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Does more market competition lead to higher income and utility in the long run?

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Abstract

In this paper, we investigate if more competition leads to higher per capita incomes and/or to a higher level of utility in the long run. To this end, we use a Diamond overlapping-generations model but relaxing the assumption of perfect competition in the good market. We show that the weaker the competition the more unequal the distribution of income. Surprisingly, we note that in general, tougher competition does not lead either to an increase in per capita incomes or to an increase in nonfirm owners' utility in the long run.

KEYWORDS
imperfect competition, inequality, lobbying, overlapping-generations model, political economy

JEL CLASSIFICATION
D31, D43, D72, O41

1 | INTRODUCTION

The usual approach to tackle the problem of market power is to apply antitrust laws to promote tougher competition and to reduce market power. Usually, it is assumed, if not argued, that stronger competition enhances growth. In this paper, we examine this by developing a simple growth model with imperfect competition and compare the outcomes with a standard growth model. To this end, we use an overlapping generations (OLG) approach developed by Samuelson (1958) and our reference model is the Diamond (1965) OLG model without exogenous technological progress. In Diamond's paper, it is assumed that the factor and goods market is perfectly competitive. The assumption of perfectly competitive markets is a usual standard

assumption in neoclassical growth models. In contrast, the market outcomes of imperfect competition are ambiguous and depend on the features of imperfectly competitive markets. In probably most known models of imperfect competition (Bertrand 1883; Cournot, 1838; Stackelberg, 1934), market outcomes are dependent on, if the firms are competing in quantities (Cournot, Stackelberg) or prices (Bertrand), and if firms are making their decisions simultaneously (Cournot, Bertrand) or sequentially (Stackelberg). For our purpose, we choose the Cournot approach because of the characteristic that the outcomes of a Cournot competition will be approximately equal to the outcomes of a perfectly competitive market if the number of competitors strives to infinity in the imperfect market. An important feature of imperfect competition that is considered in this paper is that firms can make positive profits. This implies three categories of incomes—interest incomes, wage incomes, and profit incomes.

Thus, this paper is in some sense in line with Mankiw (1988) who investigates fiscal multipliers in a static model of an economy of imperfect competition and positive profits. Mankiw introduces imperfect competition in a Walrasian equilibrium model. He shows that the weaker the competition, the more approach the fiscal multipliers (balanced budget multiplier, tax multiplier, government purchases multiplier) the values of fiscal multipliers implied by the Keynesian theory. A further reason to consider profit incomes is motivated by the empirical papers of Karabarbounis and Neiman (2018), Barkai and Benzell (2018), and Barkai (2020). The authors of these papers investigate the reasons for the declining labor share in high-income countries (Autor et al., 2017, 2020; Barkai, 2020; Barkai & Benzell, 2018; Blanchard, 1997; Dao et al., 2017; Elsby et al., 2013; Karabarbounis & Neiman, 2014, 2018; Piketty, 2014; van Reenen & Patterson, 2017). Usually, the labor income is measured directly, while the capital income is calculated as a residual which results from the difference between national income and labor incomes. In contrast to this usual approach, Karabarbounis and Neiman (2018), Barkai and Benzell (2018), and Barkai (2020) not only consider the labor share but estimate the capital share. Karabarbounis and Neiman (2018) refer to the difference between national income (value added), labor income, and capital income as factorless income. Barkai and Benzell (2018) and Barkai (2020) define this residual as profit income. Karabarbounis and Neiman (2018) confirm the decrease of the labor share but note that the imputed payments to capital are insufficient to compensate for the decline of the labor share. They offer three possible explanations for this factorless income. First, firms may have market power and make positive profits, thus the residual component represents economic profits. Second, they consider that the capital stock is not well estimated because of wrong assumptions about depreciation, obsolescence, or unmeasured investments in intangible capital. Third, and the most promising explanation in their view is that the residual could be the result of an underestimation of the interest rate because of time-varying risk premia or financial frictions.

Barkai and Benzell (2018) and Barkai (2020) attempt to explain the factorless income as profit income using the US data over the period 1946–2015 and 1984–2014, respectively. Eggertsson et al. (2018) confirm that market power and profits have increased in the US in the past decades. Bajgar et al. (2019) observe similar patterns in Europe and Canada with an increasing concentration of markets, although the speed of concentration is higher in the USA than in Europe.

Given these empirical facts, it follows that firms have market power enabling them to generate profits. It is well known from static models that imperfect competition leads to deadweight losses, which lower the welfare. Taking account of this unambiguous outcome, one can argue that the outcomes of imperfect competition will be inferior to the outcomes of perfect competition in the long run. However, we will show in this paper that this is not necessarily the case in an OLG model with imperfect competition in which the steady-state income is determined by two factors—the

income of the young generation and the savings rate, the latter depending on the expected interested rate. Assuming that the firm owners realize the profits in their first period of life, the profit incomes are partly saved and part of this profit income is withdrawn from the old generation through market power. Therefore, market power leads to an intergenerational redistribution of income from the old to the young generation. Given the same equilibrium capital intensity, if firms make profits, the incomes of capital owners (the old generation in an OLG model) and the labor incomes are correspondingly lower than in a competitive environment. This increase in the income of the young generation may lead to increased savings in the long-run equilibrium. Hence, imperfect competition in an OLG model causes two counteracting effects. On the one hand, the incomes of the young generation increase, and, on the other hand, the savings rate may decline. The overall effect determines if the steady-state incomes are lower or higher than the steady-state incomes in a world with perfect competition. In general, it is possible that an equilibrium with imperfect competition, in terms of per capita income, is superior to equilibrium with perfect competition. Subsequently, it is not always desirable to reduce market concentration and to apply an antitrust policy.

The model presented in this paper is closest to Barkai (2020) and Kumar and Stauvermann (2020). The approach of Barkai (2020) differs from the model presented here in terms of markup and the number of competing firms. In Barkai's model, imperfect competition occurs in the intermediate market, and the price markup is technologically determined by the elasticity of substitution of intermediate goods in the final production of consumer goods. While there are some merits to this model, arguably the price markup will only change if the technology in the production of final goods is changed. In our model, the markup and the number of competing firms are negatively related. The difference between Kumar and Stauvermann and our model is that the former uses a simple AK production function whereas we use a standard neoclassical production function.

It also should be noted that Laitner (1982) has analyzed a two-sector OLG model, where one sector is assumed to be perfectly competitive, while the other sector is structured like a Cournot Nash oligopoly. In Laitner's (1982) model, members of the old generation own the oligopolistic firms, because at the end of the working period individuals can invest in shares of oligopolistic firms or capital goods. Given these assumptions, Laitner (1982) shows that an increase in the number of firms in the oligopolistic market will lead to higher steady-state capital intensity and a more efficient allocation of production factors and therefore to an increased consumer surplus and real income. Thus, the outcomes resulting from an increase in the number of firms depend strongly on the ownership of oligopolistic firms or more importantly, on how the profits of oligopolistic firms are used. This conclusion is also confirmed by Kumar and Stauvermann (2021), who have shown that the results of Laitner can be reversed if members of the young generation own the firms.

The rest of the paper is organized as follows. In the next section, we review the literature on the factors which cause imperfect competition and the modeling aspects of imperfect competition. In Section 3, we introduce a general OLG model of imperfect competition, and in Section 4 we derive possible consequences for policy.

2 | LITERATURE REVIEW

Usually, all standard growth models, such as Solow (1956, 1957), Diamond, 1965; Cass (1965, 1972), and Koopmans (1965), assume that markets are perfectly competitive. This assumption is taken

from static models where perfect competition yields outcomes that are always welfare maximizing. Consequently, to address questions on optimal growth, this assumption is often extended to markets in dynamic models although the real world is full of barriers to entry and imperfectly competitive markets.

Romer (1987, 1990) was among the first to introduce imperfect competition in a growth model by allowing monopolistic competition. The main features of his model with the imperfect competition are the role of intermediate goods and the relaxation of the one-good assumption and the role of production technology in determining the markup. However, a disadvantage of such models is that their outcomes cannot be directly comparable to the standard growth models with perfect competition. An exception regarding the markup is the model of Melitz and Ottaviano (2008), which allows flexible markups, but their model is very specific regarding the assumptions on the utility functions and production functions, hence cannot be compared with the standard growth models.

An important condition for perfectly competitive markets is the nonexistence of barriers to entry and exit. Barriers to entry can be due to different reasons (Bain, 1968; Demsetz, 1982; Ferguson, 1974, Stigler, 1968).

History evidently shows that the assumptions of perfectly competitive markets were most of the time never fulfilled due to political market regulations. Ogilvie (2014) and Ogilvie and Carus (2014) conclude that guilds have existed since ancient times almost in all societies around the world. The guilds regulated the competition and market structure, security and enforced contracts, secured the quality standards, and regulated human capital investments and technological innovations. Further, the guilds could decide who should have the right to join them. The rulers guaranteed the legal rights and economic rents of guilds and in exchange the rulers received payments or others favors from the guilds' members. Not surprisingly, in the view of Adam Smith (1776), the guilds were like cartels founded to exploit consumers.

Pigou (1938) argues that legal barriers to entry are justified as desirable and necessary if they are unavoidable to guarantee quality standards and to reduce the negative impacts of information asymmetries.

Researchers on public choice theory, such as Stigler (1971) or Djankov (2009), emphasize the role of barriers to entry that are created by governments. They argue that barriers to entry and regulation are acquired by incumbent firms with the intention to protect their economic rents and profits. Acemoglu (2008) and Morck and Yeung (2004) argue that incumbent firms have enough political influence to erect barriers to entry to protect them against new market entrants. Similarly, Djankov et al. (2002) and Shleifer and Vishny (1993) argue that incumbent firms share the economic rents with policymakers via channels like campaign contributions and bribes, and in exchange, policymakers erect barriers to entry. In principle, it must be argued that firms can only support policymakers if the firms realize economic rents because a firm in a perfectly competitive market cannot afford any financial support for political parties or policymakers. Therefore, policymakers have a strong interest in firms that make positive profits. Djankov et al. (2002) points out that barriers to entry do not necessarily lead to inefficient market outcomes, however, often this is the case.

Many empirical studies on the barriers to entry (Becht et al., 2008; Bruhn, 2008; Ciccone & Papaioannou, 2007; Djankov et al., 2003; Dreher & Gassebner, 2013; Fisman & Sarria-Allende, 2010; Kaplan et al., 2011; Klapper et al, 2006; Yakovlev & Zhuravskaya, 2007) conclude that reducing the barriers to entry increase the number of market entrants and startups. Further, these studies seem to indicate that low barriers to entry are associated with a high industry turnover (number

of entries and exits are related to the total number of firms). Noting this, Cabral (2014) raises doubt if market entry and exit are good indicators to measure policy success and market performance.

Studies examining if barriers to entry reduce productivity and growth remain inconclusive. For example, while studies like McGowan (2014) or Djankov (2009) conclude that regulation, including barriers to entry, are an obstacle for economic development, others like Mahmood and Lee (2004), Aghion et al. (2005) Scherer (1967), and Scherer and Ross (1990) confirm an inverted U-shaped relationship between market regulation and productivity. Moreover, Autor et al. (2020), Ganapati (2021), and Bessen (2017) argue that increasing market concentration may enhance productivity. From these studies, it is ambiguous if greater market concentration has a growth-retarding or growth-enhancing effect.

Acemoglu (2008) differentiates between an oligarchic society, where major producers have the political power to establish significant barriers to entry to deter market entrants and a democracy where political power is more diffused with the presence of redistributive taxes, but no barriers to entry are in use. According to Acemoglu (2008), it is ex ante unclear which political system in terms of economic development and efficiency is superior because too high tax rates and too high barriers to entry have a growth-retarding effect.

Demsetz (1982) and Touchton (2013) argue that in the medium and long run only legally enforced barriers to entry (patents, taxi medallions, licenses, and the like) are meaningful. Zingales (2017) argues that firms with market power try to protect themselves against competitors by a mixture of innovation and lobbying. Particularly, Zingales argues that the latter activities lead to a "Medici vicious circle," which means that economic resources are used to get political power and the political power is used to increase profits and wealth.[1]

Hoj et al. (2007) estimate the markup of the manufacturing sector in OECD countries is between 7% (Luxembourg) and 15% (Italy), while in the nonmanufacturing sector it is between 17% (UK) and 38% (Italy).

Elhauge (2016) argues that the increasing phenomenon of horizontal shareholding as executed by BlackRock, Vanguard, Fidelity, or State Street, may lead to collusive behavior of the respective firms of a sector. Only the few institutional investors named above hold around 80% of the S&P 500 corporations. Some similar observations can be made at the stock markets of other developed countries. Moreover, the economically powerful can protect and extend their market power by regulatory capture, for example, by undermining the antitrust laws (Etzioni, 2009; Zingales, 2012, 2017).

Recently, network effects, which are associated with the evolution of the internet, have led to the emergence of the so-called superstar firms which dominate the respective markets. According to Autor et al. (2017, 2020) and van Reenen and Patterson (2017), a superstar firm evolves in industries which consists of a "winner takes most" feature, that is, one firm is able to gain a huge market share. If the production requires both fixed overhead labor input and size-dependent variable labor input, the labor share declines with the firm's size or accordingly with its market share. The same outcome is generated if the firm's size correlates positively with the price markup. Further, the authors assume that such industries are on the rise because of the diffusion of new competitive platforms (e.g., Amazon, Alibaba), or the spread of information-intensive goods like software (Microsoft) and online services (Google, Facebook), which are characterized by high fixed costs and low or nearly zero marginal costs.

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[1] The dynasty of the Medici had political and economic power in Italy between the 15th and 18th century in Italy and Europe.

To summarize, it is important to note that many markets are not competitive which are mostly due to the presence of legal market barriers and the effects of imperfect competition, in the long run, are unclear.

3 | MODEL

We use a standard OLG model (Samuelson, 1958; Diamond, 1965) with an additive separable utility function (de la Croix & Michel, 2002). In this model, all individuals live three periods, and all decisions are made in the second period of life, in which the young individual is either a worker or a firm owner. The number of firm owners is exogenously given and fixed. The right to run a firm is inherited from the old to young when the old enter the retirement age. Therefore, n lucky members of the young generation have the right to run a firm, while all other members of this generation can only earn a wage income as an employee. The assumption that members of the young generation own the oligopolistic firms is important for the results derived in this paper. However, if members of the old generation own the firms, the results derived in this paper no longer hold. In the second period of life, the individual supplies her available labor time inelastically and decides how much to save. In the first period, an individual is a child (makes no decisions), and in the third period of life, an individual consumes her savings plus interest income. Further, we assume that individuals have perfect foresight. Therefore, the utility of an individual born in $t-1$ is given by the homothetic utility function:

$$U\left(c_t^1, c_{t+1}^2\right) = u\left(c_t^1\right) + \beta u\left(c_{t+1}^2\right), \tag{1}$$

where c_t^1 is the consumption in the first period of life, c_{t+1}^2 the consumption in the second period of life, and β represents the subjective discount factor. Regarding the function u, the following assumptions are made:

$$u'(c) > 0, u''(c) < 0 \text{ and } \lim_{c \to 0} u'(c) = \infty+, \forall c > 0. \tag{2}$$

The budget constraints of the individual are given by

$$c_t^1 = y_t - s_t, \tag{3}$$

$$c_{t+1}^2 = R_{t+1} \, s_t, \tag{4}$$

where y_t represents the income in period t, s_t the savings in period t, and R_{t+1} the interest factor in period $t+1$.

Inserting (3) and (4) in the utility function (1), differentiating with respect to the savings and setting the result of the latter equal to zero leads to the first-order condition of the utility maximization problem:

$$-u'\left(y_t - s_t\right) + \beta u'\left(R_{t+1}s_t\right) = 0 \tag{5}$$

From (5), and the assumptions of the utility function, we derive the savings function as

$$s\left(y_t, R_{t+1}\right) = \theta\left(R_{t+1}\right) y_t \tag{6}$$

where $0 \leq \theta(R_{t+1}) \leq 1$, $\forall R_{t+1} \geq 0$ and $\frac{\partial \theta(R_{t+1})}{\partial R_{t+1}} \frac{R_{t+1}}{\theta(R_{t+1})} \geq 1$. The latter requirement ensures that the interest elasticity of savings is nonnegative. Further, we assume that the total number of individuals per generation is L_t and it is growing with the fixed rate $g_n > 0$, so that $L_{t+1} = (1 + g_n) L_t$.

We assume that there is only one good in the economy, which can be either consumed or invested. The respective production function of the economy can be described by a neoclassical production function, which is linear homogenous in capital and labor:

$$Q_t = F(K_t, L_t),\tag{7}$$

where K_t is the capital stock, which is fully depreciated within one period, L_t is the number of workers and Q_t is the real output. Further,

$$Q_t = f(k_t) L_t,\tag{8}$$

where we define the capital intensity as $k_t = \frac{K_t}{L_t}$. The production function fulfills the following assumptions:

$$f\prime(k_t) > 0, f\prime\prime(k_t) < 0, f(0) = 0, \lim_{k_t \to 0} f\prime(k_t) = \text{ and } \lim_{kt \to \infty} f\prime(k_t) = 0\tag{9}$$

3.1 | The goods market

The demand for goods is given by the following inverse demand function:

$$p_t = \frac{Y_t}{Q_t},\tag{10}$$

where Y_t is the nominal aggregated national income.

3.2 | The production[2]

Omitting the time index, we get the following inverse demand function[3]:

$$p(Q) = \frac{Y}{Q}.\tag{11}$$

In contrast to the usual standard OLG model, we assume that the number of firms is restricted to n. The reason could be that only n licenses were distributed for some political reasons and that a license is a necessary condition to set up a firm. Alternative reasons for assuming a fixed number of firms are provided in the latter section. However, similar to Mankiw (1988) we do not

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[2] It can be argued that the production side of this model as presented in this section is a reduced form of the model description presented in the Online Appendix. Particularly, the model in the Online Appendix considers that the oligopolies have market power regarding their product prices, but no market power in the factor markets or regarding the general price level (Hart 1982, 1985).

[3] We omit the time index when it does not create confusion.

focus on the evolution of oligopolies, but on the long-run consequences of changes in the market structure and the subsequent impact on the welfare.[4] Additionally, we assume that one person or entrepreneur manages a firm. The entrepreneurs pay themselves the market wage, and, additionally, they receive the profits of the firm. Further, we assume that all firms are identical and thus the representative firm i maximizes profit as follows:

$$\Pi_i \ (Q_i, Q_{-i}) = \ p\,(Q)\,Q_i - RK_i - whL_i, \tag{12}$$

where $Q = \sum_{i=1}^{n} Q_i$, $Q_{-i} = \sum_{\substack{j=1 \\ j \neq i}}^{n} Q_j$, R is the interest factor and w is the wage rate.

Given these conditions, a Cournot competition takes place, and the first-order conditions are:

$$\frac{\partial \Pi_i\,(Q_i, Q_{-i})}{\partial K_i} = \ Y\left(\frac{F_{K_i}\,(K_i, L_i)\,Q - F_{K_i}Q_i}{Q^2} \right) - R = \ 0, \tag{13}$$

and

$$\frac{\partial \Pi_i\,(Q_i, Q_{-i})}{\partial \tilde{L}_i} = Y\left(\frac{F_{L_i}\,(K_i, L)\,Q - F_{L_i}Q_i}{Q^2} \right) = w = 0. \tag{14}$$

Because of the assumption that only one good is available in this economy, we take it as numeraire and set the price equal to one. Because of the symmetry of all firms, $\frac{Q_i}{Q} = \frac{1}{n}$, $K_i = K_j = \frac{K}{n}$, $L_i = L_j = \frac{L}{n}$, and $\frac{K_i}{L_i} = \frac{K}{L} = k$, for $i, j = 1, \dots n$, where $K = \sum_{i=1}^{n} K_i$ and $L = \sum_{i=1}^{n} L_i$, hold. Hence, we reformulate conditions (13) and (14) to

$$\left(\frac{n-1}{n} \right) F_K\ (K, L) = \ R, \tag{15}$$

and

$$\left(\frac{n-1}{n} \right) F_L\ (K, L) = \ w. \tag{16}$$

Because of the linear homogeneity of the production function, it follows that the aggregate profit Π, is given by

$$\Pi = \ Y - \left(\frac{n-1}{n} \right)\ (F_L\,(K, L)\,L + F_K\,(K, L)\,K) = \frac{Y}{n}. \tag{17}$$

To derive the profit per firm, we divide the aggregate profits by the number of firms n:

$$\Pi_i = \ \frac{F\,(K, L)}{n^2} = \ \frac{Y}{n^2}. \tag{18}$$

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[4] A microeconomic foundation for the production side of the economy, which considers the critical statements of Hart (1982, 1995) on modeling oligopolies can be found in the Online Appendix.

An important insight from the functional distribution of income is that market concentration leads to redistribution of income from the elderly who receives interest income to firm owners, and from the workers to firm owners. This implies that more competition in the market increases the income shares of the older generation and the working class. If we transform the production function in per capita form, we get for the factor prices:

$$\left(\frac{n-1}{n}\right) f'\left(k_t\right) = R_t,\tag{19}$$

$$\left(\frac{n-1}{n}\right)\left(f\left(k_t\right) - f'\left(k_t\right) k_t\right) = \left(\frac{n-1}{n}\right) \omega\left(k_t\right) = w_t.\tag{20}$$

$$\Pi_{i,t} = \frac{f\left(k_t\right) L_t}{n^2}.\tag{21}$$

Given free market entry, the maximum number of firms is determined by the zero-profit condition. In principle, in this neoclassical model, each adult will become an entrepreneur, because the number of adults is limited and the smaller the number is, the higher the profits. If the number of adults is going to infinity, the profits will strive to zero and the factor prices will strive to their marginal productivity. As noted above, we assume that the number of firms is given and fixed, and, accordingly, the markup factor, defined as the ratio between price and marginal costs, is $\frac{p}{MC} = \frac{n}{n-1}$,[5] which increases with a declining number of firms. To explain the model in terms of the "corn parable" Solow 1970), this economy works as follows. Corn is only one good in the economy, which can be consumed or used as seed (invested) in the next period to grow corn in combination with labor input. However, some management tasks have to be undertaken to set up and manage a corn-producing firm which takes the stored corn from the older generation in exchange for the promise to pay the rental rate R in terms of corn. Additionally, the firm hires workers and promises to pay some amount of corn as a wage. However, the difference between output and aggregate wages plus interest payments determines the profit of the firm. As long as there are no barriers to entry in the market, competition between firms leads to the outcome that the firms earn the same income as workers. If the number of firms is limited to n, for example, by a legal barrier to entry, the markup factor becomes to $\frac{p}{MC} = \frac{n}{n-1}$, because of the market power of firms. In other words, the workers and capital owners receive only the share $\frac{n-1}{n}$ of the respective marginal product as compensation for one unit of input factor.

It is obvious from (17) that the distribution of income will become more concentrated if the number of firms declines, which means a smaller share of the population receives a bigger share of the total income.

Proposition 1: If the number of firms declines, the inequality of income and wealth increases.

Proof: We know the income share of firms is $1/n$, which is a continuously decreasing function in the number of firms. Thus, this share will increase if the number of firms declines. Simultaneously, the share of the population which receives profits n/L_t declines with a declining number of firms. Therefore, a declining number of firms leads to the outcome that a smaller share of the population receives a bigger share of the total income. Accordingly, the degree of inequality reaches

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[5] Accordingly, the markup is $\frac{p-MC}{MC} = \frac{1}{n-1}$.

its maximum in the case of a duopoly, and in this case each duopolist receives 25% of the total income as profit.

3.3 | The dynamics

The capital market clearing condition using the savings function and factor prices is given by

$$\theta\left(R_{t+1}\right)\left(\frac{F\left(K_t, L_t\right)}{n} + \left(\frac{n-1}{n}\right)\omega\left(k_t\right)L_t\right) = K_{t+1}. \tag{22}$$

Using (19) and (20), and dividing both sides of (27) by L_t gives us

$$\theta\left(\left(\frac{n-1}{n}\right)f'\left(k_{t+1}\right)\right)\left(\frac{f\left(k_t\right)}{n} + \left(\frac{n-1}{n}\right)\omega\left(k_t\right)\right) = k_{t+1}\left(1 + g_n\right). \tag{23}$$

To show the existence of an equilibrium, following Galor and Ryder (1989), we define $k_{t+1} = \varphi(k_t)$, where

$$\varphi'\left(k_t\right) = \frac{d\,k_{t+1}}{d\,k_t} = \frac{\theta\left(\left(\frac{n-1}{n}\right)f'\left(k_{t+1}\right)\right)\left[\frac{f'(k_t)}{n} - \left(\frac{n-1}{n}\right)f''\left(k_t\right)k_t\right]}{-\theta\left(\left(\frac{n-1}{n}\right)f'\left(k_{t+1}\right)\right)f''\left(k_{t+1}\right)\left(\frac{f(k_t)}{n} + \left(\frac{n-1}{n}\right)\omega\left(k_t\right)\right) + \left(1 + g_n\right)} \tag{24}$$

Assuming that n is constant over time, we examine if an unambiguous equilibrium k^* exists.

$$\theta\left(\left(\frac{n-1}{n}\right)f'\left(k^*\right)\right)\left(\frac{f\left(k^*\right)}{n} + \left(\frac{n-1}{n}\right)\omega\left(k^*\right)\right) - k^*\left(1 + g_n\right) = 0 \tag{25}$$

Proposition 2: A globally stable and unique steady-state equilibrium exist if the following conditions are fulfilled[6]:

(i) $k_{t+1} = \phi(k_t), \forall\, k_t \geq 0$ exists;
(ii) $\phi'(k_t) > 0$ and $\phi''(k_t) < 0, \forall\, k_t \geq 0$;
(iii) $\lim_{k_t \to 0}\phi'(k_t) > 1$;
(iv) $\lim_{k_t \to \infty}\phi'(k_t) < 1$.

The first two conditions require that the function $\phi(k_t)$ is strictly concave, condition (iii) requires that the slope of the function exceeds one in the origin, and condition (iv) guarantees that the function has one intersection with the 45-degree line in a $k_t - k_{t+1}$ plane. Given the assumptions on the production and utility functions, these conditions are fulfilled.

Particularly, the following inequality holds:

$$\phi'\left(k^*\right) < 1. \tag{26}$$

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[6] A detailed proof is sketched with insights from Galor and Ryder (1989) or De la Croix and Michel (2002).

This is the condition for the local stability of an equilibrium. Thus, this OLG model with imperfect competition does not differ much from the standard OLG model. The only difference is that now the source of savings is both the wage income and the profit income.

Assuming that for some reason the number of firms will change, we analyze the change in the equilibrium capital intensity given an increase in the number of firms. Total differentiation of (29) and reformulation deliver the reaction of the capital intensity:

$$\frac{dk^*}{dn} = \frac{\overset{+}{\overline{\theta(R^*)\left(\frac{1}{n-1}\right)\left(\frac{1}{n^2}\right)}}\left[\overset{-/+}{\overline{(\varepsilon_{\theta,R}-\varepsilon_{y,k})(f(k^*))}} + \overset{+}{\overline{\varepsilon_{\theta,R}(n-1)\omega(k^*)}}\right]}{\underset{+}{\underline{\theta_R(R^*)f''(k^*)\left(\frac{f(k^*)}{n}+\left(\frac{n-1}{n}\right)\omega(k^*)\right)+(1+g_n)-\theta(R^*)\left(\frac{f'(k^*)}{n}+\left(\frac{n-1}{n}\right)\omega'(k^*)\right)}}} \tag{29}$$

where $\varepsilon_{\theta,R} = \frac{\theta_R(R^*)R^*}{\theta(R^*)}$ and $\varepsilon_{y,k} = \frac{f'(k^*)k^*}{f(k^*)}$.

As noted, the sign of expression (31) is unclear. The denominator is positive, because of the stability of the equilibrium. The sign of the numerator depends on the difference in the interest elasticity of savings $\varepsilon_{\theta,R}$ and on the production elasticity of capital $\varepsilon_{y,k}$. If the difference is positive, the derivative (31) will become positive, but if the difference is negative, it is possible that the derivative is negative. If the elasticity of savings with respect to the interest is sufficiently low or zero, the capital intensity will decline with an increasing number of firms and as a consequence all incomes will decrease. This outcome seems to be paradoxical because a small elasticity of savings implies a small efficiency loss generated by the markup factor of an oligopoly. Further, the profit share will decrease, while the capital income share and labor share will increase. This means the share of income, which is available for savings (profits and wage incomes), will decline with an increasing number of firms. Under these circumstances, the increase in the savings rate is not sufficient to compensate for the decrease of the aggregate income of the working generation.

To summarize,

$$\frac{dk^*}{dn} \begin{cases} >0, \text{ if } \varepsilon_{\theta,R}\left(f\left(k^*\right)+(n-1)\omega\left(k^*\right)\right) > f\left(k^*\right)\varepsilon_{y,k} \\ \leq 0, \text{ if } \varepsilon_{\theta,R}\left(f\left(k^*\right)+(n-1)\omega\left(k^*\right)\right) \leq f\left(k^*\right)\varepsilon_{y,k} \end{cases}. \tag{28}$$

Proposition 3: The capital intensity will increase with an increasing number of firms, if $\varepsilon_{\theta,R}(f(k^*)+(n-1)\omega(k^*)) > f(k^*)\varepsilon_{y,k}$. If the opposite holds, the capital intensity will decline.

Proposition 4: If the interest elasticity of savings is zero, the capital intensity will decrease with an increasing number of firms.

As we note from (32), we cannot predict in general if more competition will lead to a lower or higher steady-state capital intensity. As indicated in the Introduction, the result depends on how much the savings rate will increase, and on how much the income of the young generation will decline. The left-hand side of the condition in (32), $\varepsilon_{\theta,R}(f(k^*)+(n-1)\omega(k^*))$ represents the savings (rate) effect and that the right-hand side of the condition in (32), $f(k^*)\varepsilon_{y,k}$, represents the income effect. In general, the overall effect on the capital intensity depends not only on the functional form of the production and utility functions but also on the parameter values of these two functions. However, if the utility function is a log-linear function, the interest elasticity of savings $\varepsilon_{\theta,R}$ is zero, and because $f(k^*)\varepsilon_{y,k} > 0$, the capital intensity will decline with increasing competition.

To illustrate the outcome, we present four cases in Figures 1–4, where we consider the relationship between steady-state capital intensity and number of firms.
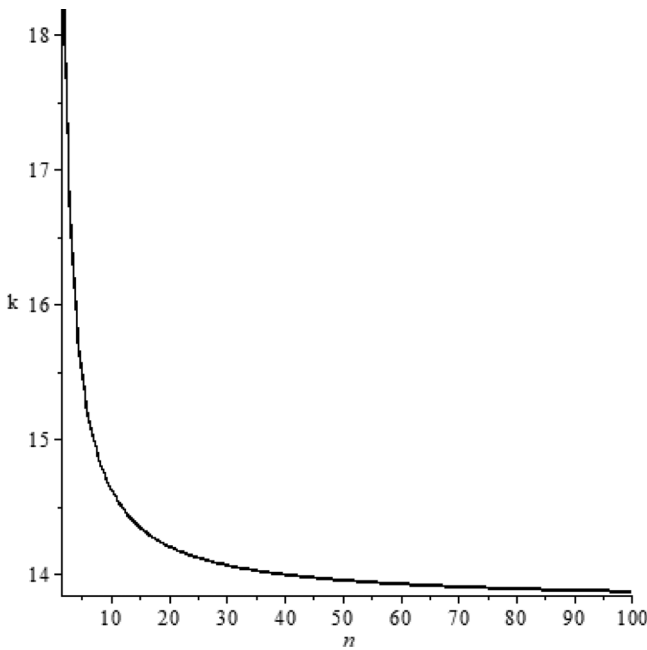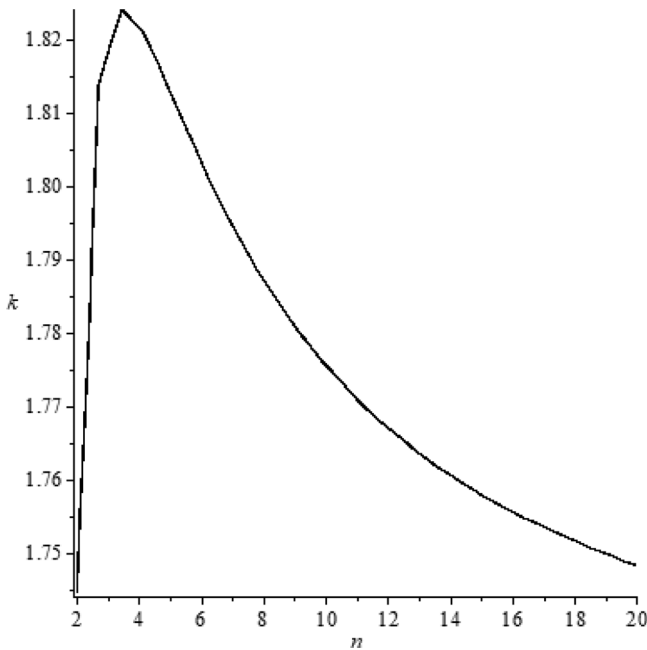
FIGURE 1   Capital intensity[7]

FIGURE 2   Capital intensity

In Figure 1, using a log-linear utility function and a Cobb–Douglas production function, the graph shows that the capital intensity declines with the number of firms. The reason is that the interest elasticity of savings is zero. This means the savings rate is constant while the total profits decline, because of a decrease in market power, and an increase in the wage and interest incomes.

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[7] The assumptions to calibrate the graphs in Figures 1–4 are provided in the Online Appendix.

FIGURE 3 Capital intensity
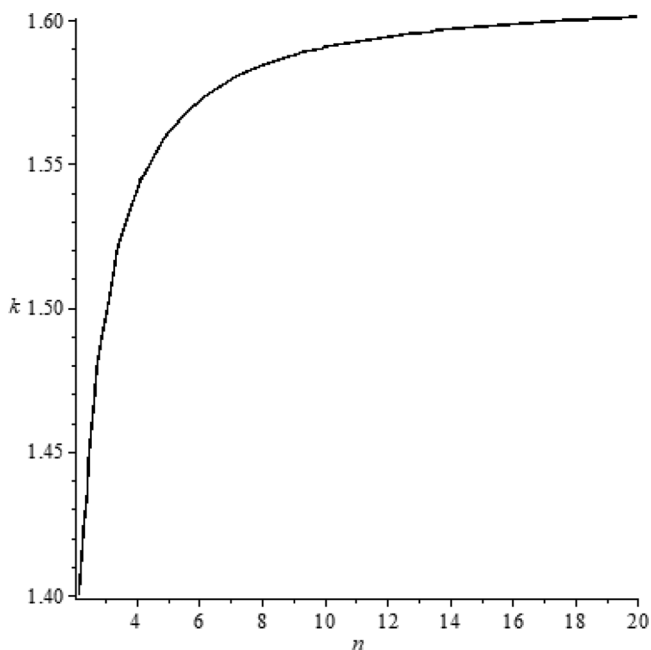
FIGURE 4 Capital intensity
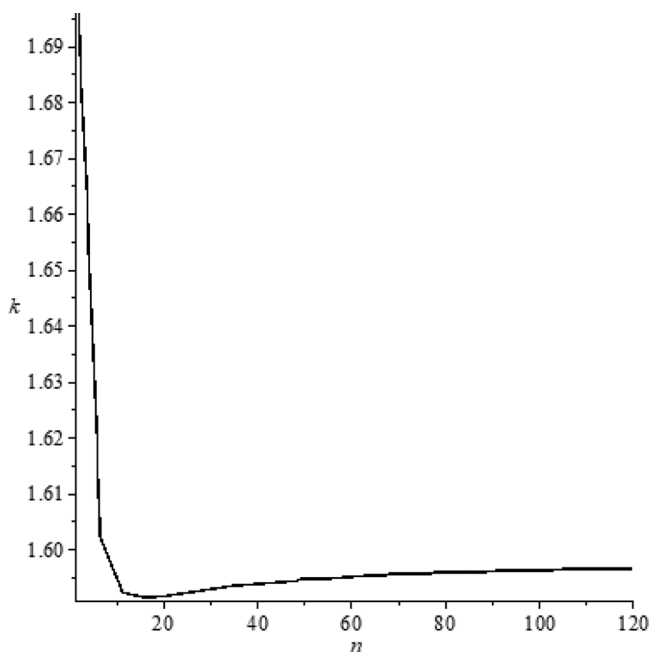
In this case, the savings effect is zero and the income effect is negative because the increase of the wage incomes is always less than the decline of the profit incomes in absolute value terms. Therefore, the capital intensity declines continuously with an increasing number of firms in the market.

The shape of the function in Figure 2 differs significantly from Figure 1 because here we use a constant inter-temporal elasticity of substitution (CIES) utility function, which implies that the

savings are interest elastic. The interest elasticity derived from a CIES utility function increases with the capital intensity. Obviously, the savings effect is relatively strong, and the income effect is relatively weak if the number of firms is less than four firms. If the number of firms exceeds four, the income effect exceeds the savings effect. Thus, the steady-state capital intensity has a maximum at $n = 4$.

To get Figure 3, we have used the same functions and parameter values as before, except that we assume a smaller production elasticity of capital (a value of 0.25 instead of 0.4 in Figure 2). This change in the production elasticity of capital weakens the negative income effect to the extent that the steady-state capital intensity will be a continuously increasing function of the number of firms.

For Figure 4, we assume a CIES utility function and a CES production function. Here the negative income effect is relatively strong, and the savings effect is relatively weak so that the capital intensity decreases with increasing competition. If the number of firms reaches $n = 16$ in this case, a minimum of steady-state capital intensity is reached. If the number of firms is more than 16, the positive savings effect overcompensates the negative income effect so that the capital intensity will increase with the number of firms.

The ambiguity of the reaction of the capital intensity with respect to changes in the number of firms causes also ambiguities with respect to the reaction of interest rate and wage rate. To show this, we differentiate the equilibrium wage rate with respect to the number of firms:

$$\frac{\partial w^*}{\partial n} = \frac{\partial(k^*)}{n^2} + \left(\frac{n-1}{n}\right)(-f''(k^*)k^*)\frac{\partial k^*}{\partial n}. \tag{29}$$

Thus,

$$\frac{\partial w^*}{\partial n} \begin{cases} >0, \text{ if } \frac{\partial k^*}{\partial n} > 0 \text{ or if } \frac{1}{n-1} > -\varepsilon_{\omega,k}\varepsilon_{k,n} \text{ and } \frac{\partial k^*}{\partial n} < 0, \\ \leq 0, \text{ if } \frac{1}{n-1} \leq -\varepsilon_{\omega,k}\varepsilon_{k,n} \text{ and } \frac{\partial k^*}{\partial n} < 0 \end{cases} \tag{30}$$

where $\varepsilon_{\omega,k} = \frac{-f''(k^*)k^*}{f(k^*)-f'(k^*)k^*} k^* > 0$ is the elasticity of the marginal product of labor with respect to the capital intensity and $\varepsilon_{k,n} = \frac{\partial k^*}{\partial n} \frac{n}{k^*}$ is the elasticity of the equilibrium capital intensity with respect to the number of firms.

Since the wage income is the product of the inverse of the markup factor and the marginal product of labor and given that $\frac{\partial k^*}{\partial n} > 0$, it follows that $\frac{\partial w}{\partial n} > 0$. This is because the inverse markup factor ($\frac{n-1}{n}$) and the marginal product of labor increase. If $\frac{\partial k^*}{\partial n} < 0$, the sign of the derivative (34) is ambiguous. An increasing number of firms causes the markup factor to decline, but this positive effect of the declining markup factor will be counteracted by a decreasing marginal product of labor if the capital intensity declines with an increasing number of firms. Then, the overall effect on the wage incomes depends on the size of both effects. It is possible that the wage incomes either increase or decrease which depends on the functional forms and parameter values.

$$\frac{\partial R^*}{\partial n} = \frac{f'(k^*)}{n^2}(\frac{1+(n-1)\varepsilon_{f',k}\varepsilon_{k,n}}{?}), \tag{31}$$

where $\varepsilon_{f',k} = \frac{f''(k^*)k^*}{f'(k^*)} < 0$ is the elasticity of the marginal product of capital with respect to the capital intensity. Therefore,

$$\frac{\partial R^*}{\partial n} \begin{cases} >0, \text{ if } \frac{\partial k^*}{\partial n} \left\langle 0 \text{ or if } \frac{1}{(n-1)} \right\rangle - \varepsilon_{f',k}\varepsilon_{k,n} \text{ and } \frac{\partial k^*}{\partial n} > 0 \\ \leq 0, \text{ if } \frac{1}{(n-1)} \leq -\varepsilon_{f',k}\varepsilon_{k,n} \text{ and } \frac{\partial k^*}{\partial n} > 0 \end{cases} \tag{32}$$

and $\varepsilon_{k,n} = \frac{\partial k^*}{\partial n}\frac{n}{k^*}$ is the elasticity of the equilibrium capital intensity with respect to the number of firms.

The interest factor is a product of the inverse markup factor times the marginal product of capital. The inverse markup factor increases always with an increasing number of firms; and the change of the marginal productivity of capital is ambiguous because of the ambiguous reaction of the capital intensity on an increase of the number of firms.

If $\frac{\partial k^*}{\partial n} < 0$, it follows that $\frac{\partial R^*}{\partial n} > 0$. In this case, the inverse markup factor and the marginal productivity of capital will increase given that the number of firms increases.

When $\frac{\partial k^*}{\partial n} > 0$, the reaction of the interest factor with respect to an increase in the number of firms is ambiguous. The ambiguity arises because the increasing inverse markup factor has a positive impact on the interest factor, but the increasing capital intensity has a negative impact on the marginal product of capital. Overall, the impact of an increasing number of firms on the interest factor is unclear. From the analysis thus far, we note that, in general, it is not possible to predict how increasing competition will impact the capital intensity, wage incomes, and interest rate in this model of imperfect competition. Detailed knowledge about the individual preferences and production technology is necessary to make reliable predictions.

3.4 | Implications for antitrust policy

In the next step, we answer the question, whether antitrust policy measures can be recommended from a long-term view. If we consider only the short-run with given capital stock, then it is obvious that the utility of workers and older individuals will increase if the number of firms increases. The reason is that in the short run, only the inverse markup factor will increase, while the marginal productivities remain constant. Therefore, increasing competition will lead to higher wage incomes and to a higher interest factor. If later-born individuals will suffer or gain is ambiguous due to the ambiguity of the capital intensity, wage incomes, and interest factor.

In this section, we will compare the steady-state utility of an individual in equilibrium with imperfect competition and perfect competition. However, we do not make any assertions regarding Pareto improvements, or that a higher steady-state utility can be realized without harming any member of any generation. The existence of a higher steady-utility only indicates that a higher steady-utility is possible, ignoring the possibility that the transition from one equilibrium to the other may cause losses for some members of a generation.

We make the assumption that L_t is sufficiently large so that $\pi^i = 0$. Accordingly, the wage rate, interest factor, and profits, denoted by pc as a superscript, are in a world with perfect competition:
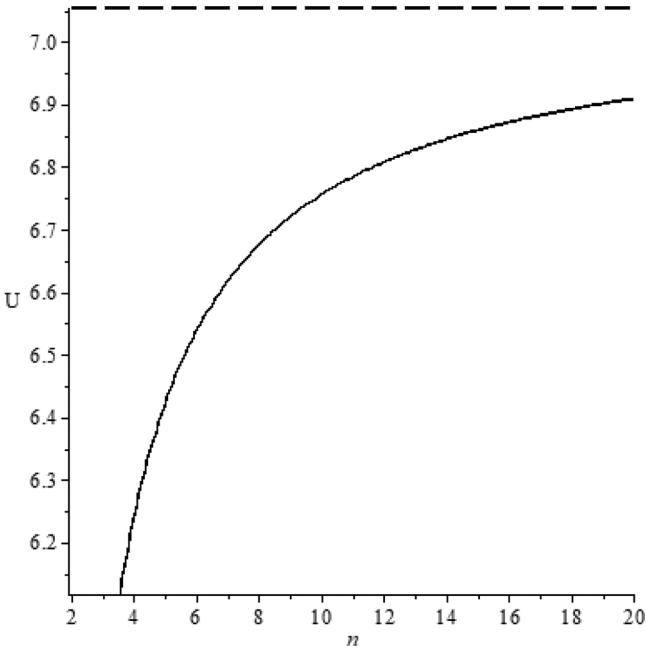
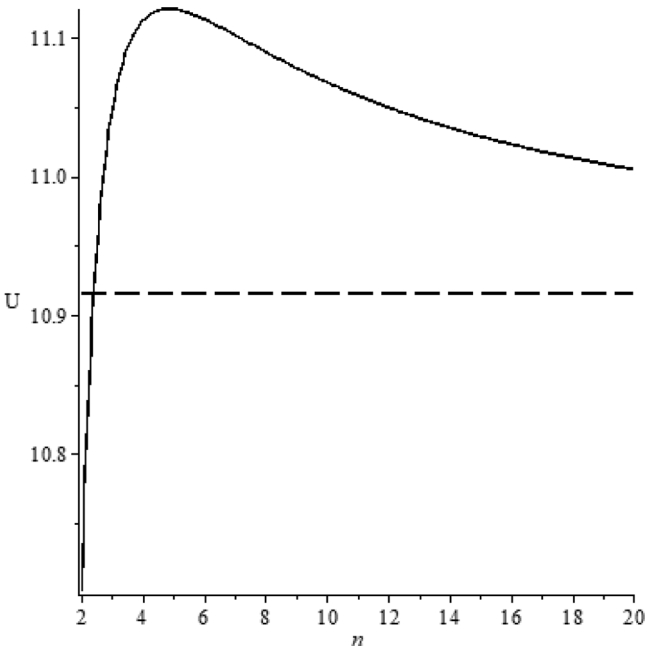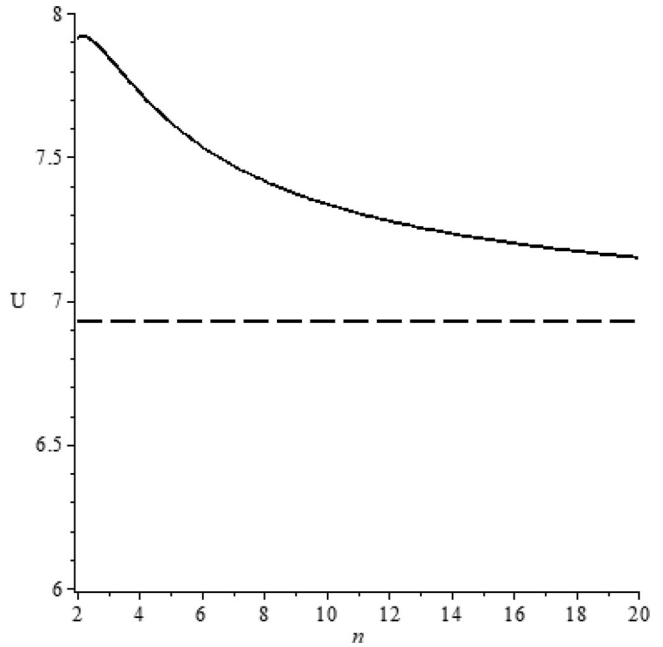$$R_t^{pc} = f'(k_t), \tag{33}$$

FIGURE 5   Steady-state utility

FIGURE 6   Steady-state utility

$$w_t^{pc} = \left(f\left(k_t\right) - f'\left(k_t\right)k_t\right) = \omega\left(k_t\right),\tag{34}$$

$$\Pi_{i,t}^{pc} = 0.\tag{35}$$

In Figures 5–7, we present the long-run steady-state equilibrium utility of an individual, who is not a firm owner. To derive the steady-state utility for the case of imperfect competition, we insert

FIGURE 7   Steady-state utility

the equilibrium factor prices, the profit from (19) to (21), and the equilibrium savings. Therefore, the steady-state utility $U^*(n)$ is given by

$$U^* (n) = u \left((1 - \theta (R^*)) \omega (k^*) \right) + \beta u \left(R^* \theta (R^*) \omega (k^*) \right). \tag{36}$$

The equilibrium utility for the case of perfect competition is given by

$$U^{pc*} = u \left((1 - \theta (R^{pc*})) w^{pc*} \right) + \beta u \left(R^{pc*} \theta (R^{pc*}) w^{pc*} \right). \tag{37}$$

We use this approach because the sign of the derivative of (40) with respect to the number of firms is ambiguous. We illustrate this using three arbitrarily selected examples; all are based on the assumption that the individuals have a log-linear steady-state utility function and that a Cobb–Douglas function represents the production function. We note from the results derived in the latter section that (a) the capital intensity will decline with the number of firms, (b) that the interest will increase with the number of firms, and (c) the reaction of the wage incomes is ambiguous regarding changes of the number of firms. Additionally, we have added the steady-state utility under perfect competition in the respective figures as a reference utility. The latter is denoted by a straight dashed line.

In Figure 5, we observe that the graph of the utility under imperfect competition is a concave increasing function in the number of firms. When the number of firms approaches infinity, the level of utility will approximate the level of utility realized in an economy with perfect competition. In this example, the highest level of steady-state utility will be realized if the market is perfectly competitive. In this case, strong antitrust policy measures are recommended given that the objective is to maximize the long-run steady-state utility.

However, as noted from Figure 6, this recommendation is no longer justified, because the graph of the steady-state utility under imperfect competition is roughly inverted U-shaped. If the number of firms is two, the level of utility is below the utility under perfect competition; if the number

of firms is three, the level of utility exceeds the level of the utility under perfect competition, and a maximum of steady-state utility is realized if the number of firms is 5. If the number of firms further increases, it approximates the level of utility under perfect competition from above. In this case, theoretically, the number of firms should be five to maximize the steady-state utility. The lowest level of utility will be realized in the case of a duopoly.

The last example is presented in Figure 7. We observe that the level of utility under imperfect competition exceeds always the level of utility under perfect competition. If the number of firms is increasing, the level of utility approximates the level of utility under perfect competition.[8] Consequently, pure antitrust policy measures are not recommended.

These simple examples indicate that the degree of competition and individual welfare have in general no continuous relationship. The direction of change of the welfare depends strongly on the underlying production and utility functions. Therefore, it is not always desired to reduce market concentration. Hence, without knowing the specific production and utility function, pure antitrust policy measures cannot be recommended.

However, we did not consider the combination of antitrust policy measures and other fiscal policy measures, which may offset the intergenerational redistribution of income or which may increase capital accumulation. We do not deny that combinations of antitrust policy and other fiscal measures exist which will lead to more preferable outcomes than doing nothing. Important is, that we have to notice that pure antitrust policy may make the situation worse.

4 | CONCLUSIONS

In this paper, we consider a standard OLG model with imperfect competition. As long as the degree of competition or the number of firms is constant, the model works similar to an OLG model with perfect competition. The only difference is that a few young individuals are both workers and firm owners who receive an economic profit. Undoubtedly, the inequality increases with increasing market concentration because a smaller share of the population receives a bigger share of the value added.

We analyzed this model to investigate if increasing the competition would lead to an increase in the lifetime utility of workers and an increase in the income per capita. In the short term, the outcome is obvious—more competition leads to lower markups and thus the incomes of capital owners and workers increase, while the profits decline. Surprisingly, in the long run we get ambiguous outcomes. We show that it is possible that more competition will increase the steady-state utility of workers or decrease the steady-state utility of workers. Hence, without knowing the underlying utility and production function, and their respective parameters, it is difficult to forecast (accurately), if more competition will increase the long-run steady-state utility of workers. The same is true regarding the change of steady-state capital intensity and wage rate. Importantly, the utility and production functions and the respective parameters determine the direction of change. Further, it is also possible that utility, wage, and capital intensity maxima can occur given a specific number of competitors. The theoretical results presented in the paper lend some support to the inconclusive results of empirical research from the literature.

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[8] Note the graph creates the impression that it has a maximum between a duopoly and an oligopoly with three firms. This maximum results only because we have treated the number of firms for simplicity as real numbers (but they have to be positive integers). In fact, the level of utility declines continuously with an increasing number of firms.

The underlying mechanism, which causes the paradoxical result that an imperfect market can be superior to perfect competition in terms of income and welfare, is that increasing market concentration leads to a redistribution of income from the old generation to the firms. Because of the assumption that the firm owners are members of the young generation, the income of the latter will increase. Accordingly, the savings and savings to total income ratio will increase given that the interest elasticity of savings is sufficiently small. The increased ratio of savings to total income will result in an increased capital intensity and increased total income. From the view of total savings, it does not matter that increasing market concentration redistributes income from the old generation to firm owners or redistribute wage incomes to the firm owners because the workers and firm owners are members of the same generation. Of course, the latter redistribution implies an increasing inequality of income and wealth.

Hence, although data supports that declining competition has led to a decrease in the labor share, this cannot be used as a basis to recommend that a stronger antitrust policy is a useful tool or strategy to improve the income distribution. This is because the following generations may suffer from a decreased capital stock and lower wage incomes. Unfortunately, the long-run consequences of a stronger antitrust policy are unclear in general, and thus it is plausible that the situation can become worse in the presence of an antitrust policy. Therefore, a suitable policy to prevent a too unequal distribution of income and wealth would be to redistribute them via the tax system or to think about a combination of antitrust policy and fiscal policy measures.

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