# Aggregate Consumption, Perception Networks and Functional Inequality

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**Abstract:** Empirical (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 (Silva and Yakovenko, 2005). 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 like in Mayerhoffer and Schulz (2021); status consumption is microfounded within a perception network as discussed in Schulz et al. (2022) 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 and open questions in the Post Keynesian literature on growth regimes. In particular, we show how upward-looking consumption externalities can be made consistent with wage-led consumption and how network segregation can explain differences in the degree of 'wage-ledness' of aggregate consumption. Our findings carry two implications: First, the effects of shifts in the functional distribution of income might well depend on social norms and the *perceived* inequality within social networks. Second, empirical studies should take the regularities both in the income distribution as well as social network topologies into account, with aggregate representations being potentially misleading.[1]

**Keywords:** Wage-led growth, Aggregate Consumption, Inequality, Perceptions, Consumption Emulation, Class

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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 (Dynan et al., 2004) that contradictory results are dubbed 'anomalous' or 'perverse' (Barbosa-Filho and Taylor, 2006; Stockhammer and Stehrer, 2011; Stockhammer, 2017). 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 as well as making the growth regime more wage-led.

We 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 et al., 2022), 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 in turn. We show that this result in Schulz et al. (2022) depends on the *type* of inequality increase and only holds unanimously, whenever the increase 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 and Stehrer, 2011; Stockhammer, 2017), 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. 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 the capitalists' consumption grows relatively more important.

The remainder of this paper is organised as follows. Section 2 introduces the model and discusses the validation strategy for the various underlying assumptions it uses. Section 3 discusses our main results both regarding the distributional regularities the model generates on a micro-level as well as the distribution-led regimes for different parametrisations and degrees of network segregation. The final section 4 concludes and discusses 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 turn.

## 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. Schulz and Mayerhoffer (2022) 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.

While the above consumption rule can be derived from a marginalist approach with a clear interpretation of all its parameters, it is consistent with Post Keynesian consumer choice, too, that 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. 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. Note that neither of the two includes goods' price, indicating that the given consumption function negates the relevance of price-based substitution. This is consistent with Post Keynesian approaches which also "negate the generality of substitution" (Schefold, 1997, p. 327). 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 (Bertrand and Morse, 2016; Bricker et al., 2020; Heffetz, 2011; Jinkins, 2016; Quintana-Domeque and Wohlfart, 2016; Drechsel-Grau and Schmid, 2014; Alpizar et al., 2005). 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 thus 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 eq. (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 et al. (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

$$c_{work} > 0 \text{ and} \tag{3}$$

$$c_{cap} = 0. \tag{4}$$

The assumption that only workers engage in conspicuous consumption is entirely conventional (perhaps to sustain tracatability) (Kapeller and Schütz, 2015; Setterfield and Kim, 2017; Detzer, 2018) 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*,[2] as is also shown for the domain of fashion by Davis (1992) and Brooks (2010). Charles et al. (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".

[2]For example, they show that 70% of American millionaires purchase cars with below average market value.

## Perception Network

Like in Schulz and Mayerhoffer (2022), the perception of workers is constrained by a perception network following Schulz et al. (2022) and Mayerhoffer and Schulz (2022).[3] 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 et al., 2001). Following Mac Carron et al. (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 $\Omega_{ij}$ and determined as follows:

$$\Omega_{ij} = \frac{1}{\exp[\rho \, |Y_j - Y_i|]} \tag{5}$$

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 (2022) and Schulz et al. (2022) show that the above linkage formation process can be microfounded within a random utility framework and that the weights in eq. (5) can be translated into probabilities $\omega$ as follows:

$$\omega_{ij} = \frac{\exp[-\rho \cdot |Y_j - Y_i|]}{\sum_{k \in W \setminus i} \exp[-\rho \cdot |Y_k - Y_i|]}, \tag{6}$$

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[4] 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 (McPherson and Smith-Lovin, 1987). While both types can be represented by the same homophily parameter $\rho$ and thus have the same effect on simulation outcomes, they might carry drastically different policy implications, as we summarise in section 4.

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 $\bar{C}_{cap}$ 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.[5]

[3] 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 indivudal 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.

[4] Cf. Schulz and Mayerhoffer (2022), Schulz et al. (2022) and Mayerhoffer and Schulz (2022) for rather comprehensive reviews of the empirical literature

[5] 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.

## 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 % super rich (Silva and Yakovenko, 2005; Shaikh, 2017; Shaikh and Jacobo, 2020; Kumar, 2021).[6] 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 labor share of national income and the Pareto tail with the profit share. With some fairly general technical assumptions, this then allows to fully characterise the income distribution by the population share of capitalists $p$ and the aggregate mark-up over unit labor costs $m$ as well as the total population size $N$. We thus provide a mapping from the continuous income distribution to categorical classes.

Like in the standard Kaleckian framework, the model world is characteriszed 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

$$P = (1 + m)\frac{W}{Y} \tag{7}$$

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

$$h = \frac{\Pi}{PY} = \frac{PY - W}{PY} = \frac{(1 + m)W - W}{(1 + m)W} = \frac{m}{1 + m}, \tag{8}$$

where $\Pi$ are aggregate profits (Hein, 2014, chps. 6 and 7).[7] The profit share $h$ is thus 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 $\lambda$, 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 mark up $m$, replicating the finding in Atkinson (2009) derived in a non-parametric manner for a specific distributional regime.

[6] 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 labor market segmentation and dualisation following the seminal work by Reich et al. (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.

[7] 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 (Johnson, 1954; Izyumov and Vahaly, 2015), implies an aggregate markup of $m = 1/2$, while a profit share of $1/2$ already implies that $m = 1$.

[8] This implies that we can express total income as

$$(1-p)\cdot N\cdot \bar{Y}_{work} + \frac{m}{1+m} N\bar{Y} = Y = N\cdot \bar{Y}. \tag{9}$$

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

$$(1-p)\cdot \bar{Y}_{work} + \frac{m}{1+m} = 1, \tag{10}$$

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

$$\bar{Y}_{work} = \frac{1}{(1+m)(1-p)}. \tag{11}$$

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

$$\bar{Y}_{cap} = \frac{m}{1+m}\cdot\frac{Y}{pN} = \frac{m}{1+m}\cdot\frac{N}{pN} = \frac{1}{p}\frac{m}{1+m}, \tag{12}$$

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

If status consumption is $c_{cap} = 0$ within the Pareto tail following assumption eq. (4), total consumption within the tail is thus given as

$$C_{cap} = w_{cap}\left(N\cdot\frac{m}{1+m}\right). \tag{13}$$

We can also derive the implied tail exponent $\alpha$ 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 $\lambda$ after $n$ draws is given by $H_n/\lambda$, with $H_n$ being the $n$-th Harmonic number. We can thus determine the threshold income as

$$Y_{cap}^{min}(p,m,N) = H_{(1-p)\cdot N}\cdot\frac{1}{(1-p)(1+m)}. \tag{14}$$

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 $\gamma$ as the Euler–Mascheroni constant and $\gamma = 0.5772...$, cf. Dence and Dence, 2009, for a survey), 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. Second, however, it also increases the number of people within the power law tail and thus ceteris paribus the mean income within the Pareto regime. Since the Harmonic number increases rather slowly with $p$

[8] 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.

(i.e., logarithmically) as the first factor, while entering as (much faster) hyperbolic decay 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.,

$$Y_{cap}^{min} \frac{\alpha}{\alpha - 1} \stackrel{!}{=} \frac{1}{p} \frac{m}{1+m} \tag{15}$$

$$\Leftrightarrow \ \alpha = \frac{m(p-1)}{pH_{(1-p)N} + mp - m} \tag{16}$$

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

$$F_{Pareto}^{-1}(q; p, m, N) = \frac{H_{(1-p)N}(1-q)^{\frac{pH_{(1-p)N}}{(1-p)m}-1}}{(m+1)(1-p)}, \tag{17}$$

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

### Sequence of events

Below, we show the proposed sequence of events to determine the aggregate APC 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 $\rho$.
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 $w_{cap} \cdot F_{cap}^{-1}(q; p, m, N)$.
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 APC is then given by

$$\frac{C_{work} + C_{cap}}{Y} = \frac{C_{work} + w_{cap}\left(N \frac{m}{1+m}\right)}{N}. \tag{18}$$

# 3 Results

For the simulation runs, we generally set $w_{work} = 0.5$, $c_{work} = 0.5$, $p = 0.02$ and $N = 1,000$ and vary $\rho \in [1; 14]$ and $m \in [0.5; 1]$, i.e., in the empirically calibrated range (cf. Schulz et al. (2022) for more details).[9] We consider first 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.

[9] Our results are robust for other parameter constellations of $w_{work}, c_{work}$ and $p$. Robustness tests available upon request.

## Median and Mean Consumption Norm

Our first result is completely analytical. We show in Figures 1 and 2 that while the mean income of capitalists unsurprisingly increases with the profit share, the median income tends to decrease in it for $p \in [0.01,\ 0.05]$. 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 typically non-ergodic (Peters, 2019) and that growth of the average income is thus often radically different from average or "typical" income growth (Adamou and Peters, 2016; Adamou et al., 2020).[10]

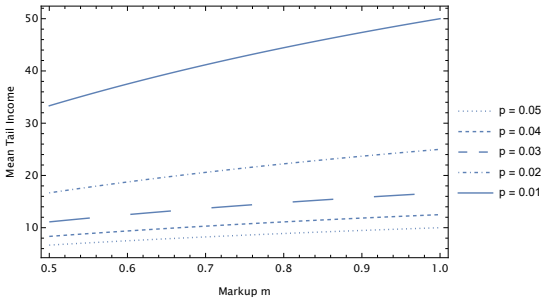


Figure 1: Mean income within the Pareto tail for varying $p$ and $m$. Mean tail incomes unambiguously increase in markups and thus, profit shares.

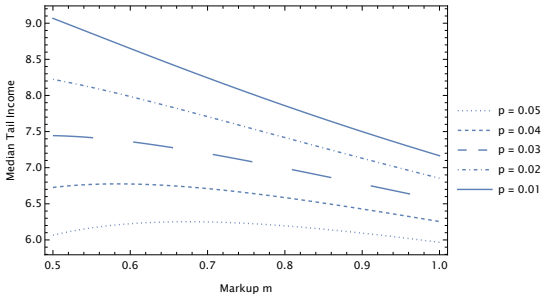


Figure 2: Median income within the Pareto tail for varying $p$ and $m$. Median tail incomes tend to *decrease* in markups and thus, profit shares.

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 to this, tail inequality also increases with the profit share, as the mean income unambiguously increases with $m$, while the minimum tail income also unambiuously decreases with 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.

## Micro: Distributional Stylised Facts

We validate our model by comparing our simulation outcomes to stylised empirical facts about consumption expenditure distributions in increasing level of detail and granularity following Fagiolo et al. (2019).[11] The first stylised fact concerns the decrease of individual APCs and is thus validated at level 1 of Fagiolo et al.'s (2019) taxonomy, i.e., it is qualitatively consistent with empirical macrostructures. First, and 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 (Dynan et al., 2004; Clementi and Gianmoena, 2017). This is what we find consistently for our model, as shown for a single parametrisation of the consumption function and different network topologies. This is the effect of expenditure cascades (Frank et al., 2014). 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 (the lower nine deciles) follows from upward-looking status consumption and is endogenous to the model. This effect on the poorest

[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.

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

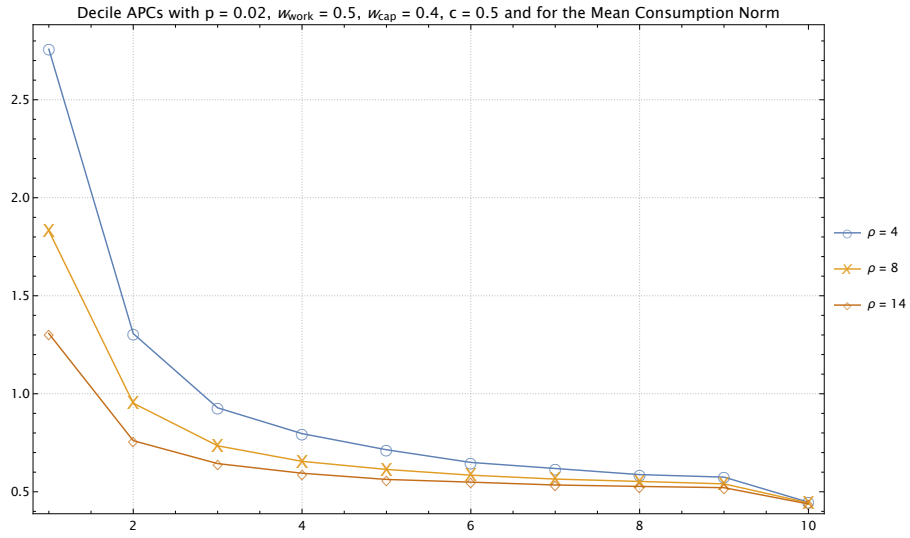


Figure 3: Decile level APCs for a single simulation run and $w_{work} = 0.5, w_{cap} = 0.4, c = 0.5, p = 0.02$ and various $\rho \in \{4; 8; 14\}$. Lines are visual aids only. APCs consistently decline in income decile with APCs being higher the lower network segregation (measured by $\rho$) is.

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.

We also replicate the stylised fact that consumption expenditure distributions are empirically much more homogeneous than income distributions (Krueger and Perri, 2006; Jappelli and Pistaferri, 2010). The model is thus also validated at level 2 following Fagiolo et al. (2019), i.e., it is in *quantitative* agreement with empirical macrostructures. We show this below in Figure 4 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 4 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 et al., 2009; Brzozowski et al., 2010; Chakrabarti et al., 2018; Hohnisch et al., 2002; Fagiolo et al., 2010; Ghosh et al., 2011; Toda, 2017), while the distribution of current income is not (Silva and Yakovenko, 2004; Shaikh and Jacobo, 2020; Kumar, 2021). Yet, there exist significant deviations from the log-normal benchmark, particularly for their upper tails (Chakrabarti et al., 2018; Fagiolo et al., 2010; Ghosh et al., 2011; Toda, 2017) that often follow power laws. This is what we also consistently find for our expenditure distributions, like e.g. Figure 5. 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 et al. (2011) find for their dataset. Without explicitly targeting it, our model is thus able to make sense of the fact that consumption is more log-normal than income (Battistin et al., 2009) and that deviations from log-normality occur primarily in the upper tail (Chakrabarti et al., 2018;

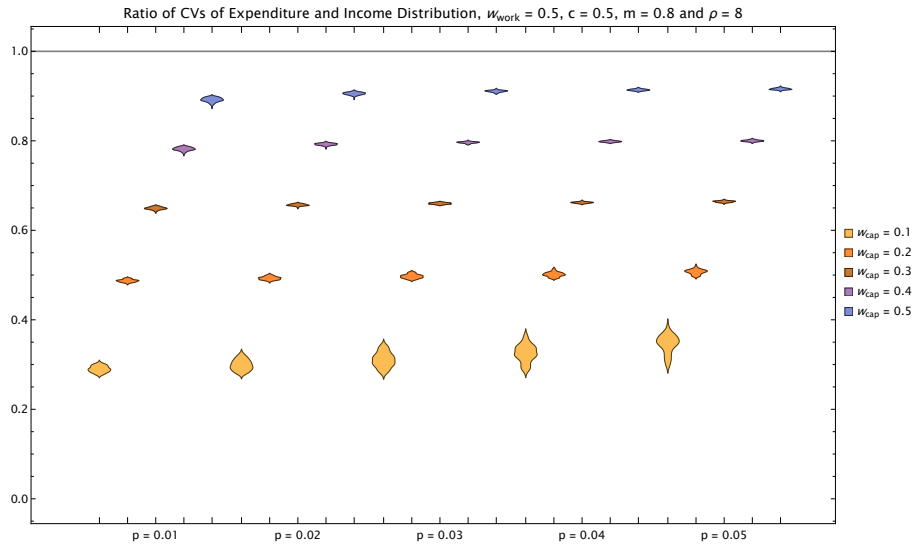


Figure 4: Violin plots of the ratios of the coefficients of variation (CV) of the consumption expenditure distributions to the coefficients of variation of the income distributions, i.e. $CV_C/CV_Y$. Values below unity (solid line) indicate that expenditure distributions are more homogeneous than income distributions, as is the case across all simulations and parametrisations.

Fagiolo et al., 2010; Ghosh et al., 2011; Toda, 2017). It is this heavy upper tail that models of intertemporal optimisation typically fail to replicate (Battistin et al., 2009). We thus also validate one property of our model at level 3 in Fagiolo et al. (2019), i.e., quantitative agreement with empirical microstructures. The generating mechanism for the log-normal part is described in Schulz and Mayerhoffer (2022). 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 expenditures are simply a rescaled version by $0 < w_{cap} < 1$ of 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 et al., 2004), the given perception network (Schulz et al., 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 unexpected number of stylised facts even at the highest level of validation that Fagiolo et al. (2019) considers. We thus consider the model sufficiently validated to at least replicate parts of empirical reality and turn to the macroeconomic outcomes it generates.

## 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 6. 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 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

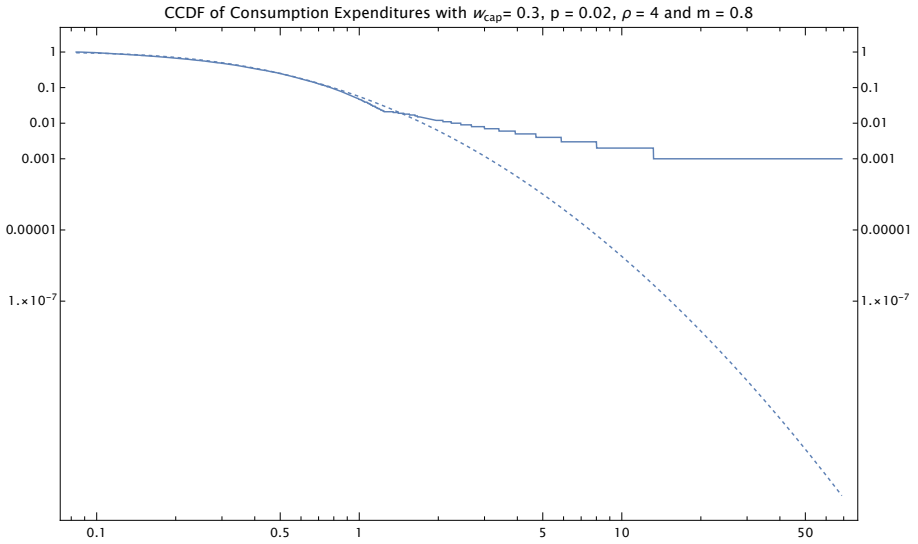


Figure 5: CCDF of consumption expenditures on double-logarithmic scale for $p = 0.02$, $w_{cap} = 0.3$, $\rho = 4$, $m = 0.8$ and $c = 0.5$. Superimposed dashed line is best log-normal fit for the data. Consumption expenditures are clearly more heavy-tailed than log-normal but are well approximated by log-normal density for lower strata of the distribution.

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.

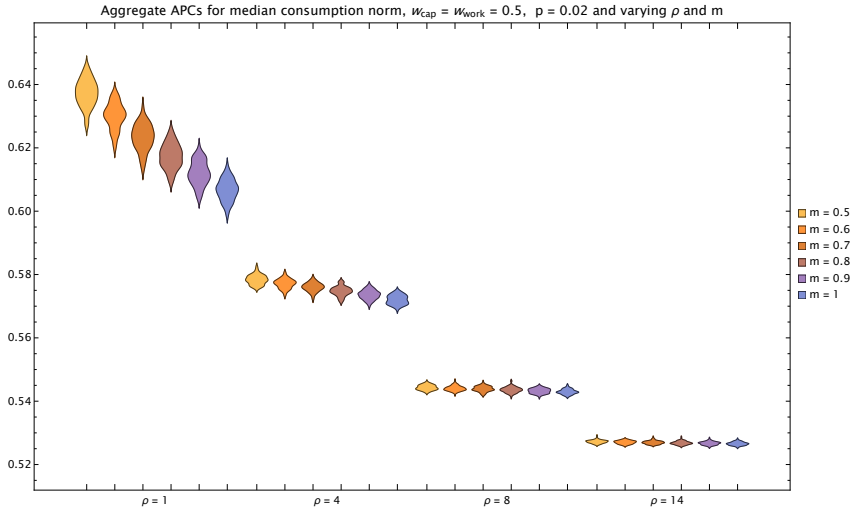


Figure 6: Violin plots of aggregate APCs of 100 Monte Carlo runs with $p = 0.02$, the consumption norm for the richest worker given by the median consumption of capitalists, identical consumption propensities $w_{cap} = w_{work}$ and for varying $m$ and $\rho$. Even for homogeneous consumption propensities, aggregate consumption is wage-led but the degree of "wage-ledness" gets much weaker for higher $\rho$.

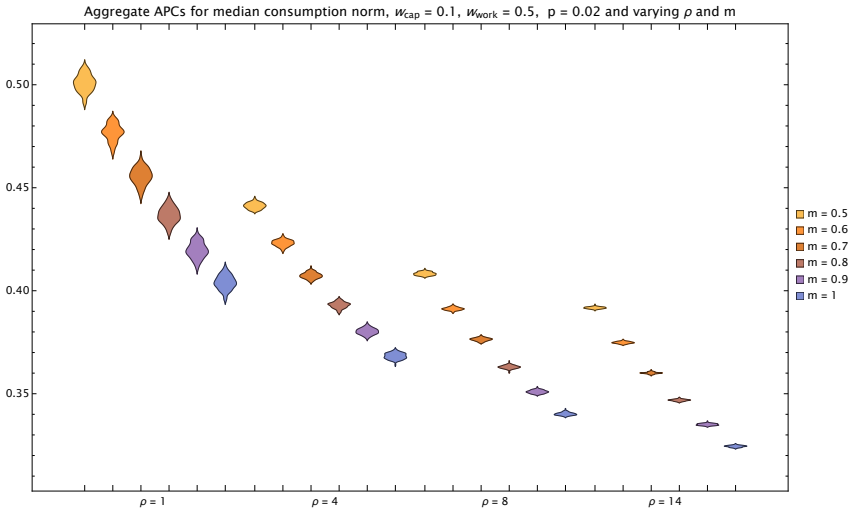


Figure 7: Violin plots of aggregate APCs of 100 Monte Carlo runs with $p = 0.02$, the consumption norm for the richest worker given by the median consumption of capitalists, $w_{cap} \ll w_{work}$ and for varying $m$ and $\rho$. For this large difference in consumption propensities, aggregate consumption is strongly wage-led.

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 7 shows the results. Aggregate APCs decay almost linearly with markups for all given levels of $\rho$. 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 and irrespective of network segregation wage-led. 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.

## 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 8. 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 ($\rho \geq 4$). This result ultimately stems from differences in segregation at the top. As Schulz et al. (2022) show, the combination of exponential wage distribution and homophilic linkage leads to a large degree of segregation at the top of the wage distribution that increases disproportionately with $\rho$. For high levels of $\rho$, 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 the higher reference consumption. For high clustering at the top, this emulation effect for the workers that observe $k$'s consumption dominates the effect of decreased income and consumption of all other workers from a lower wage share. For low $\rho$, clustering at the top is not high enough to compensate the decreased idiosyncratic consumption levels of all the workers other than $k$.[12] 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 (2022) 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

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

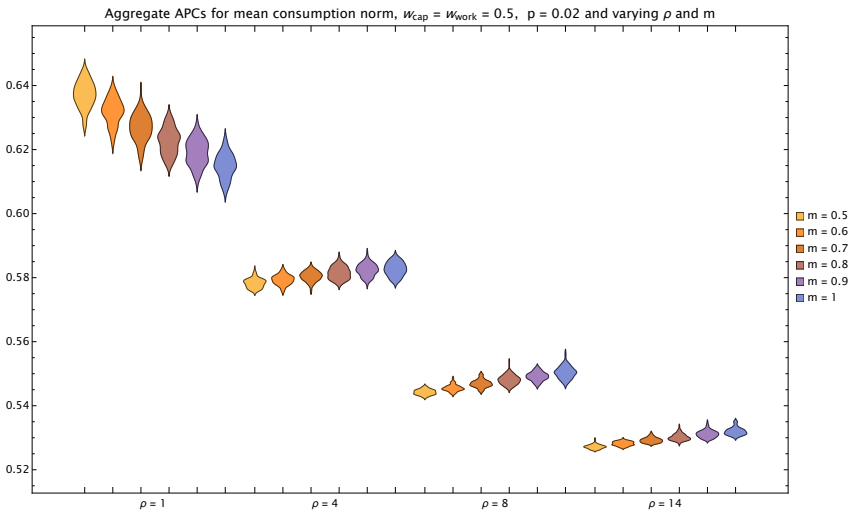


Figure 8: Violin plots of aggregate APCs of 100 Monte Carlo runs with $p = 0.02$, the consumption norm for the richest worker given by the mean consumption of capitalists and for varying $m$ and $\rho$. For low levels of $\rho$, consumption is wage-led even for homogeneous consumption propensities due to relatively low network segregation.

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 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 rather insensitive to changes at the tails of the distribution (Atkinson, 1970).

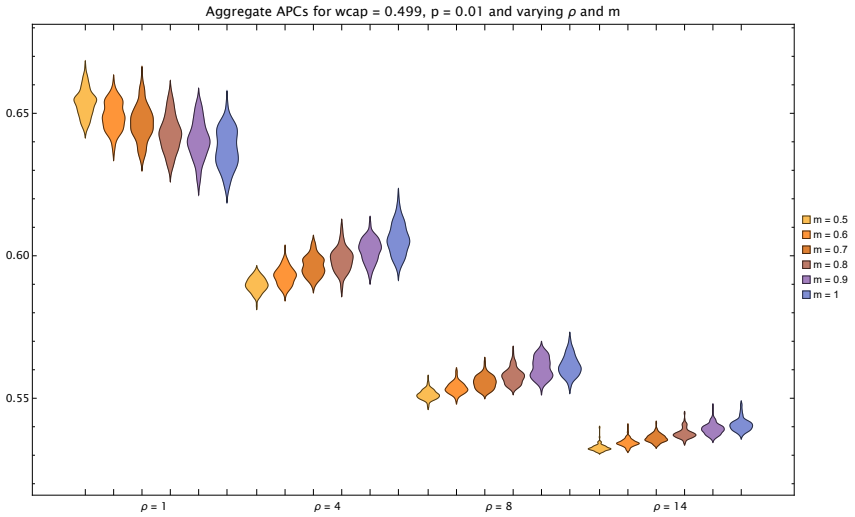


Figure 9: Violin plots of aggregate APCs of 100 Monte Carlo runs with $p = 0.02$, the consumption norm for the richest worker given by the mean consumption of capitalists and for varying $m$ and $\rho$. For medium to high $\rho$, consumption is profit-led, even though consumption propensities of capitalists are (slightly) smaller.

We also show that heterogeneous consumption propensities are not sufficient to generate wage-led consumption, if the MPC differential is sufficiently small. In Figure 9, 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.

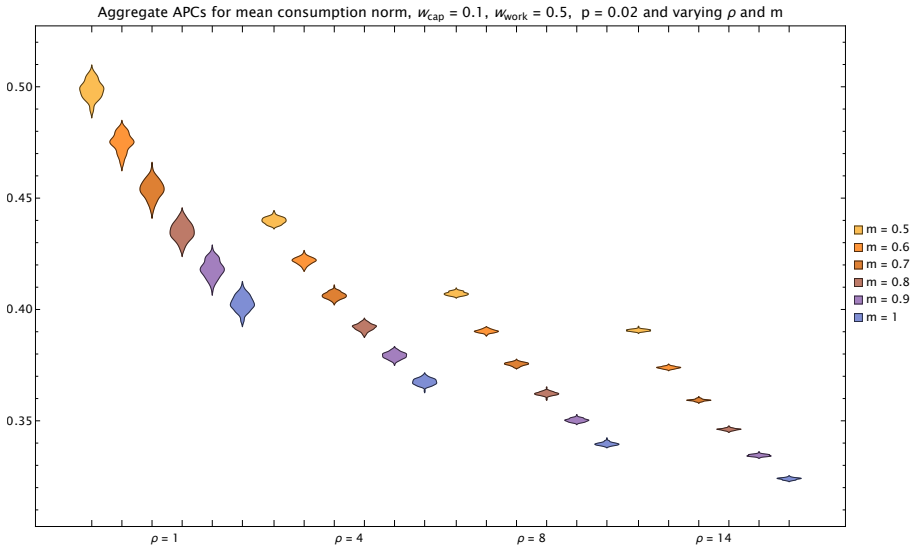


Figure 10: Violin plots of aggregate APCs of 100 Monte Carlo runs with $p = 0.02$, the consumption norm for the richest worker given by the mean consumption of capitalists, varying $m$ and $\rho$ and. For this large difference in $w_{work} \gg w_{cap}$, consumption $C$ is strongly wage-led.

Finally, Figure 10 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 believe 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 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, 2022). This might be helpful to make sense of differences in the aggregate *level* of consumption which exhibit tremendous international heterogeneity[13] 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 as well as consumption norms become important. As a final theoretical result, we also show that the result in Schulz and Mayerhoffer (2022) 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

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

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.[14] 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 an interesting policy conclusion: Decreasing network segregation might have three potentially beneficial effects. First, it tends to reduce bias in inequality perceptions and thus aid e.g. in getting more informed policy decision (Schulz et al., 2022; Mayerhoffer and Schulz, 2022). Second, it tends to increase aggregate consumption and thus might foster growth (Schulz and Mayerhoffer, 2022). 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. Here, 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., subsidising poorer neighbourhoods or appropriate public housing programs. 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.[15] 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 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 et al., 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). We aimed to make our partial consumption model compatible with such attempts to study spill-overs, e.g. by endogenizing 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 labor and capital income-rich (Berman and Milanović, 2020; Iacono and Ranaldi, 2021; Kumar, 2021). The cut-off between labor and capital income that appeared reasonable following the findings of Silva and Yakovenko (2005) or Shaikh and Jacobo (2020) might thus not be as sharp anymore. We will address the issues of liquidity constraints and *composition inequality* (Iacono and Ranaldi, 2021) in further research.

The minimal nature of our model obviously points to many limitations which we discussed above. Yet,

[14] 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.

[15] 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.

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 functional inequality can influence aggregate consumption. Ultimately, the relevance of these channels can only be established empirically, though. We hope to prompt empirical investigations 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 shapes 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 (Behringer and van Treeck, 2018; Ascione and Schnetzer, 2021). 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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