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# Secular Stagnation and Market Power

Valeria Gargiulo

## Abstract

*This work focuses on Secular Stagnation and market power and addresses the existence of a relation between the two. I provide empirical evidence concerning their evolution in the past decades and develop a theoretical analysis to understand such relationship, by looking at the equilibrium interest rates, as indicator of Secular Stagnation, and the level of markup, proxy for market power. I use an OLG model to do so, first in an exogenous markup environment, then by constructing it endogenously. I demonstrate that an increase in market power causes the equilibrium interest rate to fall and the economy reaches Secular Stagnation. I further make a digression about product market deregulation as a possible tool for enhancing competition and therefore reduce the negative effects that excessive market power has on the economy.*

# 1. INTRODUCTION

In the past few decades, the World economy has been featuring several long-term trends, such as a steady decline in real interest rates, a slowdown in growth and a fall in the employment level. However, this only became apparent after the Great Recession, as the years going from 2002 to 2007 were actually associated with satisfactory growth levels which, ex post, are known to be caused by a financial bubble rather than a sustainable economic growth. For this reason, the economic literature has been reconsidering the Secular Stagnation Hypothesis, an idea that was first introduced by Alvin Hansen before World War II. The term Secular Stagnation, despite lacking a unique definition, refers to an economy that, in equilibrium, is characterized by persistently low (or even negative) real interest rates, depressed output and employment. Among other things, Hansen focused on the role played by factor accumulation as a driver for the economic slowdown. At the same time, the new proponents of the Secular Stagnation Hypothesis stress the argument that the current economic situation is mainly due to a change in the structure of the economy, which has led to a shift in the balance between savings and investment, with an increase of the former and a decrease of the latter. Therefore, although put in different terms, it can be argued that the two views are very close to one another, with factor accumulation on one side and investment on the other.

Going one step backwards, the current fall in investment could be caused by several mechanisms. In this respect, a recently proposed explanation in the literature is the increase in market power. Indeed, as I will show below, there is evidence of a rise in the markup levels, both in the U.S. and in the rest of the World, beginning in the 1980s. This trend appears to have economic consequences that are similar to those traditionally associated to the Secular Stagnation Hypothesis, such as a fall in both the labor and capital shares, wages and labor force participation.

Motivated by these facts, I try to uncover the relationship between Secular Stagnation and market power, by investigating how markups affect the equilibrium interest rates. To do so, I employ a three-period OLG model with nominal rigidities characterized by monopolistic competition on the production side. In the baseline model, the markup is modelled as an exogenous function of the elasticity of substitution between goods, and I show that it has a negative relation with the equilibrium interest rate. The downward pressure on the latter caused by an increase in market power (seen as an increase in markup) works through the market for capital. Households, in fact, have two investment opportunities: lending to other households or renting capital to firms. When markups increase, the demand for capital by producers falls, leading households to shift their investment decision towards loans. The rise in loan supply lowers the interest rate and, because of the zero-lower bound, the economy cannot fully adjust to the shock and therefore enters Secular Stagnation. The same mechanism is at play in the extension of the baseline model, where I construct the markup as a function of the number of producers in the economy. I further introduce an entry cost, which allows me to discuss the positive effects that product market deregulation would have on such an economy in terms of boosting competition and, hence, reducing the risk of entering Secular Stagnation.

The rest of the work is organized as follows. In Section 2, I discuss the literature to which I refer. Section 3 presents some empirical evidence concerning both Secular Stagnation and market power. In Sections 4 and 5 I develop the baseline model and its extension, respectively. Section 6 concludes.

## 2. RELATED LITERATURE

The concept of Secular Stagnation was first introduced by Alvin Hansen, who originally discussed it in terms of declining economic growth, mainly due to a lower level of factor accumulation and lower population growth (Hansen, 1939). More specifically, he defined Secular Stagnation as characterized by “sick recoveries which die in their infancy and depressions which feed on themselves and leave a hard and seemingly immovable core of unemployment”. Nonetheless, few years after his speech, Hansen was proven wrong, especially for what concerns population growth. The Secular Stagnation hypothesis has gained renewed importance in the economic discussion only recently, namely after the speech held by Lawrence Summers at the 2013 IMF Annual Research Conference (Summers, 2013), where he suggested that advanced economies might find themselves in such a situation. However, Summer discusses the issue in a slightly different way, focusing not only on economic growth, but also on the stability of the financial system, how these relate to each other and to the equilibrium real interest rate (Summers, 2014). Concerning financial stability, he noted that, in the past decades, the only circumstances in which the U.S. economy reached satisfying levels of growth capacity utilization and employment were always associated to financial bubbles, hence, ex post, they were not achieved in a sustainable way. The reason for this, he argues, could be that changes in the structure of the economy have led to a shift in the balance between savings and investments, which causes a decline in the equilibrium real rate, that is the one associated with full employment. Given this decrease, the issue at hand that makes the stagnation “secular”, is the impossibility of attaining full employment and strong growth because of the constraints associated with the zero-lower bound on nominal interest rates. This last argument has been especially relevant since, during the period of interest, the inflation rate has been particularly low, even during those times characterized by acceptable growth levels.

Following the above analysis, the current definition and the discussion has slightly moved away from that of Hansen and now also focuses on the continuing downward tendency of real interest rates, which reflects an excess of savings as opposed to a decrease in investments (Eggertsson et al., 2019). A trend that, according to Secular Stagnation proponents, has begun in the 1980s and continues as of today. At the same time, the argument concerning the fall in investment is still very close to the decrease in factor accumulation proposed by Hansen. In this respect, a recently proposed explanation that is receiving increasing attention in the literature is the raise in market power (De Loecker et al., 2020). In this paper, the authors find evidence of an increase in the level of markups in the U.S. economy starting in the 1980s and study some implications that may arise because of it. They infer that such trend has some secular consequences, such as a fall in the labor and capital shares and in labor force participation. Interestingly, these facts are also associated to the Secular Stagnation hypothesis.

Therefore, one can argue that there is a relation between Secular Stagnation and Market Power.

As a matter of fact, such relation was studied in Rovo (2017). The author found (both empirically and theoretically) a positive relationship between the level of competitiveness in an economy and the associated interest rates. Motivated by this evidence, I further investigate the connection between Secular Stagnation and Market Power.

Concerning the structure of the model in Section 4, I follow Eggertsson et al. (2019), where the consumer problem is characterized by a three-period overlapping generations model (OLG) with nominal rigidities, which mostly focuses on the role of deleveraging, decreasing population growth, rising inequality, and fall in price of capital and labor share as triggers of Secular Stagnation. However, on the production side, the authors do not consider a monopolistic competition structure. Furthermore, differently from their paper, I assume another form for the downward nominal wage rigidity, following the works of Benigno and Ricci (2011) and Schmitt-Grohé and Uribe (2016).

Instead, for what concerns the production side of the economy, the model is related to the standard monopolistic competition literature (Dixit and Stiglitz, 1977), and follows the final-intermediate goods production structure of Rovo (2017). This work also relates to Galì (1995) and Bilbiie et al. (2012), which endogenously model the number of firms in order to study the macroeconomic implications arising from such a monopolistically competitive environment.

More specifically, in the extension of the baseline model presented in Section 5, I follow the structure laid out in Galì (1995) in order to relate market power to the number of firms present in the economy, through the assumption that the elasticity of substitution between intermediate goods is increasing in the number of the producers of such goods. This allows me to determine the equilibrium number of intermediate goods-producing firms via the zero-profit condition that characterizes monopolistic competition.

However, at this step of the analysis, I introduce an entry cost for the intermediate products market following Blanchard and Giavazzi (2003). This cost is meant to capture product market regulation coming from legal and administrative restrictions on entry, rather than a direct cost for the firms. For this reason, as in Blanchard and Giavazzi (2003), it is assumed to be a shadow cost in the model. It only emerges for the computation of the steady state number of intermediate goods producers, namely in the zero-profit condition. Nevertheless, its presence allows firms to make some profits in the long-run in order to cover such cost, and therefore modifies the zero-profit condition. Through this procedure, I find the equilibrium number of firms in the intermediate goods market to be a negative function of the entry cost, which allows for a discussion concerning deregulation of product markets.

Hence, the theoretical work finally relates to the literature that deals with the macroeconomic implications of deregulatory reforms that aim to reduce markups by promoting competition. Blanchard and Giavazzi (2003) is a prominent example of this literature. The authors study both product and labor market deregulation in the short- and long-run, and argue that, while deregulation may entail some negative effects in the short-run due to the risk of a lower labor demand by incumbent firms, it proves to be beneficial in the long-run in terms of both higher wages and lower unemployment resulting from an increased competition. Concerning this last result, Ebell and Haefke (2003) quantify the beneficial effects through a fully microfounded dynamic model calibrated on the U.S. economy. Further, Cacciatore and Fiori (2016) find evidence

suggesting that deregulation reduces aggregate volatility, which, in turn, causes a reduction in the welfare costs of business cycle.

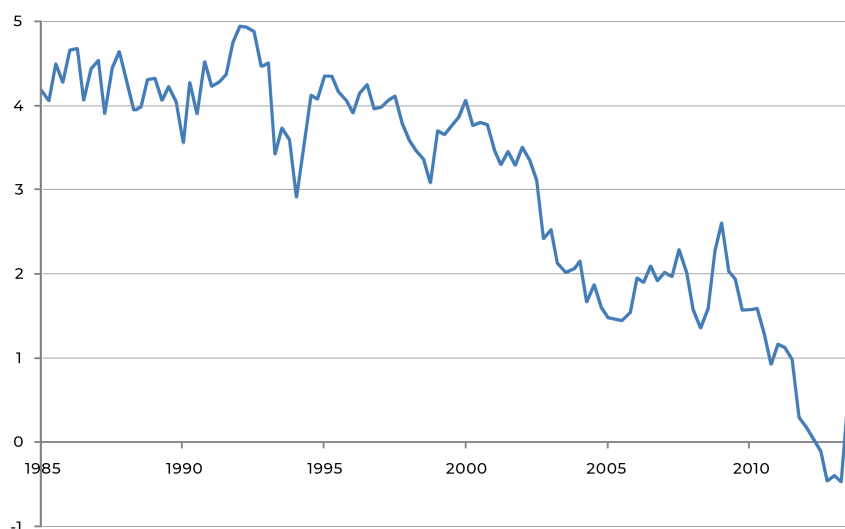
### 3. EMPIRICAL MOTIVATION

In what follows, I will be discussing some stylized facts and empirical evidence concerning Secular Stagnation and Market Power, respectively.

#### 3.1 SECULAR STAGNATION

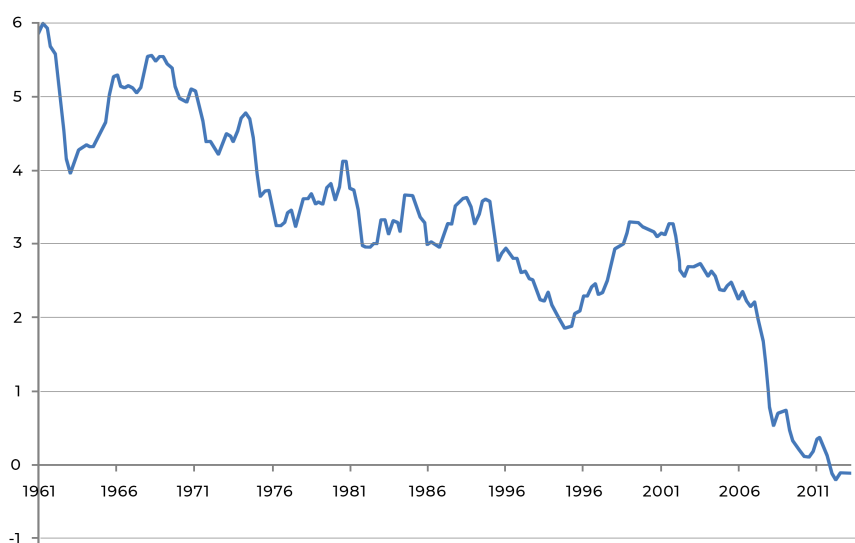
After the Great Recession, the most advanced economies such as the U.S. and the Eurozone were never able to fully recover and reach the pre-crisis output level predictions. According to the standard view this is surprising, as one would expect an acceleration of growth after a financial crisis. Therefore, the “new Secular Stagnation hypothesis” takes these issues into account and raises the possibility of a long-lasting economic environment where it is impossible to simultaneously achieve full employment, financial stability and adequate growth, at least with the policy instruments known and used as of today. The main problem is related to the interest rate. In fact, a shock that raises savings and reduces investment propensity is expected to downwardly affect the natural interest rate for the economy to adjust, without impacting its levels of output and employment. However, given the zero-lower bound on nominal interest rates, there is the possibility that the rate needed to balance savings and investments at full employment is below zero and, therefore, not attainable. Indeed, empirical evidence appears to support the existence of this circumstance and shows that both the actual real interest rate and the natural one have been on a long-term decreasing path, as it can be observed in figures 1 and 2, respectively. Figure 1 shows trends in indexed bond yields for various countries, while figure 2 is based on an estimation of the U.S. natural rate of interest made by Laubach and Williams (2003), calculated using data on actual interest rates and measures taking into account the distance of the economy from its potential.

Figure 1: World Real Interest Rate



Source: Lawrence Summers, “Reflections on the “New Secular Stagnation Hypothesis””

Figure 2: U.S. Natural Interest Rate



Source: Thomas Laubach and John Williams, "Measuring the Natural Rate of Interest"

The reasons behind the decreasing trend in the natural interest rate are several and reflect the structural changes in the modern economy. First, there is evidence of a slowdown in population growth, which, going back to Hansen (1939), is associated with a decline in the natural rate and in labor force growth. Second, the demand for debt-financed investments has decreased, reflecting a consequence of a period of excessive leverage and greater restrictions on financial intermediation. Third, a change in income distribution, both between labor and capital income and between different income classes, has operated to raise the propensity to save. This, together with a reduction in investment demand, cause a fall in the equilibrium interest rate. Then, related to the above changes, there is cheaper capital goods, which implies that investment goods can be obtained with less borrowing and spending, reducing the propensity to invest. Fifth, an increase in the demand for safe assets, observed through the increase of foreign holdings of U.S. Treasury securities, has further contributed to the decline of interest rates during the first decade of the 21st century, as empirical evidence suggests (Bernanke et al. 2004, Warnock and Warnock 2009, Beltran et al. 2013). Finally, the disinflationary policies, engineered first in the U.S. and U.K., explain much of the decrease in interest rates during the 1980s. All these factors contribute to a weakening of demand and a reduction on the natural real interest rates.

These observations, together with the present low-inflation environment, make it more difficult to lower real rates, causing the zero-lower bound to be more critical than it has ever been, due to a much higher probability of hitting it.

### 3.2 MARKET POWER

Closely related to the decrease in investment and labor capital there is another factor that has recently gained attention as one of the forces behind Secular Stagnation, that is the growing market power. The main reason is that lack of competition reduces the incentives to invest, therefore contributing to persistent economic weakness.

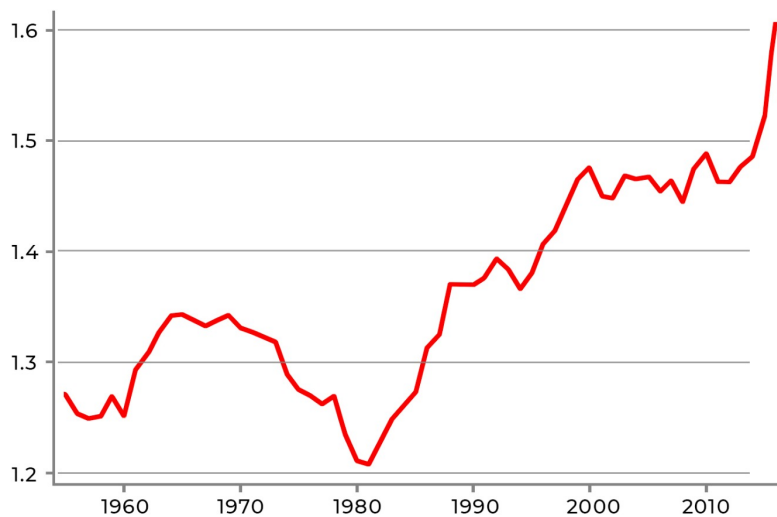
In order to understand the mechanism behind this it is useful to think of corporate profits. In fact,



the latter have been steadily increasing over the last years, which could be due to high rates of return to investment. However, this does not appear to be the case, since, as discussed above, investments have not been taking off recently, as opposed to mergers and acquisitions, despite the possibility of raising money at an incredibly low cost. Therefore, the high level of profits may be reflecting growing monopoly power. This would imply that many corporations have no incentives to expand their capacity or improve their services, resulting in an environment characterized by high profits but low investments, even with particularly low rates. In such an environment there would also be some problems in achieving or sustaining full employment, since Central Banks have limited power in fighting recessions in an economy with low interest rates. Hence, lack of competition can contribute to Secular Stagnation.

The hypothesis of growing market power has been confirmed in De Loecker et al. (2020). In this work, the authors document the evolution of monopoly power in the U.S. economy since the 1950s. The proxy used to measure it, as in standard literature, is the markup level, which they obtain by collecting individual firm output and input data. Then, employing the production approach, they solve the producer cost minimization problem. The markup is then estimated as the wedge between a variable's input expenditure share in revenue and that input's output elasticity. The results show that markups were quite stable in the period going from 1955 to 1980, and started to steadily rise since then, as can be seen in figure 3.

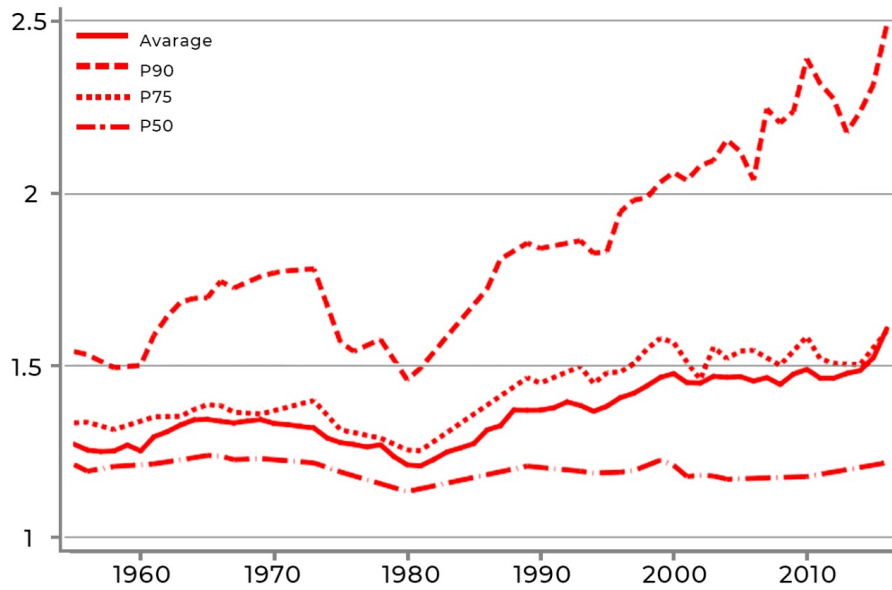
Figure 3: U.S. Average Markups



Source: De Loecker et al., "The Rise of Market Power and the Macroeconomic Implications"

However, it is also important to consider the distribution of markups, shown in figure 4 below. The latter displays the average markup together with the percentiles of the markup distribution, constructed via a ranking of firms by their markup, then weighted by each firm's market share. By looking at the figure, it is safe to infer that the increase in average markup previously observed comes entirely from the firms in the top half of the distribution, implying that most firms have not experienced any rise in their market power.

Figure 4: Percentiles Markup Distribution



Source: De Loecker et al., “The Rise of Market Power and the Macroeconomic Implications”

This upward trend has not only been observed at U.S. level, but is present all over the World, characterized by the same timing and distributional features, as it has been studied in De Loecker and Eeckhout (2018). Furthermore, the appreciable decline in competition has several long-term macroeconomic implications. First of all, there appears to be a negative relationship between the level of markup and the labor share, empirically documented in De Loecker et al. (2020). In an analogous way, another secular consequence of the rise in market power is the decline in the capital share. A third long-term consequence is the reduction in wages and labor force participation. Indeed, in a monopolistically competitive environment, an increase in markups implies a decrease in aggregate production, at least if the demand is not perfectly inelastic. This, in turn, causes both wages and labor force participation to fall, as will be shown in the following sections. All of these consequences are closely related to some of the factors traditionally associated to the new Secular Stagnation hypothesis discussed above.

Motivated by this evidence, I devote the rest of this work to a theoretical investigation of the relationship between Secular Stagnation and market power, that is, how the latter can cause or amplify the former.

## 4. BASELINE MODEL

In this section I develop a simple model with a 3-period OLG framework for what concerns the household problem, and characterized by monopolist competition in the firm one. This allows to observe how markups affect the economy and how they may cause it to enter Secular Stagnation.

## 4.1 HOUSEHOLD

The representative household has a three-period life span (young, middle age and old) and only supplies labor during middle age. The population size at period  $t$  is denoted by  $N_t$ , thus the population growth rate is defined as  $g_t = \frac{N_t}{N_{t-1}} - 1$ . The household maximizes the following utility function

$$\max U = \log C_t^y + \log C_{t+1}^m + \beta^2 \log C_{t+2}^o \quad (1)$$

Where the utility only comes from consumption, indexed by the period and whether she is young, middle aged or old. I assume the presence of a loan market, in which agents exchange one-period riskless debt assets, denoted by  $B_t^i$ , where  $i$  refers to the generation involved in the transaction.

The maximization problem that the household faces is subject to the following constraints

$$C_t^y = B_t^y \quad (2)$$

$$C_{t+1}^m + (1 + r_{t+1})B_t^y + K_{t+1} = w_{t+1}L_{t+1} + r_{t+1}^k K_{t+1} + Z_{t+1} + B_{t+1}^m \quad (3)$$

$$C_{t+2}^o + (1 + r_{t+1})B_{t+1}^m = (1 - \delta)K_{t+1} \quad (4)$$

$$(1 + r_t)B_t^y \leq D_t \quad (5)$$

Equations (2), (3) and (4) are the budget constraints of the young, middle age and old generations, respectively. When young, the household can only consume what she borrows. During middle age, the agent faces two alternative investment opportunities: she can either lend to the young, rent capital to firms (by buying it in the same period), or a combination of the two. The income is given by labor (where  $w$  denotes real wages), returns from capital ( $r^k K$ ) and profits ( $Z$ ). When old, she can only consume her savings, given by the returns on the loans supplied in the previous period, and the income coming from the sale of the undepreciated capital. Furthermore, equation (5) represents an exogenous borrowing constraint faced by the young generation, which I will assume to be binding in all periods

$$(1 + r_t)B_t^y = D_t \quad (6)$$

Which, in turn, implies

$$C_t^y = \frac{D_t}{(1 + r_t)} \quad (7)$$

Solving the problem for  $C_t^m$ ,  $C_{t+1}^o$ ,  $B_t^m$ ,  $K_t$  yields the following optimality conditions

$$\frac{1}{C_t^m} = \frac{\beta(1+r_t)}{C_{t+1}^o} \quad (8)$$

$$(1-r_t^k)C_{t+1}^o = \beta(1-\delta)C_t^m \quad (9)$$

Where equation (8) is the consumption Euler Equation, while (9) represents the capital choice of the agent. The combination of the two provides the no-arbitrage condition between loan and capital markets:

$$1+r_t = \frac{1-\delta}{1-r_t^k} \quad (10)$$

Here, I assume the presence of money in this economy. As in Eggertsson et al. (2019), combining the Euler Equation from an OLG model with and without money, it is possible to recover the standard Fisher equation ( $1+r_t = (1+i_t)P_t/P_{t+1}$ ). This allows to rewrite equation (8) in nominal terms.

$$\frac{1}{C_t^m} = \frac{\beta P_t}{C_{t+1}^o P_{t+1}}(1+i_t) \quad (11)$$

Furthermore, by no-arbitrage, the presence of money imposes a non-negativity constraint (the zero-lower bound or ZLB) on the nominal interest rate  $i_t$ .

## 4.2 PRODUCTION

### 4.2.1 FINAL GOODS

The final goods producers work in a perfectly competitive market, and they only use intermediate goods  $y_t(i)$  to produce  $Y_t$ . They face the following profit-maximization problem

$$\max P_t Y_t - \int_0^1 p_t(i) y_t(i) di \quad (12)$$

Where the production of follows a Constant Elasticity of Substitution (CES) function, given by

$$Y_t = \left( \int_0^1 y_t(i)^{\frac{\varepsilon-1}{\varepsilon}} di \right)^{\frac{\varepsilon}{\varepsilon-1}} \quad (13)$$

Here,  $\varepsilon$  represents the elasticity of substitution between intermediate goods, and the price index

$P_t$  is defined as  $P_t = \left( \int_0^1 p_t(i)^{\varepsilon-1} di \right)^{\frac{1}{\varepsilon-1}}$ , where  $p_t(i)$  is the price charged by intermediate producer  $i$ .

Solving the final goods producers problem yields the following demand for intermediate good  $i$

$$p_t(i) = \left( \frac{y_t(i)}{Y_t} \right)^{-\frac{1}{\varepsilon}} P_t \quad (14)$$

#### 4.2.2 INTERMEDIATE GOODS

Intermediate goods producers work in a monopolistically competitive market to produce good  $i$  and use both capital and labor in their Cobb-Douglas production function. They seek to maximize nominal profits

$$\max Z_t = p_t(i)y_t(i) - W_t L_t(i) - P_t r_t^k K_t(i) \quad (15)$$

Subject to equation (14) and their production function

$$y_t(i) = A K_t(i)^{1-\alpha} L_t(i)^\alpha \quad (16)$$

Solving the problem yields the following optimality conditions for labor and capital, respectively

$$\frac{W_t}{p_t(i)} = \left( \frac{\varepsilon - 1}{\varepsilon} \right) \alpha \frac{y_t(i)}{L_t(i)} \quad (17)$$

$$\frac{P_t r_t^k}{p_t(i)} = \left( \frac{\varepsilon - 1}{\varepsilon} \right) (1 - \alpha) \frac{y_t(i)}{K_t(i)} \quad (18)$$

However, the symmetry of the model implies  $p_t(i) = p_t(-i) = P_t$ . This, in turn, means

$$y_t(i) = Y_t \qquad L_t(i) = L_t \qquad K_t(i) = K_t$$

Thus, I can rewrite the optimality conditions (17) and (18) in a general form

$$\frac{W_t}{P_t} = \left( \frac{\varepsilon - 1}{\varepsilon} \right) \alpha \frac{Y_t}{L_t} \quad (19)$$

$$r_t^k = \left( \frac{\varepsilon - 1}{\varepsilon} \right) (1 - \alpha) \frac{Y_t}{K_t} \quad (20)$$

Taking the definition of  $\mu = \frac{\varepsilon}{\varepsilon - 1}$ , which is a proxy for market power, it becomes clear that both real wages and return on capital are lower, if compared to their perfect competition counterparties, by a factor equal to  $\frac{1}{\mu}$ . In fact, by allowing the elasticity of substitution  $\varepsilon$  to grow

indefinitely, the above framework becomes equal to a perfectly competitive one. This implies that, the greater the market power (either seen as a low elasticity of substitution or a high markup) the larger the efficiency loss.

### 4.3 MONETARY POLICY

Given the presence of money, I assume the presence of a monetary authority in the model, which takes decisions according to a Taylor rule given by

$$1 + i_t = \max \left\{ 1, (1 + i^*) \left( \frac{\Pi_t}{\Pi^*} \right)^\phi \right\} \quad (21)$$

Which takes into account the ZLB for the nominal interest rate. For simplicity, I assume that the target interest rate,  $i^*$ , is equal to zero, and the target inflation  $\Pi^*$  equals one. This way, the ZLB becomes binding at  $\Pi_t = 1$ .

### 4.4 EQUILIBRIUM

#### 4.4.1 LABOR MARKET

In this section, I introduce a nominal rigidity. Namely, I impose a downward nominal wage rigidity (DNWR) following Schmitt-Grohé and Uribe (2016), that is

$$W_t \geq \eta W_{t-1} \quad \eta > 0 \quad (22)$$

Where the parameter  $\eta$  determines the degree of downward nominal rigidity. The higher it is, the more nominal wages are downwardly rigid. In Schmitt-Grohé and Uribe (2016), the authors find evidence on such parameter being very close to one, meaning that workers will not accept any nominal wage that is lower with respect to the one received in the previous period. In this case, the rigidity constraint becomes like the one defined in Beningo and Ricci (2011)

$$W_t \geq W_{t-1} \quad (23)$$

For the present moment, I will consider the one of equation (22), but the latter will be useful in simplifying the analysis of the following section.

The implication of such nominal rigidity allows me to state that, whenever it is not binding, the economy reaches full employment  $\bar{L}$ . That is

$$\forall W_t = P_t \left( \frac{\varepsilon - 1}{\varepsilon} \right) \alpha \frac{Y_t}{L_t} \geq \eta W_{t-1} \implies L_t = \bar{L} \quad (24)$$

#### 4.4.2 ASSET MARKET

Equilibrium in the loans market implies that the demand for loans by the young must equal the supply provided by the middle age

$$N_t B_t^y = -N_{t-1} B_t^m \quad (25)$$

Which, given  $g_t$ , can be written as

$$(1 + g_t) B_t^y = -B_t^m \quad (26)$$

The above gives loan demand (left-hand side) and supply (right-hand side). From the young borrowing constraint, equation (6), I obtain the former

$$L_t^d = (1 + g_t) B_t^y = \frac{1 + g_t}{1 + r_t} D_t \quad (27)$$

Instead, loan supply is obtained by combining the Euler Equation with the time- $t$  budget constraint of the middle age and the time- $t+1$  one of the old, which yields the following

$$L_t^s = \frac{\beta}{1 + \beta} (Y_t - D_{t-1}) - \frac{\beta}{1 + \beta} \left( \frac{1 - \delta}{\beta(1 + r_t)} + 1 \right) K_t \quad (28)$$

Looking at equations (27) and (28), it is possible to analyze the relationship between the loan market and interest rate. An increase in the latter dampens loan demand as debt becomes more expensive.

Instead, the relation becomes less trivial concerning loan supply. First of all, by observing equation (28), it is straightforward that an increase in capital lowers loan supply. This happens through a substitution effect, where households shift their investment decision from loans to capital, which causes the real interest rate to increase. Moreover, taking into account the negative relationship between the level of markup and capital provided in equation (20), such an increase in capital may come from a decline in markups. This implies that market power and real interest rate have a negative relationship, where the former affects the latter through the market for capital.

The equilibrium interest rate for loans is then found by equating loan demand and supply

$$1 + r_t = \frac{1 + \beta}{\beta} \frac{(1 + g_t) D_t + \frac{1 - \delta}{1 + \beta} K_t}{Y_t - D_{t-1} - K_t} \quad (29)$$

Given the dependence of  $r_t$  on  $Y_t$  and the above definition of  $\bar{L}$ , one can think of the natural real interest rate as the one prevailing in the economy when it reaches full employment, that I define as  $r^f$ .

Instead, the equilibrium rate on capital can be easily found by the no-arbitrage condition, combining it with the equilibrium loan rate (equations (10) and (29)).

## 4.5 STEADY STATE

### 4.5.1 AGGREGATE SUPPLY

Starting from the AS side, two possible cases arise: one in which the DNWR is not binding, which implies

$$W_t^* \geq \eta W_{t-1} \implies W_t = W_t^* \text{ and } L_t = \bar{L}$$

And one where the rigidity binds, given by

$$W_t^* < \eta W_{t-1} \implies W_t = \eta W_{t-1}$$

The first of these cases is simply the situation in which wages behave as being perfectly flexible and the economy is at potential in steady state. On the other hand, the second case can be analyzed in steady state (under the assumption that  $W_{t-1} = W_{t-1}^*$ ) as follows

$$\begin{aligned} P_t \left( \frac{\varepsilon - 1}{\varepsilon} \right) \alpha \frac{Y}{L} &= \eta P_{t-1} \left( \frac{\varepsilon - 1}{\varepsilon} \right) \alpha \frac{Y}{\bar{L}} \\ P_t A K^{1-\alpha} L^{\alpha-1} &= \eta P_{t-1} A K^{1-\alpha} \bar{L}^{\alpha-1} \\ L &= \left( \frac{\Pi}{\eta} \right)^{\frac{1}{1-\alpha}} \bar{L} \end{aligned} \tag{30}$$

Which implies that

$$L < \bar{L} \iff \Pi < \eta$$

However, given the previously mentioned evidence from Schmitt-Grohé and Uribe (2016), I consider  $\eta$  to be close to unity, meaning that the DNWR is binding whenever  $\Pi < 1$ . Thus, concerning AS, two steady states may arise depending on the size of inflation.

### 4.5.2 AGGREGATE DEMAND

Concerning the AD side, from the assumptions made regarding the monetary policy, the ZLB for nominal interest rate binds in  $\Pi < 1$ . Therefore, there are again two cases coming from the monetary policy rule.



$$\Pi > 1: \quad 1 + i_t = \Pi_t^\phi \implies 1 + r_t = \Pi_t^{\phi-1}$$

$$\Pi < 1: \quad 1 + i_t = 1 \implies 1 + r_t = \Pi_t^{-1}$$

In order to characterize the steady state, I first derive the AD curve, found through the equilibrium interest rate in the loan market (equation (29)), which is given by

$$Y = \left(1 + \frac{1+\beta}{\beta} \frac{1+g}{1+r}\right) D + K \left(1 + \frac{1-\delta}{\beta(1+r)}\right) \quad (31)$$

Then, combining the above with the production function, capital demand, no-arbitrage condition, the two conditions for  $1 + r$  (and equation (30) for the case  $\Pi < 1$ ), I get the steady state characterizations.

Case  $\Pi > 1$ :

$$\left\{ \begin{array}{l} 1 + r = \Pi^{\phi-1} \\ Y = AK^{1-\alpha} \bar{L}^\alpha \\ r^k = \left(\frac{\varepsilon-1}{\varepsilon}\right) (1-\alpha) \frac{Y}{K} \\ r^k = 1 - \frac{1-\delta}{1+r} \\ Y = \left(1 + \frac{1+\beta}{\beta} \frac{1+g}{1+r}\right) D + K \left(1 + \frac{1-\delta}{\beta(1+r)}\right) \end{array} \right. \quad (32)$$

This first case can be defined the “good” steady state, since it is characterized by full employment, the ZLB is not binding, and the economy behaves as having perfectly flexible wages.

Case  $\Pi < 1$ :

$$\left\{ \begin{array}{l} 1 + r = \Pi^{-1} \\ L = \left(\frac{\Pi}{\eta}\right)^{\frac{1}{1-\alpha}} \bar{L} \\ Y = AK^{1-\alpha} L^\alpha \\ r^k = \left(\frac{\varepsilon-1}{\varepsilon}\right) (1-\alpha) \frac{Y}{K} \\ r^k = 1 - \Pi(1+r) \\ Y = \left(1 + \frac{1+\beta}{\beta} (1+g)\Pi\right) D + K \left(1 + \frac{\Pi}{\beta} (1-\delta)\right) \end{array} \right. \quad (33)$$

Instead, this second steady state can be labelled as the Secular Stagnation one, given the low level of inflation (making the ZLB binding) and the inefficiency in the labor market coming from the DNWR. The latter further translates into a lower level of output, *ceteris paribus*.

## 4.6 EFFECTS OF MARKET POWER

To understand the effects of market power, I first assume that the economy is initially in the “good” steady state. Given that  $L = \bar{L}$ , the real interest rate is equal to its natural level,  $r^f$ . Consider now an exogenous drop in the elasticity of substitution  $\epsilon$ , meaning an increase in  $\mu$  and, thus, market power.

On the supply side, this causes a decrease in labor demand, which now falls below  $\bar{L}$ , and in the wage level. The latter effect causes, in turn, the DNWR to be more likely binding. At the same time, demand for capital also drops, which affects the household investment choice, causing a shift in investment from capital to loan supply. This, in turn, lowers the real interest rate.

Thus, an increase in market power has a direct impact on the AS curve, making it shift downwards, and an indirect impact on the AD curve, which happens through the capital channel. This mechanism highlights the fact that an increase in market power puts a downward pressure on equilibrium interest rates. However, the adjustment dynamics are constrained by the ZLB and the economy enters Secular Stagnation.

## 5. MODEL WITH ENDOGENOUS MARKUP

In this section, I build on the baseline model and endogenously define the markup. As in Galì (1995), I construct the market power  $\mu$ , and, thus, the elasticity of substitution  $\epsilon$ , as a function of the number of firms participating in the intermediate goods market.

Since this change only affects the production side of the economy, the household problem is unchanged compared to the previous section.

### 5.1 PRODUCTION

#### 5.1.1 FINAL GOODS

As in the baseline model, final goods producers work under the same conditions and maximize nominal profits, given by

$$\max P_t Y_t - \int_0^{n_t} p_t(i) y_t(i) di$$

However subject to a different CES technology, which is now a function of the number of intermediate inputs used ( $n$ )

$$Y_t = \left[ n_t^{-\left(1 - \frac{1}{\mu(n_t)}\right)} \int_0^{n_t} y_t(i)^{\frac{1}{\mu(n_t)}} di \right]^{\mu(n_t)} \quad (34)$$

Where  $y(i)$  is the quantity of intermediate good  $i \in [0, n]$  used for final good production. The factor  $n_t^{-\left(1 - \frac{1}{\mu(n_t)}\right)}$ , as explained in Kothari (2014), scales out the love for variety from the CES

production function. Following Galì (1995),  $\mu: \mathbb{R}^+ \Rightarrow \mathbb{R}^+$  is a continuously differentiable function with the following properties:

$$\mu'(n) < 0 \qquad \lim_{n \rightarrow 0} \mu(n) = \bar{\mu} > 1 \qquad \lim_{n \rightarrow \infty} \mu(n) = 1$$

Furthermore, given that the elastic of substitution among intermediate goods is  $\varepsilon(n) = \frac{\mu(n)}{\mu(n) - 1}$ , it follows that:

$$\varepsilon'(n) > 0 \qquad \lim_{n \rightarrow 0} \varepsilon(n) = \bar{\varepsilon} > 1 \qquad \lim_{n \rightarrow \infty} \varepsilon(n) = \infty$$

The final goods producer problem yields the following demand for intermediate good  $i$

$$y_t(i) = \frac{Y_t}{n_t} \left( \frac{P_t}{p_t(i)} \right)^{\varepsilon(n_t)} \quad (35)$$

Where the price index is defined as  $P_t = \left[ \frac{1}{n_t} \int_0^{n_t} p_t(i)^{1-\varepsilon(n_t)} di \right]^{\frac{1}{1-\varepsilon(n_t)}}$ .

### 5.1.2 INTERMEDIATE GOODS

Again, for the intermediate sector, the producer  $i$  faces the same nominal profit maximization problem

$$\max Z_t(i) = p_t(i)y_t(i) - W_t L_t(i) - P_t r_t^k K_t(i)$$

Subject to its production function (equation (16)) and the new demand that it faces (35). The maximization problem yields the following optimality conditions for capital and labor, respectively

$$P_t r_t^k = P_t \left( \frac{n_t}{Y_t} \right)^{-\frac{1}{\varepsilon(n_t)}} \left( \frac{\varepsilon(n_t) - 1}{\varepsilon(n_t)} \right) (1 - \alpha) y_t(i)^{-\frac{1}{\varepsilon(n_t)}} A K_t(i)^{-\alpha} L_t(i)^\alpha \quad (36)$$

$$W_t = P_t \left( \frac{n_t}{Y_t} \right)^{-\frac{1}{\varepsilon(n_t)}} \left( \frac{\varepsilon(n_t) - 1}{\varepsilon(n_t)} \right) \alpha y_t(i)^{-\frac{1}{\varepsilon(n_t)}} A K_t(i)^{1-\alpha} L_t(i)^{\alpha-1} \quad (37)$$

Given the symmetry of the model, marginal costs, and hence prices, are the same for all the intermediate sector firms. The same reasoning applies to the quantities demanded for each input. Therefore

$$y_t(i) = \frac{Y_t}{n_t} \qquad K_t(i) = \frac{Y_t}{n_t} \qquad L_t(i) = \frac{L_t}{n_t}$$

So, on aggregate, the production function and the optimality conditions follow the same structure as in the baseline model

$$Y_t = A K_t^{1-\alpha} L_t^\alpha$$

$$r_t^k = \left( \frac{\varepsilon(n_t) - 1}{\varepsilon(n_t)} \right) (1 - \alpha) \frac{Y_t}{K_t} \tag{38}$$

$$\frac{W_t}{P_t} = \left( \frac{\varepsilon(n_t) - 1}{\varepsilon(n_t)} \right) \alpha \frac{Y_t}{L_t} \tag{39}$$

## 5.2 ENTRY COSTS

So far, I have implicitly assumed the absence of any barrier to enter the intermediate goods market. In what follows, I introduce the existence of entry costs in order to characterize the equilibrium number of firms for the steady state analysis and to discuss some implications arising from regulation of the intermediate goods market. As in Blanchard and Giavazzi (2003), I assume that firms face a cost  $c$  for entering the market, which comes from product market regulation. For this reason, it is considered to be a shadow cost in the setup with endogenous markups, and only enters the model in the steady state analysis. This assumption implies that, in steady state, firms are allowed to make some profits in order to cover such cost. Thus, in order to characterize the steady state, I need to take into account the zero-profit condition:

$$Z = c \tag{40}$$

Where,

$$Z_t = Y_t - w_t L_t - r_t^k K_t$$

$$= \frac{Y_t (\mu(n_t) - 1)}{\mu(n_t)} \tag{41}$$

## 5.3 STEADY STATE

Given the similar structure with respect to the baseline model, the AS and AD analyses previously made still hold here. Therefore, two possible steady states arise again, depending on  $\Pi$ .

Case  $\Pi > 1$ :

$$\begin{cases} 1 + r = \Pi^{\phi-1} \\ Y = AK^{1-\alpha}\bar{L}^\alpha \\ r^k = \left(\frac{\varepsilon(n)-1}{\varepsilon(n)}\right)(1-\alpha)\frac{Y}{K} \\ r^k = 1 - \frac{1-\delta}{1+r} \\ Y = \left(1 + \frac{1+\beta}{\beta}\frac{1+g}{1+r}\right)D + K\left(1 + \frac{1-\delta}{\beta(1+r)}\right) \end{cases} \quad (42)$$

Case  $\Pi < 1$ :

$$\begin{cases} 1 + r = \Pi^{-1} \\ L = \left(\frac{\Pi}{\eta}\right)^{\frac{1}{1-\alpha}}\bar{L} \\ Y = AK^{1-\alpha}L^\alpha \\ r^k = \left(\frac{\varepsilon(n)-1}{\varepsilon(n)}\right)(1-\alpha)\frac{Y}{K} \\ r^k = 1 - \Pi(1+r) \\ Y = \left(1 + \frac{1+\beta}{\beta}(1+g)\Pi\right)D + K\left(1 + \frac{\Pi}{\beta}(1-\delta)\right) \end{cases} \quad (43)$$

Given the above, I can make a similar analysis to the one made for the baseline model regarding the consequences of market power in equilibrium. The main difference here results from the fact that, now, an increase in market power is determined by a decrease in  $n$ . However, in order to complete the characterization of both steady states, I need to add a condition determining the number of intermediate products that are present in the market in equilibrium. To do so, I use equations (40) and (41) to obtain

$$n^*: Y = \frac{c\mu(n)}{\mu(n) - 1} \quad (44)$$

Moreover, to find an explicit solution for  $n$ , I need an explicit relation between the elasticity of substitution and the number of firms, assumed to be given by

$$\varepsilon(n) = \varepsilon n \quad (45)$$

With  $\varepsilon > 0$ . The above also implies

$$\mu(n) = \frac{\varepsilon n}{\varepsilon n - 1} \quad (46)$$

Then, from equation (44), the equilibrium number of firms is

$$n^* = \frac{Y}{c\varepsilon} \quad (47)$$

Which is an increasing function of output and a decreasing function of the entry costs.

#### 5.4 DEREGULATION

Deregulation of the product markets simply means the opening them up to greater competition, usually involving the removal of government legislation or, more generally, to any barrier to competition. In this stylized model, product market regulation is captured by the entry cost  $c$ . In fact, the latter is a key determinant for the structure of the intermediate goods market and, consequently, the market power within it.

Therefore, a deregulation of the goods market in this context translates into a decrease in  $c$ . This intervention, as argued by Blanchard and Giavazzi (2003), may bring about some negative effects in the short-run. In fact, the incumbents' labor demand may decrease on impact, hence increasing the risk of unemployment for the currently employed workers. However, these effects are reversed in the long-run. As a matter of fact, decreasing the entry cost  $c$  would cause a rise in the number of firms present in the intermediate goods sector in the long run (equation (47)), implying an increase in the elasticity of substitution  $\varepsilon$  and, thus, a reduction in the market power of the incumbent firms. Further, this would mean moving towards a more competitive market, which implies, on the one hand, a decrease in unemployment and an increase in wages, making the DNWR less likely to bind. On the other hand, deregulation would increase the capital demanded by firms and, consequently, the real interest rate, as discussed before.

Hence, product market deregulation allows for the possibility of the economy to exit, or even eliminate, the Secular Stagnation steady state.

## 6. CONCLUSION

In this work, I focus on market power as one of the forces driving Secular Stagnation and develop a theoretical analysis to understand the relationship between markups and equilibrium interest rates. To motivate my investigation, I present some empirical evidence concerning the trends that the variables of interest have been following in the past decades. After that, I propose a three-period OLG model characterized by monopolistic competition in production that allows me to uncover and analyze the aforementioned relationship. The development of the model shows that an increase in the markup level causes the equilibrium interest rate to fall, leading to Secular Stagnation. This happens through the market for capital. In fact, households have two possibilities for investing: lending to the next generation or renting capital to firms. Therefore, the model shows that an increase in the level of markups causes capital demand by firms to decrease, making households switch their investment decision from capital to loan supply. This, in turn, lowers the equilibrium interest rate. Because of the ZLB on nominal rates, the economy is constrained in the adjustment and enters Secular Stagnation. The same reasoning applies to the

extension of my baseline model, which, furthermore, opens the possibility for the discussion of some policy implications concerning the product market. Indeed, I discuss the consequences of the presence of an entry cost, representing product market regulation. Its existence leads to a reduction in the number of firms in the economy and, therefore, a rise in their market power. Hence, product market deregulation may bring about some positive long-run effects, as it increases market competitiveness and causes labor and capital demand to do the same. This, in turn, reduces unemployment and increases the wage level, making the DNWR less crucial, and, via the mechanism explained above, raises the equilibrium interest rate helping the economy to exit Secular Stagnation.

Besides the argument concerning deregulation, the policy implications arising from the uncovered relationship between Secular Stagnation and market power require a more thorough analysis which was not developed here, as it would fall out of the scope of this work. Therefore, further research is needed to study the optimal policy to fight Secular Stagnation considering its relationship with monopoly power, and also discuss it in terms of monetary and fiscal policy instruments.

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