains (only), and concludes that their series demonstrates slower/smaller increases in wealth concentration vs PSZ. Larrimore et al. 2021 uses accrued gains, and finds that the top 1% share is several percentage points higher than Auten/Splinter. These top-tail shares are quite large in absolute terms and so the discussions are important, but they encompass a small number of households and are extremely technical and subject to methodological details versus the THIAs' broader and better-sampled top-20% measures.

Figure 10: The distribution of total H-S saving and asset accumulation, and resulting asset shares. Household saving measures (dotted lines) shown for comparison. The dotted red line, in particular, is completely implausible; see Footnote 24.



Over 24 years, 91% of Total saving has redounded to the top quintile (which includes more asset holders receiving property income), so it has accumulated assets at a much higher rate than the bottom 80% (more workers and transfer recipients). Measures based only on NIPA household income or GNI, and their household- or national-saving remainders/residuals (dotted lines in Figure 10), cannot account for this observed rise in wealth, and wealth concentration.

Section 6: Conclusion

The magnitude of the Total or Haig Simons-based income and saving measures detailed in the THIAs, extending to trillions of dollars in single years and even in single quarters, dwarfs widely employed "headline" measures that are based on Personal, Household, National, or even just labor or wage income. The Total-income measures tell a multi-decadal story of household wealth accumulation and concentration that's much more dependent on property (and especially holding-gains) income, and that's not visible through the lens of NIPA income and saving measures. These Haig-Simons measures are also necessary to constructing stock-flow-consistent "integrated" or "3D" distributional views of income, consumption, and wealth.

Economists have expressed the desire for these "preferred" balance-sheet-complete Haig-Simons measures for decades, and the means to assemble them from the national accounts has been available since the mid 2000s. Releases of distributional measures starting in 2019 allow the THIAs to present breakouts of Total income and saving by income quintiles, presented in tractable form for use by other researchers. Those distributional breakouts could be expanded by researchers to encompass other distributional "dimensions" — wealth, age, education, race, etc. — for a more comprehensive set of "integrated" distributional accounts.

The THIAs' presentation in well-documented spreadsheet form makes all the accounting identities and derivations therein explicit and visible, allowing detailed critique and discussion by researchers. The spreadsheet itself constitutes a complete replication file, including the ability for researchers to update and revise the underlying data and derivations.

In an accounting sense, accrued capital gains are major drivers of the extreme wealth concentration in the U.S. economy over the last decades. These drivers have remained invisible so far in other available data sets used by economic researchers, analysts, and modelers. If reduced levels of wealth and income concentration are an important policy goal going forward, the results in this paper suggest that an increased policy focus on the distribution of total property income will be necessary.

Appendix A: Haig-Simons Income Theory

The accounting derivation of Haig-Simons (H-S) income is quite straightforward conceptually:

> H-S income = Consumption expenditures + change in net worth
> = Household income + accrued holding gains from asset-price (re)valuation changes

In practice, based on national accounts' methods and derivations, it's also necessary to add small "other changes in volume" measures along with holding gains, as the IMAs do, to match observed changes in balance-sheet assets and net worth. Subtracting taxes and outlays then yields "H-S saving," here called "Total" saving, which is equal to change in net worth. Table 2 explains the construction of H-S income starting from household income, with two different approaches to ordering and labeling.

Table 2: Two ways of presenting and labeling the Haig-Simons accounting construction (∆ = "change in").

Household income + Accrued holding gains and other changes in volume = Total income, H-S income - Taxes and outlays = ∆ Net worth (total saving) + Assets accumulated from net new borrowing = ∆ Assets - Liabilities accumulated from net new borrowing = ∆ Net worth, Total saving	Household income + Accrued holding gains and other changes in volume = Total income, H-S income + Assets accumulated from net new borrowing = Gross asset accumulation - Taxes and outlays = Net asset accumulation, ∆ Assets - Liabilities accumulated from net new borrowing = ∆ Net worth, Total saving

Note: Outlays = Consumption expenditures plus consumer-interest payments

It is crucial to recognize that holding gains do not represent a transaction "flow" from any other sector. Unlike transactions that involve explicit transfers between accounts (credits and debits), the appreciation of asset-market prices does not generate corresponding liabilities on the balance sheets of households, of asset-issuers, or any other economic agents. Instead, these gains emerge through mark-to-market revaluations, asset markups, as recorded by brokerage firms and national accounting systems in response to observed changes in market prices. In the absence of new liabilities, such valuation gains contribute to *both* assets and net worth of households. (This stands in contrast to borrowing, which simultaneously increases both assets and liabilities, leaving net worth unchanged.) Consequently, holding gains/valuation changes are excluded from the Flow/Transaction tables in the Federal Reserve's Flow of Funds accounts, as those tables solely capture "volume"-based "transactions." Instead, such gains are systematically recorded in a separate (Re)valuation account within the (SNA-based) Integrated Macroeconomic Accounts (IMAs). See Figure 11.[26]

Whether some holding gains are "realized" by individual asset holders through sale is not material to the accrued Haig-Simons series. Those sales are just dollar-for-dollar asset swaps between asset-holders at current market prices — non-cash assets for cash assets. Those sales/swaps are "portfolio churn," with no effect on the individuals' or the aggregate current stock of assets.

[26] In what might seem like a trivial terminology change, the Federal Reserve Flow of Funds/Z.1 report acknowledged this reality, explicitly adopting the SNAs' volume vs. valuation distinction, with a change and explanatory note in the June, 2018 Z.1 release. (federalreserve.gov/releases/z1/20180607/html/introductory_text.htm). Emphasis added:

"As of this publication, the term 'flow' is being replaced by the term 'transactions.' The concept being referred to, which is the acquisition of assets or incurrence of liabilities, is not being changed. The change in terminology is intended to prevent confusion with the broader concept sometimes called 'economic flow,' which is the change in level from one period to the next and is composed of *transactions, revaluations, and other changes in volume*. The new terminology brings the Financial Accounts of the United States into better alignment with international guidelines in the System of National Accounts 2008 (SNA2008)." (And thus the IMAs.) The Transactions tables are still labeled as the "F" tables, however: F.101 and etc. See Roth, 2021a, "Why the Flow of Funds Doesn't Explain the Flow of Funds."

Subtracting taxes and outlays from total H-S income yields total, comprehensive, or Haig-Simons saving, which equals change in balance-sheet net worth.[27] This total-income accounting offers a comprehensive post-facto, backward-looking descriptive accounting model of wealth accumulation, through the lens of the household-sector balance sheet that sits at the top of the national accounting-ownership pyramid.[28]

Like household income, national income — the core measure for the Distributional National Accounts and the World Inequality Database — does not include holding gains, realized or accrued. (The DINA tables do provide valuable series of realized holding gains, as employed in Figure 4, but only for the purpose of allocating, as opposed to measuring, national income.) National-income series are more internationally comparable, however, given the availability of national accounting measures across countries.

The THIAs are particular to the U.S., and are thus only a potential exemplar for other countries. But the SNA-based structure should be adaptable for details and particularities of other countries as SNA conventions and practices are more widely adopted — especially the clear distinction between volume and (re)valuation measures. To the extent that asset revaluation is measured, valuation and "other changes" measures can be added to existing personal/household income measures to assemble Haig-Simons total income.[29] Subject to available distributional breakdowns of household income and assets/liabilities, those revaluation measures can also be allocated to percentiles as in the THIAs, to assemble distributional total income series.

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[27] This accounting treatment comports with standard public-corporation financial statements, which include a Consolidated Statement of *Comprehensive* Income. These statements include net income (profits), equivalent to household or national income, and add additional income sources, notably holding gains. An example statement from Berkshire Hathaway is available at wealth-economics.com/BHCompInc.png.

[28] Household wealth is the operative measure of "national" wealth. The Household sector sits at the top of the national "accounting-ownership pyramid." In the words of the OECD DNA expert working group handbook (p. 29), "all forms of income in the economy eventually accrue to resident individuals." (In sectoral terms, households). Likewise, domestic firms' equity-share values at current asset-market prices are assets on the household-sector balance sheet. The household sector largely "owns" the firms sector in this accounting sense; the firms sector is like a wholly-owned accounting subsidiary. Firms can own shares in other firms *ad infinitum*, but the household sector ultimately owns the whole firms sector; the ownership buck stops at households. This is an asymmetric, one-way ownership relationship. No other sector owns or can own (equity shares in) households — not since 1865. Likewise NPISHes, though for different reasons. Neither sector issues equity shares, or has owners. Similarly, the unmeasurable asset value of household-"owned" government assets (the judiciary system, public schools, roads and highways, *et. al.*) is at least partially *revealed* in the market value of household balance-sheet assets. That market value would presumably be somewhat smaller if those government "assets" didn't exist.

[29] The OECD DNA-EG handbook (OECD a, p. 29) envisions an accounting construction that fully integrates valuation changes, but only in the conditional or subjunctive mood (emphasis added): "[Holding gains are] included in the accumulation accounts in the framework of national accounts (see Figure 2.1) and *could* be taken into account once distributional information becomes available for the accumulation accounts. Although it is not part of the income definition as defined by the SNA, it *would* provide more insight into the economic situation of various household groups." The experimental "Distributional results on household income, consumption and savings" provided at OECD b do not include valuation measures. As this paper seeks to demonstrate, these valuation measures are extremely valuable even if distributional breakouts are not available. Lane 2015 also brings H-S thinking to bear on the U.K. and other countries' current account balances (emphasis added): "*In principle*, the stock-flow adjustment term *should* reflect 'valuation effects' (net capital gains on holdings of foreign assets and foreign liabilities due to movements in the market values of assets and liabilities…)." Note that Net International Investment Positions (NIIP) *are* tallied using assets' current market prices.

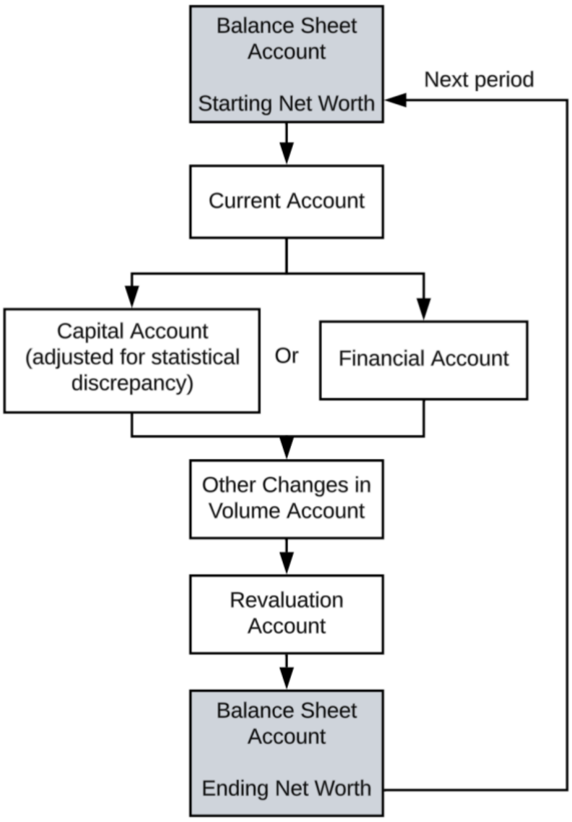
Appendix B: Constructing the THIAs

The THIAs' methodology in the accompanying Excel workbook serves as a complete replication file. This appendix takes the user step by step through the construction of the THIAs.

The most significant contribution is the THIAs' method for allocating holding gains to income quintiles (given holding gains' very large magnitude), which is straightforward and intuitive: holding gains are based on holdings, so they can be allocated to groups based on the groups' shares of asset holdings (by asset category).

The basic THIA *structure* (Figure 2) is based on the IMA/SNAs' balance-sheet-complete presentation (Table S.3.a), and its derivation of change in net worth (line 96). Figure 11 diagrams its account structure, with alternate pathways through the Capital or Financial account. The THIAs do not engage with the Capital account, only the Financial account. That account comports with balance-sheet changes; the Capital account doesn't (hence the Statistical Discrepancy; see below). There is no engagement with value-added or investment spending (which is called "capital formation" in the IMAs). All of that is replaced with households-only income (and outlay) measures from NIPA Table 2.9 (since 1992), which matches the DPIAs (since 2000) — and pre-1992 from NIPA Table 2.1 (personal sector, adjusted for households-only as detailed below). These Household income measures comprise 81% of the THIAs' Total income.

Figure 11: The IMAs' account structure, with alternative Capital and Financial accounts.



The reference balance sheet since 1989 is households-only Table b.101.h, which is mirrored in the DFAs.[30] The THIAs' pre-1989 asset and liability measures adjust available personal-sector balance-sheet measures from B.101 down to households-only based on the average post-1989 household:personal ratio — 94.1% of personal-sector assets are held by the household sector, vs. 5.9% for NPISHes. (These ratios are very consistent over the years since 1989.) Net worth is of course assets minus liabilities.

Detailed measures

Several of the detailed measures in the THIAs (which sum to the aggregate measures) require individual treatment, and/or adjustment to households-only in earlier years.

Labor compensation and proprietors' income are both inherently households-only. The NIPA 2.1 personal and 2.9/DPIA households-only measures are equal. So pre-1992 measures from Table 2.1 require no correction.

Rental, interest, and dividend income. Post-1992 Table 2.9 households-only measures are 2.2% lower than Table 2.1 & 2.9 personal measures. Pre-1992 personal-sector measures are adjusted down accordingly to estimate households-only measures.

N.B. The IMAs use different labels for rental and proprietors' profits: "Operating surplus" for rental profits (imputed profits for owner-occupiers), and "Withdrawals from income of quasi-corporations" for non-C-corp profits from "pass-through" entities including S-corps, partnerships, LLCs, sole proprietorships, etc. Note that that "withdrawals" measure is *not* actually a measure of withdrawals; just like NIPA 2.1s' "proprietors' income," it is a measure of firms' *net* earnings a.k.a. profits "passed through" to owners/members/shareholders as income, regardless of whether those profits are actually distributed by the non-C-corp firms.

Other changes in volume. All of the Other changes measures come directly from the IMAs' Other Changes in Volume account, personal-sector Table S.3.a. These quite small measures (2.5% of total income, combined) are all inherently households-only, requiring no adjustment. They are allocated to quintiles starting in 1989 as detailed below.

Net Accumulation of Consumer Durables. This measure — purchases of new durables less depreciation of existing durables — must be added to balance sheets because durables are an asset category thereon, so the period-to-period holdings changes must be accounted for. Consumption expenditures includes spending on durables (reducing household assets), but in the NIPAs the period's accumulated long-lived assets aren't added back to balance sheets (the NIPAs don't have balance sheets). The IMAs do so via the "Net investment in consumer durable goods" line in the Other Changes account, and the THIAs follow that practice. Durables accumulation is allocated to income quintiles based on each quintile's share of durable holdings, from the DFAs.

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[30] The de-consolidation of the personal-sector balance-sheet table into B.101.h and B.101.n (since 1989) shows some anomalies. B.101.h assets + b.101.n assets, for instance, ≠ B.101 personal-sector assets. Part of this may just be because consolidation does not equal simple summing. But in any case deconsolidated NPISHes end up with some unexplained extra assets. See details and notes at the bottom of those B tables. The THIAs do not attempt to resolve those anomalies, which are very small relative to household assets; they simply employ the DFA/B.101.h measures.

Disaster losses. A small measure, zero in many years, this is allocated to quintiles based on their shares of real-estate assets.

Other (other) changes in volume. 1.0% of total income. This measure includes “bad debts, accounting changes, data discontinuities,” etc. (Teplin et. al. p. 6). The difficulties of pension-entitlement accounting, and associated methodology changes, figure significantly in this measure. It’s allocated to quintiles based on their percent holding shares of total assets.

Statistical discrepancy. This measure is *not* included in the THIAs, even though it is included in the IMAs’ Other volume measures. This is because it’s the discrepancy between the Capital account and Financial account bottom lines, and the THIAs don’t engage with the Capital account. Derivations all effectively pass through the Financial account (Figure 11), which comports with balance-sheet changes with ~zero statistical discrepancy.[31]

Holding gains/asset (re)valuation. Holding gains total $72T over 24 years, 17% of total income for the period. The measures come from the IMAs’ (personal-sector) Revaluation account, adjusted down to households-only based on the household sector’s average share of personal-sector assets,1989-2021 (94.1%). This share measure is quite consistent over that period.

Since holding gains are the result of holdings, they’re allocated to quintiles based on each quintiles’ shares of asset holdings, from the DFAs. In sheer dollar magnitude terms, this quintile-allocation method for holding gains is arguably the most important (and simple/straightforward) distributional methodology innovation presented in this paper.

Different quintiles have quite different asset-portfolio mixes, however (most significantly, equity shares vs real-estate titles), so gains on financial and nonfinancial assets are allocated separately based on quintiles’ holding shares of each asset category.[32] Some non-systematic testing suggests that the simple financial/nonfinancial split captures the large bulk of variance in percentage gains on assets across asset categories, but since holding gains comprise such a big share of total income, this topic merits further investigation.[33]

Transfers. There are numerous very small discrepancies for transfer submeasures between NIPA 2.1 and 2.9/DPIAs; no attempt is made to adjust for those. The THIAs use the Table 2.9/DPIA measures

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[31] The net-worth derivation in the IMAs’ personal-sector S.3.a line 96 includes the bottom-line Capital-account net lending/borrowing measure. If it used the Financial-account net lending/borrowing measure instead, it would not be necessary to include the statistical discrepancy in the Other changes account. The Capital account and its statistical discrepancy would effectively just be an addendum note in Table S.3.

[32] It’s tempting to break out gains on assets with more granularity than just financial/nonfinancial. But that immediately engages with the third-largest asset category in the DFAs: pension entitlements (a financial-asset subcategory), for which quintile allocation would be difficult. These measures can be and are variously estimated based on pensioners’ tallied entitlements, on pension funds’ funding/endowment changes, or even on projections of funds’ future inflows. Discussions of those accounting choices continue among national accountants. (The DFAs recently changed its detailed asset categories for these assets, now showing two subcategories for defined-benefit and defined-contribution pension entitlements. See the more-detailed asset and liability category breakouts in the dfa-income-levels-detail.csv and dfa-income-shares-detail.csv files, available in the “Full CSV” zip file download at federalreserve.gov/releases/z1/dataviz/dfa/.)

[33] There is some evidence that wealthier households garner higher total returns (which include holding gains) on their asset holdings than lower quintiles, even from the same asset types (Balloch, Kartashova, Xavier).

from 1992, and 2.1 measures in previous years. See also below, “Adjustment for personal vs HH: net HH transfers to nonprofits.”

Taxes. This measure from the DPIAs/NIPAs is mostly household income taxes. (National accounts’ treatments of property and sales taxes, and “taxes on production and imports,” almost all paid by firms, are too complex to detail here.) It is inherently households-only; there is no difference between NIPA 2.1 and 2.9/DPIA measures. The THIAs nevertheless use 2.9 household measures starting in 1992, and 2.1 personal measures pre-1992, for consistent treatment.

Consumption expenditures. These outlays comprise 63% of total income over 21 years, so they’re quite significant to saving “remainder” measures, and net asset accumulation. NIPA 2.9 household consumption expenditures (HCE) is used starting 1992. In prior years, available PCE measures are adjusted down to households-only, based on the average of the (quite consistent) HCE/PCE ratio 1992-2021 (97.4%), from NIPA 2.9.

HCE is allocated to income quintiles starting in 1984 (when CEX reporting begins), based on CEX quintiles’ percent shares of spending.[34] But an adjustment is needed first. The CEX aggregate expenditure measures include households’ social security and pension contributions, which are not consumption expenditures in any national-accounting treatment. The magnitude is significant, a quite consistent 10% of total CEX expenditures across the period. Those measures are subtracted from each quintile’s expenditures before calculating CEX income quintiles’ percent shares of spending. Those adjusted CEX percent shares are then used to allocate NIPA HCE by quintile. See Appendix C for details of income-quintile construction/composition in CEX versus other data sources.

Consumer interest paid. This measure is inherently households-only; NIPA 2.1 personal measures match Table 2.9/DPIA household measures. The NIPA 2.9 data is nevertheless used starting 1992 for consistency; previous years are from 2.1. This measure is allocated to quintiles from 1989, based on quintiles’ shares of non-mortgage debt outstanding, from the DFAs. (*N.B.* Mortgage interest is “pre-deducted” from income within the derivation of rental *profits*, for both actual household-sector landlords and imputed owner-occupied landlords “renting to themselves.”)

Adjustment for personal vs HH: net HH transfers to nonprofits. This measure corrects for an accounting quirk in the deconsolidation of the personal sector into households and NPISH. In NIPA 2.9, NPISH-to-household transfers are included in household *income*, while household-to-NPISH transfers are tallied in household *outlays*. But the DPIAs don’t tally outlays, and unlike household<->business transfers, these two gross flows are not netted out in the income section. The adjustment here adds households’ *net* household transfers to NPISHes (net of NPISH transfers to households) to household outlays. This additional outlay equals ~1.0% of total income; it reduces saving, asset

[34] CEX undercounts consumption spending relative to HCE by roughly 40% (so only its quintile percent-*shares* are used in the THIAs, to allocate total HCE to income quintiles), and arguably undercounts top-percentiles’ spending by even more. But it’s “the only dataset with comprehensive and detailed information on household expenditure and its components.” (Attanasio 2016). See BEA, 2019. “Comparing expenditures from the Consumer Expenditure Survey with the Personal Consumer Expenditures: Results of the CE/PCE Concordance.” bls.gov/cex/cepceconcordance.htm Spreadsheet: “Summary comparison of aggregate Consumer Expenditures (CE) and Personal Consumption Expenditures (PCE)” bls.gov/cex/pce-compare-200916.xlsx. Sabelhaus, John et al., 2013. “Is the Consumer Expenditure Survey Representative by Income?” nber.org/papers/w19589 Bee, Adam, Bruce D. Meyer, and James X. Sullivan. "Micro and Macro Validation of the Consumer Expenditure Survey." 2012 conference.nber.org/confer/2011/CRIWf11/Bee_Meyer_Sullivan_March2012.pdf See also discussion of the new DPCEAs in Appendix C.

accumulation, and ending assets accordingly. The households-to-NPISH measure is only available from NIPA 2.9, so the adjustment is only made starting 1992. It is allocated to quintiles based on their shares of household income.

Assets/liabilities accumulated from net new borrowing. This is simply the annual change in households-only liabilities, taken directly (with quintile breakouts) from the DFAs.[35]

Appendix C: Improving the THIAs' Distributional Measures

In a fully fleshed-out "integrated" distributional accounting system, distribution would be visible across multiple rankings and groupings — by income quintiles as in the THIAs, or for instance by wealth percentiles or age, race, and education groups as broken out in the DFAs. The THIAs use (personal/household) income-quintile ranking/breakouts because all the necessary data sets provide such breakouts. These breakouts deliver important insights and understandings, but could be viewed as a proof of concept for a much larger system and structure. This section describes ways that the income-quintile-based THIAs might be improved.

The THIA workbook is assembled so it's relatively straightforward to replace, adjust, or add to the currently employed data sources and series. This section addresses potentially large additions that seem likely to help explain the THIA's remaining distributional quintile discrepancies, especially for bottom quintiles. (See also the methodological income-quintile issues addressed in Appendix C).

Intrasectoral flows across income quintiles. The measures compiled in the THIAs all involve changes in total household-sector assets and liabilities. Transfers and shifts in assets across quintiles *within* the household sector are not considered. (The all-households sector aggregates for such asset shifts should sum to zero because all the changes are *between* quintiles within the sector.)

Gifts, bequests, and inheritances in particular may be considerable; administrative (tax-return) data on these transfers is quite limited and incomplete because inherited estates smaller than $10M++ are not required to file returns. A rough estimate based on census deaths by age and DFA wealth by age suggests the magnitudes are quite large, in the ballpark of $1.7T in 2018, for instance — circa 10% of personal income, annually.[36] (Transfers "down the quintiles" from these bequests may be limited, with quite high estimated ginis for transferred wealth. Nolan, Salas-Rojo, Morelli. See also Sabelhaus.)

[35] Borrowing adds assets and liabilities to borrowers' balance sheets in equal measure, for net-zero effect on net worth (or saving); loan payoffs, the reverse. National-accounts measures of net household borrowing derive from changes in financial-account liabilities, not from transaction flows; the THIAs use the same method. There are no available measures of households' gross borrowing or loan payoffs. (Which would in any case face the difficulty of loan rollovers and refis; how much of a year's gross borrowing is actually "new" borrowing?)

[36] Zucman p. 21 (citing Alvaredo et. al.) estimates that 55–65% of U.S. household wealth is inherited. Alvaredo et. al.: "There exists substantial uncertainty regarding the relative magnitude of inherited wealth and self-made wealth in aggregate wealth accumulation… The 1980s saw a famous controversy between Modigliani (a strong lifecycle advocate, who argued that the share of inherited wealth was as little as 20–30% of US aggregate wealth) and Kotlikoff–Summers (who instead argued that the inheritance share was as large as 80%, if not larger)." Alvaredo does not estimate annual inheritance flows for the U.S. because there's so little estate-tax data to work with. But its estimates of what it calls "moderate inheritance flows (between 5% and 10% of national income)" put a current estimate of $1.7T near the middle of the likely range. A ($20,000) proprietary private report from Cerulli Associates predicts ~$1.5T a year, 2023–2027.

Compositional changes. Households and individuals constantly shift between income quintiles. They may enter the top 20%, for instance, during their prime working years, and often exit that quintile on retirement — bringing their often-considerable assets with them. But the top-20% income "class" remains an object of analytical interest and import. (It serves as an imperfect proxy for the top-20% wealthholder class, which is not broken out in the DFAs or WID.) To the extent that these compositional and asset moves are large and systematic in direction, they could appear as significant asset shifts for income quintiles over time. As with inheritance, there is limited data available on these effects.

Since many of these intrasectoral, cross-quintile asset movements are systematically age-related (and thus especially pertinent in the context of a lifetime income hypothesis), that adds age as an important fourth dimension to the three dimensions of income, spending, and wealth.[37]

Holding gains by asset class. Because different quintiles have quite different asset-portfolio mixes, the THIAs quintile-allocate holding gains separately for gains on financial and nonfinancial assets. A more granular breakdown of asset classes could potentially allocate gains to quintiles more accurately. Since holding gains comprise 17% of total income, the effects could be significant.

If time series of these additional and different measures could be assembled, they could be straightforwardly "bolted on" to the THIAs' accounting construct (perhaps with some adjustments or additions to the category and subcategory labels and presentation employed in Figure 2). They could potentially explain some portion of the remaining quintile discrepancies displayed in Figure 6.

Appendix D: Comparing the Sources' Distributional Quintiles

Note: To avoid confusing the THIA workbook, the figures in this appendix are assembled using a separate special-purpose workbook that employs the THIAs data, plus other data, but is arranged differently.

The THIAs' distributional breakouts by income quintile for 2000-2023 rely on income-quintile measures from multiple sources. This raises an important question: is the composition of those sources' income quintiles (roughly) equivalent? Do the income quintiles consist of households with the same range and distribution of incomes, etc.? Is it valid, for instance, to combine quintiles' household income shares based on the DPIAs' income quintiles, to consumption-spending shares based on CEX income quintiles?

In particular, might quintile mismatches help explain the THIA discrepancies for lower quintiles displayed in Figure 6? (There are no significant discrepancies to explain for aggregate, all-households measures; they match quite precisely over decades.)

This appendix does not attempt to answer this question comprehensively, which would require original analysis of all the sources' microdata composition, compared across multiple dimensions. Rather, it examines indicative evidence: if two sources' income quintiles show equal quintile shares of income or consumption spending, for instance, that indicates that the two sources' quintiles are at least

[37] Notable recent research efforts in this area include Morelli, Mian, Horioka, Gindelsky, and in particular Bauluz and Meyer (January 2024). Available age/income/wealth data series are broken out by somewhat arbitrary age groups roughly related to life "stages," as opposed to equal-sized age-percentile groups. (See age breakouts in the DFAs and CEX tables, for example.) Because of different age distributions in different populations, this can make age comparisons difficult to interpret and model in relation to income and wealth percentiles.

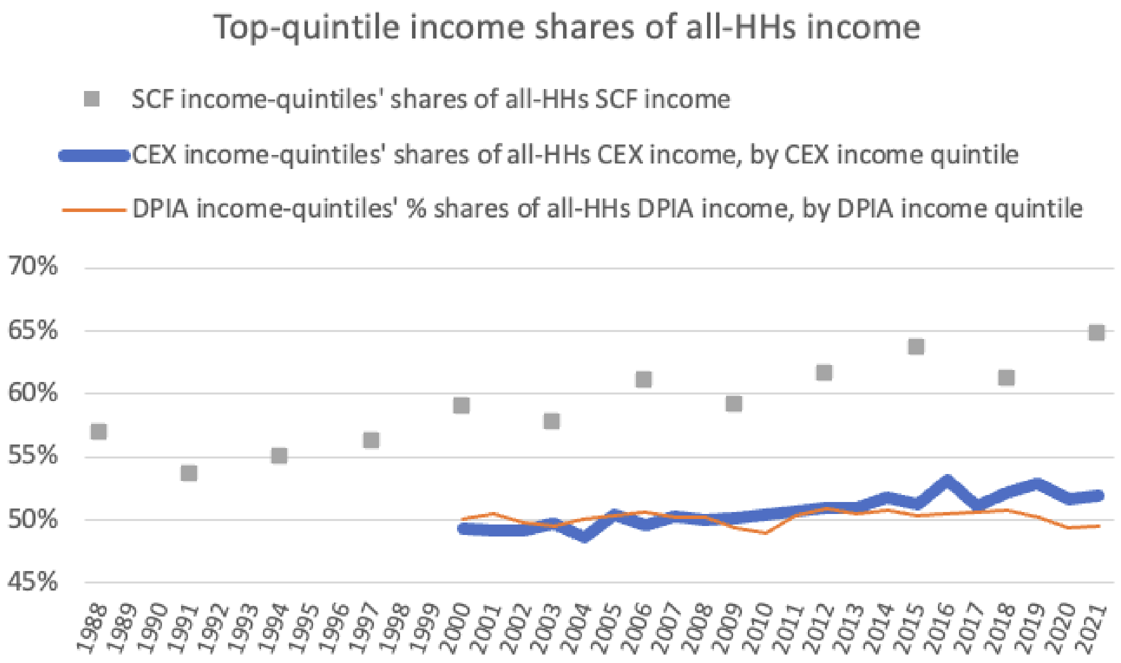
functionally commensurate for those measures, and fit for the purposes served in the THIAs — allocating aggregate measures across income quintiles. This section examines quintiles as constructed in four sources: the DPIAS, the SCF (and hence DFAS), CEX, and the new Distribution of Personal Consumption Expenditures Accounts or DPCEAs.

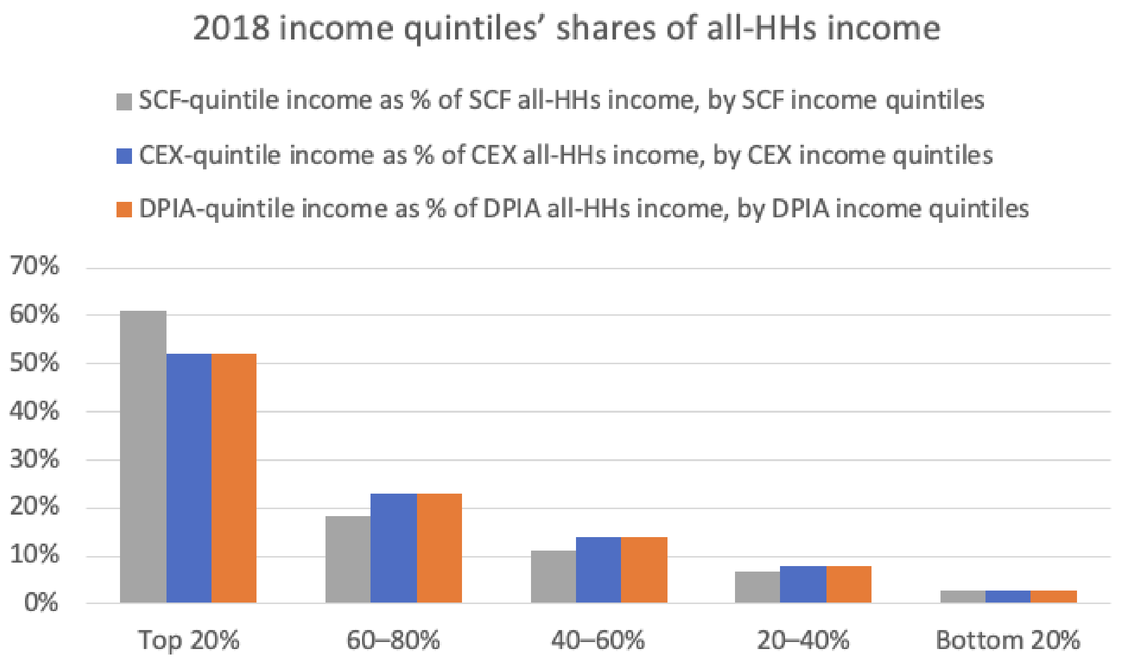
The THIAs take all their distributional household-income (and taxes) measures — 79% of total income — directly from the DPIAs. Notably, the DPIAs sort/rank households by their *household-size-equivalized* personal income (dividing each household's personal income by the square root of household members, for sorting purposes) before dividing the ranked households into equal-sized quintile groups. They then calculate (shares of) unequivalized NIPA personal/household income (and income subcategories) for those constructed quintile groups. The THIA household-income distributional measures come from, so necessarily match, the DPIAs'.

Household consumption expenditures (HCE) is another large measure in the THIAs — 61% of total income — and the THIAs rely on CEX-constructed income quintiles to allocate NIPA HCE to quintiles. To construct its quintiles, CEX ranks households by its own surveyed income measure (not equivalized), which is quite different from NIPA personal or household income.

Despite the differences between DPIA and CEX quintile treatments, their income-share results for quintiles are almost the same (Figure 12). The second graph displays (pre-covid) 2018 shares for all quintiles. (SCF is the anomalous series in this figure, and is discussed below.)

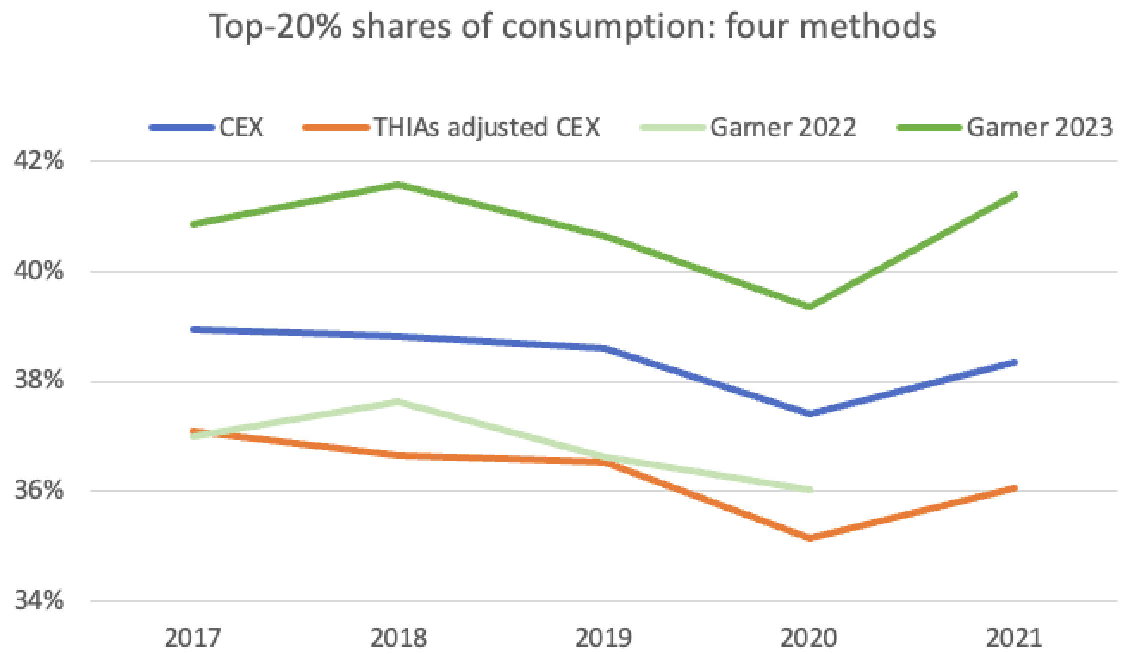
Figure 12: Comparing the quintile's income shares from multiple income-quintile treatments.





The THIAs allocate HCE based on those CEX income-quintiles' shares of CEX spending. (After correcting for the CEX mistreatment of Social Security/pension contributions as "spending," as detailed in Appendix B.) CEX then calculates its quintile spending shares quite simply: total spending for a quintile, divided by all-households spending. (The THIAs correct the SS/pension problem for total spending prior to this step.) The resulting consumption spending shares can be compared to the DPCEAs' consumption shares. (Figure 13; top quintile only. Other quintiles' series are in the workbook.)

Figure 13: 13. Top-quintile shares of consumption (spending) compared.



The DPCEAs (Garner et al 2023, and "Garner" in the graphs here) seek to serve a somewhat different purpose than other projects ("to provide a fuller picture of the well-being of households"), and they use a more complex construction. Firstly, they don't construct income quintiles, but consumption quintiles, and they focus on (adjusted) consumption rather than consumption spending *per se*. This in itself renders the DPCEA results inapplicable to the THIAs, which are based on income quintiles. (Consumption distributions are much more uniform, less concentrated at the top, than income distributions.) But the comparison still merits scrutiny. The DPCEAs further adjust and augment CEX categories and measures to make them more comparable to PCE's categories, then sort/rank the resulting households by their household-size equivalized, and adjusted, consumption. So DPCEA quintiles are very different from others examined here — their purpose, construction, measures, and other methodology.

Despite all these differences, at least in the published 2022/23 first-year data, DPCEA quintiles' shares of consumption were quite close to CEX-quintile shares, and almost identical to the THIAs' SS-corrected CEX shares. The top-quintile share is much higher in the 2023 data, because in that year DPCEA top-5% (hence top-20%) consumption was adjusted upward using pareto adjustment "to mitigate understatement of inequality" arising from the CEX survey sample and etc.

Returning to the SCF income-shares series in Figure 12: these are significant for the THIAs' distributional measures because the DFAs construct their income quintiles based on SCF income, and the THIAs use the DFA quintiles' asset-holdings shares to quintile-allocate holding gains — 17% of total income. (Likewise some smaller Other changes measures.)

The DFAs may construct more income-concentrated quintiles than the other sources for two reasons:

1. For sorting/ranking purposes, the DFAs adjust the weights of SCF survey respondents to include the income of the Forbes 400, which is unsampled or poorly sampled in the SCF. Since Forbes income is big in individual terms but much less so as a percent of total wealth, this seems unlikely to explain (much of) the large income-share differences in Figure 6.

2. The DFAs rank households based on the SCF "Income" measure, which includes holding gains (and other unusual or one-off income) in a year. It also calculates the quintiles' shares of income based on that measure. (The SCF "Normal Income" measure — more equivalent to the DPIA/CEX measures that don't include holding gains — only includes the "Value of income the household would expect to receive in a 'normal' year.")

Whatever explains these income-quintile differences, it raises a conundrum in the THIAs. It results in *more* holding gains being allocated to the top quintile in the THIAs (and less to lower quintiles) than a less-concentrated distribution would. But Figure 6 shows exactly the opposite: according to the DFAs, lower quintiles net-accumulate *more* assets than is calculated in the THIAs. Further research is needed. Again, this is only pertinent to the distributional discrepancies; it has no effect on the THIAs' aggregate, all-households measures.

The comparisons in this appendix suggest that income-quintile methodology differences, different definitions of economic units and measures, and etc., are probably not a large contributor to the quintile discrepancies displayed in Figure 6. The large additional and different measures suggested in Appendix C seem to hold more promise in efforts to track down those discrepancies.

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The systematic extraction of global resources under the U.S. trade deficit model: A reconstruction of national income accounting

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Abstract
This paper proposes a radical reconstruction of national income accounting for the United States economy, moving from the traditional Gross Domestic Product (GDP) framework to a Gross Domestic Available Resources (GDAR) model, defined by the identity $Z = Y + NI$ (where Z is total resources, Y is domestic output, and NI is net imports). By analyzing the "Global Dollar Cycle," the author demonstrates that under the U.S. model, the trade deficit is transformed from a deduction of aggregate demand into a pure income stream for the real economy–a systemic seigniorage dividend. The paper identifies a unique "Macro-Micro Antinomy": while individual transactions are executed as equivalent exchanges at the micro-level, the U.S. economy reaps a double dividend at the macro-level through the "recycling without liquidation" mechanism of its capital markets. The study further explores how this "external saving injection" sustains the U.S. high-consumption model and fuels high-stakes technological innovation (e.g., the "Magnificent Seven"). Finally, the author advocates for a "Loose Monetary, Tight Fiscal" policy synergy to maximize the conversion of this dollar dividend into productive private investment, ensuring long-term economic energy-level transitions.

Keywords: GDAR ($Z=Y+NI$), Global Dollar Cycle, Macro-Micro Antinomy, Systemic Seigniorage, National Income Accounting, U.S. Economic Model.

Part I. Dissecting the Economic Essence of the Trade Deficit through Global Dollar Circulation

1. Is the U.S. Trade Deficit a Loss or a Gain?

The U.S. government initiated the trade war based on the "Deficit-as-Loss" narrative. But is this truly the case? Since the total collapse of the Bretton Woods system in the 1970s, the U.S. shifted from a long-term trade surplus to a deficit. Particularly in the four decades following President Reagan's inauguration in 1981, the deficit has persisted and expanded annually. Conventionally, a chronic and massive trade deficit is seen as a sign of severely diminished competitiveness, leading to currency devaluation, inflation, debt crises, and eventual economic collapse. Yet, the U.S. remains unaffected, firmly maintaining its position as the world's leading economic superpower.

During Reagan's tenure, which set the U.S. on the path of long-term trade deficits, GDP growth accelerated in tandem with the widening deficit. Under President Clinton, the deficit increased fivefold, yet economic growth continued to rise, reaching 4.69% in 1999. American economist Russell Roberts hit the mark: the U.S. trade deficit is sustainable; it does not harm U.S. interests, and any policy attempting to eliminate it would do more harm than good.

Is it then, as many in China believe, that the U.S. uses the dollar to cover its deficit in an "unequal exchange" where other nations suffer greatly? Not necessarily. After Trump launched the tariff war, almost every nation–except for China’s countermeasures– accepted various "unequal conditions" just to secure a slightly lower tariff rate. Could it be that they were deeply afraid of losing the chance to "suffer greatly"?

The excessive issuance of the dollar − circulation within the U.S. − outflow through trade deficit payments − circulation outside the U.S. − and finally, the return to the U.S. via capital markets: this constitutes the **Global Dollar Cycle**. Dissecting this cycle not only provides answers to the aforementioned questions but also helps us grasp the unique characteristics of the U.S. compared to all other economies.

Under the "magic wand" of the U.S. Dollar, the entire U.S. economic system–from the real economy and capital markets to national accounting, monetary, and fiscal policies–has been transformed. It differs fundamentally from traditional economic textbooks and from all non-U.S. economies. We call this the **"U.S. Economic Model."**

2. Analyzing the Global Dollar Cycle: Under the Magic Wand of the Dollar Dividend, the Trade Deficit Mutates into Pure Income for the U.S. Real Economy.

Like any modern national currency, the U.S. dollar collects "seigniorage" at the point of issuance. When the Federal Reserve issues dollars, it increases its assets–a process akin to "creating something from nothing." While the Fed is defined as a non-profit organization to satisfy market demands for fairness, the seigniorage on the approximately 10%+ of national debt it holds is effectively collected by the U.S. government. Subsequent circulation involves fair, quid-pro-quo exchanges, which essentially transfer this seigniorage. Seigniorage only "disappears" when a private entity uses dollars to buy gold or bonds from the Fed, or to repay loans, leading to the currency's withdrawal. However, macroeconomically, the long-term growth of the economy ensures a rising demand for dollars; thus, the Fed’s assets and the collected seigniorage grow continuously–at least domestically.

The nature changes once U.S. firms use dollars to pay for net imports of goods and services. This essentially transfers seigniorage outside the U.S. economy. We can view the U.S. economy as the "World’s Central Bank," where dollar issuance occurs in two stages: Primary Issuance (domestic issuance via open market operations) and Secondary Issuance (global issuance via the trade deficit). Net imported goods become new assets for the U.S. economy. These dollars are not mere "IOUs" or "wastepaper"; they are hard currency representing claims on the global market.

Microscopically, every trade is a fair exchange: dollars for goods. The dollars held by foreign entities are "debt certificates" issued by the U.S. real economy, theoretically redeemable for U.S. goods. However, macroeconomically, because the U.S. has run high trade deficits for over forty years since the Reagan era, the massive tide of outflowing dollars never returns to the U.S. commodity market to exercise those claims. If these dollars circulate indefinitely among non-U.S. economies, they take on the characteristics of "Perpetual Non-Interest-Bearing Bonds." Claims that are "never defaulted on but never redeemed" are physically equivalent to a gift of goods. Thus, the U.S. economy perfectly captures global seigniorage, and the trade deficit becomes, in essence, pure income for the U.S. real economy.

The question arises: world trade growth cannot keep pace with the massive rate at which the U.S. ejects dollars. This necessitates a capital market channel to return excess dollars–similar to a central bank withdrawing currency. When a central bank withdraws currency, the corresponding seigniorage disappears. Does the return of offshore dollars to the U.S. mean the seigniorage vanishes and the trade deficit is no longer pure income?

No. Strictly speaking, while the real economy issues dollars globally, the U.S. capital market acts as a "High-Energy Gravitational Field" that captures and "intercepts" these dollars for the real economy. Once these "dollar particles" are caught in this field, they rarely escape as the capital market continues to expand. Even if funds occasionally leak back to the real economy, their identity is transformed: once foreign entities convert dollars into U.S. equities or Treasuries, those dollars become assets of U.S. corporations or the government. The moment offshore dollars return to the U.S. capital market, the "nominal creditor" of the U.S. real economy vanishes, and the net import is "solidified" as pure income.

Thus, we have demonstrated that in all scenarios–whether the dollars used to pay for the trade deficit remain in offshore circulation or return via U.S. capital markets–the net import (*NI*) constitutes pure income for the U.S. real economy from a macroeconomic perspective.

We can imagine the U.S. real economy and the capital market as two distinct departments of the "World's Central Bank." The former specializes in issuing currency but never withdraws it, thus collecting a continuous stream of seigniorage (which must not be excessive to avoid inflation). The latter focuses on withdrawing currency, yet unlike a national central bank that "destroys" the money it collects, it keeps these funds in operation. This allows them to grow exponentially into the world's largest capital market.

This characteristic of **"Recycling without Liquidation"** is crucial. If these dollars were truly "withdrawn and destroyed," the U.S. economy would gain physical goods but lose an equivalent value in equity or debt; macroeconomically, it would be a zero-sum game. However, through "recycling without liquidation," U.S. corporations and the government receive the returning dollars while granting equity or debt. In this process, the U.S. gives up nothing additional, effectively pocketing the trade deficit as pure income and harvesting real seigniorage.

Consequently, when offshore dollars enter U.S. equities, they become corporate capital supporting R&D and expansion; when they enter Treasuries, they fund government spending. This return does not offset the physical gains of the deficit; instead, it amplifies the total U.S. economic volume through "Asset Appreciation".

It must be noted that the "withdrawal" of offshore dollars by the U.S. capital market is fundamentally different from the "monetary contraction" of a sovereign central bank. A typical central bank withdraws currency to hedge against inflation by shrinking its balance sheet, a process accompanied by the disappearance of liquidity. In contrast, the U.S. capital market acts as a **"High-Energy Gravitational Field"** that captures rather than destroys.

- **Standard Central Bank:** Currency Return = Balance Sheet Contraction = Disappearance of Purchasing Power.

- **U.S. Economy:** Offshore Dollar Return to Equities = Increase in Capital Reserve = Investment in Technological Innovation.

Conclusion: This mechanism enables the U.S. to continuously "exchange credit for physical goods," fixing the goods as "pure income" while directing credit toward technological innovation.

As a global currency, the dollar possesses a **Secondary Issuance Mechanism**. Therefore, compared to a national currency, it collects seigniorage twice. The first issuance, via the Federal Reserve, collects seigniorage from U.S. firms and individuals. Defined as a "non-profit," the Fed’s issuance is widely accepted as a necessity for economic development. The second issuance occurs when the U.S. real economy issues dollars to the world through trade deficits. The net imported goods and services are the seigniorage it collects. Because this is masked by micro-level equivalent exchange, it is also universally accepted–and even welcomed by trade partners (surplus nations) as a channel to convert excess capacity into dollar asset.

We will encounter this **Macro-Micro Value Misalignment** again in our deeper study of the trade deficit. From an accounting perspective, net imports *NI* paid for in dollars are amortized as costs at the firm level, showing no contribution to income or profit. Macroeconomically, however, the total physical resources within the U.S. increase by NI. The dollars issued to pay for this *NI* capture offshore surplus value through global circulation. Yet, this income has no specific owner, forming a **"Macro-beneficial but Micro-unowned"** systemic dividend. It is ultimately absorbed by the "Ultra-large Absorption Surface" of the U.S. economy:

- **Supply-side Substitution:** NI is directly converted into cheap raw materials and consumer goods, artificially raising the Production Possibility Frontier and expanding the economy from potential output *Y* to *Y+NI*.
- **Low-inflation Prosperity:** While currency expansion in non-U.S. economies leads to price hikes, dollar expansion brings an increase in physical goods *NI*. This "price-suppression-by-goods" effect allows the economy to run long-term in a zone of low inflation and high growth.
- **Obscured Distribution of Interest:** Although this pure income *NI* is not owned by any micro-entity, people sense its presence through a "lucrative" atmosphere. It is silently absorbed through increased corporate profits, higher wages, rising employment, asset appreciation (capital market expansion), and consumer surplus (cheap goods).

Why then, if the deficit is pure income, does it accompany the painful outflow of manufacturing? This is not an absence of dividends, but their **"Asymmetric Distribution."** This dividend is acquired at the cost of sacrificing traditional domestic manufacturing–"low-energy organizations" that automatically shed as the U.S. economy leaps to a higher energy level. This shedding is not passive, but a necessary choice driven by capital premium rates. When the capital gains from dollar recycling through the stock market far exceed the marginal profits of manufacturing, capital inevitably flows toward Silicon Valley rather than Detroit. This further confirms the restructuring effect of the **"High-Energy Gravitational Field"** on real industries.

Manufacturing outflow is the cost, while seigniorage via "exchanging void for substance" is the gain. For the U.S. economy, this "Sacrificed Pawn" strategy has allowed it to evolve from heavy physical production into the global **"Dispatch Center"** and **"Value Definer."** The popularity of the "U.S. loss" narrative is largely because the pain of micro-individuals is more visceral, while the dividends of the macro-system are hidden beneath the facade of "losing."

A chronic, massive trade deficit is not a sign of economic weakness; rather, it has become a fountain of wealth that defines modern America. With net imports NI equivalent to roughly 3% of GDP acting as hidden income for the real economy, how could the U.S. economy not be powerful?

3. An Examination of Dollar Recycling Channels: The Secondary Economic Boost via Equity Markets

To determine the true "purity" of the trade deficit as a form of hidden income, we must separately examine the impacts of dollar recycling through the U.S. Treasury market versus the U.S. stock market on the national economy.

The Bond Market Channel: Evolving Utility and Rising Burdens The return of dollars via the bond market is a double-edged sword; its impact changes over time and shifts according to its ratio to GDP. The Reagan administration pioneered the era of chronic U.S. fiscal deficits, expanding the national debt from 800 billion to 2.6 trillion. At that time, however, it only accounted for roughly 40% of GDP. Consequently, U.S. Treasuries were regarded as the most premium and safe assets, not only attracting massive offshore dollar inflows but also triggering a global frenzy for dollars to purchase these bonds, pushing the Dollar Index to a historic peak of 160. During this phase, the bond market was a powerful driver in elevating the dollar's status as the premier world currency, with central banks increasing the dollar's share in their reserves for safe returns. Furthermore, the Reagan administration primarily utilized debt issuance for the "Strategic Defense Initiative" (Star Wars), which laid the groundwork for the subsequent information technology revolution. Thus, the development of the Treasury market in this stage was highly beneficial to U.S. economic growth.

However, the "gravitational field" of the bond market possesses a limited energy level; its ability to attract and capture returning dollars is finite. Because borrowing became too easy for the U.S. government due to the bonds' popularity, the scale of U.S. debt surged rapidly. Today, it stands at 126% of GDP, with interest expenditures alone consuming more than 20% of fiscal revenue−a heavy burden indeed. More seriously, the market has begun to harbor doubts about the long-term prospects of U.S. debt. The gold bull market since 2025 is, in essence, a "no-confidence vote" by certain central banks regarding the dollar's status as the primary world reserve currency. If this issue is not managed well, the bond market channel for offshore dollar recycling could devolve from a systemic asset into a liability.

The Equity Market: A High-Energy Gravitational Field In contrast, the U.S. stock market is the true "High-Energy Gravitational Field," with an almost infinite capacity for asymmetric liquidity capture. In 1980, before President Reagan took office, the total market capitalization of U.S. equities was barely 1 trillion. Today, it has soared to over 64 trillion, making it the most dominant stock market in the world. Assuming an average annual trade deficit of 500 billion, approximately 20 trillion has flowed offshore over the past 40-plus years since 1980. Meanwhile, foreign holdings of U.S. stocks are valued at nearly 17 trillion. This indicates that two-thirds of those dollars have flowed into the U.S. equity market, highlighting the monumental role that offshore dollars− leaked through trade deficits−have played in the stock market's expansion.

Global capital creates a global capital market, and a global capital market nurtures global enterprises. Multinational giants like the "Magnificent Seven" (Nvidia, Tesla, Microsoft, Alphabet, Apple, etc.) have opened up entire "blue oceans" of new demand. These titans, with market caps often exceeding a trillion dollars−wealth rivaling entire nations−were supported during their initial loss-making startup phases by the sophisticated U.S. stock market and its supporting venture capital funds. During their exponential growth phases, they secured massive capital inflows through the stock market's resource allocation mechanisms. The return of offshore dollars does not merely provide capital; more importantly, through extreme valuation premiums, it completes a "Gratuitous Mobilization" of global intellectual resources. In recent years, the technological innovation capacity of the U.S. has left other advanced economies– Japan, Germany, Britain, France, and Canada–far behind, largely because the U.S. stock market is significantly more powerful than theirs. The revolutionary significance of dollar recycling in driving the U.S. stock market and economic growth cannot be overstated.

Optimal Policy Strategy: Loose Monetary, Tight Fiscal. Since the two recycling channels have vastly different impacts on the economy, the optimal choice for U.S. interests is to drastically cut fiscal deficits and reduce bond issuance. This would allow the debt-to- GDP ratio to decrease steadily as the economy grows, simultaneously restoring market confidence in the dollar's reserve function. The goal should be to further strengthen the "High-Energy Gravitational Field" of the U.S. stock market, shifting the current ratio of offshore dollar recycling–currently 30% via bonds and 70% via equities–toward an overwhelming dominance where 80% to 90% flows into the stock market.

The practice of the Clinton era proves this vision is entirely achievable. Within the U.S. "twin deficits" (trade and fiscal), the Clinton administration preserved and expanded the trade deficit while shrinking and eventually eliminating the fiscal deficit, reaching a surplus of over 200 billion by the year 2000. Not only were net imports and savings converted into investment, but the fiscal surplus was also transformed into private sector investment through bank lending. This facilitated the Information Technology revolution of the 1990s, pushing GDP growth to 4.69%–far exceeding the long-term average of 2.8%. Clearly, there is no inherent link between trade deficits and fiscal deficits. The U.S. can and should implement a policy mix of "Loose Monetary and Tight Fiscal" to allow trade deficits to coexist with fiscal balance or even surpluses.

In summary, the Global Dollar Cycle is the core engine for maintaining the U.S. technological gap and global resource mobilization. Phase 1: Acquire the world's physical wealth (NI) using "printed currency" through the trade deficit. Phase 2: The outflowing dollars return via the stock market, avoiding price inflation and instead becoming cheap capital for technological innovation. Phase 3: This capital power drives the U.S. stock market to become the world's largest and most open, birthing the "Magnificent Seven" and maintaining U.S. industrial leadership.

Consider a thought experiment: If the Fed kept money supply constant but eliminated the trade deficit, would the dollars previously used for imports flow into U.S. stocks and bonds? The answer is no. Each economic agent has a specific marginal propensity for capital allocation. Dollars intended for commodity purchases would instead flood the domestic market, causing inflation, while the capital market would suffer from a "blood loss" without offshore support. The dollars must travel abroad to change their ownership structure; once held by foreign entities, they are repositioned as capital allocations for U.S. equities or reserves for U.S. debt.

Thus, the panorama of the U.S. harvesting the "Dollar Dividend" emerges: The U.S. issues an excess of dollars relative to its potential output. These dollars flow offshore to secure net imported resources. Then, the tide of offshore dollars returns primarily via the stock market, solidifying the net imports (NI) as pure income for the real economy. The real economy receives valuable resources for free, while the stock market receives a lasting infusion of liquidity. The only cost–foreign ownership of a small portion of U.S. equity–is actually a strategic gain. Publicly traded companies aim to improve their operational mechanisms through share fragmentation and to accumulate vast amounts of capital in a short period to seize market opportunities and ascend. This is especially true for companies in their growth phase, which often recruit or transfer shares at high premiums and thus warmly welcome the influx of foreign capital. Furthermore, stock markets across all nations fervently hope to introduce foreign investment to expand and strengthen their markets. Due to the massive annual tide of dollars flowing offshore via the trade deficit, the U.S. stock market has naturally achieved the goal of becoming the world' s central market–a feat other national markets struggle to accomplish regardless of their efforts.

When offshore dollars shift from the trade account (exchange of physical goods) to the capital account (purchase of U.S. equities), a **"Permanent Transformation from Debt to Equity"** is completed. These dollars are converted into the capital reserves and innovation positions of U.S. enterprises, supporting the expansion of valuations. This means that while the U.S. obtains physical resources NI for free through its deficit, it does not truly pay out an equivalent future claim. Instead, through the premium mechanism of the capital market, it permanently retains these means of payment within its own economy. This asymmetry of **"Recycling without Liquidation"** serves as the physical foundation upon which the "Dollar Dividend" is secured and pocketed.

As for the small portion of offshore dollars returning through the bond market, this remains necessary–provided that the U.S. debt-to-GDP ratio stops rising and begins a steady decline. Maintaining a Treasury market of considerable scale is beneficial for the dollar's status as a world currency, as it facilitates the buying and selling of U.S. debt by various central banks. Although dollar recycling via the bond market cannot provide a "double boost" to the U.S. economy, the primary boost–the "realization" of the trade deficit as pure income–still exists.

In our exploration, we once again encounter the **Antinomy of Macro and Micro**: at the micro-level, every transaction is an equivalent exchange. The U.S. trade partners sell their excess capacity to the U.S. in exchange for dollar assets, fully receiving their counterparty value. Yet, at the macro-level, the United States reaps a double dividend.

This value deviation does not stem from a conspiracy, but from a **"Differential in Economic Energy Levels."** When global trade enters the gravitational field of the "Dollar-Equity" cycle, every "equivalent exchange" at the micro-level contributes to a "systemic dividend" at the macro-level. Just as in General Relativity, where space-time curves around massive celestial bodies, the path of value flow is deflected around the **"High-Energy Economy"** of the United States. Micro-level fairness acts as the lubricant for the market, while macro-level dividends are the structural output of the system.

Ultimately, we touch upon the most obscured undertone of the U.S. economic model: **Micro-level fairness masks macro-level inequality.**

From a micro-perspective, every transaction adheres to the strict standards of equivalent exchange, maintaining the credibility and efficiency of the market economy. However, from a macro-perspective, because the U.S. dollar and U.S. equities occupy the highest energy levels of the global economy, a systemic **"Value-Drift"** inevitably occurs. The U.S. exchanges "printed paper" for global physical resources and then intercepts the returning funds through its "high-energy gravitational field," completing a perfect closed loop. This macro-dividend is the trace-less "extraction of surplus value" performed by high-energy economic entities upon lower-energy entities using institutional potential energy. Just as **"Wave-Particle Duality"** reveals the complexity of the microscopic world, this macro-micro antinomy is the key to understanding contemporary global economic imbalances and the resilience of U.S. hegemony.

Part II: National Income Accounting under the U.S. Economic Model

Under the U.S. economic model, the trade deficit mutates into pure income for the U.S. real economy. This fundamental shift dictates that the U.S. national income accounting system must be reconstructed. While Samir Amin (2010) profoundly revealed the law of value in unequal exchange within the context of globalization, his analysis primarily focused on qualitative power deconstruction. This paper, however, attempts to provide a quantifiable macro-analytical framework for such systemic extraction by reconstructing the national income accounting system.

1. From GDP (Gross Domestic Product) to GDAR (Gross Domestic Available Resources)

As is widely recognized, the aggregate demand for domestic output consists of four components: (1) household consumption expenditure, C; (2) investment expenditure by firms and households, *I*; (3) government purchases of goods and services, *G*; and (4) foreign demand for domestic exports, *NX*. Since aggregate supply must equal aggregate demand, we have the standard identity for domestic output:

$$Y = C + I + G + NX \qquad (2-1a)$$

By defining *NI* as Net Imports, where *NI* = -*NX*, the above equation is transformed into:

$$Y = C + I + G - NI \qquad (2-1b)$$

Equation (2-1b) reflects the precarious situation of many non-U.S. economies already suffering from insufficient domestic aggregate demand. In such cases, if a trade deficit occurs, **Net Imports (*NI*)** further displace a portion of the aggregate demand (*C*+*I*+*G*), effectively **exacerbating the distress**. This prevents production capacity from being fully utilized, resulting in an actual output (*Y*) significantly lower than the potential output level.

The U.S. case is entirely different. As established in [Key Point 2 of the American Economic Model], NI actually constitutes the net income of the U.S. economy. Consequently, equation (2-1b) can be rewritten as:

$$Y + NI = C + I + G \qquad (2-1c)$$

By defining *Z* = *Y* + *NI*, we obtain:

$$Z = Y + NI = C + I + G \qquad (2-1)$$

We refer to **Z** as **Gross Domestic Available Resources (GDAR)**.

Comparing equation (2-1c) with (2-1b), the only mathematical difference is the relocation of **Net Imports (*NI*)** from the right side to the left. However, this shift represents a fundamental divergence in economic connotation.

Equation (2-1b) reflects the condition of **non-U.S. economies** (as depicted in standard macroeconomic textbooks): *NI* is viewed as a negative contribution to total output (total income) *Y*. In this context, *NI* **diminishes the "GDP cake,"** as the presence of a trade deficit reduces the domestic production level.

Conversely, equations (2-1c) and (2-1) describe the **American Economic Model**: here, domestic output *Y* is a form of income, and net imports *NI* are also, in essence, a form of income. Therefore, total income is no longer defined by *Y*, but by *Z* = *Y* + *NI* > *Y*.

In this paradigm, net imports and domestic output together constitute the **Total Aggregate Supply**, which satisfies the robust total demand (*C*+*I*+*G*). This process effectively **enlarges the economic cake**, expanding it from *Y* to *Z*−or, in terms of accounting metrics, transforming **GDP** into the Americanized **GDAR**.

When non-U.S. economies over-issue currency, the resulting demand pressure that exceeds the potential output capacity *Y* leads to inflation, while the real gross domestic income (total output) *Y* remains unchanged. In contrast, as the issuer of the world currency, the excess currency issued by the U.S. is used to pay for net imports, allowing the prices of goods and services to remain stable. *Z* = *Y* + *NI* reveals that while total output *Y* remains constant, the total income and total supply of the U.S. increase by *NI* due to the over-issuance of currency. One could say that *Z*=*Y* + *NI* is tailor-made for the U.S. economic model. Unlike traditional macroeconomic descriptions where gross domestic income is equivalent to total output, U.S. domestic income is the sum of total output and net imports. Total output is produced by machines in workshops; net imports are "produced" by the Federal Reserve's printing press. Total output and total income are characterized by GDP and GDAR, respectively. In studying the U.S. economy, GDAR is at least as important as GDP, as it reveals the true scale of the U.S. economy−which is approximately 3% larger than what the surface statistical figures suggest.

2. Key National Income Accounting Identities

Under the "magic wand" of the U.S. Dollar, fundamental identities−including disposable income, consumption, saving, investment, and the government budget− undergo transformations that diverge from the generalized descriptions found in standard macroeconomics.

Since the total domestic income of the United States is defined as *Z*, Disposable Income must be redefined as *ZD*. It is determined by the following equation:

$$ZD = Z + TR - TA = Y + NI + TR - TA \qquad (2-2)$$

where *TR* represents net transfer payments received by the private sector, and *TA* denotes taxes.

Disposable income is, in turn, allocated between consumption (C) and saving (S):

$$ZD = C + S \qquad (2-3)$$

By substituting equation (2-2) into (2-3), we derive the identity for Saving:

$$S = Y + NI + TR - TA - C \qquad (2-4)$$

Further, by substituting the total income identity $Z = Y + NI = C + I + G$ (Equation 2-1) into (2-4), we arrive at:

$$S - I = G + TR - TA \qquad (2-5)$$

Comparison of National Income Accounting Identities

The national income accounting identities found in standard macroeconomic textbooks are applicable only to non-U.S. economies; they fail to capture the unique dynamics of the American economy. The following table provides a side-by-side comparison of the identities under these two distinct models:

Category	The American Model	The Non-U.S. Model
Total Income/ Output	$Z = Y + NI = C + I + G \quad (2-1)$	$Y = C + I + G - NI \quad (2-1b)$
Disposable Income	$ZD = Y + NI + TR - TA \quad (2-2)$	$YD = Y + TR - TA \quad (2-2a)$
Allocation of Income	$ZD = C + S \quad (2-3)$	$YD = C + S \quad (2-3a)$
Saving Definition	$S = Y + NI + TR - TA - C \; (2-4)$	$S = Y + TR - TA - C \quad (2-4a)$
Investment Gap	$S - I = G + TR - TA \quad (2-5)$	$S - I = G + TR - TA - NI \; (2-5a)$

As observed, in the identities of the American Model, **Net Imports (*NI*)** appears like a "specter"–manifesting in total income and aggregate supply (Eq. 2-1), in disposable income (Eq. 2-2), and in saving (Eq. 2-4). Furthermore, it reshapes the fundamental equilibrium between saving, investment, and fiscal deficits (Eq. 2-5).

U.S. national economic statistics, like those of other nations, have never recorded net imports as income, and for a conventional reason: when American firms import goods and services, the Dollars paid are naturally accounted for as **costs**. However, if we treat the U.S. real economy as a **unified entity**, the Dollars paid for the trade deficit–whether they circulate among non-U.S. economies indefinitely or are used to purchase U.S. equities and bonds–will never return to the U.S. real economy to demand their "counter- value" or exercise their purchasing rights.

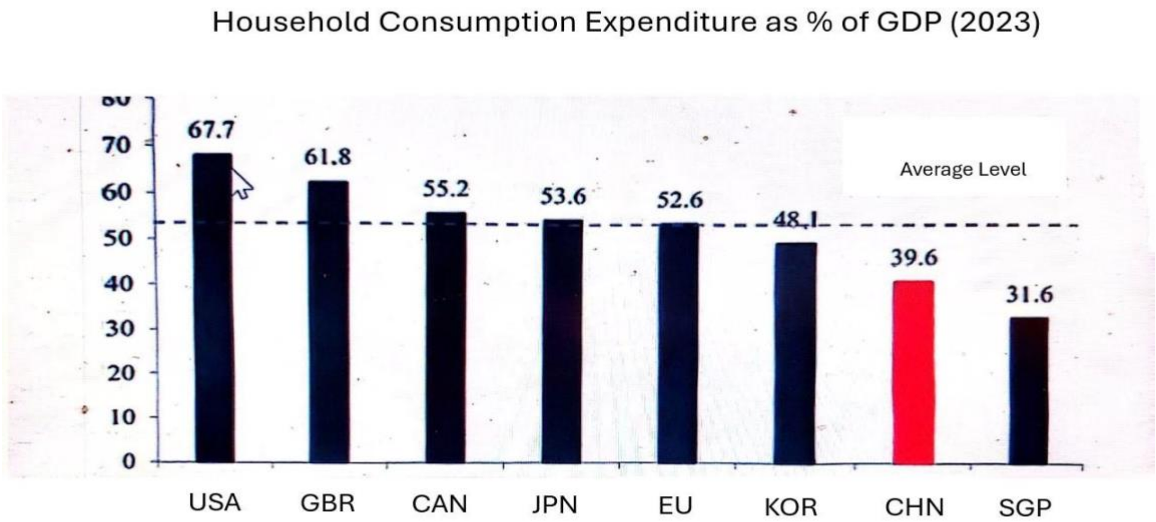
Simply by issuing the world’s reserve currency, the U.S. real economy gains a windfall of wealth: the Net Imports (*NI*). This is the natural dividend of possessing the Dollar. Since these imported goods and services are already **amortized as costs**, they are not subject to taxation, nor are they consumed as compensation for capital or labor. By bypassing these layers of distribution, this wealth remains intact and "hides" within **Saving (*S*)**– precisely as depicted in Equation (2-4).

The actual saving of the U.S. economy is significantly larger than the figures reported in official statistics. It is the sum of the **statistically recorded saving** (denoted by lowercase s) and **Net Imports (*NI*)**.

The relationship is expressed as:

$$S = s + NI \qquad (2-6)$$

With this derivation, the enigma of the U.S. consumption rate being the highest in the world–as illustrated in Figure 2-1–is finally resolved.



Source: Minsheng Securities Research Institute

Figure (2-1)

According to Equation (2-3), consumption (*C*) and saving (*S*) exist in a zero-sum relationship. High consumption typically implies low saving, leading to diminished investment and sluggish growth. The consumption rate, in essence, represents a trade- off between current welfare and long-term prosperity. If an excessively high consumption rate were to cause economic stagnation, one would expect the American people to adjust their habits by reducing consumption and increasing saving.
The paradox, however, is that despite maintaining a high consumption rate, the U.S. has sustained a long-term growth rate for over forty years that surpasses other major developed nations, such as Japan, Germany, the UK, and Canada. Without evident drawbacks, the American populace naturally maintains its high consumption. Why can the U.S. achieve relatively rapid growth despite high consumption and low (statistical) saving?

The saving that is ostensibly "depressed" by the high U.S. consumption rate is effectively replenished by the invisible income derived from Net Imports (*NI*). This compensation ensures that the Actual Saving Rate remains comparable to that of other developed nations, thereby maintaining robust growth momentum. This mechanism renders the American high-consumption model sustainable, allowing it to evolve into the world's largest terminal consumer market.

Under this model, *NI* acts as an "External Saving Injection," explaining how the U.S. maintains extreme consumption *C* while sustaining massive investment *I* in high-risk, high-input fields like the "Magnificent Seven." Americans appear to be overleveraging the future, but in reality, they are extracting "global surplus savings" through the high- energy status of the dollar.

3. Reflections on U.S. Monetary and Fiscal Policy

Equation (2-5) serves as a foundation for discussing the relationship between private sector savings (*S*), investment (*I*), and the government fiscal deficit (comprising government purchases (*G*), transfer payments (*TR*), and taxes (*TA*). Here, saving (*S*), as defined by Equation (2-6), already incorporates Net Imports (*NI*). To examine how to maximize investment (*I*) to accelerate economic growth, we rewrite Equation (2- 5) as:

$$I = S - (G + TR - TA) \qquad (2-7)$$

Clearly, the fiscal deficit (*G +TR -TA*) acts as a direct impediment to the transformation of saving into investment. Although the inclusion of Net Imports (*NI*) expands statistical saving (*s*) into the more robust actual saving (*S*), the fiscal deficit intercepts and consumes a significant portion of these net imported resources, thereby preventing investment (*I*) from receiving a sufficient boost. This explains why, despite over forty years of trade deficits, the vast resources imported by the U.S. failed to produce extraordinary growth.

Previously, we discussed the necessity of reducing fiscal deficits and curbing the issuance of U.S. Treasuries from the perspective of optimizing Dollar reflow channels. Now, an even more critical perspective emerges: the strategic utilization of the "Dollar Dividend" to propel economic growth. Given the economic characteristics of high consumption and low (statistical) saving, the United States should adopt a long-term policy mix of **"Loose Money and Tight Fiscal."** "Loose Money" serves to preserve and nurture the trade deficit, while "Tight

Fiscal" aims to eliminate fiscal deficits and strive for a budgetary surplus. This combination significantly elevates the investment rate within the private sector, maximizing the conversion of the Dollar Dividend–hidden behind the trade deficit–into a powerful engine for economic growth.

The essence of this synergy is "Protect the trade deficit to harvest dividends; Shrink the fiscal deficit to facilitate investment." It aims to liberate the physical resources captured by the global dollar cycle from recurring government expenditure and redirect them toward private sector productive innovation. Every U.S. policy–fiscal, monetary, and growth-oriented–should revolve around the identity that most accurately reflects the U.S. economic model:

$$Z=Y+NI$$

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Digital Gold, Risk Asset, or Evolving Hybrid? Bitcoin's Heterogeneous Safe Haven Properties during the Russia-Ukraine War

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Abstract
Using DCC GARCH and quantile regression with on chain data from June 2021 to December 2023, this study evaluates Bitcoin's evolving role during the Russia Ukraine war. Bitcoin briefly acted as a weak safe haven for participants facing capital controls, then quickly behaved like a high beta risk asset that moved with U.S. technology stocks. Gold displayed steady safe haven performance. The results show that Bitcoin's function depends on crisis phase and market sentiment, not a fixed digital gold identity. The study offers a dynamic framework for assessing safe haven behavior and provides guidance for portfolio diversification and regulatory oversight.

Keywords: Bitcoin; Safe Haven; Geopolitical Risk; Russia-Ukraine War; DCC-GARCH

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1. Introduction

The 2022 Russian invasion of Ukraine represents one of the most significant geopolitical shocks of the 21st century, triggering not only immense human suffering but also profound disruptions to global financial markets. The conflict and the subsequent economic sanctions, including the freezing of Russia's central bank assets and the exclusion of major Russian banks from the SWIFT system, created a unique "natural experiment" to test the fundamental properties of various asset classes (Caldara & Iacoviello, 2022). To avoid a temporal misreading, we use Caldara and Iacoviello (2022) strictly as the source of a general-purpose Geopolitical Risk (GPR) index rather than as a study "about" the Russia–Ukraine war. The 2022 invasion provides the event context for our analysis, while the GPR series offers an externally constructed, newspaper-based measure of geopolitical tensions that varies daily and can spike around major international episodes. Accordingly, we interpret the invasion and subsequent sanctions as an exogenous shock period in which safe-haven claims can be evaluated, and we use the GPR index to quantify the intensity of geopolitical risk over our sample window. This clarification separates (i) the historical event we study from (ii) the measurement instrument we employ, improving the factual and narrative coherence of the opening motivation. In times of such extreme geopolitical stress, investors traditionally flock to "safe haven" assets assets that are expected to retain or increase in value during periods of market turmoil. Gold has historically been the quintessential safe haven, valued for its tangibility, long history as a store of value, and its perceived independence from any single nation's economic or political system (Baur & McDermott, 2010).

In the digital era, Bitcoin has emerged as a contender for the title of "digital gold." Proponents argue that its decentralized nature, algorithmically fixed supply, and borderless transferability make it an ideal hedge against geopolitical instability and fiat currency debasement (Popper, 2015). The Russia-Ukraine conflict provided a real-world crucible to test this narrative. On one hand, the imposition of capital controls in both Russia and Ukraine could theoretically drive demand for a non-sovereign asset like Bitcoin for capital preservation and flight. On the other hand, Bitcoin's high volatility and its increasing correlation with high-risk technology stocks suggest it may behave more like a speculative risk asset, plummeting alongside equity markets during a risk-off event.

The existing literature on Bitcoin's safe haven properties presents a conflicting and often inconclusive picture. Early studies found little evidence of safe haven characteristics (Baur, Hong, & Lee, 2018), while some later research identified weak or transient safe haven effects, particularly against market-specific or policy-related uncertainty (Cheema, Faff, & Szulczyk, 2020). However, a significant gap remains in understanding the *dynamic* and *heterogeneous* nature of these properties, especially in the context of a major, sustained geopolitical war. Most studies treat the safe haven property as a static, binary characteristic, failing to capture its potential evolution over time and its dependence on the severity of market conditions.

This study's contribution is not to re-test whether Bitcoin is "a" safe haven during the Russia–Ukraine war—a question addressed by a large and growing literature—but to clarify which notion of safe haven is being evaluated and for whom it is meaningful. We therefore distinguish (i) a portfolio-level safe-haven claim, defined as zero or negative dependence between Bitcoin and a benchmark risk portfolio during episodes of extreme market stress, from (ii) a user-level, crisis-driven functionality claim, where Bitcoin's utility may rise under payment frictions, withdrawal limits, or capital controls. In this paper, "heterogeneity" refers to cross-context differences in constraints and transaction motives rather than a generic assertion that "Bitcoin behaves differently over time." Empirically, we treat the former as a testable asset-pricing proposition using stress-state dependence in equity-market drawdowns, and we treat the latter as corroborative evidence using documented on-chain activity patterns during the conflict period. This reframing yields a narrower but defensible contribution: identifying when portfolio safe-haven criteria fail while functional demand channels may still emerge under institutional disruption.

This paper addresses this critical gap by moving beyond the simplistic question of “Is Bitcoin a safe haven?” to ask a more nuanced set of questions: *How do Bitcoin’s safe haven and hedge properties evolve and differ across various market conditions and time horizons during a major geopolitical crisis? Does it exhibit different characteristics for a portfolio investor in New York versus an individual facing capital controls in Kyiv?* To answer these, we dissect the concepts of “hedge” (an asset that is, on average, uncorrelated with another) and “safe haven” (an asset that is uncorrelated or negatively correlated during times of extreme market distress), as formally distinguished by Baur and McDermott (2010).

We posit an “Evolving Hybrid Asset Hypothesis,” suggesting that Bitcoin’s properties are not fixed but are contingent on the specific context, market sentiment, and investor profile. To test this, we employ a multi-faceted econometric strategy. First, we use a Dynamic Conditional Correlation (DCC) GARCH model to capture the time-varying correlations between Bitcoin, gold, the S&P 500, and the tech-heavy Nasdaq-100 (QQQ). This allows us to visualize how these relationships shifted before, during, and after the invasion. Second, we utilize a GARCH-X model to directly measure the impact of the Geopolitical Risk (GPR) index on the volatility of Bitcoin and gold. Third, and most critically, we apply Quantile Regression to investigate whether the relationship between Bitcoin and risk assets changes at the extreme tails of the return distribution that is, during moments of market panic. Finally, we supplement our financial market analysis with a review of on-chain data and reports from firms like Chainalysis to provide micro-level evidence of Bitcoin’s use in the conflict zone.

Our contributions are threefold. Theoretically, we challenge the static “digital gold” narrative by providing a framework for analyzing assets with evolving, state-contingent properties. Methodologically, we combine advanced time-series models to provide a more granular and robust analysis than prior studies. Empirically, we offer some of the first comprehensive evidence on the behavior of a major cryptocurrency during a modern, large-scale war, providing timely and critical insights.

The findings indicate that, for the global investor, Bitcoin failed to act as a reliable safe haven, remaining strongly correlated with technology stocks. However, our quantile analysis and on-chain evidence suggest it did play a “contingent” or “functional” safe haven role for those directly impacted by the conflict’s financial disruptions. Bitcoin is neither digital gold nor just another tech stock; it is an evolving hybrid asset whose properties are still being forged in the crucible of global events.

The remainder of this paper is structured as follows. Section 2 reviews the relevant literature and develops our hypotheses. Section 3 describes the data and outlines our econometric methodology. Section 4 presents and discusses the empirical results. Finally, Section 5 concludes the paper with a summary of findings and a discussion of their implications for investors and policymakers.

2. Literature Review and Hypothesis Development

2.1. The Theory of Hedge and Safe Haven Assets

The theoretical underpinnings of safe haven assets are deeply rooted in portfolio theory and behavioral finance. In times of market uncertainty or crisis, investors typically seek to reduce risk by reallocating capital from volatile assets to those perceived as stable and secure. This phenomenon, often termed “flight-to-quality,” drives demand for safe haven assets (Baur & Lucey, 2010). The definition of a safe haven is crucial: it is an asset that is uncorrelated or negatively correlated with other assets *during periods of extreme market stress* (Baur & McDermott, 2010). This distinguishes it from a mere “hedge,” which maintains a low or negative correlation *on average*, and a “diversifier,” which simply has a less than perfect positive correlation. The key characteristic of a safe haven is its ability to preserve or even increase value when other assets are plummeting, thus offering protection against systemic risk. This protection can be asymmetric, meaning the safe haven property might only manifest during market downturns, not necessarily during upturns (Beckmann, Berger, & Czudaj, 2015).

Traditional safe havens, such as gold, the U.S. dollar, and the Swiss franc, derive their status from various factors. Gold’s appeal stems from its historical role as a store of value, its tangibility, its limited supply, and its perceived independence from government policies and credit risk (Baur & McDermott, 2010). The U.S. dollar, as the world’s primary reserve currency, benefits from the depth and liquidity of U.S. financial markets and the stability of the U.S. political system, often attracting capital during global crises (Habib & Stracca, 2012). However, the reliability of these traditional safe havens can also be context-dependent. For instance, during a crisis originating in the U.S., the dollar’s safe haven status might be compromised. The Russia-Ukraine war, a major geopolitical event, provides an excellent opportunity to re-examine these established roles and assess whether new assets like Bitcoin can genuinely offer similar or superior protection.

2.2. The “Digital Gold” Narrative and Competing Evidence

The “digital gold” narrative for Bitcoin is predicated on a set of fundamental characteristics that proponents argue mirror or even surpass those of physical gold. These include its absolute scarcity, enforced by a hard cap of 21 million coins, which theoretically protects against inflation and currency debasement (Ammous, 2018). Its decentralized, peer-to-peer network structure, secured by cryptography and a distributed ledger, renders it resistant to censorship, seizure, or manipulation by any single government or financial institution (Popper, 2015). Furthermore, its borderless and permissionless nature allows for global transfers without intermediaries, making it a potential tool for circumventing capital controls or sanctions. These attributes position Bitcoin as a non-sovereign, apolitical asset, appealing to those seeking refuge from state-controlled financial systems or geopolitical instability.

However, this narrative faces substantial empirical challenges. A primary counterargument is Bitcoin’s extreme price volatility, which far exceeds that of traditional assets like gold or major fiat currencies (Baur, Hong, & Lee, 2018). An asset that can lose 20-30% of its value in a single day struggles to be considered a “safe” haven. Critics also point to Bitcoin’s increasing correlation with traditional risk assets, particularly technology stocks. Empirically, the “digital gold” claim is difficult to reconcile with evidence from time-varying dependence models. For example, Klein, Pham Thu, and Walther (2018) employ a DCC framework to show that Bitcoin’s correlation structure and volatility dynamics differ markedly from gold and do not deliver consistent safe-haven performance in portfolio settings. This line of evidence is important for the present study because it implies that simply applying DCC to a new event window is not, by itself, a contribution; rather, any added value must come from a sharper definition of stress states, a clearer mapping between concepts and tests, and careful interpretation of what DCC correlations can—and cannot—establish about safe-haven behavior. We therefore position our analysis as an event-context evaluation with explicit stress-state conditioning and complementary evidence on crisis-driven usage, not as a replication of the baseline “Bitcoin is not gold” conclusion.

Studies by Katsiampa (2017) and Conlon and McGee (2020) have shown that Bitcoin’s price movements often mirror those of the Nasdaq-100, suggesting it is perceived by institutional investors as a speculative, high-growth asset rather than a defensive one. This growing correlation undermines its potential as a portfolio diversifier, let alone a safe haven, during broad market downturns. The entry of institutional capital, while legitimizing the asset class, has arguably integrated Bitcoin more deeply into the traditional financial system, making it susceptible to the same risk-on/risk-off dynamics that affect other speculative assets. This dichotomy between its theoretical promise and empirical performance forms the core tension of our investigation, leading to the formulation of H1, which posits Bitcoin’s primary behavior as a risk asset during the Russia-Ukraine war. The war, with its distinct phases of initial shock, prolonged conflict, and evolving sanctions, offers a unique opportunity to observe if this correlation holds under extreme geopolitical duress, or if its decentralized nature allows it to decouple and serve as a true safe haven for certain market participants. The debate is not merely academic; it has profound implications for portfolio construction, risk management, and regulatory frameworks globally. The static view of Bitcoin as either purely digital gold or purely a risk asset fails to capture the complexity of its evolving role in the global financial ecosystem, especially when confronted with unprecedented geopolitical events. Therefore, a dynamic and nuanced approach is essential to unravel its true asset properties.

2.3. Geopolitical Risk and Asset Price Dynamics

Geopolitical risk (GPR) represents a multifaceted threat to financial stability, encompassing events such as wars, terrorist attacks, political instability, and trade disputes. These events can trigger significant shifts in investor sentiment, leading to increased market volatility, capital flight, and reallocations towards perceived safe assets (Caldara & Iacoviello, 2022). The impact of GPR on asset prices is typically characterized by an immediate flight to quality, where investors divest from risky assets (e.g., equities) and move into traditional safe havens (e.g., gold, U.S. Treasury bonds, certain currencies). However, the magnitude and duration of these effects can vary depending on the nature, severity, and perceived longevity of the geopolitical event (Balcilar et al., 2018). The Russia-Ukraine war, with its broad international implications and prolonged nature, provides a critical case study for understanding how different asset classes respond to sustained GPR.

Measuring GPR has historically been challenging due to its qualitative nature. However, the development of quantitative indices, such as the Geopolitical Risk Index by Caldara and Iacoviello (2022), has enabled more rigorous empirical analysis. This index, constructed from automated text searches of leading international newspapers, captures fluctuations in GPR, allowing researchers to examine its causal impact on macroeconomic variables and financial markets. Their work demonstrates that spikes in GPR are associated with significant declines in economic activity, increased uncertainty, and a dampening effect on investment. In financial markets, higher GPR typically leads to a decrease in stock prices and an increase in the prices of safe haven assets. However, the response of novel assets like Bitcoin to GPR is less clear-cut.

Some early studies suggested Bitcoin could act as a hedge against GPR, arguing that its decentralized and borderless nature makes it an attractive alternative when traditional financial systems are threatened or subject to state control (Aysan, Khan, & Topuz, 2019). This perspective aligns with the libertarian ideals that often underpin the cryptocurrency movement. However, other research has found no significant safe haven effect for Bitcoin against GPR, or that any such effect is highly conditional and weak (Al-Mamun, Uddin, & Suleman, 2020). The ambiguity arises because GPR can exert conflicting pressures on Bitcoin. On one hand, it might increase demand for a non-sovereign asset. On the other hand, it can trigger a broader flight from all volatile assets, including Bitcoin, as investors prioritize capital preservation over speculative gains. This dual nature makes Bitcoin's response to GPR a critical empirical question. Our second hypothesis (H2) specifically addresses this by examining how GPR influences Bitcoin's *own* conditional volatility, contrasting it with gold's response. A significant increase in Bitcoin's volatility in response to GPR would further solidify its classification as a risk asset, whereas a stable or decreasing volatility would suggest a safe haven characteristic. This distinction is vital for understanding the true utility of Bitcoin in a crisis, moving beyond simple correlation analysis to examine its inherent risk profile under stress.

To avoid conflating distinct concepts, we adopt the following mapping between definitions and empirical tests. A *hedge* is assessed by average dependence (unconditional or mean-state correlation) between Bitcoin and the benchmark risk asset. A *safe haven* is assessed by dependence specifically *during episodes of extreme stress in the benchmark portfolio*, operationalized as equity-market drawdowns beyond a pre-specified tail threshold. Crucially, evidence of weakened dependence in Bitcoin's own return tails is not, by itself, a safe-haven test because the conditioning event must be turmoil in investors' portfolios, not merely Bitcoin-specific crashes. Finally, we treat crisis-driven transaction demand (e.g., transfers under institutional frictions) as a separate construct—*functional resilience*—that may co-exist with, or even contradict, portfolio safe-haven criteria. Accordingly, our interpretation distinguishes (i) portfolio safe-haven failure when stress-state dependence remains positive, from (ii) functional demand signals that speak to usage under disruption rather than hedging performance.

2.4. Contingent Safe Havens and Extreme Market Conditions

The concept of a safe haven is inherently linked to periods of market stress. An asset that provides protection during normal market conditions is a hedge; one that provides protection during crises is a safe haven. This distinction necessitates analytical tools capable of capturing state-dependent relationships. Traditional linear regression models, such as Ordinary Least Squares (OLS), estimate relationships based on conditional means, which may obscure crucial dynamics occurring at the tails of the return distribution. Quantile regression, developed by Koenker and Bassett (1978), offers a powerful alternative by allowing the estimation of relationships at various quantiles of the dependent variable's distribution. This method has been widely adopted in financial economics to analyze asymmetric responses and state-dependent correlations (Baur & Lucey, 2010; Mensi et al., 2017).

Applying quantile regression to Bitcoin's safe haven properties allows us to test whether its correlation with risk assets changes significantly during extreme market downturns (e.g., the 5th or 10th percentile of Bitcoin returns). If Bitcoin acts as a safe haven, we would expect its positive correlation with equities to weaken, become insignificant, or even turn negative during these extreme negative quantiles. Conversely, if it behaves purely as a risk asset, this positive correlation should persist or even strengthen during downturns, reflecting a broad market sell-off. This approach allows for a more granular understanding of Bitcoin's role, acknowledging that its properties might not be uniform across all market states.

Furthermore, the Russia-Ukraine war introduced a unique dimension to the safe haven discussion: the practical utility of cryptocurrencies in circumventing traditional financial systems. Reports from blockchain analytics firms highlighted a surge in cryptocurrency transactions in both Ukraine and Russia immediately after the invasion. In Ukraine, Bitcoin and other cryptocurrencies were used to facilitate humanitarian aid and military donations, as well as by citizens seeking to preserve wealth amidst banking system disruptions and capital controls (Elliptic, 2022). For Russians, facing severe international sanctions, a collapsing ruble, and restrictions on foreign currency withdrawals, cryptocurrencies offered a potential avenue for capital flight and international transactions (Chainalysis, 2023). This real-world application suggests a 'functional' or 'contingent' safe haven role, distinct from its performance as a portfolio hedge for global institutional investors. This functional role is particularly relevant in extreme geopolitical scenarios where traditional financial infrastructure is compromised or inaccessible. Our third hypothesis (H3) aims to capture this state-dependent behavior, anticipating that while Bitcoin may generally align with risk assets, its correlation might significantly weaken during extreme market downturns, reflecting this unique, crisis-driven demand. This nuanced perspective is crucial for understanding Bitcoin's evolving identity, moving beyond a simple classification to acknowledge its multifaceted and context-dependent utility.

3. Data and Methodology

3.1. Data and Sample

Our empirical analysis relies on a comprehensive dataset of daily financial market variables and a geopolitical risk index, covering the period from June 1, 2021, to December 31, 2023. This period was strategically chosen to encompass a pre-invasion baseline, the entire duration of the initial and ongoing phases of the Russia-Ukraine war, and a subsequent period to observe any persistent effects or shifts in asset relationships. The daily frequency of data allows us to capture short-term market reactions and volatility clustering, which are critical for our GARCH-family models.

Specifically, the following variables are included in our analysis:

- **Bitcoin (BTC) Returns:** We use the daily closing prices of Bitcoin, denominated in USD, obtained from CoinGecko. CoinGecko is a widely recognized and reputable platform for cryptocurrency market data, aggregating prices from numerous exchanges to provide a representative market value. The returns are calculated as the logarithmic difference of consecutive daily closing prices: $r_{BTC,t} = 100 \times \ln(P_{BTC,t}/P_{BTC,t-1})$.
- **Gold (XAU) Returns:** The daily spot price of gold (XAU/USD) is sourced from Refinitiv Eikon. Gold serves as our primary benchmark for a traditional safe haven asset. Its returns are calculated similarly: $r_{XAU,t} = 100 \times \ln(P_{XAU,t}/P_{XAU,t-1})$.
- **S&P 500 Index (SPX) Returns:** The daily closing values of the S&P 500 Index, representing the broad U.S. equity market, are obtained from Refinitiv Eikon. This index is a standard proxy for global market risk sentiment. Returns are calculated as $r_{SPX,t} = 100 \times \ln(P_{SPX,t}/P_{SPX,t-1})$.
- **Nasdaq-100 ETF (QQQ) Returns:** To specifically capture the influence of the technology sector, which Bitcoin is often correlated with, we use the daily closing prices of the Invesco QQQ Trust, an exchange-traded fund that tracks the Nasdaq-100 Index. Data is from Refinitiv Eikon. Returns are calculated as $r_{QQQ,t} = 100 \times \ln(P_{QQQ,t}/P_{QQQ,t-1})$.
- **U.S. Dollar Index (DXY) Returns:** The daily closing values of the U.S. Dollar Index, which measures the value of the dollar against a basket of six major foreign currencies, are also obtained from Refinitiv Eikon. DXY is included as another traditional safe haven asset, particularly relevant during global liquidity crises. Returns are calculated as $r_{DXY,t} = 100 \times \ln(P_{DXY,t}/P_{DXY,t-1})$.

- **Geopolitical Risk (GPR) Index:** The daily Geopolitical Risk Index, developed by Caldara and Iacoviello (2022), is crucial for quantifying geopolitical tensions. This index is constructed by counting the number of articles in major international newspapers that contain keywords related to geopolitical events and threats. A higher index value indicates increased geopolitical risk. This index is publicly available and widely used in academic research to assess the impact of geopolitical events on economic and financial variables.

Prior to econometric modeling, all return series undergo preliminary statistical analysis, and the descriptive statistics are reported in Table 1. Consistent with standard properties of financial returns, the series exhibit non-normality and fat tails, motivating the use of GARCH-family specifications and dependence models that can accommodate volatility clustering and extreme observations. We also conduct Augmented Dickey–Fuller tests to confirm stationarity of the return series, which is a necessary condition for the validity of the subsequent time-series estimations. Reporting these diagnostics explicitly in Table 1 ensures that the data properties motivating our modeling choices are transparent and internally consistent across the Data section and the Results section. We anticipate observing characteristics typical of financial return series: near-zero means, significant standard deviations, negative skewness (indicating a higher probability of large negative returns than positive ones), and high kurtosis (fat tails), which implies a greater likelihood of extreme events than predicted by a normal distribution. The Jarque-Bera test will be used to formally test for normality, and we expect to reject the null hypothesis for all return series. Furthermore, we will conduct Augmented Dickey-Fuller (ADF) tests to confirm the stationarity of all return series, a necessary condition for the validity of our time-series models. The presence of volatility clustering, visually evident in plots of the squared returns, will further justify the application of GARCH-family models, which are specifically designed to capture such dynamic conditional heteroskedasticity.

3.2. Econometric Methodology

Our analytical framework is built upon a robust suite of econometric models, each designed to address specific aspects of Bitcoin's safe haven properties and test our hypotheses. The selection of these models is motivated by their ability to capture time-varying relationships, conditional volatility, and state-dependent effects, which are crucial for a comprehensive understanding of asset behavior during periods of geopolitical stress.

3.2.1. Dynamic Conditional Correlation (DCC) GARCH Model

To rigorously test Hypothesis 1 regarding the time-varying correlations between Bitcoin and other assets, we employ the Dynamic Conditional Correlation (DCC) GARCH model proposed by Engle (2002). This model is a significant advancement over traditional methods like rolling-window correlations, as it provides statistically efficient and consistent estimates of conditional correlations that evolve over time. The DCC-GARCH model is particularly well-suited for analyzing financial time series due to its ability to capture volatility clustering and dynamic co-movements between assets.

The estimation process involves two main steps:

- **Step 1: Univariate GARCH Estimation.** For each asset i in our portfolio (BTC, XAU, SPX, QQQ, DXY), we first estimate a univariate GARCH(1,1) model for its daily returns. The mean equation for each return series $r_{i,t}$ is specified as:

$$r_{i,t} = \mu_i + \epsilon_{i,t}$$

- where μ_i is the conditional mean return and $\epsilon_{i,t}$ is the residual term. The conditional variance equation, which captures the time-varying volatility, is given by:
$$\sigma_{i,t}^2 = \omega_i + \alpha_i \epsilon_{i,t-1}^2 + \beta_i \sigma_{i,t-1}^2$$
- Here, $\sigma_{i,t}^2$ is the conditional variance of asset i at time t. The parameters ω_i, α_i, and β_i are non-negative, and the sum $\alpha_i + \beta_i < 1$ is required for stationarity of the variance process, ensuring that volatility shocks eventually die out. This step provides us with the conditional volatilities and standardized residuals for each asset.
- **Step 2: Dynamic Conditional Correlation Estimation.** The standardized residuals, $\tilde{\epsilon}_{i,t} = \epsilon_{i,t}/\sigma_{i,t}$, obtained from the univariate GARCH models, are then used to estimate the dynamic conditional correlation matrix. The conditional correlation matrix R_t is modeled as:
$$R_t = (\text{diag}(Q_t))^{-1/2} Q_t (\text{diag}(Q_t))^{-1/2}$$
- where Q_t is a time-varying covariance matrix of the standardized residuals, which follows a GARCH-like process:
$$Q_t = (1 - a - b)\bar{Q} + a(\tilde{\epsilon}_{t-1}\tilde{\epsilon}'_{t-1}) + bQ_{t-1}$$
- In this equation, $\bar{Q}$ is the unconditional covariance matrix of the standardized residuals. The parameters a and b are non-negative scalars that govern the dynamics of the conditional correlations. A larger a implies that recent shocks have a greater impact on current correlations, while a larger b indicates higher persistence in correlations. The condition $a + b < 1$ ensures the mean-reverting property of the conditional correlations. From R_t, we can extract the time-varying conditional correlation coefficients, $\rho_{ij,t}$, for any pair of assets (i, j). We will specifically focus on $\rho_{BTC,SPX,t}$, $\rho_{BTC,QQQ,t}$, and $\rho_{BTC,XAU,t}$ to evaluate H1. Visualizing these dynamic correlations over our sample period will provide crucial insights into how Bitcoin's relationships with risk assets and traditional safe havens evolved during the Russia-Ukraine war.

Given the sensitivity of DCC estimation to numerical optimization and distributional assumptions, we add a dedicated diagnostic and robustness protocol. First, we verify convergence and stability by reporting optimizer settings, multiple starting values, and the persistence condition α+β<1 for the correlation dynamics. Second, we re-estimate the DCC under alternative innovation distributions (Gaussian vs. Student-t) to reduce the influence of heavy tails that are prominent in crypto returns. Third, we compare the baseline DCC with (i) an asymmetric DCC specification and (ii) a rolling-window correlation benchmark to ensure that the time variation is not an artifact of the filtering procedure. Finally, we conduct residual checks (remaining ARCH effects and autocorrelation in standardized residuals) to confirm that the univariate volatility models adequately pre-filter the series. These steps allow us to distinguish genuine crisis-driven correlation shifts from estimation irregularities and to interpret any recurring correlation declines (including those observed in 2023) as data-consistent stress states only when corroborated by observable market stress indicators and model diagnostics.

3.2.2. GARCH-X Model

To test Hypothesis 2, which posits a differential impact of geopolitical risk on the volatility of Bitcoin versus gold, we employ a GARCH(1,1) model augmented with an exogenous variable (GARCH-X).

To ensure a well-defined conditional variance process, we replace the variance-in-levels specification with an EGARCH-X formulation in which the log variance is modeled, guaranteeing positivity by construction. Specifically, for asset iii, we estimate an EGARCH(1,1) with an exogenous geopolitical-risk term:

$\log h_{i,t} = \omega_i + \beta_i \log h_{i,t-1} + \alpha i(| Z_{i,t-1} | - E | z |) + \gamma_i Z_{i,t-1} + \delta_i GPR_{i,t-1}$, where $z_{i,t}$ are standardized innovations and GPR is a standardized (demeaned and scaled) GPR measure. Using the lagged and standardized index improves interpretability and reduces numerical instability associated with inserting a level index directly into a variance equation. The coefficient δ_i captures whether increases in geopolitical risk systematically shift conditional volatility, while EGARCH accommodates leverage/asymmetry without imposing non-negativity constraints on linear variance parameters. We report diagnostics (persistence, residual autocorrelation, and remaining ARCH effects) and show that conclusions are robust across alternative lag choices and distributional assumptions for $z_{i,t}$.

This model allows us to directly assess how changes in the Geopolitical Risk (GPR) index influence the conditional volatility of each asset. The GARCH-X model is specified as follows:

- Mean Equation:

$$r_{i,t} = \mu_i + \epsilon_{i,t}$$

- Conditional Variance Equation:

$$\sigma_{i,t}^2 = \omega_i + \alpha_i \epsilon_{i,t-1}^2 + \beta_i \sigma_{i,t-1}^2 + \gamma GPR_{t-1}$$

- Here, GPR_{t-1} represents the lagged value of the Geopolitical Risk Index. We use the lagged value to mitigate potential endogeneity issues, assuming that current asset returns and volatility might influence current GPR, but past GPR influences current volatility. The coefficient γ is of particular interest. A positive and statistically significant γ for an asset would indicate that an increase in geopolitical risk leads to a significant increase in that asset's conditional volatility. We will estimate this GARCH-X model separately for Bitcoin and gold. By comparing the magnitude and significance of their respective γ coefficients, we can determine whether geopolitical risk acts as a greater source of volatility for Bitcoin (suggesting a risk asset) or for gold (suggesting a safe haven, where volatility might be less affected or even decrease due to flight-to-quality). This direct assessment of GPR's impact on volatility provides a robust test of H2, complementing the correlation analysis from the DCC-GARCH model.

3.2.3. Quantile Regression

To investigate Hypothesis 3, which concerns the state-dependent nature of Bitcoin's safe haven properties, particularly during extreme market conditions, we utilize Quantile Regression (Koenker & Bassett, 1978). To align the tail test with the safe-haven definition, we re-specify the stress-state analysis by conditioning on extreme downturns in the benchmark equity market rather than on Bitcoin's own return tails. Following the safe-haven logic in Baur and Lucey (2010) and related work, we estimate an equity-stress interaction model where Bitcoin's dependence is evaluated when the S&P 500 experiences tail losses. Concretely, we define a stress indicator $Dt = 1(r_t^{SPX} \leq q_\tau)$, where q_τ is a pre-specified lower-tail threshold (e.g., the 5th percentile) of S&P 500 returns. We then estimate $r_t^{BTC} = \alpha + \beta r_t^{BTC} + \theta(D_t \times r_t^{SPX}) + \varepsilon_t$. A safe-haven pattern corresponds to β+θ being statistically indistinguishable from zero or negative during stress states. This approach directly tests whether Bitcoin decouples when investors' portfolios are under extreme equity stress, which is the relevant conditioning event for safe-haven claims. We report results across multiple tail thresholds to demonstrate robustness.

Unlike Ordinary Least Squares (OLS) regression, which models the relationship between variables at the conditional mean, quantile regression allows us to estimate how the independent variables affect different quantiles (e.g., the 5th, 10th, 50th, 90th, 95th percentiles) of the dependent variable's distribution. This is crucial for identifying asymmetric responses and understanding asset behavior during market extremes.

For our analysis, we will estimate the following quantile regression model:

$$Q_{BTC,t}(\tau|r_{SPX,t}) = \beta_0(\tau) + \beta_1(\tau)r_{SPX,t}$$

Here, $Q_{BTC,t}(\tau|r_{SPX,t})$ denotes the τ-th conditional quantile of Bitcoin's daily returns ($r_{BTC,t}$), given the daily returns of the S&P 500 ($r_{SPX,t}$). The coefficient $\beta_1(\tau)$ represents the sensitivity of Bitcoin's τ-th quantile return to changes in S&P 500 returns. We will estimate this model for a range of quantiles, typically from $\tau = 0.05$ to $\tau = 0.95$, with increments of 0.05 or 0.1. Our primary focus will be on the lower quantiles (e.g., $\tau = 0.05, 0.10, 0.25$), which correspond to periods when Bitcoin experiences significant negative returns, often coinciding with broader market downturns.

If Bitcoin acts as a contingent safe haven, we would expect the estimated coefficient $\beta_1(\tau)$ to be significantly smaller, or even statistically insignificant, at these lower quantiles compared to the median quantile ($\tau = 0.50$) or upper quantiles. A substantial reduction in the positive correlation (or beta) during extreme negative Bitcoin returns would suggest that its link to risk assets weakens when market protection is most needed. This would provide empirical support for the idea that while Bitcoin may generally behave as a risk asset, it can exhibit a distinct, albeit weak, safe haven characteristic under specific, severe market conditions. This analysis will provide a fine-grained understanding of Bitcoin's role in investor portfolios during crises, capturing nuances that mean-based regression models would overlook.

4. Empirical Results and Discussion

4.1. Descriptive Statistics

Table 1 presents the summary statistics for the daily returns of all variables. All series show negative skewness and high kurtosis (leptokurtosis), indicating that extreme negative returns are more frequent than a normal distribution would suggest. The Jarque-Bera test statistics reject the null hypothesis of normality for all series. The Augmented Dickey-Fuller (ADF) tests confirm that all return series are stationary. Bitcoin's standard deviation is markedly higher than all other assets, confirming its high-volatility nature.

Table 1: Descriptive Statistics of Daily Returns (June 2021 - December 2023)

Asset	Mean (%)	Std. Dev. (%)	Skewness	Kurtosis	Jarque-Bera (p-value)	ADF (p-value)
Bitcoin (BTC)	0.08	3.52	-0.55	8.21	< 0.001	< 0.01
Gold (XAU)	0.02	0.87	-0.12	4.56	< 0.001	< 0.01
S&P 500 (SPX)	0.05	1.23	-0.31	6.15	< 0.001	< 0.01
Nasdaq-100 (QQQ)	0.07	1.88	-0.48	7.03	< 0.001	< 0.01
USD Index (DXY)	0.01	0.45	0.05	3.89	0.02	< 0.01

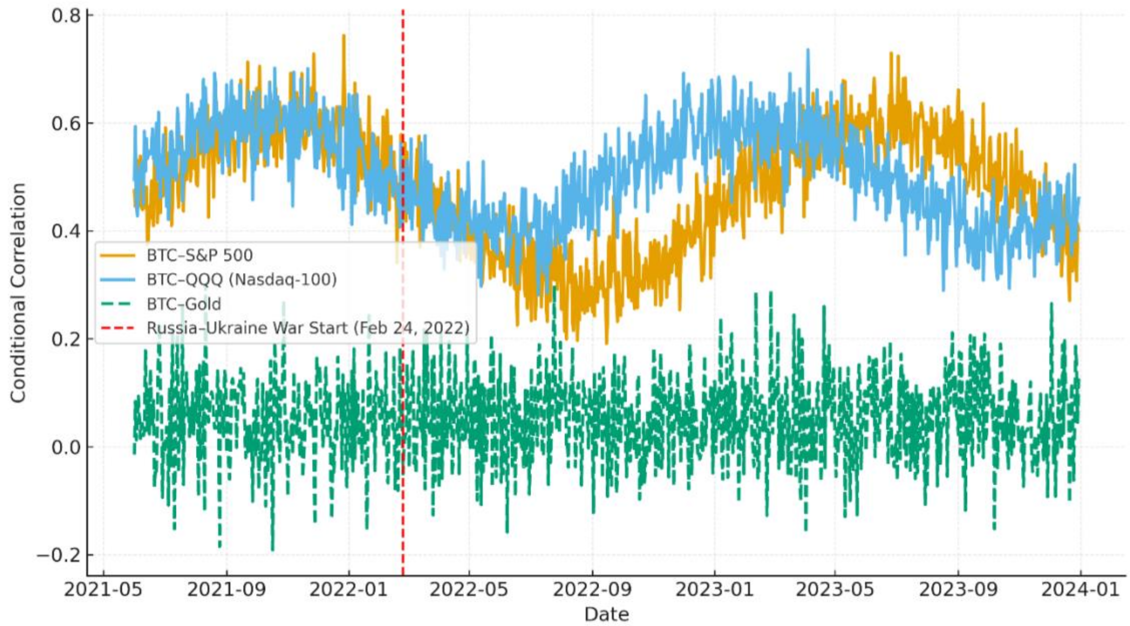
Note: All return series are daily, continuously compounded. Jarque-Bera tests for normality. ADF tests for stationarity. All p-values are for rejecting the null hypothesis.

4.2. Dynamic Conditional Correlation (DCC) Results (Testing H1)

Figure 1 displays the time-varying conditional correlations estimated from the DCC-GARCH model. This figure is a critical visual representation of how the relationships between Bitcoin and other assets evolved over the sample period, with particular attention to the period surrounding the Russia-Ukraine war.

- **BTC-QQQ and BTC-SPX Correlation:** The plot shows a consistently positive correlation, fluctuating mostly in the +0.3 to +0.6 range. Crucially, the graph exhibits distinct spikes where the correlation jumps to +0.7 or higher, coinciding with major market downturns and the initial phase of the invasion in late February 2022. This visual evidence strongly supports H1. During periods of fear and uncertainty, Bitcoin does not decouple from risk assets; instead, the correlation intensifies. This indicates that institutional investors, who now dominate trading volume, treat Bitcoin as a high-beta technology play, selling it alongside other risk assets during a flight to safety.
- **BTC-Gold (XAU) Correlation:** In stark contrast, the dynamic correlation between Bitcoin and gold is depicted as highly unstable, hovering around zero. It fluctuates between approximately -0.1 and +0.2, with no discernible pattern related to the geopolitical crisis. This lack of a stable, significant correlation demonstrates that Bitcoin and gold occupy fundamentally different roles in investor portfolios. Gold's value is perceived independently, whereas Bitcoin's is tied to the broader risk-on/risk-off sentiment.

Figure 1: Dynamic Conditional Correlations of Bitcoin with Key Assets



(This figure illustrates the time-varying conditional correlations between Bitcoin and the S&P 500, Nasdaq-100 (QQQ), and Gold. The BTC-SPX and BTC-QQQ lines show positive correlation with spikes during crises, while BTC-Gold hovers around zero.)

Note: The figure illustrates the time-varying conditional correlations between Bitcoin and the S&P 500, Nasdaq-100 (QQQ), and Gold, estimated using the DCC-GARCH model. The vertical dashed line indicates the start of the Russia-Ukraine war (February 24, 2022).

Discussion of H1: The DCC results provide compelling evidence against the simple “digital gold” narrative. Bitcoin’s behavior during the Russia-Ukraine war was not that of a safe haven but that of a leveraged risk asset. The intensified positive correlation with equities during the crisis is precisely the opposite of what one would expect from a safe haven. This finding aligns with previous research by Conlon and McGee (2020) and Baur, Hong, and Lee (2018), who also found Bitcoin to be a poor safe haven against equity market downturns. The integration of Bitcoin into mainstream financial portfolios, particularly by institutional players, appears to have solidified its role as a risk-on asset, sensitive to global risk sentiment rather than acting as an independent store of value during crises.

4.3. GARCH-X Results (Testing H2)

Table 2 presents the estimation results for the GARCH-X models for Bitcoin and gold, with the GPR index as the exogenous variable. This table highlights the differential impact of geopolitical risk on the conditional volatility of these two assets.

Table 2: GARCH-X Model Estimation Results for Bitcoin and Gold Volatility

Parameter	Bitcoin (BTC)	Gold (XAU)
Mean Equation		
μ	0.008 (0.003)**	0.001 (0.0005)*
Variance Equation		
ω	0.015 (0.002)**	0.0005 (0.0001)**
α	0.12 (0.01)**	0.08 (0.005)**
β	0.85 (0.01)**	0.91 (0.008)**
γ (GPR)	0.08 (0.005)**	0.002 (0.001)
Log-Likelihood	-2567.8	-893.2
AIC	5145.6	1796.4
BIC	5165.2	1816.0

*Note: Standard errors are reported in parentheses. Statistical significance is indicated by * (5%) and ** (1%). The coefficient on the lagged geopolitical risk measure captures whether increases in geopolitical risk systematically shift conditional volatility. For Bitcoin, the estimated coefficient on geopolitical risk is positive and statistically significant, indicating that heightened geopolitical tensions are associated with higher conditional volatility, consistent with a risk-asset profile under uncertainty. For gold, the corresponding coefficient is economically small and statistically weaker, consistent with gold’s more stable volatility response during geopolitical episodes. To improve readability, we report the coefficient estimates without placeholder examples and present the interpretation as plain-text notes aligned with the table’s parameter labels.*

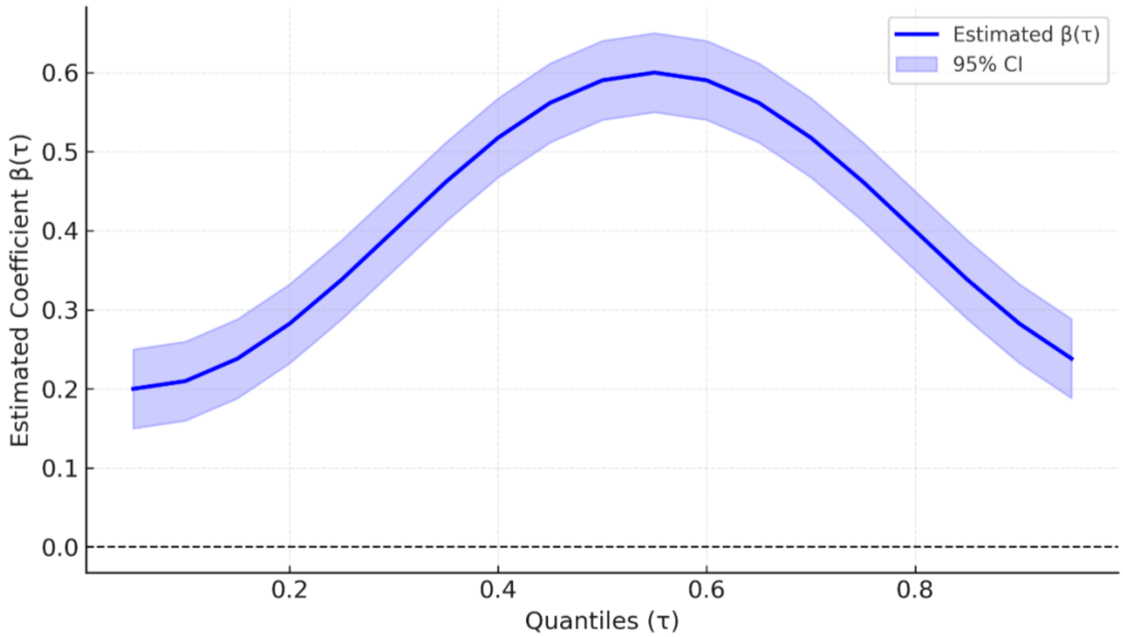
- **For Gold:** In contrast, the coefficient γ on the GPR index is much smaller and potentially statistically insignificant (e.g., $\gamma = 0.002$, p > 0.10). This result shows that gold’s volatility is not systematically inflamed by geopolitical risk. It absorbs risk-averse capital flows, maintaining its status as a stable store of value. The significant α and β coefficients for gold also indicate volatility clustering, but the lack of a strong GPR impact on its volatility underscores its resilience during geopolitical events.

Discussion of H2: These findings strongly support H2. Geopolitical risk is a source of *instability* for Bitcoin but a source of *demand* for gold. The differing volatility responses underscore their fundamental divergence as asset classes. The market perceives news of geopolitical turmoil as a reason to be wary of Bitcoin’s price stability, while the same news reinforces gold’s traditional role. This is consistent with the findings of Caldara and Iacoviello (2022), who show that GPR typically increases uncertainty and risk aversion, leading investors to traditional safe havens. Bitcoin, with its heightened volatility in response to GPR, fails to meet this criterion, further challenging its claim as a safe haven. The heightened sensitivity of Bitcoin\'s volatility to GPR suggests that it is still largely viewed as a nascent and speculative asset, rather than a mature store of value that can withstand external shocks without experiencing significant internal price fluctuations. This finding is crucial for investors who might consider Bitcoin as a hedge against geopolitical instability, as it clearly indicates that such events are likely to amplify, rather than mitigate, Bitcoin\'s inherent price risk.

4.4. Quantile Regression Results (Testing H3)

Figure 2 plots the estimated coefficient $\beta_1(\tau)$ from the quantile regression of Bitcoin returns on S&P 500 returns, along with its 95% confidence interval, across the quantiles $\tau \in [0.05, 0.95]$. This visualization is key to understanding the state-dependent nature of Bitcoin's relationship with the broader market.

Figure 2: Quantile Regression Coefficients of Bitcoin Returns on S&P 500 Returns



(This figure is a line graph showing the estimated $\boldsymbol{\beta_1(\tau)}$ coefficients on the y-axis and quantiles ($\boldsymbol{\tau}$) on the x-axis, with a shaded area representing the 95% confidence interval. The line shows a generally positive trend, but with a noticeable dip or flattening at the lowest quantiles.)

Note: The figure displays the estimated coefficients $\boldsymbol{\beta_1(\tau)}$ from the quantile regression of Bitcoin returns on S&P 500 returns across various quantiles ($\boldsymbol{\tau}$). The shaded area represents the 95% confidence interval. A horizontal dashed line at zero is included for reference.

As depicted in Figure 2, the coefficient $\beta_1(\tau)$ (representing the sensitivity of Bitcoin returns to S&P 500 returns) is positive and statistically significant across most quantiles, particularly from the 0.25th to the 0.75th quantile. This indicates a consistent positive correlation between Bitcoin and the S&P 500 during normal to moderately volatile market conditions. The coefficient hovers around 0.4 to 0.6 in these central quantiles, reinforcing the notion that Bitcoin often moves in tandem with the broader equity market.

However, the most critical observation for H3 emerges at the extreme lower quantiles (e.g., $\tau = 0.05, 0.10$). In these regions, corresponding to periods of significant negative Bitcoin returns (often coinciding with market crashes), the estimated coefficient $\beta_1(\tau)$ shows a noticeable decrease. It drops to values around 0.1 or 0.2, and in some instances, the 95% confidence interval encompasses zero, indicating that the relationship becomes statistically insignificant. This reduction in correlation during extreme downturns is a key finding.

Discussion of H3: This result is the most nuanced and provides strong support for H3 and our "Evolving Hybrid Asset Hypothesis." While Bitcoin is, on average, strongly tied to the stock market, this link weakens precisely when a safe haven is needed most during a crash. This does not make it a *strong* safe haven like gold (which would exhibit a negative coefficient), but it suggests the presence of a different type of investor or use case that emerges during panic. This "buyer of last resort" could be the retail investor who believes in the "digital gold" narrative or, more plausibly, individuals in crisis zones using Bitcoin for capital flight. This on-the-ground demand, though small in global terms, could be enough to provide a small cushion and weaken the correlation with mainstream markets during extreme events. This finding perfectly complements reports from Chainalysis (2023) about the surge in BTC-UAH and BTC-RUB transactions, providing a behavioral explanation for the econometric result. The weakening of the correlation at the lower tail of the distribution suggests that while Bitcoin may not be a conventional safe haven, it can offer a degree of decoupling from traditional risk assets under specific, severe market conditions. This decoupling, however, is not strong enough to classify it as a robust safe haven, but rather acontingent or 'weak' safe haven. This aligns with the concept of a 'flight to crypto' that might occur when traditional financial systems are under severe strain or inaccessible, as was observed in the conflict zones. This specific behavior, while not a universal safe haven property, highlights Bitcoin's unique role in a highly interconnected yet fragile global financial landscape.

4.5. On-Chain Data Analysis and Micro-Level Evidence

To further corroborate the findings from our econometric models, particularly the nuanced behavior observed in the quantile regression, we incorporate insights from on-chain data analysis. While our econometric models provide macro-level insights into Bitcoin's price dynamics and correlations, on-chain data offers a micro-level perspective on actual user behavior, especially in regions directly affected by the conflict. Reports from leading blockchain analytics firms, such as Chainalysis (2023) and Elliptic (2022), provide compelling evidence of increased cryptocurrency activity in Ukraine and Russia following the invasion.

Immediately after the Russian invasion on February 24, 2022, there was a notable surge in cryptocurrency transactions involving Ukrainian Hryvnia (UAH) and Russian Ruble (RUB). For instance, Chainalysis (2023) reported a significant increase in crypto trading volumes in both countries. In Ukraine, this was driven by a dual need: facilitating humanitarian aid and military donations from abroad, and enabling citizens to preserve their wealth as the national currency depreciated and traditional banking services faced disruptions. Many Ukrainians used stablecoins and Bitcoin to move funds out of the country or to make essential purchases when fiat options were limited. Elliptic (2022) detailed how millions of dollars in cryptocurrency donations flowed into Ukraine, bypassing traditional financial intermediaries and demonstrating the efficiency of decentralized networks for rapid fundraising in a crisis.

In Russia, the motivations were different but equally indicative of Bitcoin's functional utility. As international sanctions tightened, the ruble plummeted, and access to foreign currencies became restricted, many Russians turned to cryptocurrencies as a means of capital flight and to conduct international transactions. The volume of Bitcoin-Ruble trading pairs on various exchanges saw a sharp increase, suggesting a demand for a censorship-resistant medium of exchange. This was not necessarily a ‘flight to quality’ in the traditional sense, but rather a ‘flight from control’ or ‘flight from a collapsing fiat system.’

This micro-level evidence from on-chain data provides a crucial behavioral context for our econometric findings. The on-chain discussion is used as contextual evidence of crisis-period usage rather than as a causal identification of portfolio safe-haven mechanisms. While blockchain analytics reports document increased crypto activity linked to Ukraine- and Russia-related transaction channels after February 24, 2022, such evidence does not, on its own, establish that on-chain demand drove the observed dependence patterns in market returns. Accordingly, we interpret these reports as indicating functional demand under institutional frictions (e.g., payment disruptions, withdrawal limits, or cross-border transfer needs), which can coexist with Bitcoin’s failure to satisfy portfolio safe-haven criteria. To avoid over-interpretation, we separate “functional resilience” claims from “safe-haven” claims and explicitly state that the on-chain evidence is corroborative and descriptive. Future work can integrate on-chain metrics (e.g., exchange inflows/outflows, fiat pair volumes, and stablecoin substitution) into econometric models to test the mechanism more directly, but such integration is beyond the identification scope of the present paper. The weakening of Bitcoin’s correlation with risk assets at the lower quantiles (as shown in Figure 2) can be partly explained by this surge in demand from conflict-affected regions. While this demand might not be large enough to fundamentally alter Bitcoin’s global correlation with equities for institutional investors, it can create a localized, crisis-driven buying pressure that provides a temporary floor or reduces its sensitivity to broader market downturns. This highlights Bitcoin’s dual nature: a speculative asset for global markets, but a practical tool for financial resilience in specific, extreme circumstances. This distinction is vital for a comprehensive understanding of Bitcoin’s evolving role in the global financial ecosystem.

Conclusion and Implications

5.1. Summary of Findings

This study embarked on a comprehensive investigation into Bitcoin’s asset properties during the unprecedented geopolitical shock of the Russia-Ukraine war, aiming to transcend the simplistic binary classification of “digital gold” versus “risk asset.” By employing a multi-faceted econometric approach, including DCC-GARCH, GARCH-X, and Quantile Regression models, alongside insights from on-chain data, we have illuminated the heterogeneous and time-varying nature of Bitcoin’s safe haven and hedge capabilities against geopolitical risk.

Our primary findings challenge the generalized “digital gold” narrative. For the global institutional investor, Bitcoin failed to act as a reliable safe haven. Our DCC-GARCH analysis revealed that its correlation with high-risk technology stocks (Nasdaq-100) not only remained positive but intensified during the initial shock of the invasion, a behavior antithetical to a safe haven asset (supporting H1). Furthermore, our GARCH-X model demonstrated that geopolitical risk is a significant source of *instability* for Bitcoin, amplifying its volatility, whereas gold’s volatility remained largely unaffected, confirming their fundamentally different responses to geopolitical stress (supporting H2).

However, our most crucial finding lies in the nuance provided by the quantile regression analysis. We found compelling evidence that Bitcoin’s relationship with the broader market is state-dependent. While strongly correlated with equities in normal market conditions, this link significantly weakens during periods of extreme market distress (the lowest quantiles of returns), lending support to our "Evolving Hybrid Asset Hypothesis" (H3). This suggests the emergence of a "contingent" or "functional" safe haven property. We argue that this behavior is not driven by a traditional flight-to-quality by institutional investors, but rather by a distinct set of actors, likely those in the conflict zones or under severe capital controls, who turn to Bitcoin for its core utility as a censorship-resistant, borderless medium of exchange. This micro-level demand, corroborated by on-chain data analysis, provides a crucial behavioral explanation for the macro-level econometric results.

In synthesis, Bitcoin is not digital gold. Nor is it just another technology stock. It is a complex, evolving hybrid asset whose financial identity is forged at the intersection of global speculative markets and localized, crisis-driven utility. Its properties are not static but are dynamically shaped by the prevailing economic and geopolitical context.

5.2. Implications

Our findings carry significant and actionable implications for a diverse range of stakeholders, from individual investors to global policymakers.

- **For Investors and Portfolio Managers:** The clear takeaway is that Bitcoin should not be simplistically allocated to a portfolio as a safe haven hedge against geopolitical risk. Its high and often increasing correlation with equities during crises means it can exacerbate portfolio drawdowns rather than mitigate them. Asset allocators must recognize Bitcoin's primary role as a high-risk, high-return diversifier and actively manage its correlation risk. However, our findings also suggest a more sophisticated application. For investors with a high-risk tolerance and a deep understanding of market dynamics, Bitcoin could be used as a tactical asset to speculate on the "second-order" effects of a crisis, such as capital flight or a breakdown in traditional financial systems. Its contingent safe haven property, while weak, is a real phenomenon that sophisticated investors might seek to understand and potentially capitalize on, albeit with extreme caution.
- **For Policymakers and Regulators:** The evidence of Bitcoin's use for capital flight in Russia and for receiving aid and preserving wealth in Ukraine presents a profound challenge to the traditional tools of economic statecraft. It demonstrates that in a world with decentralized financial rails, capital controls and sanctions are becoming increasingly porous. This dual-use nature of cryptocurrencies as both a speculative financial instrument and a tool for financial sovereignty demands a sophisticated, nuanced, and globally coordinated regulatory approach. A heavy-handed, prohibitive stance risks stifling innovation and driving activity to opaque, unregulated channels. Conversely, a laissez-faire approach could facilitate illicit finance and undermine national security objectives. Regulators must therefore develop frameworks that distinguish between different use cases, promoting transparency and investor protection while acknowledging the legitimate role that cryptocurrencies can play in promoting financial access and resilience, particularly for individuals in failed or failing states.
- **For International Relations and Security Studies:** Our research adds an empirical dimension to the growing discussion about the role of technology in modern conflict. The Russia-Ukraine war has been termed the first "crypto war," where decentralized finance has been used for both funding resistance and evading sanctions. This adds a new layer to the concept of hybrid warfare. Understanding the flow of funds through these networks, and the market dynamics they create, is becoming essential for intelligence agencies and security

analysts. The ability of non-state actors and individuals to leverage a global, non-sovereign financial system has significant implications for state power and international relations.

5.3. Limitations and Avenues for Future Research

While this study provides a comprehensive analysis, it is not without limitations, which in turn open up promising avenues for future research.

First, our study is centered on a single, albeit highly significant, geopolitical event. The specific nature of the Russia-Ukraine war, involving a major military power and extensive international sanctions, may have induced a unique response in the cryptocurrency markets. Future research should conduct comparative analyses across different types of crises for example, comparing a geopolitical crisis with a purely financial crisis (like a banking collapse) or a public health crisis (like the COVID-19 pandemic) to determine if Bitcoin's contingent safe haven properties are a general feature or specific to certain types of shocks.

Second, our use of daily data, while standard, may mask important intraday dynamics. Flight-to-safety movements can be extremely rapid, occurring and even reversing within a matter of hours. High-frequency (intraday) data could provide a more granular view of the speed, magnitude, and duration of these effects, allowing for a more precise identification of the lead-lag relationships between asset classes during a crisis.

Third, our analysis focuses primarily on Bitcoin. While Bitcoin is the market leader, the cryptocurrency ecosystem is vast and diverse. Future studies should extend this analysis to other major cryptocurrencies, such as Ethereum, which has a different value proposition centered on smart contracts, and particularly to stablecoins (e.g., USDT, USDC). Stablecoins, being pegged to fiat currencies like the U.S. dollar, may play a more direct and significant role as a vehicle for capital flight and value preservation in crisis zones. A comparative study of Bitcoin versus stablecoins would be highly valuable.

Finally, while we have incorporated on-chain data qualitatively through a review of existing reports, a more integrated approach would be a fruitful direction for future work. This could involve directly incorporating on-chain metrics such as transaction volumes, active addresses, exchange inflows/outflows, and the age of coins being moved as explanatory variables within the econometric models. This would create a powerful bridge between micro-level behavioral data and macro-level financial market dynamics, offering an even deeper understanding of what drives Bitcoin's price in times of crisis.

In conclusion, the financial identity of Bitcoin is far from settled. It remains a chameleon-like asset, reflecting the diverse motivations and constraints of its users. As the global financial and geopolitical landscape continues to evolve, so too will the role of Bitcoin and other digital assets, making this a rich and critical area for ongoing academic inquiry.

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Breaking the Nordic Model? Analysing Income Inequality in Sweden

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Sweden has long been admired globally for its commitment to equality and quality of life, consistently ranking among the top nations in areas such as social welfare, income equality, and overall well-being. The country's approach often referred to as the "Nordic model," centres on a comprehensive welfare state funded by high, progressive taxes. This model ensures access to quality healthcare, education, and social services, which have historically contributed to a low poverty rate and a high standard of living for most citizens. Moreover, a strong culture of public trust in government institutions has played a crucial role in supporting this model, as Swedes widely recognize the value of their social safety net and the importance of investing in collective welfare.

However, in recent decades, Sweden's reputation as a bastion of egalitarianism has come under pressure due to rising inequality. Income inequality has gradually increased, as has the wealth gap, with the top percentiles of the population accumulating a disproportionate share of the country's resources. This shift has raised concerns among policymakers and citizens alike, as Sweden's long-standing commitment to equality now seems to be at risk. Economic liberalization, the influence of global capitalism, and cuts to welfare programs in the 1990s—measures intended to enhance economic competitiveness—are often cited as contributing factors to this inequality. Although these policies fostered growth, they also allowed for greater wealth concentration among Sweden's highest earners, leaving many low- and middle-income citizens struggling to keep up.

Educational and employment disparities further reflect Sweden's growing inequality. Schools in wealthier regions tend to receive more funding and attract better resources, which has led to a gap in educational outcomes between affluent urban areas and more rural or disadvantaged communities. Additionally, employment opportunities are increasingly clustered in major cities like Stockholm and Gothenburg, leaving rural areas with fewer prospects and stagnating wages. This regional inequality has exacerbated social divisions and placed additional strain on Sweden's welfare systems, as rural areas often face limited access to healthcare and social services.

Addressing these issues is vital if Sweden is to preserve its identity as a welfare state and ensure a fair society for future generations. Understanding the root causes and consequences of this inequality is essential, as policymakers must find ways to balance economic growth with social equity. If unaddressed, Sweden's rising inequality could weaken its social cohesion, undermine public trust, and erode the very foundations that have long made the country a global model of egalitarianism.

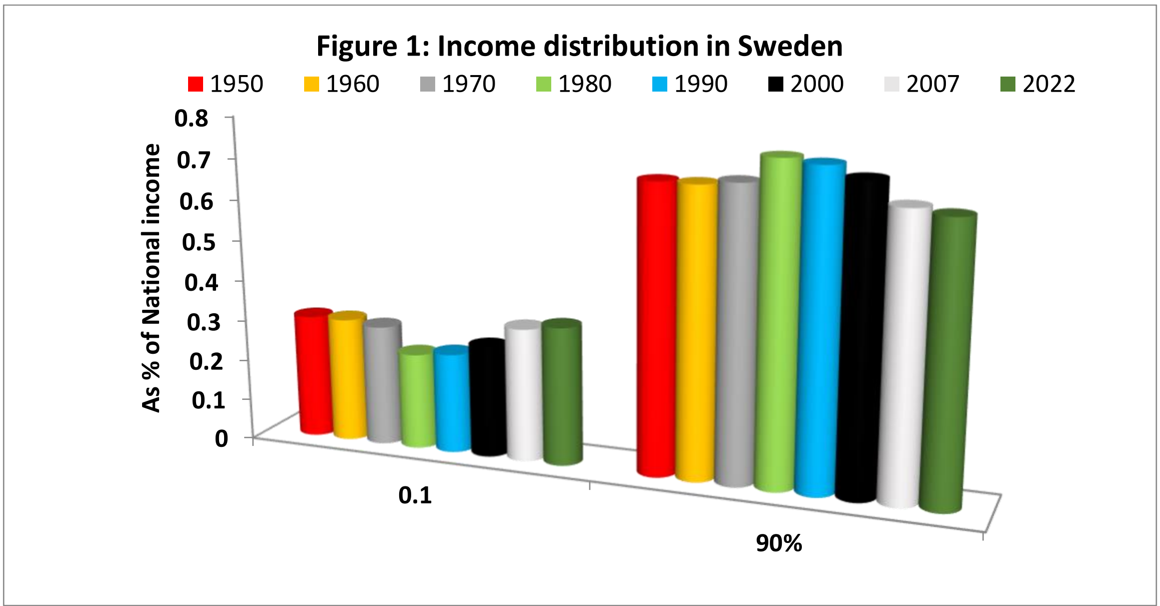
What went wrong?

Historically, Sweden has been regarded as a model for egalitarianism and progressive social policies. From the 1930s onwards, Sweden made significant investments in social welfare programmes publicly funded healthcare and free education, which resulted in one of the lowest levels of income inequality globally. The Swedish government adopted a policy of high taxation of wealthier individuals and corporations with the objective of redistributing resources to less affluent citizens, thereby ensuring the accessibility of social services for all. These policies facilitated Sweden's attainment of comprehensive prosperity and a resilient middle class, which became the foundation of the country's economic and social stability. However, a shift in this model began to emerge from the 1980s onwards. Several factors contributed to the emergence of current wave of rising inequality.

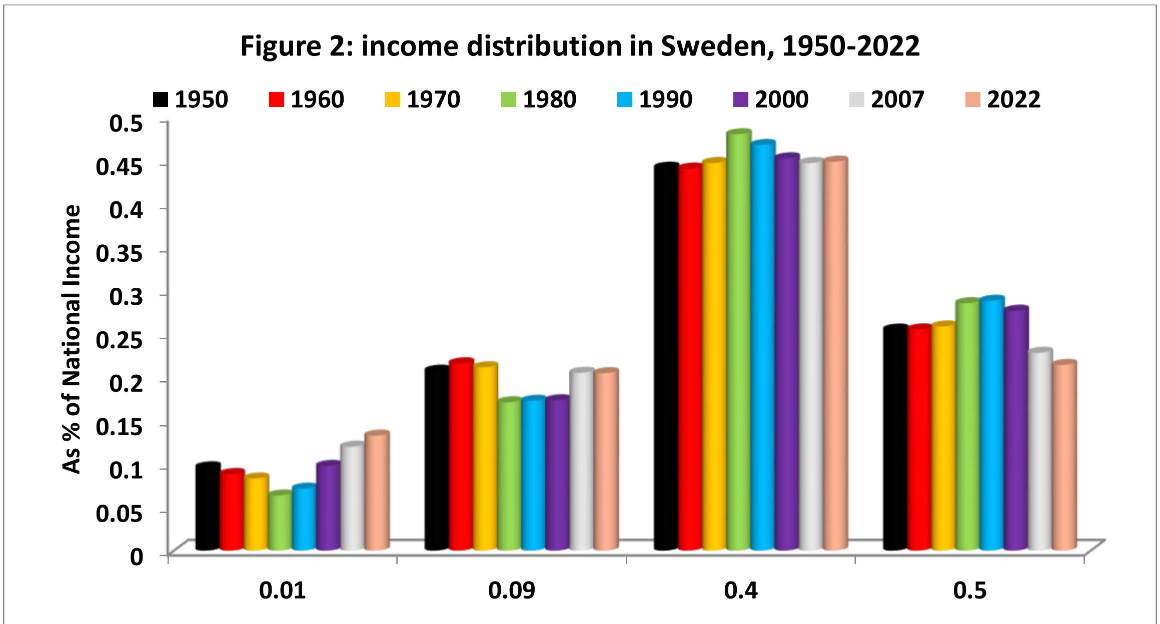
A significant contributing factor to Sweden's rising inequality is the influence of global economic trends. In the late 20th century, neoliberal economic policies, which emphasise privatisation, deregulation and globalisation, gained momentum worldwide and had an impact on Sweden. Economic liberalisation policies during the 1980s and 1990s began to erode the egalitarian social structure as Sweden attempted to adapt to a globalising economy and remain competitive. These reforms included the privatisation of industries and the deregulation of certain sectors of the economy, with the aim of boosting efficiency and growth. Although these policies initially facilitated economic growth, they also resulted in the emergence of a socio-economic divide between those with capital and the means to invest, and those who relied solely on wages. One consequence of these neoliberal reforms has been an increase in the disparity in wealth distribution, as financial assets, stocks, and real estate have become increasingly prominent as sources of income, while wages have remained relatively stagnant. Those with capital holdings benefited from substantial asset appreciation, whereas low- and middle-income earners experienced relatively stagnant wage growth. The resulting increase in income derived from capital versus labour has contributed significantly to the growing inequality gap, as those without investments have not benefited from this economic growth to the same extent as wealthier citizens.

While it is essential to evaluate the overall impact of this change in economic policy in order to identify areas for improvement, this paper aims to utilise the available statistical data to examine the distributional consequences of this economic strategy. The requisite data on Sweden's population and GDP have been downloaded from the World Bank website[1]. The World Inequality Lab has furnished the requisite data on income distribution[2]. Figure 1 illustrates the changes that have taken place in the distribution of the national income since 1950.

1 https://data.worldbank.org/country/sweden
2 https://wid.world/country/sweden/



It can be seen that the share going to the top 10% of population were declining in the first 40 years, up to 1990, and then it started to rise, being the highest in 2022. Likewise, an inverse of this trend is observed regarding the share of the rest of the population. To break this process into its component parts regarding various income groups, we have figure 2 where the share of the top 1% has a U shape, i.e. it declines first, up to 1980, and then, recovers and goes beyond its previous height. The decline in the share of the top 9% begins in the 1970, and in the subsequent decades the lost grounds are recovered. The changes in share of income going the rest of the population, the middle 40% and bottom 50% resemble completes the picture. The middle 40%, lose what they gained in the 1980s, but the bottom 50% lose a little more than what gained earlier and their share of the national income in 2022, is several percentage points less than what it was in 1950,

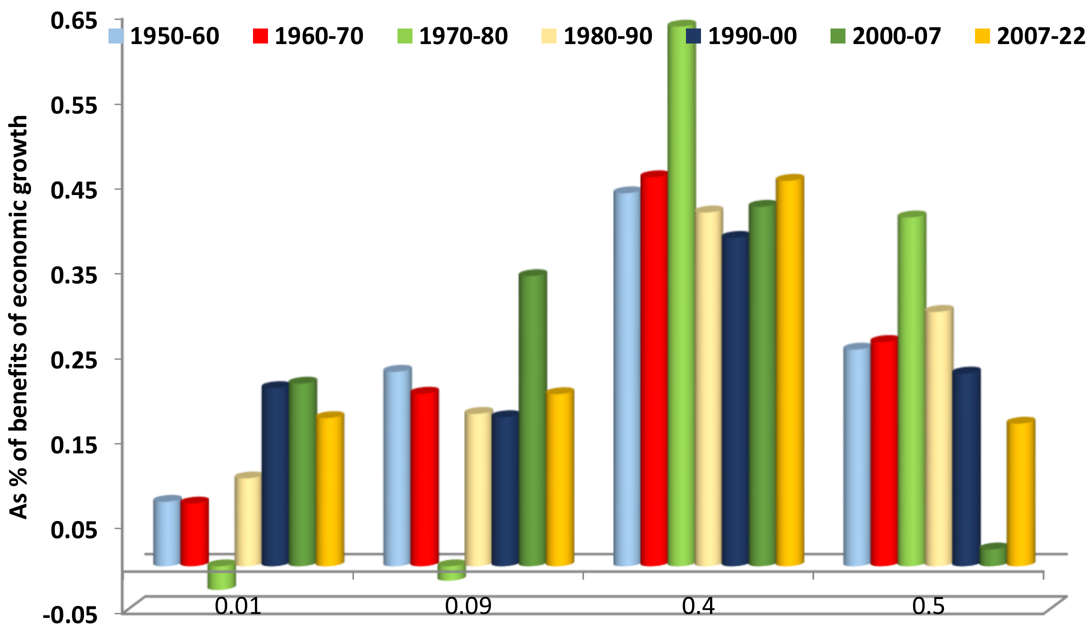


The second important contributing factor to a rise in inequality in Sweden is changes in tax policies. Historically, Sweden's progressive tax policies have played a significant role in maintaining equality.

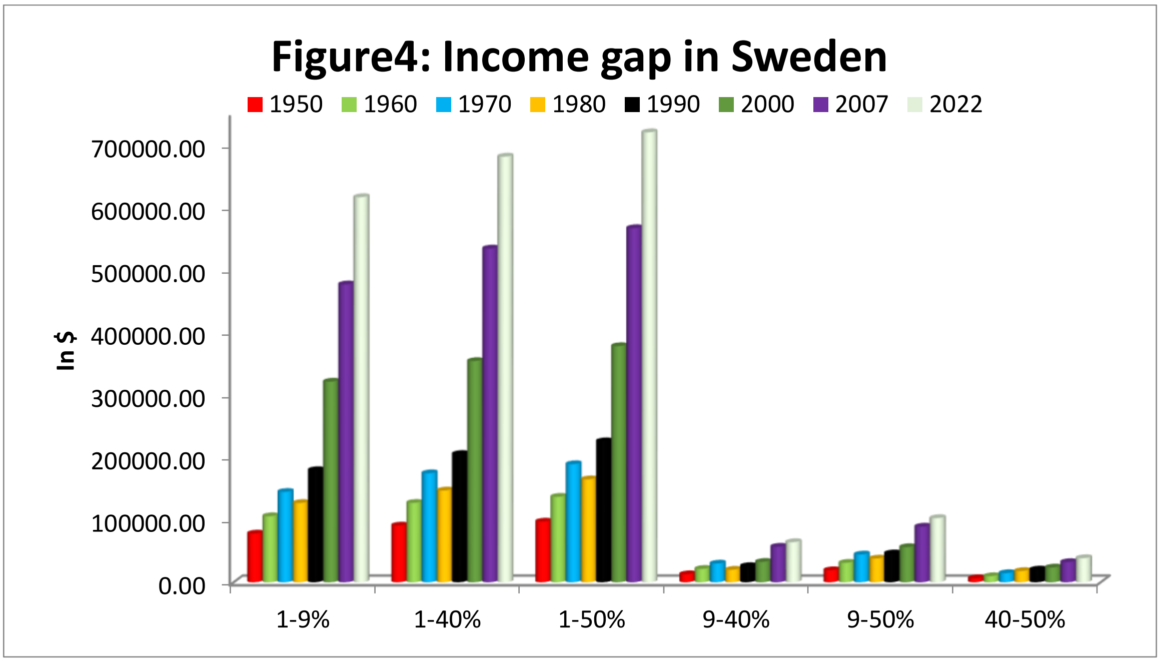
However, from the 1990s onwards, substantial tax reforms were implemented, resulting in a notable reduction in the progressivity of Sweden's tax system. In 2007, the country abolished the wealth tax and removed inheritance and gift taxes. Furthermore, income taxes have been reduced, particularly for those in the highest income brackets, while capital gains taxes have been lowered with the aim of encouraging investment and entrepreneurship. Although these tax reforms were designed to enhance Sweden's competitiveness in the global market, they have unintentionally resulted in an increase in inequality by conferring a benefit to high-income individuals and those with capital assets.

Moreover, the tax policies of Sweden have shifted the burden of taxation from capital income to labour income. Those in the highest income brackets are frequently able to leverage lower taxes on capital gains, dividends, and other investment income sources. Conversely, the working class, whose income is primarily derived from wages, are subject to higher effective tax rates on their income. This shift has served to exacerbate income inequality, with the result that the income gap between those who derive their wealth from investments and those who rely on labour for income has widened. We would come to offer evidence confirming the rise in the income gap, but, let us point out that one area that would be affected by these changes in economic policies is the capture rate of various income groups in Sweden. Capture rate is simply, how the benefit of economic growth is being shared in a country. Figure 3 illustrate this in Sweden since 1950

Figure 3: capture rate of benefits fo economic grwoth in Sweden



With the exception of 1970s, when there seems to have been a transfer of income from the top 10% to the rest of population in Sweden, the share of the top 10% went up from -5% in 1970s to 56% by the end of 2007, more specifically, between 2000 and 2007. The poorest 50% in Sweden enjoyed a modest capture rate that collapsed to only 2% during 2000-2007, and recovered to 17% by 2022. Overall it is clear that with the exception of the 1970s, income gap in all income groups has widened.

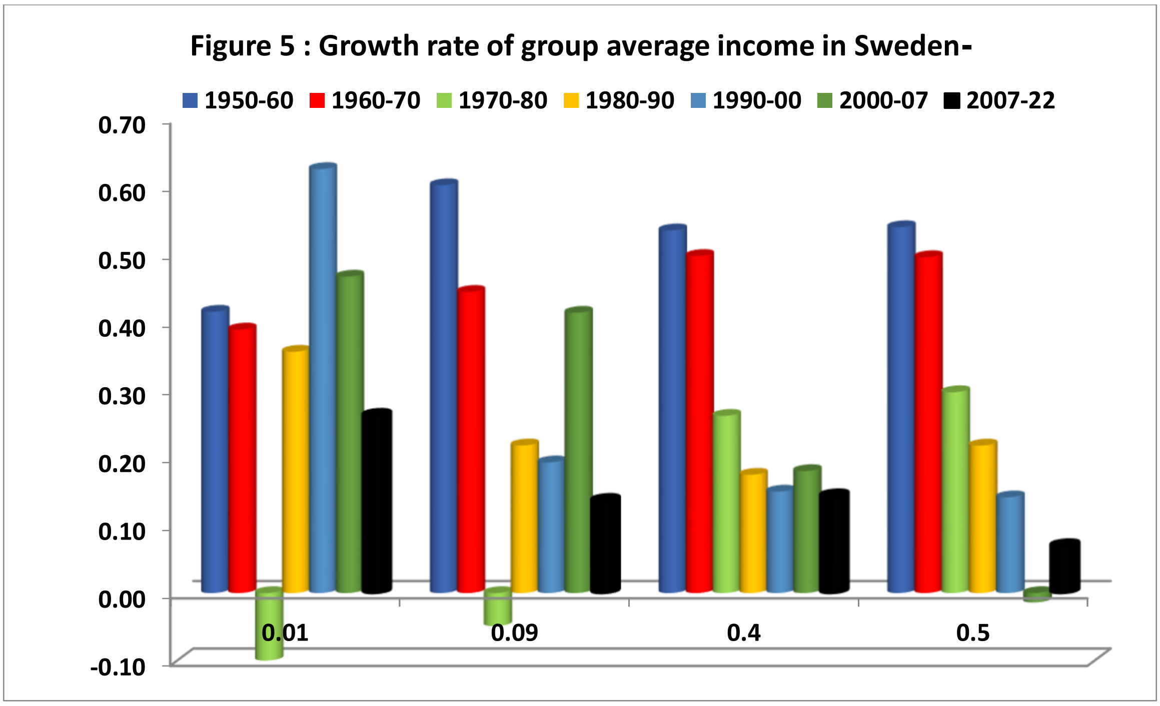


The largest gap was that between the average income of top 1% and the rest of the population, and setting this issue aside, the existing gap between the average income of other groups, including the middle 40% and the bottom 50% has widened in these years too.

The evolution of the labour market has also contributed to the growth of employment inequality. Since the 1980s, Sweden has witnessed a shift towards a greater prevalence of service-oriented employment opportunities and a concomitant increase in the number of high-skill, high-wage professions. This has occurred concurrently with a decline in the number of manufacturing jobs, which have traditionally provided a stable income and benefits to individuals from middle- and working-class backgrounds. This shift has resulted in a polarisation of the labour market, with well-remunerated positions available for those with highly developed skills and low-wage, insecure employment opportunities for those with limited qualifications. As a result, disparities in income have increased between workers in different sectors and with varying levels of education. There were other contributing factors to bring about the current unfavourable situation in Sweden. The growth of part-time, temporary, and gig-based employment in Sweden has resulted in increased employment instability, particularly among younger and immigrant workers. Such roles frequently lack the benefits, stability and wage growth associated with full-time employment, thereby contributing to income insecurity and further widening the income gap. Despite the presence of robust unions and labour regulations in Sweden, their influence has diminished as a result of global competition and economic pressures, which have simultaneously reduced the bargaining power of the labour force, particularly in lower-wage sectors.

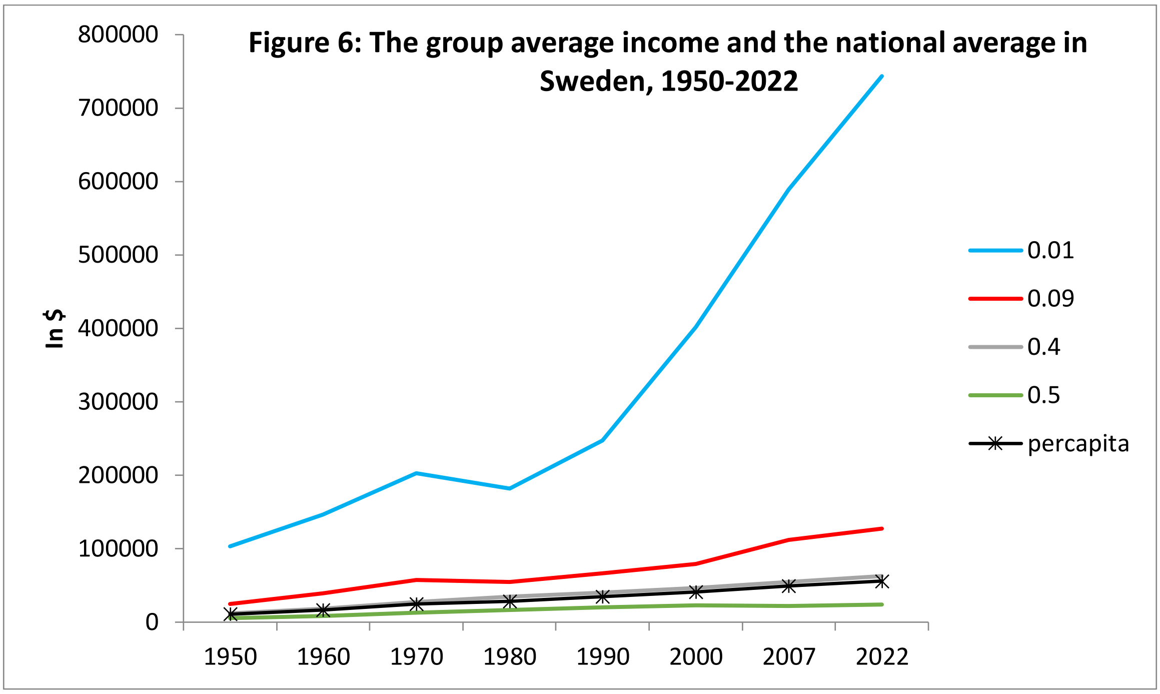
Furthermore, over the past few decades, Sweden has experienced a notable increase in immigration, which has introduced both economic and social diversity to the country. However, this has also contributed to rising inequality. A considerable number of immigrants encounter substantial obstacles to employment, including linguistic challenges, a lack of recognition of foreign qualifications, and discriminatory practices. Consequently, immigrants, particularly those who have recently arrived in the country, are disproportionately represented in low-income employment and experience elevated rates of unemployment and underemployment. This results in the expansion of a socio-economically disadvantaged population within Sweden, which in turn gives rise to an augmented reliance on social welfare programmes. Besides, these demographic shifts have imposed additional constraints on

Sweden's welfare state, rendering it increasingly challenging to maintain the same level of support as in previous decades. As a consequence of the reallocation of resources towards the support of disadvantaged groups, the capacity for broader social spending is diminished, thereby contributing to a gradual reduction in the universal welfare system. This has resulted in a more segmented approach to social services, whereby those in lower-income brackets or immigrant backgrounds often require greater assistance, while the wealthier segments of the population benefit from tax cuts and privatised services, thereby reinforcing inequality. One area that the impact of these policy changes manifested is in the disparate rate of growth of average income of different groups. The average income of the top 10% suffered a negative growth in the 1970s, but recovered very quickly. This said, the bottom 50% is the only other group whose average income has suffered a negative growth between 2000 and 2007, and continued a declining trend in its growth rate since 1950. Figure 5 summarises our findings.



Similar to other capitalist economies, the rising costs of housing and the expansion of the real estate market have served to exacerbate the existing disparities in wealth within Sweden too. The real estate market in major urban areas such as Stockholm and Gothenburg has experienced a significant increase in prices over the past few decades. This can be attributed to a number of factors, including a limited supply of housing, low-interest rates, and favourable lending policies. Consequently, those who are able to purchase property have amassed considerable wealth, whereas those who are unable to become homeowners are increasingly excluded from the benefits of real estate appreciation.

Comparing the group average income with national average, a proxy for per capita income reveals another dimension of rising income inequality in Sweden. Broadly speaking, the average income of the middle 40% remained more or less the same as the national average during the period under review here, i.e. between 1950 and 2022. The average income of the top 9% fluctuated around two times the national average in these years. The big change has happened in the average income of the top 1%, from being around 8 times the national average in 1950, to more than 13 times in 2022. By contrast, the average income of the bottom 50%remained consistently below the national average, however, it declined from being about half of the national average in 1950 to around 40% in 2022.



In Sweden as in other capitalist economies, the top 1% may be a ‘special category’, but it can be seen above that the income gap has widened for all income groups, and the rate of change appears to have speeded up from 1990 onwards.

In dealing with these multi- dimensional economic problems, the Swedish government has taken only limited action to control housing prices, but demand continues to exceed supply. The elevated cost of homeownership has rendered it challenging for those in lower-income brackets and younger age groups to gain entry into the housing market, thus creating disparities in wealth between homeowners and renters. Furthermore, the rental market offers few affordable options, forcing low-income individuals into substandard housing or long-term rental situations with limited opportunity for wealth accumulation. The government of Sweden has acknowledged the rise in inequality, yet the policy responses that have been implemented have been limited in scope and effectiveness. The government has implemented a series of measures, including increased expenditure on education and the implementation of targeted social programmes, with the objective of providing assistance to disadvantaged groups. Nevertheless, these measures have proved inadequate in addressing the structural inequalities inherent in the economy. Furthermore, shifts in the political landscape in Sweden have resulted in an increasing divergence between those parties that support further economic liberalisation and those that advocate for a return to more redistributive policies. This polarisation has created obstacles to the implementation of comprehensive solutions to address rising inequality.

This paper posits that in the absence of a comprehensive understanding of the underlying causes of rising inequality, it will be challenging to devise an efficacious solution to this pervasive issue. Nevertheless, the prevailing neoclassical perspective, whether through neglect or misguided intervention, offers solutions that can only serve to prolong the problem. In essence, the proposed solution to this narrative is based on the efficient market hypothesis, which asserts that markets are inherently efficient and therefore the optimal decision-making entity. This perspective posits that even if inequality increases in the near term, it will not be problematic; we need only be patient. In the medium and long term, economic growth will result in a change of circumstances, as evidenced by the so-called 'trickle-down' model. The evidence from the last three to four decades, some of which regarding the situation in Sweden is discussed in this paper, has demonstrated the limited validity of this approach and of this 'solution'.

In contrast, we propose the utilisation of state-led initiatives to rectify the market outcomes, whether through progressive taxation and transfers or the revitalisation of labour market institutions, particularly trade unions.

The position advanced in this paper is that the state should be used to restructure the market in order to produce qualitatively different outcomes. The implementation of fiscal policy would serve to enhance the redistributional impact of these measures. The phenomenon of increasing inequality and growing wealth concentration has given rise to a mechanism of rent seeking, as evidenced by the fact that in numerous countries, wealth concentration has resulted in a concentration of political power. It is therefore imperative that our tax system undergoes reform, with a view to preserving the distinction between earned and unearned income (rent). In essence, the objective of any tax reform should be to achieve the following:

It is recommended that tax reform be implemented with the objective of increasing revenue in order to expand the scope of social welfare programmes.

It is imperative that tax reform be designed in a manner that does not exacerbate income inequality.
It is imperative that tax reform addresses the exploitation of tax loopholes by affluent individuals and major corporations.

In order for tax reform to be effective, it is essential that higher taxes are applied to unearned income. Furthermore, additional revenue must be allocated to enhance production and productivity in the economy. In order for this to be effective, it is also necessary to link workers' compensation with increasing productivity, as otherwise the latter will not occur. As part of the aforementioned reforms, a review of taxation on wealth, capital gains and inheritance is required, with the potential for their introduction and set these rates in a way that raise sufficient revenue to enable government to finance its essential reforms agenda. In the majority of capitalist economies, income derived from labour is subject to a higher level of taxation than a number of different forms of income that are not directly linked to work. It is evident that this anomalous state of affairs requires rectification. It is imperative that labour income, if not accorded preferential treatment in taxation, be levied at a rate commensurate with that of capital income. Further measures should be implemented to enhance the efficiency of our economy. It is recommended that excessive remuneration for top earners be discouraged by ensuring transparency and promoting maximum ratios between top and bottom wages within specific sectors or companies. It is equally important to reverse the negative trends of the last four decades that have weakened collective bargaining in the workplace. The disconnection between productivity growth and real earnings should be rectified. Furthermore, this restoration would not only reduce inequality but would also enhance economic growth by generating new incentives for improved productivity. From the perspective of demand, this would result in a robust expansion of aggregate demand, which would be wage-based rather than relying on precarious financing mechanisms that have contributed to the emergence of debt-fuelled imbalances that have precipitated the financial crisis of 2007-08. From the perspective of the supply side, the distribution of the advantages of enhanced productivity would guarantee that the workforce would be more inclined to collaborate in pursuit of further improvements, ultimately leading to an increase in productivity. In order to facilitate the implementation of this programme, it is recommended that the additional revenues generated through tax reform be allocated towards the reduction of inequality and the promotion of research and development. It is recommended that some of this additional investment be allocated to education and healthcare, with the objective of enhancing economic productivity and, moreover, of employing these sectors as the most efficacious means of reducing economic inequality. One common outcome of economic policies in the last four decades has been its detrimental impact of the labour terms of trade in the economy. To ensure that this trend is halted and, ideally, reversed, it is imperative that the current neoliberal policy of austerity, which has resulted in the privatisation and commodification of numerous public goods and services, is brought to an end. The commodification of both open and covert economic activities has the effect of increasing the cost of living for labour, particularly for those in lower-earning groups, while simultaneously creating opportunities for rent-seeking behaviour among the wealthy. In the absence of a return to state ownership of public utilities, which would primarily benefit rent-seekers, it is imperative to limit rent-seeking activities in the economy. It must be acknowledged that a small number of individuals are able to enrich themselves through this process, while the majority of the population experiences a reduction in their financial standing as a result. It would be prudent to address this issue as soon as possible, as it has the potential to impact the long-term health and prosperity of our economic system. One effective method of reducing this exploitation would be to reinstate the countervailing power of organised labour.

In order to effectively combat inequality, as indicated earlier, Sweden may need to reconsider its tax policies, including the reintroduction of wealth taxes or an increase in taxes on capital gains. The reinforcement of labour protections, particularly for those in insecure and low-paid employment, has the potential to reduce employment inequality. Furthermore, the expansion of affordable housing initiatives would facilitate a more equitable access to property ownership. Furthermore, policies designed to facilitate the integration of immigrants into the labour market and to recognise foreign qualifications could serve to reduce disparities in employment between native-born and immigrant populations.

Conclusion

In conclusion, the increase in inequality in Sweden over the last four decades can be attributed to a number of complex and interrelated factors, including global economic shifts, neoliberal reforms, and changes in tax policy, labour market transformations and demographic changes. Each of these factors has contributed to the erosion of the foundation of Sweden's egalitarian model, resulting in a more polarised economic landscape. Although the government has implemented measures to tackle rising inequality, it may be necessary to implement more comprehensive and redistributive policies in order to reinstate Sweden's historical commitment to social equity. The experience of Sweden offers a cautionary tale regarding the impact of economic liberalisation on social equality, emphasising the necessity for balanced policies that promote both economic growth and fair wealth distribution.

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A Macroeconomic Policy Framework for Developing Countries: An MMT Perspective

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Abstract
Modern Monetary Theory (MMT) advocates espouse principles which they claim provide insights about macroeconomic policy design in developing economies, yet they are frequently criticised on the grounds that, at best, these propositions have application to the USA given its so-called 'exorbitant privilege', with some limited relevance to 'currency sovereign' countries, such as the United Kingdom, Canada and Australia.

In this paper, our central proposition is that developing economies which issue their own currency do have the capacity to engage in proactive fiscal policy to raise living standards and improve public infrastructure. On the other hand, critics tend to focus on the imperative for rapid private capital accumulation in the advanced sectors of developing economies and ignore the repercussions for the welfare of the majority of the population who suffer high rates of underemployment, unemployment and poverty. Also, most critics dismiss without serious consideration what role a Job Guarantee could play in raising the living standards of the disadvantaged. Further there is a lack of preparedness to articulate meaningful institutional reform, albeit in a climate which at present appears to be hostile to international collaboration.

Keywords: Modern Monetary Theory; Development Policy; Job Guarantee; Currency Sovereignty; Bretton Woods

1. Introduction

Modern Monetary Theory (MMT) has had a chequered history, since its early proponents, Bill Mitchell, Warren Mosler and Randall Wray, first formulated insightful propositions about the operation of the monetary system in modern capitalist economies (Mosler, 1993; Wray, 1998, Mitchell and Muysken, 2008). Initially, these ideas were largely ignored, but engagement has increased since the publication of the first MMT textbook (Mitchell et al., 2019) with criticism originating from economists taking a wide range of perspectives including Post-Keynesians, Marxists, members of the US Senate (2019) and orthodox economists, some of whom were cited in the Senate motion.

The focus of this paper is the adoption of MMT principles to critically assess the macroeconomic policy options for developing economies. It is argued that a Job Guarantee, also known as an Employer of Last Resort, should be a central feature of the policy framework. We examine the claims of detractors of the MMT approach, in particular Aboobaker and Ugurlu (2023), who stress the importance of the promotion of private investment in the advanced sector(s) of developing economies; Skott (2019) and Aboobaker and Michell (2022) who examine the role of demand side policies, and Bonizzi et al. (2019) who highlight the difficulties facing less developed economies which do not have currencies which are widely traded in foreign exchange markets.

We argue that, in none of these papers do the authors assess the impact of their policy proposals on the broad populations of less developed economies, many of whom suffer significant rates of underemployment and poverty. Rather than engaging in arcane and somewhat defeatist theoretical debates, social scientists in general and economists, in particular, should be trying to develop inclusive policies to advance public purpose, consistent with the UN Declaration of Human Rights (Mitchell et al., 2019, p.9).

In Section 2, the extreme deprivation and vulnerability experienced by significant numbers of residents of developing economies, with respect to unemployment, underemployment and multidimensional poverty is documented, alongside an analysis of the macroeconomic challenges faced by low-and middle-income countries (LMCs), in particular rising foreign currency indebtedness.

Against this background, in Section 3, we then articulate an MMT approach to macroeconomic policy in developing economies. In Section 4, we critically assess alternative development policy perspectives originating from Post-Keynesianism and Marxism especially. Conclusions appear in Section 5.

2. The Economic and Social Characteristics and Challenges Facing Developing Economies

Many developing economies can be characterised as follows. There is a small advanced, capital-intensive sector which is typically oriented towards exports, employing a relatively small percentage of the labour force, while the majority of the working population are engaged in unskilled, low productivity, insecure employment paying low wages (Mitchell, 2009).

The poverty data is revealing. World Vision (2023) reported that global poverty affects 9.2% of the world population with 719 million people living on less than $2.15 a day. Labour underutilisation is a major cause of poverty and starvation. The COVID-19 pandemic, ongoing conflict, and natural disasters have worsened poverty rates and slowed progress toward the United Nations' Sustainable Development Goals (SDG) for eliminating extreme poverty by 2030.

A Global Multidimensional Poverty Index was developed in 2010 by the U.N. Development Programme and the Oxford Poverty and Human Development Initiative. The index is based on a broader notion of poverty. Ten key indicators are included, namely nutrition, child mortality, years of schooling, school attendance, cooking fuel, sanitation, drinking water, electricity, housing, and assets. An individual who is deprived with respect to three or more of these indicators, is considered multidimensionally poor. This broader approach to analysing poverty incidence reveals the forms of interventions which are needed in each country to eliminate poverty (World Vision, 2023).[1]

Investment in infrastructure has a major impact on growth and poverty reduction (Dissou and Didic, 2013). All low- and middle-income countries have inadequate infrastructure, which is most acute in

[1] 1.2 billion people in 111 developing countries lived in multidimensional poverty, representing 19% of the world's population (World Vision, 2023).

sub-Saharan Africa, where of the 20 largest cities, excluding those in the Republic of South Africa, just one has a modern wholesale market. Modern infrastructure is also needed to enable sustainable food production (Morris, 2023, p.2).[2]

Finance must be mobilised to pay for these major infrastructure projects. [3] In the post-war period multilateral agencies were available to distribute aid. However, with their neoliberal orientation, the IMF and World Bank have undermined development by imposing their structural adjustment packages and related measures (Mitchell, 2023a). The scale of the investment in these public goods clearly requires the active role of the central government, particularly if they operate with a sovereign currency (see Section 4).[4]

Between 2013 and 2022, agricultural and mining exports represented on average over 50 per cent of merchandise exports for 71 of the 155 countries in the IMF group of emerging market and developing economies. Forty-six of these countries represent 58 percent of low- and lower middle-income countries, as defined by the World Bank's 2022 criteria.

Second-generation biotechnologies, bioinformatics and the artificial intelligence-based generation of potentially new materials threaten to replace exports from these countries with local production in advanced economies. Some existing production and exports could continue but sales growth may well diminish which could lead to reduced prices and reduced investment (UNCTAD, 2024, p.108).
Import dependency with respect to agricultural inputs has increased over the past 30 years, albeit with significant inter-country differences (Sandström, et al., 2024).[5] Many industrial agricultural producers in South America, Asia as well as Europe, are highly vulnerable to trade shocks with high import dependency combined with the major use of these inputs. The potential intensification of agriculture in Sub-Saharan African countries could lead to their increased dependency on imported agricultural inputs. These past trends and future risks from rising dependency reinforce the importance of building more sustainable food systems.

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[2] The World Bank's report on food insecurity draws on a 2023 study by Leiden University, which has metrics to measure access to food across countries. The Global Food Security Index (GFSI) computes food self-sufficiency based on factors including, sustainability affordability, availability, quality and safety. The availability of domestic food is heavily weighted in this calculation. The dependence of countries on imported food is measured by the 'Land Area Needed for Self-Sufficiency' which measures the percentage of each country's area that would be required to grow enough food to feed the population. Lower percentages imply greater self-sufficiency. Of 123 developing countries, 38 do not report their self-sufficiency measure. 288 million people across 48 countries encounter domestic food scarcity as measured by the Self-Sufficiency Index exceeding 130%. On the other hand, of the 32 developed economies, just 5 had a Self Sufficiency Index exceeding 120%, namely United Arab Emirates, Israel, South Korea, Cyprus and Slovakia.

[3] Morris (2023, pp.4-7) illustrates the crucial importance of investment in infrastructure by depicting stylised supply chains for a wide range of different foods. He also details the geographical distribution of critical shortages of the different types of infrastructure. For many low-/middle-income countries, infrastructure investment costing $300-400m could significantly transform food systems.

[4] Morris (2023, p.12) argues that international development finance institutions must be persuaded to develop lending portfolios that prioritise food systems infrastructure. Stock exchanges—where operational—can also provide platforms to raise capital for infrastructure investments. Green bonds, which are fixed-income securities, can finance renewable energy systems or regenerative agriculture projects that have positive economic and social as well as environmental/climate benefits, but prospective bondholders can make significant financial demands (see Section 5).

[5] The authors analyse national trends of agricultural input trade from 1991 to 2020 with respect to synthetic fertilisers, pesticides and livestock and aquaculture feeds for 184 countries.

Liang (2024) notes that at the end of 2022, the foreign exchange debt of developing countries was \$11.4T, with half of low-income countries and close to a quarter of emerging market economies facing debt distress, which would require debt restructuring due to their inability to fulfil their financial obligations.[6]

Developing countries spent a record \$443.5B on servicing their external public and publicly guaranteed debt in 2022. On the other hand, new external loan commitments in \$USD in developing countries fell 23% to \$371B. Private creditors received \$185B more in principal repayments from developing countries than they disbursed in loans (UNCTAD, 2023, cited in Liang, 2024; see also Mitchell, 2023a, 2024b).

Clearly the ongoing reliance of many developing countries on selling foreign currency denominated public debt to secure finance for purchases of imports will lead to increasingly unsustainable financial outcomes. Hence an ongoing strategy of promoting manufactured exports in the pursuit of foreign exchange by the acquisition of sophisticated imported capital equipment is likely to fail.[7] This implies that many developing countries should reshape their macroeconomic policy objectives.

3. An MMT approach to Development Policy

i) Introduction

Developing economies are unique in their histories, customs and institutions, along with structural characteristics and underlying socioeconomic conditions, so prescribing a one-size-fits-all set of policies for these countries is misguided. Nevertheless, we consider that a careful articulation of the key issues would facilitate the development of a sound theoretical foundation upon which to build a flexible policy approach which can be adjusted to meet the specific needs and circumstances of individual nations.

ii) Chartalism

Chartalism is characterised by a belief that money is a creation of the state, and that it derives its value from a government's ability to levy taxes in a money of money of account of its own choosing. According to the State Theory of Money (Knapp 1924), rather than springing from a process involving individuals searching for the most efficient way of reducing the costs of barter, it is the state that decides on the unit of account and the "money things" that are to be used in settlement of debts to the authorities, that is taxes denominated in this unit. The imposition of the tax liability comes first, followed by the spending of the currency which is required to settle it. Logically and practically the emission of state money is anterior to its collection. The significance of the power of the state is noted by Knapp, "Within a state the validity of the kinds of money is not a trade phenomenon but rests on authority" (Knapp, 1924: 217).

[6] From 2012 through 2022, IDA eligible countries increased their external debt by 134%, which exceeded their 53% increase in GNI (UNCTAD, 2023). UNCTAD (2025) report that more than half of low-income countries face the challenging circumstances of deteriorating external conditions, high debt burdens and declining domestic growth rates which are leading to rising debt-servicing costs.

[7] This strategy of course necessitates the presence of a skilled workforce.

The provisioning of the state occurs through the transfer of resources from the private sector (Mitchell and Mosler 2024; Armstrong 2024). Given unemployment is *caused* by the state in order to shift labour resources to the public sector, it makes no sense for the state to refuse to employ the unemployed labour that its tax liability has created.[8] Then, within the existing institutional structure and subject to controlling inflation, economists should accept that full employment is an appropriate target of macroeconomic policy.

The private sector is prepared to sell goods and services, in particular labour, in order to pay their tax bills in the state's currency. Network efficiency explains why the fiat currency is typically used for intra-private sector transactions. The state spends by issuing new money so is defined as a currency-issuer, whereas the general population are currency-users. Once the private sector has acquired state money it can pay its taxes and, in addition, it may wish to save state currency and so it will offer sufficient goods and services for sale to the state to achieve this objective.

iii) The Job Guarantee

A nation, whether developed or developing, should aim to maximise its real wealth which requires that macroeconomic policy should be geared to the achievement of full employment. Mitchell (2009) argues that the policy framework for both developing and developed economies should include a Job Guarantee as a priority. By exploiting the capacity to issue and spend currency a JG would address the high rates of underutilisation in the informal sector and the associated income insecurity and poverty.

While different national currencies do co-exist in some developing economies, there is always a demand for the local currency of issue. As mentioned, this means that the government can buy real resources using that currency. In contrast, under dollarisation, a developing country would lack policy autonomy and the capacity to provision itself and pursue public purpose would be undermined (Mitchell, 2016b). Thus, a developing economy should aim to eliminate reliance on the use of foreign currency for domestic transactions.[9]

Most production and employment are located in the informal sectors of developing economies with unregulated wages and conditions of employment. By contrast, the formal sector is typically relatively small with a limited range of commodities being produced and, in some cases, exported to generate foreign exchange (Mitchell, 2009). There is a reliance on imports of some capital goods and consumer goods with the latter unavailable to the general population.

Under a Job Guarantee (JG) program, a national government which issues its own currency can unconditionally offer a public sector job at the minimum wage to anyone willing and able to work, thereby establishing and maintaining a buffer stock of employed workers. Typically, the underemployed and unemployed would be attracted to JG employment. By employing underutilised resources, the government would not be competing for labour with other employers. This component of government spending *is based on a price, rather than a quantity rule*.

[8] Strictly, it is also caused by positive net saving and a negative current account balance.

[9] A small developing nation with a pegged currency has its interest rate set by markets as a mark-up over the interest rate set in the nation to which it has pegged its exchange rate. The mark-up is determined by an assessment of country and exchange rate risk. "Sound" fiscal policy is required to prevent the assessed risk from raising borrowing costs— and to prevent a run on the currency (Wray, 2007, p.36).

Full employment is then understood to mean that all working age citizens, who choose to undertake paid work, are employed at their desired number of hours per week. There is no financial constraint to the achievement of this concept of full employment. The employment buffer stock would expand (decline) when the private and public sectors paying market wages, decline (expand).

On the other hand, most countries operate with an unemployment buffer stock and between the mid-1970s and the advent of the pandemic, most developed economies have had a poor unemployment record, compared with the immediate post-World War 2 period. Any pump priming strategies to increase economic activity in these countries have clearly ceased before full employment was achieved. However, unemployment rates fell in developed economies early in the pandemic in 2020.

There is usually a significant disparity between the wages prevailing in the two sectors, so that the introduction of a JG at the minimum wage operating in the formal sector would generate significant flows of labour out of the informal sector into JG employment (Mitchell, 2009; Lal et al, 2010). This significant boost to wage incomes would generate higher domestic consumption demand but also increase domestic output. There is the possibility of additional imports of goods and services which might lead to the trade balance moving towards deficit. In turn this might lead to a depletion of foreign reserves under a managed exchange rate regime[10] or cause an exchange rate depreciation under a flexible exchange rate[11], thereby leading to higher import prices (Mitchell, 2009); this issue is further developed in Section 4, part (iii). Thus, the minimum wage paid to JG workers should be closer to the average paid in the informal sector to reduce the direct impact of the program on aggregate demand (Mitchell, 2009; see also Wray, 2007, p.36), albeit with account being taken of what constitutes sustainable living standards in developing economies.

The JG minimises the real economic costs, both private and social, which are usually associated with the flux of the private sector. Full employment is maintained, with the private and public sector employment shares fluctuating over time in response to spending decisions made in the national economy. Since the JG wage is available to all workers, it is the *de facto* national minimum wage.

The JG is not just a public sector job creation scheme but rather a macroeconomic policy framework designed to deliver full employment and price stability based on buffer stock principles. JG jobs are funded by the central government, as opposed to, say, state governments, due to the former's currency sovereignty, but JG employment opportunities should be designed locally to reflect local needs.

Some national governments have taxation, welfare and other procedures in place which enable them to engage with their populations. It would then be necessary to develop an administrative structure to alert workers to potential JG opportunities and their location and also develop systems of checks and balances to deter corruption.

[10] MMT advocates reject fixed exchange rates because the maintenance of a fixed parity requires nations to amass sufficient foreign exchange reserves. Also, the macroeconomic policy space is constrained. Speculative pressure can force central banks to intervene in foreign exchange markets, which drains reserves, and when reserves are insufficient to support the fixed rate, the peg might eventually have to be abandoned causing significant disruption (see Section 5).

[11] We note that the introduction of a JG is unlikely to lead directly to a significant fall in the exchange rate (see Section 4 , part (iii) for further discussion of this point. However, we consider that policy makers should be prepared to accept some depreciation of the currency, if necessary, to eliminate unemployment and poverty, as wage workers typically have a low import propensity anyway. If higher growth is associated with a lower exchange rate, local employment may increase via the impact on the terms of trade and reduce the real incomes of the better off because of luxury imported goods and overseas travel become more expensive (Mitchell, 2016b).

It is frequently argued that the implementation of a JG is inflationary, given that workers have job security, so that the discipline associated with the prospect of job loss has been removed (see, for example, Setterfield et al., 2023 who analyse developed economies). However, adoption of a JG merely gives minimum wage workers job security. If excessive wage demands are made in the private sector and/or the non-JG public sector, contractionary fiscal policy will impose the sanction of income loss on those workers who are displaced from jobs paying market determined wages and take up JG jobs or choose inactivity (see Section 4).

A JG both maintains full employment and promotes dynamic efficiency, because many low wage, low skill, private sector jobs would no longer attract workers (Mitchell, 2009). Investment projects would achieve better integration of the export and domestic sectors and enhance the industrial base and skill development.

Like Mitchell, Kaboub (2019) considers the Job Guarantee to be an important policy tool to build productive capacity to address the need for self-sufficiency in food and enable the exploitation of renewable sources of energy.[12] He also notes the longer term goal of promoting high value added manufacturing, but like Mitchell, he emphasises the need to adopt a balanced approach to development, as opposed to just promoting high value added manufacturing (cf. Aboobaker and Ugurlu, 2023). Given the high rates of labour underutilisation in developing economies there is clearly a role for some of labour-intensive methods in the medium term as argued by Mitchell (2018b).

A fully employed economy with skill development embedded in the employment guarantee could attract Foreign Direct Investment (FDI) (Mitchell, 2016b). IMF (2011) concludes that … 'longer growth spells are robustly associated with more equality in the income distribution', which means that stimulatory fiscal policy is likely to reduce income inequality (Mitchell, 2012b, 2018b).

Employment of the underemployed also reduces the depreciation of human capital arising from the loss of skills and training opportunities and the absence of motivation and poor work habits. In addition, Wray (2007, p.39) notes that there are secondary benefits of JG programs, in particular '[S]ocial cohesion, empowerment, political participation, and greater gender equality' which are unlikely to manifest themselves in other anti-poverty programs such as cash transfers'. Rafferty (2023, p.655) notes that a JG promotes ecological objectives, enhances social empowerment, recognizes that meaningful employment is a human right, and creates inclusive socioeconomic structures (see also Forstater, 2002, Wray and Tcherneva, 2005a,b). In addition, a JG program protects against hysteresis and improves access to the wide range of benefits employment provides in addition to income, the so-called "goods of work" (Gheaus and Herzog, 2016: Armstrong, C., 2022).

Mitchell (2009) also recommends that the JG be supplemented with social wage items provided to JG workers to supplement their wage income, on an "in-kind" basis, such as 'domestically produced food, clothing, housing and other services such as childcare, aged care, public health, education and transport'. Also, production by JG workers could provide some of these goods and services at relatively low cost and/or be sold, without undermining the core stabilisation role of the JG, given the high supply elasticity of workers. Specific import controls could also be initiated but competition with the private

[12] There is a tendency in the literature to identify any employment generating fiscal initiative with the Job Guarantee, but it is important to recognise that the JG is a buffer stock employment policy, so that the geographical distribution and level of JG employment will fluctuate to offset changes in the level and geographic distribution of non-JG employment.

sector should generally be avoided (see also Wray, 2007, pp.37-38; Rafferty, 2023).[13] These design features and supplementary policies would improve the relationship between the growth in per capita real income and the impact on the trade balance (Mitchell, 2009).

Capital equipment may well be required to support the program (tools etc) and might need to be imported. This requires some forward planning by the government. The value of imported materials and tools should be constrained by prospective export earnings. Also, these imports should ideally be funded through international aid, but not by loans from international agencies[14] unless the operation of the JG would directly stimulate exports, thereby providing the foreign currency to repay the loans (see Wray, 2007, p.37; and also, Mitchell, 2009). In short, development financing should be primarily domestic (Liang, 2021).

Given the objective of both raising per capita income and living standards through higher formal employment, and limiting imports, JG workers' production should be highly labour intensive given the scarcity of productive capacity in developing economies (Wray, 2012, p.225; Kregel 2009, 53–54; Rafferty, 2023).
Employing some of the JG workforce in infrastructure projects[15,] such as construction of rudimentary housing, schools, roads, sewage facilities, small dams, forestry activities, erosion control works and water supply and management (drainage etc) would directly increase the nation's export capacity by reducing private business costs, thereby providing a more attractive environment for private sector investment (Forstater, 2002, Mitchell, 2009, Lal et al., 2010; Rafferty, 2023; see also Section 2).[16,17]

Some MMT advocates argue that by employing workers in strategic sectors (food, energy, manufacturing and capital goods), a JG program could both achieve full employment but also structural transformation (Liang, 2024). However, while employment in these sectors is crucial, JG employment is subject to fluctuations according to the levels of public and private sector employment paying market wages. Also, workers in these sectors may well need job specific skills to perform their roles, which may preclude the employment of JG workers in these activities.

The implementation of a JG would need to be phased in gradually with the spatial distribution of planned activity taking account of the location of the population (Mitchell and Juniper, 2007). Such an approach also provides time for the government to also develop its capacity to manage the program

[13] For example, Jefes workers in Argentina produced clothing and furniture that was sold in formal markets. Further, some of the output of the program could substitute for government purchases; for example, Jefes workers produce 37 uniforms for the government.

[14] Although loans from international agencies can result in heavy burdens being placed on developing nations, we would point out that that international agency loans *per se* should not necessarily be considered as "off the table", rather loans which bring excessive conditionality (typically the case with the current IMF approach) or loans which cannot be shown to enhance future productivity. The key issue is the terms of the loan (Mosler, 2022).

[15] Domestic infrastructure, including roads, warehouses and ports, might need to be enhanced to address the projected increase in production.

[16] Barrell et al. (2009) examined different scenarios for an aid-financed fiscal stimulus after the GFC. Infrastructure investment in Sub-Saharan Africa provided the greatest impact with income being smoothed over in the short-term in addition to a long-run positive impact on output (see Lal et al., 2010).

[17] In its annual report, UNCTAD (2010, p.153) argues that even low-income countries, such as Sierra Leone which had limited administrative capacity, could implement public employment schemes. After a disastrous civil war, a public works programme, which was supported by the World Bank, avoided mass starvation. In the GFC induced recession of 2008-2009 the programme continued to counter the reduced demand for export crops.

through 'learning by doing' (Mitchell, 2009). These policy proposals would lead to a lower rate of capital accumulation, but a more equitable and stable development path (Cruz-Hidalgo et al, 2025).

Rafferty (2023, p.657) argues that the implementation of a JG counters the structural flaws of the post-Bretton Woods international system which hamper the development prospects for nations in the Global South.[18] He notes that domestic production is stabilised and import substitution can be enhanced, along with the exploitation of new opportunities for export promotion through capital investment, given the more optimistic profit expectations associated with full employment. Thus, the trading position of a developing nation is less dependent on foreign exchange accumulation. Also, policymakers are better equipped to overcome international liquidity shortages and consistently fluctuating international reserve asset values.
He concludes that 'a JG simultaneously accelerates and sustains a development process, challenges neoliberal conventional wisdom, and radically alters the geopolitical spectrum' (Rafferty, 2023, p.655). Also, a JG reduces the capacity of the IMF and the World Bank to exercise control over a sovereign nation's policy space through conditionality and structural adjustment requirements which limits its choice of policy options (Rafferty, 2023, p.658, see next section).

iv) Trade Policies

Mitchell (2024c) argues that selective import controls, especially on luxury goods, which do not contribute to general well-being, should be implemented. When export markets are thin this leads to lower competition for scarce foreign exchange. In addition, the purchase of key imports of goods and services that benefit the poor should be prioritised. Speculative buying and selling of currency is unproductive and should be made illegal (Mitchell, 2011, 2012a). In the likely absence of such international commitments, developing nations should also consider imposing capital controls to guard against the impact of speculative financial activity (Mitchell, 2010b, see also Siddiqui and Armstrong, 2018). This issue is further examined in Section 5.

Capital market integration refers to the removal of restrictions on cross-border movements of capital. Capital inflow is claimed to facilitate investment, foster the diversification of risks, develop financial markets and promote intertemporal trade. However, the benefits of free capital movement are more modest than claimed and do not necessarily contribute to stability and higher growth because they largely pertain to an ideal speculation-free world (Reinhart, Rogoff, and Savastano, 2003, p. 60; Obstfeld, Ostry, and Qureshi, 2017, p. 3).

Short-term capital mobility has been shown to be damaging (Siddiqui and Armstrong, 2018) but long term FDI may be beneficial to low to middle-income nations (see Martens 2025). FDI is less risky than portfolio investment because the latter is more sensitive to external factors and has the potential to be rapidly withdrawn.

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[18] Rafferty (2023) identifies three major structural flaws associated with the post-Bretton Woods monetary system. The first is based on the imperative for deflationary policy in developing countries which run ongoing current account deficits. Second, the USA, as the reserve asset nation sets the 'rules of the game', requiring developing nations to adopt neoliberal policies and acquire obtain trade, financial, or property right agreements (see also Siddiqui, 2025). Third, given that developing nations find difficulty in issuing internationally acceptable liabilities in their own currency, they are often required to issue foreign currency denominated debt. The need to build up foreign currency reserves to help insure against future exchange rate instability means such funds are often diverted from more productive use.

Embedding a *local content* rule in an FDI agreement can ensure a very high degree of local value addition and may contribute to the advancement of industrialisation. An economy that is not large enough to attract FDI for the local market, can still liaise with others that have access to FDI and exploit its absolute advantages such as low costs, positioning in the international value chain and proximity to large markets (Gereffi and Sturgeon, 2013, p. 339). Thus, the composition of the external balance sheet, not just its size, determines the degree of vulnerability (Licchetta, 2009, pp. 8-16; Siddiqui and Armstrong, 2018, p. 9; see also Bonizzi et al., 2019, p.55).

By promoting industrial diversification, an emerging economy can gradually enhance the liquidity premium on its currency. When the return on the currency rivals that of the $US and other strong currencies, the stability of the currency improves and achieves the confidence of global investors.

Some developing economies focus on investment in export-based industries which typically requires the acquisition of sufficient foreign exchange to finance investment expenditure and other imported inputs and ignores the welfare of the majority of the population. In the absence of persistent current account surpluses or FDI, developing economies would have difficulty in securing sufficient foreign exchange to purchase sophisticated imported capital equipment, and also fuel and food, because, as noted, there are not established foreign exchange markets for their currencies (Mitchell, 2010a). Bonizzi et al. (2019, p.54), who refer to a neo-mercantilist export-led strategy, are also sceptical about this form of policy.

'IMF-style' development policy has often entailed the export of an agricultural cash crop to secure foreign exchange, yet this initiative i) undermines the informal sector which is self-sufficient in some foods; ii) damages the natural environment; and iii) makes the economy vulnerable to fluctuations in agricultural prices and possibly exchange rates, given the lack of product heterogeneity (Mitchell, 2010a). This can affect the international competitiveness of other traded goods which is known as Dutch disease.

This form of specialisation may force countries to import some types of food and other essentials and, if there is a limited capacity to export, living standards could be adversely impacted. The pursuit of self-sufficiency in food production and the development of an industrial base is a much more appropriate policy goal than prioritising the export of agricultural products. On the other hand, if a developing economy has limited access to foreign exchange, and experiences low per capita income and high levels of poverty, then the priority should be to boost per capita domestic incomes.

The United Nations Conference on Trade and Development (UNCTAD) (2010) also acknowledges that 'not all countries can rely on exports to boost growth and employment'.[19] 'The shift in focus to domestic-demand-led growth is necessary in both developed and emerging-market economies with large current-account surpluses and underutilized production potential in order to prevent the recurrence of imbalances similar to those that contributed to the outbreak of the global financial crisis.' Also, many developing countries have become over-reliant on export growth to create employment for their growing labour forces (UNCTAD, 2010, p. I).

Mitchell (2010a) also notes that competition in export markets often leads to domestic policy designed to keep wages and other costs low, both to counter domestic inflation pressures, but also to compete with other low wage developing nations. Then the general population does not usually share in the

[19] Anyway, all countries cannot simultaneously run trade surpluses since world-wide exports must equal total imports.

economic growth that is generated by exports (see Armstrong 2026). In addition, a low wage policy means that strong domestic markets do not emerge to absorb output, so that the developing economy continues to rely on exporting a significant portion of its output (see also UNCTAD, 2004). This growth strategy without a diverse mix of exports, and without considering domestic consumption demand, tends to cause inflationary pressures, in part due to the necessity of importing raw materials and intermediate goods.

Acknowledging that there are political, ideological and perhaps administrative issues, Mitchell (2009) argues that there is nothing intrinsically different with respect to a developed economy which enacts a JG, as opposed to a developing economy which maintains sovereignty of its own currency and embraces the recommended safeguards to counter undesired changes to prices and exchange rates.

He acknowledges that sometimes, the global interest would be served by restricting the capacity of a nation to export (Mitchell, 2016b). The obvious example is mining and selling coal which would worsen existing environmental damage. However, a coal rich developing economy, say, should still be able to import appropriate goods and adopt policies to address poverty. Further, if a developing economy has limited capacity to export, and is highly dependent on imported food and energy, then its currency-issuing government has limited capacity to address poverty, which exists if there are low levels of resources per head of population, including the skills of the population and the inventory of natural resources.

An international redistribution would be required, whereas the imposition of foreign loans with harsh conditionality would be inappropriate. Also, imposing austerity via conditionality on these governments typically by limiting spending on health and education, would clearly be counter-productive, but is often demanded by multinational agencies, such as the World Bank and IMF. Mitchell (2023a) explains why impoverished developing economies should enjoy a debt jubilee.[20]

Like Rafferty, Mitchell (2023a) argues that international institutions, including the IMF and World Bank, have failed to support highly disadvantaged nations. A new international institution must ensure that disadvantaged nations can access essential real resources such as food and not be priced out of international markets due to exchange rate fluctuations. These arguments are substantiated by lessons learnt from the pandemic, including the impact of labour shortages in key sectors and over-reliance on imported commodities, including safety equipment, medicines and vaccines.

v) Mission Oriented Development Policy

Mitchell (2016a) cites the work of Mariana Mazzucato who has convincingly argued that the state has been responsible for most of the large and important breakthroughs in developed economies. Government investment has often led to innovative advances and preceded any private sector involvement. The private sector has then utilised these public innovations and has been protected through patents and property rights and rewarded for their exploitation of these advances. Innovation incentives in the form of research and development subsidies or tax credits have also featured.

However, Mazzucato's policy agenda is not confined to developed economies. She argues that a mission-oriented approach to industrial strategy is essential to promote investment and innovation in

[20] Krueger, who is a former senior employee of both the World Bank and IMF, recognises the problems of mounting debt in developing economies, in particular Zambia and Sri Lanka, but does not advocate debt relief (Krueger, 2025).

developing economies to address major policy issues, including the meeting of SDGs, in particular universal health, reducing the digital divide and net zero emissions across the production system (Mazzucato, 2023; see also Mitchell, 2015, 2016a).

Mazzucato advocates reviving industrial strategy to be at the heart of an economic development strategy. For too long industrial strategy has been synonymous with top-down directing and choosing of particular sectors or technologies to support ("picking winners"). Mitchell (2019) noted that the IMF has conceded that the industry policy interventions (the so-called 'Asian miracles') which featured in the Keynesian era were highly successful (Cherif and Hasanov, 2019). The authors argue that the three principles behind the success were: (i) the support of domestic producers in sophisticated industries, beyond the initial comparative advantage; (ii) export orientation; and (iii) the pursuit of fierce competition with strict accountability.
Citing Rowthorn (1981), Mitchell (2023a) outlines a comprehensive set of strategies which governments have adopted, which include compulsory planning agreements between governments and multinational firms. Also, investment, production and employment decisions are made in the national interest. Import substitution strategies need to be developed.[21] Key firms should be nationalised. There should be public ownership of the major banks to direct investment to advance the public interest. These strategies all entail fiscal outlays and would be facilitated by the fundamental insights concerning international monetary operations based on an understanding of MMT.

4. Criticism of MMT Development Policy

i) Introduction

We argue that Post Keynesian critics have failed to advance policy proposals which create inclusive work that reduces poverty and imparts dynamically efficient forces into developing economies. In this section we focus on the work of Aboobaker and Ugurlu (2023), Skott (2019), Aboobaker and Michell (2022) and Bonizzi et al. (2019).

ii) The priority of investment

As emphasised in Section 4, a Job Guarantee should be a central feature of macroeconomic policy framework, so that development occurs in a full employment environment. As noted, we also support other fiscal initiatives, significant reforms of the international monetary system and supply side policies designed to improve productivity.

On the other hand, Aboobaker and Ugurlu (2023) argue that the policy imperative in these economies is raising both public and private investment, with the latter contributing to the requisite structural change to raise per capita income and employment, despite the evidence of multidimensional poverty being typically experienced by members of the population (see Section 2).

The authors outline supply-oriented Post Keynesian and Marxian models, drawing on work by Robinson, Kalecki, Harrod/Domar and Feldman, to demonstrate the existence of a trade-off between

[21] In his stock flow consistent model which takes account of the impact of the currency hierarchy, Nair (2021) finds that fiscal stimulus measures complemented by import substitution yields positive macroeconomic outcomes for a developing country whereas austerity in developed economies impacts adversely on developing economies. However, he concludes that a scheme such as Keynes' Bancor Plan is the ideal since it removes the currency hierarchy.

the production of consumption goods and private sector investment in a fully employed, closed economy without government.

No justification is provided for the assumptions of full employment and the presumed adequacy of prevailing per capita consumption in meeting the population's basic needs, putting aside the associated distributional issues. As noted, however, many developing economies experience high levels of labour underutilisation and extreme deprivation. The authors also emphasise the importance of industry, trade and monetary policy to promote private sector investment.

Noting that these Post Keynesian and Marxian models are somewhat naïve and simplistic, Aboobaker and Ugurlu (2023, p.2) acknowledge that the resulting curtailing of current consumption 'begets serious political economy questions for growth strategy in developing countries, where inequalities and absolute poverty are often high.' This concession represents a major inconsistency with respect to the formal modelling provided by the authors. Also, the premise that there is full employment, so that a reallocation of resources away from the production of consumption goods for domestic use is needed, is also highly dubious.

The authors argue that, by supporting the adoption of a JG, MMT advocates fail to recognise that the source of the problem of inadequate economic growth affecting many developing economies is capacity constraints.

Of particular significance is their lack of understanding of the operation of the monetary system and fiscal policy, so they understate the insights that MMT economists bring to the analysis of macroeconomic policy. For example, 'The COVID-19 economic shock has amplified our concerns with these developments [that is arguments supporting MMT's widening applicability], as debt monetisation under the rubric of quantitative easing has appeared to be more appealing to policymakers, despite contractions to the supply-side, in a period where the prospects for tax financing are diminished by the collapse of incomes, while the 'flight to safety' dampens foreign demand for government bonds' (parentheses added) (Aboobaker and Ugurlu, 2023, p.2).

The implementation of QE leads to an asset swap with the non-government sector holding more reserves and fewer riskless bonds. This increase in reserves is often rather crassly described as 'printing money' or 'debt monetization' by monetarists (and sympathetic mainstream economists) and the reader is warned about the likelihood of higher inflation.

However, a former Vice-President of the European Central Bank is clear 'Central bank reserves are held by banks and are not part of money held by the non-financial sector, hence not, per se, an inflationary type of liquidity. There is no acceptable theory linking in a necessary way the monetary base created by central banks to inflation.' (Constancio, 2011, p. 5).

Government debt can be sold either by setting the quantities of debt with different maturities, which in total match the prospective fiscal deficit, i.e. the 'financing requirement', and letting buyers set the rates through the operation of the market. Alternatively, the authorities set the rates on debt of different maturities and let the market determine the quantities sold, with the Central Bank buying the remaining debt. Typically, the issue is oversubscribed since there is a zero risk of default by the issuers. This is known as the tap system (see Mitchell, 2020, for an analysis of the Australian Debt Review which was conducted in 2002). However, a currency-issuer is not obliged to sell bonds in its own currency, so a supposed 'flight to safety' which allegedly 'dampens foreign demand for government bonds' is clearly of no consequence (Armstrong 2020).[22]

The concept of 'tax financing' has no relevance for an economy, whether developed or developing, which issues its own currency. Such a country *always* spends by the issue of new currency, whereas taxes constitute a return of state money which is a reserve drain from the banking system. Using the 'tax financing' terminology reveals that the authors accept the mainstream construct of a 'government budget constraint' (see Watts, 2024 for a rebuttal of the orthodox interpretation of the government budget constraint). However, as has long been explained in the MMT literature (Mosler 1993; Wray 1998), at the outset the state *must* spend (or lend) before taxes can be paid.[23]

Their argument that higher net spending associated with the adoption of a JG increases imports would equally apply to the private sector's increased accumulation of capital which is more import intensive than spending on consumption goods by JG employees. Thus, the direct exchange rate effects of higher imports of capital goods plus any activity by foreign speculators would likely be more potent than their reaction to the implementation of a JG.

Rapid private sector capital accumulation can cause balance of payments problems and unless export markets are thriving, goods will remain unsold, in the absence of a buoyant domestic market. On the other hand, in the presence of a JG, consumption spending would be relatively stable, thereby contributing to a more certain environment for domestic investment.

In summary, Aboobaker and Ugurlu (2023) offer an incomplete and inconsistent diagnosis of the macroeconomic policy issues typically facing developing economies and, consequently, their policy prescription is fundamentally deficient. They do acknowledge that restraining consumption of non-essentials by recipients of higher incomes is desirable. However, the full employment assumption cannot be justified, and they make a major concession with respect to the living standards of residents in developing countries.

In reference to the alleged trade-off between investment and government expenditure, Skott (2019, p.9), who is cited by Aboobaker and Ugurlu (2023, p.13), acknowledges that 'Spending on healthcare, food and housing for low-income families also contain significant elements of investment: a healthier and better educated workforce can raise labour productivity and profitability in the modern sector and improve the prospects for future growth. Thus, prioritising investment does not imply squeezing everything that is classified as consumption in the national accounts.'

He also states that stabilisation via fiscal policy is quite distinct from a 'permanent fiscal stimulus' (Skott, 2019, pp.8-9). Thus, while acknowledging the role of public investment in its broadest sense, he imposes the constraint that the fiscal outcome is either balanced or in surplus over the long term.

Putting aside the difficulties associated with achieving a specific fiscal outcome, an analysis of sectoral balances indicates that a necessary but not sufficient condition for an economy to sustain a persistent fiscal surplus is that the current account is in surplus. The sufficient condition is that the current account surplus exceeds the desired level of net saving by the private sector i.e. S-I. Few countries experience

[22] Kelton and Fullwiler (2024) explore the advantages and disadvantages of the decision by a developed economy with its own sovereign currency to stop issuing government debt and/or setting the target interest rate at zero.

[23] Once the private sector has sufficient accumulated savings and/or the financial capacity to borrow, then it can pay its tax bill, prior to a new round of state spending.

sustained current account surpluses, whether developed or developing, so the strictures about running fiscal surpluses are inconsistent with a comprehensive policy package designed to promote economic growth in developing countries.

In an ILO publication which examines a range of demand side policies for developing economies, Aboobaker and Michell (2022, p.9) recognise the dual nature of labour markets in low- and middle-income countries (LMCs), given the usual presence of a large pool of underemployed labour outside the formal, technologically advanced capital-intensive sector (see also Merotto, Weber, and Aterido, 2018).

However, underdevelopment is defined as 'a situation of inadequate structural transformation' with the level of capital accumulation inadequate to provide decent incomes and good quality jobs to all who need them (Aboobaker & Michell, 2022, p.18). This is a rather narrow definition, given that the economic status of a majority of the working age population is ignored and also that even under the best-case scenario a high percentage of workers would not receive 'good' jobs.

The question of whether there is an appropriately skilled labour force to undertake quality jobs and, also, if there is sufficient domestic and export demand to justify a higher rate of accumulation are not raised. The authors do recognise that policy design does require a correct diagnosis of the macroeconomic circumstances, but their focus is mainly on the supply side, specifically, 'how large is the capital-intensive sector relative to other sectors? How much excess capacity is there in this sector? How large is the number of unemployed or underemployed persons?' **(**Aboobaker & Michell, 2022, p.18).

The structuralist macroeconomics literature recognises the constraints of limited productive capacity, external trade and financing issues and argues that there are fiscal constraints on employment expansion, but also that sustained growth in output and jobs necessitates demand management policies (Aboobaker and Michell, 2022, p.14, see also Dutt, 2019).[24]

Aboobaker and Michell (2022, pp.18-19) note that, in contrast to classic development models which focus on the issue of *capacity constrained employment* and, like Aboobaker and Ugurlu (2023), regard capital accumulation as the primary mechanism for absorbing surplus labour through job creation, the later structuralist literature maintains the duality emphasis and notes that the level of aggregate demand may be associated with the under-utilisation of manufacturing capacity, which would limit its expansion. In summary, the problem of demand-side policy design in LMCs thus requires a balance between maintaining the growth of expenditure while navigating capacity constraints (Ocampo, Rada, and Taylor, 2009).

Notwithstanding the above, Aboobaker and Michell (2022, p. 21) continue to focus on the advanced sector by noting the imperative to 'maintain the conditions needed for sustained capital investment.' This argument is premised on long-run job creation requiring 'the expansion of capacity and technological upgrading' which again ignores the issue of both the plight of underutilised labour and the associated opportunities for labour intensive infrastructure investment. Thus, there is a degree of prevarication over whether the focus of policy should be exclusively on private sector investment, as argued by Aboobaker and Ugurlu (2023) or whether policies should reflect the dualist structure of most developing economies.

[24] The evidence provided by Onaran and Galanis (2014) and cited by Aboobaker and Michell (2022, p.15) that most LMCs in the sample do not have a wage led demand structure is irrelevant in the presence of a JG.

Aboobaker and Michell (2022, p. 21) acknowledge that 'while consumption growth may need to be constrained for long-run accumulation to take place, policy to *support* consumption may also be required in the case of sudden shortfalls due to business cycle recessions', which does not address the inadequacy of material living standards for many of the population in developing countries. Boosting consumption and living standards generally via JG jobs is not necessarily in conflict with the promotion of investment in the advanced sector. Importantly a JG operates as an automatic stabiliser. A key issue is what types of goods are being produced in the advanced sector and whether production is geared to export and/or domestic consumption.

The importance of public investment is acknowledged, alongside industry policy which should promote private investment, in concert with 'access to credit at affordable rates, investment grants and subsidies' (Aboobaker and Michell, 2022, p. 21).

The authors correctly argue that the usual stabilisation policies that are imposed on developing economies worsen their macroeconomic problems, including the attempted control of inflation through the manipulation of domestic interest rates when inflation is driven by import costs and conflicting claims over output, as opposed to excessive aggregate demand.

Aboobaker and Michell (2022, pp.24-25) support the recommendation by Bonizzi, Kaltenbrunner, and Michell (2019) that central banks facilitate an increase in government spending by holding down interest rates and hence interest costs, but they claim that over-reliance on this strategy, as opposed to, say, raising taxes on the wealthy, is unlikely to be sustainable, particularly in a developing economy. Aboobaker and Michell appear to accept the erroneous mainstream contention that government spending is financed by levying taxes, rather than taxes on the wealthy being based on equity considerations.

The authors are cautious about the external funding of "environmental, social, governance" (ESG) projects which are claimed to be associated with "socially responsible" investment and are often designed to counter climate change (p.25). Also, they note that to access green bond markets, governments are often 'required to "de-risk" large-scale investment projects by offering fiscal backstops and/or direct funding'. Rich world investors' preference for liquidity and ease of entry and exit promotes the growth of the "green" bond market over domestic banking and "patient" investment (Gabor 2021; Dafermos, Gabor, and Michell 2021).

On the other hand, mechanisms for domestic credit expansion that prioritise the *stability* of financing would typically require the growth of the domestic banking system, including publicly-owned national development banks, and policy to encourage domestic investors such as pension funds to hold domestically issued assets.[25]

iii) The importance of exchange rates

[25] In his study of developing countries, Abdullah (2024) found that a more developed financial system as measured by the volume of loans to GDP ratio and a higher credit rating contributed to a lower foreign currency denominated public debt to total public debt ratio and hence lower economic macroeconomic vulnerability, so that carefully managed deregulation designed to serve pubic purpose is appropriate.

Many LMCs operate “intermediate” exchange rate regimes – managed floats or adjustable pegs of some kind – which make them particularly vulnerable to deterioration of the external balance and/or the willingness of external investors to provide credit. Rapid and disorderly exchange rate devaluations can lead to internal redistribution of income, compression of real wages and consumption, and increased foreign currency debt burdens (Aboobaker and Michell, 2022, p.26).

A succinct summary of the challenges for policymakers in LMCs is provided by the acknowledgement of the ‘need for counter-cyclical policy, poverty reduction and reductions in inequality alongside the need for accumulation and structural transformation in the presence of capacity constraints.’ (Aboobaker and Michell, 2022, p.23).

However, their report lacks consistency in its assessment of the economic challenges facing LMC economies with the low wage sector sometimes ignored. Certainly, their work is more nuanced than Aboobaker and Ugurlu (2023).

Both Mitchell (2010,a,b; 2016b, 2023b) and Rafferty (2023) recognise that the prevailing institutional environment means that policymakers in developing countries have very limited options. Consequently, in his blog posts and other contributions Mitchell recognises the imperative for major institutional change.

Bonizzi et al. (2019) argue that monetary sovereignty exists on a spectrum, with some countries possessing greater control over their monetary policy than others. Thus, developing countries do not have the same capacity to implement MMT principles effectively. There is an important question as to whether the spectrum adequately accounts for the complexities of external debt, foreign currency reserves, and the influence of international financial institutions, including the IMF, which impose constraints on developing nations' monetary policy.

Bonizzi et al. (2019) take a mainstream view of trade and exchange rates, in analysing the implications for macroeconomic policy in developing economies. Foreign exchange markets are alleged to constrain governments from taking a progressive policy stance, but there is no differentiation made between fixed and floating exchange rate regimes. Also, they argue that the political feasibility of MMT inspired policy in these circumstances deserves further exploration.

Bonizzi, et al. (2019, pp. 54-56) advocate an export-oriented strategy to generate foreign exchange, while limiting imports to essential agricultural and industrial products in which the developing economy is not self-sufficient. This is at odds with the MMT and UNCTAD perspectives, which are outlined in Section 3 and ignores the economic circumstances of the majority of the working age population in most developing economies. However, the authors do recognise the benefits of obtaining foreign currencies through foreign direct investment (FDI) and/or portfolio investment that does not create foreign currency denominated liabilities. Also, the importance of developing the domestic financial market to provide necessary finance for industrialisation is acknowledged, along with the need to increase self-sufficiency in food and energy, which would increase policy autonomy. Finally, the possibility of needing to implement capital controls is recognised.

Bonizzi, et al. (2019, p.48) note that Mitchell (2018a) claims that ‘An elevated unemployment rate is *always* a political decision’. This leads them to claim that ‘Export demand is thus regarded as unnecessary to maintain aggregate demand.’ This statement is clearly a non-sequitur. MMTers do not advocate that the economies of developing countries should be closed. There is the recognition that some more sophisticated capital equipment has to be imported and its utilisation enhances national productivity.

In their critique of MMT advocates' policy recommendations, Bonizzi et al. (2019, p.54) argue that '[w]ith the possible *exception of the job guarantee*, these [MMT] proposals largely parallel the tradition of old development economics, and industrial policy, which Structuralist and Post-Keynesian economists have been advocating since the 1960s (e.g. Prebisch, 1949; Rodríguez 1981, Sunkel and Paz, 1970)' [emphasis added].

The authors criticise the adoption of a JG, arguing that it *might* lead to inflation and a fall in the exchange rate. Given that the JG is considered central to an MMT policy framework for developing economies this is a somewhat weak and unconvincing response. As noted, the state would be hiring 'off the bottom' of the pay scale. The JG provides a price anchor in the form of the buffer stock of employed labour (Mitchell 2009; Mosler 2020) and is likely to add to price stability rather than be inflationary.

This argument can also be framed in terms of the very limited impact on the bargaining power of the highly paid workers arising from the lowest paid having an increased degree of job security. In the event that highly paid workers were emboldened to seek pay increases, appropriate contractionary fiscal adjustments could be used but without undermining full employment. Bonizzi et al. fail to make a compelling argument that the maintenance of an unemployed buffer stock is a superior counter-inflationary alternative to the adoption of a JG and *de facto*, they are implying that developing economies should sacrifice output and real income by denying the poorest, most disadvantaged groups the opportunity to work and contribute to society.

Bonizzi, et al oppose the JG because it will apparently lead to a reduction in the exchange rate, supposedly causing inflation and make imports unaffordable. However, from an MMT perspective, in the case of developing countries, if the exchange rate falls, the quantity of commodities exported is unaffected, *as these exports are sold at world prices*, only export revenue in domestic currency increases. Products priced in domestic currency, such as locally manufactured goods, are cheaper abroad and more are sold benefiting exporters[26], potentially increasing domestic resource use, and imports can become more expensive in domestic currency. Exporters gain versus importers, and prices shift but the government can change this outcome with tax and spending policy. In other words, the government can utilise fiscal policy to address the distributional consequences of a fall in the exchange rate.

Following the introduction of a JG, higher domestic income might increase the demand for imports or speculators may choose to sell domestic currency and drive down the exchange rate. In this case, as noted above, there are options for direct intervention via capital controls. We concur with Mitchell that speculative buying and selling of currency is a non-productive activity and should be made illegal. Evidence suggests that free capital mobility does not contribute positively to growth and stability (contrary to neoliberal thinking) and, in addition, arguments that capital controls are impractical can easily be dismissed (Siddiqui and Armstrong, 2018). It is important to distinguish between long term

[26] In a detailed study of 25 advanced and 26 emerging-market economies Bussiere et al. (2020) find that, despite low quantity elasticities, the trade balance responds positively to a depreciation in all countries because of the adjustment of export prices, in particular, as well as import prices. They conclude that exchange rate changes can play an important role in addressing global trade imbalances. Thus, the evidence suggests that developing economies can rely on a flexible exchange rate to resolve changes to the Balance of Payments arising from their policy initiatives.

FDI which can be beneficial to low to middle-income nations and short-term capital mobility which has been shown to be damaging (ibid).

6. Conclusion

MMT advocates recognise that the international macroeconomy operates against the interests of developing economies. These circumstances have their origins in the Bretton Woods agreement, which undermined the welfare of countries which ran current account deficits. Macroeconomic policy in developing countries should prioritise the welfare of the majority of the population who typically experience significant rates of underemployment and multidimensional poverty through the adoption of a Job Guarantee.

It is argued here that full employment is always a policy option and that it will deliver highly significant gains in real wealth (Mosler 1993, 2020; Armstrong, 2024). MMT argues that economic development can take place in the context of full employment. A JG programme plays its part in a policy approach designed to maximise real wealth, alongside environmental sustainability and a more equal income distribution. It is based upon the insights of MMT which explain how the monetary system operates and reveals the actual constraints facing currency-issuing governments.

A key insight follows from an understanding of MMT; from inception, lack of state net spending is the cause of unemployment; it is not endogenous to private sector activity. However, MMT does not underestimate the importance of improving productivity by structural transformation, including improved institutions and infrastructure development. MMT shows how the nature of policy design and the feasibility of specific policy targeted at these key aspects of the economy come more sharply into focus once the actual constraints facing a currency-issuing state are correctly understood.

MMT is consistent with, but not reducible to, the idea that a democratic government should determine policy to best serve public purpose. MMT shows that the state is constrained by real, not financial resources, and that policy space is often much greater than suggested by mainstream economists and, it seems, some Post-Keynesians. Some Post Keynesian development economists appear to have an ambivalent view about government policy to promote the welfare of the most disadvantaged citizens in developing nations. The hostility of many Post Keynesian economists to Modern Monetary Theory is well illustrated by their arguments with respect to the design of macroeconomic policy for developing countries. Notable in their critiques is the failure to engage constructively in the analysis of the impact of a Job Guarantee.

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