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Consumption Emulation and Demand Regimes: An Inclusive Modeling Approach

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ABSTRACT

Personal income distributions robustly follow a two-class structure, with an exponential bulk of labour income accruing to the lower 95 - 99 % population share and an upper Pareto tail of the 1 - 5% richest, where capital income is concentrated. The implications of this regularity for macroeconomic outcomes, especially aggregate consumption, are not yet fully understood, though. We introduce this two-class structure into a Post-Keynesian consumption model with workers and capitalists corresponding to the two classes within the personal distribution. Agents consume according to idiosyncratic and social motives. Status consumption is microfounded within a perception network that replicates empirically observed inequality and social self-perceptions. Our findings indicate that the non-market interactions in perception networks are potentially highly relevant for aggregate outcomes and that they can shed some light on recent puzzles in the Post-Keynesian literature on growth regimes. In particular, we show how network segregation can explain differences in the degree of 'wage-ledness' of aggregate consumption. Aggregate representations of consumption might thus be misleading. Empirical studies should therefore take the regularities both in the income distribution as well as social network topologies into account.

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1. Introduction

The foundational contribution by Bhaduri and Marglin (1990) has spawned a vast literature on growth regimes and the possibility of wage-led growth. This is unsurprising, since wage-led growth implies a synergy rather than a trade-off between the two goals of equity and prosperity, rendering the predictions of the neo-Kaleckian model immensely relevant for economic policy. While the literature has largely focused on elaborations of the investment function or open-economy models (Lavoie 2022), the consumption function has not attracted similar attention and is still largely based on the original premise of heterogeneous consumption propensities that are higher for workers than for capitalists. Redistribution from profits to wages thus unanimously increases aggregate consumption within those models. This theoretical assumption of heterogeneous consumption propensities is so well established empirically

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(Dynan, Skinner, and Zeldes 2004) that contradictory results are dubbed 'anomalous' or 'perverse' (Barbosa-Filho and Taylor 2006, table 1; Stockhammer and Stehrer 2011, table 2; Stockhammer 2017).[1] Our model is an attempt to go beyond class-based heterogeneous consumption propensities and show that accounting for interaction and emulative motives between heterogeneous agents enriches the picture. We find that both wage – and profit-led consumption regimes can emerge within our synthesis model and that decreasing income-based segregation both increases aggregate consumption levels and makes the growth regime more wage-led. The main contribution of this paper is to explicate the relevance of non-market interactions by showing that they exhibit significant influence on aggregate variables with several examples. Methodologically, our paper draws from several other heterodox schools of thought: The relationship between the functional income distribution and growth we examine is a central tenet of the Post-Keynesian school, the interaction network draws on methods from complexity economics, the notion of consumption emulation is rooted in evolutionary and old institutionalist thought and homophilic segregation features prominently in economic sociology. We thus also hope to convince the reader of the merits of such a pluralist approach to economics.

Content-wise address two apparent empirical paradoxes within heterodox consumption theory: First, we explore the puzzle that consumption functions featuring upward-looking status comparisons should always imply profit-led consumption (Schulz and Mayerhoffer 2023), in contrast to the overwhelming majority of empirical studies that show consumption to be wage-led (cf. e.g., Onaran and Obst 2016). This is due to the fact that increases in the profit share theoretically and empirically should generally also imply increased inequality in the personal distribution of income (Atkinson 2009). This, in turn, increases aggregate consumption in models of upward-looking status comparisons. We show that this result in Schulz and Mayerhoffer (2023) only holds unanimously, whenever the increase in inequality results from within-class rather than between-class increases in inequality. The problem can be remedied by introducing the standard Kaleckian assumption of heterogeneous consumption propensities between workers and capitalists. Consequently, the wage-ledness of consumption depends on the relative population shares of capitalists and workers and the degree of income homophily within the perception networks, though, not only on the different consumption propensities. Second, these factors might help to interpret the recent aforementioned 'perverse' results regarding the implied profit-ledness of consumption in several empirical studies (Barbosa-Filho and Taylor 2006; Stockhammer 2017; Stockhammer and Stehrer 2011), in violation of the prediction of the Bhaduri-Marglin framework (Bhaduri and Marglin 1990). By contrast, our framework can indeed feature both profit – and wage-led consumption.

Theoretically, we also demonstrate that heterogeneous consumption propensities between workers and capitalists are neither necessary nor sufficient to generate wage-led consumption: Consumption can be wage-led for homogeneous marginal consumption propensities, and it can be profit-led even in the presence of such heterogeneity.

[1]Note that the foundational paper by Barbosa-Filho and Taylor 2006 does not discuss the 'anomality' of their estimated consumption function. Yet, table 1 clearly shows that consumption responds negatively to an increase in the wage share in contrast to the Kaleckian argument. For a related discussion, cf. Kapeller and Schütz 2015.

We show this result to be dependent primarily on the network topology of perceptions that represents real world day-to-day interactions. Network segregation generally makes consumption more profit-led, since expenditure cascades within the working class become weaker and thus consumption out of profits grows relatively more important.

The remainder of this paper is organised as follows. Section Two introduces the model and the validation strategy for the various underlying assumptions it uses. Section Three presents our main results on both the distributional regularities the model generates on a micro-level and the distribution-led regimes for different parametrisations and degrees of network segregation. Section Four concludes with policy implications and limitations of the model.

2. Model

Our model setup consists of three distinct building blocks: i) a consumption function with heterogeneous, class-based parameters, ii) the perception network that determines reference consumption for all agents and iii) the income distribution by which we initialise both the perception network and the consumption function. We introduce and discuss all three building blocks in the following.

2.1. Consumption Function

All agents, indexed $i \in \{1, \ldots, N\}$, consume according to a consumption function with identical functional form. The individual consumption expenditure C_i by agent i is given by:

$$C_i = w_i \cdot Y_i + (1 - w_i) \cdot c_i(C(j|i) - w_i \cdot Y_i), \tag{1}$$

where Y_i denotes current disposable income and reference consumption $C(j|i)$ is the highest consumption level by agent j that agent i observes in their perception network.[2] The parameter $c_i|$is a catching-up parameter, determining how much of the gap to the expenditure of the reference consumption level is closed by the consumer. The parameter w_i can be interpreted as the weight the non-status goods in the consumption basket of consumer i, while $(1 - w_i)$ weight of status-goods for the case that consumers fully catch up to the reference consumption level (i.e., $c_i| = 1$).

While the above consumption rule can be derived from a marginalist approach with a clear interpretation of all its parameters, it is also consistent with Post-Keynesian consumer choice which motivated the model in the first place. In this interpretation, the consumption rule would be an expression of 'procedural rationality' (Simon 1976) which Lavoie (1994) considers to be a central tenet of Post-Keynesian consumer theory.

[2]Schulz and Mayerhoffer (2023) show that this consumption rule emerges from utility maximisation for Cobb-Douglas preferences that penalises deviations from reference consumption $C(j|i)$. The parameter w_i is then the elasticity parameter for consumption expenditures and $(1 - w_i)$ for savings to capture intertemporal motives, while $c \geq 0$ determines the intensity of (linear) disutility from falling short of the reference consumption level. Note that the $(1 - w_i)$ term in the consumption function is a direct consequence of the Cobb-Douglas preferences within the marginalist approach. Yet, formally, it merely scales down social consumption (linearly) and could thus be straightforwardly integrated into the c_i parameter without loss of generality. We stick with the above variant to be more consistent with the original model and derivation.

The given consumption rule thus explicates a rule of thumb that allows consumers to decide quickly and efficiently. The first term would correspond to idiosyncratic consumption with w_i as the marginal propensity to consume (MPC) out of current disposable income. By contrast, the second term includes social motives and captures status consumption. Finally, the social term follows what Lavoie (1994) calls 'non-independence'. Consumers have a 'desire to impress the Joneses, which makes each family strive to keep up at least an appearance of being as well off as those that they mix with' (Robinson 1956, p. 251). The upward-lookingness of consumption is also empirically well established (Alpizar, Carlsson, and Johansson-Stenman 2005; Bertrand and Morse 2016; Bricker, Krimmel, and Ramcharan 2020; Drechsel-Grau and Schmid 2014; Heffetz 2011; Jinkins 2016; Quintana-Domeque and Wohlfart 2016). Palley (2010) reviews the history of economic thought on emulation motives in consumer theory and shows that those were likely discarded due to institutional reasons and not necessarily only based on merit. Like in the above consumption function, consumption 'thus reflects the lifestyle of the households that constitute its social reference group' (Eichner 1986, p. 160). The functional form of the consumption function therefore follows a common Post-Keynesian vision of consumer choice.

We also follow the Post-Keynesian vision regarding the *parameter choices* for the consumption function in equation 1. In particular, we consider two classes, workers and capitalists (indexed *work* and *cap*). Parameters are homogeneous within but not between classes. Regarding the MPC out of current disposable income, we employ the conventional Kaleckian assumption that MPCs out of profits are much lower than those out of wages (Kalecki 1971; Lavoie 1992), which implies:

$$0 \leq w_{cap} \leq w_{work} \leq 1. \tag{2}$$

This assumption is empirically verified, cf. e.g., Dynan, Skinner, and Zeldes (2004). Note that the above relationship allows for the possibility of workers' savings like in Harris (1974) and Mott and Slatiery (1994) as a generalisation of the original argument by Kalecki (1971) who abstracted from any savings by workers. Regarding the social component, we set:

$$\begin{aligned} c_{work} &> 0 \text{ and} \\ c_{cap} &= 0. \end{aligned} \tag{3}$$

The assumption that only workers engage in conspicuous consumption is entirely conventional (perhaps to sustain tracatability) (Detzer 2018; Kapeller and Schütz 2015; Setterfield and Kim 2017) but also justifiable empirically: Stanley and Danko (1996) show that the super rich do not engage in conspicuous consumption and, if anything, practice conspicuous *frugality*[3] or explicitly *inconspicuous consumption*, as is also shown for the domain of fashion by Davis (1992) and Brooks (2010). Sherman (2018) and Friedman and Reeves (2020) confirm this finding and show that the modes of distinction for the super rich have in today's Western cultures shifted towards less conspicuous pursuits. Charles, Hurst, and Roussanov (2009) demonstrate empirically that belonging to a relatively poor group (in our case, the working class) induces conspicuous consumption, presumedly to fend off the perception of 'looking poor'.

[3]For example, they show that 70 per cent of American millionaires in their samples purchase cars with below average market value.

2.2. Perception Network

Like in Schulz and Mayerhoffer (2023), the perception of workers is constrained by a perception network following Schulz, Mayerhoffer, and Gebhard (2022) and Mayerhoffer and Schulz (2022).[4] They show that applying this random geometric graph type of model generates perception graphs that can efficiently reproduce the documented stylised facts about overall inequality perceptions as well as perceptions of intergroup inequities. They also show that the emergent network topologies are consistent with real world social networks, i.e., they feature small-worldiness.

Given these externally validated properties, this type of graph is a reasonable way to replicate the real-world interactions of workers. The major ingredient of the model is income homophily, the empirical tendency of individuals with similar income to form ties to each other (McPherson, Smith-Lovin, and Cook 2001). Following Mac Carron, Kaski, and Dunbar (2016), each agents draws five other agents to link to. Draws are weighted by income distance, i.e., agent j's weight in agent i's draw is denoted by Ω_{ij} and determined as follows:

$$\Omega_{ij} = \frac{1}{\exp[\rho|Y_j - Y_i|]} \tag{4}$$

The relative weights in the draws are a function of the homophily strength $\rho \in \mathbb{R}_0^+$ and the respective income levels Y_j and Y_i. Schulz and Mayerhoffer (2023) and Schulz, Mayerhoffer, and Gebhard (2022) show that the above linkage formation process can be microfounded within a random utility framework and that the weights in equation 4 can be translated into probabilities ω as follows:

$$\omega_{ij} = \frac{\exp[-\rho \cdot |Y_j - Y_i|]}{\sum_{k \in W \setminus i} \exp[-\rho \cdot |Y_k - Y_i|}, \tag{5}$$

with $W \setminus i$ as the set of all workers except i. For any given income distribution of discrete income levels Y, the linkage probabilities are thus fully determined by the homophily strength. It is easy to see that for $\rho = 0$, the graph reduces to an Erdös-Renyi random graph (Erdős and Rényi 1960) but for increasing $\rho > 0$, the network grows more and more segregated as choice becomes more homophilic in income. We are just building on the empirically well-established correlation[5] in reduced form but are silent on the specific *cause* of emergent segregation. In particular, we do not assume that income homophily is necessarily the product of specific choices of individuals and allow for *induced* homophily by shared workplaces or educational stratification (Chetty et al. 2022a; McPherson and Smith-Lovin 1987). While both types can be represented by the same homophily parameter ρ and thus have the same effect on simulation outcomes, they might carry drastically different policy implications, as we summarise in section four.

[4]Capitalists are not included within the network since they do not engage in status consumption. This ensures that we can isolate the effects of the *aggregate* measure of capitalists' consumption and do not need to worry about confounding effects by individual capitalists' consumption that are used as reference consumption. This assumption is equivalent to assuming that the two classes do not interact directly with each other.

[5]Cf. Schulz and Mayerhoffer (2023), Schulz, Mayerhoffer, and Gebhard (2022) and Mayerhoffer and Schulz (2022) for rather comprehensive reviews of the empirical literature

Finally, we need to close the model and specify, how the two classes interact with each other. To this end, we assume that the reference consumption level of the *richest worker* indexed k, $C(j|k)$ is given by a measure of central tendency of the consumption of capitalists, i.e., either their mean $\overline{C}_{cap}$ or median consumption C_{cap}^{median}. Here, we follow the intuition that workers plausibly do not observe the consumption patterns of particular capitalists but rather a general picture that is mediated by social networks (Wang et al. 2017) or television (Ger and Belk 1999). As it turns out, the choice between the mean and median consumption as the reference level has drastic aggregate consequences.[6]

2.3. Income Distribution

As the final building block, we need to determine the income distribution by which the perception network and consumption formation is initialised. Here, we build on the well-established finding of a two-class income distribution that is characterised by an exponentially distributed bulk for the vast majority and a power law upper tail of the 1–5 per cent super rich (Kumar 2017, 2021; Shaikh 2017; Shaikh and Jacobo 2020; Silva and Yakovenko 2005).[7] We follow Silva and Yakovenko (2005) and Shaikh and Jacobo (2020) who show that the exponential bulk of the distribution consists primarily of labour income (i.e., wages), while the Pareto tail is populated by capitalists earning capital income. Consequently, we identify the exponential part with the labour share of national income and the Pareto tail with the profit share. The income distribution with the underlying respective factor shares is exogenous to the model, rather than being endogenously determined by some generating process. We use the empirically well-established regularity of this two-class distribution for model initialisation. While identifying the two classes of empirical income distributions with the two societal classes of workers and capitalists might seem ad-hoc, we argue that this mapping is empirically sensible. As Silva and Yakovenko (2005) as well as more recently Shaikh and Jacobo (2020) show, an exponential distribution emerges from a rather slowly varying, additive growth process. The major assumption here is that growth increments are uncorrelated to levels, i.e., the change in income in currency terms does not depend on previous income. This additive process is characteristic of wage income without any multiplicative component. By contrast, a power-law distribution emerges from stochastically multiplicative growth, i.e., growth increments depending on initial levels (Shaikh and Jacobo 2020).[8] Multiplicative processes might arise from

[6]Apart from these contentual reasons, this assumption is also necessary to guarantee the internal validity of the model: Pseudorandom draws from a power law with small sample sizes are notoriously problematic and vary dramatically between samples (Talaga and Nowak 2020, Appendix C). Since we want to study out the effect of the profit share on aggregate consumption rather than the noise of the random number generator, we work with aggregate measures instead that do not vary between draws.

[7]The findings by Silva and Yakovenko (2005) were heavily criticised by Schneider (2015) and Schneider and Scharfenaker (2020) for relying too heavily on graphical methods and thus failing to account for mixtures that include other components, in particular, a log-normal component. As a theoretical rationale, they propose labour market segmentation and dualisation following the foundational work by Reich, Gordon, and Edwards (1973). While being beyond the scope of this paper, it would in principle be possible to include such a mixture into the model here to study the effects of dualisation on aggregate consumption in a model extension.

[8]Another technical assumption is the one of an reflecting boundary (Schulz and Milaković 2023). If this ingredient is missing and incomes can go infinitesimally close to zero, a log-normal stationary distribution emerges instead (Weber and Schulz 2023).

return-generating assets such as financial assets or speculative housing that are subject to the constant revaluation of financial markets, generating multiplicatively varying incomes (Schulz and Milaković 2023). In national accounting, this type of income would fall under capital income and thus correspond to the profit share. Indeed, empirically, the Pareto tail is dominated by this capital income, while the exponential bulk is characterised by labour income (Silva and Yakovenko, 2005).

With some fairly general technical assumptions, this distinction allows to fully characterise the income distribution by the population share of capitalists p and the aggregate mark-up over unit labour costs m as well as the total population size N. We thus provide a mapping from the continuous income distribution to categorical classes. We derive the moments of this income distribution in the appendix, especially of the mean and median tail income and consumption that the richest worker takes as reference consumption.

We show that the total consumption of capitalists is given by:

$$C_{cap} = w_{cap}\left(N \cdot \frac{m}{1+m}\right),$$

With $0 < w_{cap} < 1$ as the consumption propensity of the capitalists, N as the total number of agents and m as the aggregate mark-up over unit labour costs. Intuitively, total consumption of capitalists thus increases in the aggregate mark-up, the consumption propensity of capitalists and in a higher number of agents that translates for a given population share of capitalists and workers also to a higher number of capitalists. This is because all these variables increase capitalists' income.

2.4. Sequence of Events

Below, we show the proposed sequence of events to determine the aggregate consumption-to-income ratio for one Monte Carlo run:

(1) Initialise $(1-p)N \in \mathbb{N}$ workers.
(2) Allocate income according to exponential distribution with desired rate parameter.
(3) Generate network for workers based on income distribution for given homophily strength ρ.
(4) Initialise consumption of workers by determining their idiosyncratic consumption levels and setting the reference consumption $C(j|k)$ of the richest worker either to the mean consumption within the tail $w_{cap} \cdot \bar{Y}_{cap}$ or some consumption quantile $w_{cap} \cdot F^{-1}_{cap}(q; p, m, N)$.
(5) Sequentially update the consumption levels of all workers going down the income distribution by always taking as reference consumption the highest observed consumption level. Sum over workers' consumption to get C_{work}.
(6) The aggregate consumption-to-income ratio is then given by

$$\frac{C_{work} + C_{cap}}{Y} = \frac{C_{work} + w_{cap}\left(N\frac{m}{1+m}\right)}{N}.$$

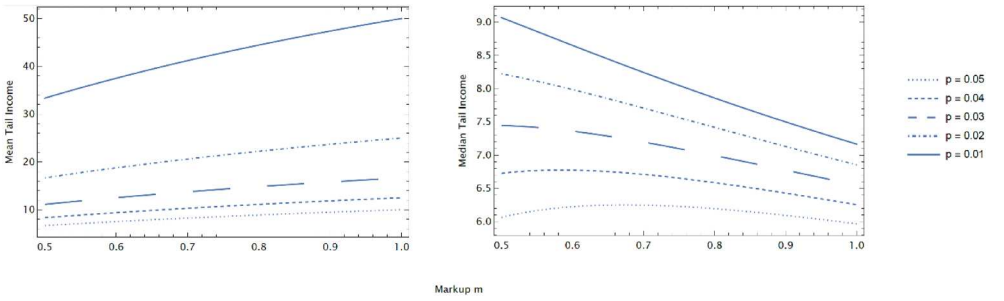

Figure 1. Mean (left panel) and median (right panel) income within the Pareto tail for varying p and m. While the mean tail income unambiguously increases in markups, the median tail incomes tend to decrease in markups and thus, profit shares.

3. Results

For analysis, we set all parameters within the empirically calibrated range,[9] i.e., $w_{work} = 0.5$, $c_{work} = 0.5$, $p = 0.02$ and $N = 1,000$ and vary $\rho \in [1; 14]$ and $m \in [0.5; 1]$. We consider the empirical results on the micro level for external validity to show that the emergent consumption expenditure distributions indeed replicate empirical stylised facts. The goal of the macro results is to show that both the level and wage-ledness of aggregate consumption depend crucially on parameters beyond the idiosyncratic MPCs of each class. Note that especially $c_{work} = 0.5$ might appear excessive, as it corresponds to $c_{work} \cdot (1 - w_{work}) = 0.25$, i.e., for all workers closing about 25 per cent of the gap to their respective highest observed consumption level. We choose this particular parametrisation to illustrate our results and make regime shifts more visible. However, they are not materially sensitive to the specific choice of $c_{work} > 0$. All other parameter values are also chosen primarily to illustrate the underlying mechanisms rather than calibrating the model to empirically observed values. We hope to calibrate the model (in a full-fledged macro framework) in further work.

3.1. Analytical Results on Consumption Norms

Our first result is completely analytical. We show in Figure 1 that while the mean income of capitalists unsurprisingly increases with the profit share, the median income tends to *decrease* in it for capitalist population shares $p < 0.05$. Thus, while the capitalist class as a whole benefits from a higher share of profits, the *typical* capitalist is left worse off. This result is reminiscent of the basic premise of ergodicity economics that economic variables are regularly non-ergodic (Peters 2019) and that growth of the average income is thus often radically different from average or 'typical' income growth (Adamou, Berman, and Peters 2020; Adamou and Peters 2016).[10]

[9]The range for the homophily parameter is the result of a calibration with a comprehensive dataset on inequality perceptions in Schulz, Mayerhoffer, and Gebhard (2022). We also conduct sensitivity analyses covering the whole parameter space. Results are available upon request.

[10]Identical concepts were already introduced in Milanovic (2005) and Saez and Zucman (2019) as a 'population-weighted average growth rate' and 'people's growth rate', respectively.

The reason for this behaviour is that an increase of the profit share has two counteracting effects on the median tail income: Firstly, by construction, it increases the total tail income and thus also median income. However, secondly, the minimum tail income Y_{min}^{cap} is defined as the (expected) threshold between the exponential and power law regime and thus depends negatively on the mean income in the exponential regime. As we show above, the second effect appears to dominate the first for (almost all) reasonable p and m and the median tail income declines in the profit share. As a direct corollary, tail inequality also increases with the profit share, as the mean income unambiguously increases in m, while the minimum tail income also unambiuously decreases in the profit share. Since capitalists' consumption is directly proportional to their income (due to $c_{cap} = 0$) the polar behaviour of the mean and median tail income has strong implications for the effect of the mean or median consumption norms the richest worker takes as reference consumption, as dicussed in section 2.2 and 2.3.

3.2. Validation: Distributional Stylised Facts

We validate our model by input calibration and comparison of the simulation output to stylised empirical facts. See Section Two for details on how the model setup is based on empirically established data and mechanisms on income inequality, homophily in income, and individual perception. As stylised facts for output validation we consider (1) the decline on individual APCs in income as well as the expenditure distribution (2) being more homogenous than the income distribution, and (3) following a log-normal shape.[11] The first stylised fact concerns the decrease of individual APCs: Almost trivially by construction, we find that like in the real world, APCs tend to decline in income, i.e., the rich save more out of current income (Clementi and Gianmoena 2017; Dynan, Skinner, and Zeldes 2004; Palley 2010).

This effect of expenditure cascades (Frank, Levine, and Dijk 2014) is what we find consistently for our model, as shown in Figure 2 for a single parametrisation of the consumption function and different network topologies. Workers aim to catch up to higher levels of consumption they observe which implies that status consumption accumulates in its way down the income distribution with the poorest consequently exhibiting the highest share of status consumption. Thus, part of the decline of individual APCs is per assumption ($w_{work} > w_{cap}$) but the decline within the working class follows from upward-looking status consumption and is endogenous to the model. This effect on the poorest varies with the network topology though, with the poorest decile being heavily affected for low levels of network segregation. This follows from the fact that low income homophily tends to increase the increment between observed (highest) consumption and own idiosyncratic consumption by construction. Thus, the more diverse the network contacts are on average, the stronger the expenditure cascade.[12]

[11] All results are for the mean consumption norm but hold for the median consumption norm with different parametrisations as well.

[12] At this point, it is worth noting that the APCs of the lowest income deciles in Figure 2 are well above unity. This result is rather general and holds for large parts of the parameter space. It highlights one crucial assumption and limitation of our model: With our consumption rule without any budget constraint, we implicitly assume that consumers can realise any desired level of consumption expenditures by accruing debt. Likely, leverage ratios of this size are unsustainable and contribute to financial fragility which also indicates that the consumption-led regimes we describe in our model are potentially short-lived. In particular, we cannot account for differential degrees of ease of access to consumer credit that

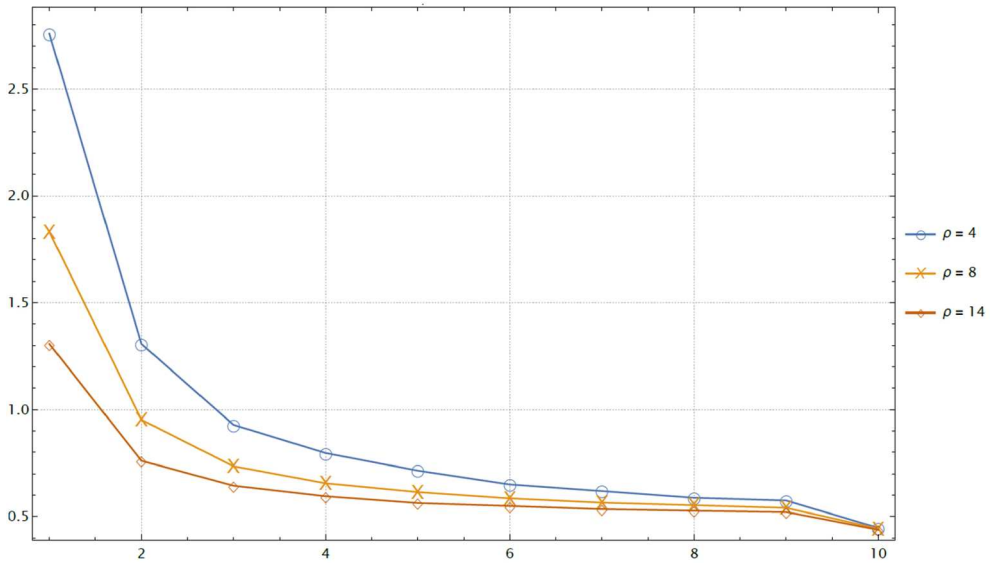

Figure 2. Decile level APCs for a single simulation run and $w_{work} = 0.5$, $w_{cap} = 0.4$, $c = 0.5$, $p = 0.02$ and various $\rho \in \{4; 8; 14\}$. Lines are visual aids only. APCs consistently decline in income decile with APCs being higher the lower network segregation (measured by ρ) is.

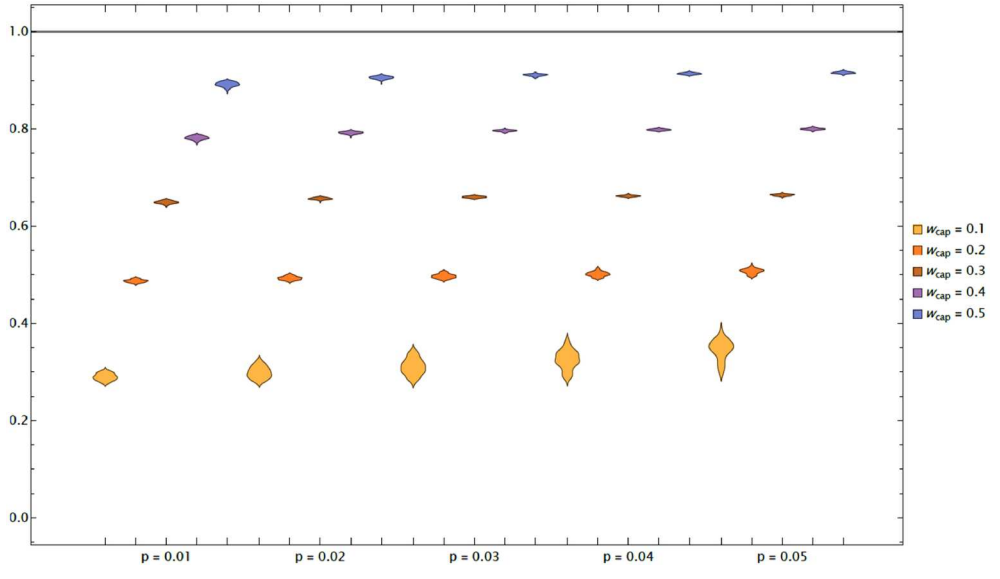

Figure 3. Violin plots of the ratios of the coefficients of variation (CV) of the consumption expenditure distributions to the coefficients of variation of the income distributions, i.e., CV_C/CV_Y. Values below unity (solid line) indicate that expenditure distributions are more homogeneous than income distributions, as is the case across all simulations and parametrisations.

Stockhammer and Wildauer (2016) find to be of crucial relevance for household debt. A full-fledged macro framework such as the foundational paper by Kapeller and Schütz (2015) going beyond our partial mechanism would require to explicitly incorporate a credit market as well as intertemporal considerations of consumers in one form or the other. Our results thus aim to isolate the effects of network segregation, differential consumption propensities and emulation

Our also replicates the stylised fact that consumption expenditure distributions are empirically much more homogeneous than income distributions (Jappelli and Pistaferri 2010; Krueger and Perri 2006; Palley 2010). We show this below in Figure 3 only for a specific parametrisation ($w_{work} = 0.5$, $c = 0.5$, $m = 0.8$ and $\rho = 8$) but income distributions are consistently more heterogeneous than expenditure distributions for parametrisations we considered within the permitted range.

We measure the variability of both distributions by their respective coefficients of variation. Figure 3 shows the ratios of coefficients of variation of CV_C over the coefficients of variation for the income distributions CV_Y. Ratios below unity thus indicate that the stylised fact is replicated. This is indeed the case, both for homogeneous and heterogeneous consumption propensities and for different population shares of capitalists and workers: All simulated ratios are below the grid line at unity. This is due to the fact that the poor catch up to the rich, as also indicated by their higher MPCs. The emergent expenditure cascades thus homogenise consumption. Heterogeneous marginal consumption propensities, i.e., $w_{work} > w_{cap}$ add to this homogenising tendency. Capitalists consume absolutely more than workers due to their higher income but this effect is mitigated, when they consume relatively less idiosyncratically. The lower their idiosyncratic MPC, the more homogeneous the expenditure distribution. This effect is visible in the Violin plots that indicate a clear increase in expenditure heterogeneity for increasing w_{cap}.

Finally, empirical studies find that the distribution of consumption expenditures is as a first-order approximation well fit by a log-normal distribution (Battistin, Blundell, and Lewbel 2009; Brzozowski et al. 2010; Chakrabarti et al. 2018; Fagiolo et al. 2010; Ghosh, Gangopadhyay, and Basu 2011; Hohnisch, Pittnauer, and Chakrabarty 2002; Toda 2017), while the distribution of current income is not (Kumar 2017, 2021; Shaikh and Jacobo 2020; Silva and Yakovenko 2005). Yet, there exist significant deviations from the log-normal benchmark, particularly for their upper tails (Chakrabarti et al. 2018; Fagiolo et al. 2010; Ghosh, Gangopadhyay, and Basu 2011; Toda 2017) that often follow power laws.

This is what we also consistently find for our expenditure distributions, like e.g., Figure 4. The bulk of the distribution is well approximated by a log-normal that is superimposed on the CCDF but the distribution also clearly has a much heavier upper tail that is approximately linear on a double-log scale. We thus find a mixture of a log-normal for the vast majority with an upper Pareto tail which is the exact functional form that Ghosh, Gangopadhyay, and Basu (2011) find for their dataset. Thus, even though our model does not explicitly target that consumption is more log-normal than income (Battistin, Blundell, and Lewbel 2009) and that deviations from log-normality occur primarily in the upper tail (Chakrabarti et al. 2018; Fagiolo et al. 2010; Ghosh, Gangopadhyay, and Basu 2011; Toda 2017), it provides an explanation for this stylised fact. It is this heavy upper tail that models of intertemporal optimisation typically fail to replicate (Battistin, Blundell, and Lewbel 2009). The generating mechanism for the log-normal part is described in Schulz and Mayerhoffer (2023). Our consumption rule coupled with exponentially distributed wages leads to an expenditure distribution that is hypoexponential and thus well approximated by a log-normal density (Yanev 2020). The consumption

without considering these other institutional constraints. We nevertheless hope that our basic model mechanism is sufficiently general to be integrated into other frameworks.

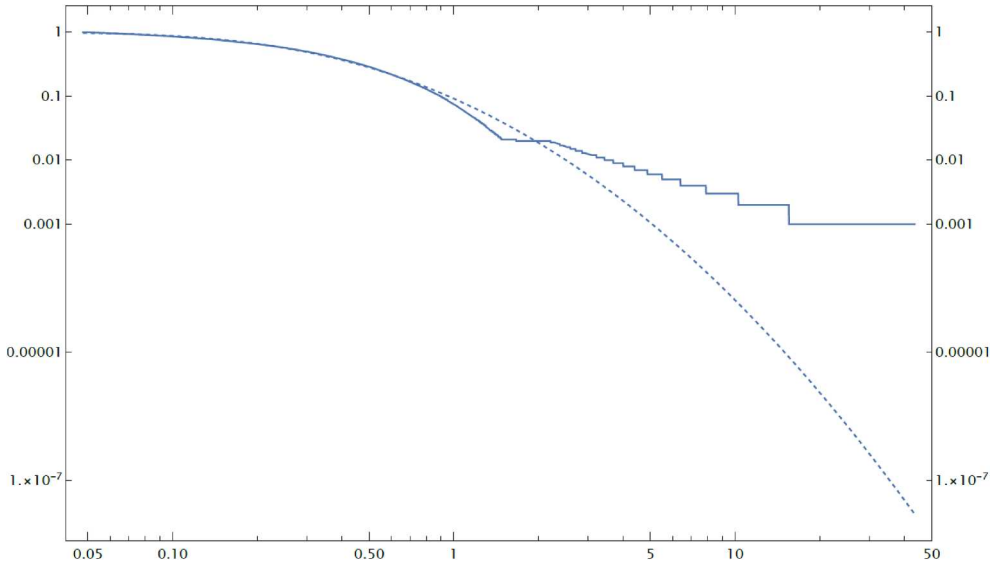

Figure 4. CCDF of consumption expenditures on double-logarithmic scale for p = 0.02, w_{cap} = 0.3, ρ = 4, m = 0.8 and c = 0.5. Superimposed dashed line is best log-normal fit for the data (via MLE). Consumption expenditures are clearly more heavy-tailed than log-normal but are well approximated by log-normal density for lower strata of the distribution.

expenditures are simply a rescaled version by $0 < w_{cap} < 1$ for the upper tail of the income distribution and thus follow a power law by construction.

Our model is thus validated both with respect to the input parameters, i.e., the income distribution and inequality perceptions that are in line with empirical data, and regarding the output distribution of consumption expenditures. The main model mechanisms taken in isolation are also already established in the literature, i.e., heterogeneous consumption propensities regarding consumption out of profit and wages (Dynan, Skinner, and Zeldes 2004), the given perception network (Schulz, Mayerhoffer, and Gebhard 2022) as well as upward-looking consumption behaviour (Heffetz 2011). Gräbner (2018) considers this a rare but desirable feature of models to be validated both in terms of input and output variables and mechanisms. Even though the model is rather stylised, it thus replicates an unexpectedly high number of stylised facts even at the highest level of validation that Fagiolo et al. (2019) considers. We therefore consider the model sufficiently validated to at least replicate parts of empirical reality and turn to the macroeconomic outcomes it generates.

3.3. Macro: Median Consumption Norm

We first simulate the model for homogeneous marginal consumption propensities (i.e., $w_{work} = w_{cap} = 0.5$) and show the shares of aggregate consumption with respect to total income for 100 Monte Carlo runs in Figure 5a. Consumption is wage-led even for homogeneous consumption propensities, with effect sizes quickly decreasing for high degrees of homophily. This is exactly the result we expect from our analytical derivation for the median and mean tail income: Increasing the profit share decreases both the median tail

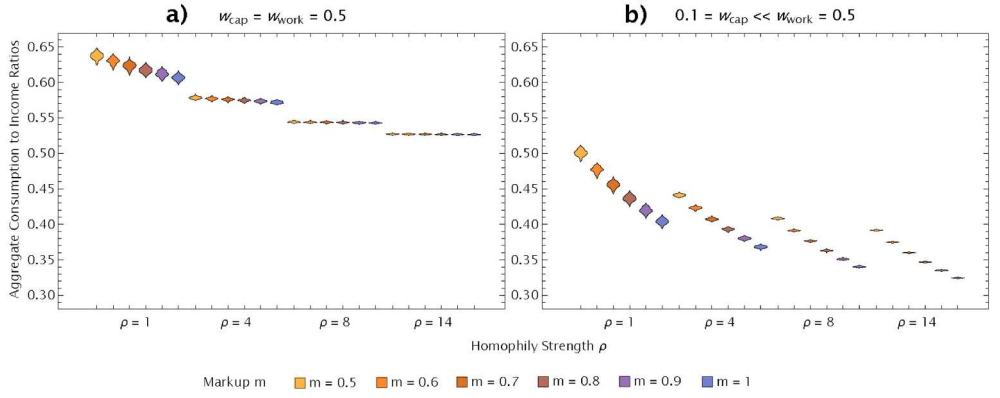

Figure 5. Violin plots of aggregate consumption-to-income ratios of 100 Monte Carlo runs with p = 0.02, the consumption norm for the richest worker given by the median consumption of capitalists, for varying consumption propensities w_{cap}, w_{work}, markups m, and homophily strengths ρ. If for a given combination of w_{cap}, w_{work} and ρ, the aggregate consumption to income ratio increases in m, consumption is profit-led, and wage-led otherwise. Even for homogeneous consumption propensities, aggregate consumption is wage-led but the degree of 'wage-ledness' gets much weaker for higher ρ. For a large difference in consumption propensities, aggregate consumption is strongly wage-led.

income and thus the reference consumption of the richest worker as well as the individual income and idiosyncratic consumption of all workers. Consumption expenditures of workers thus unambiguously decrease with an increasing profit share. By contrast, consumption expenditures of capitalists unambiguously increase with the profit share. This effect cannot compensate for the loss in workers' expenditures, though, since the APCs of capitalists are strictly below the ones of workers due to $c_{cap} = 0$. The effect appears to be stronger (and aggregate consumption levels are generally higher), when the increments between own and observed reference consumption are larger, i.e., when network segregation is lower. Workers tend to observe a more diverse set of other workers, whenever the homophily parameter is low which increases both the consumption increment and the emergent expenditure cascades. The standard Kaleckian assumption of heterogeneous consumption propensities is thus not necessary to generate wage-led consumption but for the effect of the profit share to be significant, perception networks need to be sufficiently heterogeneous.

Introducing the Kaleckian assumption of heterogeneous consumption propensities compounds the initial wage-ledness of consumption for these assumptions. Here, we let the idiosyncratic MPC of workers be 5 times large than the MPC of capitalists, i.e., $w_{work} = 0.5 \gg w_{cap} = 0.1$. Figure 5b shows the results. Aggregate APCs decay almost linearly with markups for all given levels of ρ. Consumption is thus strongly wage-led irrespective of homophily, with the consumption level again being inversely related to the level of network segregation. If reference consumption of the richest worker is given by median tail consumption for the given parameter restrictions, aggregate consumption is thus always wage-led, irrespective of network segregation. Yet, the level of marginal propensities to consume of both classes and the degree of income homophily determine the level of aggregate consumption, without affecting the growth regime regarding consumption.

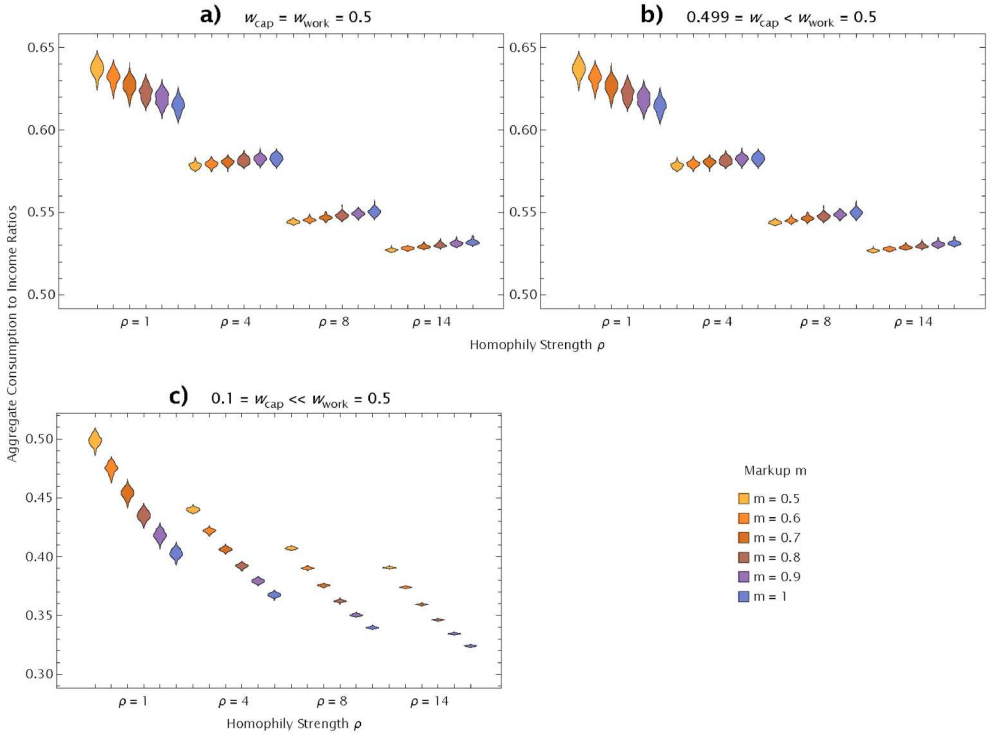

Figure 6. Violin plots of the aggregate consumption-to-income ratios of 100 Monte Carlo runs with p = 0.02, the consumption norm for the richest worker given by the mean consumption of capitalists, for varying consumption propensities w_{cap}, w_{work}, markups m, and homophily strengths ρ. If for a given combination of w_{cap}, w_{work} and ρ, the aggregate consumption to income ratio increases in m, consumption is profit-led, and wage-led otherwise. Both wage-led and profit-led consumption is possible for all but the least segregated networks and for workers' consumption propensity (not) exceeding capitalists' one.

3.4. Macro: Mean Consumption Norm

If reference consumption of the richest worker is determined by the average tail consumption, the growth regime responds to network segregation, though. Consider again the case of homogeneous consumption propensities with results summarised in Figure 6a. Here, consumption undergoes a regime shift and is wage-led for low homophily parameters ($\rho = 1$) but becomes profit-led for higher levels of network segregation ($\rho \geq 4$).

Since network segregation generally tends to decrease aggregate consumption, this regime shift with higher levels of homophily is fairly surprising. In fact, it is arguably the only instance of true emergence within our model framework (O'Connor and Wong 2020), since the regime shift is something that is certainly unexpected from the general assumed direction of our proposed mechanism. Since network segregation decreases the gap in idiosyncratic consumption between workers, it will also tend to decrease status consumption depending on this gap. We would thus expect that the consumption of a lower wage share (higher m) would lead to lower consumption by workers the higher network segregation is and thus the lower the gaps between the idiosyncratic

consumption levels are. The rationale for this surprising effect stem from the fact that homophily affects workers at different positions of the wage distribution very differently. As Schulz, Mayerhoffer, and Gebhard (2022) show, the combination of exponential wage distribution and homophilic linkage leads to a large degree of segregation for the richest workers that increases disproportionately with ρ. For high levels of ρ, the number of workers that directly perceive the consumption of the richest worker is thus sufficiently high to let aggregate consumption be profit-led: The consumption of the richest worker k increases with the profit share due to their higher reference consumption. For high clustering at the top, this compounding emulation effect for the workers that observe k's consumption dominates the effect of decreased income and consumption of all other workers with a lower income resulting from the lower wage share. By contrast, for low ρ, clustering at the top is not high enough to compensate the decreased idiosyncratic consumption levels of all the workers other than k.[13] We thus show that the network topology can induce a regime shift in aggregate consumption and confirm the finding that heterogeneous MPCs are not a necessary condition for wage-led consumption.

As a direct corollary to this, we also show that not all inequalities are alike: Schulz and Mayerhoffer (2023) demonstrated that increases in interpersonal inequality within a class (i.e., increasing the dispersion parameter of a log-normal income distribution) unambiguously increases aggregate consumption for homogeneous parameters. By contrast, we show that increases of interpersonal inequality caused by changes of the functional distribution, i.e., an increase of the profit share, might very well decrease aggregate consumption. Summary measures of interpersonal (income) inequality such as the Gini coefficient might thus mask differences in the specific *type* of inequality that is considered. Empirical studies on the inequality-growth nexus might thus benefit from including measures that focus on top tail incomes or the functional distribution more generally rather than just the Gini coefficient (Berg et al. 2018; Flechtner and Gräbner 2019) that is comparatively insensitive to changes at the tails of the distribution (Atkinson 1970).

We also show that heterogeneous consumption propensities are not sufficient to generate wage-led consumption, if the MPC differential is sufficiently small. In Figure 6b, we show the simulation results for MPCs of capitalists being slightly lower than the ones of workers, i.e., $w_{cap} = 0.499 < w_{work} = 0.5$ to illustrate this. As is clearly visible, consumption stays profit-led for medium to high degrees of homophily. Heterogeneous consumption propensities are thus neither necessary nor sufficient to generate wage-led consumption for our parameter restrictions. Much like in Kirman's (1992) classic, aggregate consumption behaviour is thus irreducible to micro consumption rules: Neither does wage-led consumption imply lower MPCs of capitalists nor do lower MPCs by capitalists imply wage-led consumption.

Finally, Figure 6c shows that aggregate consumption exhibits the expected pattern, whenever MPCs are highly heterogeneous, in this case $w_{work} = 0.5 \gg w_{cap} = 0.1$. If we empirically determine that the consumption behaviour differs strongly between classes, we are thus indeed justified to ignore perceptions and network effects. In this sense, our model recovers the original insight by Kalecki (1971) that consumption is

[13]We also verify this mechanism by monitoring the perception sets of workers for different ρ. Simulation results and the corresponding Julia codes are available upon request.

wage-led, if workers do not save or, in the language of the well-known aphorism 'spend what they get' (Gladys Foster 1990), while capitalists' consumption propensity is much lower. If classes are similar or even equal in their idiosyncratic consumption behaviour, perceptions and interaction in networks become important, with even the growth regime shifting between network topologies.

4. Discussion

We introduce a parsimonious consumption model that synthesises the main insights of class-based heterogeneity following Kalecki (1971) and non-independence following e.g., Robinson (1956) and Eichner (1986). Independent of the reference consumption norm for the richest worker, aggregate consumption (as a share of national income) is higher, the lower network segregation is (Schulz and Mayerhoffer 2023). This might be helpful to make sense of differences in the aggregate *level* of consumption which exhibit tremendous international heterogeneity[14] and are often ignored by studies that typically focus on the sign and effect size of the derivative of GDP with respect to the wage share. Focusing on the growth regime of aggregate consumption, we recover the original Kaleckian insight that consumption is wage-led, whenever the differential in consumption propensities is sufficiently large. The picture becomes much more nuanced, when the two classes converge in terms of consumption behaviour. In this case, both the network segregation and consumption norms become important. As a final theoretical finding, we also show that the result in Schulz and Mayerhoffer (2023) that interpersonal inequality unanimously increases consumption has to be qualified: If the increase in interpersonal inequality results from within-class changes, aggregate consumption indeed increases but for increases that result from changes in the functional distribution, it is possible for aggregate consumption to *decrease* instead. Disentangling the two channels is thus also a promising direction for empirical studies.

If the reference consumption of the richest worker is given by the median consumption level of capitalists, consumption is unambiguously wage-led.[15] This is due to a curious analytical result that the *typical* capitalist might get poorer when the *average* capitalist benefits, reminiscent of the findings of Adamou and Peters (2016). The more interesting case is thus certainly the one where the reference consumption of the richest worker is the mean of capitalists' consumption. Here, we document the distinct possibility of profit-led consumption for empirically plausible parameter regions which might imply that the 'anomalies' found by Barbosa-Filho and Taylor (2006), Stockhammer and Stehrer (2011) and Stockhammer (2017) might not be so anomalous after all and can be explained within the confines of our model. Our simulations also provide proof of concept that heterogeneity in consumption propensities are neither necessary nor sufficient to generate wage-led consumption.

Profit-led consumption tends to emerge for high degrees of network segregation and consumption behaviour that is rather homogeneous between classes. This points to a

[14]Values for the consumption share of GDP range from 15 per cent for Turkmenistan to 146 per cent for Somalia, with large differences even for OECD countries, e.g. Germany with only 49 per cent compared to 67 per cent for the US (World Bank 2022).

[15]It might also appear distribution-neutral for high levels of network segregation and homophily, since the effect of status consumption is greatly diminished here, leaving the impression that the profit share has no effect at all.

further policy conclusion: Decreasing network segregation might have three potentially beneficial effects. First, it tends to reduce bias in inequality perceptions and thus aids in getting more informed voting decisions (Mayerhoffer and Schulz 2022; Schulz, Mayerhoffer, and Gebhard 2022). Second, it tends to increase aggregate consumption and thus growth (Schulz and Mayerhoffer 2023), while it also appears to enhance economic mobility (Chetty et al. 2022b). And finally, it might provide the foundations for a strategy of wage-led growth, i.e., benefit policies that aim to simultaneously decrease inequality and foster economic growth. Thus, the specific type of homophily becomes important that we both represent in reduced form by a single parameter: If homophily is primarily *induced* homophily, policy might arguably indeed decrease segregation by targeting the structural characteristics that cause it, e.g., by subsidising poorer neighbourhoods or by appropriate public housing programmes. By contrast, for *choice* homophily one would need to influence the preferences and beliefs of people themselves which is perhaps the much harder task and would require educational campaigns.[16] Empirically, both types of homophily are likely interlinked (Kossinets and Watts 2009) and disentangling both types might provide an exciting new avenue for further research regarding *desegregation-led* growth.

This synergetic relationship between the three points above is evidently appealing for policy. Yet, it also highlights a potential shortcoming of the model: It completely abstracts from any intertemporal motives and, in particular, household debt. Expenditure cascades imply that individuals at the lower tail of the income distribution exhibit the highest APC and thus, bear the brunt of necessary debt to finance consumption expansions. This might have problematic distributional consequences (Frank, Levine, and Dijk 2014) and contribute to financial fragility á la Minsky (Kapeller and Schütz 2015). Our model is blind for these causes of aggregate volatility and fragility.

While the focus on consumption appears justified due to increased relevance of consumption-led expansions (Kharroubi and Kohlscheen 2017), studying e.g., the effect of debt and liquidity constraints requires a full-fledged macro model that integrates other markets, in particular, financial markets (Kapeller and Schütz 2015). Also, the model completely abstracts from any kind of policy that might help to overcome instability, as is shown for monetary policy by (Proaño et al. 2011). We aimed to make our partial consumption model compatible with such attempts to study spill-overs, e.g., by endogenising income and market power materialising itself in changes in national income and its distribution to ease integration within a macro framework. Finally, one recently documented phenomenon could also complicate the applicability of the rather strict assumptions of the model at hand: Homoploutia, the fact that the rich are increasingly both labour and capital income-rich (Berman and Milanović 2020; Iacono and Ranaldi 2023; Kumar 2021). The cut-off between labour and capital income that appeared reasonable following the findings of Silva and Yakovenko (2005) or

[16]Choice homophily is indeed a potential major factor for residential segregation according to race and refutes intuitions that people's preferences are typically only 'mildly' racist or segregationist. The ALLBUS 2006 study for Germany included an item on the preferred degree of segregation with the vast majority of respondents preferring almost completely segregated neighbourhoods with only a few 'foreigners' (GESIS – Leibniz-Institut für Sozialwissenschaften 2011). These individual determinants of segregation are likely to be overlooked when focusing only on structural characteristics.

Shaikh and Jacobo (2020) might become more and more fuzzy.[17] We will address the issues of liquidity constraints and *composition inequality* (Iacono and Ranaldi, 2023) in further research.

The minimal nature of our model obviously points to various limitations which we discussed above. Yet, our findings indicate that the use of aggregate statistics might be severely misleading, when heterogeneity is large and behaviour is interdependent (Kirman 1992). We introduce both heterogeneity and interaction in form of the empirically validated income distribution and perception network and explicate several theoretical channels by which the functional distribution of income can influence aggregate consumption. Ultimately, the relevance of these channels can only be established empirically, though. We hope to prompt empirical investigation into the effect of network segregation on aggregate consumption. We thus underline the need to go beyond *actual* inequality and study the effects of *perceived* inequality, since perceptions and not necessarily the actual state of affairs shape behaviour. While precise measurement of network segregation, consumer norms and perceptions is a hard problem to solve empirically, considering those factors might enrich the literature and help to explain international variability in growth regimes and aggregate consumption shares. In particular, the more macroeconomically oriented literature on institutional differences in growth regimes might benefit from the theoretical mechanisms presented here to study the microeconomically heterogeneous effects of aggregate norms (Ascione and Schnetzer 2022; Behringer and Treeck 2018). Chapter 11 of Shiller's (2019) *Narrative Economics* analyses the effects of norms and narratives on frugality and conspicuous consumption which illustrates how a focus on extra-economic norms and perceptions might aid in understanding (shifts in) growth regimes. In the terminology of Colander (1993), the two-class structure of income distributions and perception network thus might provide the *macrofoundations* of consumption behaviour that is *microfounded* with upward-looking consumption behaviour on the micro level that is itself endogenous to consumer norms. Our main contribution with this model is to show that both cannot be studied in isolation from each other.

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No potential conflict of interest was reported by the author(s).

[17]Note however that this phenomenon of homoploutia might be partially explainable by the recent surge in CEO payments (Gabaix and Landier 2008) that are more 'akin to profits' (Kalecki 1971, p. 76). In particular, the consumption behaviour by CEOs might resemble the one of more traditional capitalists and CEO payments will typically be located within the Pareto tail. The sharp cut-off might thus continue to be a reasonable approximation for the boundary between classes even in the presence of homoploutia. We thank Malcolm Sawyer for pointing us to this argument.

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Appendix

Like in the standard Kaleckian framework, the model world is characterised by oligopolistic competition. In particular, we assume that the aggregate mark-up m on unit labour costs is exogenous, leading to the following equation for the economy-wide average price level P as:

$$P = (1+m)\frac{W}{Y} \tag{A1}$$

with W as the the total wage bill and Y as total output. We are thus abstracting from raw material costs for simplicity (Hein 2014, p. 247). The profit share h of total income can thus be derived as:

$$h = \frac{\Pi}{PY} = \frac{PY - W}{PY} = \frac{(1+m)W - W}{(1+m)W} = \frac{m}{1+m}, \tag{A2}$$

where Π are aggregate profits (Hein 2014, chps. 6 and 7).[18] The profit share h is therefore uniquely determined by the average mark-up m. We assume that profits only accrue to the p-th upper percentile of the income distribution that marks the onset of the Pareto distribution. The lower part of the income distribution consisting of wages follows an exponential distribution with rate parameter λ, such that the mean of the exponential regime $\bar{Y}_{work} = 1/\lambda$. Note that with this assumption, interpersonal inequality as measured by the Gini coefficient always increases with the profit share h and the markup m, replicating the finding in Atkinson (2009) derived in a non-parametric manner for a specific distributional regime.[19] This implies that we can express total income as:

$$(1-p)\cdot N \cdot \bar{Y}_{work} + \frac{m}{1+m} N\,\bar{Y} = Y = N \cdot \bar{Y}\,. \tag{A3}$$

Since we are only interested in shares, we can assume without loss of generality that the mean total income $\bar{Y} = 1$, such that $Y = N$, which implies:

$$(1-p)\cdot Y_{work} + \frac{m}{1+m} = 1, \tag{A4}$$

and thus $\bar{Y}_{work}$ can be expressed as

$$\bar{Y}_{work} = \frac{1}{(1+m)(1-p)}. \tag{A5}$$

The mean income within the Pareto tail of capitalists is given by:

$$\bar{Y}_{cap} = \frac{m}{1+m}\cdot\frac{Y}{pN} = \frac{m}{1+m}\cdot\frac{N}{pN} = \frac{1}{p}\frac{m}{1+m}, \tag{A6}$$

since there are pN incomes within the Pareto tail and $Y = N$.

[18] Since m is directly proportional to the profit share h, we could restate the whole sequence of derivations following this part in terms of h. We choose to state all variables in terms of m, though, to be compatible with the canonical model and to hopefully ease integration into a full-fledged macro model, where m is endogenous. Also, it is helpful to consider, what different profit shares imply in terms of market power: A profit share of 1/3, following the famous rule of thumb (Izyumov and Vahaly 2015; Johnson 1954), implies an aggregate markup of $m = 1/2$, while a profit share of 1/2 already implies that $m = 1$.

[19] Silva and Yakovenko (2005) show that the Gini coefficient G for a two-class distribution of this kind can be approximated for a low population share within the power law regime as $G = (1+f)/2$, with $f \geq 0$ denoting the share of income within the power law tail with respect to total income. In our model, f is defined as the profit share $m/(m+1)$ which implies that $G = 1 - 1/(2\cdot(1+m))$ with the expected behaviour. For $m = 0$, $G = 1/2$ which is simply the Gini coefficient of the exponential wage distribution, while for $m \to \infty$, $G \to 1$, since then the income share of vanishingly small population share of capitalists approaches unity. Finally, G is unambiguously increasing in m, i.e., functional inequality translates into interpersonal inequality.

If status consumption is $c_{cap} = 0$ within the Pareto tail following assumption equation 3, total consumption within the tail is thus given as:

$$C_{cap} = w_{cap}\left(N \cdot \frac{m}{1+m}\right). \tag{A7}$$

We can also derive the implied tail exponent α from the mean tail income Y_{cap}^{min} by setting the minimum income parameter of the Y_{cap}^{min} to the (expected) maximum of the exponential, i.e., Y_{cap}^{min} marks the (expected) threshold income between the two distributional regimes. Order statistics of an exponential involve the number of draws from this distribution. Rényi (1953) shows that the expected value of the maximum of an exponential distribution with rate parameter λ after n draws is given by H_n/λ, with H_n being the n-th Harmonic number. We can thus determine the threshold income as:

$$Y_{cap}^{min}(p, m, N) \quad = H_{(1-p)\cdot N} \cdot \frac{1}{(1-p)(1+m)}. \tag{A8}$$

The threshold income increases with N (as there is then a higher number of draws and the exponential density is unbounded from above) by the Harmonic number $H_{(1-p)\cdot N}$. Since the Harmonic number is well approximated by $\log[n] + \gamma$ (with $\gamma = 0.5772\ldots$ as the Euler–Mascheroni constant (Dence and Dence 2009)), the effect of a change in population size is logarithmic and thus rather small, though. Also, the higher the markup m, the higher the share of income accruing to profits for fixed other parameters and thus, the earlier the 'onset' of the power-law regime in terms of income. Finally, there are two counteracting effects of an increase in p. Increasing p first decreases Y_{cap}^{min} due to a decrease in the number of draws from the exponential, as can be seen from the Harmonic number as the first factor. Second, however, it also decreases the number of people within the exponential bulk and thus ceteris paribus increases the mean income of workers. Since the Harmonic number decreases rather slowly with p (i.e., logarithmically) for $p \ll 1$ as the first factor, while entering as (much faster) hyperbolic growth in the second term, the whole threshold income tends to increase in p which we also verify for our simulations.

This then allows us to derive the implied tail exponent by equating the mean tail income derived purely from economic considerations above with the mean income implied by a Pareto distribution, i.e.:

$$\begin{aligned} Y_{cap}^{min}\frac{\alpha}{\alpha-1} \quad &\overset{!}{=} \frac{1}{p}\frac{m}{1+m} \\ \Leftrightarrow \quad \alpha \quad &= \frac{m(p-1)}{pH_{(1-p)N} + mp - m} \end{aligned} \tag{A9}$$

Using the quantile definition of a Pareto distribution $F_{Pareto}^{-1}(q) = Y_{min}^{Pareto}(1-q)^{-1/\alpha}$, we can thus finally derive the implied median (or any other quantile) of this Pareto tail as:

$$F_{Pareto}^{-1}(q; p, m, N) \quad = \frac{H_{(1-p)N}(1-q)^{\dfrac{pH_{(1-p)N}}{(1-p)m} - 1}}{(m+1)(1-p)}, \tag{A10}$$

with the median at $q = 1/2$.