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The Role of Characters and Productivity for Economic Inclusiveness in Decentralized Economies: An Agent-Based Model

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Abstract

Characters—understood as persistent preferences, habits, and behavioral dispositions—shape economic outcomes by influencing agents' pricing, purchasing, and consumption decisions. Through decentralized interactions, character heterogeneity affects access to essential goods and income, thereby determining who can sustain adequate living standards over time. This paper studies the role of character in shaping economic inclusiveness—defined as collective survival at adequate living standards—in decentralized market economies. We develop an agent-based survival model with heterogeneous characters. The simulations reveal a systematic trade-off between extractive characters and economic inclusiveness mediated by merit-based entitlement. Extractive agents leverage their productivity and market power to translate higher productivity into a larger share of the surplus when "productivity-based merit" entitles them to do so, at the expense of less productive agents, thereby gradually excluding them. This mechanism reduces economic inclusiveness in the absence of redistribution. Extractive characters increase short-term economic performance through selection—by eliminating low-productivity agents—while undermining long-term economic inclusion, which is fundamental to sustained prosperity. The results indicate that the inclusiveness and performance of decentralized market economies depend on the distribution of characters, and that cultivating generative characters is central for long-term economic inclusiveness in decentralised economies.

Keywords: decentralized economy, economic inclusiveness, productivity, generativity, extractiveness, characters

Jel codes: C63, D31, D63, D91, Z13

1 INTRODUCTION

The relationship between character and economic outcomes has long occupied classical political economy, yet contemporary economic analysis largely treats preferences and dispositions as exogenous and normatively neutral (Sandel 2005). This paper argues that decentralized market outcomes are not neutral with respect to characters and that allowing extractive characters to proliferate reduces economic inclusiveness.

Economic inclusiveness refers to individuals' effective access to the resources required to sustain adequate living standards, which, as Amartya Sen argues, constitutes a measure of success prior to aggregate output or average income (Sen 1999, 2010). Without economic inclusiveness, deprivation may persist even in abundant societies when market-mediated access to goods fails.

Economic inclusiveness concern has become increasingly salient in many economies, where rising income inequality has coincided with stagnating or declining living standards for significant segments of the population. Empirical evidence documents growing in-work poverty, housing insecurity, inequality and vulnerability despite sustained aggregate growth, resulting in rising relative poverty alongside more ambiguous trends in absolute poverty (Decerf and Ferrando 2022; Lucas et al. 2022;

Moller et al. 2003). These patterns indicate that the core issue is not insufficient production or lack of surplus but the mechanisms through which access to them is organized.

This observation is consistent with institutional explanations of prosperity and the role of inclusive political and economic institutions for generating innovation and aggregate wealth (Acemoglu and Robinson 2013). In this view, prosperity depends on a sufficient degree of centralization combined with political and economic inclusiveness, while extractive institutions—such as elites using power to appropriate resources—undermine innovation, freedom, and broad-based participation.

Extractive dynamics may also arise endogenously from individual behavior within decentralized markets. For instance, it is well-known that agents may leverage on their market power to extract excessive surplus from others. A second, less systematically examined source of decentralized power arises from productivity-based entitlement. When M*erit* is legitimated and understood as an entitlement to a share of surplus as large as the relative productivity (Mulligan 2017), the most powerful (productive) may acquire a disproportionate surplus share becoming source of exclusion.

Power does not turn automatically into extractiveness, only agents with *extractive* characters take advantage of power to acquire a larger surplus share. By extractive agents, we mean those who are willing to leverage their power to gain personal advantage. On the contrary, *generative* agents orient their power and productivity toward the common good rather than opportunistic extraction. Empirical evidence shows that generative agents, characterized by contribution, restraint, and concern for others, are systematically associated with higher social capital, trust, civic engagement, and support for inclusive economic arrangements (Becchetti and Bellucci 2021; Becchetti, Bova, and Semplici 2024, 2025).

To be extractive or generative is a matter of character, understood as the set of dispositions, preferences and habits an agent possesses. In decentralized markets, character affects pricing, buying and consumption decisions and, through them, aggregate economic outcomes, including the capacity of the economy to sustain adequate living standards of all.

The central objective of this paper is to test whether generative and extractive characters constitute a dominant factor shaping economic inclusiveness and prosperity in decentralized economies. The model abstracts from the role of redistributive policies to isolate the role of characters in decentralised economies, creating a theoretical framework close to the situation of globalized markets where the redistributive power of domestic institutions is weakened by corporate delocalization threats and household tax avoidance strategies.

Along this line the paper proposes and analyzes a survival-based agent model in which agents having heterogeneous characters and productivities interact repeatedly in a decentralized market.

Our findings suggest that

(i) economic inclusiveness is not neutral with respect to different characters;
(ii) here is a trade-off between extractiveness and economic inclusiveness. At one extreme, extractive character concentrates income among highly productive agents by leveraging market or productivity-based power; at the other, generative character sustain broader inclusiveness but at lower average productivity. Decentralized markets generate a trade-off between productivity and economic inclusiveness when productivity is translated into surplus entitlement;
(iii) in homogeneous population, extractive characters extinguish soon while generative characters survive longer;

(iv) when heterogeneous characters coexist, extractive agents survive generative ones and the overall population collapses fast.
(v) as a consequence of (iii) and (iv), to be extractive is strategically rational at individual level while it is not at social level. As a consequence, to achieve economic inclusiveness it may be necessary to cultivate generative characters since decentralized economy does not preserve it automatically.

By "cultivating characters," we refer to the accumulation and embodiment of stable norms, dispositions, preferences, and habits that govern economic behavior and decision-making in ways that sustain higher economic inclusiveness (i.e., generative), an idea that is not new (MacIntyre 2007; Sandel 2005). In this sense, character functions as a form of civic and behavioral capital: just as human capital enhances productivity and social capital supports trust and cooperation, character capital shapes how productivity is translated into surplus appropriation and access within decentralized markets and is fundamental for survival of decentralized economies.

This perspective complements standard economic analyses centered on incentives: while incentives shape behavior at the margin, character operates at a deeper level, rooted in preferences and dispositions, and is therefore not neutral with respect to economic outcomes.

The remainder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 introduces the agent-based survival model rules. Section 4 presents the simulation results. Section 5 discusses their implications. Section 6 concludes.

2 LITERATURE REVIEW

2.1 INSTITUTIONS, GENERATIVITY AND PROSPERITY

A central insight of modern political economy is that institutions play a decisive role in explaining why some societies prosper while others stagnate. Acemoglu and Robinson (2013) famously argue that cross-country differences in economic performance are largely explained by differences in institutional quality. They argue that two elements are fundamental for economic prosperity, a sufficiently centralized state and inclusive institutions. Inclusive institutions—characterized by secure property rights, broad political participation, and constraints on the arbitrary use of power—create incentives for investment, innovation, and productive effort, enabling individuals to exploit economic opportunities and generate wealth for themselves and for society as a whole. By contrast, extractive institutions concentrate power and resources in the hands of a narrow elite, undermine property rights, distort incentives, and systematically discourage productive economic activity, ultimately preventing societies from thriving.

The growing concentration of wealth observed in many countries commonly classified as institutionally inclusive (Lucas et al. 2022; Piketty and Goldhammer 2014) raises questions about whether forces internal to market economies may be undermining effective inclusiveness over time creating elites which will in turn reduce economic inclusiveness and shape extractive institutions. If this is true, then decentralized market under certain conditions switches from an inclusive institution to a competitive arena undermining itself. What is this condition?

Agent based models allow to go beyond assumptions which were necessary due to analytical and computational limitations. In canonical general equilibrium theory, the fundamental theorems of welfare economics rely crucially on strong assumptions such as complete markets, price-taking behavior, and the existence of a representative selfish profit maximizer agent whose preferences and constraints can aggregate all individual behaviors into a single optimizing decision problem (Jackson

and Yariv 2015; Kirman 1992). However, economies consist of heterogeneous agents interacting locally and subject to bounded rationality and incomplete information; aggregate outcomes coincide with the hypothetical welfare theorem allocation only under excessively (i.e., unrealistic) *conditions* (Jackson and Yariv 2015; Kirman 1992). Empirical and theoretical research shows that the welfare equivalence between heterogeneous and representative formulations breaks down in the presence of distributional asymmetries, non-linear responses, and interaction effects that cannot be captured by a single aggregate agent (Poledna et al. 2023; Steinbacher et al. 2021). Agent-based models, by simulating interactions among diverse, boundedly rational agents without imposing equilibrium or representative aggregation, can generate *emergent macroeconomic patterns and welfare distributions* that differ systematically from those predicted by representative-agent frameworks and therefore challenge the normative implications of the classic welfare theorems in complex economies (Axtell and Farmer 2025; İmrohoroğlu 2025).

Our original contribution to this literature is assuming that the extractive/inclusive character mix of individuals is at the root of the institutional design discussed in this section. We argue that different characters have different outcomes in decentralized economies. Some of these outcomes preserve economic inclusiveness, some others foster concentration and exclusion. By analyzing the outcomes over time, we can check which conditions, which characters, allow for maintaining inclusive economic market. We do so by pointing at extractive characters. Extractive characters are willing to take advantage of their power, such as market power, to acquire a larger share of surplus. We restrict our analysis to two types of powers. Market power and Productivity power. While the first is well-known, the latter requires a specification. Productivity power arises when the agent is willing to extract surplus thanks to its higher productivity and is legitimated to do so. A specific case of productivity power is meritocracy as intended in common sense, where higher productivity is rewarded with a higher surplus share.

The effect on aggregate surplus and economic inclusiveness of market power is well-known, the effect of meritocracy less. The common interpretation of merit is firmly grounded in the dominant tradition of economic theory, according to which higher productivity justifies higher income or higher share of surplus. From the classical formulation of marginal productivity theory to its neoclassical and contemporary extensions, competitive remuneration is understood as reflecting agents' productive contribution. In this view, income differentials are not distortions but the legitimate outcome of differences in productivity, skills, or efficiency (Clark 1899; Samuelson 1947). Human capital theory further reinforces this logic by interpreting higher earnings as the justified return on productivity-enhancing investments in education and skills (Becker 1966). More recently, explicit defenses of meritocratic inequality have reiterated that market incomes largely reflect what individuals contribute to production, and are therefore normatively acceptable within competitive economies (Mankiw 2013). Under this widely shared "common-sense" conception of merit, rewarding more productive agents with higher income or surplus appropriation is both efficient and fair. However, merit, as entitlement to larger surplus -cancel out- its net social surplus and rises the surplus of the meritorious agent potentially creating a net negative social surplus. This critique can be largely extended to entitlements creating privileges and not oriented to common good (Sandel 2020).

Opposite to extractiveness, generativity refers to a character trait oriented toward contributing to overall surplus and not to its own. In this literature, generativity is understood as the disposition to create, care for, and transmit resources—material, relational, or institutional—that benefit other individuals and future generations (Becchetti and Bellucci 2021; Erikson 1993, 1998). Generativity therefore concerns how individuals use their freedom within a landscape of opportunities, emphasizing intentional contribution and pro-social orientation rather than the balance between production and appropriation per se. Empirical evidence shows that generative individuals are

associated with higher civic engagement, stronger social capital, greater trust, and more cooperative institutional environments (Becchetti and Bellucci 2021; Becchetti et al. 2024, 2025; Bova 2025).

Insofar as we understand virtues as these traits, embodied in character, that serve the common good, and vices as those who diminish it, we can recall that already several authors have emphasized that well-functioning market economies presuppose a stock of virtues—such as trust, responsibility, and concern for others—that markets themselves neither automatically generate nor reliably sustain (Bowles 2016; Sandel 1998, 2005). From this perspective, cultivating virtuous or "good characters" is constitutive of economic performance (Bova 2025).

2.2 AGENT BASED MODEL

Decentralized markets allow independent individuals to exchange on the basis of local information and price signals, in line with Hayek's (1945) account of decentralized coordination, yet prices and purchasing decisions themselves are shaped by the character of the agents who generate them. To account for character heterogeneity (instead of the solo selfish profit or utility maximizer), we adopt agent based modelling (ABM). Agent-based models consist of populations of heterogeneous agents interacting locally according to explicit behavioral rules. Aggregate outcomes are not imposed ex ante, but arise endogenously from repeated interactions over time. As emphasized in the ABM literature in economics and finance, this class of models is particularly suited to studying systems characterized by heterogeneity, non-linearity, path dependence, and out-of-equilibrium dynamics—features that are intrinsic to real-world economic processes and central to the present analysis (Axtell and Farmer 2025).

From an epistemic standpoint, the ABM employed here is best understood as a generative model. Rather than deriving results through closed-form solutions or comparative statics, the model demonstrates how specific macro-level patterns—such as high survival with weak selection, or strong selection with population collapse—can arise from explicitly specified micro-rules. In this sense, the model functions as a *sufficient theorem*: if a given configuration of decentralized rules systematically generates or undermines survival, then those rules are sufficient to explain the observed outcome, even if they are not logically necessary (Ehrenfeucht 1957; Newell and Simon 1956).

2.3 SURPLUS AND MERIT-BASED CONSUMPTION

In marginalist economics, surplus is defined as consumer or producer surplus derived from willingness-to-pay and marginal cost schedules evaluated at equilibrium prices (Marshall 1890). This notion presupposes equilibrium, stable preferences, and prices as sufficient statistics for welfare. Under decentralized interaction, partial information, and irreversible exit, these assumptions fail: willingness to pay becomes endogenous to survival histories, prices are path-dependent, and equilibrium counterfactuals lose meaning. As a result, marginal surplus is neither analytically robust nor normatively informative in survival-based, out-of-equilibrium settings.

The approach adopted here aligns instead with the *classical surplus tradition*, in which surplus is defined as what remains after the reproduction of agents at a given standard of living (Marx 1867; Ricardo 1817; Smith 1791; Sraffa 1960). In this framework, surplus is a real, stock–flow residual—logically prior to prices—while prices govern its distribution and appropriation rather than its existence, provided resources flow sufficiently to those generating them as in our survivors case. This conception is particularly appropriate for models focused on viability and reproduction constraints, where the central issue is not marginal efficiency but the capacity of decentralized interactions to sustain life over time.

Consistent with this tradition, the model employes *quantitative (real) surplus*—the excess of physical production over subsistence consumption. This allows surplus appropriation to be analyzed independently of monetary and equilibrium welfare measures and makes it possible to identify extractive outcomes as situations in which agents appropriate surplus beyond their net productive contribution. This surplus concept is consistent with ***s****tock–flow reasoning and viability theory*, where survival depends on maintaining state variables above critical thresholds rather than on instantaneous utility maximization (Aubin 1991). In agent-based survival models, buffers and reserves dominate marginal conditions, and surplus matters insofar as it expands the set of viable future states (Epstein and Axtell 1996). Crucially, defining surplus in real terms allows the analysis to include nominal variables without being grounded in them: prices and incomes affect access and selection, but surplus remains meaningful under inflationary or deflationary dynamics, non-clearing markets, and irreversible exit.

2.4 CHARACTERS

We identify and operationalize a character as a specific combination of heuristic rules incorporated into agents' habits, dispositions and preferences. We focus on heuristic rules concerning, sell, buy, and consumption decisions. This interpretation aligns with the behavioral tradition in which agents and organizations rely on *procedural rationality*, simplifying rules, and aspiration/constraint-based decisions when optimization is infeasible under limited information and computational constraints (Simon 1955) where observed prices are not best understood as optimal solutions but as outcomes of administrative and adaptive pricing procedures revised using salient feedback signals (e.g., sales outcomes, inventories) (Blinder et al. 1998; Cyert and March 1963).

We employ heuristic rules reflecting contemporary market mechanisms s as well as reciprocity-based and income-based norms of exchange which play have played a central role in many societies (Mauss 2024; Polanyi 1957; Sahlins 1972). This "rules-as-character" approach is particularly appropriate in decentralized environments where (i) information is local, (ii) interaction is repeated, (iii) exit is irreversible, and (iv) inventories act as buffers that mediate short-run disequilibrium.

We introduce here the heuristic rules and leave their mathematical formulation to the next section.

2.4.1 Seller rules

Seller rules operationalize alternative *pricing dispositions* by specifying how sellers revise prices based on minimal feedback and feasibility constraints. The four modalities adopted here correspond to well-established traditions in the theory of the firm and empirical price research.

2.4.1.1 Zero-markup (reproduction) pricing

The zero-markup rule sets prices at the reproduction level, defined as the minimum compatible with maintaining the seller's living standard. This pricing rule corresponds to the broad family of cost-based pricing doctrines—where prices are anchored to costs rather than derived from marginalist calculations—documented in classic empirical investigations of business pricing (Hall and Hitch 1939) and systematized in Post-Keynesian price theory as "normal-cost" or "administered" pricing (Lee 1999).

2.4.1.2 Sell-seeker pricing

Sell-seeker sellers aim to sell all the output they produce. When goods remain unsold, they interpret this outcome as a signal of insufficient demand and respond by lowering prices, subject to the

constraint that prices never fall below the reproduction threshold. When all output is sold, prices are kept unchanged and only adjusted to match the living-standard requirement. This pricing modality is consistent with empirical accounts of firm behavior emphasizing that price adjustments are often triggered by operational signals such as inventories, unsold output, or perceived demand slack, rather than by formal marginalist calculations (Blinder et al. 1998; Hall and Hitch 1939).

2.4.1.3 Gain-seeker pricing

Gain-seekers raise prices under scarcity and reduce prices only when doing so preserves income, approximating an opportunistic mark-up disposition rather than a fully optimizing selfish. This is strongly aligned with the mark-up pricing tradition associated with oligopolistic competition and administered prices, where prices are often set as costs plus a margin that reflects market power, competitive conditions, and strategic aims (Hall and Hitch 1939; Kalecki 2013; Lee 1999). It is also consistent with the inventory-and-pricing literature in which firms use quantities (sales/inventories) as the primary state variables and adjust prices only intermittently, reflecting limited information and adjustment frictions (Blinder et al. 1998). Thus, the gain-seeker is a parsimonious behavioral representation of *extractive pricing power* under local competition.

2.4.1.4 Merit-seeker pricing: meritocratic mark-ups conditioned on productivity

Merit-seeker pricing combines the sell-seeker response under excess supply with price increases under excess demand, where price varies according to mark-ups scaled by a "merit" index measured as relative productivity (see next section). The normative justification reflects the canonical meritocratic logic debated according to which higher productivity warrants higher remuneration and a larger share of the surplus. In this sense, the rule formalizes a widely observed moralized market heuristic: scarcity legitimizes higher prices, and merit legitimizes a larger share of the surplus. Merit-seeker pricing is therefore analytically useful for studying when meritocratic justifications translate into exclusionary or inclusive price dynamics in a decentralized economy.

2.4.1.5 Benchmark

We add *Fixed random price* rule as benchmark where prices are drawn uniformly at initialization within a bounded interval and subsequently held constant.

2.4.2 Buyer rules

Buyer selection mechanisms (BSMs) specify how agents choose a trading partner among nearby sellers. In decentralized environments with limited observability, buyers typically cannot reconstruct demand schedules or compute intertemporal plans; instead, they adopt heuristics that rely on salient cues (prices, visible seller attributes, or simple social signals). This is consistent with the broader bounded-rationality tradition in which agents "satisfice" using limited information and procedural rules rather than solving a full optimization problem (Gigerenzer and Goldstein 1996; Simon 1955). In markets with search frictions, such heuristics are also theoretically coherent: when information is costly and incomplete, transaction outcomes are shaped by partner-selection rules and can sustain persistent price dispersion and non-clearing trade patterns (Burdett and Judd 1983; Stigler 1961; Varian 1980).

2.4.2.1 Lowest-price

Under the lowest-price BSM, buyers choose the cheapest available seller. This rule corresponds to the canonical microeconomic benchmark under homogeneous goods and perfect substitutability:

conditional on feasibility, the buyer minimizes expenditure for a given need. In decentralized markets, it is best understood as a *search heuristic* that uses the most salient and readily comparable signal—posted price—rather than a complete demand system. The theoretical relevance of this rule is reinforced by models of consumer search and price dispersion, where even simple price-based selection can generate strong competitive pressure without requiring full information or equilibrium clearing (Burdett and Judd 1983; Stigler 1961; Varian 1980). Empirically, a large body of evidence on price-setting and price dispersion also supports the idea that buyers respond to posted prices under limited knowledge, thereby disciplining sellers in a decentralized manner.

2.4.2.2 Lowest-consumption

Under the lowest-consumption BSM, buyers prefer sellers who display the lowest consumption level. This rule is not expenditure-minimizing and is not directly equivalent to pro-poor targeting; rather, it formalizes a *normative inference* buyers may make under informational scarcity: low consumption is taken as a signal of temperance, restraint, or non-extractive behavior. Such inference is consistent with research on social preferences and norm enforcement, where agents condition support on perceived "deservingness," restraint, and avoidance of greed—particularly when direct measures of contribution or exploitation are unavailable (Bolton, Brodley, and Riordan 2000; Falk and Fischbacher 2006; Fehr and Schmidt 1999). More broadly, it parallels literatures on "moralized markets" and ethical consumption, where buyers use observable attributes (including perceived frugality or low-footprint behavior) as proxies for fairness or sustainability when the true distributional incidence of exchange is opaque. In the model, lowest-consumption selection therefore operationalizes a plausible but noisy informational shortcut: it can reward non-extractive conduct, but can also penalize high-output sellers whose income may raise their consumption.

2.4.2.3 Lowest-income selection

Under the lowest-income BSM, buyers select sellers with the lowest current income. This modality represents explicitly redistributive market behavior: rather than optimizing private expenditure, buyers allocate their demand to increase the survival odds of economically disadvantaged agents. The rule is directly aligned with experimental and theoretical work on social preferences—inequity aversion, altruism, and support for redistribution—showing that many individuals are willing to sacrifice efficiency or personal payoff to reduce inequality or assist the worse-off (Andreoni 1990; Bolton et al. 2000; Fehr and Schmidt 1999).

2.4.2.4 Highest-merit (productivity) selection

Under the highest-merit (productivity) BSM, buyers allocate demand to the most productive sellers. This mechanism instantiates a meritocratic logic rewarding higher productivity. In normative terms, this aligns with the marginal productivity tradition and its moral-political interpretations (Clark 1899; Samuelson 1947), and with a broad empirical literature showing that many subjects endorse "merit" or effort-based allocation rules, especially when they perceive them as efficiency-enhancing (Cappelen et al. 2007; Konow 2000). In positive terms, it can be seen as a buyer-side analogue of "supplier development" or quality selection: buyers concentrate demand on sellers who can reliably supply and potentially lower long-run costs. However, because it channels demand toward already-advantaged agents, this rule can intensify inequality and amplify survival selection against low-productivity types, even if aggregate capacity is not binding.

2.4.2.5 Random selection

Random selection chooses a seller uniformly at random among available options. This is not intended necessarily as a behavioral claim about real consumers; it is a benchmark representing frictional matching absent systematic preference over price, income, consumption, or productivity. It is widely used in agent-based and search models to isolate the causal contribution of structured partner selection from background stochasticity and spatial proximity. Random matching therefore provides a useful counterfactual against which to measure how "structured access" rules generate distributional bias and selection dynamics.

2.4.3 Consumption rules

In contrast to standard approaches that represent consumption as the outcome of instantaneous utility maximization, we conceptualize consumption as well as a habit slow to change, a socially determined standard of living that conditions reproduction and continued participation.

A foundational insight shared by classical political economy and modern welfare theory is that consumption defines the conditions of economic reproduction prior to distribution and exchange. In the classical surplus tradition, agents must reproduce at a given standard of living before any surplus can be meaningfully generated or appropriated (Marx 1867; Ricardo 1817; Smith 1776). Consumption standards therefore delineate the boundary between viability and exclusion. This view is echoed in Sen's capability approach, where living standards are understood as socially and historically determined thresholds that condition effective participation in economic life (Sen 1985, 1999). From this perspective, consumption is not merely an expression of preference but an institutionalized norm that evolves with circumstances. Consistent with this tradition, the model treats consumption as a rule-governed adjustment of living standards operating under subsistence constraints. Consumption standards adapt over time in response to experienced economic conditions rather than forward-looking optimization. Importantly, in line with common practice in agent-based modeling, adaptation is based primarily on real and observable variables, namely realized consumption, rather than on nominal income. Income, being mediated by prices and endogenous to distributional mechanisms, is an unreliable signal of effective living standards in decentralized, out-of-equilibrium environments. Basing adaptation on realized consumption allows the model to track material adequacy directly while avoiding confounding nominal effects arising from price dynamics and access restrictions.

2.4.3.1 Adaptive standards and temperance

A substantial body of empirical and theoretical literature documents that realized consumption shapes future norms and perceived necessities. Duesenberry's (1949) relative income hypothesis established that consumption aspirations depend on past consumption and relative position, implying that higher realized consumption tends to redefine what is perceived as necessary. Subsequent work on habit formation and reference dependence has reinforced this insight, showing that consumption standards adjust upward with experience and exhibit persistence over time (Abel 1990; Carroll, Overland, and Weil 2000). These contributions document a robust empirical regularity, sustained abundance alters norms, and do not rely on full intertemporal optimization.

Consequently, within this framework, heterogeneity in consumption behavior arises from differences in how rapidly agents translate abundance into higher living standards. We capture this dimension through the notion of *temperance*. Temperance governs the speed at which experienced abundance becomes incorporated into consumption standards.

Beyond temperance, we also consider consumption cap. A possible reason to limit consumption is responsible consumption in which individuals make deliberate choices to reduce consumption due to its environmental impacts in light of ecological, social and ethical considerations (De et al. 2025). Research reviews show that attitudes toward environmental values, moral motives, and awareness are key drivers of lower consumption and sustainable choices, reflecting an orientation in which less consumption is itself a normative goal, not merely a by-product of purchasing preferences (De et al. 2025).

Another reason to include limiting consumption echoes the merit aspect of distribution discussed. When merit is identified with productivity, higher productivity legitimizes higher (income and therefore) consumption, and lower productivity a lower consumption. Accordingly, we add to the heuristic behaviors the *merit cap,* which consists of not consuming more than what an agent produces.

Taken together, the literature motivates two orthogonal dimensions of consumption behavior: temperance, governing how strongly abundance is translated into higher consumption, and merit cap, captured by the presence or absence of a productivity-based cap. Their combination yields four consumption modalities implemented in the model:

1. Temperate, where agents adjust consumption slowly and face no cap relative to productivity.
2. Intemperate, where agents rapidly expand consumption and have no cap.
3. Temperate with cap, where agents adjust consumption slowly and face a productivity cap.
4. Intemperate with cap, where consumption adjust fast to experienced abundance and but consumption contained by the merit cap.

2.4.4 Extractive classification

The characters defined above are classified as *extractive* insofar as they entail systematic appropriation of surplus beyond net productive contribution. In the framework of the model, extractiveness refers to behavioral rules that translate market power or productivity-based entitlement into disproportionate surplus absorption, thereby reducing the resources available for others' survival at adequate living standards.

On the seller side, gain-seeker and merit-seeker pricing modalities are structurally extractive. Gain-seekers exercise market power by increasing mark-ups whenever scarcity allows, thus aiming at appropriating additional surplus. Merit-seekers, by contrast, operationalize productivity-based entitlement: they raise prices in proportion to relative productivity, thereby translating merit into surplus claims. While the merit-seeker is constrained by its own productivity, the rule remains extractive because it legitimizes surplus appropriation on the basis of relative advantage, reinforcing differential access through price dynamics.

Buyer-selection rules are not directly extractive in the same mechanical sense, since they allocate demand rather than directly determine surplus absorption. However, they can either counteract or amplify extractive tendencies. Lowest-price selection disciplines mark-ups and therefore operates as an anti-extractive mechanism. Lowest-income and, under informational interpretation, lowest-consumption selection introduce redistributive or pro-social access channels that mitigate exclusionary dynamics. By contrast, highest-productivity (merit-based) selection reinforces extractive structures, as it systematically directs demand toward already advantaged agents, strengthening cumulative surplus concentration.

On the consumption side, extractiveness is defined relative to productivity. Intemperate consumption increases the propensity to appropriate surplus rapidly as resources become available, thereby raising

the likelihood that consumption exceeds net productive contribution. Generative consumption reduces such appropriation by limiting the translation of abundance into higher living standards. When the merit cap is active appropriation is structurally bounded, preventing consumption from exceeding productive contribution and thereby eliminating extractive consumption by construction.

The extractive/non-extractive classification does not "judge" characters ex ante; rather, it expands the analytical space beyond the canonical profit- or utility-maximizing agent, which have traditionally been evaluated positively, being associated with the welfare theorems and often metaphorically defended through the "bees" argument—that individual self-interest promotes collective welfare. Our objective is not to contest that benchmark normatively, but to evaluate its systemic implications on economic inclusiveness alongside alternative characters.

2.5 HYPOTHESES

The line of reasoning followed insofar bring us to the following hypotheses

- *H1. Economic outcomes in decentralized markets are not neutral with respect to the prevailing distribution of characters.*
- *H2. In homogeneous economies (i.e., composed of a solo character), economic inclusiveness trades off against extractive characters.*
- *H3. In hybrid economies, extractive characters prevail over generative characters (i.e., the latter are excluded first).*
- *H4. As a consequence of H2 and H3, hybrid economies bring extractive characters to prevail which in turn generate later a fall of economic inclusiveness. Thus, decentralized markets alone are insufficient to ensure economic inclusiveness (even when aggregate* productive capacity is sufficient)
- *H5. As a consequence of H4 and H1, decentralized economy alone undermines their long term economic inclusiveness (without characters control).*

These hypotheses are formulated within a precise analytical domain. The analysis abstracts from technological change, capital accumulation, credit, redistribution, and institutional evolution, and holds the distribution of productive capacity fixed. Aggregate productive capacity is sufficient to sustain universal survival in principle in all simulations. Differences in survival, income, consumption, and productivity therefore arise exclusively from decentralized pricing and buyer-selection rules, interpreted as manifestations of agents' characters. Accordingly, the hypotheses do not concern long-run economic growth or welfare in a general equilibrium sense. They concern the *viability and performance of decentralized market coordination under fixed technological and subsistence conditions*, focusing on how character-driven micro-level exchange rules jointly shape average economic outcomes and survival at adequate living standards over time. The aim is to isolate the role of characters in generating inclusion, selection, and collapse in decentralized economies.

3 METHOD AND MODEL

3.1 MODEL PREMISES

The model is a decentralized agent-based survival game designed to evaluate how alternative characters shape consumption, collective survival at adequate living standards (economic inclusiveness), selection, and average productivity. The economy is deliberately kept simple and fully decentralized: agents interact locally under partial information, without market-clearing conditions, credit, or centralized redistribution. This structure isolates the role of characters and their heuristic rules and, across simulations, it is the only systematic source of variation.

Consistent with the objectives of the paper, the literature reviewed, and computational feasibility, the model adopts the following assumptions.

There are two goods. Each agent produces one good and consumes the other; apart from this specialization, agents are identical. Production is proportional to an idiosyncratic, exogenous, and time-invariant productivity parameter K. The distribution of K is chosen such that aggregate productive capacity is sufficient for universal survival in principle; therefore, any exclusion or collapse arises from decentralized interaction rather than technological scarcity.

Markets are local, implying limited competition. Agents are spatially located and interact only with nearby neighbors, observing only local conditions. As a result, sellers may (or may not) exploit limited competition to impose markups. Buyers, in turn, can access only a small local set of potential sellers. In each purchase decision, a buyer identifies the two nearest feasible sellers of the required good and selects one according to its buyer rule (e.g., lowest price, lowest income, highest productivity).

Sellers observe only their own realized sales, consumption and income at the end of each period. Unsold inventory constitutes a sufficient local signal of excess supply, possibly triggering price adjustments in the subsequent period. Prices therefore evolve endogenously as a function of inventories, target income (which depends on the usual consumption), productive capacity, in a combination reflecting the seller's pricing character.

Across all modalities, prices respond exclusively to realized outcomes. Inventories thus act both as buffers and as the sole feedback signal governing price dynamics. This design avoids imposing market-clearing conditions or nominal equilibrium targets, while ensuring that reproduction constraints discipline pricing behavior whenever survival is at stake.

The model assumes limited information and procedural rationality. Sellers set prices before observing buyers and therefore cannot condition prices on buyers' characteristics or constraints. By contrast, buyers may observe salient seller attributes—such as posted prices or observable income—before making their purchasing decision. This informational asymmetry reflects decentralized market interaction under bounded rationality, where pricing decisions are made ex ante on the basis of local feedback rather than contingent contracting.

Additional assumptions are as follows. Income constraint: buyers cannot spend more than their current monetary holdings; borrowing is not allowed. Survival: after trading and consumption, agents who fail to meet minimum consumption standards exit permanently. Survival—interpreted as economic inclusiveness—is therefore a state variable with absorbing failure. Time horizon and path dependence: simulations run for a fixed maximum number of turns and terminate earlier if population decline makes meaningful market interaction impossible (e.g., fewer than three agents remain alive or with positive income).

The next subsection presents the formalization of the model, including equations, algorithmic steps, and parameter values.

3.2 NOMENCLATURE AND KEY DEFINITIONS

Time is discrete ($t = 0,1,2, \ldots$). Each agent i has a random productivity ($K_i > 0$) (units produced per turn), a consumption at time t ($m_{(i,t)}$) (in units), and a unit cost ($c_{(i,t)}$) (implemented as the last transaction price paid by i for the consumed good).

3.2.1 Income constraint

Let us define monetary income ($I_{(i,t)}$) constraint to reproduce the current living standard of the agent *i* at time *t* as:

$$I_{(i,t)} \equiv c_{(i,t)} m_{(i,t)}$$

$I_{(i,t)}$ is not necessarily the agent's survival cost since the agent's consumption may exceed the minimum necessary for surviving at adequate living standard (m_0). We will denote the survival income constraint (I_0) as

$$I_0 \equiv c_{(i,t)} m_0$$

3.2.2 Production

The production of an agent *i* at each time *t* is the agent's productivity (K_i).

3.2.3 Revenues

Maintenance of consumption is obtained when income constraint equates to the revenues given by the price ($p_{i,t}$) times the quantity sold ($q_{s_{i,t}}^*$)

$$I_{(i,t)} \equiv c_{(i,t)} m_{(i,t)} = p_{i,t} q_{s_{i,t}}^*$$

From the Income constraint equations, we obtain the price of maintenance p_{i,t_M} and price of survival p_{i,t_0}, respectively:

$$p_{i,t_M} = \frac{I_{(i,t)}}{q_{s_{i,t}}}, \qquad p_{i,t_0} = \frac{I_{(i,t)_0}}{q_{s_{i,t}}}$$

3.2.4 Real Surplus

Surplus (S) of an agent is given by the difference between the quantity the agents produce and that it should consume to survive

$$S = K_i - m_0$$

We assume that both the good consumed and produced have the same value, and that aggregate initial surplus is largely positive (abundance economy).

The agent can take the surplus for itself (S_i) or give it to others (S_{-i}) according to its consumption

$$S_i = m_i - m_0, \qquad S_{-i} = K_i - m_i$$

Agent surplus is minimum when it consumes nothing beyond its survival consumption ($m_i = m_0$).

Let us define the markup on quantity μ^m as

$$m_i = (1 + \mu^m) m_0$$

Such that

$$S_i = (1 + \mu^m)m_0 - m_0 = \mu^m m_0,$$

where $\mu^m \geq 0$. When surplus is $1 + \mu^m = \frac{K_i}{m_0}$ the agent absorbs as much as it produced, when it exceeds this threshold it consumes more, vice versa, less.

3.3 PRICE MECHANISMS

The model implements four seller pricing modalities—zero-markup (reproduction), sell-seeker, gain-seeker, and merit-seeker—which replace standard constant mark-up rules. These modalities are intended to capture boundedly rational pricing heuristics under limited information, local competition, and survival constraints.

3.3.1.1 Zero markup (reproduction)

Under the zero-markup rule, the agent sets its price equal to the reproduction price (p_{i,t_M}), i.e. the unit price required to reproduce its customary consumption level.

$$p_{i,t} = p_{i,t_M}$$

This modality represents a purely reproductive pricing behavior: the agent aims only at maintaining its living standard, neither extracting surplus nor competing strategically through price adjustments.

3.3.1.2 Sell-seeker sellers

Sell-seeker sellers prioritize sales. Their behavior is driven by the objective of avoiding unsold output, subject to a strict reproduction constraint.

If unsold inventory exists $\left(K_i - q^*_{i,t-1} > 0\right)$, sell-seekers reduce prices of a share μ^* and proportionally to the share of unsold production:

$$p_{i,t} = p_{i,t-1} \cdot \left(1 - \mu^* \frac{K_i - q^*_{i,t-1}}{K_i}\right).$$

If no unsold inventory exists, the price is left unchanged. In all cases, prices are bounded below by the reproduction price $p_{i,t} = \max\left(p_{i,t}, p_{i,t_0}\right)$.

3.3.1.3 Gain-seeker sellers

Gain-seeker sellers prioritize income extraction, while remaining responsive to excess supply. When sales fall short of productive capacity, the seller considers lowering the price only insofar as doing so does not reduce revenues.

Assuming that a price reduction enables the sale of at least one additional unit, the revenue-preserving condition is, $p_t(q^*_{t-1} + 1) \geq p_{t-1} q^*_{t-1}$, which implies: $p_t \geq p_{t-1} \frac{q^*_{t-1}}{q^*_{t-1}+1}$.

To satisfy this constraint, the gain-seeker sets:

$$p_{i,t} = p_{i,t-1} \frac{q^*_{i,t-1}}{\min\,(K_i, q^*_{i,t-1} + 1)} + \mu^*,$$

where $\mu^* > 0$ is an exogenous mark-up parameter.

This rule implies that prices decrease sharply when sales are low, decline less as sales approach capacity, and eventually increase once sales are sufficiently high. When the agent sells at full capacity, it applies the full mark-up.

As previously, prices are bounded below by the reproduction price: $p_{i,t} = \max\,(p_{i,t}, p^0_{i,t})$.

3.3.1.4 Merit-seeker sellers

Merit-seeker sellers implement a hybrid pricing rule, balancing responsiveness to excess supply with merit-based mark-up extraction.

A normalized merit index is computed as:

$$\text{merit}_i = \frac{K_i - \min\,(K)}{\max\,(K) - \min\,(K)},$$

where the minimum and maximum are computed among alive agents in the economy.

When the agent sells its entire output, it applies a mark-up proportional to its merit. Formally:

$$p_{i,t} = \begin{cases} p_{i,t-1} + \mu^* \cdot \text{merit}_i, & \text{if } q^*_{i,t-1} = K_i, \\ p_{i,t-1}\left(1 - \mu^* \dfrac{K_i - q^*_{i,t-1}}{K_i}(1 - \text{merit}_i)\right), & \text{otherwise.} \end{cases}$$

Under on-merit pricing, agents set a productivity-indexed mark-up that increases with their productivity relative to the least productive agent in the economy. More productive agents are therefore entitled to higher prices, aiming at appropriating a larger share of the surplus. This rule reflects a common-sense interpretation of merit, according to which higher productivity justifies higher remuneration.

3.3.1.5 Random fixed

The last is a benchmark/counterfactual, useful for comparing performances, where the price assumes a random value uniformly distributed between p_{min} and p_{max} at the beginning and is maintained fixed.

$$p \in [p_{min}, p_{max}]$$

3.4 BUYING SELECTION MECHANISMS

Buyer selection mechanisms (BSMs) specify how a buyer chooses a seller among a locally available set when purchasing the required good. Let $F_i(t)$denote the set of feasible sellers available to buyer i at time t, and let $p_x(t), c_x(t), and\ y_x(t)$ represents respectively the posted price, the consumption, and the current monetary income of seller x. The buyer selects one seller $j \in F_i(t)$ according to the following rules:

- Lowest-price selection: $j = \arg\min_{x \in F_i(t)} p_x(t)$.

- Lowest-consumption selection: $j = \arg\min_{x \in F_i(t)} c_x(t)$.
- Lowest-income selection: $j = \arg\min_{x \in F_i(t)} y_x(t)$.
- Highest-productivity (merit-based) selection: $j = \arg\max_{x \in F_i(t)} K_x$.
- Random selection: $j \sim \text{Uniform}(F_i(t))$.

If multiple sellers satisfy the selection criterion, ties are broken uniformly at random.

3.5 ADAPTATIVE CONSUMPTION

Agents adjust consumption endogenously in response to realized availability of the consumed good. Let $m_0$denote the subsistence (minimum) consumption level, and let $q_{i,t}$denote the total quantity of the consumption good available to agent $i$at time $t$after trading. Consumption adjusts upward from subsistence when resources exceed this minimum.

Let $\alpha_i \in [0,1]$denote agent i's degree of *intemperance*, governing the speed at which abundance is translated into higher consumption. Baseline adaptive consumption is defined as:

$$m_{i,t} = m_0 + \alpha_i \max(0, q_{i,t} - m_0).$$

Higher values of α_i imply faster upward adjustment of consumption standards in response to abundance.

When the generative cap is active, consumption is bounded above by a fraction of individual productivity. Let $\gamma \in [0, +\infty]$ denote the share of productivity that can be converted into consumption. Consumption then becomes:

$$m_{i,t} = m_0 + \min(\alpha_i \max(0, q_{i,t} - m_0), \gamma K_i),$$

Values of $\gamma \leq 1$impose a merit cap, ensuring that consumption remains below productive capacity.

The four consumption modalities correspond to combinations of temperance and generativity cap:

- Temperate consumption: Agents have low α_i, implying slow adjustment of consumption above subsistence and no merit cap ($\gamma = +\infty$).
- Intemperate consumption: Agents have high α_i, implying rapid adjustment of consumption toward available resources and no merit cap ($\gamma = +\infty$).
- Temperate–generative consumption: Agents are temperate (low α_i) and face a finite merit cap.
- Intemperate–generative consumption: Agents are intemperate (high α_i) and have a finite generative cap.

To test the hypotheses that common merit sense, where an agent is entitled to a share as large as its productivity, is at odd with economic inclusiveness, we introduce the index Beyond Merit Consumers (BMC), which counts the number of agents whose consumption exceeds the merit cap. Formally:

$$BMC_t = \frac{\sum_{i \in SUR_t} \begin{cases} 1 \; if \; m_{i,t} > K_{i,t} \\ 0 \; otherwise \end{cases}}{n}$$

Where SUR_t is the set of agents in the market at time *t* and *n* is the number of agents in that set.

3.6 SIMULATION

Each simulation initializes a population of 150 agents on a 50×50 spatial grid. For each configuration of pricing and buyer-selection rules, the simulation is repeated 40 times; results are reported as means and standard deviations across repetitions.

Before each simulation the seller and buyer modalities are set for every agent and will not change. These are the same for everyone except for the random-random combination, which chose randomly the buyer and seller modalities at beginning (and then hold them constant).

At initialization, each agent is assigned: a fixed productivity parameter K, drawn uniformly from $[10,50]$; a random initial position on the grid; one produced good, $x$or y, assigned at random (and consumes the other good); an initial monetary endowment (income) of 100; an initial resource endowment of 20 for the consumed good; an initial posted price equal to 2, the same the unitary cost; a cost of living of 10 (for the resource the agent does not produce); temperance degree (α) equal to 0.25 for agents with temperance, vice versa 0.75, moreover, agents with generative consumption consumes only the 85% of their productivity ($\gamma = 0.85$), used only when adaptive consumption is activated; Mark-up is set at 6.6% (that is on average the double of the price reduction of gain-seeker, given by $\frac{average\ K}{average\ K+1}$).

Figure 2 illustrates the initial configuration of the simulation: agents are randomly located in space, endowed with heterogeneous productivity levels, and start with identical monetary resources.

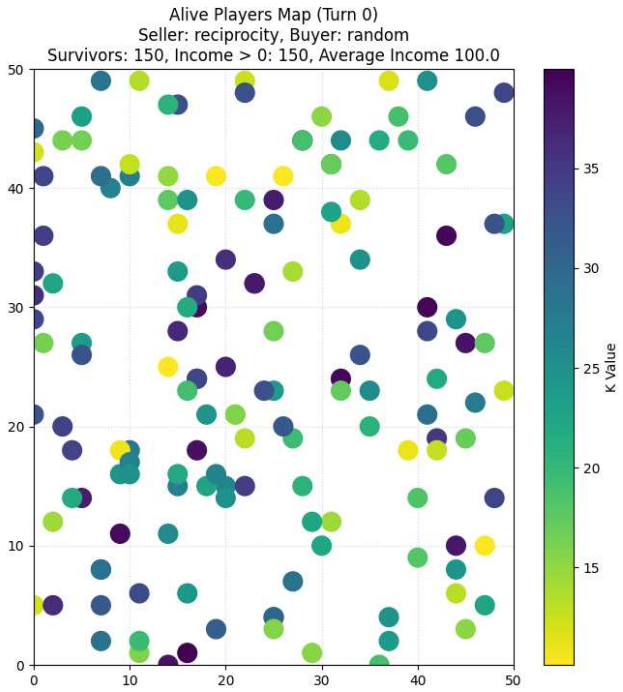


Figure 1 Initial set up example.

Each simulation unfolds as a sequence of discrete turns with the following structure:

1. *Production Phase.* All agents produce their assigned good in quantity proportional to their productivity K, adding it to their inventory.
2. *Price Phase.* All agents set their price.
3. *Movement Phase.* Each agent performs a random movement in space, introducing local variation in trading opportunities.
4. *Trading Phase.* Agents sequentially take the role of buyer:
    - The buyer identifies the two closest feasible sellers of the required good. Only sellers possessing a quantity higher than zero are selectable.
    - The buyer selects one seller according to the buyer rule.
    - A transaction occurs, updating monetary income and inventories for both agents, subject to feasibility constraints. There are *exchange constraints*. Agents cannot spend more income than they currently possess.
5. *Consumption Phase.* After all buyers have acted, agents adapt their consumption according to the reserves and then they consume the required quantities. *Agents unable to meet subsistence requirements exit (do not survive).*

The simulation proceeds for a maximum of 500 turns. It terminates earlier if fewer than three agents remain alive or if fewer than three agents have a positive income, reflecting the collapse of meaningful market interaction.

4 RESULTS

This section discusses the main patterns emerging from the simulation results for homogenous and hybrid markets. Results are summarized in Figures 2-4 and Table 3 (in appendix I).

4.1 HOMOGENEOUS MARKET - H1 AND H2

This section presents cross-sectional results by character configuration, averaged over 40 independent simulation runs. The dependent variable is the survival rate, interpreted as economic inclusiveness. All estimates exclude hybrid configurations which is considered later alone.

The analysis focuses on turn 25 and turn 50. Turn 25 is the primary horizon of interest, as by turn 50 a non-negligible subset of configurations has already reached extinction or near-extinction, reducing the effective cross-section and limiting comparability across characters. Extending the horizon further would mechanically bias comparisons toward surviving configurations only. Survival patterns by configuration and horizon are reported in Table 3 (appendix I).

For each explanatory variable, we consider three samples: (i) the full sample; (ii) a restricted sample excluding *random* and *fixed-random* seller modalities; (iii) a further restricted sample excluding configurations with *merit cap*. This strategy allows us to assess sensibility and robustness.

4.1.1 Hypothesis H1

H1. Economic outcomes in decentralized markets are not neutral with respect to prevailing distribution of characters.

To assess H1, we examine the cross-sectional variation of survival rates across character configurations, measured at turn 25 and turn 50. If decentralized outcomes were neutral with respect to character distributions, survival rates would display limited dispersion across configurations. Results are displayed in Table 1.

Table 1 Cross-sectional dispersion of Survivors % across characters

Sample	***Turn***	***N***	***Min (%)***	***Max (%)***	***Std. Dev.***
Full	25	100	10.4	100.0	28.8
Excluding random / fixed-random	25	80	10.4	100.0	30.1
Excluding merit cap	25	50	10.4	99.3	27.0
Full	50	95	0	99.9	28.7
Excluding random / fixed-random	50	75	0	99.9	30.4
Excluding merit cap	50	47	0	96.2	25.5

The data show substantial heterogeneity in survival outcomes. At turn 25, survival rates span almost the entire admissible range. In the full sample, survival ranges from 10.4% to 100.0%, with a standard deviation of 28.8. This dispersion remains pronounced when progressively restricting the sample to control for random noise and merit-cap rules. Excluding configurations with *random* or *fixed-random* modalities, survival continues to range from 10.4% to 100.0%, with a standard deviation of 30.1. When configurations with *merit cap* are excluded, survival still spans 10.4% to 99.3%, with a standard deviation of 27.0. These figures indicate that large cross-configuration differences persist under all control restrictions.

At turn 50, the effective cross-section is reduced because several configurations have already reached extinction. Nevertheless, survival outcomes among remaining configurations remain highly dispersed. In the full sample, survival ranges from 2.0% to 99.9%, with a standard deviation of 28.7. Comparable dispersion is observed when excluding *random* or *fixed-random* configurations (SD = 30.4) and when excluding *merit cap* (SD = 25.5). The reduction in the lower bound reflects selection induced by earlier extinction rather than convergence across outcomes.

Overall, the large and persistent dispersion of survival across character configurations provides clear support for H1. Economic inclusiveness in decentralized markets is not neutral with respect to the distribution of characters but varies systematically with the underlying interaction rules. *(H1b) As a consequence, decentralized markets alone are insufficient to ensure economic inclusiveness.*

4.1.2 Hypothesis H2

H2.1 In homogeneous economies (i.e., composed of a solo character), economic inclusiveness trades off against extractive characters.

In homogeneous decentralized markets a pattern emerges (Figure 2, Table 3). Configurations characterized by extractive seller rules—namely gain-seeker and merit-seeker pricing—systematically display lower economic inclusiveness compared to zero-markup and sell-seeker pricing. At turn 25, zero-markup pricing yields survival rates close to full inclusion, typically 95–100%, reaching 100% in several configurations, while sell-seeker pricing generally ranges between 75% and 95%. By contrast, merit-seeker pricing reduces survival to approximately 60–80%, and gain-seeker pricing frequently drives survival below 40%.

Buyer-selection rules condition these effects in a quantitatively identifiable way. When seller pricing is non-extractive, the lowest-price rule yields the highest survival rates (inclusion). Under zero-markup pricing at turn 25, survival with lowest-price selection reaches 100.0% with temperate with cap and intemperate with cap and remains slightly above 99% in uncapped variants (99.2–99.3%). Under sell-seeker pricing, lowest-price selection sustains survival between 85.6% and 98.2%, consistently outperforming alternative buyer rules within the same seller modality. Under extractive pricing regimes, redistributive buyer rules—especially lowest-income selection—partially mitigate exclusionary dynamics. For instance, under merit-seeker pricing at turn 25, survival with lowest-income selection lies between 77.4% and 79.4%, whereas under highest-merit (productivity-based), it falls sharply to approximately 38.0%. A similar pattern holds under gain-seeker pricing: survival with lowest-income selection is around 37–40%, while it declines to roughly 19–20% under highest-merit selection.

Consumption rules further reinforce this ordering. Within each character, higher temperance and the presence of a merit cap are systematically associated with higher survival. Under merit-seeker pricing with lowest-income selection at turn 25, survival is 77.4% under intemperate consumption and rises to 79.4% under temperate consumption. Under merit-seeker with lowest-price selection, survival remains stable (74.1% intemperate, 74.0% temperate, and 73.8% temperate generative), remaining systematically above the corresponding uncapped configurations. The effect becomes sharper under gain-seeker pricing. With lowest-income selection at turn 25, survival is 38.0% under uncapped intemperance, 38.2% under temperance, and declines further under more extractive combinations (e.g., around 20% under highest-merit selection). Under lower-consumption buyer rules, survival reaches its minimum levels (around 10–13%), confirming that productivity selection and lower consumption buyer dissonance amplifies exclusionary pricing dynamics. Overall, within any given seller modality, configurations with capped and/or temperate consumption never underperform their uncapped intemperate counterparts. This confirms that the speed and limits with which agents translate available surplus into consumption materially affect economic inclusiveness, reinforcing the structural trade-off generated by extractive pricing.

Overall, the results indicate a systematic inverse relationship between extractiveness and economic inclusiveness in homogeneous decentralized economies. The more strongly a character translates market power, merit, or abundance into surplus appropriation, the lower the resulting inclusiveness and survival rate.

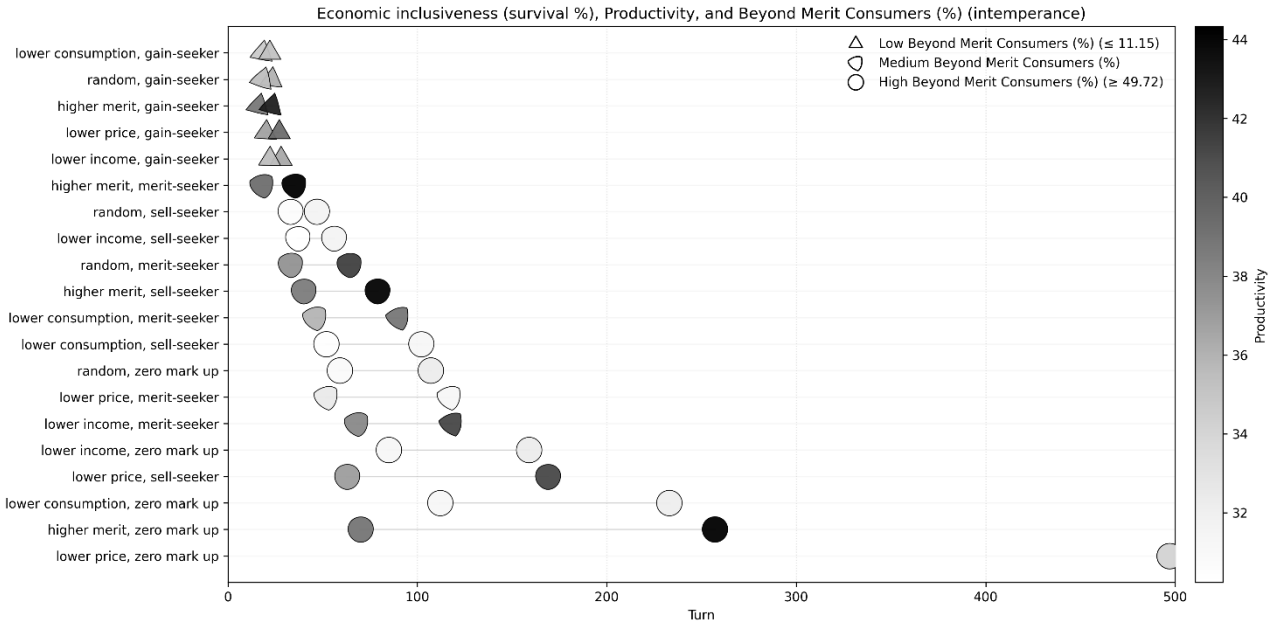


Figure 2 Average economic inclusiveness (survivors) at 50% (left dot) and 25% (right dot) overturn, productivity (color), and beyond merit consumers (shape) on characters with consumption intemperance. Figure legend: each row corresponds to one character averaged over 40 repetitions. The vertical axis orders according to economic inclusiveness measured as the percentage of agents surviving at adequate living standards. Survival is reported on two horizons: the turn when there are 75% of survivors (left dot) and 25% (right dot), illustrating both short-run and long-run viability. Marker color represents the average productivity of survivors (higher productivity corresponds to warmer colors), while marker shape indicates the percentage of consumers whose consumption exceeds their productivity. The figure summarizes the core pattern of the model: decentralized economies display wide dispersion in inclusiveness depending on the prevailing distribution of characters, extractive configurations select most productive agents, inclusive presents far-from merit consumptions.

H2.2 Extractives select (reduce inclusiveness) via productivity.

We test H2 by estimating univariate regressions of survival (economic inclusiveness) on productivity at turn 25 and 50 in Table 2.

Table 2 Univariate regressions across alternative samples at turn 25 and 50. Dependent variable Economic Inclusiveness (survivors %)

Variable	***Sample***	***B_0***	***β***	***R^2***
25th turn				
Productivity	Full	256.8***	–5.65***	0.69
	No random	266.8***	–5.89***	0.70
	No cap	253.4***	–5.53***	0.70
50th turn				
Productivity	Full	178.8***	–3.76***	0.58
	No random / fixed	195.3***	–4.12***	0.63
	No cap	173.7***	–3.61***	0.51

*Significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.*

Productivity is strongly and negatively associated with economic inclusiveness (survival %) across all samples. The magnitude and explanatory power of the coefficient are remarkably stable when excluding both random trading rules and capped regimes. This indicates that selection operates via productivity when reducing economic inclusiveness.

4.2 HYBRID - H3, H4, AND H5

This section examines the dynamics of a hybrid population composed of heterogeneous agents interacting under decentralized market rules. The hybrid configuration combines extractive and generative characters on the seller, buyer, and consumption dimensions and is simulated over 40 repetitions with 1,400 initial agents. Given the dimensionality of the resulting data, outcomes are summarized graphically in Figure 2, Figure 3 and Figure 4, while aggregate indicators at turns 25 and 50 are reported in Table 3 (appendix).

At turn 25, the hybrid economy exhibits an economic inclusiveness on average at 51.9%. By turn 50, it collapses to 5.2%, despite average productivity among survivors remaining high and stable (33.2 at turn 25 and 33.8 at turn 50). Beyond Merit Consumers share remains substantial throughout and slightly increases from 36.6% to 39.2%. These elements indicate that collapse is not driven by declining aggregate capacity, but by access and selection dynamics.

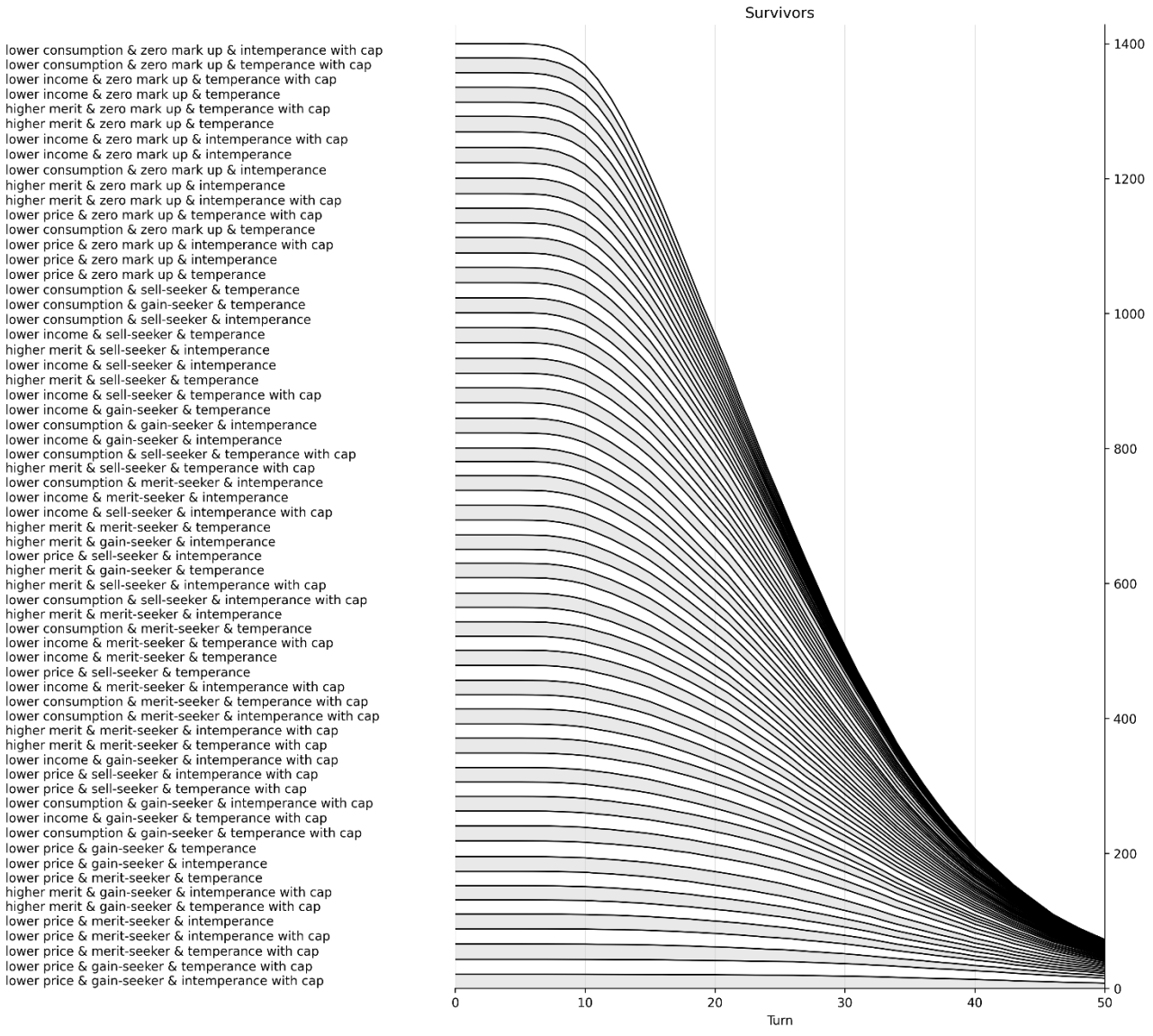


Figure 3 Survivors characters for hybrid population. This figure reports outcomes for the hybrid economy, in which heterogeneous characters coexist simultaneously. The figure illustrates a strong evolutionary selection effect: extractive strategies tend to persist longer and increase their relative weight among survivors, while generatives are progressively eliminated.

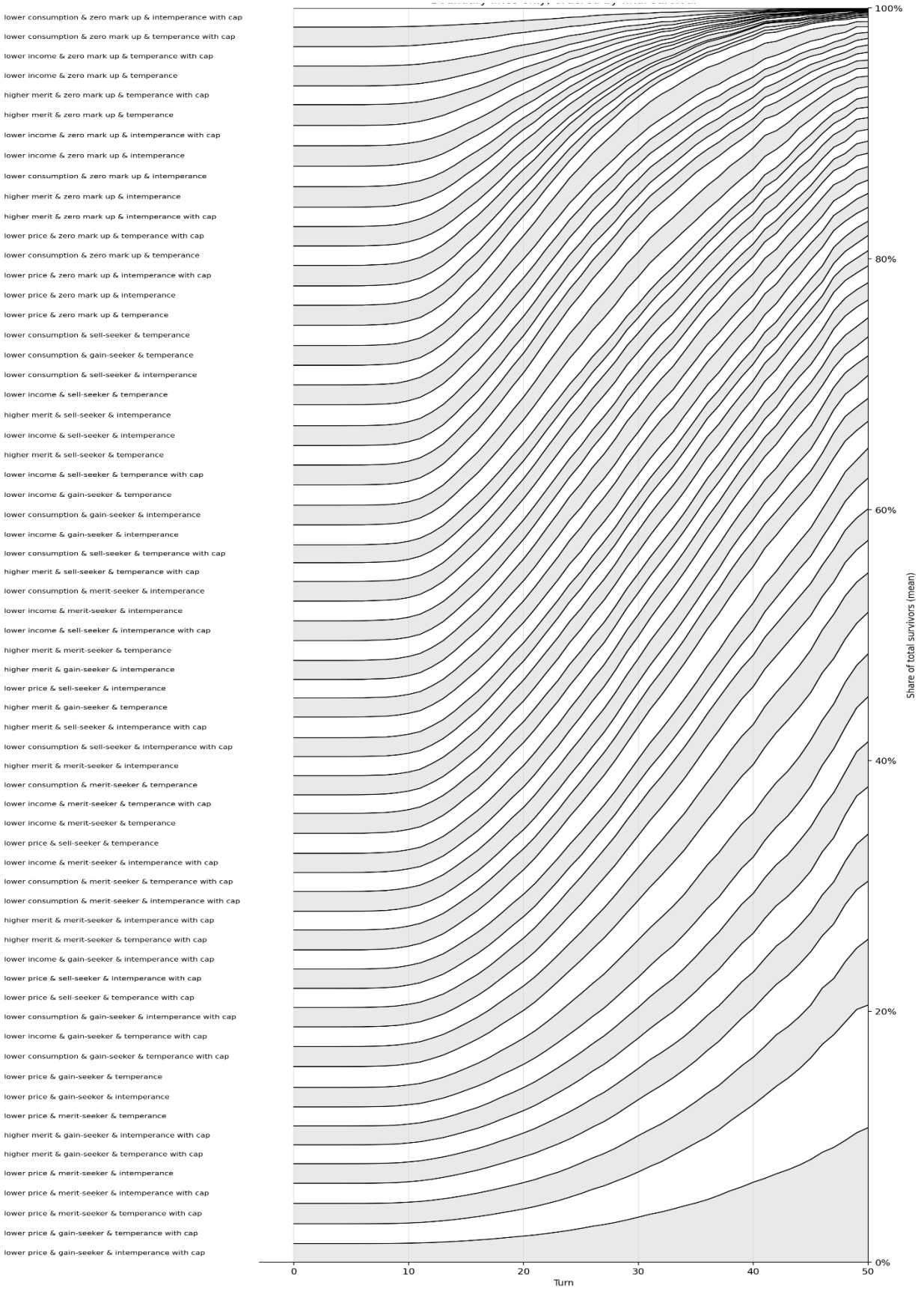


Figure 4 Survivors share for hybrid population until turn 50. This figure reports the time-series evolution of survival in the hybrid economy. The vertical axis shows the share of surviving agents over time, while the horizontal axis reports simulation turns. The plot shows the emergence of increasing share of extractive characters over time.

H3. In hybrid economies, extractive characters prevail over generative characters (i.e., the latter are excluded first).

Figures 2 and 3 reveal the key mechanism. When extractive and generative characters coexist, generative agents are systematically eliminated first. Their pricing, selection, and consumption rules expose them to appropriation by extractive agents, who benefit from the presence of generatives without reciprocating their access-preserving behavior. As the generative population shrinks, extractive agents initially continue to survive by exploiting the residual inclusive structure. Once generative agents disappear, however, extractive agents face only one another, at which point exclusion accelerates and survival collapses rapidly.

H4. Because of H2 and H3, hybrid economies bring extractive characters to prevail which in turn generate later a fall of economic inclusiveness. Thus, decentralized markets alone are insufficient to ensure economic inclusiveness (even when aggregate productive capacity is sufficient)

This dynamic implies that extractive characters prevail endogenously in mixed populations, not because they are collectively viable (see 4.1), but because they are individually resilient in the presence of generatives and insofar as there are generative. Prevalence here should be understood in evolutionary terms: extractive characters persist longer and expand their relative weight among survivors, even though their dominance undermines aggregate survival. Generative characters, by contrast, are collectively sustainable but individually fragile when exposed to extraction.

H5. As a consequence of H4 and H1, decentralized economy alone undermines their long term economic inclusiveness (without characters control).

In hybrid decentralized economies, generative survive less than extractives, which in turn reduce economic inclusiveness in the long run. Because of selection happens via productivity, decentralized markets alone generate short-term gains in productivity which may hide declining economic inclusiveness.

5 DISCUSSION

This paper examined how heterogeneous characters shape economic inclusiveness and productivity in decentralized market economies through an agent-based survival model. Economic inclusiveness was defined in viability terms as collective survival at adequate living standards, under fixed aggregate productive capacity and in the absence of redistribution or institutional correction. The results provide systematic support for the hypotheses advanced in 2.5.

First, the cross-sectional analysis across homogeneous character configurations documents substantial dispersion in survival outcomes at both turn 25 and turn 50. Survival rates span nearly the entire admissible range even when progressively excluding random trading rules and generative consumption regimes. This large and persistent dispersion confirms H1: decentralized market outcomes are not neutral with respect to character configurations. Under identical technological conditions and sufficient aggregate productive capacity, alternative combinations of pricing, buyer-selection, and consumption rules generate sharply different levels of economic inclusiveness.

Second, the ordering observed in homogeneous economies supports H2. Characters with extractive seller rules—gain-seeker and merit-seeker pricing—are systematically associated with lower survival rates relative to zero-markup and sell-seeker pricing. This ordering persists across buyer-selection rules and consumption modalities. Redistributive buyer rules, such as lowest-income selection,

partially mitigate exclusion under extractive pricing, yet do not restore survival to the levels observed under non-extractive seller regimes. Similarly, temperate and capped consumption rules are typically associated with higher survival within a given seller–buyer configuration. Taken together, these results indicate a robust inverse relationship between extractiveness in decentralized exchange rules and economic inclusiveness.

Third, the regression evidence shows a strong negative association between survival and average productivity. These patterns are consistent with productivity-based selection dynamics: configurations that generate higher average productivity among survivors tend to do so by excluding a larger fraction of lower-productivity agents. The explanatory power of productivity declines at turn 50, reflecting the fact that the later cross-section is already conditioned on prior survival, but the qualitative relationship persists.

Finally, the hybrid simulations provide dynamic confirmation of these cross-sectional patterns. In the hybrid configuration, survival declines sharply between turn 25 and turn 50, while average productivity among survivors remains stable and above the initial population mean. The joint increase in average productivity and decrease in survival is due to progressive selection rather than generalized decline in productive capacity (which is fixed by construction). Even under aggregate abundance, decentralized interaction combining extractive pricing and merit-based access rules generates cumulative exclusion over time.

Overall, the results establish a coherent empirical pattern: decentralized markets operating under fixed technological conditions generate a structural trade-off between productivity-based selection and economic inclusiveness. Extractive pricing and merit-indexed access rules are associated with stronger selection and higher average productivity among survivors, but lower economic inclusiveness. Generative and reproduction-oriented rules sustain broader survival, albeit with weaker average productivity.

5.1 THE ROLE OF POWER AND MERIT

Standard microeconomics recognized the role of market power as a source of surplus loss and misallocation while failed to recognize productivity-based-power as such, especially when the mask of common sense of merit hides its real effect.

Decentralized markets allocate resources through mechanisms that inevitably operate as mechanisms of selection. Whether allocation is organized around explicit criteria such as productivity or emerges indirectly through prices, scarcity, and market power, the result is differential access to resources and survival contingent on relative position rather than absolute need. A large critical literature has emphasized that such outcomes are often retrospectively interpreted as deserved, even when they primarily reflect structural advantage, power, or luck rather than contribution (Bruni and Sugden 2013; Sandel 2020; Sen 1999).

The results of this paper concur to clarify how merit operates within this process. When merit is defined in the common sense—as entitlement to a larger share of surplus proportional to productivity—productivity-based rules raise average productivity among survivors precisely by intensifying selection and lowering economic inclusiveness.

The key limitation of classical merit lies in its focus on gross contribution while remaining blind to net contribution. What matters for economic inclusiveness is not how much an agent produces, but how much remains available to others once appropriation is taken into account. The simulations show that when higher productivity systematically translates into higher consumption, highly productive

agents also become highly extractive. Their superior performance does not necessarily translate into greater generativity in net terms, in fact, it may lead many to lower economic inclusiveness.

It must be stressed that when merit operates on consumption—reducing appropriation to less than what agents produce—economic inclusiveness increases. This reflects the net contribution of an agent: only by producing more than one consumes can one contribute to the overall surplus. However, this implies that merit should not be understood as entitlement to a larger share of the surplus. On the contrary, merit is the difference between what an agent generates and what it consumes (Bova 2024, 2025). Under this definition, an agent is meritorious not simply because she produces more, but because she produces more for others. Merit, in this sense, is rewarded with honor and greater economic inclusiveness; merit, in the conventional sense, instead rewards power with higher consumption, thereby reducing inclusiveness.

The appendix II provides a regression of economic inclusiveness on productivity, Beyond Merit Consumers percentage, temperance, and merit cap. The results suggest that cultivating temperance and merit cap on consumption increases economic inclusiveness, which in turn would legitimate character cultivation to foster economic inclusiveness.

5.2 THE ROLE OF CULTIVATING GOOD CHARACTERS

The results of this paper point to a specific and neglected source of market failure which arises in case of the lack of cultivation of generative characters. In the decentralized environment studied here, the absence of mechanisms that favor generative characters allows extractive ones to prevail, generating systemic negative effects that are not internalized by individual agents and leading to progressive lower survivors and economic inclusiveness. To accept that any character is equally valid and legitimate leads consequently to a *characters neutrality based -market failure*.

In the hybrid model, extractive agents do not fail individually, in fact to be extractive guarantees higher survival rate. The failure emerges at the system level: when extractive characters become prevalent, their pricing and selection rules impose negative externalities on others' access to goods, progressively pushing otherwise viable agents below subsistence thresholds. Individual extraction is privately profitable but socially costly, as it erodes the conditions that sustain collective survival at adequate living standards.

Decentralized market interaction does not internalize the long-term survival costs generated by extractive behavior. Even when aggregate productive capacity is sufficient for universal survival in principle, the system converges toward exclusionary outcomes. The market therefore fails not because it lacks efficiency in allocation, but because it lacks capacity to discipline extraction and reward generativity.

From this perspective, the results reopen a dimension of economic policy that has largely disappeared from contemporary economic analysis: the role of character cultivation as a condition for market viability. In classical political economy, markets were not conceived as morally neutral devices, but as social institutions whose functioning depended on agents' dispositions and habits (Smith, 1759; Hirschman, 1977). Modern economics, by contrast, has largely bracketed character formation, treating preferences as given and focusing on incentive compatibility and institutional design (Bruni & Sugden, 2013; Sandel, 2020). This interpretation is consistent with a growing body of work emphasizing that traits such as reciprocity, restraint, and concern for others have economically relevant consequences, not as moral virtues per se, but as determinants of systemic performance (Bowles, 2016; Heckman et al., 2023).

Character cultivation is not meant to substitute institutions, redistribution or incentive based policies, arguments we voluntarily excluded from the analysis, instead, insofar as good characters provide self-sustaining and inclusive market, it may be a good candidate as a prevention instead of the post-market transactions cures.

The conclusion of our research is that, to preserve short and long term inclusion, cultivating characters is an economic policy. Since pricing, purchasing, and consumption behavior systematically shapes economic inclusiveness, policies that influence preferences, norms, and dispositions are not ancillary but central. This includes narratives, social norms, and incentive-compatible frameworks that encourage restraint, reciprocity, and limits on extraction. As emphasized by Sandel (2020) and Bruni and Sugden (2013), markets presuppose moral and civic foundations they do not generate themselves. The present results provide a micro-founded rationale for such policies: when agents voluntarily limit appropriation relative to productivity, decentralized interaction remains viable and inclusive. Sustainability-oriented policies—already widespread in environmental and social domains—can thus be interpreted as character-shaping interventions that operate upstream of redistribution, affecting market outcomes directly rather than correcting them ex post.

5.3 Limitations and Future Research

This study adopts a deliberately parsimonious agent-based framework to isolate the role of decentralized pricing and access rules in sustaining survival at adequate living standards. Several limitations follow from this choice.

- Characters have been considered determinant to understand long-term results; however, these can be extended from heuristic in many circumstances.
- A clarification on the role of incentives is warranted. The analysis deliberately abstracts from incentives, learning, and strategic adaptation: productivity and characters are fixed, and agents do not respond to rewards or sanctions. This is not a limitation, but a methodological choice consistent with the purpose of the exercise. By removing incentives from the picture, the model isolates which combinations of behavioral orientations and pricing rules are structurally compatible with inclusion and survival, independently of motivational distortions. Exclusionary outcomes, when they arise in this setting, cannot be attributed to moral hazard or opportunism, but to the way merit, prices, and access are institutionally combined. In this sense, the analysis does not speak to how incentives should be designed, but to which preferences and dispositions would need to be cultivated for market interaction to remain both viable and inclusive (Bowles 2016; Bruni and Sugden 2013).
- Future work may introduce endogenous character evolution or learning to compare structural and behavioral sources of inclusiveness.
- Institutions are held constant to assess whether decentralized market interaction alone can sustain viability. Extending the framework to include institutional feedbacks—such as taxation or transfers—would allow analysis of interactions between market-level extractiveness and institutional inclusiveness.
- Further possible extension concerns the role of technological progress. The model deliberately abstracts from endogenous productivity growth and from technological spillovers that could raise living standards more broadly over time. Productivity is exogenous and fixed, and aggregate productive capacity is sufficient for universal survival in principle. This modeling choice isolates exclusionary dynamics that arise purely from decentralized pricing, access rules, and merit-based entitlement under abundance. In real economies, however, productivity improvements may generate technological progress capable of expanding opportunities for all agents. An important extension would therefore examine whether, and under which conditions, technological progress diffuses broadly enough to counteract extractive and merit-

based selection dynamics, or whether it becomes captured by extractive mechanisms. The present results show that exclusion can arise even without technological scarcity; future work should assess whether growth mitigates or amplifies these dynamics.

- Finally, we focused on economic inclusiveness. While appropriate for a viability-based analysis, future research could integrate richer welfare metrics, including inequality-sensitive or capability-based measures.

These limitations reflect a deliberate modeling strategy. By isolating core coordination mechanisms, the analysis clarifies how decentralized market rules translate productivity into inclusion or exclusion. Extensions along the dimensions outlined above would test the robustness of this result in more complex environments.

6 CONCLUSIONS

This paper examined how character affects economic inclusiveness in decentralized market economies. We developed an agent-based survival model in which heterogeneous agents interact locally under partial information, without market-clearing, credit, technological progress, or centralized redistribution. Economic inclusiveness was defined in viability terms as collective survival at adequate living standards. By abstracting from institutional correction and growth dynamics, the model isolates how decentralized exchange rules alone translate productive capacity into differential access to essential goods over time.

The results show that decentralized market outcomes are not neutral with respect to character. Alternative embodied rules of pricing, buyer-selection, and consumption generate large and systematic differences in economic inclusiveness. A robust trade-off emerges between economic inclusiveness and productivity when characters let the latter select access to production. Extractive pricing and merit-based access rules increase average productivity among surviving agents by accelerating the exit of low-productivity individuals. Generative characters, by contrast, sustain broad survival at adequate living standards by limiting appropriation and preserving access, albeit with weaker selection and lower average productivity among survivors.

When extractive and generative characters coexist, extractive strategies systematically prevail over time. Generative agents preserve others' access but are vulnerable when facing extractive counterparts; extractive agents exploit inclusive structures without reciprocating them. The resulting hybrid dynamics reveal a sharp divergence between individual rationality and collective viability. Even when aggregate productive capacity is sufficient for universal economic inclusiveness in principle, decentralized markets can generate cumulative exclusion through the interaction of two reinforcing mechanisms: extractive mark-ups that erode the purchasing power of weaker agents, and merit-based entitlement that translates productivity into disproportionate income disparities.

In this sense, the distribution of characters is foundational. The prevalence of inclusive and generative characters may be a necessary condition not only for decentralized markets to remain viable, but also for societies to activate and sustain the redistributive and institutional mechanisms through which growth becomes broadly shared. Sustained economic prosperity therefore depends not solely on incentives or formal institutions, but also on the character distribution that governs how economic freedom is exercised. Cultivating generative characters may thus be central to preserving both economic inclusiveness and the long-term viability of decentralized market economies.

More broadly, the model suggests that long-run prosperity in market economies is shaped by four interacting forces: extractiveness, merit-based entitlement, redistribution, and technological progress.

Extractiveness and merit, when left unchecked, can jointly produce exclusion and collapse even under conditions of abundance. Redistribution and broadly diffused technological progress represent the two principal countervailing forces capable of sustaining inclusion over time. However, these countervailing forces are not automatic stabilizers. Redistributive policies require political support, trust, and civic commitment, while the diffusion of technological progress to weaker agents depends on inclusive institutions and public choices that prevent the capture of innovation gains.

Declarations

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APPENDIX I. RESULTS

Table 3 Results at the end of the survival game with adaptative consumption over 40 repetitions. Results at turn 25 and 50.

			Survivors %		Productivity		Beyond Merit Consumers %	
seller modality	***buyer modality***	***consumption modality***	*25*	*50*	*25*	*50*	*25*	*50*
zero mark up	*lower price*	*intemperance with cap*	100.0	99.9	29.7	29.8	51.9	52.5
zero mark up	*lower price*	*temperance with cap*	100.0	99.8	30.2	30.2	50.6	51.8
zero mark up	*lower income*	*temperance with cap*	99.8	86.9	29.9	29.3	51.4	59.5
zero mark up	*lower income*	*intemperance with cap*	99.8	88.2	30.3	29.7	50.8	59.3
zero mark up	*random*	*intemperance with cap*	99.5	85.1	29.9	29.1	51.8	60.1
zero mark up	*lower price*	*temperance*	99.3	96.2	30.0	30.5	50.7	50.8
zero mark up	*lower consumption*	*temperance with cap*	99.3	86.8	29.8	29.1	50.3	56.9
zero mark up	*random*	*temperance with cap*	99.2	82.1	30.0	29.1	52.2	61.4
zero mark up	*higher merit*	*temperance with cap*	99.2	87.2	30.1	31.6	51.9	57.1
zero mark up	*lower price*	*intemperance*	99.2	95.7	29.9	30.4	50.8	50.2
zero mark up	*higher merit*	*intemperance with cap*	98.9	84.2	30.0	31.7	51.9	56.4
zero mark up	*lower consumption*	*intemperance with cap*	98.9	86.0	30.1	29.4	50.3	57.3
sell-seeker	*lower price*	*temperance with cap*	98.2	84.8	30.0	30.8	51.7	57.6

sell-seeker	*lower price*	*intemperance with cap*	98.2	88.5	30.4	30.9	50.2	56.9
sell-seeker	*lower income*	*temperance with cap*	97.6	63.7	29.9	28.1	48.9	57.8
sell-seeker	*lower income*	*intemperance with cap*	96.9	65.2	30.0	28.3	46.7	57.4
zero mark up	*lower income*	*intemperance*	96.2	74.1	30.2	30.7	47.5	50.9
zero mark up	*lower income*	*temperance*	95.4	73.3	30.1	30.6	47.6	50.5
sell-seeker	*higher merit*	*intemperance with cap*	94.9	66.4	30.3	34.3	50.3	59.1
sell-seeker	*random*	*intemperance with cap*	94.4	57.2	29.8	27.4	49.1	62.8
sell-seeker	*higher merit*	*temperance with cap*	94.4	66.0	30.6	34.4	49.7	56.0
sell-seeker	*random*	*temperance with cap*	94.2	55.1	29.7	27.0	49.3	63.6
sell-seeker	*lower consumption*	*temperance with cap*	93.7	61.5	30.0	28.1	48.4	58.5
zero mark up	*lower consumption*	*temperance*	93.6	76.3	30.0	30.3	49.1	49.1
sell-seeker	*lower consumption*	*intemperance with cap*	93.5	59.2	29.3	27.2	46.6	59.0
zero mark up	*lower consumption*	*intemperance*	93.2	74.8	29.9	30.2	48.7	49.9
zero mark up	*random*	*temperance*	92.8	61.9	30.3	30.6	48.2	51.0
zero mark up	*random*	*intemperance*	90.9	58.5	30.0	30.8	50.5	51.8
zero mark up	*higher merit*	*intemperance*	89.0	60.9	31.5	36.6	45.9	47.0
zero mark up	*higher merit*	*temperance*	88.2	59.8	31.9	37.0	46.0	45.5
sell-seeker	*lower price*	*intemperance*	86.5	58.5	31.6	35.5	44.1	44.7
sell-seeker	*lower price*	*temperance*	85.6	57.7	31.8	35.5	44.6	47.4
sell-seeker	*lower consumption*	*intemperance*	81.4	51.9	30.0	30.5	44.8	47.5
merit-seeker	*lower income*	*temperance*	79.4	63.1	33.9	36.4	34.5	34.4
merit-seeker	*lower income*	*intemperance with cap*	79.0	63.7	33.2	35.6	43.2	45.9
sell-seeker	*lower income*	*intemperance*	78.8	30.9	30.0	31.1	38.5	41.1
sell-seeker	*lower consumption*	*temperance*	78.2	47.6	30.3	30.9	42.1	46.7
merit-seeker	*lower income*	*temperance with cap*	77.5	62.8	33.4	35.9	43.0	45.5
merit-seeker	*lower income*	*intemperance*	77.4	60.2	33.6	36.3	35.4	35.0
sell-seeker	*lower income*	*temperance*	77.0	26.1	29.7	31.0	39.1	40.6
merit-seeker	*lower price*	*intemperance with cap*	76.2	54.9	32.5	32.8	40.6	44.7
sell-seeker	*higher merit*	*intemperance*	74.8	41.3	33.8	40.6	41.2	39.3
merit-seeker	*lower price*	*intemperance*	74.1	51.5	32.3	32.5	33.8	34.8
merit-seeker	*lower price*	*temperance*	74.0	53.8	32.5	32.5	36.0	34.0

merit-seeker	*lower price*	*temperance with cap*	73.8	54.0	33.3	33.7	44.3	47.8
sell-seeker	*random*	*intemperance*	73.0	21.0	30.4	31.9	41.2	45.7
merit-seeker	*lower consumption*	*intemperance with cap*	71.2	50.0	33.8	36.2	40.0	44.7
merit-seeker	*lower consumption*	*intemperance*	71.2	46.8	33.6	36.3	34.8	32.0
merit-seeker	*lower consumption*	*temperance*	70.9	47.7	33.8	36.4	34.1	32.0
merit-seeker	*lower consumption*	*temperance with cap*	70.5	49.8	34.1	36.9	40.1	46.3
sell-seeker	*random*	*temperance*	69.8	19.6	29.9	31.6	41.4	46.7
fixed random	*lower income*	*temperance with cap*	69.2	57.8	33.1	33.9	48.5	52.6
fixed random	*lower income*	*intemperance with cap*	69.0	57.1	33.0	33.9	48.8	53.5
sell-seeker	*higher merit*	*temperance*	69.0	36.5	34.6	41.4	40.2	39.8
fixed random	*lower income*	*intemperance*	68.9	56.7	33.2	34.4	43.4	42.6
fixed random	*lower income*	*temperance*	68.1	55.9	33.4	34.3	41.0	43.4
merit-seeker	*random*	*temperance with cap*	61.5	37.1	36.1	40.2	45.9	53.9
merit-seeker	*random*	*intemperance with cap*	61.1	35.8	36.1	40.4	44.4	52.9
merit-seeker	*random*	*temperance*	60.5	34.7	35.9	40.0	35.7	38.1
merit-seeker	*random*	*intemperance*	60.2	33.9	35.8	40.0	36.0	36.5
fixed random	*lower consumption*	*intemperance with cap*	51.4	30.1	33.5	34.1	45.0	50.8
fixed random	*lower consumption*	*temperance*	51.0	28.1	33.9	35.5	37.6	37.1
fixed random	*lower consumption*	*temperance with cap*	50.9	32.1	33.2	33.7	42.6	51.1
fixed random	*lower consumption*	*intemperance*	50.2	27.3	33.4	35.3	37.1	37.5
fixed random	*random*	*intemperance with cap*	45.7	29.0	34.5	36.2	53.3	59.6
fixed random	*lower price*	*intemperance with cap*	44.6	30.3	34.6	36.0	40.3	43.8
fixed random	*random*	*temperance*	44.6	24.4	35.2	36.9	41.6	46.2
fixed random	*random*	*temperance with cap*	44.4	26.5	34.5	35.9	52.5	59.5
fixed random	*random*	*intemperance*	43.5	24.8	34.9	37.0	42.3	43.8
fixed random	*lower price*	*temperance*	43.3	28.7	34.7	36.4	34.4	32.7
fixed random	*lower price*	*intemperance*	42.8	28.4	34.9	36.3	35.2	34.0
fixed random	*lower price*	*temperance with cap*	42.2	27.9	34.7	36.2	37.0	41.9
gain-seeker	*lower income*	*intemperance with cap*	40.2	4.1	35.6	43.3	14.5	7.0
gain-seeker	*lower income*	*temperance*	38.2	3.8	36.0	42.4	11.1	6.3
gain-seeker	*lower income*	*intemperance*	38.0	3.4	36.0	43.2	11.3	4.2

merit-seeker	*higher merit*	*intemperance with cap*	38.0	14.5	41.8	46.5	46.8	51.5
merit-seeker	*higher merit*	*temperance*	38.0	13.0	41.9	46.9	35.9	36.5
merit-seeker	*higher merit*	*intemperance*	38.0	13.2	41.7	46.8	34.9	35.1
merit-seeker	*higher merit*	*temperance with cap*	37.7	14.3	41.5	46.5	43.6	58.1
gain-seeker	*lower income*	*temperance with cap*	37.4	3.0	35.8	42.6	14.2	2.5
gain-seeker	*lower price*	*intemperance with cap*	31.5	3.0	38.0	44.5	14.2	0.0
gain-seeker	*lower price*	*temperance with cap*	31.3	-	38.2	-	14.3	-
gain-seeker	*lower price*	*intemperance*	30.0	2.0	38.6	41.2	9.8	0.0
gain-seeker	*lower price*	*temperance*	29.4	-	38.2	-	10.6	-
fixed random	*higher merit*	*temperance with cap*	27.5	13.8	42.3	45.8	47.2	51.4
fixed random	*higher merit*	*intemperance with cap*	26.8	12.6	42.9	46.1	46.8	54.8
fixed random	*higher merit*	*temperance*	26.4	12.6	43.0	46.4	36.1	31.6
fixed random	*higher merit*	*intemperance*	25.9	12.6	43.5	46.6	36.3	33.6
gain-seeker	*higher merit*	*temperance with cap*	20.3	2.8	43.0	48.4	24.3	6.7
gain-seeker	*higher merit*	*intemperance with cap*	20.1	2.5	43.4	47.7	23.3	29.2
gain-seeker	*higher merit*	*temperance*	20.0	4.0	44.0	47.5	17.0	0.0
gain-seeker	*higher merit*	*intemperance*	19.4	3.0	43.7	49.2	18.7	0.0
gain-seeker	*random*	*temperance with cap*	18.0	2.5	35.4	41.0	24.2	0.0
gain-seeker	*random*	*intemperance with cap*	17.5	*0*	34.8	-	25.1	-
gain-seeker	*random*	*intemperance*	16.5	*0*	36.4	-	12.8	-
gain-seeker	*random*	*temperance*	15.1	*0*	36.1	-	14.2	-
gain-seeker	*lower consumption*	*intemperance with cap*	12.9	4.0	34.0	37.0	13.5	15.9
gain-seeker	*lower consumption*	*temperance with cap*	12.8	4.0	33.8	36.9	14.5	11.1
gain-seeker	*lower consumption*	*intemperance*	10.5	4.1	35.8	37.7	7.6	10.5
gain-seeker	*lower consumption*	*temperance*	10.4	3.7	35.9	38.0	7.1	10.2
hybrid	*hybrid*	*hybrid*	51.9	5.2	33.2	33.8	36.6	39.2

APPENDIX II. ADDITIONAL REGRESSION ANALYSIS

This appendix reports additional regression results aimed at assessing whether cultivating temperance and merit-based consumption caps as character traits contributes to economic inclusiveness. The

analysis focuses on the joint role of beyond-merit consumption, productivity, and consumption regimes.

The dependent variable is the percentage of surviving agents at turn 25 and turn 50 from Table 3. The key explanatory variable is the share of beyond-merit consumers (BMC). This variable captures the extent to which agents consume beyond their merit-based entitlement. The estimation sample excludes all configurations with buyer modality equal to random and seller modality equal to fixed random, in order to isolate outcomes driven by structured behavioral rules. The resulting sample includes 63 observations.

The following specification is estimated separately at turn 25 and turn 50:

$$Survival_t = \beta_0 + \beta_1 BMC_t + \beta_2 K_t + \beta_3 Temperance + \beta_4 Cap + \epsilon_t$$

where K_t is average productivity, Temperance is a dummy equal to one for temperate consumption rules, and Cap is a dummy equal to one when a generative merit cap is in place.

Table 4 reports the results.

Table 4 OLS regressions of Economic Inclusiveness (survivors %) on BMC, productivity, temperance, and cap.

Variable	***Turn 25***	***Turn 50***
Constant	183.80*** (12.77)	103.25*** (18.83)
BMC	3.11*** (0.24)	2.34*** (0.37)
Productivity	-6.47*** (0.26)	-4.65*** (0.31)
Temperance	12.04 (8.45)	36.43** (14.84)
Cap	6.62*** (2.14)	8.57** (3.77)
R-squared	0.93	0.81

*Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

The results show that, controlling for productivity and consumption extractiveness, the presence of a merit-based cap is positively and significantly associated with economic inclusiveness at both time horizons. This indicates that institutional constraints limiting consumption relative to merit systematically increase the share of surviving agents.

Temperance has a positive coefficient in both regressions and becomes statistically significant at turn 50. This suggests that temperate consumption behavior contributes to inclusiveness over longer time horizons, likely by moderating the dynamic accumulation of advantages.

Productivity is negative and highly significant, confirming that productivity-based selection reduces inclusiveness by excluding less productive agents. In contrast, beyond-merit consumption is positive and significant, indicating that redistributive consumption patterns are associated with higher survival once productivity is accounted for.

Taken together, these results support the interpretation that cultivating temperance and merit-based consumption caps as character traits contribute to economic inclusiveness. While productivity governs selection, temperance and merit constraints act as countervailing forces that sustain broader participation over time.