Dottorato in Economia

XXX CICLO

Tesi di dottorato

An enquiry about the Secular Stagnation theory

Dottorando: Stefano Di Bucchianico

Relatore: Prof.ssa Antonella Stirati

AN ENQUIRY ABOUT THE SECULAR STAGNATION THEORY

XXX doctoral cycle – Roma Tre University

PhD candidate – Stefano Di Bucchianico

Supervisor – Prof. Antonella Stirati

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General introduction

The Great Recession that unravelled in the United States in 2007 impacted later on the Eurozone as well. Japan in the meanwhile kept on experiencing a period of weak growth that started already in the late '80s. Generally speaking, the entire Western capitalism is witnessing since almost a decade weak economic performances, without any foreseeable optimistic prospect. It comes perhaps with little surprise that the modern version of the Secular Stagnation Hypothesis coined by Larry Summers in a speech delivered at the IMF in 2013 has gained a great deal of attention in both the academic and the public opinion environments. As for all the famous ideas, good timing is a requisite to get widespread attention and curiosity. Paul Krugman, in his blog on the New York Times, has repeatedly cited Summers' hypothesis as something he himself had been trying to coherently conceive and convey to the public, thanking the Harvard economist for the effort spent in successfully doing it.

The contribution of Summers has spurred a debate in which many scholars have taken part. Among them we can find Krugman, Gordon, Eichengreen, Blanchard and so forth. What can be reckoned to be a fascinating aspect of the reasoning of Summers is the engagement in building up a framework that aims at putting many empirical patterns interacting together. It has perhaps not happened by chance that such a debate has been started by an economist that for many years has worked in political environments such as the US Treasury Department. It appears indeed evident the willingness to give the point of view of an academic member that is concerned with real world issues. Given the importance of the topic for economic policy, and the fruitful enquiry that could have come within the theoretical parts of the matter, the decision to treat Secular Stagnation as the main subject of this thesis appeared natural.

In 2014 Baldwin and Teulings have published a book gathering several viewpoints, ranging from direct discussions of Secular Stagnation from both a demand and supply side, to general comments upon stagnation, the long term pattern of the real interest rates etc. In it we have found the most interesting attempt so far to formally model the ideas of Summers, which is the overlapping generations model of Eggertsson, Mehrotra and Robbins. In it what has been retrieved by Summers from old ideas of the past has been adapted by the authors to the actual situation of the present. We have deemed these analytical exercises to be very intriguing, since

they aim at employing what is nowadays a common toolkit for economists to major concrete world issues. Therefore, what we wanted to ascertain was whether the renewed Secular Stagnation hypothesis of Summers could have been overall judged has a theory that is sound on both the theoretical and empirical aspects, and thus used as a guide for the understanding of the issue of economic stagnation.

The thesis is organized in the following manner: five chapters aimed at analysing the so called Secular Stagnation theory are presented. They all have their own conclusions, and at the very end a general assessment of the entire study is provided. The first three chapters are devoted to the study of the neoclassical demand side Secular Stagnation models, while the fourth deals with the heterodox approaches to the issue. These four chapters together constitutes the theoretical part of the thesis. The fifth chapter contains an empirical analysis about one of the aspects of the theory that are going to be emerge from the theoretical discussion.

The first chapter introduces the general framework of the neoclassical theory, within which the Secular Stagnation hypothesis is placed. Then, the main research questions are described. The theoretical proposal of Summers is illustrated and a discussion of the critical points we pinpoint in it is provided. The chapter closes with a description of the difference between the demand side and the supply side Secular Stagnation theories.

The second chapter goes back to the main inspiration for the intuitions of Summers, which is the 1998 article of Krugman about the Japanese long lasting stagnation. After having presented the model in its economic meaning and formal garment, we discuss the weak points that we have spotted within it, making a connection with the theoretical apparatus of Summers and with our main lines of research.

The third chapter deals with the most recent demand side Secular Stagnation model by Eggertsson, Mehrotra and Robbins. We present it in its main features and then we critically review them, posing a particular accent upon some of the novel aspects that they introduce to justify their results, which have not yet been discussed in the critical literature about Secular Stagnation. Again, a connection with our main lines of research and with the previous discussion of the models of Krugman and Summers is spelt out.

The fourth chapter highlights the presence in the heterodox literature of some models that can explain economic stagnation without incurring in the issues that we have pointed out with respect to the neoclassical models. We make a distinction between the models that retain some feature from the neoclassical explanation, and the ones that neatly propose a radically different viewpoint, discussing which is our preferred alternative.

The fifth chapter hosts an econometric exercise on the empirical literature about the relationship between price variables, in particular the interest rate, and private investment. This allows us to complement the theoretical part, and to analyse an aspect that had not been directly questioned in the previous chapters. In it we describe how the dataset has been built, which econometric technique we have utilized, what are the main results that we have obtained.

CHAPTER I - THE NEW SECULAR STAGNATION HYPOTHESIS

Since the speech given at the International Monetary Fund in 2013 by Larry Summers, the idea of an economy stuck in a 'Secular Stagnation' has been brought back on the stage. The first proposer of such a concept had been Alvin Hansen in the thirties during the 1938 Presidential Address. He referred to the aftermath of the Great Depression originated in the United States, being in awe of a possible long term stagnation as a likely outcome of several warning signals present in the economy at those times. First and foremost, he was worried about the long run prospects of population growth and technological progress (Hansen 1939). In between there has been a long lasting debate about the topic. Among others, Joseph Steindl expressed his concern about the prospects of prolonged stagnation for the post World War II American economy.[1] Then the issue slowly fell back in a forgotten corner, given the economic boom occurred during the so called 'Golden Age' (roughly speaking, the thirty years following the end of the IIWW) in the major Western economies. A careful and comprehensive reconstruction about the Secular Stagnation debate since its inception until today is provided by Backhouse and Boianovsky (2016). Lately Krugman and Bernanke promptly took up the issue brought to the stage by Summers, providing their own interpretations. The debate among them mainly developed through blog posts on the Internet and newspaper articles. Later on, very recently, a spur of academic articles has begun. A general overview of the ongoing debate will be provided for the sake of better framing the principal positions about the topic.

What will be of main concern to us is the born and rise of the analytical category of the 'negative real equilibrium interest rate', which stands as the cornerstone of the neoclassical explanation of the current stagnation, known as the 'Secular Stagnation hypothesis'. That concept and its immediate emanations will be at the hearth of the present work. As we are going to see, its first appearance can be traced in the seminal paper of Krugman (1998) about the Japanese stagnation of the late eighties – nineties. Indeed, since such a notion has been proposed in 1998 by Krugman, it appears to have been so convincing to the eyes of the mainstream academic environment to be nowadays the main piece of work to be quoted in university courses textbooks

[1] Cfr. his seminal 1952 book *Maturity and stagnation in American capitalism*.

when the subject of the negative real natural interest rate concept is mentioned.[2] An immediate issue arising when dealing with a negative equilibrium interest rate is the strict connection between it and the profit rate, that in the neoclassical theory is determined by the marginal productivity of capital: in equilibrium the two ought to coincide. Are we then saying that the owners of capital are willing to earn a negative profit rate on the amount of capital utilized in production? Some possible ways to answer to such a question are going to be expounded. Among the several analytical contributions dealing with Secular Stagnation and the negative equilibrium real interest rate we deem four of them to be crucial: Krugman (1998), Summers (2014), Eggertsson, Merhotra (2014), Eggertsson, Mehrotra and Robbins (2017). In such an order, they prepare the ground for the appearance of the negative interest rate, then they allow it to be present in equilibrium, and finally (in the last two) they make it a permanent characteristic of the economy.

1.1 - The traditional neoclassical framework

Since we are going to discuss and review a theory which is based on the presence of a negative natural real interest rate within a neoclassical apparatus, let us initially make reference to the aspects in the neoclassical theory which are relevant in this respect. This will serve as a guide throughout the development of the discourse. Indeed, before analysing the causes that can render the real natural interest rate negative, and what this can mean within the theory in object, it would seem appropriate to have a look at what the theory states in general about the determination of the natural interest rate. Then, it will be clearer what it means to say that such a variable may turn negative in special instances, giving rise to the phenomenon called Secular Stagnation. In general terms,[3] the neoclassical theory can be described as a theoretical body which claims to be capable of determining the relative prices of goods and the distributive variables (real wage rate and real interest rate, with rent usually set aside by supposing that land is available in unlimited quantity) starting from the following givens: the preferences of individual agents, the technical conditions of production, the quantity of factors of production. From the data just mentioned the theory can

[2] Some example is to be found in Romer (2012), Woodford (2011).
[3] On this sketch of the core of neoclassical theory cfr. Garegnani (1978, Sec. 3 – 5 – 6, pp. 341 – 342, 344 – 349).

thus arrive at calculating the relative commodity prices and the factors' remunerations, which together ensures on the one hand that in equilibrium the amount of total production equals the aggregate demand for it, and on the other that the available amount of factors of production are fully employed. Overall, when in the long run the short term transitory disturbances to production and price rigidities can be set aside, the economic system is, according to this theory, characterized by a tendency to fully employ the productive capacity that the economy is endowed with. This long run tendency is warranted by the 'principle of substitution', according to which there is a continuous inverse relationship between the remuneration of a factor of production and its quantity demanded for production, when the quantities demanded of the other factors are taken as given. The validity of this principle relies on the technical possibility to vary in a continuum the proportions in which the factors of production enter the production process of commodities. This leads the neoclassical theory to determine the relative factors' remunerations according to their marginal productivity. According to this latter principle, indeed, the profit maximization problem faced by entrepreneurs operating in a perfectly competitive market for products requires that each factor of production employed earns in equilibrium a remuneration determined by its marginal contribution to production. The two distributive variables to be arrived at are the real interest rate, the remuneration for the employment of the factor capital, and the real wage rate, the remuneration for the factor labour. Accordingly, the marginal product of capital will determine the real interest rate it earns, the marginal product of labour the real wage rate it earns, both measured in terms of a chosen numeraire. Price rigidities being absent, if temporarily a factor of production is not fully employed, competition among entrepreneurs for the employment of capital and among labourers for being hired will ensure that the remuneration of both factors will sufficiently decrease in order to render its utilization profitable. There is therefore a demand curve for the employment of a factor which stands in a continuous inverse relation with the price for the service it delivers, and at the intersection with the supply curve for the factor's service, which is in a direct relation with the price for that service, the equilibrium remuneration is arrived at. It is according to this latter reasoning that it is possible, within the neoclassical theory, to state that the equilibrium factors' remunerations, on the same footing of the relative prices of commodities, can be calculated at the equilibrium between demand and supply for their services, and that the equilibrium position thus attained is stable. There is a strict analogy between the derivation of the relative factors' remunerations of capital and labour. Yet, since we are going to

deal closely with the concept of a natural real interest rate, we will thereby focus on the capital side of the issue.

The supply of the different capital goods available for production is, in the traditional treatment of the subject within neoclassical theory, taken as given in value, and the different capital goods earn, in equilibrium, all the same remuneration, i.e. an interest proportional to the values of their quantities employed. In this way the tendency due to free competition to ensure that all capital goods earn in equilibrium the same rate of return is warranted. Thus, by evaluating each capital good not in physical units but in price units, it is possible, according to the neoclassical theory, to have a total quantity of a factor capital that in equilibrium yields a real interest rate coming from the sharing of the net product of the economy.[4] The real interest rate is thus arrived at when the decreasing demand curve for the factor capital, representing the demand curve for the service of that factor, and the upward sloping supply curve of savings, coming from the agents' decision not to consume all the income they earn, intersect. Within such a schema when the real interest rate decreases entrepreneurs will, *ceteris paribus,* find profitable to demand a higher quantity of the factor capital (or a lower quantity of capital when the real interest rate increases).[5]

In light of what we will be going to discuss within the Secular Stagnation debate, the traditional approach to the determination of the real natural interest rate proper of the traditional version of the theory,[6] worked out by taking the quantity available of the factor capital as given in value terms, as in the approaches of J. B. Clark, Böhm-Bawerk and Wicksell,[7] will be useful as a reference point to study the different aspects which according to the contemporaneous authors have been exerting a downward pressure on the natural real interest rate. In particular, a

[4] The same will happen on the labour market side, where the quantity of labour available and fully employed will earn a real wage rate determined by the marginal product of the factor of production labour.
[5] Garegnani (1978, pp. 345 – 346, 352) differentiate between a demand for capital as a stock and a demand for capital as a flow, which is the proper demand for investment.
[6] Neoclassical theory is obviously not a monolithic framework: historically it has taken many facets and versions, and the theories of investment proposed have been many. We can, following Petri (2004, Ch. 7, pp. 256 – 294) find a full list of investment theory in the literature, the ones that have gained most attention are the 'array-of-opportunities' approach, the Jorgensonian adjustment costs approach, and the Tobin's Q approach. Yet, it can be said that what is the rationale beneath the neoclassical discussion of investment is the basic tenet affirming that a systematic inverse relationship between the rate of interest and the demand for investment exists and is non-negligible in magnitude. On the old and new neoclassical theories of investment, cfr. Girardi (2017).
[7] Cfr. Garegnani (1978, p. 345).

traditional author often cited and referred to still nowadays is Knut Wicksell, given that his seminal treatment of the natural interest rate determination and the possible divergence between it and the market interest rate is at the foundation of the modern analysis of how to conduct monetary policy. In his words, the natural real interest rate has the following meaning:

> "The rate of interest at which *the demand for loan capital and the supply of savings* exactly agree, and which more or less corresponds to the expected yield on the newly created capital, will then be the normal or natural real rate. It is essentially variable. If the prospects of the employment of capital become more promising, demand will increase and will at first exceed supply; interest rates will then rise and stimulate further saving at the same time as the demand from entrepreneurs contracts until a new equilibrium is reached at a slightly higher rate of interest. And at the same time equilibrium must *ipso facto* obtain—broadly speaking, and if it is not disturbed by other causes—in the market for goods and services, so that wages and prices will remain unchanged." (Wicksell K., 1935, p. 193, emphasis in the original)

The great improvement (among others) that Wicksell brought within the determination of an equilibrium position in which capital goods earn a uniform real interest rate determined by the marginal productivity of factor capital was the treatment of the monetary disturbances that may hinder, at least temporarily, the attainment of such an equilibrium.[8] Therefore, in his theory we find a main body in which the distributive variables are determined by real factors (productivity and thrift), and in particular the natural interest rate is arrived at starting from the data we have earlier mentioned (consumers' tastes, technical conditions, factors' endowments), and building the demand curve for investment and the supply curve of savings. Then, in the financial market for savings in which banks operate, the interest rate charged on loans may momentarily diverge from the natural rate, thereby causing a disequilibrium situation that, according to Wicksell, would be signalled by the presence of lasting inflation (or deflation).[9]

If we frame the Wicksellian analysis by means of a simple graph we can get an intuition of how things work within this theoretical apparatus.[10] In an initial state of equilibrium, we have that at point M the investment and saving schedule intersect, setting the natural interest rate at the

[8] On this topic we are going to refer chiefly to Garegnani (1979) e Ackley (1978).

[9] The strict connection that would exist between the natural interest rate determined by marginal productivity on newly installed capital and the market interest rate is broken, in the Wicksellian theory, by the ability of banks to collect the bulk of the savings present in the economy: this feature permits to the banking system to concede loans to entrepreneurs without changing the interest rate they charge to the borrowers.

[10] Cfr. Ackley (1978), pp. 135 – 138. In the graph we have the investment schedule I, the saving schedule S, and the natural interest rate *i*.

level of i_0; given the equilibrium condition, the natural interest rate and the market interest rate set by banks coincide. If a change in one of the given data of the theory occurs, say a technical improvement renders capital more productive at the margin, *ceteris paribus*, the demand curve for investment will be shifted to the right, since by transforming the given supply of savings into physical capital we can now earn a higher marginal product per unit of capital. Thus, the natural interest rate is now higher, at point i_1, but it is very likely that banks, since they have no clue about the shift occurred in the natural interest rate, decide to finance the higher demand for investment by supplying the required credit without changing the interest rate they charge on what they lend.

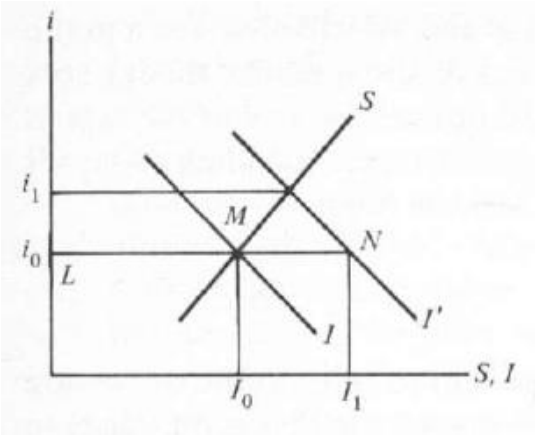


Figure 1 - Reconstruction of the determination of the natural interest rate in Wicksell's theory and the possible divergence of the market interest rate from it, from Ackley (1978, p. 136)

The new forthcoming amount of demand comes about in a situation of initial equilibrium, where the full employment of resources was already in place. This means that the additional demand can only cause a rise in money expenditure and prices.[11, 12] The new equilibrium can be then reached when the banking sector moves up the interest rate towards i_1.[13] We have thus a clear cut example of a situation in which, given the general validity of the principle that the marginal

[11] The increase in the price level does not come about at once: the investment goods sector will be the first to experience such a phenomenon, followed by the consumer goods sector. Under the supposition that the nominal remunerations for the production factors rise in the same proportion of the rise of prices, the inflationary process could continue indefinitely; cfr. Garegnani (1979), p. 66.

[12] An analogous but inverse process would happen if we suppose that the natural real interest rate falls below the market interest rate charged by banks, with the ensuing deflation.

[13] Under the hypothesis of an accommodation of the new demand for savings at the old interest rate i_0, in the financial market we find ourselves at point *N*, when at the initial interest rate the amount of investment has increased from I_0 to I_1.

productivity of capital determines the natural real interest rate, a temporary friction arising in the financial market for savings can give rise to a transitory disequilibrium condition, which is in the specific case signalled by the materialization of inflation (or deflation). As we will see in what follows, the general picture drawn by Summers does not deviate much from the reasoning set forward by Wicksell: in it, several factors concur in shifting both the investment schedule and the supply schedule in such a manner that the natural interest rate is pushed in the negative territory. Then, the efforts of the Central Bank to restore equilibrium by moving the nominal interest rate down are disappointed by the presence of the zero lower bound, thereby causing the disequilibrium situation to last. As in Wicksell, we have an equilibrium real interest rate determined by the intersection between the investment – savings schedules, and a friction on the financial market hinders the process of equalization between the market and the natural real interest rate.

- *Analytical flaws of the traditional neoclassical theory*

Before going forward to enter the theory of Secular Stagnation, let us now take a stance about the general validity of the neoclassical treatment of income distribution and relative prices determination, which is necessary in order to understand also which is the spirit guiding the subsequent discussion of Secular Stagnation. It is well known that in the literature the validity of the neoclassical derivation of the natural interest rate in terms of demand for investment and supply of savings has been harshly contested. In particular, the famous 'Cambridge Capital Controversy' culminated in the 1966 symposium on the *Quarterly Journal of Economics* has witnessed the neoclassical side of the debate conceding to the critical side the validity of the arguments brought against the logic behind the derivation of the demand and supply curves necessary to arrive at a stable equilibrium in the production factors' markets.

The debate, started by Joan Robinson in 1953 and arrived at a crucial point with the publication of the seminal book of Sraffa, *Production of Commodities by Means of Commodities* (1960), has shown the untenable nature of the reasoning beneath such a theoretical construct. The phenomena of 'reverse capital deeping' and 'reswitching', thoroughly analysed after the seminal

contribution of Sraffa,[14] show respectively how the monotone inverse relation between the remuneration of a factor and its employment in production is not necessarily valid,[15] and how the choice of the technique to be used for producing can entail that a certain process is chosen at both a low and then a high rate of interest, when the latter is varied continuously from zero to its maximum value. There are therefore strong doubts about the tenability of the entire neoclassical apparatus, since its basic logic does not seem to have a general internal validity.

Despite the acknowledged relevance of the critiques moved to the neoclassical apparatus, the theory has survived and is still dominant in the academy. Our opinion in this respect is quite neat: given the validity of those critiques, and the availability of alternative frameworks of analysis that do not depend on that kind of substitutability principle tied to the marginal productivity concept, we would not rely at all on a neoclassical explanation about what could be the causes of the Secular Stagnation, as we would not rely at all on that theory to explain income distribution, economic growth, unemployment and so forth. Indeed, in chapter four of the present thesis, a sketch of an alternative framework of analysis not relying on the natural interest rate category in order to explain stagnation will be provided. Yet, the extensive influence and acceptance that neoclassical theory has in the general academic environment renders in our opinion inescapable a discussion trying to understand whether the thesis set forward about Secular Stagnation are convincing and theoretically coherent. As we are going to see, the main tenet of the Secular Stagnation theory is that the contemporaneous presence of a negative natural real interest rate and of the zero lower bound of the nominal interest rate hinders the adjustment of production towards its potential. In light of our mention of the capital debates, it is hardly a matter of dispute whether a "natural" real interest rate[16] that turns negative can be a problematic concept to be sustained within those models: we do not believe that any natural interest rate exists, either positive or negative. Yet, given the widespread discussion that Secular Stagnation has generated in recent years, both at the academic and policymaking levels, we believe that it would be useful to ask whether the neoclassical attempt could be judged in some sense successful

[14] For a comprehensive reconstruction and explanation of these results, cfr. Petri (2004, Ch. 6, pp. 206 – 255).

[15] Cases in which when the interest rate rises the capital/labour ratio rises as well (or viceversa) can be a theoretical outcome of the problem of profit maximization.

[16] Natural in the neoclassical sense, hence as a variable bringing into equality the supply of savings and the demand for investment at full employment.

in its own terms or suffers from internal difficulties or contradictions. Therefore, we are willing to concede to the authors we are going to review that the drop of the natural real interest rate into a negative territory is a theoretical category worth being discussed.

- *A brief introduction to the main arguments we are going to discuss*

As we will see soon below, the main strand of the neoclassical Secular Stagnation theory maintains that we are experiencing a shortage of demand, and this lack of demand does not allow to bring actual production up to the potential output of the economy. This lack of demand manifests itself as a low level of private investment, which is not sufficient to fully employ the available amount of savings supplied into the economy. The impossibility for the monetary authority to stimulate private investment by lowering the nominal interest rate, and with given inflation expectations also the real interest rate, is the crucial factor holding back private investment. As we have said, this issue arises since the natural real interest rate has become negative, according to the main proposers of the theory, and the zero lower bound on the nominal interest rate does not permit to the Central Bank to reach the targeted equilibrium real interest rate.

What we would then expect to find in this literature is a coherent explanation of a Secular Stagnation stemming from the demand side of the economy, and in which aggregate demand plays a key role in causing a slack in the economic performances of an economy. Indeed, since in the literature we find also a Secular Stagnation theory from the supply side, what we want to check is whether the concerns of the so called demand side Secular Stagnation truly respond to the claim that this phenomenon can be explained within the neoclassical theory in terms of a low level of aggregate demand.

Since we have anticipated that the main novelty of this strand of literature is the argument stating that the natural real interest rate can be negative in a long run equilibrium position, we want also to assess whether this analytical category can be accepted even when no criticism against the general structure of the neoclassical theory is raised. In other words, we would expect to find within this strand of literature the description of how the natural real interest rate can be negative in an economy with production and capital. In a commonly utilized neoclassical schema, indeed, the general equilibrium between the households sector and the firms sector is arrived at when the respective utility and profit maximization problems are simultaneously solved.

Therefore, assuming that in equilibrium the natural real interest rate is negative would mean that the Euler equation usually employed for the intertemporal utility maximization problem can host a negative real interest rate, but also that some kind of production function could at the same time deliver a negative real interest rate as a remuneration for the factor capital employed production. What we are going to discuss therefore is whether the various attempts to treat these aspects can be deemed as successful.

1.2 - Larry Summers retrieval of Hansen's notion and the ensuing debate

Larry Summers can be granted the merit to have restated the Secular Stagnation hypothesis in modern terms and in a modern age. In Summers (2014a, 2014b) we can find a clear cut summing up of the main concerns and propositions of the former US Treasury Minister. In these contributions the approach of the Harvard economist is quite virulent against the received wisdom looking only at the variance of fluctuations of production in the short run, while the long run prospects of economic growth are taken as independently given: "To reverse Keynes a bit, if you die in the short run, there is no long run". According to him, short term fluctuation over the cycle may end up having a lasting effect on longer run trends too. In the aftermath of the Great Recession started in 2008, we have been left with the apparent impossibility to fruitfully conjugate *full employment*, *growth* and *financial/price stability* by means of *monetary policy*, that ought to be sufficient usually to ensure the realization of potential output. The most important concepts mentioned by Summers in the development of his analysis, we will see, are then *Secular Stagnation,* the *zero lower bound* and a *negative real natural interest rate*.

What is the overall picture for the US economy that Summers tries to describe?[17] According to him, a comprehensive framework explaining stagnation should take into account the main features of the US economy, such as the evolution of potential output and the natural rate of interest, demographic patterns, income distribution and private debt dynamics, the relative price of investment goods with respect to consumption goods. In his 2014 articles Summers presents some graph displaying the patterns of these variables.

[17] Even though here and there the discussion is extended to the Eurozone and to Japan, we are going to remain confined to the key points valid for the US economy.

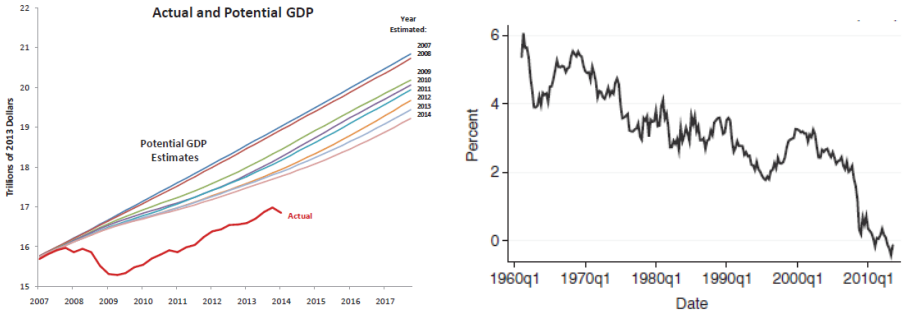


Figure 2 - US potential output estimations and the trend of the natural interest rate, from Summers (2014b, p. 28)

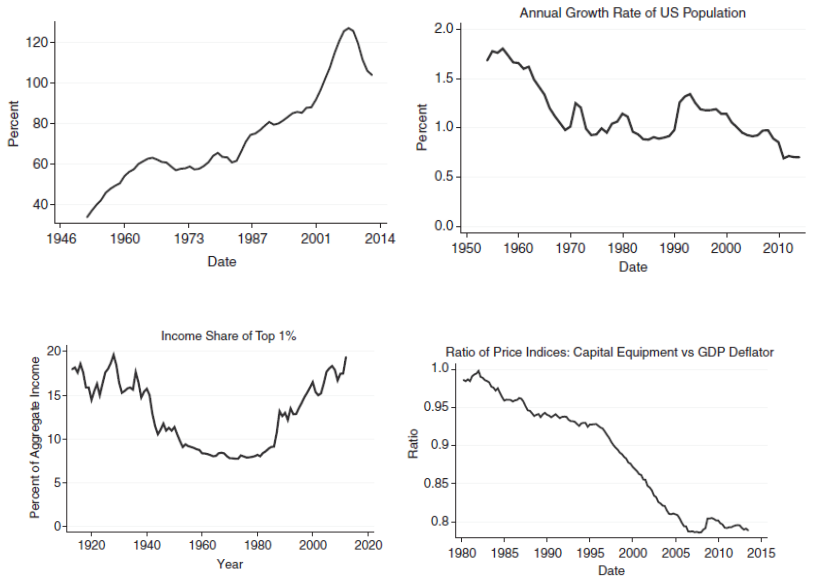


Figure 3 - US households' debt/income ratio, population growth rate, top 1% share of income, relative price of capital goods, from Summers (2014a, pp. 69 - 70).

By means of these graphs, the author shows, respectively:

- the continuous downward revision of the US potential output growth, that in each reassessment takes up a lower value, and the continuous downward trend of the US natural real interest rate;
- the skyrocketing pattern of the private debt/income ratio of US households, which only after 2008 arrived at a halt;
- the slackening of population growth, that in particular from the early nineties has markedly slowed down, following the general trend visible since the peak in the fifties;

- the sort of U-shaped curve drawn by the percentage of income accruing to the individuals belonging to the top 1% upper tail of income recipients in the US, resembling today the situation visible in the pre – war period;
- the noticeable fall in the relative price of investment goods with respect to the GDP deflator, exhibiting a dramatic drop from the middle of the nineties.

How can these tendencies be put in a theory that claims to explain stagnation? Summers sets forth an all-embracing framework to take into account as many relevant factors as possible as he asks himself whether the decline of real interest rates testified in the US in the recent decades can be seen as a manifestation of a decline of the natural real interest rate itself, possibly to negative values. He thus wants to link the tendencies described above to the pattern of the real interest rate. In his framework of analysis this is possible by assessing how each single phenomenon impacts either on the demand for investment or on the supply of savings. Let us review each factor in this light, as Summers does (Summers 2014a, pp. 69 – 71, Summers 2014b, pp. 33 – 36):

- debt-financed investment demand, considering the nature of modern firms (such as WhatsApp and Facebook), tends to be reduced since much less physical capital is nowadays needed to setup a leader sector enterprise. Furthermore, the downward pattern of the relative price of capital goods, with the latter considerably falling in comparison to the consumption goods side, means that a given amount of physical capital can be bought or rent for a lower price than before, therefore absorbing a smaller quota of savings;
- decreasing population growth (and perhaps technological progress[18]), forecasted to keep on going forward also in the next decades, acts as a drag on investment, but no specific reason for this is provided;[19]
- worsening income distribution, by favouring the capitalist class acts bringing about a rise in the economy's propensity to save. Capitalists are generally characterized by a marginal propensity to save higher than the one of wage earners, and thus redistributing income to them leads to a higher supply of savings in the economy. On the other side, worsening

[18] Summers remains cautious when talking about technical progress; he mentions the possibility of a slower rate of growth of technical progress but not with the same emphasis put on the sluggish population rate of growth, that is obviously much easier to measure.

[19] In the two mentioned 2014 and 2015 contributions Summers does not state explicitly how population trends ought to be linked to the demand for investment.

income distribution is mirrored by the rise in the debt/income ratio, with labourers resorting to debt to sustain consumption levels despite the stagnant or decreasing real wage earned.

Hence, in a conventional neoclassical market for investment and savings, within which the natural real interest rate emerges at the intersection between the full employment schedule of the demand for investment and of the supply of savings, there are according to Summers factors moving downward both schedules. These forces manifest concretely themselves in the aspects enlisted before, such as population growth, technical progress, income distribution. When all these tendencies operating upon the schedules of investment and saving are particularly persistent as in recent years, an *equilibrium (or full employment) real interest rate that is strongly pushed to ever-low values by the combined effect of a weaker demand for investment going hand in hand with a dramatic increment of the supply of savings* may eventually result in a *negative natural real interest rate*. Recalling the presentation of the Wicksellian natural interest rate shown before, we can graphically see how the two schedules may actually intercept below zero:

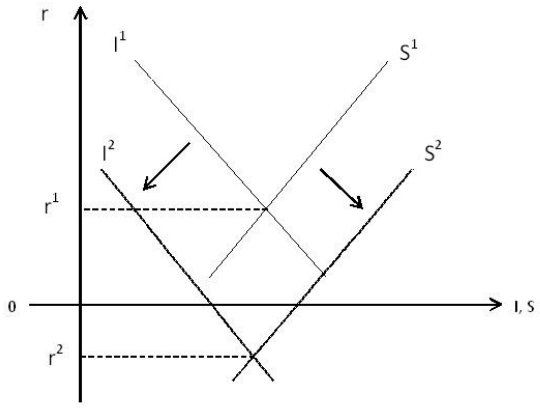


Figure 4 - The transition towards a negative natural real interest rate in Summers exposition, own graph.

Why would such a situation be an issue for policymakers? After all, whatever the intersection between the investment and saving schedules, the Central Bank has the capability of setting the appropriate nominal interest rate that, given inflation expectations, ensures that the market real interest rate equals the natural real interest rate.[20] In a 2015 article Summers keeps on reflecting

[20] In Taylor (1993) it is possible to find the first contribution referring to the now famous 'Taylor rule'. The latter rule ought to describe in a stylized form the setting of the nominal policy interest rate by the

about his theoretical setup. Openly suggesting a comeback to the old-fashioned IS-LM analysis, he clearly maintains that

> "[…]if one assumes that investment is a decreasing function of the interest rate and that saving is an increasing function of the interest rate and that the level at which equilibrium with full employment takes place requires a negative nominal interest rate, then adjustment will take place in the form of a lower level of output, and that lower level of output may continue indefinitely." (Summers 2015, p. 61)

We are therefore assured by Summers himself about the credibility of our reconstruction of his argument in terms of a Wicksellian traditional neoclassical framework where the investment demand schedule and the saving supply schedule intersect, delivering the natural real interest rate. Then, the presence of some disturbing factor may prevent the economy from hitting the equilibrium interest rate; in the version of Wicksell, as we have seen before, a financial friction stemming from the behaviour of banks was the main problem, while today that friction has been replaced by the zero lower bound on the nominal interest rate set by the Central Bank.

According to Summers, it is indeed this rigidity the cause of the problems getting in the way of the realization of an appropriate monetary policy operation. Were it not for the presence of the zero lower bound, the equilibrium position could be reached as usual: the saving schedule is pushed down to the right, the investment schedule is pushed down to the left, and they intersect determining a negative real natural interest rate. A Central Bank tracking down the pattern of the natural real interest rate would then continuously revise downward the level of the policy nominal rate, taking into account inflation expectations. By setting the policy nominal interest very low, even possibly negative, the equalization between it and the natural interest rate would be realized, therefore letting the economy produce its full employment output. As said, the rigidity on the nominal interest rate prevents such a smooth process from coming about, and output is stuck to a level below its potential, in particular because the demand component given by private non-residential investment cannot be properly stimulated by setting an interest rate lower than the lowest attainable.

Central Bank, that for given inflation expectations aims at targeting the natural real interest rate. Within the widespread formulation of the Taylor rule, the monetary authority takes into account, when fixing the policy nominal interest rate, the output gap and the discrepancy between actual realized inflation and the inflation target. The Taylor rule has gained through the years a wide acceptance, to the point that in the new consensus New Keynesian models it is employed to describe the determination of the nominal interest rate in financial markets as the outcome of an autonomous decision of the Central Bank.

How does this reasoning relate then to the actual situation of the US economy? The answer from Summers is twofold: on the one hand, he re-reads the recent US economic history in light of its supposed inherent tendency to stagnation caused by the list of elements he has recounted. When evaluating in retrospect the domestic economic performances over the last three decades, Summers comes to conclude that the advent of a stagnation era could have been spotted years ago, since in the years preceding the Great Recession growth was not spectacular even in presence of loose credit constraints, a gigantic house bubble and sustained public budget deficits. These latter factors would have thus operated in the sense of sustaining aggregate demand while stagnation was already about to come up, and so delaying the materialization of its effects on the economy. Once the most powerful engine of growth for the US economy, namely the sustain to consumption demand coming from rising private indebtedness, encountered its limits during the burst of the financial bubble occurred in 2007, Secular Stagnation became eventually visible. On the other hand, Summers gives a clue about the future evolution of the US potential output. If, as hypothesized, the impossibility to reach the real natural interest rate causes a prolonged shortfall of private investment, the long term adjustment may require a fall in the potential output towards the lower actual one, in what Summers calls an "inverse Say's Law": a lack of demand generates a closely-linked lack of supply.[21]

What can then be done at the policymakers' level? Summers has vocally called forth a public deficit spending intervention aimed at boosting investment demand into the economy.[22] Recalling again our exposition in terms of the neoclassical demand for investment and supply of savings, the argument of Summers can be translated into the following insight: once we find ourselves stuck in a situation in which monetary authorities cannot fix the nominal interest rate to a level that would ensure the equality between the market real interest rate and the negative natural real interest rate, there may be essentially two ways to restore equilibrium. One way is to leave the market get to equilibrium by a drop in the level of output: given the impossibility to stimulate investment by lowering the market nominal interest rate below zero, a drop in the

[21] In Summers and Fatas (2018) it is possible to find empirical evidence for the so called 'hysteresis' effect: a level of aggregate demand that does not consent to fully exploit productive capacity can cause damages to the long term evolution of potential output. In the case of the cited article, the authors contend that austerity measures curtailing public expenditure can easily results in permanent losses of production and lead to a slower growth rate of the potential output.

[22] Summers suggests that the program of public spending may be accompanied with regulatory and tax reforms, policies promoting exports, higher inflation target settings, income inequality reducing programs.

realized output lowers the incomes accruing to individuals, and for a given marginal propensity to save, the amount of saving supplied to the market falls, therefore shifting the saving supply schedule back to the left. In this way, by eliminating the savings in excess present in the economy that are not absorbed by private investment, the natural real interest rate can move upward and regain a positive value. Then, the usual adjustment process running through the adaptation of the controlled nominal interest rate by the Central Bank can become again operative and effective. Since an adjustment via recession is not desirable, given the possible consequences upon employment and growth, Summers maintains that the best way to address the issue is by implementing a deficit-financed public spending policy directed towards a large-scale investment plan. The latter would indeed lift back the natural real interest rate into the positive territory by a different route: the intervention of the government within the economy would act in such a way as to move the investment schedule to the right, therefore exploiting the operation of the public authority as a substitute for the lack of the private sector demand for investment.

- *Critical considerations*

The problem that Summers wants to tackle, as we are seeing, appears to be the following: given that the US economy has been experiencing a prolonged period in which several factors have been contributing to weaken the demand for investment and to boost the supply of savings, the natural real interest rate can be argued to be nowadays negative. Given the constraint on monetary policy set by the zero lower bound on the nominal interest rate, there is an impossibility to reach equilibrium by a conventional strategy moving the policy rate controlled by the Central Bank. How do we deal with a situation like that? How do we bring back the natural interest rate to a level which would render monetary policy again effective?

What we ask ourselves is: even granting the neoclassical framework a general validity, is an equilibrium situation involving a negative value for the natural real interest rate a tenable theoretical position that can explain the problem of stagnation? Closely linked to this question we have the other issue we want to investigate: is the theoretical framework falling under the label of ‘demand side Secular Stagnation’ capable of hosting an explanation for stagnation genuinely relying on a lack of aggregate demand to explain the observable weak economic performances?

We have seen that in a full equilibrium situation, with perfectly competitive markets for factors and products, without uncertainty, the neoclassical theory determines the pure

remuneration of capital as given by its marginal productivity in value terms. By stating that the equilibrium position characteristic of a Secular Stagnation features a negative natural real interest rate, and remembering from Wicksell that the natural interest rate "more or less corresponds to the expected yield on the newly created capital", it would seem that Summers is supposing that, being absent the rigidity labelled 'zero lower bound' on the nominal interest rate, the economy would find its equilibrium in a long run position in which entrepreneurs demand a quantity of capital such that the last unit employed in production yields a negative net product. It appears therefore that Summers supposes that the only obstacle to the attainment of equilibrium is the zero lower bound, while in our opinion what ought to be questioned is the meaning of an equilibrium position featuring a negative natural real interest rate. It would seem, indeed, that within the reasoning in neoclassical terms carried out within a traditional IS framework in which Summers puts himself, such a result could be attributed to a capital/labour ratio so high that the ensuing marginal product of capital becomes not only very low, but even negative. Let us not question where does such a possible 'over-accumulation' of capital may come from; rather, let us try to understand what does it mean in terms of the neoclassical theory.

The utilization of the CES (constant elasticity of substitution) family of production functions,[23] that allows to represent in a simple analytical form the aggregation of the factors capital and labour, thereby permitting to describe the technical features of the production process, is very common. They show, in fact, the maximum amount of production that can be obtained using alternative combinations of capital and labour. Within such kind of general representation of the production process as a direct relationship between the final net product and the amount of inputs available, the most famous version is the standard Cobb – Douglas aggregate production function with constant returns to scale. We are going to employ that kind of aggregate production function as it is the most commonly utilized form in theoretical and practical applications. Employing a Cobb – Douglas of the form[24]

$$Y = AF(K, L) = AK^{\alpha}L^{1-\alpha}, \qquad 0 < \alpha < 1 \tag{1}$$

and rewriting it by making the net product a function of the per capita capital

[23] Arrow *et al.* introduced the general CES aggregate production function; cfr. Arrow, Chenery, Minhas, Solow (1961).

[24] In which *Y* is the net product of the economy, *A* is the total factor productivity, *K* and *L* are the capital and labour inputs, α and 1- α are the output elasticities of capital and labour.

$$y = Af(k,1) = A\left(\frac{K}{L}\right)^{\alpha}\left(\frac{L}{L}\right)^{1-\alpha} = Ak^{\alpha} \quad (2)$$

the first derivative with respect to the capital per capita gives the marginal contribution to production of an additional unit of capital to be employed, which in the neoclassical theory also determines the remuneration of capital:

$$f'(k) = A\alpha k^{\alpha-1} \quad (3)$$

It is possible therefore to see the inverse relation between the remuneration of the factor capital given by its marginal product and the quantity of capital per capita employed in production. In this case, as the quantity of capital employed in production increases, the marginal product of capital decreases; in the limit, as capital per capita approaches infinity, its marginal product tends to zero. This implies that a proper decrease of the interest rate allows for a demand for capital per capita to be employed in production that can potentially absorb any amount of savings at disposal in the economy. A graphical sketch of such an intuition would look like:

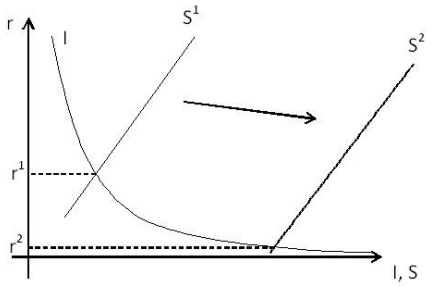


Figure 5 - The intersection between the savings – investment schedules supposing an aggregate production function without a maximum finite capital/labour ratio , own graph.

The investment schedule is thus described by the technical conditions proper of the production function we have hypothesised, and a smooth continuous substitutability of labour and capital ensures that whatever the amount of savings supplied, they can always be converted into capital to be utilized in production. We can notice how the employment of the commonly used aggregate production functions belonging to the CES (constant elasticity of substitution) family yields the same result: even when the capital/labour ratio is supposed to tend to infinity, the marginal productivity of factor capital approaches in the limit the value of zero, but not negative. Indeed, the Cobb – Douglas production function is known to be the case in which the elasticity of substitution between capital and labour is constant and equal to one; it is an intermediate case

between the linear case with an infinite elasticity and the fixed proportions case with zero elasticity. Let us show how even these other two cases do not seen to contemplate the possibility of an over-accumulation of capital.[25] In the case of infinite substitutability between factors of production we have a production of this type:

$$Y = F(K, L) = aK + bL$$

And after performing the same transformation in per capita terms as before we can then get the first derivative with respect to the capital/labour ratio, getting

$$y = f(k, 1) = ak + b, \qquad f'(k) = a \tag{4}$$

Which is a finite positive constant and does not depend on the value of the capital/labour ratio. Developing the same steps for a Generalized Leontief Production Function[26] we get:

$$Y = F(K, L) = K + L + 2\sqrt{KL} \rightarrow y = f(k, 1) = k + 1 + 2k^{0,5} \rightarrow$$
$$\rightarrow f'(k) = 1 + k^{-0,5} \tag{5}$$

In this instance the capital/labour ratio enters the determination of the marginal productivity of capital, but as in the case of the Cobb – Douglas above, when that ratio tends to infinity the marginal productivity tends to a finite value, this time to 1.

The three mentioned cases, namely an aggregate production function featuring an infinite, positive and zero constant elasticity of substitution between capital and labour do not seem to allow for a natural real interest rate determined by the marginal productivity of capital that converges to a negative value when the capital/labour ratio remarkably rises. As these cases are the possible ones entailed by the widespread CES production functions family, it seems that in order to sustain the intuition of Summers a particular kind of production function involving a finite value for the capital/labour ratio at which the marginal productivity of capital becomes zero is necessary; when the required full employment capital/labour ratio surpasses that value, then it would be possible to state that the natural real interest rate, for that given description of technology, falls below zero.

[25] For a textbook presentation of the different cases involved by the use of the CES aggregate production functions family we are utilizing in this part, cfr. Nicholson and Snyder, *Microeconomic Theory – Basic principles and extensions*, tenth edition, 2007, pp. 306 - 311.

[26] Which is one example of a kind of Leontief production function, but the result would hold true for the general fixed coefficient form: with a production function of this kind, the eventual excess of capital over the required amount to be combined with labour would result in a zero marginal productivity of capital, but not in a negative value for it.

Three additional considerations may be set forth besides the argument we have just developed. In the first place, let us discuss whether Summers' reasoning in terms of the decision to invest in a newly installed amount of capital yielding a negative marginal product is economically meaningful. Let us assume therefore that the above considerations looking at the feasibility of such a result when employing the CES production functions can be set aside for a moment. Hence, we conceive as technically possible the existence of a finite capital/labour ratio at which the marginal product of capital becomes zero; further additions of capital would yield a negative marginal product. Indeed, at the pure abstract level there may seem to be little doubt about the possibility of conceiving a production process in which capital may yield a negative marginal product, exhibiting a portion of the marginal productivity of capital schedule falling below zero. In other words, we do not see as particularly problematic the concept of an 'excess' quantity of capital that would push the marginal productivity of this factor below zero. What appears much more problematic is to state that the demand curve for capital could follow below zero the graph of the marginal product of capital, which on the contrary could reasonably be argued to be negative in particular circumstances. It therefore appears acceptable to state that a negative marginal product of capital is nothing else than one of the possible values that the variable can take up, but it could hardly feature an equilibrium position since an entrepreneur has always the possibility not to employ the amount of capital that would render its marginal product negative; in this respect, the lowest value for the marginal product of capital that appears reasonable to assume is zero. In other words, while it seems reasonable, by framing the problem in terms of marginal productivity of a factor for a given amount of the other factor employed, that the marginal product curve will fall below zero when the capital/labour ratio is pushed to an elevate level, it does not appear reasonable to state that the demand curve for capital will have the same shape. Such a curve is in our opinion meaningless below the zero value for the marginal product of the factor capital. Thus, even when the technical conditions of production would allow for the possibility of an equilibrium in which the marginal product of capital turns negative, a rational decision by entrepreneurs may seem to suffice to rule out that possibility.

A second point entails lingering for a moment on what would imply stating that the natural interest rate becomes negative in terms of income distribution. By utilizing a constant returns to scale aggregate production function it is possible to describe the distribution of income in the economy by means of the 'Product exhaustion' theorem. That theorem states that under a

regime of constant returns to scale, paying the factors of production according to their marginal products would ensure that the entire net product is distributed. Formally we have that[27]

$$Y = F(K, L) = F'_K K + F'_L L = rK + wL \tag{6}$$

and hence the net product resolves itself into the factor capital earning the real interest rate and the factor labour earning the real wage rate, both remunerations being determined by their marginal products. Given this condition, a negative natural interest rate entails the following condition to be verified

$$Y = rK + wL \rightarrow r = \frac{Y - wL}{K} < 0 \rightarrow wL > Y \tag{7}$$

namely, that the share of the net product going to the factor labour exceeds the net product of the economy. Such a situation seems to be difficult to accept, even granting to Summers the validity of every piece of the theory he has been proposing. In fact, by accepting this kind of reasoning, it would seem that we would be accepting to envisage an equilibrium position in which the capitalists invest in real capital in order to get a negative rate of profit, since in a neoclassical world the pure remuneration of capital (the rate of interest) and the rate of profit are equal in an equilibrium situation without uncertainty and with perfect competition, and are determined by the marginal productivity of capital. Let us now recall the point raised above upon the possibility to conceive a demand curve for capital falling below zero, which is in our opinion not acceptable since at the least that curve can be drawn down to the point in which the real interest rate plunges to zero. By applying this concept to the present case made by utilizing the product exhaustion theorem, we would therefore maintain that the most extreme case which is possible to envisage is one in which the amount of capital employed in production is so high that its remuneration falls to zero, and thus the whole net product would be absorbed by the wage bill.[28]

At last, we want to mention a possible counterargument to the critical considerations we have been hitherto enlisting. It might be replied to the critiques laid on the concept of an equilibrium characterized by a negative natural interest rate that such a position ought not to be

[27] In the formula we have a generic aggregate production function, with *K* and *L* the capital and labour inputs, F'_K the first derivative of the production with respect to capital and F'_K with respect to labour, *r* is the interest rate earned on capital employed and *w* the wage rate earned on labour employed.

[28] It may be stated that a situation in which the amount of capital employable in production is so high to let its remuneration fall to zero can be described as a situation in which a factor of production becomes so abundant that actually it ceases to be scarce, and therefore it is not necessary to pay a price to reward its utilization.

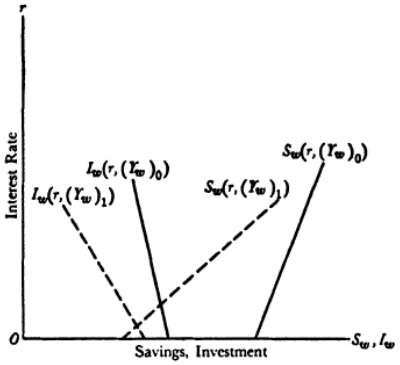
taken at face value. Speaking of an equilibrium with a negative natural real interest rate may be, it could perhaps be stated, tantamount to saying that the natural interest rate in some particular instances does not exist; in other words, it simply would mean that the investment and savings schedules do not intersect at any positive or zero interest rate. If this is the case, the economy remains blocked in a suboptimal equilibrium and the market solution would come about through a recession which eliminates the undesirable excess of savings. Hence, the demand side Secular Stagnation theory simply aims at describing a suboptimal situation, and the attention directed to the study of the equilibrium position with a negative natural real interest rate would be misplaced. From this viewpoint then, the previous critiques may be fully accepted, because the argument could be possibly ran in these terms: "The Secular Stagnation argument takes that equilibrium position only as a theoretical counterfactual. Indeed, the capital/labour ratio that would be necessary to ensure the full employment of resources and the equilibrium between the flows of savings supplied and investment demanded ought to be so high to imply a negative natural real interest rate. Since such a position cannot be taken as a feasible long period equilibrium for the reasons explained, then we have stagnation and persistent unemployment."

We think that, on the contrary, the demand side Secular Stagnation theory of Summers is not ambiguous in believing that the negative natural real interest rate theoretical category lies at the centre of the enquiry. In particular, the great emphasis put on the zero lower bound rigidity is in our opinion a clear hint confirming our vision.[29] In fact, the continuous and repeated focus placed on the presence of such a constraint on monetary policy is indicative of the fact that, according to the proposers of the theory we are debating, it is precisely that rigidity the obstacle that gets in the way of policymakers. Without it, the Central bank might move the nominal interest below zero, thereby attaining (for given inflation expectations) the equality between the market and the natural real interest rate. The theoretical stance supported appears therefore quite difficult to be mistaken for the description of a simple suboptimal condition; there is a clear cut assertion about the characteristic of an equilibrium position, and there is also the mention of the main factor preventing the achievement of that position.

[29] We will see later on that also in other contributions upon the issue of demand side Secular Stagnation the description of an equilibrium position featuring a negative natural real interest rate is the clear and unambiguous target of those analysis.

In order to further reflect on the latter point it is interesting in our opinion to read at length an extract from the seminal book of Lawrence R. Klein *The Keynesian Revolution* (1966). The wider point Klein had been looking at in the third chapter of his work was the illustration of how the contribution of Keynes modified radically the explanations of the level of production, the role of the interest rate, the way in which rational decisions were modelled and so forth, with respect to the pre – Keynesian theories. The interesting part in light of our discussion comes when the author discusses whether the Keynesian system can always be supposed to be able to deliver an equilibrium real interest rate in the market for savings and investment, in contrast to what happened in the so labelled Classical system:

> "But now, let us become Keynesian and see what happens. As before, solve the background equations for real wages, employment, and output. Substitute full-employment income into the savings-investment equation. Is there always a solution for the interest rate? There are as many equations as variables, but does that guarantee an economically possible solution? The answer is that it certainly does not! More must be done than merely to count equations and variables. We must consider the shapes of our functions. The Keynesian Revolution rejected the classical theory of interest. It denied that the equation[30]
>
> $$S_w(r, (Y_w)_0) = I_w(r, (Y_w)_0)$$
>
> need always have a positive solution for the interest rate, *r*, when $(Y_w)_0$ is given *at the full-employment level*. When the saving process is analyzed, the slope of the savings function with respect to the interest rate might be negative or positive and will probably be small in absolute value. More recently, we have come to believe that the investment function is also interest inelastic. It is more likely than not that there will be no positive value of *r* which satisfies this equation. *Perfect equilibrium of perfect competition is not in general compatible with the system of Keynesian economics*. A feasible graphic presentation of this situation is given in Figure 4.



[30] In the equation, the author uses S_w and I_w for the schedules of savings and investment measured in wage units, r is the real interest rate, $(Y_w)_0$ is the level of income measured in wage units.

> When income is at the full-employment level, $(Y_w)_0$, it is both possible and probable that the savings-investment schedules as functions of the interest rate will appear as the two solid lines. The relative positions of the two schedules mean in this case that no matter how low the interest rate is pushed, savings out of a full-employment income exceeds investment out of that same income. It is obvious that this result becomes more possible as the two schedules become more interest-inelastic. If there were unlimited investment opportunities at the going interest rate, the investment schedule would be a horizontal straight line - infinitely elastic - and consequently always intersect with a non-horizontal savings schedule. Many orthodox economists use a model of the latter type, although it does not describe a savings-investment process that could exist in the present world, no matter how perfect the system might be. The case of the horizontal investment schedule and the non-horizontal savings schedule comes in the end to Say's law.
>
> But there is an adjustment which takes place within the Keynesian system, so that a positive interest rate can be determined. If income falls from $(Y_w)_0$ to $(Y_w)_1$, then the two schedules of Fig. 4 will shift to the positions of the dotted lines. Incomes will have to adjust to that level, $(Y_w)_1$, at which savings out of that income will be equal to investment out of that income. Only after a theory of the adjustment of output is introduced can the rate of interest be determined for the general case." (Klein, 1966, pp. 84 – 86, emphasis in the original)

The way in which Klein framed the problem comes in peculiarly useful for our discussion. In fact, in his argument we find some point we have already singled out above. When defining the two schedules for investment and savings at full employment, the author claims that there will generally be no guarantee that they intersect at a positive level of the real interest rate. How did he arrive at such a conclusion? The basic tenet necessary to claim such a result is an hypothesis about the interest inelasticity of the two curves. Such a point is what we have been raising against the general framework of Summers as well. It may seem, indeed, that if one wants to claim that nowadays the natural real interest rate has become negative, such a statement would need in the first place the employment of a production function entailing a finite level for the capital/labour ratio at which the marginal productivity of capital falls to zero. The shape of the investment function showed by Klein appears to implicitly represents exactly this feature. In his words, actually, with a horizontal investment schedule we would always get an intersection with the saving schedule at a positive interest rate. We have tried to argue that with the usual aggregate production functions of the CES family we would get a conclusion analogous to the one of Klein, hence it would always be possible to convert the savings supplied into a flow of investment in real capital demanded for production. Apart from this consideration, what has drawn our attention is also the fact that Klein does not linger at all on the supposition that equilibrium may be reached

at a negative value for the real rate of interest: in other words, as we have pointed out before, it appears problematic to suppose that the equilibrium may be reached at a negative natural real interest rate, with the zero lower bound preventing the attainment of such a position. Indeed, we have reported this passage taken from Klein exactly to maintain that the possible interpretation of the demand side Secular Stagnation argument in terms of a simple underemployment equilibrium in which no equilibrium real interest rate exist would not be tenable: in the theory of Summers there is a defined equilibrium position, and a rigidity on the nominal interest rate does not consent to reach it.

So far we have thus discussed the position of Larry Summers about Secular Stagnation. This author suggests that the cause of a stagnation ought to be traced back in the combined effect of several patterns within the US economy (population growth, technical progress, income distribution) on the value of the natural real interest rate. Given the combined and concomitant effect of a weakening demand for investment and the rise of the supply of savings, the result is a continuous downward trend in the natural real interest rate up until its drop below zero. At that point, monetary policy becomes ineffective since the zero lower bound on the nominal interest rate prevents the Central Bank from properly hitting the natural rate value for given inflation expectations. A disequilibrium situation thereby emerges, when investment cannot be stimulated by lowering the policy nominal interest rate, and so aggregate demand does not suffice to ensure that the full potential output is realized. While the preoccupation of Summers, as we have said, points to look for possible solutions to lift the economy back to its potential, and the answer is found in an active deficit financed fiscal policy, our attention has been directed elsewhere. We have in fact questioned the validity of a reasoning that, even granting to it the usefulness of employing the natural interest rate category, explicitly states that the latter variable has turned negative. It may seem indeed that supposing an equilibrium position in which entrepreneurs select a production process entailing a capital/labour ratio so high that the marginal product of capital is negative may encounter many difficulties in being advocated. It can be said that, rather than focusing the attention upon the rigidity constituted by the zero lower bound on the nominal interest rate, some scepticism can be put on the capability of the neoclassical Secular Stagnation framework of explaining the recent disappointing performances of the Western capitalist economies. In what follows we are going to review some other neoclassical explanations for

Secular Stagnation, in order to ascertain whether the version of Summers is the most credited, and therefore the most susceptible to capture our attention. Afterwards, we are going to review a model proposed by Krugman, in which an attempt similar to what Summers has lately tried (explaining stagnation by means of a negative natural real interest rate) had been carried out with regard to Japan.

1.3 - Other mainstream contributions to the Secular Stagnation theory

In the previous section we have presented the way in which Larry Summers has framed what in his opinion is the situation in which the major Western economies are stuck, namely a Secular Stagnation.[31] The explanation of Summers is not the only one that is present in the literature, and in this section we are going to review some other viewpoint from the mainstream standpoint. In particular, we are going to distinguish between the demand and supply side versions of Secular Stagnation.[32]

- *Demand side Secular Stagnation*

The demand side version proposes a rationale for the Secular Stagnation hypothesis in which the price rigidity on the nominal interest rate (the zero lower bound) hinders the realization of the full employment amount of investment, given the savings available in the economy. In order to stimulate adequately investment, a real interest rate lower than the lowest attainable would be needed. The impossibility to reach the natural real interest rate when the latter is negative therefore causes a lack of the component of demand represented by private investment.[33]

Indeed, Secular Stagnation coming from the demand side is the version of the argument that has received most attention, and as we are going to ascertain the major part of neoclassical

[31] As in the case of Summers, most of the references from 2014 are extracted from the important book of Baldwin and Teulings *Secular Stagnation: Facts, Causes and Cures* in which many renowned economists have made comments about the issue; amongst them there are the ones cited in this work.
[32] A recent contribution dealing at length with the division of the Secular Stagnation hypothesis into these two categories is Suma (2017).
[33] A prolonged period of time during which output falls short of its potential value may then cause the dynamics of the potential itself to slow down, and in this case the case for retrieving the concept of hysteresis comes up. Nevertheless, we are not going to inquiry the possible routes through which a lower level of production today could impart a slower dynamics to the growth rate of the potential output.

contribution besides the one of Summers frame the argument in a similar manner, discussing how several factors have contributed to create a pool of savings in the US economy which is not matched by a sufficient demand for investment capable of absorbing it at any positive rate of interest. Later on we will analyse the seminal 1998 contribution of Krugman on the Japanese stagnation case, and we will argue how in that work it is possible to find the first explanation for a slack in economic performances caused by a negative real natural interest rate. Krugman himself joined the debate about Secular Stagnation in the years after the 2014 contributions of Summers, claiming many times (in particular on the Internet and on his blog on the New York Times) how the work of Summers has been spectacularly effective in bringing the kernel of what he had been theorizing about Japan into the US debate. Moreover, as we are going to see in the second chapter of the present work, the most important formal model about Secular Stagnation, which is the OLG model of Eggertsson, Mehrotra (2014) and Eggertsson, Mehrotra and Robbins (2017), overtly claims to be the translation of the conclusions of Summers into an analytical framework. This amounts to saying that, even though the distinction between the supply and the demand side of Secular Stagnation is important and ought not to be neglected, yet the term Secular Stagnation in most cases implicitly refers to the demand side Secular Stagnation theory.

As said, the most active supporters of the demand side Secular Stagnation theory of Larry Summers have been Krugman, Eggertsson and Mehrotra. Krugman (2014) took part in the discussion providing some reasons why the Summers' hypothesis may be well founded. Krugman in the first place warns about the increased likelihood of hitting the zero lower bound in the future, because monetary policy is currently still stuck there (it is a decade now that Central Bank controlled nominal interest rate is close to zero in the US) and the real interest rate has been moving markedly down during the last three decades.[34] From the demand side the end of the debt

[34] The long term trend of the natural real interest rate is the principal aspect discussed also by Blanchard, Furceri and Pescatori (2014), as they point the attention to its evolution in the last decades, trying to understand why it has been trending downwards so markedly. Obviously the matter is not disconnected from the Secular Stagnation theory, in as much as very low interest rates make the monetary policy ineffectiveness more impending, preventing then the attainment of potential output. According to the three economists, the downward trend of the Wicksellian natural real interest rate is due mainly to the increased supply of loanable funds (that corresponds to the savings forthcoming when potential output is realized). In their view a consistent flow of savings has been coming in the global market from fast growing emerging economies, but it has not been matched by a sufficiently strong demand for loanable funds (corresponding to potential output investment demand). Especially during the post US Great Recession of 2008, uncertainty about future economic prospects boosted the demand for safe assets; the before

consumer era on the one hand, and the slowing population growth on the other are taken as good predictors of an investment demand destined to be abated. We see then how Krugman sticks closely to the picture depicted by Summers: he felt the need to link the long term movements of the nominal interest set by the monetary authority and of the factors (debt – financed consumption and slow population growth in this case) that supposedly concur to the determination of the demand for investment and the supply of savings. The tendency for the materialization of an excess of savings due to the mentioned factors results in a continuous collapse of the real natural interest rate, a pattern becoming worrisome once this latter variable gets close to the zero level, since at that point monetary policy comes to its limits in terms of effectiveness.

Eggertsson and Mehrotra (2014) set up the first comprehensive model to analyse Secular Stagnation, a model we are going to deal with in the third chapter of the thesis.[35] Herein we just briefly introduce it in order to enlist it within the demand side versions of Secular Stagnation. The two economists choose to employ an overlapping generations structure within which the natural real interest rate is pinned down by the several elements which have been brought to the stage by Summers. The factors that can make the natural rate negative are indeed, in the model: slower population growth, falling relative price of investment goods, collapsing exogenous debt limit, increasing inequality. While the first three shift down the demand for savings schedule, the last one pushes the supply of savings schedule to the right. One prominent feature of their model is that the real natural interest rate remains negative even in the steady state. In that situation, according to the authors, fiscal policy is the best way to offset the contraction of output due to monetary policy ineffectiveness. As said, it is natural to include these authors within the demand side Secular Stagnation advocates since they chiefly refer to Summers as the main inspirer of their work, whose fundamental scope is to provide analytical grounds to the general scenario described by the modern father of the theory.

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mentioned increase in savings from emerging market has been for a considerable share invested in US treasury bonds, causing the collapse of the associated real interest rate on them. In the end, Blanchard, Furceri and Pescatori join Summers in considering a low real natural interest rate a problem for monetary policy, advocating for a fiscal policy public spending intervention.

[35] Here we cite the 2014 initial version because it provided the foundation of the model, that has been afterwards enriched with a simulation model in the version of 2017.

Barry Eichengreen is another author ascribing to the demand side Secular Stagnation theory, as he says:

> "Here I define secular stagnation as a downward tendency of the real interest rate, reflecting an excess of desired saving over desired investment, and resulting in a persistent output gap and/or slow rate of economic growth." (Eichengreen B., 2015, p. 66)

As we are going to see from a recent contribution, his general take on the argument can be summarized as follows: the analysis in terms of a supply schedule of savings and a demand schedule for investment lies at the hearth of his reconstruction, and the effect of several factors can make the two curves intersect at a level of the natural real interest rate that causes the economy to remain stuck into a situation of underutilization of productive capacity. Yet, Eichengreen remains more prudent than Summers in assessing the current stagnation as the new normal situation, because in his opinion the several interacting causes of weak economic performances will not for sure be in place also in the foreseeable future.

In 2015 on the *American Economic Review* he substantiates his position by showing a review from a long run perspective of the main variables scrutinized; according to him, under that light the current period of low interest rates looks more like a convergence towards a long term mean. Indeed, the prolonged downward pattern of the nominal interest rate on US government bonds can be read, following Eichengreen, as a return to a range of values typical of the last two centuries. It is the peak experienced in the late seventies and early eighties that appears as a sort of outlier when the prospect from which one sees the general trend goes way further back in time; current analysis would be misleading since it generally concentrates, on the contrary, upon the downward trend started after such a peak had been attained, as shown in the graph:

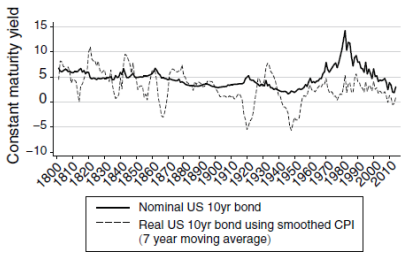

Figure 6 - Secular pattern of US nominal and real 10yr government bonds, from Eichengreen (2015, p. 66)

The main aspects that contribute to the downward trend of interest rates of the last decades, according to Eichengreen, are:

- a saving glut coming from Eastern emerging markets, driven by an underdeveloped financial system and a lack of social security policies. These factors tend to keep precautionary savings in the economy high, and given the rising share of world GDP constituted by those developing economies, a higher global saving rate ensues. This element therefore boosts the supply of savings in financial markets, thus moving to the right the saving schedule. Eichengreen argues that such a pattern for the economy wide saving rate characterized also the US in the last part of the nineteenth century, but afterwards the development of the economy entailed a decrease of the US saving rates. If emerging economies will follow the same development, the saving glut will therefore tend to disappear in the future;
- the plunging relative price of investment goods, which Eichengreen consider an evident long term trend visible in several studies. This factor enters the analysis because such a relative decline means that a given set of investment projects can be financed by resorting to a lower than before amount of savings; therefore, it constitutes a drag on the demand for savings needed for investment. Eichengreen Solomonic consideration is that there is no reason why such path cannot be reverted in subsequent evolutions, since technological improvements could make in the future consumption goods relatively more costly;
- the slower population growth rate, with developing economies seemingly imitating the advanced ones' demographic trends, i.e. at the global level the population growth rate is slackening. The scepticism of the author this time comes from the fact that Eichengreen does not take for granted the effect of an ageing population on the amount of desired savings. As he puts it, it is difficult to make a univocal statement about the effect of lower population growth and aging on the supply of savings, and then the effect of these elements on the pattern of the natural real interest rate are not determined with certainty;
- the shortage of innovative technology to invest in, due to the lighter impact of the IT revolution on economic activity compared with older innovations. The author is possibilist even on this respect: he in fact introduces the distinction between 'range of

applicability' and 'range of adaptation' of the inventions;[36] the attention is pointed to the fact that in both respects the absorption of technical improvements into the production process takes time, hence in future years we will fully benefit from current discoveries.

Eichengreen therefore entertains a sort of 'moderate' demand side Secular Stagnation analysis. The attitude towards the explanation of stagnation by means of a declining natural real interest rate delivered by the interaction of several factors operating in the savings - investment market is that the theory is sound. What is less clear cut according to the author is the long run prospect for what concerns the future evolution and trend characterizing the main relevant elements entering the picture, which are in his description population growth and ageing, technical progress in terms of new discoveries and the effect on the relative price of investment and consumption goods. So, if the situation remains the same of the recent years, the demand side Secular Stagnation framework can well explain what is going on, but there is the possibility that the future conditions in the market for savings and investment will not necessarily keep on delivering an excess of supplied savings over desired investment.

- *Supply side Secular Stagnation*

The supply side version of Secular Stagnation points the attention instead towards the supply side factors affecting the dynamics of the potential output, such as population growth and technological progress. There is, according to this view, no need to resort to the trend of the natural interest rate with its alleged fall in the negative territory to explain stagnation. Indeed, it suffices to refer to the slow demographic progress and the supposed lack of novel technological ground-breaking improvements to justify the sluggish economic performance that the Secular Stagnation theory ought to account for. In this version therefore there is no mechanism hindering the realization of the full employment output, it is the dynamics of potential itself that is much slower than what we have witnessed in previous decades. The most important author setting forward a supply side analysis of the Secular Stagnation phenomenon is Robert Gordon. In Gordon (2014, 2015) we find indeed a description of the causes for stagnation relying on the sluggish growth rate of the potential output for the US economy. The main concerns expressed by Gordon regard the following two factors:

[36] The first regards the amplitude of the economic sectors that can utilize the innovations, the second the degree of organizational reform needed to fruitfully implementing the novelties.

- demography trends, reflected chiefly in ageing population and plummeting labour force participation rates;
- the total factor productivity growth slowdown, caused by both a weakening effect of technical improvements on the growth of TFP and the diminishing returns from education in terms of human capital accumulation, once the large scale transition to a universally educated society had been completed already by the '70s.

Gordon analyses stagnation by putting a close eye to the technological innovations cycles. The slower pace of potential output growth is said to be in the first place due to the fact that, after the waves of productive innovations coming from the first and second industrial revolution, we would nowadays be facing the waning of the impact of the third one. The reorganization of business activity involving new IT technology and equipment could be now have come to an abrupt halt; this causes also a considerable decrease in new start-up firms' creation. Along with it, the major obstacles to reinvigorating growth stem from the sluggish rate of growth of labour productivity and worked hours, in turn affected by the disappointing numbers of population and labour participation growth.

This Secular Stagnation explanation is thus evidently based on purely supply side factors such as population dynamics, accumulation of human capital, a low labour participation rate, a slower rate of technical change. As illustrated in the introduction to this section, such an explanation does not rely on the negative natural real interest rate category to explain stagnation. Rather than questioning the correct functioning of the market relative price adjustment that would ensure the realization of full capacity output, this version of the theory envisages the sluggish growth of potential output as the main cause of weak economic growth. Being based on a neoclassical conventional growth model, it is not surprising that the theory of Gordon worries about the trends of population growth and technical progress.

Even though the explanation of Gordon constitutes an important strand within the Secular Stagnation theory, it has gained much less attention and discussion with respect to the demand side strand. In what follows, therefore, we will basically discuss Secular Stagnation as the demand side strand has described it. Nonetheless, we will see how some basic concept of the supply side version will come up again within the analysis of the meaning of the demand side theory.

Conclusions

The first chapter of the present thesis has been devoted to the presentation of the new Secular Stagnation theory brought onto the stage by Larry Summers. According to this economist, the recent prolonged economic stagnation, which makes him worry about a possible Secular Stagnation similarly to what happened to Hansen decades ago, can be explained within a traditional neoclassical theoretical apparatus in which the schedules of the demand for investment and the supply of savings intersect below zero, therefore determining a negative natural real rate of interest. The rigidity on the nominal interest rate constituted by the zero lower bound prevents monetary policy from being effective, and therefore, without a proper State intervention through a deficit spending fiscal policy targeted towards an investment plan, the economy can remain stuck into a persistent stagnation. What we have tried to question is the feasibility of a theoretical position in which the natural real interest rate turns negative, setting aside the (however valid) critiques upon the existence of a natural real interest rate determined by the full employment marginal productivity of capital. Our answer is that, at least in the version of Summers, there is no room to argue, within that neoclassical apparatus, that the long period position involving a negative natural real rate of interest is acceptable. In addition to this, it appears that the role of aggregate demand in the explanation of stagnation is of secondary importance. It seems, in fact, that the various elements contributing to the weak economic performances that Summers enlists have a role only inasmuch as they concur to push the natural real rate of interest below zero, since the lack of investment might be fixed by monetary policy, were the zero lower bound absent; we will return to this aspect even in the following two chapters. Finally, we have distinguished between the demand side Secular Stagnation theory and the version based on the supply side vision. We have seen how the supply side version does not encompass the analysis of the negative natural interest rate, but only states that the stagnation is due to a slow rate of population growth and technical progress. Since the demand side version is by and large the most credited in the widespread literature, we have made this distinction, and we have then concluded that the better strategy is to focus only on the demand side version, which is also the one presenting the more novel and interesting analytical features. In what follows we are going to analyse the first demand side stagnation model of Krugman, which has served as a benchmark for the subsequent

literature, and then the most recent versions based on the contributions of Summers. What we are going to enquire is whether the same issues we have spotted in this first chapter are traceable even in the broader literature about the phenomenon of a persistent stagnation studied in neoclassical terms and with a particular concern about the demand side of the economy.

CHAPTER II - THE ROOTS OF THE DEMAND SIDE SECULAR STAGNATION THEORY ANALYTICAL FRAMEWORK

In this chapter we are going to go back to the 1998 contribution of Paul Krugman about the long lasting Japanese stagnation of the late eighties – nineties, many times referred to as the Japanese 'lost decade'. How is this detour to a contribution of twenty years ago justified in light of our enquiry upon the renewed Secular Stagnation debate started by Summers in 2013? Krugman (1998) discusses extensively the Japanese prolonged stagnation, trying to trace back its ultimate causes. His aim at the time was to provide a possible explanation for that situation by means of a new analytical concept. Later on such contribution has been often cited by the author himself as one of his best pieces, and will gain widespread acceptance in the academy as a path-breaking article. From our perspective, we are going to see how the germs of what after the Great Recession will be called the new Secular Stagnation strand of thought can be found in this contribution. In particular, in the stylized model that Krugman set forward to provide a rationale for the Japanese sluggish growth we are going to find a formal treatment of how a negative natural real interest rate can emerge in an economy, and what issues in this instance causes a zero lower bound on the nominal interest rate. Therefore, the analysis carried out in this chapter has a twofold role: on the one hand it serves to discover the roots of the demand side Secular Stagnation theory. On the other, it constitutes another step in the general research upon the two main features we want to ascertain within this strand of literature: what is the role of aggregate demand in the explanation of the long term economic stagnation of an economy, and how the novelty constituted by a theoretical equilibrium position featuring a negative natural real interest rate is justified analytically.

2.1 - The 1998 seminal contribution of Paul Krugman about Japan

Krugman, in the writing of the model, was mainly interested in retrieving the Keynesian 'liquidity trap' category from the old – fashioned IS – LM analysis. This is the objective of the first half of the paper, while the second is devoted to applying the conclusions of the model to the Japanese case. In working out such task however, Krugman aims also at updating that tool with three features: an intertemporal structure based on rational expectations, an open economy treatment with foreign trade and capital mobility, the role of financial intermediaries. In what

follows, we are going to deal with the basic formulation of the model.[37] Our interest points mostly to the general initial formulation since in that framework the natural real interest rate is shown to be negative given some specific condition, and the zero lower bound on the nominal interest rate prevents the economy from attaining full employment. As Krugman formulates it, a 'liquidity trap' is

> "a situation in which conventional monetary policy has become impotent, because nominal interest rates are at or near zero: injecting monetary base into the economy has no effect, because base and bonds are viewed by the private sector as perfect substitutes". (Krugman 1998, p. 141)

By coupling this description with the condition about the negativity of the real natural interest rate that we are going to show below, we get the exact same picture described by the intuition of Summers, which depicts the stagnation of the US economy in the same manner. As we have seen, Summers handles the US case proposing a reasoning in which the real natural interest rate turns negative when the demand for investment is peculiarly weak while the supply of savings is high, thereby causing the emergence of an insufficient aggregate demand since the zero lower bound on the nominal interest rate and the low inflations prospects prevent the Central Bank from being able to hit the equilibrium real interest rate. While the analytical point is thus analogous in the contribution of Summers to the seminal one of Krugman set forward back in 1998, the latter author as we said in many occasions praised Summers for the ability to confer to its basic intuitions a more appealing and comprehensive garment. Therefore, in our opinion it is interesting discussing the 1998 model as the first in which a negative real natural interest rate is presented as an impediment to full employment output realization, and to relate it to the recent discussion about Secular Stagnation as the closest predecessor we find in the literature.

Given the very stylized nature of the model we are going to review, it is in our opinion useful starting with a narrative description of the most important messages that Krugman wants to convey to the reader. Then, we are going to follow Krugman in putting those clues in a simple model. The American economist aimed at recreating in a modern intertemporal two periods model a situation of Keynesian flavour in which, given a rigidity on the nominal interest rate

[37] In what follows we are not going to deal with the international and financial dimensions of the problem. As Krugman shows, those refinements do add interesting aspects to the treatment of the issue, but do not modify the overall conclusions: in other words, the gist of the matter rests in the study of the equilibrium position in which the natural real interest rate becomes negative.

determined on the financial market, the real natural interest rate is not attainable by monetary policy.[38] The initial version of the model is built upon these initial hypothesis:

- agents in the model are described by a single representative agent with a given utility function;
- there are two time periods, today and tomorrow. Once tomorrow comes about, the economy remains in the state described by the second period situation. Only the transition between the two periods is described;
- there is no production, as only endowments of a single consumption good are given to the representative agent today and tomorrow;
- the Quantity Theory of Money holds, as the Central Bank can raise the price level by injecting money into the economy;
- there is price flexibility for what concerns the price of the single consumption good available, but there is also a rigidity on the nominal interest rate, which cannot go below zero;
- the price level tomorrow is given.

As said, let us now describe the rationale beneath the model before presenting the equations describing it. Krugman in the first place wants to reproduce analytically a situation in which a liquidity trap emerges. As we will see, by supposing that the endowments of the consumption good are given for the two periods, and given the utility function of the representative agent, he can arrive at the real natural interest rate. When a specific condition upon the amount of endowments available is made, namely that the endowment tomorrow is adequately lower than the one of today, such a natural interest rate becomes negative. Given the zero lower bound on the nominal interest rate, the Central Bank can push the nominal interest rate at most down to zero, but no further; yet the attainment of the equilibrium real rate could be brought about by stimulating inflation. Indeed, even if the nominal interest rate is stuck at zero, raising inflation expectations can succeed in appropriately lowering the real interest value down to the negative natural real interest rate, thus achieving equilibrium.

[38] We are not going to deal with the differences that are recognizable between the new liquidity trap of Krugman and the old versions of Keynes and Hicks; for a treatment of this topic we refer to Taylor (2014), Boianovsky (2004), Kregel (2003).

It is here that the hypothesis about the given price level of tomorrow acquires an important role. Such an hypothesis in fact represents a way to formalize the idea that agents are so convinced about the reliability and willingness of the monetary authority to preserve price stability that they will not believe that the price level tomorrow will be considerably higher than today. Krugman therefore fixes the price level tomorrow and utilizes such an hypothesis as a metaphor for the fact that, even though the Central Bank can today raise prices by boosting money supply, agents believe that such a behaviour will not be kept in the future, and the CB will revert to its conservative approach. This hypothesis comes from the fact that, according to Krugman, entire decades have been spent by monetary authorities in convincing the public that their primary mission would have been keeping inflation low and stable; a single case of necessary monetary expansion will not be sufficient to change their ingrained expectations about the future monetary conduct. Were it not for such an hypothesis, indeed, an appropriate policy on the future money supply would have been sufficient to boost inflation expectations and thus get the negative real natural interest rate, whatever the rigidity on the nominal interest rate.

So far therefore we have described, following the spirit of the Krugman's reasoning, a situation in which, given the utility function of the representative agent, his preferences and the two periods' endowments of a single consumption good we are able to derive the real natural interest rate by means of the Euler equation for intertemporal utility maximization. When the natural real interest rate turns negative monetary policy encounters the obstacle represented by the zero lower bound on the nominal interest rate. The second obstacle, we have just seen, rests in the difficulty to convince agents that the Central Bank will keep on disregarding its traditionally conservative role; hence, even if monetary policy today can be expansionary and exert an influence on prices, it will not be sufficient to shift the expectations about the price level tomorrow. If this were possible, then we would have reached the negative natural real interest rate by just raising inflation expectations, regardless of the zero lower bound on the nominal interest rate. At this point, Krugman argues, the degree of price flexibility becomes crucial: if prices today are fully flexible, then it will be possible to attain the negative real natural interest rate by deflation today. Let us expand on this last point: the Central Bank target is to set a negative real interest rate equal to the negative natural rate, but it cannot do it directly by setting adequately the nominal policy interest rate because of the zero lower bound on it. In addition to this, the price level tomorrow is given, and thus the strategy passing through agents' expectations

is not available as well. Being outside equilibrium, if prices are flexible today, for a given level of prices tomorrow a drop of them today causes inflation expectations to rise. Despite the zero lower bound on the nominal interest rate and the fixed expectation about tomorrow prices, price flexibility today can still ensure the attainment of the negative real natural interest rate.

- *The stylized model of Krugman*

After having described narratively what happens in the economy described by Krugman, let us see the first stylized model.[39] In what follows we have two periods: period 1 (today) and period 2 (tomorrow, variables with asterisk); after period 2 the variables are supposed to remain constant, with the change happening between the two moments in time. Thus, after the transition from the first period to the second, the economy reaches a steady state. In the economy we have that the only consumption good is inelastically supplied, and the representative agent derives his utility from consuming it.[40] The utility function of the representative agent has the following form:

$$U = \frac{1}{1-\rho}\sum c_t^{1-\rho}\,\beta^t \tag{8}$$

where *c* is consumption, ρ the relative risk aversion, β the discount factor; there is, in this first version of the model, no investment.[41] In a steady state position, when endowments and money supply remain constant, we would have the price level and interest rate so defined:

$$P^* = {}^{M^*}\!/_{y^*} \tag{9}$$

$$i^* = {}^{(1-\beta)}\!/_{\beta} \tag{10}$$

[39] Krugman (1998), p. 143, labelled the "Minimalist Model".

[40] The representative agent is subject to a 'cash in advance' constraint. In the text the acquisition of the only available good is described as a 'two-stage process' (cfr. Krugman 1998, pp. 143); in the first one individuals trade cash and one period bonds, while in the second they trade cash for consumption. The aggregate amount of cash, constituting the money supply is exogenously given by the Central Bank. Obviously the amount acquired in the first phase limits the magnitude of attainable consumption. There is also space for government intervention in the form of open market operations and imposition of lump sum taxes, but the author does not explicit models these aspects.

[41] In the original text he uses *D* for the discount factor, but I will hereby retain the usual notation β.

where P^* is the price level tomorrow, M^* the money supply tomorrow, y^* the endowment tomorrow, i^* the real equilibrium interest rate. The price level is set once we have the endowment of the unique consumption good and the money supply delivered exogenously by the Central Bank.[42] The equilibrium real interest rate in equation 10 is pinned down by the discount factor of the representative agent, which means that the term 1+i* equals the ratio of the two periods' marginal utilities.[43] From the initial utility function we are going to arrive at a relationship between the price level today and the nominal interest rate. Such a relationship is derived by obtaining the ratio of the two periods' marginal utilities, and exploiting the Euler equation for intertemporal utility maximization:

$$U = \frac{1}{1-\rho}\sum c_t^{1-\rho}\,\beta^t \rightarrow U_1' = c^{-\rho}, U_2' = \beta(c^*)^{-\rho}$$

$$\frac{U_1'}{U_2'} = \left(\frac{c}{c^*}\right)^{-\rho} = \beta(1+i)\frac{P}{P^*};\; c = y \rightarrow\; 1+i = \frac{P^*}{\beta P}\left(\frac{y^*}{y}\right)^{\rho} \;: CC\ curve \qquad (11)$$

Equation 11 is obtained by firstly employing the Euler equation, thus equating the ratio between the marginal utilities to the product of the discount factor of the representative agent times the gross real interest rate (the gross nominal rate multiplied by the ratio of the price level today and tomorrow), and then by substituting in the ratio between marginal utilities the two amounts of endowments, since as we have said they are wholly consumed (there is indeed no investment). Equation 11 shows, Krugman comments, a simple relation between the nominal interest rate and the price level arising from the intertemporal choice of how to allocate consumption in order to maximize utility for a given level of endowments. It shows such an inverse relation for given future price level, present and future endowments, discount factor. The Central Bank can thus set the desired nominal interest rate by appropriately moving the current price level, which is

[42] In this simplified model the price level is thus arrived at by means of the Quantity Theory of Money, where the velocity of circulation of money is equal to 1, and so the equation takes the form described by Krugman.

[43] Let us notice that in an equilibrium position in which the interest rate is determined only by the discount factor of the representative agent it would not be possible to derive a negative natural real interest rate; indeed, as the beta factors is always supposed to be positive but less than one in order to represent the lower weight attached by individuals to future consumption with respect to present consumption, the equilibrium interest rate cannot but be positive in that formulation.

determined by means of the exogenously given money supply (with given endowment today), in analogy to equation 9:

$$P = \frac{M}{y} : MM\ curve \tag{12}$$

The real natural interest rate of the model is instead obtained without any reference to prices. Reformulating equation 11 in terms of the real interest rate we get:[44]

$$1 + i = \frac{P^*}{\beta P}\left(\frac{y^*}{y}\right)^{\rho} \rightarrow (1 + i)\frac{P}{P^*} = \frac{1}{\beta}\left(\frac{y^*}{y}\right)^{\rho} \rightarrow \ 1 + r = \frac{1}{\beta}\left(\frac{y^*}{y}\right)^{\rho} \tag{13}$$

As we can see, with the subjective discount rate, the relative risk aversion and the two endowments as givens, the real natural interest rate is fully determined. Krugman suggests an interpretation for the latter formula:

> "[…]there is an *equilibrium interest rate*, which the economy will deliver whatever the behaviour of nominal prices. Meanwhile, since the future price level *P** is assumed held fixed, *any rise* in the current level creates *expected deflation*; hence higher *P* means lower *i*." (Krugman 1998, p. 145, italics added)

The suggestion of Krugman can be taken as a description of the natural real interest rate as an equilibrium variable which is set only by real phenomena, in the case under discussion the individual preferences and the amount of endowments, which can serve as a metaphor for production. Thus, the behaviour of prices is immaterial to the determination of the natural real interest rate, while it is relevant when determining the nominal interest rate, as seen before (though, only the current price level variations can have an impact, since the future price level is assumed fixed by expectations). Therefore, with a given real interest rate, if the inflation rate is expected to drop when the price level today rises, for a given price level tomorrow the nominal

[44] One can show that the term to the LHS is indeed a real interest rate (where π is the inflation rate):

$$1 + r = (1 + i)\frac{P}{P^*} \quad and \quad 1 + r = \frac{1 + i}{1 + \pi} \quad iff \quad \frac{1}{1 + \pi} = \frac{P}{P^*} \rightarrow 1 + \pi = \frac{P^*}{P} \rightarrow \pi = \frac{P}{P^*} - 1$$

rate drops as well to maintain the predetermined level of the real rate (and vice versa). Krugman depicts also graphically equations 5 and 6:[45]

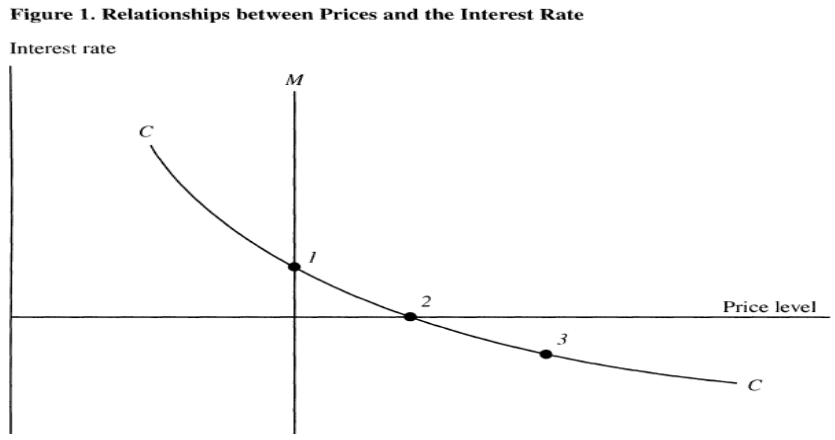

Figure 7 – The minimalist model, Krugman (1998), p. 145.

In the graph it is recognisable the above mentioned inverse relation between the price level and the nominal interest rate. In normal times, with a positive natural real interest rate the policy maker intervention can move the nominal interest rate along the CC line with the only constraint being set by the zero lower bound, which is placed on point 2 in the graph. The movement along the CC is guided exploiting the MM equation: by exogenously controlling the money supply the Central Bank can fix the price level today, and by this means it can also set the nominal interest rate through the inverse relation between these latter two variables described by the CC curve. Yet, Point 3 would be out of reach due to the fact that with a negative nominal interest rate, Krugman states, "[…] money would then dominate bonds as an asset"; therefore, at the zero lower bound bonds and money become perfect substitutes, and agents do not have any incentive to acquire bonds with the additional money provided by the Central Bank.[46, 47, 48]

[45] In the original text, the direct relation between money supply and price level today (equation 12) is called MM, while the inverse relation between the price level and the nominal interest rate (equation 11) is called CC.

[46] Krugman (1998), p. 146.

[47] As explicitly posited by Krugman, in any case the zero interest rate situation characterizes only one period bonds, whereas longer term ones are still yielding a positive rate. It may be said, though, that the interest rate relevant for investment decisions ought to be the long-term one, which is compared by entrepreneurs with the expected profitability of their project, when one tries to apply the insights provided in the article to a real world situation. The close attention to the short-term rate can thus be understood

The question then is: why the Central Bank should target a negative nominal interest rate, such as the one placed at point 3 in the graph? In order to answer this question, Krugman argues that indeed the model can well feature a natural real interest rate that is negative. The policy maker would thus try to reach equilibrium by moving the nominal interest rate into the negative territory, and in so doing it would eventually hit the zero lower bound. As mentioned, at that point the MM curve would lose its power to push the price level above its maximum attainable, since any additional amount of money exogenously supplied would just be substituted for bonds. But then, how would it be possible for the system to be characterized by a *negative equilibrium real interest rate*? Krugman overtly answers by saying that it would be the case for a negative rate "[…]*if the marginal utility of consumption in period two is greater than that in period one, which will be the case if the economy's future output is expected to be sufficiently less than its current output*." Analytically this is translated into the following condition[49]

$$\left(\frac{y^*}{y}\right)^{\rho} < \beta \tag{14}$$

Let us first show how this condition is arrived at, and then recall the general framework within which Krugman can arrive at its proposition about the negative value for the natural real interest rate. Equation 13 showed how the natural real interest rate is obtained in the model formulated by Krugman; from it, just imposing the negativity condition directly leads to equation 14:

$$1 + r = \frac{1}{\beta}\left(\frac{y^*}{y}\right)^{\rho} \rightarrow r = \frac{1}{\beta}\left(\frac{y^*}{y}\right)^{\rho} - 1 < 0 \rightarrow \left(\frac{y^*}{y}\right)^{\rho} < \beta$$

We have that, in order to get a negative natural real interest rate, we need that for given risk aversion and discount factor parameters, the level of endowment tomorrow has to be sufficiently

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only when a strict relation between the short and long term rates is warranted, i.e. a well-behaved and fixed interest rates' structure.

[48] Given the zero lower bound on the nominal interest rate, Krugman argues, there would be a minimum rate of inflation and a maximum rate of deflation attainable. This is due to the fact that once the zero lower bound becomes active, there is no possibility anymore for the monetary authority to control the price level, which in correspondence with the zero lower bound has attained its maximum level. For a given future price level, this set the minimum rate of inflation, or maximum rate of deflation that the economy can deliver.

[49] Krugman (1998), p. 147, italics added.

less than the endowment today.[50] Since the natural real interest rate is set by employing the Euler condition for intertemporal utility maximization, if tomorrow there is a lower quantity of consumption good, the marginal utility of consuming it will be higher tomorrow than today. The fact that the representative agent would thus prefer at the margin to consume tomorrow rather than today will render negative the equilibrium interest rate.

At this point we hence have that the natural real interest rate is supposedly negative, because the endowment tomorrow is sufficiently less than the endowment today. The policymaker recognizes the necessity to bring about in the economy a real interest rate equal to the equilibrium one, and tries to push the price level up by injecting money into the economy. Once the nominal interest rate hits the zero lower bound money and bonds becomes perfect substitutes, and thus the additional money injected is no more effective in raising the price level. At this point, Krugman argues, given the inability of monetary authority to hit the negative natural real interest rate, the flexibility of prices still ensures the attainment of equilibrium. Indeed, the author argues, an adequate drop in the price level today, for a given price level tomorrow, creates expectations of inflation and thus even with a zero nominal interest rate it is possible to get the equilibrium real interest rate. In the words of the author:

> "[…]the economy deflates now in order to provide inflation later. That is, if the current money supply is so large compared with the future supply that the nominal rate is zero, but the real rate needs to be negative, P falls below P*; the public then expects the price level to rise, which provides the necessary negative real interest rate. And to repeat, this fall in the price level occurs regardless of the current money supply, because any excess money will simply be hoarded, rather than added to spending." (Krugman P., 1998, pp. 147 – 148)

So far the model proposed by Krugman appears rather orthodox in his treatment of the possibility of the materialization of a liquidity trap: the real natural interest rate is determined by the preferences of the individual representative agent and the given endowments of a single consumption good. The solution of an intertemporal utility maximization problem delivers the equilibrium real interest rate. Monetary factors enter the picture only as a side element, which do not exert any influence on the evolution of output (which is equal to consumption) or the determination of the equilibrium real interest rate; the Quantity Theory of Money holds within

[50] The discount factor beta is positive but lower than one, and thus the amount of endowments tomorrow has to be not only strictly lower, but sufficiently less than the amount today in order to let the real natural rate of interest be negative.

the model. The novelty introduced by Krugman in the discussion thus rests fundamentally in two elements: the discussion of the possibility for the natural real interest rate to turn negative, and the consequence brought about by the presence of a rigidity on the nominal interest rate. Yet, with flexible prices the economy can still get the equilibrium position.

- *The model with price rigidity*

The extension of the model discussed so far implicates the introduction of a rigidity on the current price level, which is in the section '*The Hicksian Liquidity Trap'* (pp. 148 – 150) assumed fixed, on the same footing as the future price level. In this version we find some other novel feature: there is now a maximum capacity output y^f in period one, while in period two output is still given by y^*. It is important now to be very cautious when we deal with this 'capacity output'; it is difficult, in general, not to imagine that together with a concept involving a maximum level of output there will be the introduction of investment, capital and so on. Yet, the capacity output that Krugman mentions does not have anything to do with these other concepts. Indeed, as we are going to see below, investment will be treated by Krugman only in the following section. Thus, again here output is only constituted by consumption of the single good available which is now not given by endowments, but produced. Again, the Euler equation for intertemporal utility maximization is exploited to get a relation analogous to that of equation 11, but this time the inverse relation is stated to exist between consumption (and thus output, since there is no investment) and the nominal interest rate; therefore, consumption responds to interest rate variations by the standard intertemporal substitution between consumption today and consumption tomorrow.[51] Such a relation takes up the label of an "IS curve determining real output",[52] since a lower nominal interest rate boosts consumption today, and hence output today. Let us have a look at the IS version of the CC curve written down by Krugman:

[51] Assuming a well-behaved intertemporal substitution mechanism, in which income effects are ruled out, a higher interest rate curbs consumption today since it provides an incentive to postpone consumption until tomorrow.

[52] Cfr. Krugman 1998, p. 148. Let us notice how the formulation of an IS does not require, according to Krugman, any consideration about the demand for investment and the supply of savings. On the contrary, the IS is obtained when only the amounts of consumption are given. Therefore, at the aggregate level given the two predetermined amounts of consumption and the discount factor, the real interest rate adjusts to reach intertemporal equilibrium.

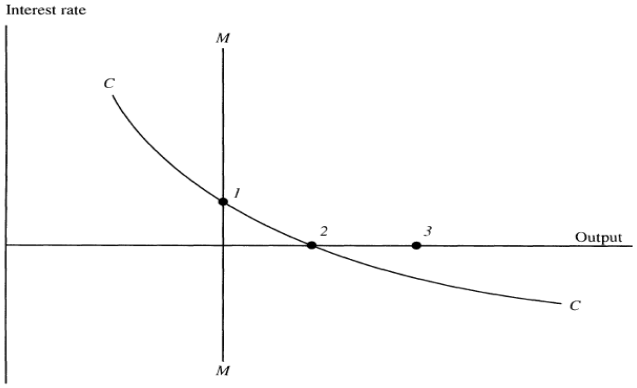
$$CC: c = y = y^* \left(\frac{P^*}{\beta P}\right)^{1/\rho} (1+i)^{-1/\rho} \qquad (15)$$

In it we thus find that for a given price level tomorrow, price level today, relative risk aversion, discount factor, output tomorrow, there is an inverse relationship between the nominal interest rate and the amount of consumption today, which is equal to total output today. As before, we also have a MM curve relating this time the supply of money to the output today, since now we have a level of prices today that is given by the hypothesis of rigid price for period 1:

$$MM: \ y = \frac{M}{p} \qquad (16)$$

A higher supply of money can thus now stimulate consumption for a given output price: additional money provided to the public will foster the representative agent consumption. Krugman shows a graph analogous to that of figure 7, but this time the relationship described is between output and the interest rate:

Figure 8 - Relationship between output and nominal interest rate; source Krugman (1998), p. 149



We can notice how the causal chain envisaged by Krugman starts from a decision of the Central Bank to boost output today; it can achieve such a target by supplying more money into the economy. Given the MM curve, for a given level of prices today output increases, and the MM is shifted to the right. The intersection with the CC curve delivers now the nominal interest rate, which within the Euler condition, given the rate of inflation (both price levels, today and tomorrow, are given), ensures that intertemporal utility maximization is satisfied. The mechanism relating the supply of money to the nominal interest rate in this stylized financial market is the

following: a higher money supply causes the nominal rate to decrease, but the latter is a variable that, rather than stimulating consumption by decreasing after the Central Bank intervention on the supply of money, adjusts to ensure equilibrium once output has already been boosted by the monetary authority operation.

Given the downward sloping CC based only on consumption demand, and the MM curve, we see in the graph how output may be brought up until point 2. What happens when the maximum productive capacity is placed at point 3? Following Krugman, full employment output[53] would be out of reach. The reason, according to him, remains basically unchanged with respect to what we have been seeing before: the zero lower bound on the nominal interest rate prevents the attainment of equilibrium. In his words:

> "since the nominal interest rate cannot become negative, any increase in money beyond the level that drives the rate to zero will simply be substituted for bonds, with no effect on spending. And therefore no open market operation, however large, can get the economy to full employment. In short, the economy is in a classic Hicksian liquidity trap." (Krugman 1998, p. 149)

The equilibrium real interest rate in this case, even if Krugman does not show it, can be negative when

$$1 + r = \frac{1}{\beta}\left(\frac{y^*}{y^f}\right)^{\rho} \rightarrow r = \frac{1}{\beta}\left(\frac{y^*}{y^f}\right)^{\rho} - 1 < 0 \rightarrow \left(\frac{y^*}{y^f}\right)^{\rho} < \beta \quad (17)$$

Krugman describes this condition by saying that

> "[…]even if prices are expected to be stable, y^f is high compared with the future – or, equivalently, people's expected future real income is low compared with the amount of consumption needed to use today's capacity. In that case, it may take a negative real interest rate to persuade people to spend enough now, and with downwardly inflexible prices that may not be possible." (Krugman 1998, pp. 149 – 150)

Thus, the reasoning remains close to what we have seen in the case with given endowments and a flexible price level today: if output tomorrow is sufficiently lower than capacity output today, equilibrium requires a negative natural real interest rate. This time, and here we have the relevant

[53] Let us again recall that 'full employment' is an hazy concept within this model. Indeed, there is no formalization of investment, accumulation of capital, labour market etc. The model serves as a metaphor which only provides some intuition upon the main elements Krugman wants to show. Then, the fact that the maximum capacity output cannot be reached in some particular case ought to demonstrate that in reality there may be cases in which an economy gets stuck below full employment.

difference with respect to what happened in the flexible price environment, the rigidity on the price level today prevents the economy from hitting the negative real natural interest rate by having deflation today. In the previous instance such a deflation, taking as given the price level tomorrow, would have made the agents revise inflation expectations upward, thereby generating an expectation of inflation that would have brought about the negative real interest rate required by equilibrium, despite the presence of the zero lower bound on the nominal interest rate. The consequence of the hypothesis inserting a rigidity on the price level today is thus that the inflation rate is now given: we have both the price level of today, and the one of tomorrow. Besides, there still is a rigidity on the nominal interest rate given the fact that bonds and money at the zero lower bound are perfect substitutes. As a result, when the real natural interest rate is negative the economy can be in a situation in which monetary policy is ineffective due to the zero lower bound, and inflation expectations cannot be revised. Hence, the economy may find itself stuck in a position in which it is not possible to stimulate consumption up to its capacity level. This should represent, in the idea of Krugman, a concrete real world situation in which the presence of a negative natural interest rate that is not attainable by conventional policies gives rise to underutilization of productive capacity and unemployment.

- *A comparison between the two models and the policy prescription*

Once we have presented the two versions of the model, after the initial general introduction of what he aimed to describe, and a discussion of the logical processes involved in the development of the argument, it seems useful now to recall their general structure only in terms of equations. This can make us understand how, despite the shift in some givens, the structure of the two models remains the same. The two versions of the full model are described by the following set of equations

$$Natural\ real\ interest\ rate: 1 + r = \frac{1}{\beta}\left({y^*}/{y}\right)^{\rho} \tag{18}$$

The natural real interest rate is given by equation 18, and is arrived at once the preferences of the representative agent are given, and when the two periods' endowments of a single consumption good are given in the initial case, or the two periods' capacity outputs are given in the second

example. When the endowment or capacity output are sufficiently lower tomorrow than their respective counterpart today, the natural real interest rate becomes negative.

$$Nominal\ interest\ rate: 1 + i = \frac{P^*}{\beta P}\left({y^*}/{y}\right)^{\rho}, subject\ to\ i \geq 0 \quad (19)$$

Equation 19 comes from the intertemporal utility maximization problem of the representative agent solved by means of the Euler equation, and differs from equation 18 only because it explicitly differentiates between the nominal interest rate component and the inflation rate component of the real interest rate involved in the Euler equation. Since in the first model the price level tomorrow is given, Krugman formalizes an inverse relation between the price level today and the nominal interest rate. In the second case, since we have as a given the price level today, the inverse relation is between the nominal interest rate and current consumption, which is not anymore determined by a given endowment. In both cases we have a zero lower bound on the nominal interest rate.

$$Price\ level\ today: P = \frac{M}{y} \quad (20) \qquad Price\ level\ tomorrow: P^* = \frac{M^*}{y^*} \quad (21)$$

Equations 20 and 21 determine the price levels of the two periods; while the second period price level in both instances is set by the given output and money supply, the first period price level is exogenously controlled by the Central Bank exploiting a simple Quantity Theory of Money in the basic model, and is given by hypothesis in the second model, thereby letting the quantity of money directly exerting a positive influence on the level of consumption today.

$$Fisher\ Equation: r = i - \pi^e \quad (22) \qquad Expected\ inflation: \pi^e = \left(\frac{P^* - P}{P}\right) \quad (23)$$

Equations 22 and 23 simply describe the real market interest rate determination once the nominal interest rate and the price levels are obtained. In the first model, the Central Bank by supplying money into the economy can on the one hand boost the price level today, and for a given price level tomorrow can thus control inflation expectations; on the other hand it can move the nominal interest rate by exploiting the inverse relation between the latter and the price level today. In the second model since the inflation expectations are given, the Central Bank can only move the nominal interest rate, with the constraint given by the zero lower bound.

Now that we have seen how Krugman has framed the issue of the Japanese case in which allegedly the economy has found itself stuck into a liquidity trap, we can mention also which would be, according to the author, the best solution to address it. The Krugman's version of the liquidity trap basically involves a credibility problem regarding the future price level, which is supposed given and fixed since agents strongly believe that the Central bank will follow a conservative price stability rule, despite the possible expansive policy today. Given this belief, the model is developed reasoning always in terms of a fixed price level tomorrow. Once the economy is stuck into a liquidity trap due to the emergence of a negative natural interest rate and the presence of a zero lower bound on the nominal interest rate, with a given price level tomorrow there are two cases: either price flexibility today ensures the attainment of equilibrium, or a price rigidity today prevents it. The hypothesis of price rigidity today is introduced to explain the impossibility to arrive at the negative natural real interest rate by means of a deflation today, and to show the point that Krguman wants to convey: without the needed price flexibility today, the only way to overcome the problem for monetary policy constituted by the zero lower bound is to try in any manner to remove the belief ingrained into the agents' minds about the future behaviour of the monetary authority. In other words, it is necessary to convince the public that the Central Bank will not stick to its long lasting commitment to ensure a low and stable inflation rate; from here it comes the famous policy prescription: "the Central Bank must promise to be credibly irresponsible". By freeing the future price level from being fixed, it becomes an instrument of monetary policy, which could therefore bring about the necessary inflation rate needed to get the value of the natural real interest rate despite the presence of the zero lower bound on the nominal interest rate. The ultimate issue causing a liquidity trap would thus be, according to Krugman, a credibility problem concerning the actions of the Central Bank, which has in that particular case the duty to reverse the traditional commitment to price stability in the long term.

- *A negative rate of return on investment*

At this point we can follow Krugman into another step, which is treating investment in real capital within this framework of analysis. In the section devoted to the analysis of investment (cfr. pp. 150 – 151) Krugman dwells upon the meaning of a *negative* equilibrium interest rate in

an economy with productive investment. As soon as the paragraph begins, Krugman in fact writes:

> "One way of stating the liquidity trap problem is to say that it occurs when the equilibrium real interest rate - the rate at which saving and investment would be equal at potential output - is negative. An immediate question is how this can happen in an economy in which, in contrast with the simple endowment economy described above, productive investment can take place and the marginal product of capital, while it can be low, can hardly be negative." (Krugman 1998, p. 150)

It seems thus that as soon as we abandon the determination of the natural real interest rate by means of only a Euler equation for intertemporal utility maximization, we are shoved back to the very same issue we had been discussing in the first chapter while reviewing the position of Summers. Hence, the problem of maintaining that the natural real interest rate can turn negative in a world in which capital and investment have a place resurfaces. Krugman promptly recognizes the issue, and briefly provides two possible answers:

- a sufficiently high 'equity premium' may permit the existence of positive return on real capital while leaving the interest rate in a negative zone. Unfortunately the mention to such a solution to the problem is given by only mentioning the presence of an equity premium. Yet, what Krugman has in mind can perhaps be framed in the following way: in a real world environment in which there is a premium to reward risk-bearing, a positive marginal product of capital, and thus in a neoclassical conception a positive profit rate can coexist with a negative natural interest rate, the spread between the two being given by that premium for risk;[54]

- the second solution relies on the analysis of the rate of return of an investment. The rate of return, Krugman argues, is made up of two elements: the marginal product of capital and the expected rate of change of its price. Indeed, the 'expected rate of return' on an investment decision is so defined:

$$1 + r_t = \frac{R_{t+1} + q_{t+1}}{q_t} \tag{24}$$

[54] Although being mentioned, this factor is not treated by Krugman, who rapidly moves to the second point. We are not going to discuss it; the discussion on how riskiness can enter the picture will be developed in the third chapter of the thesis.

where R_{t+1} is the marginal product of the asset, while q_t, q_{t+1} are the prices today and tomorrow of the asset on which the investment has been undertaken. In the presentation of the example proposed Krugman states that "This point is easiest to make if one considers an economy with not capital but land (which can serve as a sort of metaphor for durable capital)". The author employs an overlapping generation framework with only two generations; in it, by assumption, the young cohort work without consuming. The whole product obtained from cultivating is invested in land bought from the elders. Under these hypothesis, the price of land q in terms of the product obtained is arrived at as

$$q_t A_t = w_t L_t \rightarrow \ q_t = \frac{w_t L_t}{A_t} \tag{25}$$

where we have A_t the stock of land, w_t the marginal product of labour, L_t the labour force. The driver of the decline in the price of land would be, Krugman envisages, a decline in labour force; it is in other words determined by a demographic factor. Under the further assumption of an elastic demand for labour, a decline in population will make the price of land tomorrow in terms of products obtained cultivating it drop.[55] Therefore, even if the marginal product of land is positive, by considering the overall rate of return, the latter turns negative when a capital loss obtains because the price drop of the asset more than outweighs its marginal productivity. Thus, as the author says, "[…]the expected return from investing in land can, in principle, be negative". The condition for the negativity of the rate of return on investing in land, that Krugman does not show, would be

$$r_t = \frac{R_{t+1} + q_{t+1}}{q_t} - 1 < 0 \rightarrow \ q_t - q_{t+1} > R_{t+1} \tag{26}$$

And it displays how, as said, in order to get a negative overall return the rate of price decrease ought to more than outweigh the positive marginal product of land. We have at this point seen how the author contends to have found an intuition to sustain the possibility of the emergence of a negative natural real interest rate even in an economy with investment.

[55] As we will see below, the condition ensuring that the price level tomorrow will drop by a sufficient amount rests in the elasticity of the demand curve for labour.

2.2. - Critical considerations

Let us now, in order to start the present section, recall the overall reasoning developed by Krugman, but only by discussing the economic meaning of what he wants to convey by means of his simplified model. All the formal treatment of the issue has been presented before, and we can now only focus on what is the gist of the argument. Krugman proposed in 1998 an explanation for the considerably lengthy Japan stagnation built up upon the idea of retrieving the insight of Keynes about the possibility for an economy to get stuck into a liquidity trap. The basic intuition for his renewed version of the liquidity trap is that there may be situations in which the real natural interest rate becomes negative, and the existence of a zero lower bound on the nominal interest rate prevents monetary policy from being effective: when the zero lower bound is active, and inflation expectations are not sufficient to lower the market interest rate towards the natural real interest value, an economy can find itself in a disequilibrium condition. The natural real interest rate becomes negative, in a framework without investment but only consumption, when the maximum amount of consumption tomorrow is sufficiently less that then maximum amount of consumption today. In a Euler equation for intertemporal utility maximization, once we have the preferences of the representative agent and the amount of consumption today and tomorrow, the equilibrium real interest rate adjusts in order to ensure an optimality situation for the ratio of the two periods marginal utilities. As we have seen, the total amount of available consumption can be given either in terms of endowments distributed today and tomorrow, which was our base case, or in terms of a given productive capacity, as in the second instance.

When the natural real interest rate turns negative, monetary policy could in principle target a negative nominal rate in order to bring about a market real interest rate equal to the natural determined by intertemporal consumption maximization. The zero lower bound on the nominal interest rate at this point becomes crucial. Since on the money market there is the possibility to choose between keeping money or investing in a bond, at the zero lower bound the two alternatives become perfect substitutes and then monetary policy loses its effectiveness. At this point, since the nominal interest rate is constrained to be non-negative, the disequilibrium situation in which the real market interest rate cannot fall by the necessary degree to meet the natural real interest rate can be solved in two manners. If prices today are flexible the economy can be lifted to the equilibrium by a drop in the price level today. Such a drop, for a given price

level tomorrow, pushes up inflation expectations of the agents, thereby giving rise to the inflation needed to lower the real interest rate down to the level of the natural real interest rate even if the nominal interest rate is stuck at the zero lower bound. When an assumption about the presence of a rigidity on the current price level is made, the fact that the inflation rate is given once for all (both the current and the future price level are fixed) coupled with the zero lower bound prevents the attainment of the natural real interest rate.

The next step that Krugman entertains is assessing whether the introduction of investment and capital within the model significantly alters the conclusions he had reached so far. He works out the treatment of investment by constructing a stylized example in which land is utilized as the only non-producible asset present in the economy, and its price is determined in terms of the output obtainable by cultivating it. The rate of return on investing in this asset is decomposed in two parts: the marginal productivity of the asset and the rate of variation of its price. Given the positive marginal productivity of the asset land, a negative rate of return on investing in it can come about when its price sufficiently drops tomorrow with respect to today. This occurs when population tomorrow decreases by a sufficient magnitude, causing also the price level tomorrow of land to drop, thus making the overall rate of return on the asset negative, since the capital loss ensuing from the price decrease more than outweigh the positive marginal productivity of the factor. According to Krugman therefore, a full model in which the natural real interest rate can become negative even in presence of investment has been formalized. There are some points to be in our opinion highlighted in the model set forward by Krugman as not convincing.

- *The difference between the flexible price model and the fixed price model*

In the first place, let us question the validity of the logical step in which the author passes from the flexible price model with only endowments to the version in which there is a price rigidity. Krugman tells us that when the natural real interest rate is negative and monetary policy is constrained by the zero lower bound on the nominal interest rate, yet an equilibrium is attainable when there is price flexibility. When, in the following step, a price rigidity today is introduced, then equilibrium may not be reached, in so leaving an amount of consumption capacity today not exploited. We are now going to illustrate the 1998 model by means of a simple numerical example for the sake of seeing whether the general meaning of the Krugmanian models without

investment fits into the formalization he proposes.[56] Utilizing the equations 18 to 23 we get the general structure of the models with and without price rigidity. In the model with price flexibility, the givens were the endowments tomorrow and today, the discount factor, the relative risk aversion of the representative agent, the money supply and price level of tomorrow. We thus assign to those elements the following vector of values: (y^*; y; β; ρ; P^*; M^*) = (95; 100; 1; 1; 150; 14250).[57] We can now arrive at the natural real interest rate, which is set once we have the representative agent's preferences and the two endowments:

$$r = \frac{y^*}{\beta y} - 1 = \frac{95}{100} - 1 = -0{,}05 = -5\% \tag{27}$$

We see how the latter variable is negative, since we have imposed an endowment for tomorrow which is sufficiently lower than the one of today, as equation 7 above showed. By utilizing the equations for the nominal interest rate, the market real interest rate, the money supply and price level today, the expected inflation rate, we get the solutions entailed by the values we have given to the variables of the models

$$\begin{cases} i = \dfrac{y^* P^*}{\beta y P} - 1 = \dfrac{95 * 150}{100 * P} - 1 \\ r = i - \pi^e \rightarrow -0{,}05 = i - (\dfrac{150}{P} - 1) \\ \mathrm{M} = \mathrm{P} * 100 \\ \pi^e = \left(\dfrac{150 - P}{P}\right) \end{cases} \tag{28}$$

We get the following vector of solutions *(i; r; P; M;* π^e*)* = (0; -0,05; 142,5; 14250; 0,05). We have thus fully described one solution for the model of Krugman with price flexibility. We have chosen the vector of initial values for the givens to start with the precise intent to get a negative real natural interest, and a zero valued nominal interest rate. Since the nominal rate of interest is zero, the price level today we have found is the maximum price level attainable. Inflation expectations are of the same magnitude of the real natural interest rate but with the sign changed:

[56] None of them modifies anyhow the model; we just give some parameter to better get acquainted with the possible outcomes.

[57] In the first example all the relevant passages will be illustrated, then we will directly provide the outcomes. Let us notice that for simplicity we have set both β and ρ to 1 in order to simplify calculations.

this is not surprising since at a zero nominal interest rate inflation expectations have to be equal in absolute value to the real natural interest rate.

Recalling the full system of equations described by equations 18 to 23 we can now, step by step, reduce the model to the narrowest form possible, by means of simple substitutions. Equation 18 and 23 can be directly plugged into equation 22. In other words, we are inserting into the Fisher equation the given natural real interest rate and the expected inflation. We get

$$r = i - \left(\frac{P^* - P}{P}\right) \tag{29}$$

Then, since both the money supply and endowments tomorrow are given, the price level tomorrow in equation 21 can be just taken and inserted in equation 19 for the nominal interest rate. We do the same for equation 20 describing the price level today: we plug it in equation 19 for the nominal interest rate. We obtain

$$1 + i = \frac{P^*}{\beta \frac{M}{y}} \left(\frac{y^*}{y}\right)^{\rho} \rightarrow i = \frac{P^*}{\beta M} y^{*\rho} y^{1-\rho} \tag{30}$$

In equation 29 we simply have the Fisher equation for the real interest rate in which the natural real interest rate is given because we have all the elements needed to calculate it (preferences and endowments), and the price level tomorrow is given. Equation 30 differs only because the price today does not appear since it has been replace by the money supply today. Yet, equation 29 and 30 are equivalent; in equation 30 we have both the givens necessary to get the natural real interest rate, and the inverse relation between the nominal interest rate and the price level today (which, again, is only obscured by the substitution undertaken). Therefore, we seem to be left with only one necessary equation, in which we have that once we know the price level today to be set by the Central Bank through money supply we get the nominal interest rate. But having one equation with two unknowns means that the system does not have a single solution; rather, there is a continuum of solutions to get the natural real interest rate.

A simple excel simulation comes in handy to show the point. We have built an example of the continuum of solutions that are valid for our problem:

Real int.rate	Nominal int.rate	Price today	Money supply today	Rate inflation	Fisher real rate
-0,05	-0,00279916	142,9	14290	0,049685094	-0,052484255
-0,05	-0,00210084	142,8	14280	0,050420168	-0,052521008
-0,05	-0,001401542	142,7	14270	0,051156272	-0,052557814
-0,05	-0,000701262	142,6	14260	0,051893408	-0,05259467
-0,05	0	142,5	14250	0,052631579	-0,052631579
-0,05	0,000702247	142,4	14240	0,053370787	-0,052668539
-0,05	0,001405481	142,3	14230	0,054111033	-0,052705552
-0,05	0,002109705	142,2	14220	0,054852321	-0,052742616
-0,05	0,002814919	142,1	14210	0,055594652	-0,052779733
-0,05	0,003521127	142	14200	0,056338028	-0,052816901
-0,05	0,00422833	141,9	14190	0,057082452	-0,052854123
-0,05	0,00493653	141,8	14180	0,057827927	-0,052891396
-0,05	0,00564573	141,7	14170	0,058574453	-0,052928723
-0,05	0,006355932	141,6	14160	0,059322034	-0,052966102
-0,05	0,007067138	141,5	14150	0,060070671	-0,053003534
-0,05	0,007779349	141,4	14140	0,060820368	-0,053041018
-0,05	0,008492569	141,3	14130	0,061571125	-0,053078556
-0,05	0,009206799	141,2	14120	0,062322946	-0,053116147
-0,05	0,009922041	141,1	14110	0,063075833	-0,053153792
-0,05	0,010638298	141	14100	0,063829787	-0,053191489
…	…	…	…	…	…
…	…	…	…	…	…

We are therefore simulating the behaviour of the main variables involved in the description of the flexible price model. Each column shows the variables which are liable to change, within equation 30, when we move the money supply. For a given natural real interest rate shown in the first column, a higher money supply lowers the nominal interest rate until zero and possibly even further down. From the model setup we know that the solutions involving a negative nominal interest rate are not acceptable, and therefore we can neglect them. Still, there are the solutions entailing a positive nominal interest rate which are valid (in yellow we have highlighted the vector of values for the solution we have shown before in the numerical example). The Fisher equation in the last column checks that, neglecting a small approximation,[58] the real interest rate obtained with the vector of values found coincides with the given natural real interest rate.

[58] Let us notice that while the first real rate is fixed once and for all by the given parameters, the one resulting from the Fisher equation suffers from the approximation. As expected, once the departure from the initial small values of the nominal interest rate and the inflation rate is considerable, the real rate tends

Given the degree of freedom represented by the money supply exogenously set by the Central Bank, we can see how there is no need to worry about the zero lower bound when the natural real interest rate is negative. Indeed, it seems that a negative natural rate can be reached with a zero nominal rate and an inflation rate equal in absolute value to the natural rate, but also with a positive nominal interest rate and a higher inflation rate. This amount to saying that, with one degree of freedom, any intersection occurring in the positive region between what in figure 7 above were the CC and MM curves may be a solution. Indeed, given the inverse relation between the nominal interest rate and the price level, when the former rises the latter decreases (and viceversa); for a given price level tomorrow, the inflation rate therefore rises. Thus, along the positive part of the CC curve, however the Central Bank modifies the money supply, the intersection with the MM curve delivers a value for the price level and the nominal interest rate that is an equilibrium solution. On the contrary, when in the second version of the model there is the introduction of a rigidity on the price level today, there is for the system a single definite solution. Thus, when such a solution lies in a region which is not achievable by the operation of the monetary authority, then we can conclude that we cannot reach the equilibrium solution.

This example worked out by means of a small numerical simulation serves to show that, even when we concede to Krugman the validity of every proposition he has made in order to get to his results, the description of his model in the terms he has used does not seem to entirely fit within the model. The author, in fact, tells us that when the natural real interest rate is negative and there is a zero lower bound, then price flexibility can ensure that the disequilibrium situation caused by the ineffectiveness of monetary policy once the nominal interest has become nil will be fixed by a deflation today. When, in the case of price rigidity instead, such a deflation cannot occur, the system will remain stuck into a liquidity trap. If our view about how the model works is correct, instead, in the flexible price environment there is no need to deflate today in order to get the equilibrium; actually, there is no need either to hit the zero lower bound. The Central Bank can directly supply the amount of money that it deems necessary for the sake of getting the pair of price level today and nominal interest rate that would ensure the attainment of the natural real interest rate. Each pair along the CC curve would be a solution, and the model does not seem to need deflation to reach equilibrium.

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to diverge more and more from the fixed one. In the simulation we show the values up to a 2% nominal interest rate.

- *The role of aggregate demand in the demand side Secular Stagnation theory*

We have seen how Krugman gauges the shrinking of the Japanese population as the main cause for the materialization of a negative natural real rate of interest. The decrease in endowments in the first model, the decrease of capacity consumption in the version with sticky prices and the decrease of population in the example with land all point to the same meaning for the metaphor that the author wants to convey. The message is actually that a decrease of the population casts shadows on the future evolution of the potential output of the economy. Even though it is an extremely stylized model, the assumption of Krugman about population decrease seems to be quite demanding because we are not speaking of a slower growth rate, but of an absolute value drop. Nevertheless, in the case of Japan the hypothesis seems not so distant from reality, rather the contrary, as we can see from the actual data for the Japanese working age population growth rates of the last decades:

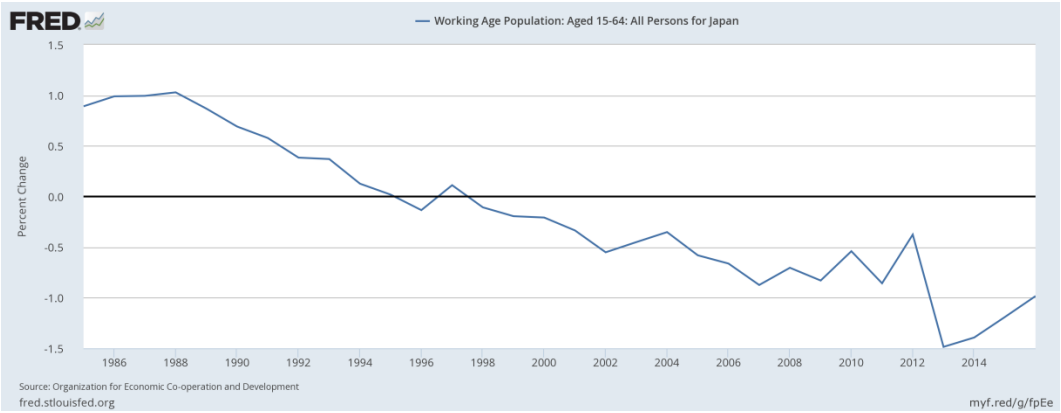

Figure 9 – Working age Japanese population pattern (age 15 – 65, years 1985 – 2015, source: FRED database)

The FRED dataset shows how the working age Japanese population has been shrinking since the middle ‘90s. Therefore, the concern of Krugman does not seem to have been groundless. The general opinion of Krugman about the determinants of the long term evolution of potential output in an economy, at least in this discussion, appears to be strongly in favour of seeing population as the main driver of growth. Indeed, forecasts about the population’s foreseeable trend made Krugman suppose that the natural real interest rate would have turned negative, making the Bank

of Japan impotent because of the zero lower bound on the nominal rate of interest. There are two main problems, though, about the preoccupation of the author.

First of all, even if one is willing to employ a neoclassical growth model in its simplest form, as the model of Solow,[59] to study the Japanese case, yet there is at least another factor to be considered along with population growth, i.e. the evolution of technical progress. Let us suppose, for the sake of discussing the point, that the neoclassical Solow growth model holds. We can thus think about the evolution of the potential output of an economy as driven by exogenous population growth and exogenous technical change. This means that even if population decreases, there is at least another factor to be evaluated when forecasting the future growth of the economy; a downsize in population can be compatible with a growing potential product if there is technological improvement. Having a glance at some data about potential GDP growth for Japan confirms that the latter has been growing for the decade after the Japanese stagnation: [60]

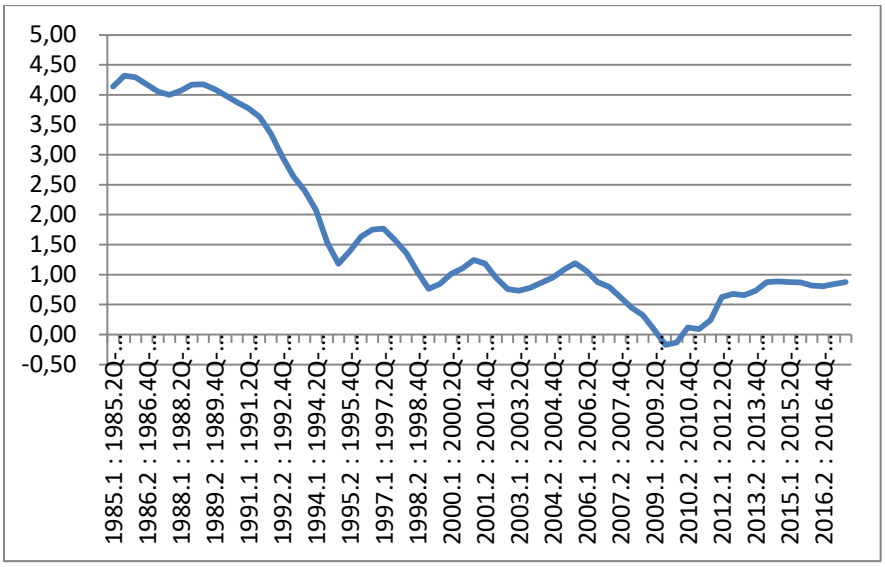

Figure 10 – Japanese potential output semi-annual growth rate estimate (1985 – 2016) (source: Bank of Japan).

[59] Cfr. Solow (1956).

[60] Data taken from the Bank of Japan website, which refers to the study of Kawamoto et al. "Methodology for Estimating Output Gap and Potential Growth Rate: An Update," Bank of Japan Research Paper, May 2017. The series shown is the semi-annual percentage change of the potential output estimate for the Japanese economy obtained by means of a Cobb – Douglas aggregate production function and calculated as the contribution to growth provided by the growth rate of the availability of capital and labour, and the growth rate of the total factor productivity.

Potential output growth exhibits an increasing pattern that tends to empirical disprove the theoretical apparatus of Krugman. Despite slow and even negative population growth rates, potential output has been growing all along the period taken into consideration,[61] even if its growth rate has remarkably decelerated across the years. So, even though population is actually an element that exhibits the trend reported by the author, potential output does not confirm a fundamental hypothesis of the model: the potential output tomorrow is not sufficiently less that the one of today, actually it is not even slightly lower, since its growth rate has been always positive. Even remaining confined to a neoclassical explanation of growth as we have hypothesized, one may say that despite the decrease in the working age population, technical progress has more than compensated such a decrease, thereby permitting to potential output to keep on growing.

The second point that we want to highlight regards the ultimate causes of stagnation which are traceable in the model of Krugman. At first glance the model of Krugman is aimed at looking for explanations of the Japanese stagnation in light of the possibility of the reappearance of the old-fashioned liquidity trap. To work out such a task the author utilizes a model that in principle ought to explain a lack of investments due to the impossibility for the interest rate to sufficiently decrease. Initially investment is set aside because the American economist is convinced that a model with only consumption would suffice. The lack of effectiveness of monetary policy is found to stem from a particular condition making the natural real interest rate to be targeted negative, while on the nominal interest rate controlled by the Central Bank there is a zero lower bound. Then investment is introduced in the picture by a stylized example with only land and labour. Therefore, it may seem that the problem rests in a lack of investment demand. But what does cause the equilibrium point to be reached to be characterized by a negative natural interest rate? As we have discussed right above, in the author's belief it is the pattern of the population growth the main driver of the collapse of the natural real interest rate. In this light, the logical process seems to be rather different from the framing in terms of a lack of demand. Indeed, the reconstruction of the meaning of the model appears to be reasonably described in these terms: given an exogenous drop in the main determinant of economic growth, which is population growth, the natural interest rate becomes negative; this, *per se*, would not give rise to

[61] The only exception being the year 2009, in which there has been a slightly negative growth rate.

specific troubles, were it not for the presence of a constraint on the operations of monetary policy. Being a zero lower bound on the nominal interest rate present, it is not possible to reach the negative natural real interest rate, and thus investment demand cannot be adequately stimulated. Let us for a moment assume that there is in the model the possibility for the Central Bank to set directly the nominal interest rate in the negative territory; in other words, let us temporarily remove the zero lower bound. In that instance, even though the natural rate can turn negative, a conventional monetary policy would be sufficient alone to bring the economy in an equilibrium position. If such a reconstruction is correct, the lack of demand generating the economic stagnation in this analysis seems to be a by-product of a supply side issue plus a rigidity on a policy variable. Krugman himself, in the empirical section discussing the supposed halt of private investment characterizing Japan in the nineties, continuously refers to population growth as the main driver of sluggish economic performances.[62]

In the review presented above about the demand side and the supply side version of Secular Stagnation we have seen that the two strands of explanation mainly differs in how they evaluate the relationship between potential and actual output. The demand side explanation, which is by and large the most accredited version, envisages the potential output as given, and the prominent role in explaining the lack of investment demand is assigned to the emergence of a negative natural real interest rate coupled with the zero lower bound on the nominal interest rate. These two factors, together, hinder the smooth operation of monetary policy, which can normally stimulate investment by setting the policy rate to such a level that, for given inflation expectations, it is equal to the natural real interest rate. The supply side version instead expresses concerns mainly on the long term pattern of the potential output itself, that is deemed to be slowing down because of the sluggish dynamics of both population growth and technical progress. Krugman has enthusiastically joined the demand side version field, thanking several times Summers for his ability to provide a comprehensive framework built on the foundations he had provided back in 1998. Seen in retrospect, the evolution of the theory of Secular Stagnation casts some doubt about the meaning of 'demand side' Secular Stagnation. As we are ascertaining now by discussing the model of Krugman, which is widely accepted in the mainstream literature as the cornerstone in which the causes of a prolonged liquidity trap due to a negative natural

[62] Cfr. Krugman (1998), pp. 171 – 174.

interest rate where pinned down, in its origins the modern theory of stagnation from the demand side appears to arrive at theorizing the lack of investment demand not as a problem *per se*, but rather as the final outcome of a process started from the supply side. Demand concerns arise only when the natural real interest rate cannot be hit by monetary policy because of a rigidity on the controlled policy rate. The subsequent refinements of Summers surely widens the range of causes that can determine the materialization of a negative natural interest rate. Nonetheless, on the one hand in the list of determinants of a negative natural real interest rate ageing population and slow technical progress still retain a prominent role. On the other hand, let us take as an example how income distribution is analysed: it is visible how its role is not appreciated in its importance as an aggregate demand drag. One would perhaps expect that an income distribution utterly favouring capital income recipients would be assessed dangerous in the first place because of its probable adverse effect on aggregate consumption, given that capitalists have a lower marginal propensity to spend out of the income they perceive. Instead, we find that the issue comes from the fact that their higher marginal propensity to save delivers in the economy an amount of savings that contributes, together with other factors, to push down the natural real interest rate.[63]

The upshot of the argument is thus that if we take a view on the birth and development of the modern neoclassical Secular Stagnation theory, we find in the literature the distinction between a demand side and a supply side approach. The demand side approach has witnessed the widest acceptance, and can enlist as main advocates important authors such as Summers and Krugman. In the specific, Krugman in 1998 has laid down the foundation for a stagnation theory in which a negative natural real interest rate plus a zero lower bound can cause an economy to remain stuck in a liquidity trap with a lack of investment demand. Summers in 2014 has taken this analytical structure, adding new considerations about the elements that can force the natural real interest rate to become negative. What appears puzzling in our opinion is the fact that a 'demand side' Secular Stagnation theory has been firstly set forward grounding its main cause on a purely exogenous supply side shock (as we have studied, a decrease in population) causing a disequilibrium situation that cannot be fixed given a rigidity on a policy controlled variable; hence, the ensuing demand side lack of investment. Later on, the development of the theory has enriched the list of factors that can cause the disequilibrium condition given by a divergence

[63] Obviously the two visions are describing the same economic fact, what we want to show is which side of the coin is more relevant to the eyes of the demand side Secular Stagnation theory.

between the natural and market real interest rate. Yet, the scepticism about the inner meaning of the demand side theory of stagnation remains: true, the version of Summers does not hinges on a population decrease alone, but all the narrative proposed in the new attempt still does not contain a proper concern about a lack of demand. Again, each of the factors enlisted by Summers are relevant in his framework because they either curb investment demand or boost the supply of savings, thereby putting a downward pressure on the natural interest rate. When the zero lower bound prevents monetary policy from being effective, then the lack of investment materializes. Again, therefore, the demand side concern only appears at the end of the logical process envisaged by demand side authors.[64, 65]

- *How investment is introduced in the model*

In the presentation of the formal model of Krugman, we have shown how the author introduces investment once the conditions for a negative natural real interest rate had already been described. According to him, passing from a model with only consumption to a model with production does not significantly changes the results of the analysis. In what follows we are going to argue that the example presented by Krugman is based on a series of hypothesis which are so restrictive to seriously cast doubts about whether a treatment of investment in those terms can really be considered acceptable, even granting as convincing the results achieved in the model with only consumption. In the first place, it appears hardly acceptable to open a section about investment by stating that the argument will be treated using land as a metaphor for capital. Land and capital are obviously two altogether different factors of production; in other words, even within a neoclassical world in which capital is considered as a factor of production that in equilibrium earns a remuneration set by its marginal productivity, land and capital cannot be used as substitutes. Indeed, a non-producible asset in given supply cannot be compared to a producible

[64] In the fourth chapter of the thesis we are going to state that, when one renounces to explain stagnation in light of a negative natural real interest rate, there is plenty of alternative explanation truly based on aggregate demand concerns. In those versions, aggregate demand in itself is the driver of long run economic growth, and therefore issue such as ageing population, income distribution and so forth can be given their fair share of relevance in explaining weak economic performances without any recourse to their alleged effect on the natural interest rate.

[65] The excess of savings and the lack of demand are again two faces of the same coin; indeed, stating that there is an amount of savings which is not absorbed by investment is tantamount to saying that aggregate demand falls short of potential output.

factor which emerges from production decisions concerning capital goods. Even granting neoclassical theory that the available stock of capital is fully determined by the decision to invest the whole amount of past savings offered in the market, the treatment of capital cannot be analogous to the treatment of land. A non-reproducible factor in given supply as land can be indeed experience variations in its price determined by the demand for it. Capital is a produced factor that has a price given by its cost of production, and therefore needs a separate and different analysis. Despite the strong scepticism about the relevance of a model in which actual capital is not even mentioned, let us review the further restrictive assumptions needed to get the conclusions at which Krugman arrives.

We can see how, in order to get to the result that a negative real rate of return on investment can be an outcome of his model, Krugman needs to hypothesise that land is the only asset available for investment, consumption in period one is zero as the whole amount of product obtained by cultivating land is utilized to buy it from the old generation, the demand curve for labour is very elastic, that the negative rate of return materializes only temporarily.

The absence of any alternative for the investor permits to focus on what happens to the rate of return of the asset land, which can turn negative under the assumptions made by Krugman. But what would happen in a world in which there is only one asset and, say, money? After all, money is present in the stylized model of Krugman, and as we have seen, at the zero lower bound Krugman states that the nominal interest rate on bonds cannot go below zero since in that case money would dominate bonds. The same reasoning may be applied to this case: if there is only one investment possibility, and the forecasted rate of return on it is negative, then the presence of a store of value as money gives to the investor the possibility to preserve its purchasing power by simply keeping his savings in liquid form. Therefore, in this case the restriction difficult to accept rests in the fact that in the model with land all the amount of product obtained cultivating land has to be invested in an asset delivering a negative rate of return.[66]

[66] This point is connected also with the second restriction about the level of consumption today of the agents: they do not consume at all, but rather use the product of land and labour to buy the asset from the old cohort. Krugman himself labels it a "special assumption"; it may be stated that the intertemporal decisions about consumption should at least ensure the possibility for the young generation to become old by consuming a portion of what has been produced.

Another point necessary to get the conclusions advocated by Krugman is that the demand curve for labour ought to be fairly elastic: this assumption appears necessary in order to ensure that the price of land actually falls once the population tomorrow drops. Indeed, a decrease in the cohort of people available to cultivate the given land would render the marginal product of labour higher. Recalling equation 25 for the land price in terms of product

$$q_t = \frac{w_t L_t}{A_t}$$

we can see how for a given amount of land A_t, if labour force L_t decreases the marginal product of labour w_t increases and therefore there may the possibility that, despite the population drop, the price of land in terms of product q_t may not be affected by such an exogenous shock, or at least not to the extent needed to make the overall return on investment negative. The final effect of the price of land so defined depends indeed on the elasticity of the demand curve for labour. If the latter is steep, a drop in the available labour force may cause a remarkable rise in the real wage determined by the marginal product of labour; such a rise may therefore prevent the necessary (for the author's conclusions) fall of the price of land. A fairly elastic labour demand curve, on the other hand, allows to say that even when the population drop is dramatic, the marginal product of labour does not rise by a degree sufficient to counteract the effect of the exogenous shock.

Lastly, Krugman states that the liquidity trap can actually be caused by a negative rate of return on investing in a specific asset, but it would seem that the result of his analysis depends in this case upon the willingness to study the value of what ought to represent a negative real natural interest rate outside a steady state position of equilibrium, in which relative prices would not change. Let us recall equation 24, by means of which Krugman shows that the rate of return $1 + r_t$ on the asset land can be decomposed into the marginal productivity of land R_{t+1} and the variation of the price q of the factor:

$$1 + r_t = \frac{R_{t+1} + q_{t+1}}{q_t}$$

In a transition, the supposed price drop assumed by Krugman can surely make the overall rate of return negative; but if we want to study an equilibrium position in which the natural real interest rate is negative, then we can see that it would be difficult to suppose that such a situation may

occur. Indeed, in a steady state position in which relative prices do not change we would have that:

$$1 + r_{ss} = \frac{R_{ss} + q_{ss}}{q_{ss}} \rightarrow r_{ss} = \frac{R_{ss}}{q_{ss}} < 0 \qquad (31)$$

Equation 31 displays that in a steady state the rate of return on the investment, which ought to represent the natural real interest rate, can be negative in two cases: either the marginal productivity of the asset is positive and its price is negative, or the marginal productivity is negative while the price is positive. Neither case would be acceptable, since a negative price for the asset would deprive the reasoning of economic meaning, while showing the coexistence of a positive marginal productivity of the asset with a negative real return on investing was the initial target of the author.

Generally speaking, the list of hypothesis that are necessary to get the conclusions of Krugman may perhaps be accepted singularly. Actually, it may be interesting to analyse an economy with only labour and land, an economy with only one asset, an economy with an elastic demand curve for labour, an economy operating outside a steady state equilibrium position. They are all particular cases that may provide interesting insights about some specific argument of research. What appears doubtful is their relevance when they are taken all together to answer a quite demanding research question. If such a question is indeed: is it possible to state that the natural real rate of interest in an economy with investment can be negative while the marginal product of capital is positive? Then it appears that a result obtained under a full list of *ad hoc* assumptions as the ones we have been reviewing is deprived of relevance, or at least of the possibility to convincingly answer the initial question.

- *A neoclassical critique to the negative natural real interest rate concept*

Before going to the next section, it is in our opinion interesting to mention the work of a neoclassical economist who has tried to argue how, within a neoclassical framework in which the three factors of production labour, land and capital are present, it is not possible to state that the natural interest rate can be negative. We have indeed argued that the model of Krugman does not essentially answers the question of whether a positive marginal productivity of capital can coexist with a negative natural real interest rate. This author is linked to our discussion since he shows

that, even accepting the neoclassical framework of analysis, the theoretical result claimed by Krugman is not generally valid. Stefan Homburg (2014) has made a case against the possibility of over-accumulation in economies where land is taken into account together with labour and capital.[67] In the example provided by Homburg (2014, pp. 416 - 420), considering land (supplied in a positive fixed amount) together with productive capital gives us the total non-financial wealth[68]

$$S_t = K_t + q_t L \tag{32}$$

Land is thus an additional savings' fund, and by neglecting it, Homburg states, one neglects an important investment alternative which can absorb a considerable portion of the available savings.[69] The German author then firstly employs an aggregate production function with constant returns to scale to define the remuneration of land, which is the rent to be paid for its use in production, in terms of its marginal productivity:[70]

$$F(N_t, K_t, L_t) \rightarrow \frac{\partial F(N_t, K_t, L_t)}{\partial L} = \rho_{t+1} \tag{33}$$

Then, by taking the rate of land rent so defined, he calculates the overall return on investing in land in the same way as Krugman did in the 1998 article. The rate of return on the investment is made up of a part stemming from the marginal productivity of the factor, and also the price variation of the asset between today and tomorrow is taken into account:[71, 72]

$$R_{t+1} = 1 + r_{t+1} = \frac{q_{t+1} + \rho_{t+1}}{q_t} \tag{34}$$

Homburg shows how in a steady state the interest rate cannot but be positive:

$$1 + r = \frac{(q + \rho)}{q} \rightarrow r = \frac{\rho}{q} \rightarrow q = \frac{\rho}{r} \tag{35}$$

[67] In the fourth chapter of the thesis we are going to review an analogous stance taken by Thomas Palley (2016a, 2016b), from a Post – Keynesian perspective.

[68] The terms in the equation are, in their order, S_t private wealth, K_t capital stock, q_t land price in output units per square meter, *L* the given supply of land.

[69] Empirically the order of magnitude of this alternative is displayed to be quite close to the one of capital (2014, sec. 4, p. 420 – 422)

[70] In equation 33 we have an aggregate production function *F(.)* in which the arguments are the factors' endowments; *N* is the amount of labour, *K* of capital, *L* of land, ρ_{t+1} is the rate of land rent.

[71] The overall return on land is arrived at by calculating profits as total production minus the amount of factor employed times its marginal remuneration, and differentiating it with respect to used land.

[72] In equation 34 we find R_{t+1} the gross rate of return of investing in land, r_{t+1} the net rate of return, q_{t+1} and q_t land price tomorrow and today.

In analogy to our considerations based on equation 31 for a steady state valuation of the rate of return on investing in land, there may seem to be little space for the conclusions of Krugman. While we were content with stating this critique even granting to Krugman the implausible assumption of an economy with only one asset, Homburg states the case in an economy with all the three factors entering an aggregate production function. His interpretation of the result that the natural real interest rate cannot fall below zero is that if the presence of a fixed amount of land is taken into account, a decrease in the real interest rate would cause the price of land to increase since investors can direct a portion of their savings towards the acquisition of the non-producible asset. In the limit, as the real interest rate approaches zero, the price of land will tend to an infinite value, and therefore there is no possibility for the economy to experience a situation in which an 'excess' of savings that cannot be absorbed emerges, thereby letting the natural real interest rate fall below zero.[73]

The example provided by Homburg backs up our intuition about the unfortunate choice of Krugman to treat the issue of how the natural real interest can turn negative without any recourse to the introduction of capital into the reasoning. While in our opinion only the restrictive nature of several assumptions made by Krugman from the start plus the analysis of a non-steady state solution made possible to conclude that a negative natural real interest rate can emerge in an economy, the example of Homburg displays how even in a fully orthodox neoclassical literature there are instances of discontent with the theories envisaging the negativity of the natural real interest rate.

- *Krugman's sources of inspiration*

In 2004 Mauro Boianovsky has published an interesting paper in which the history of the liquidity trap from the Keynesian/Hicksian origins until the novelties introduced by Krugman in 1998 is reconstructed. After lingering over the several developments over time of the basic Hicksian IS – LM framework, he discusses the modern treatment of Paul Krugman (pp. 112 –

[73] A more analytical treatment of the introduction of land into an aggregate production function and how it affects the study of the equilibrium determination of factors' remunerations can be found in Homburg (1991). A similar point has been singled out, this time in an overlapping generations models, by Geanakoplos (2008).

120). According to him, one of the most important features of the old Hicksian trap was the role of the 'elasticity of price expectations' (a concept to be then fully developed by Hicks in his *Value and Capital*, 1939), in other words how sensitive are the expectations about the future level of prices with respect to changes of prices seen today. Such a concept, as we have seen above, is fundamental also in the modern reappraisal of the liquidity trap made by Krugman: in the model we have studied, since the Central Bank is believed not to be able to change price expectations of the agents by moving the price level today with an exogenous injection of money within the economy, equilibrium can only be reached only deflation, provided that prices today are flexible. Boianovsky argues that when the elasticity of expected future prices with respect to current prices is zero, as in the case of the model of Krugman, a change in today's prices will be compensated by a substitution mechanism reinstating intertemporal equilibrium, and that this kind of reasoning is taken from Hicks.[74]

The interesting overview published by Boianovsky thus contends in one of his sections that the main theoretical inspiration for Krugman when he was reinstating the liquidity trap concept in modern models has to be found in the work of Hicks. There can be little doubt about the relevance of the work of Hicks to the eyes of Krugman, indeed. That author is often referred by Krugman himself as one of his main influences, and for instance in the 1998 article his name comes up at the very beginning of the discourse. What may be of interest in our opinion is to integrate Boianovsky's considerations with what seems to be the other main source of Krugman inspiration along with Hicks: Paul Samuelson's 1958 overlapping generations model. In fact, while the general structure of the model proposed by Krugman back in 1998 draws heavily on Hicks' reasoning in terms of intertemporal price elasticity and money/bonds substitutability (let alone the choice of renovating the liquidity trap concept), as we have seen above the central core of the troubles the economy can run into rests in the emergence of a negative natural real interest rate. Hence, while the backbones of the model of Krugman have been structured borrowing many concepts from the seminal work of Hicks, we contend that the case involving a negative natural interest rate may have been borrowed by Samuelson's 1958 path-breaking article. Let us therefore try to compare the work of Samuelson with the one of Krugman.

[74]Such a process is frustrated when the elasticity is one (or higher), since a change in today prices causes a cumulative dynamics. In that case, the presence of a nominal wage rigidity may prevent endless deflationary spirals; cfr. Boianovsky (2004), pp. 94 - 95.

In 1958 Samuelson attempted to determine the equilibrium interest rate in an economy in which along the years different generations overlap and the interest rate is obtainable in a market among generations in which loans are demanded only for consumption. The author, during the introduction to the formal setup of the model, recalls the causes envisaged by Böhm-Bawerk for the appearance of a positive natural rate of interest. They were three: first, there is generally the prospect to have a more prosperous economy in the future, and to earn a higher income in the future at the individual level; the second reason referred to the psychological feature according to which people normally prefer to consume today rather than tomorrow, and they want to be compensated if they have to give up consumption in the present; the third reason related to the technical fact that by giving up consumption today it is possible to free resources to be invested in more roundabout and mechanized processes that tomorrow will yield a greater amount of output. Samuelson then states the problem he is going to handle in these terms: what would be the equilibrium interest rate in an economy in which the first cause is reversed, the second is ignored and the third disappears? The meaning of this question will be clearer as soon as we cite the assumptions made by Samuelson in building his overlapping generations model. The main assumptions of the model assumptions were (1958, pp. 468 – 469):

- each cohort of agents experiences a three periods life: in the first two periods individuals work and produce, while in the third they retire and have to find a way to keep on consuming without receiving anymore a labour income. Thus, later years will not be wealthier but poorer;
- the ordinal utility function of the individual representative consumer has as arguments the three periods dated consumptions quantities, but there is no formalization for the subjective discount factor;
- no good can be used as a store of value because none keeps through time (in his words, an "extreme assumption").

We can see now how the Samuelson's assumptions were related to the three causes for the appearance of a positive interest rate envisaged by Böhm-Bawerk: the prospect of a richer-than-today future economy is reversed, the greater weight attached to present consumption with respect to future consumption disappears since the utility function of the individual agent has no

positive discount factor, the greater productivity of more roundabout processes of production is ruled out since there is no investment.

After having demonstrated that in such a stylized economy the interest rate can be seen as a by-product of human fertility (a "biological theory of interest", in his words) since the rate of interest is equal in magnitude to the rate of growth of the population, Samuelson analyses also the multiplicity of possible equilibrium interest rates. In his numerical example (1958, pp. 477 – 478) the relevant root from which to extract the equilibrium interest rate delivers a negative valued solution. How does the author comment such a surprising outcome?

> "Is this negative interest rate a hard-to-believe result? *Not, I think, when one recalls our extreme and purposely unrealistic assumptions.* With Böhm's third technological reason for interest ruled out by assumption, with his second reason involving a systematic preference for the present soft-pedaled, and with his first reason reversed (that is, with people expecting to be *poorer* in the future), *we should perhaps have been surprised if the market rate had not turned out negative*. … [I]t incidentally confirms… that a zero or negative interest rate is in no sense a *logically* contradictory thing, however bizarre may be the *empirical* hypotheses that entail a zero or negative rate." (Samuelson 1958, p. 479, emphasis in the original on 'poorer', 'logically', 'empirical')

Once the possibility of a negative equilibrium interest rate has been acknowledged in such a simplified model,

> "It may help us a little to isolate the effects of adding one by one, or together, (a) technological investment possibilities, (b) innovations that secularly raise productivity and real incomes, (c) strong biases toward present goods and against future goods, (d) governmental laws and more general collusions than are envisaged in simple laissez faire markets, or (e) various aspects of uncertainty. To be sure, other orderings of analysis would also be possible; and these separate processes interact, with the whole not the simple sum of its parts." (Samuelson 1958, p. 479)

Lastly, Samuelson commented about the overall aim of his work:

> "I do not pretend to pass judgement on the policies related to all this. But I do suggest for economists' further research the difficult analysis of capital models which grapple with the fact that each and every today is followed by a tomorrow." (1958, p. 482)

The theoretical picture drawn by Samuelson appears therefore quite clear: he accepted without many concerns the fact that his model was able to deliver as an equilibrium solution a negative interest rate. Because of the nature of the assumptions he made. Indeed, since the three conditions for the emergence of a positive natural interest rate stated by Böhm-Bawerk, where either absent or reversed, Samuelson takes the result as a rather normal outcome. Then, he goes on saying that the result of his analysis can be taken as a starting point, a sort of benchmark to be later moved

forward by inserting improvements, the first on the list being the possibility to treat the investment in real capital.[75]

Let us now relate the 1958 article of Samuelson to the 1998 contribution of Krugman. The Krugmanian model can be indeed argued to be able to host a negative natural real interest rate precisely because of the reasons listed by Samuelson. In it, as we have studied above, the natural interest rate is arrived at in an economy with only consumption, through the intertemporal maximization of utility by the representative agent. As in the case of Samuelson, the first cause envisaged by Böhm-Bawerk for a positive rate of interest existence was reversed, since the future level of endowments or capacity consumption was assumed to be lower than today's level. Again as in Samuelson, technological concerns were set aside since there was neither a production function nor investment; the Böhm-Bawerk's third cause for the appearance of a positive interest rate was set aside. If we follow the list of possible improvements we have cited from Samuelson soon above, Krugman has entertained an attempt to bring onto the stage the modification at point (c), namely a "strong biases toward present goods and against future goods", which is nothing else than the beta discount factor present in the utility function of equation 8. Such a discount factor takes up in the widespread literature of neoclassical consumption theory positive but lower than one values, representing therefore the weight attached to future consumption, which is systematically less important than consuming today. Samuelson instead did not make any hypothesis about the discount factor of the individual consumer, therefore remaining silent on which effect has the second cause of Böhm-Bawerk. We have seen what actually was the effect in the model of Krugman: the presence of the discount factor beta made the condition about the realization of a negative natural interest rate stricter that what would have been otherwise. Let us expand this last consideration by recalling equation 14 for the negativity of the natural rate of interest in the model of Krugman without production:

$$\left(\frac{y^*}{y}\right)^{\rho} < \beta$$

We have seen how the decrease of future endowments has to be sufficiently high in magnitude to let the ratio between future and present endowments be lower than the discount factor beta.[76] If,

[75] And therefore, to reintroduce the third cause for the existence of a positive rate of interest described by Böhm-Bawerk.

on the contrary, we assume that no particular systematic preference for present consumption over future consumption characterizes the preferences of the representative agent, the beta factor can be set equal to one. In this manner, present and future consumption have for the agent the same weight, and our condition for the negativity of the natural real interest rate becomes:

$$\left(\frac{y^*}{y}\right)^{\rho} < 1 \qquad (36)$$

The new condition thus requires only that the endowments tomorrow are lower than the endowments of today, with no particular rate of decrease required. Thus, relating this example made within the model of Krugman, we can say that the author's insertion of a systematic preference for present consumption answers point (c) of the Samuelsonian list: such a factor renders the condition for the appearance of a negative natural real interest rate stricter.

What about points (a), the introduction of technological investment possibilities, and (b), the introduction of innovations[77] that secularly raise productivity and real incomes? In the previous discussion of how Krugman carried out the treatment of investment, we have harshly criticized his attempt to model investment only by means of a non-producible asset, thereby ruling out any consideration about whatever production function involving capital. Therefore, in light of the list wrote down by Samuelson, we can say that point (a) referring to the third cause for the existence of a positive rate of interest has been basically disregarded by Krugman. Point (b), linked to the first cause, has been also left to the point in which Samuelson had left it sixty years ago: Krugman assumed that the endowments tomorrow would have been lower than the ones for today. Therefore, as in Samuelson, the first cause for a positive rate of interest has been reversed.

Overall, we can thus state two important things in light of our discussion of the attempt of Krugman to justify the presence in modern macroeconomic modelling of a natural negative real interest rate, a feature that links his 1998 article to the modern revival of the Secular Stagnation theory. In the first place, it is in our opinion possible to integrate the considerations of Boianovsy

[76] In the discussion of the point let us assume for simplicity that the relative risk aversion parameter is equal to one.

[77] There seem to be no clear cut distinction between the discussion of the difference between a raise in productivity ensuing from the choice of a more capital intensive technique from a given list of technological possibilities and the introduction of a novel process. Yet, the point appears of minor relevance in the present context.

upon the main influences that helped Krugman get to the formalization of a modern liquidity trap. Needless to say, Boianovsky can hardly be criticized for having pointed the attention towards the Hicksian contributions: after all, the seminal article of 1937 which saw the birth of the IS – LM model is still today the background of many authors, and in particular Krugman and Summers say today that they keep on using it. What we want to add to the reconstruction of Boianovsky is the possibility that Krugman has taken from Hicks the general structure within which conducting the analysis, but the main result to be obtained within the given liquidity trap framework might have been inspired by another fundamental author, namely Paul Samuelson. Indeed, back in 1958 the latter author derived, when dealing with the establishment of what is now labelled the overlapping generations model, a negative equilibrium interest rate by proposing a set of assumptions which we have found also in Krugman's 1998 seminal work.

This leads us to the second consideration we want to make. If our reconstruction is correct and an analogy between the 1958 article of Samuelson and the 1998 contribution of Krugman can be sustained, then it is difficult not to point out how different are the viewpoints of the respective authors when discussing their results. Indeed, we have discussed how Samuelson looked at the solution involving a negative equilibrium interest rate as a sort of very basic result obtained under overtly restrictive assumptions, and which could nonetheless be used as a starting step to be integrated with the list of improvements we have reported above. On the contrary, Krugman has basically taken the same set of assumptions, modifying only the hypothesis upon the intertemporal discount factor of the agents. In his model, indeed, there is a systematic preference of the representative consumer for consuming today. This latter feature renders the conditions for a negative natural interest rate stricter, but the general framework setup by Samuelson does not seem to be fundamentally changed. The problem is that, upon such a stylized structure, while Samuelson was not keen to provide any concrete policy recommendation, Krugman instead wished to take a strong stance on which were the causes for the Japanese lasting stagnation.

Conclusions

Larry Summers has been greatly helped by both Alvin Hansen and Paul Krugman in his effort to provide a rationale framing the reasons why Western capitalist economies are facing a long lasting stagnation. While Hansen back in the '30s introduced in the literature the concept of Secular Stagnation, Krugman in the late '90s formalized a new liquidity trap featuring a negative

natural real interest rate. The former general framework has thus been retrieved to provide a comprehensive model within which it would have been possible to place all the empirical elements characterizing the evolution of the last decades of the US capitalism. The latter is the outcome of the interaction among those forces, that renders monetary policy not reliable in order to get the economy back to full employment.

The seminal work of Krugman about Japan is grounded on a stylized model that starts without capital and production. Even in a such a simple base case, we have been asking ourselves whether the description of the process leading to an equilibrium is sound and keeps on being consistent when different cases are analysed, as for instance in the passage from the scenario without price rigidity to the one with sticky prices. When capital is subsequently introduced, the example featuring only labour and land did not seem to be particularly compelling for various reasons. The introduction of a rate of return on investment that separates the marginal productivity of capital from the real interest rate was the solution envisaged by Krugman, but the extremely a*d hoc* nature of several different assumptions needed to maintain that the natural real rate of interest can be negative while the marginal productivity of capital remains positive casted doubts about the general reliability of that result. Moreover, within the very same neoclassical environment some author claimed that an economy with capital *and* land cannot welcome a negative natural real interest rate. In addition to this, the abandonment of a steady state analysis, which is a relevant methodological departure, points again to the difficulty of making an overall compelling case for the coexistence of positive marginal productivity of capital together with a negative real natural interest rate in a long run equilibrium position. As we have seen, even in the roots of what can be argued to be one of the main inspirers of Krugman, namely Samuelson with his 1958 piece, the relevance and strength of the assumptions required to get a negative equilibrium value were continuously highlighted, and no concrete policy recommendation was made out of it.

In addition to the unresolved issues coming up when trying to justify theoretically such a long run position, we have seen also how the inception of the demand side Secular Stagnation strand of literature has been based on the consequences on the economy of a pure supply side shock, described in the form of a decrease in population. Then, the negativity of the natural real rate of interest and the presence of the zero lower bound on the nominal rate of interest resulted in an excess of savings over investment. Therefore, even though the final result of the analysis is

that actually there can be a persistent lack of private investment, the role of aggregate demand in this neoclassical explanation of stagnation appears rather ancillary to that of the supply side factors, which are the real responsible for the slack in the economic performances.

Despite the several doubtful points we have tried to raise and discuss in the previous chapter and in the present one about the demand side Secular Stagnation theory plausibility, what we want to do now is to keep them in mind and go on searching for some more satisfying answer in the most recent contribution to this strand of literature, which may perhaps be expected to take into account the weak spots involved in these preliminary attempts.

CHAPTER III - A FORMAL MODEL OF THE DEMAND SIDE SECULAR STAGNATION THEORY

This chapter is aimed at analysing what so far has been the principal attempt to model the insights about Secular Stagnation provided in the literature by Summers and Krugman, which are the two authors we have been reviewing in the first and second chapter of the present work. Such an attempt has to be found in the articles of Eggertsson and Mehrotra (2014) and Eggertsson, Mehrotra and Robbins (2017).[78,79] As in the spirit of the relative literature, the aim of these economists is to provide a rationale for the long term decreasing trend of the real interest rates experienced by advanced economies, and to relate it to factors such as population, private debt, income distribution. Then, they calibrate a model trying to replicate the behaviour of the main US economic variables in the last decades.

By studying the last and most analytically sophisticated contributions to the demand side theory of Secular Stagnation we aim at closing a theoretical path started in the first two chapters. In fact, we have studied in the first chapter of the present thesis how the recent revival of the stagnation theory has been set forward by Summers with two contributions setting the benchmark for the theory. After presenting the main thesis of Summers, whose principal contribution has to be traced in the explanation of stagnation as caused by a negative natural real interest rate plus the zero lower bound on the nominal interest rate, we have introduced also the differentiation between the demand side and the supply side Secular Stagnation theory. As it is ascertainable in the literature, the demand side version of Summers is by and large the strand more credited and mostly discussed; therefore, we have pointed our attention towards the origins of the demand side Secular Stagnation theory. What we have been looking for was something different: we wanted to search for an explanation of a long term Stagnation that employed the analytical structure of Summers, in order to see if and where the latter author had found inspiration for the modelling of his intuition. It turned out in the second chapter that the answer resides in a 1998 article of Paul

[78] The major part of our discussion will run through the 2014 contribution, which is the one mostly cited and also referred to by the authors in other contributions. The 2017 basically retains the theoretical parts, while enriching the study with a simulation of their model.

[79] There are additional contributions over the same topic, such as Eggertsson, Mehrotra, Singh, Summers (2016), and Eggertsson, Mehrotra, Summers (2016) which treat the subject of Secular Stagnation in an open economy scenario. We are going to concentrate on the source of the insights provided by the authors in the 2014, 2017 works.

Krugman about the long lasting stagnation of the Japanese economy. In there, we have studied, there is a model whose spirit is very close to the attempt of Summers. A negative natural real interest rate, Krugman argued, brought about by a population decrease in that Eastern economy, caused for japan a liquidity trap which resulted in a persistent slowdown of economic performances since the zero lower bound on the nominal interest rate prevented the Bank of Japan from attaining the equilibrium real interest rate by an appropriate manoeuvre on the nominal one.

Since we have tried to argue that both contributions appear to suffer from the same doubtful point, which is the theoretical position envisaging the presence of a negative natural real interest rate in an economy with production and capital accumulation, and no convincing solution for justifying it has been found in those attempts, we want to carry forward our enquiry to see if and how the last contribution on the topic have tackled the issue. The other important aspect that we want to put under scrutiny in this third chapter is also the role of aggregate demand in the explanation of stagnation. Indeed, we have seen in both the version of Summers and the one of Krugman that the role of aggregate demand emerges only as the last chain in the overall reasoning about Secular Stagnation. The factors entering the explanation (population, income distribution, private debt) are important inasmuch as they determine a negative natural real interest rate, and then the presence of a rigidity on the nominal interest rate let a lack of private investment emerge. Therefore, there seems to be only small room to state that aggregate demand is actually a prominent factor in the explanation of stagnation, despite the alleged importance that characterises the 'demand side' Secular Stagnation theory.

This twofold exercise allows also to close a circle started in the first two chapters of the thesis: once we have studied the first attempt to model a demand side Secular Stagnation and the more recent renewed version, by analysing the last effort present in the literature we can arrive at a comprehensive assessment about the reliability of the demand side Secular Stagnation as a good theory to explain the weak economic performances of the Western economies after the Great Recession started in 2008. Let us therefore start with the presentation of the model of Eggertsson, Mehrotra and Robbins.

3.1 - Modelling Secular Stagnation

The model we are going to study is the one originally presented by Eggertsson and Mehrotra in 2014, and afterwards integrated by a calibrated model in the version of 2017. The authors claim that their contribution is of relevance since it provides an analytical vestige to the insights provided by Larry Summers. Thus, the link between the articles of Summers (2014, 2015) and those of these authors is immediate: the contributions of 2014 and 2017 of the three economists overtly aim at ascertaining whether the situation described by Summers could claim to stand the test of a formal modelling. The final target of Eggertsson, Mehrotra and Robbins is to provide a foundation in terms of modern macroeconomic modelling to the clue of Summers, namely that the recent stagnation can be explained by a negative real natural interest rate that cannot be hit by monetary authorities because of the zero lower bound on the nominal interest rate. The negative natural real interest rate allegedly comes about owing to the contemporaneous downward pressure imparted to the equilibrium real interest rate by several factors such as population, income distribution, debt deleveraging; the list of elements is visibly inspired by the analysis of Summers reviewed before. These factors either weaken investment demand, or boost the supply of savings, by this route causing the materialization of an excess of savings which cannot be absorbed. The result of the forced divergence between the natural and the market real interest rate due to the zero lower bound causes a slump in investment demand; the uneasy situation can be fixed, according to the authors, by an appropriate fiscal policy financed by deficit spending, which can lift the investment schedule to the right, thereby moving the natural real interest rate in the positive territory. Let us see how the authors arrive at these conclusions.

Their chosen specification for modelling the subject is an overlapping generations (OLG) model encompassing three generations: young, middle-aged, old. The analysis is carried on starting with an endowment economy. No aggregate saving is allowed, as all incomes are spent in the aggregate. Endowments are assumed to be distributed in the following manner: the young do not receive any endowment and therefore borrow from the middle-aged, who in turn lend in order to get a reward when they become old (at that stage they spend all the income, since in the next

period they exit the model). The young are limited in the amount they can ask for, which is exogenously given. Formally:[80]

Utility function: $$\max_{C_t^y,\, C_{t+1}^m,\, C_{t+2}^o} E_t\{log(C_t^y) + \beta log(C_{t+1}^m) + \beta^2 log(C_{t+2}^o)\} \quad (37)$$

Budget constraints: $$C_t^y = B_t^y \quad (38)$$

$$C_{t+1}^m = Y_{t+1}^m - (1 + r_t)B_t^y + B_{t+1}^m \quad (39)$$

$$C_{t+2}^o = Y_{t+2}^o - (1 + r_t)B_{t+1}^m \quad (40)$$

Exogenous borrowing limit: $$(1 + r_t)B_t^i \leq D_t \quad (41)$$

Consumption Euler equation: $$\frac{1}{C_t^m} = \beta E_t \frac{1+r_t}{C_{t+1}^o} \quad (42)$$

The budget constraints describe the amount of consumption that each generation can enjoy: young people do not have any endowment, and are thus compelled to borrow by subscribing a bond, the middle-aged consume the endowment, repay the previously signed debt, and save for retirement, the elders consume the endowment and the savings for retirement plus the interest rate earned by investing those savings. The exogenous debt limit for the amount of savings that the youngsters can borrow is exogenously given, and will then acquire a meaning, as we will see, linked to the description of the effect of a sudden deleveraging.[81] The Euler equation for intertemporal consumption ensures that the path of consumption through periods allows for utility maximization.

Given the generic structure of the utility maximization problem, the authors can describe how the savings and investment schedules are arrived at. The demand schedule for loans is derived by coupling the binding exogenous debt limit of the young with the growth rate of their population, whose borrowed credit matches the supply by the middle generation. Equation 41 for the debt limit is supposed to be described by an equality: the young generation will borrow savings up to the maximum limit they can reach. The young generation also grows at an exogenous growth rate g_t; hence the demand for bonds will grow also at that rate. Obviously, the amount of savings borrowed by the young will be matched by an exactly equal amount of

[80] Where 'y', 'm', 'o' identify the respective generation, Y^j is the endowment, C^j consumption, B^j a risk – free bond, r_t the interest rate, D_t exogenous debt limit, β discount factor.

[81] It will serve as a metaphor for the financial collapse occurred in the Great Recession.

lending provided by the middle –aged. Thus, the two determinants of the demand for savings, which are the exogenous amount obtainable on the market and the growth rate of young population, concur to depict a demand schedule for savings of the following form:

$$C_t^y = B_t^y = \frac{D_t}{1+r_t} \; and \; (1+g_t)B_t^y = -B_t^m \rightarrow$$

$$L_t^d = \frac{1+g_t}{1+r_t} D_t \tag{43}$$

The supply of savings is derived by substituting within the Euler equation the budget constraints of the middle-aged and old generations, getting:

$$L_t^s = \frac{\beta}{1+\beta}(Y_t^m - D_{t-1}) - \frac{1}{1+\beta}\frac{Y_{t+1}^o}{1+r_t} \tag{44}$$

We see how the amount of savings supplied to the market depend on the discount factor of the representative agent, the amounts of exogenous endowments, the debt limit and the interest rate. Equating the two schedules permits to arrive at the *natural real interest rate*:

$$L_t^d = L_t^s \rightarrow 1 + r_t = \frac{1+\beta}{\beta}\frac{(1+g_t)D_t}{Y_t^m - D_{t-1}} + \frac{1}{\beta}\frac{Y_{t+1}^o}{Y_t^m - D_{t-1}} \tag{45}$$

The natural real interest rate in equation 45 is determined by: endowment distribution, debt limit, population growth, discount factor.[82] Each of these factors play a role in the emergence of a secular stagnation situation. The demand and supply of loanable funds are far from the traditionally considered loans meant to invest in real capital. Here capital is still not present. What we find out are quests for spare amounts of endowments not consumed by a single generation. It is that kind of request which constitutes the demand for saving in this simplified version. Across time everyone is going to be both borrower and lender, depending on the group of belonging, or on the life period of reference.

Any factor contributing to raise the supply of saving on the one hand, or to depress the demand for loans on the other is liable to affect the determination of the natural real interest rate. Three major aspects are illustrated by Eggertsson and Mehrotra on this respect:

- *sudden deleveraging*. The debt limit is given, and its collapse forces a spending reduction; accordingly, the interest rate drops to outweigh that reduction. This happens since the deleveraging process involves a consistent reduction of the demand for loans in the face

[82] Cfr. Eggertsson, Mehrotra, Robbins (2017), pp. 7 – 12.

of an unchanged supply of savings given by the middle aged. The debt limit drop serves as a metaphor for the financial collapse experienced by the US economy during the Great Recession. Without entering the causes for such a drop, the authors want to describe the effect that the impossibility to borrow as much as before has on the equilibrium interest rate. A reduction of the demand for savings, *ceteris paribus*, lowers the natural real interest rate;

- *slowdown of population growth*. A decline in the birth rate of the youngsters has the same influence on the equilibrium interest rate of a debt limit drop: for a certain supply of savings, a smaller new generation of young people, that in the model are the sole responsible for demanding loans, implies a decrease in such a demand and so a diminution of the natural real interest rate;
- *income inequality*. For what concerns income inequality instead, its impact on the equilibrium interest rate operates through the supply of savings. If endowments are distributed more unequally between the middle-aged and the old (the young do not receive any endowment) in such a way that the middle-aged have a higher endowment, the supply of savings to the market will increase. That generation is in fact the sole responsible for supplying savings to the economy, and if they get more endowments they can consume more but offer more savings as well to finance their retirement. When more savings are offered into the market, for an unchanged demand schedule the natural interest rate will tend to drop in value.

We can see therefore how the basic mechanism envisaged in the contributions of Summers (2014, 2015) that we have reviewed in the first chapter of the thesis is exploited in the contribution of the authors we are analysing now. Even if the general analytical framework is different now, since we are studying an OLG model with three generations instead of a basic IS market for savings, the conclusions are analogous. For the moment the loan demand and the savings supply are described within a market without investment in real capital; thus, all savings are spent in the aggregate and are employed to finance consumption. Investment will be treated in a subsequent stage of analysis. Within this OLG version of the market for loans without capital the authors contend that there is basically no reason why the natural real interest cannot be negative. Indeed, when the forces operating upon the demand for loans and the supply of savings sufficiently push

the two schedules respectively to the left and to the right, the equilibrium real interest rate can easily turn negative. In figure 11 we have the graphical representation of the issue provided by the authors: the two curves can intersect at point A, delivering a positive natural real interest rate. When the supply of savings diminishes, for a given demand curve, the intersection can move to point D featuring a higher natural real interest rate. When, on the contrary, from point A we move to point B because of a weaker demand for loans, the natural real interest rate goes down to zero, and if we add to such an element a higher supply of savings, we find the intersection at point C, where the natural real interest rate is negative.

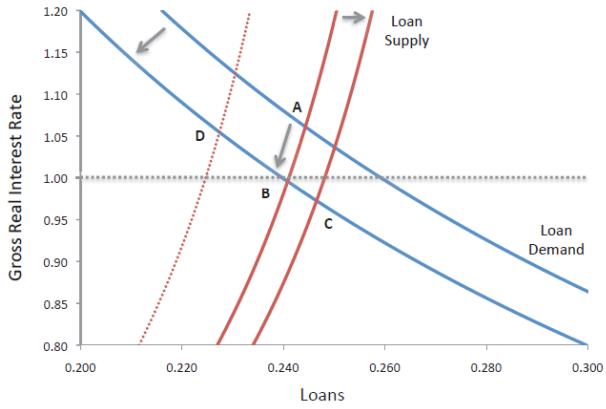

Figure 11 - The investment demand schedule and the savings supply schedule in the OLG model of Eggertsson, Mehrotra (2014), Eggertsson, Mehrotra and Robbins (2017); from Eggertsson, Mehrotra and Robbins (2017, p. 9)

Once the basic model designed to recreate a sort of investment – saving schedule without capital is set forth, the model can be enriched with many improvements. We are going to focus on fiscal policy and the introduction of capital, the elements that in our opinion are central to the message the authors want to convey.[83] Fiscal policy is introduced in the discourse in order to explain which policy could be exploited for the sake of lifting the economy out of the disequilibrium condition caused by the presence of the zero lower bound on the nominal interest rate. Again, in fact, the materialization of a negative natural real interest rate causes troubles since the contemporaneous presence of an impediment to the correct functioning of monetary policy does not consent to appropriately stimulate private investment by lowering the market real

[83] Other aspects that the authors treat are the price level determination, endogenous output, determinacy of the equilibrium. We have decided not to treat them since they provide a more articulated description of the functioning of the model, without altering the basic conclusions. In our opinion, therefore, it would have been better not to complicate the general initial structure.

interest rate down to the natural one. In such a situation then the policymaker, in the authors' opinion, ought to intervene in the economy through a deficit financed fiscal policy. Let us see how this insight is presented within the OLG model we are studying.

In the model setup displayed in equation 37 to 42 above the State is introduced by rewriting the budget constraints when the public sector is added (the utility function remains the same):[84]

$$C_t^y + T_t^y = B_t^y \tag{46}$$

$$C_{t+1}^m + (1 + r_t)B_t^y = Y_{t+1}^m - T_{t+1}^m - B_{t+1}^m \tag{47}$$

$$C_{t+2}^o = Y_{t+2}^o + (1 + r_{t+1})B_{t+1}^m - T_{t+2}^o \tag{48}$$

so the government can impose a tax on the three generations. On the asset market side, the government constitutes a new agent borrowing savings, and therefore its demand has to be added to the demand of young people. The asset market-clearing condition becomes now:

$$-N_{t-1}B_t^m = N_t B_t^y + N_{t-1}B_t^g \tag{49}$$

And the new loan demand curve, which is arrived at by following the same reasoning shown above for an economy without a public sector, is:

$$L^d = \frac{1+g}{1+r}D + B^g \tag{50}$$

Therefore, the intervention of the public sector can increase the demand for savings, which is represented by B^g and is the sole new element added to the basic demand for loans of equation 43. The supply of savings of equation 44 as well is enriched with the taxes on the middle-aged and the old:

$$L^s = -B^m = \frac{\beta}{1+\beta}(Y^m - D - T^m) - \frac{1}{1+\beta}\frac{Y^o - T^o}{1+r} \tag{51}$$

The government's budget constraint is the new equation to be added to the budget constraint of the private sector. It shows that the public sector collects savings by taxing and subscribing bonds, and it employs them to finance public spending and the reimbursement of the debt plus the interests to be paid on it:[85]

[84] The new variables added to the model are: $T^{y,m,o}$ taxes on all generations, B^g government's bond demand, G public spending.

[85] The authors normalize public expenditure by the size of the middle age cohort, and also the tax scheme is interpreted by taking that cohort as reference, so in the equation the variables are corrected by the growth rate of population g.

$$T^m + B^g + \frac{1}{1+g}T^o + (1+g)T^y = G + (1+r)\frac{1}{1+g}B^g \tag{52}$$

An intertemporal tax distribution scheme for middle-aged and old is introduce in order to prevent fiscal policy from modifying the supply of savings:

$$T^m = \frac{1}{\beta}\frac{1}{1+r}T^o = T \tag{53}$$

Such an equation ensures that the taxes introduced do not incentivize agent to modify their supply of savings; as we can see it follows the same structure of intertemporal consumption optimization of a Euler equation, so the introduction of public intervention in the consumption problem does not shift the savings supply schedule.

Generally speaking, fiscal policy is constituted by a set of values for both taxation and public expenditure subject to the State budget constraint. In this framework, according to the authors, the most straightforward way to affect the natural interest rate is permanently[86] augmenting the stock of public debt.[87, 88] It is so since the government now plays the role of borrower, thus shifting the loan demand function for a given supply. Since the tax structure enters the supply of savings schedule in such a way that the overall amount offered in the market is not affected, the government can raise the demand for loans by running a deficit spending fiscal policy. The pressure put by the public sector on the supply of savings moves then the demand for loans schedules to the right, and therefore the natural real interest rate can be brought back into the positive region along the unchanged savings' supply schedule.

The successive improvement we are going to treat is the introduction of capital in the model.[89] Now the middle generation can decide to employ their savings either by lending them to the young generation or by acquiring capital that is leased by firms. Thus, while in the basic

[86] With only a temporary increase of it Ricardian equivalence would lead agents to expect a corresponding level of future taxation to meet today spending, thus leaving the natural real interest rate unchanged.

[87] The three economists also claim their preference about fiscal rather than monetary policy, since the former can altogether cancel off the secular stagnation equilibrium, and not only moving the economy away from it as the latter could.

[88] Such an additional demand works out regardless of how public expenditure is then utilized. At the zero lower bound, a public debt increase has a multiplier value above 2; cfr. Eggertsson, Mehrotra and Robbins (2017), pp. 28 – 30.

[89] The section studying the role of capital will be taken from the version of the model present in Eggertsson, Mehrotra (2014), Sec. 9, pp. 29 – 33. The version of 2017 does not contain a treatment of the issue, since there is no explicit argument concerning capital and how it would affect the general conclusions of the model.

scenario we only had a demand for savings in the form of loans to be devoted to consumption, now there is also the possibility to utilize savings to undertake an investment in real capital aimed at producing for the market. Capital enters a conventional Cobb – Douglas aggregate production function[90]

$$Y_t = K_t^{1-\alpha} L_t^{\alpha} \tag{54}$$

The marginal product of capital r_t' comes from the first derivative of the Cobb – Douglas function with respect to capital. Then, the marginal product of capital and the rental rate of capital r_t^K are posed equal

$$r_t' = (1-\alpha)\frac{Y_t}{K_t} \rightarrow r_t' = r_t^K = (1-\alpha)\frac{Y_t}{K_t} \tag{55}$$

Since the authors want to study the model in a steady state position, the marginal product of capital and its rental rate must coincide. The rental rate of capital is a variable that contains both the marginal productivity of the factor to be rented and its price variation between the moment in which the factor is bough and the one in which it is sold. Since in a steady state position relative prices are supposed not to vary among periods, the rental rate of the factor coincides with its marginal productivity. Given exogenously the relative price of investment goods, that expresses the cost of transforming a consumption good into an investment one, the authors formulate the optimal choice of the representative agent, which is arrived at by firstly rewriting the budget constraints of the middle-aged and old generations, adding in them the investment in capital:[91]

$$C_{t+1}^m + p_{t+1}^K K_{t+1} + (1+r_t)B_t^y = w_{t+1}L_{t+1} + r_{t+1}^K K_{t+1} + B_{t+1}^m \tag{56}$$

$$C_{t+2}^o + (1+r_{t+1})B_{t+1}^m = p_{t+2}^K (1-\delta)K_{t+1} \tag{57}$$

The budget constraints take now into account the presence of capital: the middle aged pay the rental for the services of the capital good, and obtain on it its rental rate. When old, they sell the

[90] In which *Y* is the net product of the economy, *K* and *L* are the capital and labour inputs, α and 1- α are the output elasticities of capital and labour.

[91] Where the new variables added to the budget constraints are p_{t+i}^K the exogenously given relative price of the capital good in terms of the consumption good, r_t^K the rental rate of capital, δ the rate of capital depreciation. The term $w_{t+1}L_{t+1}$ is the product of the real wage rate earned by the amount of middle-aged labour supplied, which substitutes the given endowments of the basic case. Below we are going to mention the fact that one of the refinements of the model is substituting endowments with the remuneration of labour in terms of its marginal productivity. Yet, such a modification does not alter the conclusions of the model.

capital good at its new price, after having discounted the amount of capital by its depreciation rate. The equation for the optimal choice of capital shown here

$$(p_t^K - r_t^K)C_{t+1}^o = \beta p_{t+1}^K (1-\delta) C_t^m \tag{58}$$

is then combined with the Euler equation so to make the choice about how much to invest in capital consistent with intertemporal utility optimization. From the intertemporal optimization of consumption, the authors derive a relation between the rental rate of capital and the real interest rate described by the following equation[92]

$$r_t^K = p_t^K - p_{t+1}^K \frac{1-\delta}{1+r_t}, \qquad r_t' = r_t^K \geq 0 \tag{60}$$

The rental rate of capital accounts thus for the difference in the price of the capital good between the period in which it is bought and then sold, with the valuation of the second period involving the depreciation of the item, and the discounting of the term by the real interest rate between periods. The second condition imposes a non-negative value for the rental rate that stems from the equality of the latter with the marginal product of capital, that according to the authors is always positive; in terms of the discussion on the point entertained in the first chapter of the thesis, we have seen how by employing a Cobb-Douglas aggregate production function one can get at the least a zero marginal product of capital as the capital/labour ratio approaches infinity in the limit. When equation 60 is evaluated at the steady state, when relative prices do not change,

[92] The authors do not show how they arrive at the result. Developing the passages they suggest, we get the following system of two equations

$$\begin{cases} (p_t^K - r_t^K)C_{t+1}^o = \beta p_{t+1}^K (1-\delta) C_t^m \\ \dfrac{1}{C_t^m} = \beta \dfrac{1+r_t}{C_{t+1}^o} \end{cases} \tag{59}$$

By substituting in the second equation the C_t^m isolated in the first we get

$$1 = \beta \frac{1+r_t}{C_{t+1}^o} \frac{(p_t^K - r_t^K)C_{t+1}^o}{\beta p_{t+1}^K (1-\delta)} \rightarrow p_{t+1}^K (1-\delta) = (1+r_t)p_t^K - (1+r_t)r_t^K$$
$$\rightarrow (1+r_t)r_t^K = (1+r_t)p_t^K - p_{t+1}^K (1-\delta) \rightarrow r_t^K = p_t^K - p_{t+1}^K \frac{1-\delta}{1+r_t} \quad .$$

Which is the formulation for the rental rate suggested in the text.

the steady state real interest rate is shown to be bound from below by the depreciation rate of capital:[93]

$$r_{ss} \geq -\delta \qquad (61)$$

It is possible to see how the steady stare real interest rate, in the formulation just shown, may hence fall within a range that includes negative values as well, but with a floor fixed by the rate of capital depreciation. Thus, the author contend to have found the possibility to demonstrate that even when the possibility to invest in real capital is added to the model, the steady state position involving a negative natural real interest rate is a possible outcome of the model. In addition to this result, the authors show also the new equation for the supply of savings:

$$L_t^s = \frac{\beta}{1+\beta}(Y_t - D_{t-1}) - \frac{\beta}{1+\beta}\left(p_t^K + \frac{p_{t+1}^K(1-\delta)}{\beta(1+r_t)}\right)K_t \qquad (62)$$

In such a new version, the relative price of investment goods and depreciation now play a role: a falling relative price of investment goods and a higher depreciation rate can both contribute to impart a downward trend to the equilibrium interest rate, since they both tend to augment the supply of savings in the economy, while the demand function is the same as before. Thus, to the basic treatment shown above the authors have now added other factors that can explain why an economy can get stuck into a situation in which the natural real interest rate turns negative.

The article is concluded by a simulation exercise carried out[94] in the last section. A calibrated model based on the equations thus far presented is built; the target of the simulation is to try to replicate the time series of the factors that in the model affect the natural real interest rate. In so doing the authors want to ascertain whether the natural real interest rate that they calculate exhibits a downward trend in the long period, until a negative value is reached in the most recent years.

The exercise carried out by the authors delivers some interesting outcome: according to the simulation the US natural interest rate has been trending continuously downward since the

[93] The passages to get to that result, which are not shown, are

$$r'_{ss} = r_{ss}^K = \bar{p} - \bar{p}\frac{1-\delta}{1+r_{ss}} \geq 0 \rightarrow \bar{p}\left(1 - \frac{1-\delta}{1+r_{ss}}\right) \geq 0 \rightarrow \frac{\cancel{1}+r_{ss}\cancel{-1}-\delta}{\cancel{1}+r_{ss}} \rightarrow r_{ss} + \delta \geq 0 \ .$$

[94] The calibration of the various parameters, such as elasticity of intertemporal substitution, capital/labor elasticity of substitution, depreciation rate etc. is carried over by looking at both time series aggregate US data and the estimates from the general literature.

seventies, and has reached in 2015 the value of -2.2%. The authors suggest that the alleged downward trend of the natural real interest rate started in the seventies can be well approximated by the model, and the main factors that has been driving the natural rate down are primarily population and technology sluggish growth rates,[95] while private debt does not play any remarkable role in the process; on the other hand, the increase experienced by the government debt has been the main counteracting force to such a trend. Yet, according to their model it would take a doubling of the public debt amount today to increase the natural real interest by a mere 1%; this would call into question the feasibility of such a strategy in terms of long term sustainability of the public debt. Historically, the 'baby boom' generation of the post-WWII decade is said to have constituted a boosting element for the natural rate, and therefore the progressive retirement of that generation is one of the main factors behind the natural rate waning. Overall, the conclusions drawn from the model are the following:

> "The reductions in fertility, mortality, and the rate of productivity growth play the largest role in the decrease in real interest rates. The main factor that has tended to counterbalance these forces is an increase in government debt." (Eggertsson, Mehrotra, Robbins, 2017, p. 38)

> "From 1970 until 2000, the baby boom tends to increase real interest rates owing to an increase in the rate of population growth. Following the baby boom comes the baby bust, and fertility rates drop as the boomers enter retirement, which leads to a sharp drop in real interest rates." (Eggertsson, Mehrotra, Robbins, 2017, p. 42)

The three economists conclude that, given the trends of the main factors enlisted above as the determinants of the natural real interest rate, future forecasts suggest that the natural rate will keep on moving close to the edge of the zero lower bound when not being just negative. Thus, the issue of Secular Stagnation appears to be destined to remain a concern for the foreseeable future.

In order to conclude the presentation of the OLG model set forth by Eggertsson and Mehrotra (2014) and Eggertsson, Mehrotra, robbins (2017), we recall the main features of the analytical setup they have offered in the literature on Secular Stagnation. The main aim of the authors cited was constructing a model able on the one hand to provide a more formal garment to the insight about Secular Stagnation given by Larry Summers, and on the other hand to test whether those clues holds true in a more refined model, which then served as a benchmark to

[95] The role of technology is introduced briefly only in a passage of the 2017 version, and is then added to the simulation without changing the structure of the base case model that we have illustrated before.

simulate the results in a calibrated version. The main argument of the three authors is therefore analogous to what we have been discussing in the first chapter of the present thesis: it can be argued that several interacting factors have been shaping a persistent downward trend for the natural real interest rate in the last decades for the US economy. These elements, which are traceable mainly in the population growth, technical progress, income distribution, private debt accumulation, concur to lower the natural real interest rate down to negative values by weakening investment demand on one side and boosting the supply of savings on the other side. Once the natural real interest rate reaches a negative value, the zero lower bound on the nominal interest rate prevents monetary policy from being effective, and therefore the most useful tool for the public authority is said to reside in a deficit financed fiscal policy. The treatment of the factor capital does not alter the picture: the natural real interest rate can be in fact negative despite the presence of a non-negative marginal productivity of capital. In the final part of the paper, the calibration model confirms the fact that when the actual trends experienced by the US economy of the main factors entering the model are placed into the simulation, the natural real interest rate obtained starts to drop in the seventies and plunges to negative values in the most recent years, thereby confirming the concerns about the possibility for the US economy to remain stuck in a Secular Stagnation for the years to come.

3.2 - Critical considerations

- *Questioning how the subject has been modelled*

We have seen that the backbones of the model set forth by Eggertsson, Mehrotra and Robbins are grounded, among other things, upon the distribution of endowments among generations. In order to arrive at a less stylized treatment of the issue, in the subsequent treament[96] endowments are replaced by the marginal products of factors[97] in order to have a less stylized description with respect to simple endowments, and by assumption only the middle generation can supply labour for the sake of obtaining income. In the basic version the young generation did not receive any endowment; the demand for intergenerational loans, which takes the form of a demand for

[96] Cfr. Eggertsson, Mehrotra (2014), pp. 13 – 17, Eggertsson, Mehrotra and Robbins (2017), pp. 15 – 19.
[97] Without modifying neither conclusions, nor the general structure of the model.

savings to be used for consumption, emerged because of the hypothesis on the distribution of endowments. As the authors state:

> "If all generations receive the same endowment $Y_t^y = Y_t^m = Y_t^o$, then it is easy to see that there is no incentive to borrow or lend, and, accordingly, the real interest rate is equal to the inverse of the discount factor $1 + r_t = \beta^{-1}$. It is thus inequality of income across generations that is responsible for our results and triggers possibly negative real interest rates." (Eggertsson, Mehrotra and Robbins, 2017, p. A.5)

Nevertheless, while with a simple endowment economy an assumption of restriction upon one generation consumption possibilities may well be understood as an attempt to provide a metaphor for a world in which some agents are credit constrained, the same seems harder to accept when actual production is introduced.[98] One may expect that with actual production the issue ought to be stated in these terms: within the labour market some factors, such as for instance a rigidity on the nominal wage (or possibly other elements), prevent the realization of full labour employment; since the problem could be argued to be felt more by the young generation, which suffers from unemployment, then the desired consumption which is not satisfied through the income received when working will be obtained by borrowing savings from the middle-aged. Instead, in the model we find an assumption analogous to the previous hypothesis of no endowments distributed to the young; simply, youngsters cannot access the labour market.[99, 100] Thus, the presence of unemployment is not a result of the analysis, it is rather a starting point. Given the presence of a fraction of the labour market that cannot work, then they do not have any alternative: if they want

[98] Agents would be subject to an intertemporal optimization problem, and they have now also the choice of how much to work, but even this aspect is left aside by assuming an inelastic middle generation labour supply.

[99] The role of an assumption may be thought as a simplification permitting to avoid some useless complication not hindering the emergence of the important concept to be shown. In our case, it may be thought as something of this kind perhaps: a portion of the agents in real economies keep on working even when they pass the retirement age. In the model setting, it would mean that the old age category has some income deriving from a labour endowment. Assuming that they do not have it at all would then simplify the setting of the budget constraints, making negligible difference with actual economies. It does not seem to respond to the same need the assumption that the *young* generation is not granted a labour endowment at all.

[100] Another crude simplification which do not keep up with the basic description of what is being analysed is the presence of a real wage determined by marginal labour productivity (Appendix A, Section A.2, p. 40). The oddity resides in not introducing another factor of production together with labour in order to speak of a 'marginal product'. Such task will be accomplished no earlier than Section 9 (p. 29). If only one factor is assumed, it may surely get a reward, but the very same concept of marginal product of its employment is difficult to conceive.

to consume, they have to borrow money, and this demand for savings will let the natural real interest emerge from the equality with the supply of savings.

Such an assumption could be thought as a way to mimic some US economy's features like the huge private debt incurred into for studying or buying a house. Indeed, it is undeniably true that the US economy has been characterized and it is still characterized by the necessity for young generations to ask for credit. Therefore, it may be said that the assumption of a young generation that in the model cannot consume as much as it wish is a good representation of an actual problem of the economy that is being modelled. The problem in our opinion rests in the fact that the model would more satisfactorily deal with the description of the US situation if the demand for credit from the young generation were explained as a result of the impossibility to find a job in the labour market. Instead, the young cannot work by assumption, and then they ask a certain amount of credit, subject to an exogenous maximum limit; this feature provides the demand for loans necessary to theorize the presence of a natural real interest rate, that can eventually turn negative.

On the contrary, in that model it would seem that without some kind of constraint of this kind young could simply access the labour market, find a job and get the income they need, without asking for loans. And without the latter quest, since capital as well is not present, no interest rate can emerge in the economy.[101]

[101] A critical piece which can be seen as highly complementary to our viewpoint is Spahn (2016). His main targets are the way in which the credit-debt market is formalized (with the ensuing warranted effect on the interest rate) and the saving-investment nexus entailed by the model. The crucial assumption is said to be the no-endowment condition imposed to the young, that is found to be all the more unsatisfying when introducing market factors' rewards (cfr. note 5, p. 7). Another argument set forth is that the three generations framework is necessary to establish a meaningful intertemporal dynamic with the young undertaking a debt to be repaid once the middle age generation gets old; in a two generations structure borrowers and lenders would only meet once. The author addresses also a different question: is that warranted the supposed relation between society's age structure and the interest rate? In a two generations framework a smaller young generation would mean less demand for the bonds sold by old; their price would then fall causing a rise in the interest rate. An additional reason for higher rates may also be in his opinion that an ageing society leads to shrinking aggregate savings. Furthermore, another mechanism affecting the interest rate imagined by Spahn is that a smaller young generation may be supported by transfers by the old, thereby needing less credit in the aggregate. Spahn then moves to tackling the possible real world explanation for low rates based on a 'savings glut' hypothesis. The first remark arises in the comparison between natural rate estimates and market interest rate behaviour: the latter is said to have the possibility to persistently diverge from the former due to its mostly financial connotation. Since no prior saving is necessary to expand agents' debt exposure, the market interest rate can well follow its own pattern that is in principle unrelated to thrift conditions. In the end the German economist tries to

We have so far questioned the way in which the model has been setup; what we want to highlight now on the other hand is the meaning of the main conclusions of the analysis set forth by Eggertsson, Mehrotra and Robbins. As we have seen above, the simulations ran through the calibrated model designed by the three authors has delivered some interesting outcome. It would appear, indeed, that even if the initial proposal of the three economists was to confer an analytical garment to the insights of Summers, an thus to back up the demand side version of Secular Stagnation. As we have seen in the first two chapters of the thesis, we have doubts about whether a true demand side issue arises in this version of the theory. We have shown, in fact, that the supply side version overtly dismisses any concern about aggregate demand for the sake of focussing on the long term trend of the potential output, which is supposed to be shaped by supply side factors, such as population growth and technical progress. The demand side version instead points the attention to the fall of the natural real rate of interest in the negative territory, and such a drop cannot be tracked by the policy controlled nominal rate of interest; at this point, the lack of aggregate demand materializes in the form of a lack of private investment. What we have questioned was the meaning of the demand side Secular Stagnation: indeed, we have shown how in the first version proposed by Krugman in 1998 a prolonged stagnation from the demand side was actually originated by a purely supply side shock lowering the working age Japanese population. Such a shock then caused the fall of the natural real interest rate into the negative territory, which resulted according to Krugman in a persistent shortfall of desired investment over supplied savings because of the impossibility from the Central bank part to set the appropriate real interest rate because of the zero lower bound. The later attempt of Summers, we have argued, has the merit to have widened the list of reasons which can be deemed relevant to explain where does the stagnation stem from: besides population growth, Summers talks about technical progress, income distribution, private debt.[102] Eggertsson, Mehrotra and Robbins closely follows

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reconcile the two positions, stating that the various elements brought on stage by Eggertsson and Mehrotra do have an impact on the interest rate determination, but that in modern context the financial nature of the latter variable allows to think about a liquidity glut together with a savings glut.

[102] Yet, we were still not convinced about the relevance of the explanation in light of a concern about weak aggregate demand, since each element enlisted by Summers (and the other demand side advocates) seems to be relevant only inasmuch as it contributes to weaken the investment demand or boost the supply of savings, thus making the natural real interest rate negative. Without the lower bound on the nominal interest rate it would be possible for the monetary authority to reach equilibrium by appropriately lowering the nominal interest rate it controls.

Summers when setting up their OLG model; their aim, as seen, was to put the narrative of the former US Minister of Treasury into a more analytically refined model. The calibration exercise offered in the last part of the 2017 paper appears, in light of our reconstruction of these models from the original version of Krugman onward, a step backwards towards a supply side explanation of stagnation. Indeed, the main determinants of the alleged long term drop of the natural real rate of interest are population growth and technical progress, with the progressive retirement of the baby boom post-WWII generation playing the most prominent role. It would appear therefore that the latest version of a demand side Secular Stagnation model falls back precisely on an explanation purely based on supply side factors. Again, as in Krugman, the bulk of the evolution of the natural real interest rate hinges mostly on the long term pattern of population growth; when the equilibrium real interest rate drops below zero, then the zero lower bound becomes effective in limiting monetary policy, and therefore private investment cannot be sufficiently stimulated. In our opinion such a reconstruction casts serious doubts about the general message to be taken from the demand side Secular Stagnation; we actually concluded the study of the 1998 model of Krugman doubting the actual role of aggregate demand in that modern version of a liquidity trap. Now we can make a comparison with the most recent formal model of the demand side Secular Stagnation, and the conclusions do not seem to differ. Yes, some factors such as the long term trend of private debt accumulation and income distribution are not altogether irrelevant, but they have to give up to the usual supply side factors the role of protagonists in the long run. Therefore, recalling the discussion started in the first essay upon this point, we conclude our discussion on the meaning of the demand side Secular Stagnation theory by pointing out that in our opinion there is no such thing as a real role for aggregate demand within this strand of literature. Indeed, what we have seen within the reconstructions of the main models available in the literature is a role for aggregate demand purely ancillary to the shocks pushing downwards the natural real interest rate and the rigidity constituted by the zero lower bound on the nominal rate of interest. We have not recognized any direct role for aggregate demand, nor an attempt to argue that a shortage of aggregate demand can pose limits to actual production and employment. Rather, the lack of demand comes about when a rigidity on the nominal interest prevents the monetary authority from being successful in stimulating private investment by lowering the policy controlled interest rate.

- *The role of fiscal policy*

Let us recall how public spending can be useful, according to the authors we have been discussing: public expenditure financed by increasing public debt in the OLG model can raise the natural real interest rate because the State intervention adds to the demand for savings of the young generation. Thus, by constructing a State policy that leaves untouched the supply of saving but increments savings' demand through deficit spending moves to the right the demand for loans curve; a sufficiently high pressure on the available amount of savings can eventually bring the natural real interest rate back to the positive territory.

Notwithstanding the interesting point in support of the above policy, a preliminary perplexity may arise from the fact that the advanced strategy looks more like a way of raising the demand for loans than a proper public spending policy. The suggestion of the authors is indeed that the actual utilization of savings does not matter; what it is of importance is that the excess of savings present in the economy is disposed of:[103]

> "The key for successful fiscal policy is that it must reduce the oversupply of savings and raise the natural rate of interest. Fiscal policy that instead increases desired savings by, for example, reducing future disposable income through tax increases, can exacerbate a secular stagnation." (Eggertsson, Mehrotra, Robbins, 2017, pp. 2 – 3)

Moreover, the traditional mistreated 'crowding-out' effect is now an allied: a pressure against a given amount of available savings lifts the real natural interest in the positive region. Such an effect is usually mentioned as one of the most important undesirable side effects of a deficit spending public policy, since it would raise the interest rate, thereby damping private investment. In a world in which the equilibrium real interest rate is negative, the rise of the latter variable caused by a deficit spending policy can serve as a tool to lift the natural real interest rate back in the positive region, where monetary policy can be again effective.

What we want to argue is that a public spending policy ought to be reckoned essential during a prolonged stagnation for reasons which are drastically different from the ones proposed in the articles we are discussing. As we are going to see below, in the section devoted to alternative non-neoclassical visions of stagnation, it is possible to look at the role of the public sector as a true driver of growth and employment without resorting to any supposition about the

[103] Perhaps the old Keynesian suggestion of wastefully spending for useless jobs would hold up well according to them as long as it boosts savings demand.

value of a allegedly existing and negative natural real rate of interest. Indeed, two things may be pointed out in this respect.

First of all, the policy of public expenditure is *per se*, if one envisages the emergence of the stagnation as being caused by a lack of aggregate demand, a beneficial action from the government part. The issue rests in the fact that in the framework we are analysing a deficit spending programme is suggested only inasmuch as the natural real interest rate is supposed to be negative. Without such a qualification, we would fall again in the neoclassical realm in which public spending hinders the prospects of long run private capital accumulation. Moreover, as we have mentioned when describing the results of the simulation model, the same authors are not fully convinced about the feasibility of a deficit spending policy. It is so since according to their simulation it would take a doubling of the public debt today to push the natural real interest rate up by only a 1%. Therefore, the authors cast doubts about the feasibility of such a measure, since they do not judge it sustainable in the long run. Here we have another example of what may mean being content with the proposal of a deficit spending public policy within this theoretical context. Not only the public policy is desirable only when the natural real interest rate is negative, but then one can always retreat from proposing that policy because of the worries coming from the assessment of its long term sustainability.

Second, it is possible in our opinion to show that within the OLG framework of Eggertsson, Mehrotra and Robbins the solution suggested to lift the natural real interest rate into the positive territory is not the only possible. Specifically, public policymakers can act through the supply of savings as well, something deliberately prevented by Eggertsson, Mehrotra and Robbins. To show our point, let us rewrite the budget constraints of the private sector by inserting also transfers (Tr^i) together with taxes and public debt. Actually, transfer are a fiscal policy instrument usually employed that the authors do not consider at all. By doing so we get:

$$C_t^y + T_t^y = B_t^y + Tr_t^y \tag{63}$$

$$C_{t+1}^m + (1 + r_t)B_t^y = Y_{t+1}^m - T_{t+1}^m - B_{t+1}^m + Tr_{t+1}^m \tag{64}$$

$$C_{t+2}^o = Y_{t+2}^o + (1 + r_{t+1})B_{t+1}^m - T_{t+2}^o + Tr_{t+2}^o \tag{65}$$

and we modify the government budget constraint as well by cancelling out the demand for savings and public expenditure; we only leave a tax-transfers schema:

$$T^m + \frac{1}{1+g}T^o + (1+g)T^y = Tr^m + (1+g)Tr^y + \frac{1}{1+g}Tr^o \qquad (66)$$

The intertemporal tax scheme of equation 53 has been dropped for the sake of allowing the supply of savings to be modified. That equation made possible to design a tax schema such that the aggregate supply of saving would not have been modified by a government intervention. By running again the same passages of the authors, and therefore building a demand for loans – supply of savings schedules we can arrive at the formulation of the natural real interest rate with a public intervention based on only taxes and transfers. The demand for loans of the young is summed to the transfers to them, thus becoming more since they are still constrained by the debt limit.[104] The old, on the other side, will also see their consumption increased by a transfer, since they do not save at all, because they are going to exit the model. The natural real interest rate can be thus formulated in the following manner:

$$1 + r = \frac{(1+\beta)(1+g)D + (Y^o - T^o + Tr^o)}{\beta(Y^m - D - T^m + Tr^m) + (T^y - Tr^y)(1+\beta)} \qquad (67)$$

So it is possible to show that for given discount rate, debt limit, endowments and population growth rate a transfer to the middle aged and a tax on the old and young generation reduces the equilibrium real interest rate, while a tax on the middle aged and a transfer to the young and old generation increase it. We now suppose a fiscal policy setting the transfer to the middle aged, the tax on the old generation and the tax on the young generation to zero ($Tr^m,\ T^o, T^y = 0$), so we can isolate the effect of the elements of fiscal policy raising the equilibrium real interest rate. We obtain:

[104] In fact Eggertsson, Mehrotra and Robbins say that in the original scheme a tax on the young makes no difference for output because they will cut consumption one for one since the constraint is anyway binding in equilibrium. Here, young do consume above the amount allowed by the maximum level of debt they can ask for thanking the transfers from government.

$$1 + r = \frac{(1+\beta)(1+g)D + (Y^o + Tr^o)}{\beta(Y^m - D - T^m) - Tr^y(1+\beta)} \tag{68}$$

and, correspondingly, the government budget constraint is now adjusted in this way

$$T^m = (1+g)Tr^y + \frac{1}{1+g}Tr^o \tag{69}$$

we end up with a two equations-three unknowns system, where the unknowns are the tax and transfers to be exogenously set. The tax on the old can be then distributed in such a way so that the young and old can receive a transfer, that they will employ by consuming more. In this way the oversupply of savings can be directly channelled into consumption, and therefore the alleged excess is removed.[105] The latter simple exercise aims at showing that the fiscal policy schema set forward by the three authors appears to allow for a way out from the issues caused by the negative natural real interest rate which does not require a deficit spending policy. In other words, we want to single out the fact that if the problem has to be sought in an excess of savings over investment at any positive equilibrium real interest rate, then the solution may not necessarily require an active fiscal policy running a deficit of the public sector, it may suffice to redistribute the excess of savings towards the cohorts that are going to use it for consumption.

Obviously, our viewpoint on public spending is rather different: we do not look at the State intervention as a way to boost the demand for savings for the sake of pushing up the natural real interest rate. Rather the contrary, public expenditure can be regarded in our opinion as a long run sustain for aggregate demand and growth, appending to it an importance far from the unsatisfying secondary role attributed to it by the authors. The upshot is therefore: if public debt is only a tool permitting to overcome the troubles caused by a negative natural real interest rate, the same target can be hit by directly affecting the supply of savings. No tortuous way to arrive at suggesting an active fiscal policy appears to be needed in such a reasoning. As we are going to see in the fourth

[105] A simple numerical example tells us that for $\beta = 0.99$, $g = 0{,}005 = 0.5\%$, $Y^m = 1500$, $Y^o = 500$, $D = 150$ the apt tax-transfers scheme would be, assuming a perfectly even amount of transfers to the old and young, to impose a tax of 215.90€ on the middle aged and to split it in two transfers of 107.95€. In this manner we direct an amount of savings provided by the middle aged to two sets of agents spending all their income: the young because they are not endowed at all and also credit constrained, the old because they are going to exit the model. Under the same parameter setting, but not allowing for a public redistribution intervention (i.e. exogenously restricting the values of taxes and transfers to zero), the entailed value for the natural real interest rate would be -40%, hence confirming the fact that the solution via higher public debt is not, in the framework under scrutiny, the only way to solve the zero lower bound issue.

chapter, outside this framework of analysis a much more fundamental role can be attributed to public spending, which is an engine of growth regardless of whether the natural real interest rate turns negative or not, and regardless of whether a natural real interest rate actually exists or not.

- *Uniformity of the rates of return on investments*

We have hitherto dealt with the conclusions of Eggertsson, Mehrotra and Robbins that had been obtained in an economy without capital. We have seen that capital is introduced within a Cobb – Douglas aggregate production function: its rental rate, which then is inserted within the budget constraints, is equal to the marginal productivity of capital. We have pointed out the fact that, since the three economists want to analyse the feasibility of a theoretical steady state position characterized by a negative natural real interest, we have to refer to a long run position in which relative prices do not change. Thus, the rental rate of capital coincide with the marginal productivity of capital, because the difference between the price of the capital item today and tomorrow will be the same, and hence the rate of return on renting that item is influenced only by its marginal productivity. Recalling equations 60 – 61, we have seen that in order to arrive at the rental rate of capital the authors utilize the real interest rate to discount the price of the capital item tomorrow; then, we have shown how in the steady state the authors claim that the steady state real interest rate can be negative down to its lower limit set by the capital depreciation rate, while the marginal productivity of capital, and its rental rate, cannot fall below zero. Let us recall also the fact that so far in the article no reference to factors such as imperfect competition or riskiness had been made. Therefore, what the authors appear to be claiming is that in an economy with perfect competition and without riskiness, in a steady state position there can be a natural negative real interest rate while the marginal productivity of capital and its rental rate cannot fall below zero.

What appears to be an issue in this respect is the fact that the real interest rate in this economy can serve as a discount factor to calculate the net present value of an investment, but is also the reward for investing in a bond. Let us recall, indeed, that the agents can, in the example with capital, decide to invest either in a bond issued in order to consume more today, or in real capital. Therefore, there are two possible alternatives to evaluate when investing. This means that in a steady state the returns on the two investments must be equal, otherwise the investment

yielding less will not be chosen at all. In other words, what seems to be missing is an equation for the uniformity of the rate of returns. The lower bound on the level of the rental rate is zero, because of the equality with the marginal productivity of capital and the assumption that the constraint that marginal productivity cannot fall below zero. Accordingly, the lower bound on the real interest rate should be set, in steady state, by the requirement of uniformity across investments of their rate of return. The latter amounts to saying that even the real interest rate will have a lower bound, the same of the rental rate, i.e. zero. In terms of equations 60 – 61, we contend that they ought to be rewritten by taking into account the requirement for the rates of return on investments to be equal:

$$r_t^K = p_t^K - p_{t+1}^K \frac{1-\delta}{1+r_t}, \qquad r_t' = r_t^K = r_t \geq 0 \quad \rightarrow \quad r_{ss} \geq 0 \tag{70}$$

With the new version of the steady state equilibrium we are thus saying that the equality ought to hold for all the rates of return in the economy. Employing an aggregate production function of the CES family, we have argued in the first chapter, we know that the marginal productivity of capital cannot fall below zero even when the capital/labour ratio tends to an infinite value. Therefore, there are technical conditions preventing the marginal productivity of capital from falling to negative values. From the discussion of the case envisaged by Krugman in his article of 1998, we have also seen how it is true that the rate of return on an investment may be negative despite the positive marginal productivity of a single asset, because the price tomorrow of the asset might sufficiently fall, hence causing a capital loss rendering the whole return on the investment negative. Yet, differently from the example of Krugman with only land, here we are evaluating a steady state position, and therefore, for a non-negative marginal productivity of capital, if prices do not vary, we can be sure about the non-negativity of the rental rate of capital. In addition to this, we also have to consider, we contend, that in the economy there is also the possibility to invest in a bond, which will yield a real interest rate as a reward. Therefore, if one kind of investment is constrained to be non-negative in the steady state, then also the other available alternative must not yield less. Hence, even the real interest rate to be earned on the bond investment cannot fall below zero, not because of a technical condition, but simply because the uniformity of the rates of returns has to be warranted.

Let us suppose that we find ourselves in a situation such as the one described by equations 60 – 61: the rental rate of capital is positive, while the real interest rate on bonds is negative.

Since we have argued that this cannot be a steady state situation, let us see what ought to happen to the relative rates of remuneration. Since there is no hypothesis ruling out the possibility to move capital between the two kinds of investment, the subjects investing in the bond will not be content with the fact that they earn a remuneration lower than the one obtainable on real capital investment. Hence, they will progressively move towards the investment in real capital. Under the supposition of a technical description of production via Cobb – Douglas, a higher amount of capital utilized will push its marginal productivity down, and with it, its rental rate. On the other side, the capitals flowing away from the investment in bond will cause its price to fall, because of a lower demand for that asset, and consequently the real interest rate yielded to rise. Such a process will continue until the two rates of return converge to a uniform value, and thus investors will cease to steer capitals from one sector to the other. In the extreme case in which a huge amount of capitals flow towards the real sector, we are ensured about the fact that the marginal productivity of capital will not drop below zero by the fact that the production process described can allow for any finite value for the capital/labour ratio. Hence, we are ensured about the fact that uniformity will be realized at a non-negative value for the two rates of remuneration. In light of what the three authors suggest, we can thus see how in a steady state position, for an economy in which there are no riskiness or monopoly factors, the uniformity of the rates of return makes not possible to state that the natural real interest rate can be negative while the marginal productivity of capital and its rental rate are positive.

3.3 - The mark-up and riskiness factors

So far we have seen how the models of Eggertsson, Mehrotra (2014), Eggertsson, Mehrotra and Robbins (2017) try to explain the possible coexistence of a positive marginal product of capital with a negative natural real interest rate in an equilibrium position. Without some element yet to be added to the explanation, we have seen how it appears that the two variables ought to coincide in a steady state due to the necessary hypothesis of an equalization of the rates of return across different investment opportunities. In the final section of their articles the authors introduce two elements: the degree of monopoly and riskiness. These two factors should make the argument right because in the authors' intention they allow to say that even though the real interest rate on bonds turns negative, the marginal product of capital remain positive and the difference is due to

the elements just mentioned. What appears to be the main concern of the authors is to preserve the validity of the conclusions even when capital is introduced in the model; in particular they want to avoid to state that the marginal productivity of capital has to turn negative to justify the negative value of the real natural interest rate. Putting aside the fact that, perhaps disappointingly, in the end an entire Secular Stagnation theory boils down to these factors, something more can be added.[106, 107]

- *The mark-up element*

When dealing with the presence of imperfect competition and thus some degree of monopoly power, Eggertsson, Mehrotra and Robbins make the distinction between the marginal product of capital and its rental rate. They present the rental rate of capital and its relationship with the marginal product of capital in this form (2017, p. 44):

$$r^k = \frac{1}{markup} * MPK \tag{71}$$

with the ensuing comment:

> "With positive markups, the marginal product of capital is higher than the rental rate of capital. Thus, in equilibrium, there can be positive *social* returns to capital (even net of depreciation) while the rental rate (net of depreciation) and hence the real interest rate is negative." (emphasis in the original)

From the formula they show, it is difficult to provide a reason for the rental rate to become negative: it is the product of two positive terms. The '*markup'* term can be supposed to mean '1+μ' (its common formalization, where the addend μ stands for the degree of monopoly), thus in perfect competition the rental rate of capital equals its marginal product. The lower limit to the mark-up is obviously zero, the case of perfect competition just mentioned. The only variable that can hence render the rental rate negative seems to be the marginal productivity of capital itself, which however can be argued to become negative, but not in their line of reasoning, since they precisely want to show how their reasoning holds despite marginal productivity remaining positive. The only way out appears to be the 'even' in brackets in the cited sentences: the rental

[106] At most, one might say, they can be complementary to other possible fundamental explanations.
[107] Another thing that will just be mentioned is that, as admitted by the authors themselves, these factors are even rather difficult to measure.

rate *net* of depreciation may be negative, while the *gross* marginal product is positive,[108] but still this conclusion seems to be dependent on the fact that we compare a net product with a gross one. As we have seen before, the rental rate of capital and its marginal product are linked by a relation in which the former is regarded to be lower than the latter when competition is not perfect. Yet, they cannot have a different sign: if one is positive, the other is bound to be positive as well (or negative if the other is negative). Thus, the net rental rate can be negative if the net marginal product is negative as well. In that case the gross marginal product is surely positive, but the net is not; we seem to be describing a situation in which the marginal product of capital does not even suffice to cover depreciation. Why is it so it is not mentioned at all by the three economists, which content themselves by saying, as seen, that there could be a case in which the rental rate turns negative despite a positive marginal productivity of capital. One may envisage such a situation as one characterized by an overaccumulation of capital, that in the neoclassical framework may push the marginal product of capital down to a level in which it does not cover its necessary cost of reproduction. However, as we have seen the gist of the argument set forward in the article does not follow such a route to attain its central conclusions; actually, an hypothesis of overaccumulation of capital does not even come up anywhere. Rather, the writers attempt is explicitly to find a way to justify the presence of a negative real interest rate on bonds, which stands for the natural real interest rate, together with a positive marginal product of capital. It is difficult to imagine that the marginal product that should matter is the gross in place of the net one.

- *The role of the mark-up in models with imperfect competition*

In this particular formulation set forth by Eggertsson, Mehrotra and Robbins (2017) the mark-up acts as an element lowering the rental rate of capital, which could be therefore negative, and thus the natural real interest rate can allegedly go below zero as well despite the positivity of the marginal productivity of capital. Setting aside the doubts arose in the previous section, what we

[108] Their analytical strategy seems to be thus the same of the 2014 article, where in Sec. 9 (pp. 29 – 34) it is precisely the rate of depreciation on real capital that allows the real interest rate to be negative. Unfortunately in the updated version the authors do not feel the need to bother with a clear statement of the entire argument, comprehensible only to the ones coming across to the earlier version, which is nonetheless overtly said to be entirely replaced by the 2017 one. In the 2017 work the term 'depreciation' recurs 17 times, but its role is never explicitly discussed.

want to question now is the *ad hoc* use of the mark-up element made in order to justify the divergence between the marginal product of capital and its rental rate. In fact, if one accepts the widespread new – Keynesian treatment of the issue of imperfect competition, then he would have to recognize how the general role attributed to the market power allowing firms to charge a mark-up which would not be present in perfect competition is to lower the real wage determined by the marginal productivity of labour.

In a standard profit maximization problem[109] faced by a single firm operating in a non-perfectly competitive market for products, in which labour is by hypothesis the only factor of production, we have that the equality between marginal revenues and marginal costs requires:[110]

$$p = \left(\frac{\epsilon}{\epsilon - 1}\right)\frac{w}{MPL} \quad \rightarrow \quad p = (1 + \mu)\frac{w}{MPL} \tag{72}$$

and hence the real wage can be derived by rearranging:

$$\frac{w}{p} = \frac{MPL}{1 + \mu}$$

In this simple formulation, for a given nominal wage rate and physical marginal productivity of labour, the possibility to charge a higher mark-up if the elasticity of the demand for the product diminishes causes the price to rise and therefore the real wage rate is lowered.[111]

Therefore, even if we accept the widely accepted view of modelling imperfect competition, we ought to recognize that the usual way in which mark-up influence distribution is by constituting an addition over the marginal productivity of capital. Thus, a higher mark-up does usually impact distribution by lowering the real wage earned by labourers, and not by lowering the rental rate of capital for any given level of the marginal productivity of capital. The way in which Eggertsson, Mehrotra and Robbins model the impact of the mark-up on distribution, therefore, appears as an *ad hoc* treatment of the issue even within the broader group of models they utilize.

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[109] We are here referring to the example in Carlin and Soskice (2015), pp. 75 - 76. In there, a broad discussion of the new – Keynesian treatment of the market for labour and products can be found.

[110] Where p is the price for the output of the firm, ϵ is the elasticity of the demand curve for the product (measuring the responsiveness of the demand for product to the change in its price), w is the nominal wage, *MPL* is the marginal product of labour, μ is the mark-up charged on marginal labour costs, and it is equal to $\mu = \frac{1}{\epsilon - 1}$.

[111] The description of the wage setting curve is coupled with the description of the price setting curve in order to arrive at the determination of the NAIRU, the non-accelerating inflation rate of unemployment, obtained at the intersection between the two curves.

- *The riskiness element*

Besides imperfect competition, another element that can, according to the authors, allow for the coexistence of a negative riskless rate and a positive marginal product of capital is riskiness. Even though they do not formally introduce aggregate risk in the model, in appendix K (p. A.26) a simplified example is provided. Therein, with a perfectly competitive banking system the intermediation between borrowers and lenders is worked out by banks, that charge on lending a r_b interest rate arrived at by summing a base rate r_l on deposits and the factor $\emptyset$, namely the cost for the bank of every unit of investment or final good offered to borrowers:

$$r_b = r_l + \emptyset \tag{73}$$

In the main text, at page 44 discussing the conclusions, Eggertsson, Mehrotra and Robbins illustrate the meaning of this specification:

> "All borrowing and lending must now occur through a bank, which charges a spread between the borrowing and lending rates of interest. With a spread of 2%, for example, it is possible to have a borrowing rate of interest that is positive while the lending rate of interest is negative. Since firms borrow at the higher rate, the marginal product of capital in excess of depreciation is positive in this economy."[112]

The term $\emptyset$ is thus the spread between the two rates, standing for riskiness (we will label it '*rf*', risk factor). The formalization appears coherent with the neoclassical explanation of the profitability of the banking sector offering the service of channelling savings from households to entrepreneurs, in this way taking also care of sharing risk within the economy between risk averse and risk neutral agents.

Let us now expand the very stylized argument of the three economists. The positive borrowing rate r_b can be thought as the marginal product of capital net of depreciation, as the authors claim. Rewriting the equation

$$r_b = (MPK - \delta) = r_l + rf \tag{74}$$

and following the argument, the lending rate r_l ought to be negative. Hence, by rearranging the formula we get

[112] Let us notice how in this passage the three economists speak about a marginal product of capital in excess of depreciation that should remain positive, in this way providing some evidence about the discussion upon the degree of monopoly: it is the net productivity of capital which should matter. Though, if the latter is positive, the rental rate will be lower than the marginal product when there is a positive mark-up, but yet positive regardless of the mark-up value.

$$r_b = MPK = r_l + rf + \delta \tag{75}$$

where the lending rate is still given by a sort of 'purely financial' mechanism.[113] If the lending rate turns negative

$$r_l < 0 \rightarrow (MPK - \delta) - rf < 0$$

$$rf > (MPK - \delta) \tag{76}$$

the cause, in the present framework, might be thus attributed to a net marginal product of capital that is not sufficient to cover up the risk factor required by investors. As already pointed out, one explanation of neoclassical flavour could be that the amount of capital installed in the economy is so high that its marginal product has fallen to very low levels. Nevertheless, this is not the strategy chosen by the authors, that prefer instead to resort to the treatment of the difference between risky and riskless interest rate offered in a seminal article that we are going to analyse in this peculiar respect. The theoretical route preferred by the authors, as we are going to see, points to pick up the factor 'riskiness' in order to explain the difference between the natural real interest rate and the marginal productivity of capital.

As said, let us start the discussion about how to model the difference between risky rates of return and safe ones. Keeping the discourse along the lines delineated by Eggertsson, Mehrotra and Robbins, a way to reconcile a positive marginal product of capital with a negative riskless interest rate is to be found in the seminal article of Abel, Mankiw, Summers and Zeckhauser (1989), which constitutes a cornerstone for the diagnosis of dynamic inefficiency, both in a situation with and without uncertainty:[114]

[113] Within the neoclassical apparatus the general profit rate of an economy without monopolistic competition but with riskiness can be in principle arrived at by summing up marginal productivity, that is the pure remuneration of capital, and the risk factor: $r = MPK + rf$. Therefore one can see how the basic rate ought to be given by *MPK*, the addition above it being covered by *rf*: the result provides the rate at which firms borrow capital from banks, and absent monopolistic competition it sets the general profit rate of the banking and industrial sector, arrived at by means of free capital mobility. A riskless interest rate not governed by the marginal productivity of capital is a well-known and quite old concept. A concept that was studied by prominent authors such as Tooke, Marx, Keynes, and later on studied in depth by Pivetti (1985, 1991, 2004) following an insight hinted at by Sraffa (1960). In other words, a risk free interest rate not determined by marginal productivity is not at all a novelty, but it does not seem to be compatible with neoclassical theory, or at least only temporarily, as in the case of Wicksell, where banks can charge an interest rate on the money market higher or lower than the natural real rate. Yet, in the long run the interest rate charged by the banking sector has to converge towards the natural one to prevent a sustained period of inflation (or deflation) caused by the divergence between the market and natural interest rate.

[114] The most important innovation of that seminal article is precisely the treatment of the issue of dynamic efficiency in an economy with uncertainty.

> "Adding risk to our model is another rejoinder to Samuelson's argument. As Abel et al. (1989) show, adding aggregate risk can lead to a negative *risk-free* interest rate, while the average and marginal return from capital (net of depreciation) remains *positive*." (Eggertsson, Mehrotra and Robbins, 2017, p. 44)

The major point for our discussion, in the sense that it is directly linked to the propositions found in Eggertsson and Mehrotra (2014) and Eggertsson, Mehrotra and Robbins (2017), is the study in Sec. III (pp. 12 – 14).[115, 116] The question they aim to treat in that part of the article is the following:

> "[…]how can the measured rate of profit suggest that the marginal product of capital is so high at the same time that the real interest rate is so low? […]can physical capital assets that always yield a positive dividend have a finite value when the short-term safe real interest rate is always zero or negative?" (Abel *et al.* 1989, p. 12)

The primary factor they highlight to have a role in shaping the difference between the risky and safe interest rate is the uncertain intertemporal market value change to which capital can be subject, owing mostly to worsening expectations about future profitability prospects and falling wealth demand. The section devoted to the treatment of the difference between risky and riskless rates of return, which is worked out by means of small analytical demonstration, is started by presenting a utility function for the infinitely lived representative agent of this type[117]

$$U = E_t \sum_{i=0}^{\infty} \beta^i U(C_{t+i}) \tag{77}$$

It is by supposition a one asset economy, where there is a single non reproducible asset that delivers each period a certain dividend, which represents an amount of product delivered by the asset itself. Such dividend follows a dynamic process described by a random walk:

$$D_t = D_{t-1}(1 + g + v_t), g > 0, \qquad v_t \sim zero\ mean\ i.i.d.;\ v_t > -(1 + g) \tag{78}$$

[115] Cfr. Abel *et al.* (1989, pp. 6 – 7) for a formal analytical proof of the statement.

[116] The general enquiry they work out is a study of whether the issue of dynamic inefficiency arises in the major Western advanced economies. In general, in an overlapping generation context, it is said that if it is possible to increase utility for a generation without decreasing that of the others, the equilibrium we are considering is dynamically inefficient; it is efficient otherwise. The empirical findings of the authors do always confirm the presence of dynamic efficiency for several OECD countries. Two possible source of overestimation of the efficiency condition are enlisted by them: the inclusion of land rents in the returns to capital, and the assumption of perfectly competitive markets with constant returns to scale. Overall they do not believe that the magnitude of the potential distortion imposed on their estimation exercise is so high to overcome the final outcome.

[117] Where U is total utility, E_t is the expected value operator, β is the rate of time preference of the representative agent, C_{t+i} is the amount of consumption per period, D is the dividend to be earned and consumed, g is the exogenous rate of growth of the dividend, v_t is an exogenous shock to the dynamic process followed by the dividend.

$$C_t = D_t \tag{79}$$

The economy has no investment. The only asset is supposed to be always productive as g (its growth rate) is strictly positive as well as the dividend income *D*. The absence of investment depends on the assumption that all the dividend obtained from the asset is entirely consumed. Asset pricing in such an economy is carried out by employing the Euler equation for intertemporal consumption maximization:[118]

$$E_t\left\{\frac{R_{t+1}\beta U'(C_{t+1})}{U'(C_t)}\right\} = 1, \qquad where\ R_{t+1} = 1 + r_{t+1} \tag{80}$$

and supposing a logarithmic utility function, as the authors do, yields the safe equilibrium interest rate

$$U(C) = \ln(C) \rightarrow$$
$$E_t\left\{\frac{R_{t+1}\beta}{(1+g+v_{t+1})}\right\} = 1 \rightarrow\ R^F_{t+1} = 1 + r^F_{t+1} = \frac{1}{E_t\left[\frac{\beta}{1+g+v_{t+1}}\right]} \tag{81}$$

The risk free interest rate therefore depends on the discount factor of the representative agent, the growth rate of the productive asset, and a stochastic shock to the random walk shaping the evolution of that same asset. It follows that a sufficiently large variance of the random walk, that reflects output volatility, can render negative the net riskless interest rate negative. This can happen even with a positive output growth rate pattern, when the gross terms $1 + r^F_{t+1}$ falls below one. Abel *et al.* prove it by assuming a lognormal distribution of the term shaping the evolution of the productive asset:[119]

$$(1 + g + v_{t+1}) \rightarrow ln(1 + g + v_{t+1}) \sim N(\mu, \sigma^2) \tag{82}$$

The expected value of a term lognormally distributed is given by

[118] Where R_{t+1} is the gross equilibrium interest rate, and r_{t+1} is the net equilibrium interest rate. The subscripts F and R will signal the difference between the safe and risky interest rate, μ, σ^2 are the mean and the variance of the lognormal distribution.

[119] It means that one can apply a logarithmic transformation to the series of data, provided that all the terms in it are positively valued, and the new series obtained features a normal distribution with a certain mean and variance. In the case under scrutiny, since the economists are analysing a series of dividends that represent an amount of product delivered by a productive asset, it is natural to assume that the product can be either high or low, but surely positive. This kind of distribution is commonly utilized in financial application studying the behaviour of shares' prices, since in an analogous manner they can fluctuate over time but are never negatively valued.

$$E(1+g+v_{t+1}) = e^{\left(\mu+\frac{1}{2}\sigma^2\right)}$$

and accordingly its reciprocal is

$$E[(1+g+v_{t+1})^{-1}] = e^{\left(-\mu+\frac{1}{2}\sigma^2\right)}$$

Therefore, it holds that

$$E(1+g+v_{t+1}) * E[(1+g+v_{t+1})^{-1}] = e^{\left(\mu+\frac{1}{2}\sigma^2\right)}e^{\left(-\mu+\frac{1}{2}\sigma^2\right)} = e^{\left(\mu+\frac{1}{2}\sigma^2-\mu+\frac{1}{2}\sigma^2\right)} = e^{\sigma^2} \rightarrow$$

$$E[(1+g+v_{t+1})^{-1}] = \frac{e^{\sigma^2}}{E(1+g+v_{t+1})} = \frac{e^{\sigma^2}}{(1+g)} \tag{83}$$

The last term arrived at is substituted in the formula of the safe interest rate attained before, eventually getting

$$R^F_{t+1} = 1 + r^F_{t+1} = \frac{1}{E_t\left[\frac{\beta}{1+g+v_{t+1}}\right]} \rightarrow R^F_{t+1} = \frac{1}{\frac{\beta e^{\sigma^2}}{(1+g)}} \rightarrow R^F_{t+1} = \left[\frac{(1+g)}{\beta}\right]\frac{1}{e^{\sigma^2}} \tag{84}$$

which shows the inverse relation between the riskless rate and the variance of the random shock; when such a variance is sufficiently large it can force the riskless rat into the negative territory. A further claim is made by the authors when deriving the risky rate of return (we will label it r^R) of the productive asset, which takes into account also its price variation (V_{t+1} - V_t) between periods:[120]

$$1 + r^R_{t+1} = \left(\frac{V_{t+1} + D_{t+1}}{V_t}\right) \tag{85}$$

In this case, still exploiting the Euler condition, the authors claim that the mean return of the productive asset, which is

$$1 + r^R_{t+1} = \frac{(1+g)}{\beta} \tag{86}$$

is not affected by the degree of uncertainty of the investment. The risk premium influences only the riskless rate: a higher degree of uncertainty has the effect of lowering the safe interest rate,

[120] It is obtained by Abel *et al.* without showing the relevant passages; however they claim that the procedure to be followed is analogous to the one presented in the base safe interest rate case.

leaving the risky one unscathed. With a sufficiently high risk premium required, the safe interest rate can become negative, while the risky rate remains positive. This amounts to saying that in equilibrium a growing productive asset can go hand in hand with a negative real rate of interest. This last conclusion appears to be remarkably appealing to the eyes of the Secular Stagnation authors, since it is the exact point they wanted to demonstrate in order to confer theoretical validity to their arguments.

- *Questioning the logic of the model of Abel et al.*

Once we have laid down the reasoning of Abel *et al.* (1989), let us try to single out some doubtful point within their propositions. A first point arises when assessing the overall structure of the proof provided. Our question is: is it warranted that in that framework the marginal return from capital keeps on being positive while the risk-free rate turn negative? As seen, in their example it was so. Nevertheless, the positivity of the return on the productive asset was taken for granted since its rate of growth g was assumed to be positive. Recalling equation 84 for the risk free interest rate they derived:

$$R_{t+1}^{F} = \left[\frac{(1+g)}{\beta}\right]\frac{1}{e^{\sigma^2}}$$

one can try to evaluate what happens by initially assuming that the variance of the shock is zero; hence, we analyse the return on the productive asset without uncertainty. Let us recall as well that, by the problem setup itself, there is no capital and investment; the productive asset yields a certain dividend which is entirely devoted to consumption. At this point it seems that, as in the Krugman (1998) stylized model utilized to study the Japanese long term stagnation, the only determinants of the real equilibrium interest rate are the evolution of output and the agents' discount factor. Given that beta is bounded to be positive and between 0 and 1,[121] without uncertainty the safe interest rate can be negative if the productivity of the only existing asset (that in the case of Krugman was supposed to be a given amount of land, or given endowments in the case without production) to be consumed sufficiently decreases across time. Unsurprisingly, this was already the outcome of the Krugman's article on Japan where there were the assumptions of no uncertainty and rational expectations. In that case the condition making negative the real

[121] With a negative beta we would have to assume that agents' strictly prefer to systematically consume tomorrow instead of today.

equilibrium interest rate was the sufficient decrease of consumption between periods caused by a drop in the amount of the only available consumption good, in the base case due simply to a decrease in the endowments given to the population, in the case with land due to a decrease in population pushing down the amount of product obtained from the given land (and with it a decrease of the land price came along, making the return on investing in land negative). When the amount of product to be consumed was sufficiently less tomorrow than today, the real equilibrium interest rate turned negative.[122]

In the case under discussion in the 1989 article, where the variance of the shock is positive, now things do not appear to be all that different. The productive asset delivers each period a certain amount of product which is wholly consumed; that amount can be higher or lower than the one of today with a probability dependent on the variance of the shock that could hit the process. When the variance is high to the point that the asset can deliver tomorrow a product considerably lower than today, the safe interest rate can easily become negative.[123] In the end therefore the interest rate is determined in the contribution of Abel *et al.* for a given rate of time preference of agents, consumption level today, uncertain consumption level tomorrow; with those givens, the Euler condition for intertemporal optimization delivers the equilibrium rate of interest. It seems thus that the problem singled out in the first essay of the thesis for what concerned the seminal article of Krugman on Japan resurfaces even here: the model lacks a formal treatment of the introduction of capital, which is ruled out as soon as the assumption of no aggregate saving is made. The productive asset referred to by the authors can be assimilated to the land utilized by Krugman: indeed, Abel *et al.* state that this asset is the only available in the economy and cannot be reproduced. Hence the issue of studying the phenomenon of a negative real equilibrium interest rate fixed despite the presence of a positive marginal productivity of capital does not seem to be tackled. This leaves us in a world in which the intertemporal choice of agents with respect to consumption patterns is the only determinant of the interest rate. With no investment, no production function, no marginal product it is difficult to understand whether the

[122] Krugman provided for such a result the rationale that since tomorrow consumption is lower, it yields a higher marginal utility, and therefore individuals, for a given positive rate of time preference β, prefer to consume tomorrow rather than today.

[123] As seen, the risky interest rate instead is not influenced by the level of riskiness, and we can notice how it coincides exactly with the interest rate of Krugman 1998.

marginal product of the factor capital can be tied up together with a negative equilibrium interest rate obtained from the Euler equation.

Nevertheless, let us suppose that such a task is accomplished. What would mean introducing the marginal productivity of capital within this theoretical exercise? We have seen in equation 85 that the risky interest rate is defined by both the dividend yielded by the asset and its rate of price variation between periods. Then, in equation 86 we have seen that such an interest rate is determined by the discount factor of the representative agent and the rate of growth of the dividend, assumed to be always positive. By hypothesis, we introduce a different specification for the risky interest rate, which involves the formalization of a certain aggregate production function delivering the remuneration of capital in terms of its marginal productivity. Yet, the economic meaning of the solution provided by the authors would not be clear. The difference between the interest rate of equation 84 and the one of equation 85 is that the former is a riskless interest rate, while the latter is a risky interest rate. Hence, the economic explanation for such a difference ought to reside in the fact that the investor, if he wants to avoid the risks connected with the investment in real capital, can always choose to invest in a riskless asset. If the variance of the future outcomes is considerably high, the investor might be content even with a riskless interest rate which is negative.

First, we consider the case of a risky interest rate. As said, we suppose that the dividend earned is the marginal product of capital; the risky element in this formulation comes from the fact that there is a price variation between periods. If such a variation makes the future price of the capital asset sufficiently lower than its price today, the overall rate of return can be negative. In this instance, we have seen, the authors maintain that the degree of riskiness does not enter the determination of the interest rate. The rationale behind such a conclusion, in light of how they have setup their theoretical example, runs in our view in these terms: since by considering the price variation the overall rate of return can be negative, it is not possible to apply to the whole series of rates of return the log-normal distribution used in the riskless case, because such a specification requires that all values must be positive. Without the log-normal specification it is not possible to take into account the variance of the shock within the formulation of the interest rate, and therefore the risky interest rate is described only by the simple mean of the expected rates of return, as it is the case when one employs a normal distribution, which can admit negative values.

Secondly, we turn the attention to the riskless interest rate. In the example developed above the riskless rate formulation does not involve any consideration about the behaviour of the asset price, but only upon the evolution over time of the dividend yielded by the productive asset, which we suppose now to be representative of the marginal product of capital. If one does not take into account at all the behaviour of the asset price, as the authors appear to do (it does not shows up in any consideration about the riskless interest rate), then the meaning of the riskless interest rate would remain unexplained. Indeed, there would be no clue about a proper interest 'rate', since the whole example is developed only in terms of an absolute value, the amount of marginal product delivered by the capital asset. Despite the absence of any formalization of a proper rate of return in the riskless case, since the price of the capital asset does not enter it, let us assume that implicitly the authors are just envisaging a situation in which there is no risk involved in the capital asset price variation because the price remains simply constant. Thus, all the risk comes from the variability of the marginal product delivered by the asset. Now, despite its variability, we know that the marginal product of capital will always be positive; by hypothesis, its growth rate g is positive, and the random shock can make the product tomorrow higher or lower than today, but without questioning the fact that the capital asset will deliver a positive quantity of product. In fact, such a feature consents to the authors the employment of the log-normal distribution they exploit for the sake of arriving at the formula in equation 84. What is in this case the meaning of the example? We have stated that the price level remains constant, hence there is no riskiness coming from this element, and the amount of product is always positive. Therefore, what we are saying is that the rate of return in this case will always be positive since there is no element that can make it negative; the only risk present comes from the fact that the rate of return could be high or low, depending on the evolution of the marginal product of capital. Recall that we are in the riskless case scenario, in which, the authors contend, the safe interest rate can be, and in their example is, negative. Is the rationale behind the example acceptable? It would indeed seem that, in this specific case, an investor might choose to earn a negative riskless interest rate because there is a variability of the rates of return; but such a variability never implies that there is a state of the world in which the rate of return is actually negative.

Above, in the case of the risky interest rate, we have seen that the possibility of a negative rate of return then involves the impossibility to formalize a risky interest rate in which the

variance of the shock enters its determination. Therefore, it seems that the case in which a real rate of return is depicted does not involve any influence of riskiness, as the authors themselves promptly recognizes. On the other hand, the case in which the variance enters the determination of the riskless interest rate does not either deal with a proper rate of return, or leaves unexplained why an investor ought to choose a negative riskless rate of return when the riskiness of investing does not entail any scenario in which the rate of return obtainable is negative.

- *How to treat riskiness in relation to distribution?*

Going forward with the discussion, we can now turn the attention to another issue: is the treatment of the riskiness element relevant for determining distributive variables? When dealing with the issue of how to make the negative real natural interest rate coexist with a positive marginal product of capital, Eggertsson, Mehrotra and Robbins appear to conceive the riskiness element among the factors to be included within an explanation of distribution. As we have seen before, they couple their analysis of the Secular Stagnation phenomenon together with the insights from the 1989 article of Abel *et al.*. The overall picture may be summarized in the following manner: for a certain positive marginal product of capital, and given the determinants of the real natural interest rate (which is the one to be earned on safe bonds), the element of risk[124] can explain how the latter can be negative while the former is not. What are we then going to discuss is whether it is actually sensible to treat riskiness only once we have arrived at the analytical stage of the determination of income distribution.

It may be of some interest looking at the way of assessing the role of riskiness in shaping distribution and the difference between a safe and a risky rate of interest of two important authors, namely Frank H. Knight and Irving Fisher.[125] We are not going to develop a comprehensive study of the insights provided by these two important economists, but rather take some clue upon this specific issue from two cornerstone books they wrote. We have chosen these two neoclassical authors fundamentally because, as we are going to see, they offer two insights directly related to the matters we have been discussing so far. Obviously a satisfying review of

[124] Together with positive mark-ups arising from imperfectly competitive markets.

[125] A search in the operas of other influential neoclassical authors such as Wicksell in his *Lectures on Political Economy* or Hicks' *Value and Capital* showed the presence of passages related to the role of riskiness, but without the clarity and adherence of the two authors we are going to cite.

the thought of these giants on the subject we are treating would require a separate work with its own ends. What we want to bring within our enquiry is some other clue from important economists which have straightforwardly tackled the same issue we are now analysing.[126]

One contribution we want to mention herein is from the milestone written by Frank H. Knight, which is *Risk, Uncertainty and Profit* (1921). This wide-ranging book aimed at treating the role of uncertainty in affecting income distribution in a perfect and imperfect competition market system. What constituted one the most successfully developed concepts within the work was what is now called the 'Knightian uncertainty', in other words a situation in which the possible future states of nature in an economy are not known and it is not possible to describe them by a known probability distribution. How does such a concepts interplays with the factors we are discussing in the present work? What we are going to see stems from Ch. II, pp. 22 – 48 of the book, where Knight reviews the theories of profit present in the literature of his times, focusing on the versions imputing the origin of profits to 'change' and 'risk':

> "Mr. Hawley is in agreement with Professor Clark and his followers in defining profit as "residual income", and as to the nature and basis of the special income connected with the assumption of risk as an excess of payment above the actuarial value of the risk, demanded because exposure to risk is "irksome"; but Hawley insists that residual income and uncertain income are interchangeable concepts, while Clark is equally sure that the reward of risk-taking necessarily goes to the capitalist as such and that the pure profit of the entrepreneur is a species of monopoly gain arising in connection with dynamic disturbances, and that his only income under static conditions would be wages of management or coordination." (Knight F. H., 1921, *Risk, Uncertainty and Profit*, p. 42)

> "The result of the foregoing analysis should be to show the inadequacy of the two opposed theories of profit and to indicate the reasons for it and the direction in which a tenable solution of the problem of profit is to be sought. […] there is a principle of truth in both the "*dynamic*" and the "*risk*" theories, and the true theory must to a considerable degree reconcile the two views. On the one hand, profit is in fact bound up in economic change (but because change is the condition of uncertainty), and on the other, it is clearly the result of risk, or what good usage calls such, but only of a unique kind of risk, which is not susceptible of measurement.[…] The meaning of "*uncertainty*," and of the different kinds of uncertainties, and their significance in competitive economic relations, will therefore constitute the principal subject which we have finally to investigate in the present study." (Knight F. H., 1921, *op. cit.*, pp. 47 – 48, italics added)

[126] It is important to mention here the fact that in the citations we are going to illustrate the term interest relates to the pure remuneration of the factor capital, while profit is the excess arising over the pure remuneration of capital.

According to Knight, the views imputing the origin of profit to the willingness to face economic change[127] or to bear the risks of investing are misplaced and neglect the fundamental role of uncertainty, which is a separate category with respect to risk. Knight will then argue how it is true uncertainty, rather than risk, to be responsible for the emergence of a remuneration called business profit within the social product (cfr. Ch. IX). For what concerns riskiness, instead, there are some passages that relate to our discussion about the role of riskiness:

> "He and his opponents alike have failed to appreciate the fundamental difference between a determinate uncertainty or risk and an indeterminate, unmeasurable one. […] Now a little consideration will show that *there can be no considerable "irksomeness" attached to exposure to an insurable risk, for if there is it will be insured; hence there can be no peculiar income arising out of this alleged indisposition. If risk were exclusively of the nature of a known chance or mathematical probability, there could be no reward of risk-taking; the fact of risk could exert no considerable influence on the distribution of income in any way*. For if the actuarial chance of gain or loss in any transaction is ascertainable, either by calculation *a priori* or by the application of statistical methods to past experience, the burden of bearing the risk can be avoided by the payment of a small fixed cost limited to the administrative expense of providing insurance.
>
> The fact is that while a single situation involving a known risk may be regarded as "uncertain", this uncertainty is easily converted into effective certainty; for in a considerable number of such cases the results become predictable in accordance with the laws of chance, and the error in such prediction approaches zero as the number of cases is increased. Hence it is simply a matter of an elementary development of business organization to combine a sufficient number of cases to reduce the uncertainty to any desired limits. This is, of course, what is accomplished by the institution of insurance.[…] When the technique of business organization has reached a fairly high stage of development a known degree of uncertainty is practically no uncertainty at all, for such risks will be borne in groups large enough to reduce the uncertainty to substantially negligible proportions." (Knight F. H., 1921, *op. cit.*, pp. 46 - 47, italics added)

These insightful considerations made by Knight in his now classic book can be linked to our previous discussion in two respects.

First of all, Knight seems to be quite adamant in disregarding at all risk as a category having any influence on income distribution. When such a risk is a variable which can be

[127] Which can be ascribed to the increase/decrease of factors' endowment (population, capital), evolution of technology, change in the tastes of consumers and so on, cfr. Knight F. H. (1921), p. 33.

described by means of a certain statistical distribution, it can and will be taken into account by recurring to the services of a specific branch of production falling under the label 'insurance'. Hence, there will be some capitalist investing in a sector offering those services in order to obtain the general rate of profit. The payment for that service therefore can be enlisted among the various intermediate inputs necessary to carry out production, and it has no role in the sharing of the final net product.

Secondly, there are two respects in which the Knightian differentiation between risk and uncertainty appear rather relevant. The first case is the hypothesis made by Eggertsson, Mehrotra and Robbins (2017, Sec. 8, pp. 30 – 42) when they put the formal OLG model they built to test into a calibrated simulation model. This means giving coefficients to the main exogenous parameters entering the model[128] for the sake of ascertaining whether the latter is capable of delivering the supposed results about the pattern of the natural real interest rate. In particular, their aim is to reproduce the alleged fall of the natural interest rate started in the late seventies and continued until recent times, when the natural real interest rate is supposed to be negative. In the opening of the section devoted to the simulation of the transition dynamics of the natural real interest rate in the US economy since the seventies, the authors make clear a strong hypothesis they are making:

> "So far, we have confined our analysis to stationary equilibria. While this is one natural benchmark, we can also consider transition dynamics. This *requires taking a strong stance on agents' expectations* during the transition. Here, we document numerical experiments in which it is assumed that the economy was at a stationary equilibrium in 1970, and then project the model forward, *assuming agents have perfect foresight about the path of exogenous processes*. We feed into the model the dynamic paths for each of the forcing variables in Table. On impact in 1970, *agents have perfect foresight about each of the exogenous and endogenous variables*. For example, in 1970 all living agents will realize that there will be a productivity slowdown over the next 40 years and *will adjust their optimal decisions accordingly*." (Eggertsson, Mehrotra and Robbins, 2017, Sec. 8.6, p. 40, italics added)

The three economists afterwards go on showing how their simulations appear to fit rather well the suppositions about the downward marked trend of the natural real interest rate in the US economy. Without entering in the study of the construction of the calibrated model, what we can question at the theoretical level is how such an hypothesis, carefully stated by the authors, can

[128] Which in their case are the rate of time preference, the borrowing limit, the capital/labour elasticity of substitution; cfr. Eggertsson, Mehrotra and Robbins (2017, pp. 32 - 34).

relate to our line of reasoning. Our question is: how is possible to state in the conclusions of the article that the main role in divaricating the marginal productivity of capital and the natural interest rate is to be attributed to riskiness, if just some page before an entire simulation model has been built ruling out altogether riskiness? It would appear, indeed, that riskiness is of no concern at all, if agents are endowed with perfect foresight[129] and thus they are fully aware of all the processes of all the relevant variables involved, adjusting their behaviours in consequence of this. In terms of what we have been seeing before when talking about riskiness and uncertainty, in this example we have neither uncertainty nor riskiness. Where does therefore the negative value for the natural real interest rate come from in a simulation in which riskiness is absent, even trying to remain as close as possible to what the authors attempt to argue, appears difficult to be ascertained. Let us then turn our attention to the other reviewed case of Abel *et al.* (1989), in which there seems to be present riskiness but not uncertainty. As we have seen above, the section in which the authors present the demonstration regarding the differentiation between the risky and the safe interest rate was set forward supposing the existence of a single productive non-reproducible asset. Its output followed a law of motion in which the term containing the shock to the random walk had a definite mean and variance, i.e. it was supposed to be log-normally distributed with given mean and variance, as we have shown in equations 78 and 82. And, recalling only the results of that demonstration, the shape of the expected values when supposing such a distribution led the authors to conclude that the safe interest rate is the only one affected by riskiness, in such a way that higher riskiness results in a lower safe rate (with unchanging risky rate). What can we now add to the points already raised above upon the formal demonstration offered by Abel *et al.*? In the example the risk element appearing refers to the possible shocks occurring to the realization of the output delivered by the sole productive factor available. This gave rise to the uncertainty that an investor has to face, and made the two interest rates diverge. Now we know that if we consider the fact that risk and uncertainty are not the same thing, we could account for at least riskiness when knowing how the possible future events' distribution can be described. In the specific case we are discussing, the importance of suck a knowledge is so crucial for the authors that the final result they get is conditioned by the assumption they made about the distribution of the shocks. Since, in fact, the initial series of

[129] We are neglecting the discussion about whether the assumption of perfect foresight can be appropriate or too far from reality; we simply accept it.

output realizations is always positively valued (output in each period is a positive quantity of product) it is possible to apply to it the log-normal distribution (because the logarithmic function is defined only for positive values of the independent variable).[130] On the other hand, after the discussion of the insights coming from Knight we can say that knowing with certainty the probabilistic distribution of future events confers to the investor an advantage: she can now insure herself against the case in which an unfavourable situation materializes. In other words, as Knight clearly theorized in his 1921 classic book, a known distribution of risk can be always taken care of by paying a small fixed prize to an insurer. Here we have a situation in which the hypothesis about such a distribution shapes the results of the analysis, and appears therefore hardly escapable; at the same time, this hypothesis may deprive the results of their economic meaning, since in that case the interest rate earned by the investor ought not to carry any influence from riskiness considerations because they can be accounted for by means of a proper insurance contract.

The other contribution we want to mention comes from the seminal book of Irving Fisher *The Theory of Interest, as determined by Impatience to Spend Income and Opportunity to Invest it* (1930); we find in Part II, Chap. IX, pp. 120 – 131 a discussion of how uncertainty enters the pictures when it comes to determine the rate of interest in an economy. According to him, uncertainty is the most important feature of future events seen from today's perspective, and leaving it aside would deprive any theory of interest of realism. By introducing it in the picture, we get to deal with a variety of interest rates, rather than a single one:

> "One consequence of changing our assumption as to the certainty of future events is to compel the abandonment of the idea of a single rate of interest. Instead of a single rate of interest, representing the rate of exchange between this year and next year, we now find a great variety of so-called interest rates. These rates vary because of risk, nature of security, services in addition to the loan itself, lack of free competition among lenders or borrowers, length of time the loan has to run, and other causes which most economists term economic friction." (Fisher I., *The Theory of Interest*, 1930, p. 120)

And within this treatment, according to Fisher it would be appropriate always being careful in distinguishing between the safe and risky component of interest:

> "But for practical purposes, a good usage is to limit the term "interest" to fairly safe loans and staple or standard market quotations and to designate by some other term,

[130] We have also seen that the risky rate of return is not affected by riskiness, since a possibly negative value for the overall return makes impossible the application of the log-normal; the common normal which can be applied to it does not involve any variance within it, therefore ruling out the role of riskiness.

> such as dividends or profits, the other less certain and less standardized rates." (Fisher I., *op. cit.*, p. 121)

Therefore, it would seem that Fisher gauges the safe rate as a proper rate of interest, while riskiness is a component remunerated by profit (or dividend). Among the factors influencing the evaluations of investors regarding the degree of riskiness of an investment with respect to the possible alternatives Fisher enlists the period of time spanned by a loan or a bond, its degree of liquidity, the changes in value of collateral securities required to obtain it. When arriving at discussing how riskiness enters the determination of the safe and risky interest rates, Fisher sorts out two possible aspects on which risk impacts: the uncertainty of life and the uncertainty of the future income stream of an individual. Concerning the first case, the author tells us that:

> "Even when there is no risk (humanly speaking) in the loan itself, the rate realized on it is affected by risk in other connections. The uncertainty of life itself casts a shadow on every business transaction into which time enters. Uncertainty of human life increases the rate of preference for present over future income for many people, although for those with loved dependents it may decrease impatience. Consequently *the rate of interest, even on the safest loans, will, in general, be raised by the existence of such life risks*." (Fisher I., *op. cit.*, p. 125, italics added)

But our attention is directed more towards the second case, the one linked to the uncertainty about the future income prospects of a single agent in the economy:

> "When the risk relates, however, not to the individual's duration of life, but to his income stream, the effect upon the rate of interest will depend upon which portions of the income stream are most subject to risk. If the immediately ensuing income is insecure, whereas the remoter income is sure, the rate of preference for an additional *sure* dollar immediately over an additional *sure* dollar in the remoter period will, as was shown in Chapter IV, tend to be high, and consequently the effect of such a risk of immediate income upon the rate of interest will be to raise it. A *risky* immediate income acts on interest like a *small* immediate income.
>
> But *if, as is ordinarily the case, the risk applies more especially to the remoter income than to the immediate, the effect is the exact opposite, namely, to lower the rate of interest on a safe loan*. The *risky* remote income acts as the equivalent of a *small* remote income. This example is, perhaps, the most usual case. If a man regards the income for the next few years as sure, but is in doubt as to its continuance into the more remote future, he will be more keenly alive to the needs of that future, and will consequently have a less keen preference for the present. He will then be willing, even at a very low rate of interest, to invest, out of his present assured income, something to eke out with certainty the uncertain income of the future. *The effect of risk in this case, therefore, is to lower the rate of interest on safe loans, though at the same time, as already explained, it will raise the rate of interest on unsafe loans*. Consequently, *in times of great social unrest and danger, making the future risky, we witness the anomalous combination of high rates where inadequate security is given coexistent with low rates on investments regarded as perfectly safe*.[…] It has been noted in times

> of revolution that some capitalists have preferred to forego the chance of all interest and merely to hoard their capital in money form, even paying for storage charges, a payment which *amounts to a negative rate of interest*." (Fisher I., *op. cit.*, pp. 125 – 126, italics in the original on sure, risky, small)

In this second case thus Fisher appears to conceive the risky element as something that enters the way in which the safe and risky interest rates are set by affecting both; it lowers the safe and makes the risky rate higher. In particular instances, the effect might be so strong to push the safe rate into the negative territory. In these passages we find therefore what can be seen as an important predecessor of the basic idea that we have found in the more recent article of Abel *at al.* (1989): riskiness acts by lowering the safe rate of interest, rather than being an addition over it. The chief difference is of course the fact that in the 1989 article the risky rate of interest was left unchanged by changes in the degree of riskiness, while here in the quotes from Fisher risk acts on both sides.

A final consideration relates to the description of why riskiness ought to be today higher than in the previous decades. In other words, even if one accepts anything it has been advocated by the literature we are reviewing, there is still the need to justify the presence of a degree of riskiness that would make the safe and risky interest rates diverge. As we have seen, the role of population growth, technical progress, income distribution, private indebtedness have been accurately modelled. One can be highly critical towards the way in which these factors enter the discussion of Secular Stagnation, yet there is a clear cut proposal on the table. Such kind of statements are not traceable for what regards riskiness, which is a factor entering the discussion in a purely *ad hoc* manner, without any further justification. Therefore, even if one concedes to the authors the validity of their vision concerning riskiness, there would still be the need to justify why its role ought to be so relevant nowadays. Fisher, for instance, as we have just seen, justified the possibility to have a negative safe interest rate only in very specific and extreme cases, such a war, or a revolution, so to confer to such a possibly odd situation an explanation in terms of a very unlikely event.

- *An alternative way to treat riskiness*

If there are reasons to doubt about the role of riskiness within the explanation of Secular Stagnation, there may be an alternative way to take it into consideration? The proposed

alternative, indeed, would be to look at that factor as another among the intermediate elements of cost that have to be covered up in order for the economy to deliver a positive net product. Accordingly, therefore, riskiness could be listed among the factors that would enter production, but with respect to which one may abstract when considering the sharing of the net product among social classes.

We are going here to base our proposal on the view advocated by Knight: we think about riskiness as an element that can be taken into account within the other intermediate costs to be sustained in order to start production. In addition to his viewpoint, we want to have also a look at a hint given by Piero Sraffa in this respect in some part of his unpublished writings. We are going to refer to the reconstruction of the steps taken in the '30s by Sraffa in building his critique of the theory of value and the use of the concept of representative firm of Alfred Marshall offered by Stirati (2013). In particular, for our purposes it is of great interest the passage discussing Sraffa's arguments about the Marshallian theory of business profits (par. 5 and 6.1, pp. 448 – 454). In the series of Sraffa's writings Stirati analyses some parts were devoted by the Italian economist to the discussion of how the Marshallian representative firm is linked, in the explanation of the English writer, to the determination of the industry output supply price and of the distributive variable labelled 'business profits'. We are herein going to review only the parts in which Sraffa directly handles the issue of how to treat the riskiness inherent in the investment decisions. Sraffa studies the components of the costs borne by the representative firm when carrying out production, and the cost related to the organizational work needed to plan production is among them; therefore in the 'pool' of business profits, a part has to reward the employment of managerial ability.[131, 132] The latter remuneration adds up to the interest component which is

[131] One of the conclusions to which Sraffa arrived at was that it is not necessary to refer to a representative firm for the sake of explaining the magnitude of normal business profits entailed by entrepreneurial ability (Stirati 2013, p. 449). Indeed, if the latter is a prerogative of a particular industry, then the remuneration for it can be seen as a rent earned by that special factor of production; such a remuneration would show itself as a component making the rate of return in that sector higher than average. However, under the hypothesis of perfect competition, and thus of a uniform supply price for the product of the firms belonging to a certain industry, a possibly lower overall cost faced by a firm owning the 'higher than average managerial ability' factor would be fully offset by its remuneration.

[132] One of the considerations made by Marshall and that Sraffa found quite unconvincing was the view of business profits, in which the reward for the factor 'ability of the manager' is comprised, are to be reckoned as a percentage of the capital advanced for production. In Marshall, Sraffa noticed, such a conception can be rationalized as the possibility to have control over capitals of larger amount characterizing managers smarter than less skilled colleagues. (Stirati 2013, p. 450).

earned by the factor capital; it is determined by its marginal productivity and therefore depends on the technical conditions of production. Things get more interesting from the viewpoint of our enquiry when Sraffa lays down his doubt upon an alleged additional element of business profits which ought to be rewarded as well: a compensation for risk bearing. The quotes from the section D3/7 of the Sraffa unpublished writings reported in Stirati (2013, pp. 453 – 454) are worth being reported at length:

> "'risk-bearing', if it can be regarded at all as the function of a 'factor of production', with a share in distribution of the product (which is doubtful) is a function of the capitalist, or of some capitalists; it cannot be a function of the pure entrepreneur (who supplies only managing capacity) who, as such, owns nothing and therefore can stake nothing (slavery being excluded from our assumptions)." (D3/7 62)

On why it would be unclear whether 'risk-bearing' ought to share in a part of the net product of an economy:

> "To avoid misunderstandings it is necessary to make it clear that this is not a "compensation for risks": "distribution" is only between men, and insurance premiums, or their equivalent, are already accounted for as are depreciation of machinery, waste of material, etc.: these are bookkeeping, not economic categories." (D3/7 62)

> "this part of Marshall's analysis implies rather a private firm, of an owner-manager, in which the three element of profits can be seen in isolation in the earnings of Company directors who neither manage the business nor own any part of its capital; but by the mere presence on the board enable it to obtain loans or to place its shares." (D3/7 62)

In light of our purpose, namely discussing whether the riskiness entailed by investing in real capital is univocally conceivable as a component to be remunerated *ex post* or also as an element to account for *ex ante*, those quotes appear to carry some interesting insight. Let us now not question if looking at the origin of profits as partly determined by the marginal productivity of capital and the reward for managerial ability is correct, but rather at this 'third component'. The clue provided by Sraffa appears to be directed at excluding risk bearing considerations from the sharing of the net product. According to such a view, riskiness is an element which is already present in the accounting of the elements necessary to start production, and thus what happens to income distribution once from the gross product the remunerations for them are subtracted is not affected by it. In order to give a formal garment to this insight, let us employ the Sraffa price equations in the manner in which Panico (1988, Ch. 6, pp. 186 – 187) did for the sake of setting

forth a monetary theory of distribution.[133] Our aim is to try to exploit that analytical structure aiming at providing a formal treatment to the quotes of Sraffa reported above. The model of Panico entails the presence of two sectors, the industrial one and the credit one, with the latter supplying credit to the former, and earning a profit from the difference between the rate of interest charged on loans and the rate of interest paid on deposits. The credit supplied enables the production of the industrial sector, which accounts for the difference between the two interest rates as an element to be covered by the price of the product sold. Both sectors aim at earning, in equilibrium, the same general rate of profit r . In equations, Panico settles the problem in this way: [134]

$$\begin{gathered} Industrial\ sector: (\boldsymbol{Ap} + \boldsymbol{l}w)(1+r) + (\boldsymbol{q}i - \boldsymbol{d}\tau) = \boldsymbol{p} \\ Credit\ sector: (\boldsymbol{K}_b\boldsymbol{p} + l_b w)(1+r) + D\tau = Qi \\ w = w^* \\ \tau = i - \sigma_b \\ \tau = i_L - \sigma_L \\ \tau = r - \sigma_k \end{gathered} \qquad (91)$$

[133] The starting hypothesis of the model of Panico, which we are going to retain, are: the economy produces *n* goods, there are no joint products and durable capital, prices are normalized by the given money wage, bank loans are settled by the industrial sector at the end of each period, paying on them the same short term interest rate of a short term bond. In it, monetary authorities are able to affect distribution by the exogenous fixation of the short term interest rate on public bonds. Given a term structure of the rates of interest on various kinds of investment, a movement of the short term interest rate can shift the entire structure of the interest rates. For the given money wage rate, technical conditions of production and amount of physical product, a higher (lower) nominal short term interest rate causes the general price level to rise, since the interest rate enters the components of normal cost of production, and the real wage accordingly decreases (increases) as the general profit rate rises. An analogous way of conceiving the influence of monetary factors on distribution has been set forth by Pivetti (1985, 1991) as well; we have chosen the model of Panico in order to show our point since in there it is possible to find a more clearer distinction between sectors. This latter feature permits to insert more easily a third sector called 'insurance'.

[134] In it we find ***A,*** the input matrix of the industrial sector, ***p***, the price vector, ***l***, the labour vector of the industrial sector, *w*, the given money wage, *r*, the rate of profit, ***q***, the credit input vector of the industrial sector, *i*, the short term interest rate, ***d***, the deposit vector of the industrial sector, τ, the rate of interest on deposits, $\boldsymbol{K}_b$, the input vector of the credit sector, l_b, the labour employed in the credit sector, *D*, the total amount of deposits, *Q*, the total amount of loans, σ_b, σ_L, σ_k are the required differentials demanded by investors over the deposit rate when investing respectively in short term bonds, long term bonds and real capital.

The system has n+5 equations and n+5 unknowns, namely $\boldsymbol{p}$, i, i_L, τ, r ; σ_b, σ_L, σ_k are given parameters. The system is determinate, and delivers a full vector of prices plus the distributive variables.

Keeping the same identical overall structure, one may try to add another sector, the insurance sector, whose scope is to make a profit from providing such a service to the other two (industrial and credit). In this way the insurance provided by this third branch of production can be inserted in the 'bookkeeping', as Sraffa suggested. Let us point out that the equations we are going to employ do not by themselves imply any specific theory of income distribution and relative price determination to be valid. In fact, they simply account for the fact that the intermediate costs of production have to be covered up, and the prices of the various good and services to be brought to the market must be set as to allow each productive sphere to earn a general rate of profit that, in a long run equilibrium position, must be uniform. Therefore, the question of whether a neoclassical closure of the model instead of an alternative one do not modify the conclusions we are going to arrive at. In this way we preserve the possibility to close the model in any manner, but we keep on running our critique by supposing that the neoclassical theory could be valid, and yet the possibility to explain the coexistence of a negative natural real interest rate and a positive marginal productivity of capital cannot be sustained within it.

In the model of Panico, the credit sector delivers a vector of credit loans to the industrial firms, earning a rate of interest i on them, and paying a rate τ on the deposits it keeps. Here, the addition of the insurance sector follows the same outline: the specific sector has a vector of physical inputs times their price $\boldsymbol{K}_i\boldsymbol{p}$, labour inputs times the given the money wage rate $l_i w$, a general rate of profit to be earned r, a credit requirement payed at the relative interest rate $(q_i i - d_i \tau)$, an insurance service provided which implies a total amount of insurance payments received and insurance premiums delivered ($Tp_p - Tp_e$):[135]

[135] The new variables added to the model are T, the total amount of insurance contracts signed, t, the specific insurance input required by the firm (that in the case of the industrial sector takes up a vector form), p_p, the insurance premium collected from clients, p_e, the payment due to clients in case of a bad event, α, the probability for the event to happen, $(1-\alpha)$, the probability complement to one, σ_i, a given mark-up/illiquidity discount desired by investors in that sector.

$$
\begin{aligned}
&Industrial\ sector: (\boldsymbol{A}\boldsymbol{p} + \boldsymbol{t}p_i + \boldsymbol{l}w)(1+r) + (\boldsymbol{q}i - \boldsymbol{d}\tau) = \boldsymbol{p} \\
&Credit\ sector: (\boldsymbol{K}_b\boldsymbol{p} + t_b p_i + l_b w)(1+r) + D\tau = Qi \\
&Insurance\ sector: (\boldsymbol{K}_i\boldsymbol{p} + l_i w)(1+r) + (q_i i - d_i \tau) + Tp_e = Tp_p \\
&w = w^* \\
&\tau = i - \sigma_b \\
&\tau = i_L - \sigma_L \\
&\tau = r - \sigma_k \\
&p_p = p_e(1+\sigma_i)
\end{aligned}
\tag{92}
$$

Basically, the spirit of the model remains unchanged. The only modification is the inclusion of an additional sector, whose scope is to earn the general rate of profit, which must be uniform in equilibrium. We call it 'Insurance sector', standing side by side with the industrial and credit ones.[136] With respect to the former model, we have added three novel terms in the sector price equation, which are T, p_e, p_p. The total amount of insurance contracts signed is given from the vector input insurance requirement of the industrial sector, plus the requirement of the credit sector. Since the compensation to be paid to the clients and the premium earned annually are two different variables, with one equation only the model is not closed. For the latter to be determined, we add an equation relating the two prices. In it we have the given probability α, and the given illiquidity/mark-up term σ_i . two suppositions about the prices are made: in general, the compensation to be paid to the client when the insured bad event occurs is higher than the premium earned when the event does not occur, but the premium discounted for the probability α is higher. It is so since the probability of the bad event happening ought to be fairly small with respect to the base case without the event materializing. This permits to have, on average, a total amount of premiums earned higher than the allowances to the clients: it means that the sector, on average, does not rely on other operations to be profitable, but can claim a share on the net product primarily running its characteristic enterprise. In formulas:

[136] Let us notice how, in general, there would not even be needed the addition of a specific sector in order to discuss the role of riskiness. Being the insurance sector absent, indeed, the other capitalistic sectors would account for riskiness within their own management decisions. The formalization of a separate sector helps illustrating the point, and reflects an element of realism, being the insurance sector an important branch of many capitalist economies.

$$Tp_e < Tp_p \; on \; average$$
$$p_e > p_p \qquad (93)$$
$$\alpha p_e < (1-\alpha)p_p$$

Then, once the equation relating the two prices is introduced along with the others, the system is determinate. As said, confronting it with the one of Panico, there are two more prices and two more equations. Whatever the closure of the model,[137] once the sector taking care of the risk in the economy is introduced we have a branch of production looking after that peculiar task and earning the general rate of profit from doing it. Therefore, when such a component is accounted for in the gross product, being it transformed in a cost on the same footing of depreciation, labour, material and interest costs, the sharing of the net product can be carried out. If the preferred closure points at the marginal productivity of the factors for the sake of determining distribution, yet the marginal productivity of capital and what in that case would be called the natural interest rate ought to coincide. Such an attempt to formalize within a Sraffa price equation system the hints coming from Knight and Sraffa concerning riskiness as doubtfully being a factor to be rewarded with a share in the net product, rather than an intermediate factor to account for before starting it, is an embryonal exercise far from satisfactorily treating all the possible aspects of the problem. Anyway, it can constitute a way to put in a more formal framework a scepticism emerging from an 'external' viewpoint: rather than checking the internal validity of the reasoning proposed by some Secular Stagnation author as Eggertsson, Mehrotra and Robbins (resorting in turn to Abel e*t al*.) as in the previous part, we have tried now to question the inclusion of riskiness within the factors that are able to affect distribution *after* production, and accordingly tried to rationalize a hint of Sraffa claiming that riskiness could be taken care as an element of cost. Accordingly, the gross product would be affected by it, but not the net; in order to stick to the argument and view it principally under this aspect, we have neglected the way in which the system is closed, regardless of whether it involves social relative bargaining strength or the marginal productivity of factors. Even accepting the latter perspective, then it would be difficult

[137] Let us mention the fact that the system features a given nominal wage rate, which may be supposed to come from exogenous bargaining processes mediated by unions.[137] The real wage rate is then arrived at residually, once the interest rate is fixed by monetary authorities. Together with the other production coefficient and the nominal wages, the general price level is set and so the residual real wage. As said, a closure in terms of a real wage determined by the marginal productivity of labour would not alter our conclusions in this specific respect.

to imagine a situation in which the marginal product of capital and the natural interest rate would diverge in an equilibrium position, which can be the steady state analysis of the 2017 Secular Stagnation article we have been reviewing.

We have thus tried to see how some influent author in the past has dealt with the subject of riskiness and its influence on distributive variables, and in which manner those insights can be linked to the most recent attempt to resort to that element in order to confer coherence to a theoretical proposition, namely the plausibility of a negative real natural interest rate in an economy despite the positivity of the marginal productivity of capital. We have tried to argue that in presence of an element that can be legitimately called 'risk', it seems difficult to argue for an influence of the latter upon distribution, since the insurance sector transforms it into a term to account for among the other intermediate input. Yet, given the fact that in the literature we have also singled out the vision of an author as Fisher, whose opinion appeared instead to contain the germ of what Abel *et al.* have subsequently formalized, we do not claim to have posed a final word upon the discussion. Rather, we aim at conveying the doubts about the proposal set forth by the three cited Secular Stagnation authors, together with a possible alternative way to look at the role of riskiness in shaping distribution.

- *The individual and the aggregate levels of analysis*

The last point we want to raise abstracts even from this last discussion about the way in which riskiness can be taken into account when dealing with income distribution. So far we have seen how there can be internal doubts about the relevance of the proof provided by Abel *et al.* (1989) in terms of explaining the divergence between marginal productivity of capital and equilibrium safe interest rate due to the volatility of output. We have then seen how there could be a different perspective from which one may look at how riskiness enters (or not) distribution. Let us now try to understand what implications has to say that a risk free interest rate represents a safe alternative to a risky investment in real capital, and so how there can be a negative equilibrium interest rate. In order to simplify the most the formal treatment of the issue but staying close to the statements of the authors we are discussing, we suppose that in the economy there are only these two types of alternatives: investing in real capital or in a safe bond. By hypothesis, there are only two possible states of nature: a state in which the investment in real capital yields a positive

return, and a state in which a loss occurs. In order to have an expected value for the investment in real capital, we have to weigh these two states by their probabilities to occur. Formally:[138]

$$r^e = \alpha r^g + (1 - \alpha) r^b \tag{94}$$

Since the investor faces the possibility to either have a positive or negative rate of profit, she may decide to be content with an investment carrying for sure the expected value, which is lower than the best possible outcome but allows to avoid bearing the risk associated with investing. The expected value for the return on the safe asset can be thus seen as a sort of certain equivalent that a risk-averse agent desires instead of participating to the lottery of investing. In terms of our example, investing in the safe bond yielding the expected value is the alternative to the risky investment in real capital. The specific case of our interest envisions a negative expected rate of return on the safe bond. This can mean various things: such a negative return may be attributed to a low (high) probability of the favourable (unfavourable) event to happen, to a low (high) value of the positive (negative) rate of profit, or to a mixture of all these factors. There is therefore the possibility that the expected value for the investment in real capital can have a negative expected value, and therefore the certain equivalent for the investor would be a safe bond yielding a negative interest rate.

Our question then is: how can this reasoning in terms of expected value be translated into an economically meaningful concept? It may be stated that, following again the example, an investor may decide to invest in a safe asset even when the latter carries a negative rate of return, because fundamentally investing in real capital may mean facing the chances to end up with an even worse outcome. In this respect, despite the initial scepticism that an example of this kind may generate (since at least the safe rate of return ought to be, normally, positive), from the individual viewpoint of a single agent it seems to have a rationale. Indeed, the individual investor can always face several concerns such as the availability of only inefficient techniques, the difficulty to find a market for its own specific product, the expected adverse weather conditions, the extreme specialization of its production entailing an elevated degree of obsolescence, and so on and so forth. From its singular viewpoint, therefore, there may be cases, perhaps not even so infrequent, in which a wise choice can be to subscribe a safe bond carrying a sure rate of return;

[138] Where r^e is the expected value on the investment, α, $(1 - \alpha)$ are the relative probabilities for the two events to happen, r^g is the rate of return in the favourable case, r^b is the rate of return in the case of a loss.

in extreme cases, such a decision may involve even choosing an alternative that earns a negative rate of return, but at least prevents the realization of an even worse scenario.

What can be more difficult to maintain is the transposition of this way of framing the issue to the aggregate level. Indeed, neither ourselves nor the Secular Stagnation authors are interested in ascertaining what is the best choice of a single investor facing an uncertain outcome on an entrepreneurial decision, but rather how at the macroeconomic level there can be a negative real natural interest rate when the marginal product of capital is positive. Therefore, it appears necessary to make some considerations about what at the aggregate level may cause the natural rate of interest defined in terms of a certain equivalent to turn negative. In other words, we are asking ourselves which may be, at the aggregate level, the causes that can determine a negative rate of return on investing in real capital in the 'bad' scenario, such that the expected value of the natural real interest rate becomes negative as well.

Basically, in a neoclassical framework the rate of profit is determined, for given factors endowments (land, labour, capital), technical conditions and people's preferences, by the marginal productivity of capital. In this theoretical environment Say's Law is operative, and therefore what is produced is always sold since aggregate demand does not pose limits to the realization of what has been brought to the market. Thus, at the aggregate level, where is a factor determining a negative rate of return on investing on capital in the 'bad' state of the world to be found? On the one hand, at the production level, for given endowments of factors and state of technology, it would appear that only some sort of technical issue such as either technical regress or grave impediments to production may prevent production to be properly carried out. On the other hand, once production is done, the alleged validity of Say's Law permits to claim that aggregate supply creates its own demand.[139] In fact, whatever the size and composition of production, the leftover not used for consumption will constitute an amount of savings that will

[139] It may be stated that in the case of Secular Stagnation, the validity of this law is hindered by the presence of a price rigidity, namely the zero lower bound on the nominal interest rate. Notwithstanding, the analysis of Secular Stagnation in article of 2017 (and its precedent version of 2014) is carried forward separately with respect to the issue of how a positive marginal product of capital goes hand in hand with a negative natural real interest rate. As we have mentioned, the last point is briefly brought up together with riskiness only as an addendum to be made in the end of the analysis to justify the divergence of the two variables. Accordingly, we are not going here to look for possible links between the obstacle posed to Say's Law by the zero lower bound, a feature proper of the Secular Stagnation debate, and the gap between marginal productivity of capital and natural real interest rate. We shall treat the two issues separately, thus keeping on stating that in general, in the neoclassical theory Say's Law is fully operative.

be invested for the next period production. Now, given that there seem difficult to envisage issues of purely technical nature when producing, and one of the cornerstone laws of the theory ensures that the production is then entirely sold, it appears difficult to find a source of troubles making the general rate of return on capital negative.[140]

At the aggregate level the formation of an overall rate of profit seems to require a certain marginal product of capital given the endowments of factors and the techniques at disposal. At this point therefore a possibility mentioned in the discussion of the positions of Summers carried out in the first chapter of the thesis seems to come up again: a negative general rate of profit could be supposed to come from an overwhelming abundance of capital, such that its marginal product does not even suffice to cover the remunerations for the intermediate factors employed in production. Let us notice that, even if such a case could appear rather implausible, it has a logic coherent with the neoclassical theory.[141] Yet, it is not a case of interest for the mentioned authors of the 2017 article since in their line of reasoning the marginal product does not turn negative, and indeed on the contrary the struggle for them rests exactly in trying to argue that despite this hypothesis the natural interest rate can be negative. Actually, recalling our reasoning developed on two levels (individual and aggregate), it seems appropriate to state that at the aggregate level the relevant distributive variables are determined following the marginal productivity principle, and then at the individual the single investor can, subject to its own constraints and expectations, decide whether to productively invest or to simply subscribe a bond to preserve her savings, even when from time to time this may mean to earn a negative overall return. Moreover, even accepting the explanation of a negative general rate of profit in terms of a supposed 'over-abundance' of capital, this would not be, at the aggregate level, an argument that can back up the reasoning in terms of a variance of the expected outcomes that makes the expected value of investing in real capital negative. Rather, it is a situation that describes how the general rate of profit determined by the marginal productivity of capital can turn negative, since at the aggregate level there may seem to be little room to state that the general rate of profit in a 'bad' state of the world can be negative. Therefore, in our view the riskiness element can well be utilized at the

[140] In the short run there may be fluctuations of aggregate demand, but as we said on average in the longer term the system is supposed within the neoclassical literature to be characterized by the tendency to full utilize the available resources.

[141] Yet, we have argued in the first chapter how even this proposition appears to face remarkable theoretical problems.

individual level to describe the choice of a single entrepreneur, but does not properly describe the situation at the aggregate level.

- *A summary*

Let us now briefly summarize the gist of the various points we have singled out in the discussion about how imperfect competition and riskiness can enter the theory of Secular Stagnation. The preliminary question we wanted to address was: is it possible to conceive a situation in which in equilibrium the marginal productivity of capital is positive while the natural real interest rate is negative? Can the elements of imperfect competition and riskiness justify such a result? These are, translated into questions, the claims of Eggertsson, Mehrotra and Robbins.

For what concerns imperfect competition, we have seen that the very same formulation of the three authors leaves little room for arguing the possibility of a positive net marginal product of capital going hand in hand with a negative net rental rate of capital. Since the rental rate is formulated, in equation 71, as a magnitude that equals the marginal product when there is perfect competition, and is lower than the marginal product when there is imperfect competition, it follows that the net rental rate will always have the same sign of the net marginal product, and will be no lower than zero. Hence, a negative net rental rate of capital comes up only when also the net marginal product of capital is negative, a condition violating the premises of the analysis of the Eggertsson, Mehrotra and Robbins. Moreover, the introduction of the mark-up element that is exploited to say that the marginal productivity of capital and its rental rate can diverge appears a rather *ad hoc* way of formulating the argument even within a wholly neoclassical framework. In fact, the usual effect of a positive mark-up in the nowadays commonly used models describing imperfect competition is to lower the real wage that would be paid to worker in a perfectly competitive economy.

The analysis of riskiness has been more articulated, entailing several different aspects to be treated. We have initially tried to understand what does it involve saying that a risk factor can make the safe interest rate negative while the marginal productivity of capital is positive. It seems that the argument may imply stating that the net marginal product of capital does not suffice to cover its necessary costs of reproduction, with the latter including depreciation, risk compensation, etc. A natural way to frame the issue in a neoclassical framework may be thought to be asserting that capital has become so abundant that the ensuing drop in its marginal product

would cause such a situation. The three authors of our interest do not try to take this route to arrive at their conclusions; rather, they resort to a seminal contribution from the late eighties in which it is possible to find an analytical case showing the coexistence of a positive productivity of an asset with a negative safe interest rate. Therefore, the first step has been questioning the relevance of the proof provided by Abel *et al.* in 1989 (to which Eggertsson, Mehrotra and Robbins chiefly refer) for our discussion. It might be said, in fact, that the proof appears to be discussing an economy in which there is no proper capital with its marginal productivity, but rather a generic non reproducible asset. As in Krugman (1998), given the product of this asset and the rate of time preference of the representative agent, the employment of the Euler equation for the intertemporal maximization of utility derived from consumption yields the equilibrium interest rate. Yet, if the question to be answered related to the marginal productivity of capital, there seem to be no sign of it in the example provided, as the interest rate is fully set by the representative agent's allocation of consumption between periods. We have then argued that, even supposing the introduction of a marginal productivity of capital in that stylized model, it seems that the economic meaning of the safe interest rate in that framework would remain puzzling: why an investor ought to accept a negative riskless interest rate if in the worst scenario she can face she would earn a low but positive rate of return on capital?

In the next step we have shown the thoughts of Frank H. Knight and Irving Fisher about the role of riskiness in connection with the distribution of income; it can be said that while the former provided a vision about the role of riskiness as an element that can be accounted among the intermediate costs to be sustained before starting production, and that can be always insured against if it follows a known statistical distribution, the latter offered a standpoint which resembled almost a precursory version of the conclusions achieved by Abel e*t al.* some decade after. The Knightian distinction between 'risk' and 'uncertainty' resurfaced in the models of the authors we had been discussing in this chapter. Indeed, we have shown how in the contributions of Abel *et al.* and of Eggertsson, Mehrotra and Robbins the element of risk is either specified through a statistical distribution, or it is ruled out by supposing perfect foresight of the agents; therefore, we have argued that the riskiness element cannot be capable of influencing income distribution by lowering the natural real rate of interest below zero when the marginal productivity of capital remains positive.

The considerations of Knight led us to try to specify an alternative manner in which riskiness can enter the picture. We have reviewed some hint provided by Sraffa, who appeared to look at the riskiness element in a manner analogous to Knight. Therefore, we have tried to put these clues within a system of price equations, in order to show that it is possible to account for riskiness as an insurable factor that therefore does not exert an effect on the final distribution of income, since it is already taken care of among the other bookkeeping of firms. In terms of our line of reasoning this would mean that, even granting the neoclassical theory the validity of a determination of the distributive variables by means of the marginal productivity principle, riskiness could not exert an influence such as the one envisaged by the Secular Stagnation authors.

Our last point concerned the discussion of the investment in a risk-free bond as a sort of certain equivalent yielding a warranted return for a single individual, allowing her to avoid the lottery of investing, with its uncertain outcome. At the micro level this kind of choice looks reasonable, since a single investor facing many concerns when planning production may prefer to be content with a low but safe return (which in special cases may be even negative). At the aggregate level things appear less convincing: in a theory in which the interest rate on capital depends on the technical conditions of production and there are no realization issues due to the validity of Say's Law, where does the case for a negative interest rate on investment in a 'bad' state of the world come from? Again, the only case that may be coherent with the theory, if one wants to avoid to resort to hypothesis of some sort of technical regress or severe impediments to production coming from disastrous events, appears to be supposing a situation of over-accumulation of capital. This condition may involve a marginal product of capital so low that it does not suffices to cover the necessary intermediate expenses of production. Yet, as already seen, this is not the argument of the authors we have been studying, and it would perhaps appear, though coherent with the general structure of the theory, no less implausible than the other alternatives.

Conclusions

In the present chapter we have reviewed the most recent attempt to formalize in an analytical model the insights provided by Summers (2014, 2015) about the demand side Secular Stagnation theory. Thus, we have tried to ascertain whether the twin contribution of Eggertsson, Mehrotra

(2014) and Eggertsson, Mehrotra, Robbins (2017) constitute a substantial advancement towards a convincing formulation of the recent neoclassical explanation of the long lasting economic stagnation witnessed by the major capitalist economies. We have seen that within a novel way to formalize the subject, i.e. by means of an OLG model, the main features of the proposal of Summers are present: the several interactive factors contributing to shift downwards the natural real rate of interest can eventually make it negative, and thus they render monetary policy ineffective. In a model with the presence of capital, the authors justify the coexistence of the negative natural real interest rate with the positive marginal productivity of capital exploiting the elements of imperfect competition and riskiness. We have reviewed how the theoretical solution to the problem of stagnation is, according to the authors, the recourse to a deficit spending fiscal policy directed to public investments. The simulation that is carried out in the most recent version of the paper signals that population growth is by and large the main cause for the negativity of the natural real interest rate.

We can now conclude that, despite the relevant attempt to study the demand side Secular Stagnation issue within a more refined analytical model, the work of Eggertsson, Mehrotra and Robbins does not seem to convincingly back up the thesis of Summers, since their theoretical exercise leaves the fundamental issues of this analytical framework unsolved. First of all, the demand side Secular Stagnation theory does not give to aggregate demand and fiscal policy a prominent role in the explanation of the stagnation even in this very recent version. Indeed, by taking at face value the results of the simulation offered by the authors, we can ascertain how population growth is according to them the main determinant of the long term pattern of the natural real interest rate, until its drop below zero. We are therefore back to the explanation of Paul Krugman (1998) with respect to Japan; while Summers enlarged the list of factors contributing to that trend, the model based on his insights appears to sustain the prominent role of a pure supply side factor (the following one in order of relevance being the technical progress) in the emergence of a long period equilibrium position in which the natural rate of interest is negative. Once monetary policy is found to be ineffective due to the zero lower bound on the nominal rate of interest, then there can be room to state that there is a lack of private investment, with the closely linked excess of savings. Accordingly, a fiscal policy ran through a deficit spending investment plan can drain those savings from the economy despite the impossibility for the Central Bank to stimulate investment by lowering the policy controlled nominal rate of

interest. Therefore, it would appear that so far the demand side Secular Stagnation theory encompasses a role for demand that is purely ancillary to both the supply side shocks moving downwards the natural rate of interest and the rigidity on the nominal rate of interest.

Then, the attempt to explain how it is possible to reconcile a positive marginal productivity of capital with a negative natural real interest rate does not seem to have solved the theoretical ambiguity satisfactorily. In fact, we have tried to show that the role of imperfect competition and riskiness does not seem to add much to the discussion. Therefore, the issue that has been not explicitly tackled by Summers, and has been only briefly handled by Krugman remains in our opinion open. What is more, if we can claim to have shown that this theoretical position is untenable even within a neoclassical framework, than the demand side Secular Stagnation theory can be questioned on its main theoretical ground: there would be indeed no coherent explanation for the alleged long period position in which the natural real interest rate turns negative. Since the issues regarding the role of aggregate demand in the explanation of stagnation and the envisaged long period equilibrium position appear to remain an open problem even within the most refined model present in the literature, then our natural attempt would be that of looking outside the neoclassical framework in order to find a well suited theory which might be able to provide a rationale for the recent log lasting economic stagnation of the advanced capitalist economies.

CHAPTER IV - HETERODOX VIEWS ABOUT SECULAR STAGNATION

In the discussion of the neoclassical 'demand side Secular Stagnation' models we have pointed out two main recurring features, which are the secondary role of aggregate demand in the explanation of economic stagnation and the plausibility of a long run equilibrium position featuring a negative natural real interest rate. On the first issue, we have pointed out that in the models of Krugman, Summers and Eggertsson, Mehrotra and Robbins the lack of an amount of private investment sufficient to absorb the supplied savings does not seem to properly account for a shortage of aggregate demand as a cause for stagnation.[142] Rather, it is the result of a process starting from a supply side shock (in which population growth and technical progress are the most important factors) that causes the natural real interest rate to become negative. The zero lower bound on the nominal interest rate then makes monetary policy ineffective; otherwise, it would be possible to stimulate private investment by means of an adequate lowering of the policy controlled nominal interest rate.

In addition to this, the alleged long run equilibrium position featuring a negative natural real interest rate appears to be not consistent with the neoclassical apparatus employed to carry forward the analysis of Secular Stagnation. Moving from the initial attempt of Krugman until the last contribution of Eggertsson, Mehrotra and Robbins, we have not found a satisfactory answer to the question of whether it is possible to conceive a steady state position in which the natural real interest rate is negative while the marginal productivity of capital is positive. The various attempts to study the problem by means of models without capital, with only labour and land, or by resorting to the elements of imperfect competition and riskiness do not in our opinion convincingly deal with the issue.

The next step of our enquiry will accordingly be to look for a treatment of the subject of a long term stagnation of the economy that does not remain confined within the neoclassical strand of analysis. In so doing, we will try to see what an alternative way of dealing with the issue we have been investing so far can offer to the understanding of the recent episodes of prolonged stagnation. In this final step of the theoretical study we will evaluate an attempt coming from the post – Keynesian literature, and then we will turn the attention to other heterodox contributions.

[142] Even though it is true that saying that there is an excess of savings over investment means that aggregate demand falls short of potential output.

In the opening of the chapter we are going to pose our attention on the following aspect: what happens when a non-neoclassical attempt to explain stagnation does not get rid of the two main elements we have tried to question? In other words, do we get a different viewpoint with respect to the 'demand side Secular Stagnation' theory if we still base the analysis on both a long run equilibrium position featuring a negative equilibrium rate of interest and a rigidity that does not allow to get to that equilibrium position?

As we are going to see, we think that a study of stagnation retaining these characteristics appears to be bound to incur in the same problems we have already singled out before: the analysis would imply as a necessary condition an implausible equilibrium position, and aggregate demand would not play a primary role in the explanation. Therefore, we will argue that in our opinion the best way to deal with the problem of a long term stagnation is to resort to models in which aggregate demand is a long-run engine of growth, and it can play such a role because the whole framework of analysis is freed from the need to justify the use of a deficit spending fiscal policy from any concern about the value of an allegedly existing natural real interest rate.

4.1 - A non-neoclassical viewpoint retaining the main features of the 'demand side Secular Stagnation' theory

- *An alternative model*

An interesting discussion of the demand side Secular Stagnation theory is offered, from a post – Keynesian/neo – Kaleckian point of view, by two recent working papers of Thomas Palley (2016a, 2016b).[143] In what follows we are going to review the main claims set forth by the author. Palley focuses principally on the works of Krugman and Summers that we have reviewed in the first two chapters. The main targets of his criticisms are: the restoration within that framework of the loanable funds theory, seeing the real interest as the variable bringing into equilibrium loan demand and savings supply, and the concept that it is always possible to ensure full employment by appropriately setting the policy controlled nominal interest rate in such a way

[143] In the text we are going to treat the two papers as substitutes, since they basically reflect the same perspective on the argument, while being the first more theoretical in nature and the second more targeted at policy recommendations. The two are therefore highly complementary, but the main body of propositions is identical.

as to let the market real interest rate to be equal to the natural real interest rate. After showing the basic structure of the reasoning presented by those New Keynesian authors, Palley displays the negative shock pushing the equilibrium real interest rate in the negative camp (Palley 2016a, pp. 6 – 9, Palley 2016b, pp. 4 - 6), which are the ones we have been illustrating in the first chapter of the present thesis.

During the theoretical discussion of the zero lower bound issue, Palley pins down two major critical points about the neoclassical attempt to analyse stagnation: according to him, the zero lower bound is only a new rigidity introduced by New Keynesian theorists to explain the failure of the market mechanisms to reach full employment, even when monetary policy acts proactively. Moreover, the problem has to be found in the presence of additional investments possibilities beyond real capital that serve as a store of wealth, such as land, commodities, gold, patents, etc., and not in the zero lower bound, since they disincentive firms from investing, even if in principle there is the possibility for the monetary authority to set a negative nominal interest rate. The first point is raised by Palley for the sake of criticizing the demand side stagnation theory proposal as too close to the works of the Neoclassical Synthesis reabsorption of the Keynesian revolution. The lower bound on the nominal interest rate would thus act, Palley argues, similarly to the nominal wage rigidity typical of the neoclassical synthesis framework, preventing the price adjustment that would lead to full employment. The dissatisfaction of Palley therefore is due to the reliance on those kinds of rigidities to explain the dramatic recession-stagnation spiral of Western capitalism. The critique going to the heart of the issue is however the second: Palley does not believe in the impossibility to lower the policy controlled nominal interest rate below zero, and argues that some Central Bank is nowadays setting that interest rate below zero, and therefore the supposed presence of the zero lower bound cannot be taken as a guide for analysing monetary policy. He then moves forward by stating that the presence in the economy non-producible stores of value would make firms unwilling to provide the required amount of private investment that would render possible the attainment of full employment.[144] In order to show analytically his insights, Palley sets up a model in which he builds two schedules, one for the demand for investment and one for the supply of savings. The two curves are arrived

[144] During the discussion about the 1998 model of Krugman we have showed how a similar critique has been laid against the concept of a negative natural real interest rate even within the mainstream literature; we have shown the position on Homburg about the role of land in a marginalist framework of analysis.

at by horizontally summing the different components of the total demand for investment (savings to be invested in real capital, to be invested in stores of value, to be kept liquid) and of the supply of savings (which can take the form of loans or equities). The former schedule is downward sloping due to the decreasing returns on investment and rising adjustment costs for investing, while the latter is increasing because of the increasing riskiness associated with a higher amount of credit conceded in the economy. At the intersection between the two schedules Palley finds the equilibrium position in which the uniformity of the rates of return on the several investment possibilities is obtained.

The full model put forward by Palley to arrive to his conclusions is illustrated as follows:[145]

$$
\begin{aligned}
& r_I = R(K_0) - \kappa(I) - \delta + \pi && R(K_0) > 0,\ R_K < 0,\ \kappa_I > 0,\ \kappa_{II} > 0,\ \kappa(0) = 0,\ \delta > 0 \\
& r_M = i_M + \varphi(M) - \pi && \varphi(M) \geq 0,\quad \varphi_M < 0,\quad \varphi_{MM} < 0 \\
& r_G = \psi(G) + \pi && \psi(G) \geq 0,\quad \psi_G < 0,\quad \psi_{GG} < 0 \\
& i_L = i_F && \\
& r_E = \xi(E) + \pi && \xi(E) > 0,\ \xi_E > 0,\quad \xi_{EE} > 0 \\
& r_L = i_L + \rho + \lambda(L) && \rho > 0,\quad \lambda(L) \geq 0,\quad \lambda_L > 0,\quad \lambda_{LL} > 0 \\
& i_M = i_F - c && c > 0
\end{aligned}
\tag{95}
$$

The components of the schedules of demand for investment and supply of savings are enlisted, and then the equilibrium condition calling for the uniformity of returns is imposed:[146]

$$r_I - \theta = r_M = r_G = r_E = r_L \tag{96}$$

In a 'conventional' equilibrium, Palley argues, all curves are drawn in the positive quadrant, with the exception of the marginal efficiency of capital schedule, that passes continuously from the

[145] Where r_I marginal efficiency of investment, $R(K_0)$ marginal efficiency of capital, $\kappa(.)$ capital stock adjustment cost, δ depreciation, π inflation, r_M return on money, i_M deposit interest rate, $\varphi(M)$ own liquidity return on money, r_G return on non-produced stores of value, i_L risk-free loan rate, i_F money market rate set by the central bank, r_E cost of equity finance, r_L interest rate on loans to firms, ρ loan administration cost, $\lambda(L)$ default risk premium, c deposit administration cost. The implicit functions with one subscript denote the first derivative with respect to that term, while two subscripts denote the second derivative.

[146] Where θ represents a minimum required rate of return, that can be thought of as depending on 'fundamental uncertainty' of Keynesian flavour.

positive sector to the negative because of the decreasing marginal efficiency of capital.[147] Therefore, the equilibrium position can be found at a strictly positive value for the marginal efficiency of capital linked to a certain amount of private investment in real capital. According to the author, a lower policy interest rate would normally cause firms to ask additional credit to finance investment (and to change portfolio composition in favour of loans rather than equities, since their price is now relatively lower). Hence, in the author's words:

> "In *normal* times, a *lower policy interest rate stimulates investment*. Just *how much* depends on several factors including the sensitivity of the MEI to investment spending (i.e. the steepness of the MEI function) and the sensitivity of the marginal return on non-produced assets." (Palley 2016a, p. 26, emphasis added)

In "abnormal times" of long lasting stagnation the Central Bank may be forced to push the policy controlled nominal interest into the negative territory in order to do whatever is needed to stimulate investment. Palley therefore does not follow the models we have been reviewing in the previous chapters of the thesis in looking at the zero lower bound as a rigidity that does not consent to monetary policy to fix the policy controlled nominal interest rate below zero. Monetary policy, according to him, can well fix the nominal interest rate below zero, and for a given price level the real interest rate as well. Yet, the post – Keynesian economist argues that this move will not be sufficient to stimulate private investment. In fact, since there is the possibility to invest in stores of value in order to earn at least a non-negative rate of return, there will not be an incentive to invest in real capital by an amount sufficient to reabsorb unemployment. In the author's words:

> "The critical point is that if the marginal return to non-produced assets is always greater than or equal to zero, there comes a point when the MEI hits zero and all extra loan finance from negative loan rates will be directed to increased holdings of the non-produced asset rather than investment. *Once the MEI has fallen to zero, firms will not invest for a negative return when they can do better by acquiring additional non-produced assets*. The ZLB is not the problem: *the problem is the existence of non-produced assets* such as cash, land, commodities like gold, assets like patents and copyrights, assets like knowhow and organizational capital embodied in existing firms, and streams of rents owned by firms with monopoly power. The price of these assets will be bid up by negative interest rates, but investment will not. Firms will borrow to return equity to shareholders and they will engage in bidding wars (e.g. take-overs) for existing assets, but they will not invest.
>
> Interest rate insensitive investment spending is widely associated with a vertical IS schedule in the IS-LM model. Historically, this feature has been interpreted as a

[147] Cfr. Palley (2016a, p. 25).

> technical feature of the investment function. However, the above analysis shows it is a product of the existence of non-produced assets, alternative stores of value, and balance sheet re-engineering options. From that perspective, *a vertical IS schedule is an intrinsically financial phenomenon rather than the product of the technical characteristics of the marginal efficiency of investment*." (Palley 2016a, pp. 27 – 28, emphasis added)

The upshot of the stylized model is saying that the amount of investment needed to reach full employment might well be beyond the intersection of the marginal efficiency schedule with the x-axes, implying that a negative marginal efficiency of capital would be needed. Graphically, the diagram is drawn in the following manner:

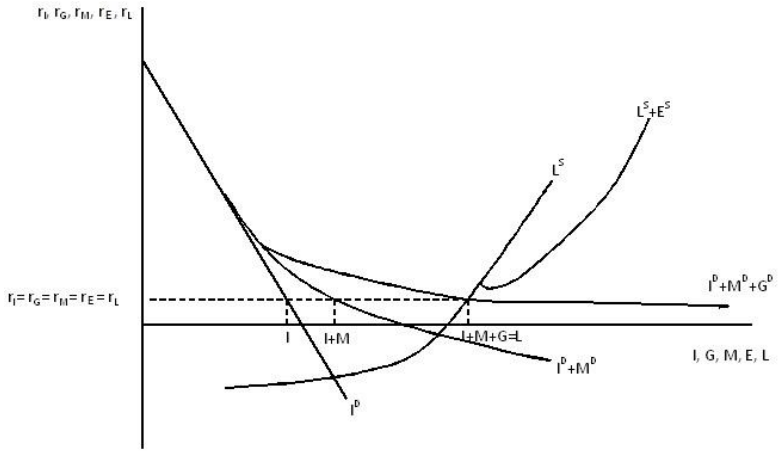


Figure 12 – The analytical framework of Palley with a demand for investment and a supply of savings schedules with a portion of the marginal efficiency of capital schedule in the negative territory, Palley (2016a, p. 27)

Therefore, the amount of investment needed to get to full employment would cause the marginal efficiency of capital to become negative. Given that the rate of return on the non-produced assets is at least zero, that amount of investment will not be realized. Investment can be stimulated if the real interest rate decreases, but this reasoning holds true until the real interest rate falls to zero. Even though the Central Bank is actually able to move the nominal interest rate (and for given price level, the real interest rate) below zero, this move will not be sufficient to reach full employment. Indeed, the investors will prefer to keep private investment to the point in which its marginal efficiency is equal to the rates of return on the other kind of investments; a lower bound is therefore still present and it is not set by the nominal interest rate constraint, but rather by the presence of non-produced assets.

- *Critical considerations*

A preliminary appraisal of Palley's model may signal some issue in the drawing of the two schedules of the demand for investment and the supply of savings. We have seen that the supply curve is upward sloping because of the riskiness involved by a higher amount of credit conceded; the latter implies, according to Palley, a higher level of overall risk of default and therefore a higher compensation required by creditors. Since the interest cost on the credit conceded is an upward sloping function of its quantity, it reflects a 'structuralist' view of the interest rate determination. A 'horizontalist' viewpoint would suggest to draw that curve horizontal, with the amount of spread among different classes of loans being set by relative riskiness conditions of each borrower. Considering that there is no functional and necessary relationship between the amount of credit borrowed and the interest rate charged on that aggregate level of lending, there may be no need to draw an upward sloping savings supply function. Therefore, given the 'safe' nominal base rate from the Central Bank part, a given spread may be added upon it in order to arrive at the horizontal curve, and then any amount of credit asked may be conceded at that interest rate.

The other issue to be pointed out regards the non-producible assets demand curve. In Palley (2016a, p. 23, note 15) we find the rationale for its decreasing shape; given the following formulation for *G*, which is the total real value of the non-produced assets[148]

$$G = \frac{q * g}{p} \tag{97}$$

since their supply and the general price level are assumed fixed, a higher demand for the available amount of stores of value causes their price to rise together with their total value; a rising stores' price today lowers the expected return on that kind of investment. But, if the higher price today univocally means a lower expected rate of return on those assets, this means that their future price is assumed to be fixed, perhaps by some kind of 'fundamental' or long run evaluation towards which there is a tendency to converge. If this is the case, it seems difficult to contend that the rate of return is decreasing but does not fall below zero: if for instance there is an inelastic long run asset price (with respect to the current asset price), a remarkable rise in the demand for the asset today, caused for example by gloomy prospects on real capital investment returns, can

[148] Where q is their price, g their fixed supply, p the general price level.

force the actual price above its long term value. The expected rate of return could thus become negative when *G* rises.[149] The possibility of a negative rate of return on the stores of value investment seems to be troubling, because the entire argument of Palley is grounded upon this feature to claim its difference with respect to the demand side Secular Stagnation theory.[150] Nevertheless, what we are mostly interested into is to ascertain whether the theoretical proposal of Palley is basically different from the already reviewed neoclassical attempts to study the demand side Secular Stagnation or not. Therefore, we are going to accept the way in which he has drawn the schedules of the demand for investment and the supply of savings.

As we have seen above, Palley argues that the equilibrium characterizing a Secular Stagnation situation would entail a negative marginal efficiency of capital, and therefore the possibility to invest in a non-producible asset would not consent to reach the amount of private investment needed to have full employment. In the previous chapters of the thesis we have tried to argue how, in a neoclassical context, an equilibrium position featuring a negative natural real interest rate does not appear to be acceptable. In our opinion, even in a framework in which the rate of return in an investment in real capital is described by the marginal efficiency of capital schedule and an interest rate given from the monetary market (in which the Central Bank can fix it), it can be stated that investing in order to get in equilibrium a negative marginal efficiency of capital would be economically meaningless.

Let us try to grasp the basic meaning of a negative real rate of return on investment in a framework encompassing the marginal efficiency of capital concept. The easiest way to do so is to employ the reasoning involved in the old-styled 'Array of Opportunities' approach (AOA).[151] The basic idea of such a schema is that for a given list of investment projects, each yielding a different rate of return, firms will deliver the overall outlay on capital once the interest rate is

[149] If, on the contrary, the long run price of the stores is elastic, it could be difficult to determine the rate of return, since it would be necessary to specify a systematic way in which the asset price tomorrow reacts to changes in the asset price today.

[150] It may be noticed also that, as in the old liquidity trap, this lower bound put by non-producible assets does not need to be binding at zero, but could be effective also above it.

[151] Even though nowadays it has gone out of fashion, it allows to take a straightforward picture of the issue; moreover, it permits to treat the alleged inverse relation between the interest rate and the amount of investment without relying on the common neoclassical mechanism which sees the interest rate as the price of a 'factor capital' whose employment rises when becoming cheaper. In addition, it had been built up precisely on the Marginal Efficiency of Capital (MEC) notion which we widely find in Palley, and it can be easily incorporated into the investment function utilized by him.

exogenously set. The amount of investment will be limited by the fact that at the margin the marginal efficiency of capital should be equal to the risk-free real interest rate for the profit maximization principle to be verified.[152] The conventional version did not encompass the negative real return part, which has been added here on purpose.

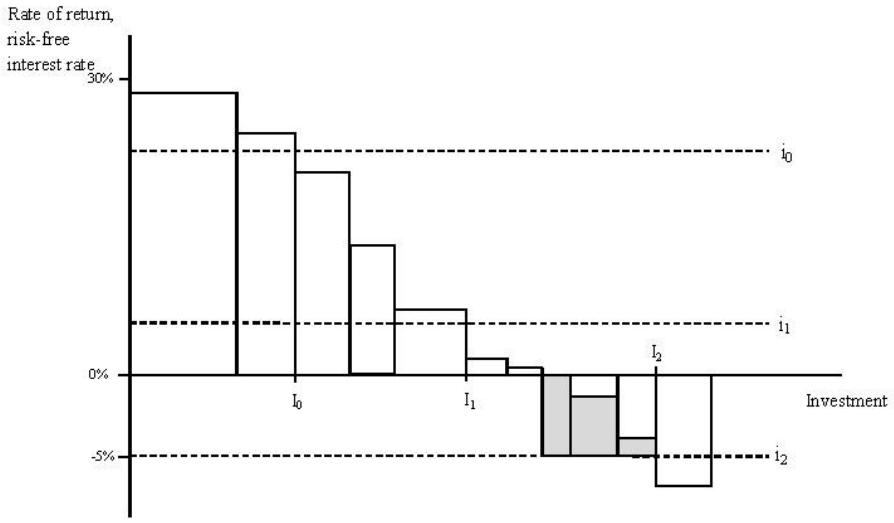


Figure 13 - The 'array of opportunities' graph with a negative marginal efficiency of capital, own elaboration.

In the graph, when we move from i_0 to i_1 there is an increment of investment due to the supplementary projects that will be undertaken; then, the same would allegedly happen when we further move to i_2. Is that warranted? It could, but with some qualification. Let us remain for a moment at i_1 (or i_0, which is the same): we would invest in the last project because the net rate of return is positive, and it is so since the rate of return on that enterprise consents to retain a quota

[152] The problem is that such an approach, though appealing, has encountered many critiques which surely contributed to its progressive abandonment. Three main problems can be located within that analytical framework. First of all, since the guide to investment is profitability, once a rate of return higher than the others pops up in the economy all firms would rush towards it, giving rise in so doing to the establishment of a uniform rate of profit throughout the system. It follows that the AOA can be assessed as a good approximation of disequilibrium situations, but hardly one well describing a long period one. Secondly, the fact that the array itself is given in the face of a varying interest rate signals the neglect of the role that the latter variable plays in determining normal costs, and therefore normal prices. The latter amounts to saying that the shape of the list of opportunities varies together with the variations undertaken by the interest rate and does not remain fixed as it is considered in that framework. Third, besides the shape of the list, even the position on the graph is bound to shift after a persistent interest rate movement: since firms do charge a mark-up on normal costs, a (say) lower interest rate would cause the entire graph to move downward because of competition (and this regardless of whether firms borrow all their capital or the interest rate represents for them simply an opportunity cost). For a deeper treatment of the subject, cfr. Petri (2004, Ch. 7, pp. 262 - 268), Girardi (2017, Sec. 2, pp. 10 - 11), Ackley (1978, pp. 620 – 624).

of the positive revenues out of interest payments to the initial capital lenders. Why one would then keep on investing at i_2? Because, allegedly, even though those projects have a negative real rate of return, the interest received on the capital borrowed[153] allows to more than cover the loss involved in that project. While before the net profit to be earned was simply measured by the difference between the upper side of any rectangle and the lower one given by the interest rate, in the negative portion it is given by the shaded areas, which stand for the *interest received on the loans demanded minus the losses incurred in the activity*.[154] Although this might have logical coherence, it is hardly imaginable as having some role whatsoever in describing a possible long run equilibrium. The conclusion to be drawn is thus that once the marginal efficiency of capital has fallen to zero, no firm will keep on carrying out investment projects because none of them would invest to make losses, and not because there are different investments opportunities beyond those in real capital. The issue with investment at negative interest rates appears to be therefore in the first stance *technical*, and *not financial* as Palley claims. Accordingly, investment will be limited by the fact that any profitable investment opportunity has been already undertaken, and not by the presence of non-producible stores of value.

Anyway, the AOA as said has gone out of fashion in the last decades, and its place has been taken by the adjustment costs theory of investment (ACA), which is indeed the one chosen by Palley as well. The whole picture is nonetheless only slightly modified: the ACA is the preferred specification, and within there is still the marginal efficiency of capital; the investment costs are 'operational' (in the sense of installation, organization etc.) and 'financial' (with this component be neatly determined by the 'increasing risk' of Kaleckian flavour).[155, 156]

Generally speaking, the noteworthy attempt of Palley seem not entirely satisfying principally because of the overall framework in which the analysis is conducted. Let us recall the general picture: there is a decreasing marginal efficiency of capital schedule inversely related to the amount of investment carried out. In normal times the monetary policy of the Central Bank can deliver the equilibrium real interest rate, giving rise to the appropriate private investment

[153] The interest rate has turned negative.
[154] Hence, the last project represented in figure 9 will not be selected since the operational losses are not covered by the interest payments received from banks on the capital borrowed from banks themselves.
[155] The main source of inspiration for the increasing risk logic is the classic article of Kalecki (1937).
[156] Adding a fixed spread upon the risk-free rate allows to put into the picture the mark-up pricing of private banks, but this element does not modify the conclusions: for a sufficiently low policy rate and a given mark-up on it, the marginal efficiency can trespass the zero lower bound.

level. When for several reasons (uncertainty, weak animal spirits etc.) the equilibrium marginal efficiency ought to be negative, the CB could simply fix the nominal rate in the negative field. The presence of non-producible stores of value impairs such a strategy by putting a lower limit to the uniform rates of returns in the economy, which cannot be realized below zero since those assets deliver at least a zero rate of return. It is possible to recognize in this reasoning the extreme similarity with the demand side Secular Stagnation theory propositions. The main difference rests in the mechanism depressing the amount of realized private investment: in the mainstream theory the zero lower bound on the nominal interest rate made monetary policy ineffective, while now the presence of several stores of value sets a lower limit to the rate of return to be earned in equilibrium[157].

We are then somehow back to the situation that Garegnani (1978, 1979) was attacking some decade ago: the openness of the Keynesian critique to the reabsorption carried over by the Neoclassical Synthesis of Hicks, Modigliani, Samuelson and Tobin. Indeed, according to him the most useful strategy to give the Keynesian theory strength was to unveil the grave logical problems entailed by the Wicksellian natural real interest rate concept. The nevertheless brilliant idea of Keynes to introduce a financial rigidity hinging on the liquidity preference and on the liquidity trap left the equilibrium interest rate notion practically unscathed. It came then at almost no surprise that Hicks (1937) and Modigliani (1944) successfully managed to curb the Keynesian revolution into an orthodox jail. Nowadays in this discussion something akin to that diatribe reappears: a financial rigidity ought to explain why investment does not kick starts even when the nominal interest rate is very low, or even negative. While in the old debate the equilibrium rate was positive and the liquidity trap occurred at positive values (despite possibly very low) the novelty appears to rest in the *negativity* of the equilibrium rate, with the financial friction becoming effective at the *zero lower bound*. But as in the old case, the better strategy appears to be a direct questioning of the meaning and existence of an equilibrium negative real interest rate, instead of trying to find out the best rigidity that would explain the difficulty (or impossibility) in reaching it.

[157] Let us mention that, anyway, the presence of non-producible stores of value can well be argued to be a factor preventing the emergence of a negative natural real rate of interest, as we have studied in chapter two through the example of Homburg. Yet, what we are arguing is that, regardless the validity of this kind of critique, it is the long run theoretical position envisaged within this strand of analysis that appears not acceptable.

What we want therefore to maintain is that it does not appear sufficient to attack the mainstream framing of the demand side Secular Stagnation by just replacing one kind of rigidity with another, but to question the validity of the entire theoretical apparatus and to look for an altogether different explanation.

4.2 - An heterodox viewpoint about Secular Stagnation without a negative natural real interest rate

So far we have reviewed the neoclassical models trying to explain the demand side Secular Stagnation through the impossibility to reach a long run equilibrium position featuring a negative natural real interest rate because of the zero lower bound on the nominal interest rate; this was the target of the first three chapters of the thesis. In the first part of the present chapter we have critically analysed also a post – Keynesian model, in which the theoretical strategy appears analogous to the mainstream attempt: the presence of alternative investment possibilities allegedly prevents the economy from delivering an amount of private investment in real capital resulting, in equilibrium, in a position in which the marginal efficiency of capital is negative. We have tried to argue how these attempts are not convincing under two main respects. First of all, the theoretical long run equilibrium position envisaged in these theories does not appear to be acceptable, since it involves in all cases a negative natural real interest rate, which does seem to be admissible within the overall structure of the theories employed for the reasons we have presented in the previous discussions. Secondly, the demand side concerns of these attempts do not appear to confer to aggregate demand a prominent role in the explanation of stagnation. Basically, indeed, the lack of private investment detected by the authors we have been citing arises because there is some rigidity that does not allow to stimulate the demand for investment by a sufficient degree. Therefore, since we have not found a convincing explanation neither in the previous neoclassical attempts nor in this latter post – Keynesian proposal, we want now finally turn the attention to theories which do not rely at all on a natural real interest rate, regardless of whether the latter variable is supposed to be positive or negative, and in which aggregate demand is an engine of growth independently from a supposed inverse relationship between private investment and the real interest rate.

By discussing an alternative way of treating the issue, which does not rely on a long run position characterized by a negative natural real interest rate and a rigidity preventing the attainment of such an equilibrium, we want to show that in our opinion there is a natural way to avoid the difficulties encountered in the models hitherto studied. Our preferred strategy to study a demand side Secular Stagnation is indeed to discard the theoretical strategy that is now prevalent in the academy, and which is well described by the models we have reviewed before, and then argue in favour of the heterodox fields of analysis.

In fact, outside the mainstream realm there is plenty of studies about some of the elements that we have already encountered in the explanation of Secular Stagnation. On the one hand, outside that realm one has the possibility to look at the determinants of long run economic growth without being tied to the evolution of population growth and technical progress. Indeed, outside a theory in which there is a long run tendency to full employ the available resources, there is no need to suppose that there is a lack of private investment because of the presence of a zero lower bound constraining monetary policy. Simply, a low level of aggregate demand growth does not provide to entrepreneurs the incentive to invest in real capital for the sake of being endowed with a productive capacity capable of satisfying demand by operating at a normal level of plants utilization, keeping a spare amount of capacity to be utilized when some unexpected peak of demand come about. On the other hand, the absence of a natural real interest rate determined by the intersection of a demand for investment schedule with a supply of savings schedule allows to better grasp the role of the several factors contributing to the stagnation of the economy. As we have been seeing, if each element entering the discussion about stagnation can be assessed as relevant only if it contributes to push downward the natural real interest rate, they on the whole lose their specificity. In this respect we have taken as paradigmatic the discussion of how income distribution can contribute to the stagnation of the economy. A purely aggregate demand concern regarding this aspect would look at the issue by supposing that when the portion of income accruing to the richest classes rises, given their low marginal propensity to consume, the overall pattern of demand may be negatively affected. Instead, in the demand side Secular Stagnation theory we have found a different explanation: the high propensity to save of the richest classes determines an increase of the pool of savings offered, and thus the natural real interest rate is *ceteris paribus* lowered. Hence, it would be now more likely the case in which the natural real interest rate turns negative, and so the economy gets stuck into a Secular Stagnation equilibrium.

- *The role of aggregate demand in an alternative analytical framework*

We have seen in the previous discussion of the demand side Secular Stagnation theory how the preferred policy measures proposed by the main authors taking part to the recent debate is an active deficit spending fiscal policy aimed at lifting back the natural real interest rate into the positive territory. The rationale beneath this proposal lies in the fact that for a given savings' supply schedule, a movement towards the right of the demand for investment schedule caused by a State investment policy would absorb from the economy the pool of savings that cannot be absorbed by private investment, since the equilibrium real interest rate cannot be hit because of the zero lower bound. In the previous discussions we have maintained that such a policy is on the one hand not strictly necessary within that framework, since it would be possible to drain those savings by an appropriate policy ran through a set of tax and transfers, and on the other hand, more importantly, it deprives fiscal policy from having a clear role as an engine for sustaining aggregate demand. Fiscal policy can be seen, outside the neoclassical framework within which the demand side Secular Stagnation theory is placed, as a fundamental element that can sustain aggregate demand in the short run, and also serve as a driver of the long term growth of the economy. What we are going to mention here are some contributions that point to the role of a deficit spending fiscal policy as a primary factor behind the growth of a capitalist economy; therefore, one of the main concerns arising from an alternative point of view ought to be directed towards the dynamics of public spending. A slow growth of public spending can thus be an element contributing to a slack in the general economic growth rate, possibly resulting in a stagnation.

Hein (2016) confronts the neoclassical demand side Secular Stagnation on several aspects. According to him, the reliance of those theories on a concept as the 'natural interest rate', which ought to bring into equilibrium the full capacity amount of savings with the demand for investment, poses serious doubts about the theoretical plausibility of those models. In his opinion in fact the 'Cambridge capital controversies' showed the more than doubtful analytical solidity of that theoretical concept. Whether positive or negative, it is then the very same existence of an interest rate equilibrating full employment savings with desired investment that is not warranted. With this it comes then naturally to question also the logical chain that sees prior savings to be translated into investment. It is apt to recall here that, as we clearly stated into the preliminary

introduction to the study of the demand side Secular Stagnation theory, we fully recognize the validity of the Cambridge capital critiques. Despite the undeniable relevance of those debates, our aim has been exactly to try to show how, even when one sets aside those direct critiques to the existence of a so called 'natural interest rate' determined by the full employment marginal productivity of capital, the neoclassical broad theoretical framework does not seem to be capable of hosting a negative natural real interest rate. Now that our discussion has been developed at length with respect to the major demand side Secular Stagnation models, we can join authors such as Hein in discarding those attempts in favour of the purely demand side models already present in the heterodox debate.

Following Hein, there is also the possibility to reconsider the role of aggregate demand driven primarily by a deficit spending fiscal policy in terms of the two main elements highlighted by the neoclassical authors we have been reviewing, which are population growth and technical progress.[158, 159] Once the long term pattern of aggregate demand is recognized as the main driver of economic growth, the supply side factors do not obviously lose relevance in shaping economic performances, but can rather be assessed as elements that endogenously adjust to the path of aggregate demand growth, instead of being exogenous both the value of the natural real rate of interest and the trend of the potential output. In addition to this, the role of income distribution can be freed from the ties to natural real interest rate, and become another element contributing to a slacking aggregate demand pattern.

Hein then goes on maintaining that an alternative view is open to the analysis of the role of the progressive financialization that we have been experiencing even prior to the unravelling of the Great Recession. The starting point ought to be the recognition of the chief role played by the dramatically enlarged role for the financial sector in advanced economies, encompassing a shift in investors' desires towards rapid short term profitability and a reorganization in favour of a more deregulated labour market. Therefore, the broad policy proposal of Hein to address stagnation is mostly nurturing public autonomous expenditure growth directed towards general purpose infrastructures, education and technological research. Those actions can also create

[158] We have seen that in particular the models of Krugman (1998) and Eggertsson, Mehrotra (2014) – Eggertsson, Mehrotra, Robbins (2017) heavily rely on population growth as the main factor causing the drop of the natural real interest rate below zero.

[159] It has to be said, however, that even if timidly, the issue of hysteresis is coming back in the neoclassical framework; cfr. Summers and Fatas (2018).

spillover effects on the private sector investment propensity and the labour force bargaining power if they result in a thick labour market. The latter effect can in return increase the wage share and thus aggregate demand, in particular if coupled with a tight regulation of the financial sector and a progressive tax reform. The overall strategy ought then be to sustain a 'wage led' growth, with the chief role played by a strong increase in public spending. Summing up, the approach suggested chiefly looks at the demand side drain related to stagnation, with the supply side elements seen as endogenous. The supply side potential output growth rate is not at the centre of the stage as in the mainstream Secular Stagnation debate, and the aggregate demand is not tied to the alleged negative value of the natural real rate of interest.

Another heterodox viewpoint about the determinants of long term economic growth and stagnation comes from the Sraffian theory. Within it, a natural way to treat the role of aggregate demand would ran through the employment of the 'supermultiplier theory'. Starting from the clues provided by Garegnani (1992), in which a capitalist economic system was supposed to be capable of accommodating a higher level of demand by varying the degree of capacity utilization in the short run, and by enlarging the capacity itself in the long run, a strand of literature starting with Serrano (1995) has now becoming accepted even in the post – Keynesian/neo – Kaleckian framework.[160] According to this view, there are components of aggregate demand that to do not depend on current income, and in this sense are autonomous. Moreover, they do not contribute to create productive capacity; the main elements of aggregate demand falling under this classification are government spending, exports, autonomous consumption.[161] A sustained period of growth of these components of aggregate demand would stimulate private investment, which is deemed to be almost wholly induced by the desire to build an amount of economic capacity sufficient to satisfy the expected future level of demand at a normal degree of capacity utilization.[162] Within this strand of literature the distribution of income between social classes characterized by different propensities to consume does exert an influence on the level of demand: a redistribution of income towards the labour income recipients would sustain the level

[160] Cfr. Lavoie (2016), Allain (2014) for some example of how the insights to be found in the supermultiplier theory are becoming accepted in the literature.

[161] For a full taxonomy of the various components of aggregate demand in light of the supermultiplier theory, cfr. Cesaratto, Serrano, Stirati (2003).

[162] The process of growth characterized by a tendency to converge to a normal degree of capacity utilization has been the protagonist of an interesting debate; on this aspect of the theory, cfr. Palumbo, Trezzini (2003), Trezzini (1995), Trezzini (1998).

of demand. Despite this important feature, the supermultiplier models show how the rate of growth of the economy is only shaped by the rate of growth of the autonomous non-capacity creating components of aggregate demand cited here above.[163] Therefore, a slack of the long term pattern of those elements can be sufficient to explain, by itself, a tendency for the economy to stagnate; income distribution can be treated as exogenous, and dependent on the relative bargaining power of the different social classes involved in the social conflict.

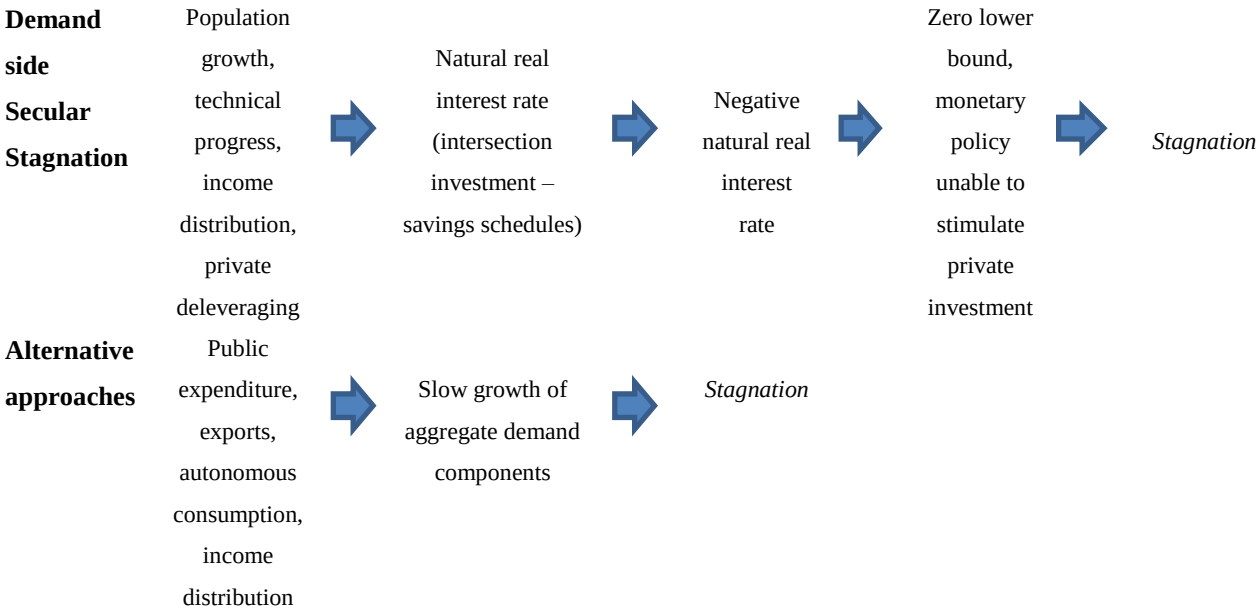
Let us single out an example of how the supermultiplier theory can be utilized to study the consequences of a slower rate of growth of a particular autonomous component of aggregate demand. In Pariboni (2016) we find an effort directed towards a formalization of the supermultiplier growth model in which the autonomous consumption brought about by consumer credit demand (accommodated by private banks endogenous credit creation) is the principal driver of aggregate demand evolution and capital accumulation.[164, 165] Investment, a said, is in the model a component of demand allowing firms to be endowed with the adequate level of capacity that enables them to satisfy demand at a normal level of capacity utilization, and therefore its evolution follows the expansion of the autonomous components of demand; a multiplier process is operative in the short run, while an accelerator mechanism operates in the long term. A sudden collapse occurring in the financial sector that results in a lower amount of credit to be borrowed would thus, in this peculiar framework, cause a deceleration in the rate of growth of one of the autonomous drivers of demand, and therefore a slower rate of accumulation can ensue from an episode like the recent Great Recession in the US. The way to look at the role of private debt would therefore be the following: since the financing of households credit by private banks was not anymore feasible in the aftermath of the Great Recession, a slacking aggregate demand

[163] For a comprehensive discussion of the differences between the post – Keynesian, neo – Kaleckian and Sraffian views about the role of income distribution in light of a long run theory of growth, cfr. Cesaratto (2015).

[164] The supply of credit is made fully endogenous and dependent on the growth of the autonomous components of aggregate demand; in analogy to this model, it is possible to model also the roles of net exports and government expenditure through the supermultiplier lenses. An empirical work surveying the effects of those components and their associated trends on the development of major Western economies is to be found in Pariboni and Girardi (2016).

[165] The sustainability of the process depends on the differentials between consumers' autonomous demand and the growth of the other components, in particular in that example capitalists' autonomous demand and public expenditure (Pariboni 2016, section 3, pp. 222 – 228). The process can feasibly generate a long term growth process when the rate of growth of the private sector indebtedness does not outweigh the rate of growth of the other mentioned components.

dynamics followed by a slump in private investment is a natural consequence of a sudden halt in the growth of one of the main elements driving economic growth. As it is possible to notice, there is no need to resort to the more convoluted explanation of the demand side Secular Stagnation theory. Let us make a comparison between the two different ways of analysing economic stagnation via a simple graphical reconstruction of the two narratives:



We can see how the alternative approaches looking at the role of aggregate demand as a long term engine of growth appear to have two appealing advantages.

First of all, they provide an explanation for the phenomenon of stagnation which is much simpler, immediate and intuitive: since both the short run economic performances and the long run *growth* of the economic system are steered by the autonomous components of aggregate demand, and income distribution is particularly relevant in terms of the *level* of aggregate demand, we have to look at those aspects in order to understand stagnation. A slow growth of those elements straightforwardly causes a slow growth of the economy. As said, the case of the US can be therefore tackled by supposing that the end of the era characterised by credit financed consumption has meant for that economy that an important source of demand suddenly expired, and therefore unless that growth strategy is replaced by another strategy led by another component of demand, stagnation is a rather normal outcome to be expected.

Secondly, those explanations do not need the concepts of a demand for investment and supply of savings curves, that are untenable in light of the Cambridge capital critiques, of a negative natural real interest rate, which is hard to accept even remaining within the neoclassical apparatus, and of a fiscal policy useful only when the zero lower bound binds. As we are arguing, in fact, within this framework the concept of Secular Stagnation can difficultly be handled without recurring to the hardly defensible concept of a negative natural real interest rate, and aggregate demand matters only inasmuch as it is allegedly constrained by an ineffective monetary policy. We are trying to show here how it is possible to free the role of aggregate demand together with the removal of a concept, the negative natural real interest rate, which does not seem to add much to our understanding of the phenomenon of Secular Stagnation.

- *How to look at the elements contributing to stagnation*

In this final section of the chapter devoted to an alternative viewpoint about Secular Stagnation, we want to highlight how outside the demand side Secular Stagnation apparatus there is space to treat the several aspects contributing to stagnation in a more comprehensive way. In the previous part we have been stating that if the role of aggregate demand is freed from the theoretical chains of the negative natural real interest rate analytical category, it is possible to study population growth, which appears to be the main factor behind the neoclassical explanation of stagnation, as an endogenous factor rather than an exogenous determinant of growth; the same applies to technical progress. We have also mentioned how income distribution can be treated more satisfactorily as another element impacting upon aggregate demand levels; moreover, as in the cited case of Pariboni (2016), the expansion and burst of the households' capacity to borrow credit can be analysed in light of a long run theory of growth looking at the autonomous non-capacity creating components of aggregate demand. We have therefore tried to advocate the validity of alternative approaches relying on aggregate demand dynamics in terms of a superior ability to explain stagnation without tortuous chains of reasoning.

In this section we want also to argue that a viewpoint of this kind is also much more open to a realistic description of the concrete patterns of the main variables involved in the study of Secular Stagnation. Since a reconstruction of all the factors involved would be beyond the scope of the present thesis, we are going to show how it is possible to describe the main feature of the

US crisis occurred in 2008, which is the end of the era in which it was possible for the households to easily get access to private credit in order to keep their expenditure growing. As we have seen in particular in the model of Eggertsson, Mehrotra (2014) and Eggertsson, Mehrotra and Robbins (2017), within the demand side Secular Stagnation apparatus this matter has been treated by supposing that by hypothesis the young generation does not have access to any form of income, and therefore they need to ask for savings from the elders. This demand is subject to a maximum limit, which is exogenously given; when the latter collapses, the demand for loans decreases as well and this contributes to impart a downward push to the natural real interest rate. We have already singled out the poverty of this way of describing the issue: whereas this approach clearly tries to describe a real world situation in which it is true that the younger generation need loans to sustain the consumption pattern, it is in our opinion possible to give to this clue a much more realistic and rich description.

Let us now see how it is possible to treat the very same issue in a different light. We are going to review some contribution from two important heterodox strands of though: Barba and Pivetti (2009), Cynamon and Fazzari (2008, 2015), respectively from a Sraffian and post – Keynesian point of view.[166] Barba and Pivetti (2009) were preoccupied with the rising private indebtedness of the bottom 80 per cent of the US households (going hand in hand with a plunging saving rate). The cornerstone of the paper is the analysis of the profound manner in which private debt and worsening income distribution are interwoven; in spite of this, the latter has been providing a considerable portion of the aggregate demand needed to sustain the US economy in the last decades. The associated cost has been paid, the authors argue, in terms of a growing instability of the financial system.[167] The part of main interest in light of our discourse is the third section (pp. 117 – 121): in it the neoclassical point of view on the subject is critically reviewed. They aptly point out that on the one hand that the orthodox economists worry about the falling saving rate witnessed the US economy because of their undesirable effects on capital accumulation, but on the other hand they welcome the rise of private household debt, which is

[166] It is perhaps not of secondary importance to get a glimpse of the period in which those works have been published: in particular Barba and Pivetti (2009) and Cynamon and Fazzari (2008) went out before the world wide collapse of the western economies (US first, and then the European ones), pinning down problems at the heart of what was going to unravel in a short while. The explanations reviving the Secular Stagnation category have instead seen the light not before 2013, well after the economic downturn.

[167] Instability that, as the authors maintain (cfr. Section 10, pp. 129 – 131), could have been much better faced resorting to public debt in place of the skyrocketing private debt.

described as a Pareto improving phenomenon. Indeed, according to the mainstream life cycle explanations of the pattern of consumption through a lifetime, the spreading presence of efficient financial markets helped households to smooth the intertemporal path of consumption by means of debt, allowing to tackle the short run fluctuations in income experienced by the households. Barba and Pivetti then contend that within an alternative approach the issue may be studied without relevant inconsistencies. Worsening income distribution, together with consumption habits grounded on social norms and customary attitudes, can explain why households facing a stagnant real wage have been continuously resorting to more debt. The latter offered a relatively easy way out to the undesired necessity to curtail current expenses, even considering the relative better position enjoyed by upper income classes that contributed to feed the willingness to 'keep up with the Joneses'.

Cynamon and Fazzari (2008, 2015) published some contribution about the same issues, scrutinizing the problem in a similar vein, thereby directing the attention primarily on social customs and habit formation in the society at large. Then, they formulate an interpretation which goes hand in hand with that of Barba and Pivetti (2009), saying that the desire to keep up with high income households consumption patterns in the face of stagnating real incomes drove continuously up the debt/income ratio of the bottom groups up until a 'Minsky Moment' got in the way. In the 2008 paper we find a study warning on the gloomy short run prospects that the US economy had been meticulously erecting by piling up a huge amount of private debt (and providing the rationale already singled out for that evolution). *Ex post* instead, they describe the substantial halt to aggregate demand put by forced deleveraging, as in the 2015 article's conclusions we find:

> "Therefore, we fear that the demand drag from rising inequality that was postponed for decades by bottom 95% borrowing is now slowing consumption growth and will continue to do so in coming years. The unusually sluggish recovery of consumption in the Great Recession is immediately evident in the large demand gaps created by slower PCE growth relative to the pre-recession trends, for both the bottom 95% and the top 5%, shown in Figure 7. We argue that the economy needed the pre-recession trend growth of PCE to attain full employment. But the data presented here show that *this demand growth before 2008 could not continue due to the unsustainable way it was financed*." (Cynamon and Fazzari, 2015, p. 21, emphasis added)

It is therefore immediate a comparison with the neoclassical demand side Secular Stagnation way of describing the role on indebtedness. In the models of Eggertsson, Mehrotra (2014) and Eggertsson, Mehrotra and Robbins (2017) private indebtedness and income distribution are just

two phenomena among the various entering the explanation of stagnation since they exert a downward pressure upon the natural real rate of interest. In the description of the model we have seen that income distribution enters the picture through the assumption that there are given endowments for the old and middle – aged generations, while the young do not have any income. Therefore private debt becomes a necessary mean to obtain consumption, and it is subject to another assumption, namely that there is an exogenous limit to its amount. A sudden collapse of this limit mimics then the event of a financial crisis. But the role of income distribution and private debt accumulation, as we are contending, can well be treated outside this schema. In the previous section we have stated that the effect on the growth of the economy can be well studied without resorting to how they affect the natural real interest rate, but rather by focussing on how they impact on the pattern of the aggregate demand. In this section we want to add the consideration that there is a more satisfactorily way to treat the evolution of income distribution and of the amount of private indebtedness of households: instead of translating them into simple assumptions which shape the results of a model built to evaluate the pattern of the natural real interest rate, they can be the object of a study in light of the social determinants of consumption and the recourse to debt, that in turn are influenced by the concrete sociological and political factors determining income distribution and the habits of the different social classes composing the society.

Conclusions

In this chapter we have examined some viewpoint alternative to the neoclassical demand side Secular Stagnation theory about the issue of the long term stagnation of an economy. In particular, we have tried to differentiate between the explanations that keep on retaining some prominent feature of the demand side Secular Stagnation theory, and alternatives that more clearly reject those aspects. The post – Keynesian viewpoint of Palley, as we have been arguing, is prone to incur in the same issue we have pointed out when dealing with the attempt of the neoclassical authors. Indeed, even though Palley is clear in his critique to the role of the zero lower bound typical of the neoclassical explanations, assessing it as a rigidity that ought to explain a crucial phenomenon as a long lasting stagnation, we think that his analytical strategy do not satisfactorily deal with the matter at stake. In fact, the overall apparatus set forward by Palley

is based on a demand for investment and supply of savings schedule that intersect to determine the equilibrium marginal efficiency of capital. In unconventional periods such as the aftermath of a financial crisis, the equilibrium marginal efficiency of capital may lay below zero, and the presence of non-producible stores of value can convince investors not to accumulate real capital, but to buy them. Therefore, the problem would not rest, according to Palley, in a zero lower bound constraining the effectiveness of monetary policy, as in the explanation set forth by Summers, Krugman, Eggertsson, Mehrotra and Robbins, but rather in the presence in the economy of assets which are in given supply and that serve as alternatives to the investment in real capital. We have tried to argue that such an alternative explanation is liable to face a criticism analogous to the one laid upon the neoclassical reasoning: a long term equilibrium position in which the marginal efficiency of capital is negative appears deprived of economic meaning, on the same footing of the explanation in terms of a negative natural real interest rate. The critique based on the presence of alternative stores of value seems therefore not very strong, since it basically only replaces the zero lower bound with another kind of friction.

We have therefore finally tried to turn the attention to the strands of heterodox literature that do altogether away with an equilibrium position featuring a negative natural interest rate. Without that theoretical concept, we have advocated, the treatment of Secular Stagnation can be carried out in a much more satisfying way, and without incurring in the theoretical issues pointed out in the previous chapters of the thesis. In these frameworks the role of aggregate demand is freed from the ties encompassed by the determination of the natural interest rate at the intersection between the demand for investment and the supply of savings schedules. Indeed, fiscal policy is relevant in both the short and long run, and there is no need to suppose that the natural real interest rate has turned negative to sustain the necessity to boost aggregate demand by a deficit spending public fiscal policy, as in the position of the demand side Secular Stagnation authors. Moreover, the analysis of the accumulation of private debt and of income distribution can be carried out without the necessity to reduce them to simple assumptions to be made within a model built to analyse the pattern of the natural real interest rate, but are rather a central element of the long term evolution of the economy. The social and political factors driving the evolution of income distribution and of the attitude of consumers towards borrowing play therefore a much richer role in these alternative explanations. The final message from the present chapter is therefore that, while the neoclassical demand side Secular Stagnation offers an

interesting attempt to explain the recent long lasting stagnation of the Western advanced economies, it is outside that realm that a more convincing way to look at economic growth and stagnation can be found.

CHAPTER V - THE EMPIRICAL RELEVANCE OF INVESTMENT RESPONSIVENESS TO PRICE VARIABLES

The renewed interest on the topic of Secular Stagnation, spurred in particular by the articles of Larry Summers (2014, 2015), has resulted in a considerable amount of theoretical works and analysis. Besides those two articles, we have been studying the other major contributions from the neoclassical side, in particular the seminal work of Krugman (1998) and the latest papers of Eggertsson, Mehrotra (2014) and Eggertsson, Mehrotra, Robbins (2017).[168] We now know that in the demand side Secular Stagnation theory a long lasting stagnation[169] arises when the natural real interest rate becomes negative, and the zero lower bound on the nominal one coupled with mild inflation expectations do not allow for the appropriate monetary policy crackdown. If this is the case, the amount of investment that would be needed to absorb full employment savings does not materialize because the market real interest rate remains 'too high' with respect to the natural real interest rate. The other side of the coin is that there is an excess amount of savings in the economy, something that a negative interest rate may make vanish.

The proposed solutions for such an unpleasant situation are basically relying either on monetary or fiscal policy, with the latter proposal that is most vocally advocated by the demand side Secular Stagnation authors.[170] As we have seen in chapter three, nowadays the role of a government deficit spending policy channelled towards public investment is strongly emphasized as the solution to a Secular Stagnation situation. But why is it so? As the demand side Secular Stagnation authors purport, a policy enlarging the stock of public debt will put pressure on the

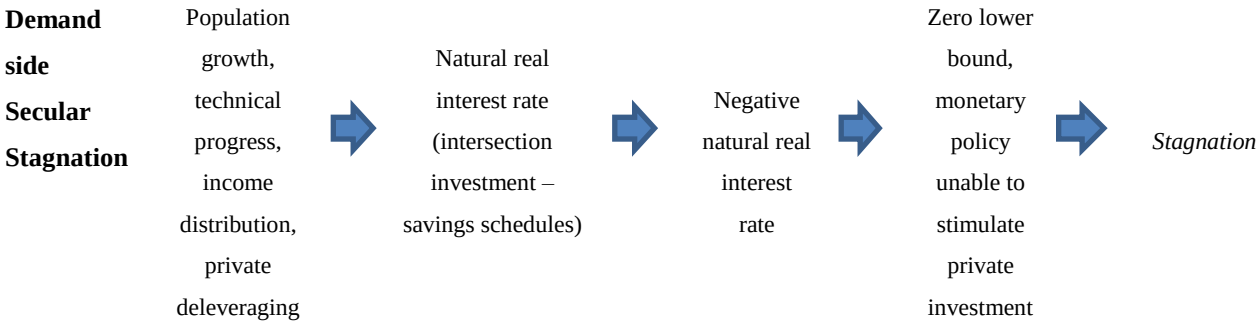
[168] Other interesting contributions have been collected in a book on this very issue of Baldwin and Teulings (2014), gathering both demand and supply side explanation for the ongoing stagnation of the major Western economies.

[169] As a consequence of such a stagnation, hysteresis may arise as well: a prolonged period of underutilization of resources spills over the growth of potential output itself (Summers and Fatas 2017). Secular Stagnation can thus be a self-reinforcing phenomenon, since a long lasting period of time in which output is well below potential means higher unemployment values and destruction or obsolescence of skills, therefore hindering the long term growth prospects of the economy.

[170] The first solution, the one originally proposed by Krugman (1998) for Japan, would run through the channel of agents' expectations: even when the nominal interest rate is stuck at zero, a higher inflation target could convince them that the Central Bank will act in such a way that the right real interest rate is attained by hitting the appropriate rate of price change. Krugman himself later on admitted that a policy fully based on agents' expectations and Central Bank announcements can hardly be gauged as a proper way out from a long-lasting stagnation, cfr. Krugman (2005). The dissatisfaction with such a suggestion made more compelling the case for an active fiscal policy based on deficit spending.

amount of available savings, therefore raising the natural real interest rate. Thus, the well-known 'crowding out' effect[171] in this instance helps the policy maker to restore the positive values of the natural real interest rate.[172]

Let us now recall the chain of reasoning of the neoclassical demand side Secular Stagnation theory that we have used in chapter four to make a comparison with the heterodox approaches that do not rely on the natural real interest rate category:



It appears indeed convenient to briefly review some theoretical weak points in this mainstream reconstruction of the argument before getting to the empirical side of the matter. In the theoretical work we have been expounding since the beginning of the present thesis we have deliberately chosen to set aside the doubts about the reliability of the very first step that connects the role of the various elements studied by the demand side Secular Stagnation scholars to the issue of stagnation: population growth, technical progress, income distribution, private deleveraging can together determine a stagnation because they impact on the natural real interest rate by making it negative. We have decided not to doubt the existence of a theoretical concept labelled 'natural interest rate' determined by the full employment marginal productivity of capital, despite the fact that the Cambridge capital controversies of the '60s and '70s have shown the fact that it is theoretically untenable. In the first three chapters of the thesis we have therefore tried to tackle the second logical step: given the supposed existence of a natural real interest rate on which several factors have been putting a downward pressure, we have questioned the internal

[171] A deficit spending policy delivers, as a side consequence, a higher level of the interest rate; in normal times, such an effect would discourage private investment.

[172] Indeed, as the three economist point out, given some simulation made to track down the evolution of the natural interest rate in the last decades, the recent negative values would be difficult to fix even with such a policy operation. This because the size of public debt that would push the interest rate up to the positive region in their opinion is very high, up to the point that it would call forth doubts upon its sustainability; cfr. Eggertsson, Mehrotra and Robbins (2017).

theoretical feasibility with respect to neoclassical theory of the statement that the natural real interest rate can be negative in a long run steady state position. Our main claim, together with our viewpoint about the fact that aggregate demand does not have a prominent role in the demand side Secular Stagnation theory, is that there is no convincing way to argue that the demand side Secular Stagnation steady state position is acceptable as a theoretical equilibrium position. Accordingly, we have then tried to look for alternative explanations not relying on the natural real interest rate category.

In the final part of the thesis we want to set aside the critical points raised thus far. In fact, what we want to question herein is the third passage of the logical reasoning developed within the demand side Secular Stagnation debate. In this passage the role of the zero lower bound on the policy controlled nominal interest rate becomes crucial because without it it would be possible to stimulate private investment by appropriately lowering the market real interest rate down to the negative natural real interest. It is therefore evident how beneath this strand of analysis there is present the traditional neoclassical vision about the fact that the real interest rate is the primary determinant of the demand for investment, and that the latter is systematically inversely related to the former. The main task of the present work is to ask us (and to provide an answer) to the following question: even setting aside any theoretical doubt about the existence of a natural real interest rate and the plausibility of its fall below zero, does the interest rate have any connection with the performances of the economy in terms of investment and growth? The upshot of the argument would then be that if data analysis displays a scant and negligible relation between investment and interest rate, then even a supposedly coherent neoclassical theoretical framework ought to face a feeble empirical evidence.

The paper will develop a brief review of the existing literature on the subject, and then a meta-analysis will be conducted.

5.1 - Narrative evidence

The seminal work of Chirinko (1993) stands out still today as the most important survey having as object the empirical works about the determinants of private investment. As is notorius, after reviewing several investment models sorted out into large categories (VAR, Q, Euler equation, direct forecasting, liquidity constraints), Chirinko concluded that overall the responsiveness of investment to price variables is negligible and substantially lower than the response to quantity

variables. In what follows we will take this cornerstone paper as a fundamental step in the literature about the determinants of private investment, and we will therefore try to develop our enquiry by examining what the empirical literature that came after the publishing of Chirinko (1993) has added to our understanding of the issue. Let us mention some other general narrative enquiry about the determinants of private investment before turning to our empirical investigation.

Chirinko (2002) sorts out the elasticity estimates coming from empirical studies on US data in which the dependent variables are aggregate investment or the demand for capital stock. Following his reconstruction, the long lasting ample variance of results that has been featuring the literature since the breakthrough constituted by the contribution of Jorgenson in the '60s about the neoclassical way of modelling private investment has not been noticeably downsized by later developments. In the developing of the study the author recalls on the one hand the dissatisfaction with the employment of aggregate data, that only allow for a limited variability at the micro level (industry, firms). According to him the employment of macro data can lead to estimates that can easily be imprecise and biased towards zero. Moreover, the simultaneity between investment patterns and interest rates setting by monetary authorities can lead to spurious relationships. On the other hand, the recourse to microdata drawing on enormous datasets with thousands of observations does not seem to pose a final word on the debate, with the general value obtained being still far from the supposed unity elasticity implied by a Cobb-Douglas description of the production process. Even at the theoretical level, micro data can suffer from both the fact that that information contains short run investment variation which is not related to the long run relationship of interest, and the fact that the formalization of an investment function to be tested may easily lead to specification errors which negatively affects the following econometric exercise. Therefore, Chirinko concludes that the literature has not been able neither to shown the primary relevance of price variables for determining private investment, nor to find a suitable strategy to gauge reliably the empirical support for the neoclassical theory of investment.

Chirinko (2008) reviews several empirical studies aimed at estimating the elasticity of substitution between capital and labour, concentrating in particular on whether the exploited techniques are aimed at analysing the issue from a short or long run perspective. The coefficients found in that literature exhibit a considerable range of variation, but on average they oscillate

mostly between an absolute value interval of 0,40 – 0,60. The author thus concludes decisively against the continuous reliance on Cobb-Douglas production functions that are widely used in order to theoretically model the economy and to inform also the policy debate. Additional interesting considerations are given along the piece. Models concentrating on the long rather than the short run (as cointegration and interval-difference vs Q and Euler equations models) appear to be better equipped to arrive at an estimate for the elasticity of substitution that could be satisfying; besides, they allow to get more easily rid of the difficulty of formalizing short run frictions. The novelty constituted by the diffusion of panel micro data estimations features according to Chirinko pros and cons. In his opinion, what can be gained at the econometric level in terms of precision of estimates could be lost from the interpretation viewpoint. Differentiating for each sector the price variable to be looked at makes the connection with the aggregate level theory loose and cumbersome to interpret as a straightforward response of capital accumulation to interest rate variations. A summary table from the article is hereby reported:

Estimates of the elasticity of substitution[a]

	σ	Characteristics of the study
A. Investment data – aggregate		
Jorgenson (1963)	1.00	Cobb–Douglas production function
Hall and Jorgenson (1967, 1971)	1.00	Cobb–Douglas production function
Eisner and Nadiri (1968)	0.16 to 0.33	CES production function
Chirinko (1993a,b)	0.00 to 0.30	Survey of econometric estimates
Tevlin and Whelan (2003)	0.18	US aggregate investment
	1.59	US computer investment
Bakhshi et al. (2003)	0.32	UK aggregate investment
	1.33	UK computer investment
Ellis and Price (2004)	0.44	UK aggregate investment
B. Investment data – panel		
Cummins and Hassett (1992)		Years of major tax reforms
Equipment	0.93 [0.23[b]]	
Structures	0.28 [0.07[b]]	
Clark (1993)	0.18 to 0.28[c]	Fifteen asset classes
Cummins et al. (1994, 1996)	0.67 [0.17[b]]	Years of major tax reforms
Chirinko et al. (1999)	0.25	Variety of estimators
Ramirez-Verdugo (2006)	1.10	Major Mexican tax reform
C. Capital stock data		
1. *Unadjusted first-order condition*		
Lucas (1969)	0.30 to 0.60	Variety of specifications
Berndt (1976)	0.00 to 1.24	Variety of specifications
Berndt (1991)	0.97	Translog system
Jorgenson and Yun (2001)		Translog system
Corporate	0.50	
Noncorporate	0.70	
Chirinko et al. (2007)	0.52	US panel data
Klump et al. (2007)	0.60	Three equation system, US data
Klump et al. (2008)	0.70	Three equation system, Euro Area data
2. *Cointegration model*		
Caballero (1994)	0.65[c]	US aggregate data
Caballero et al. (1995)	0.70[c]	US (plant) panel data
Schaller (2006)	1.20	Canadian aggregate data
Ramírez-Verdugo (2006)	3.40	Mexican panel data and major tax reforms
Barnes et al. (2006)	0.32 to 0.42	UK panel data
Chirinko et al. (2007)	0.54	US panel data
Smith (2008)	0.40	UK panel data
3. *Interval-difference model*		
Barnes et al. (2006)	0.32	UK panel data
Chirinko et al. (2007)	0.40	US panel data
Chirinko and Mallick (2007a)	0.33	US (industry) panel data

Figure 14 – Range of estimates tabulated by Chirinko (2008, p. 682).

Lastly, we want to mention a particular approach to the issue, taken by Sharpe and Suarez (2014). They examine the sensitivity of investment plans to interest rates variations using a survey approach drawing on interviews to entrepreneurs.[173] According to what they report most firms are not sensitive to interest rates decreases and are weakly responsive when they rise; when firms foresee a growth in sales they tend to be even less responsive than usual to interest rates movements. When interest rates increases are found to be effective in curbing the willingness to invest, it is usually found that the required increase has to take up a remarkable magnitude. One appealing feature of their work is that they focus on the ex-ante planning of the investment strategy rather than looking at ex-post data as generally done in the literature.[174] The two authors conclude stating that, even if their results have to be interpreted with caution, there seem to be some evidence for the view that investment is not much responsive to interest rates variations in the concrete operation of firms, contrary to what the neoclassical theory would suggest.

5.2 - Meta-analysis

The main purpose of this section section will be to have a review of the literature concerning the responsiveness of investment with respect to price variables. It will be proposed for the sake of analysing this topic a meta-analysis, which is in a nutshell a quantitative description of the results to be found in the already existing literature.

- *What is a meta-analysis?*

Such a methodology is nowadays widespread in the wider academic environment, encompassing many fields of research; in the last two decades even economics has welcomed it as a potentially fruitful tool. What a meta-analysis is basically aimed at is the construction of a dataset in which the already published studies dealing with the subject under enquiry are categorized under several featuring characteristics relative to how the study has been conducted. The most important information to be taken from each paper is the specific coefficient (or group of coefficients) that

[173] They worked within the Global Business Outlook Survey conducted in the third quarter of 2012. In this peculiar case the 'dataset' is a list of more than five hundred answers.
[174] Firms not in the need to borrow from banks or the market are even less responsive to interest rates variations.

has been found by the authors. Once this process has been worked out, it is possible to conduct an econometric analysis on it for the sake of ascertaining whether the manner in which the studies under scrutiny have been carried out is systematically related with the outcomes that have been arrived at.

Marc Lavoie has entertained in his recent 2014 book a presentation of the meta-regression technique.[175] We are going to base the illustration of our study of the empirical relationship between the interest rate and private investment upon such a clear and accurate recount of this econometric tool. Lavoie describes the meta-regression analysis as a regression ran on the results of previous regression analysis, that is conducted with the target of handling two peculiar issues that can come up when assessing the validity of the empirical literature about a specific subject. Firstly, the authors of those studies can be naturally inclined to report only the results of econometric studies that shows highly significant values for the relationship they want to investigate. Scant evidence in favour of the supposed relationship under enquiry can easily be discarded or kept unpublished. This attitude may go hand in hand with the second problem, which is the tendency for editors and journals to accept empirical outcomes that tend to confirm their broad theoretical beliefs; this can lead also the researchers to hand in econometric works that are carried forward until the 'right' result is obtained. These two possible sources of incentive to conduct the econometric analysis having already in mind from the beginning what the best outcome ought to look like may lead to the so called 'publication bias'. This issue can make the appearance in the literature of results that seem to confirm the validity of a certain theoretical statement, but may conceal a process of distorted selection of the outcomes that are present in the published works.[176]

Lavoie explains how in general the presence of publication bias can be preliminary suspected when the plot of the coefficients found in the literature, sorted according to their degree of precision (which is given by the reciprocal of the relative standard error), does not broadly distribute as a normal. The rationale behind this supposition is that one ought to expect that when

[175] Cfr. Lavoie (2014), pp. 64 – 70.

[176] One famous example can be in the 1995 piece of Card and Krueger we are going to mention below, which exposed the presence of publication bias within the empirical literature backing up the thesis according to which a minimum wage rise would have caused a reduction in employment in the US labour market.

the precision of the study is not very accurate (which means that the standard error of the coefficient is considerably high), the coefficients ought to tend to be distributed roughly symmetrically around the true mean value that can be extracted from the empirical works. If the results distribute in an asymmetric manner, this may signal that the less precise outcomes tend not to vary randomly around the alleged true value, and that this feature may be attributed to the publication bias. Lavoie goes on illustrating the meta-regression equation commonly employed to check for the presence of publication bias:

$$\left(\frac{e_i}{SE_i}\right) = t_i = \beta_0 + \beta_1\left(\frac{1}{SE_i}\right) + \varepsilon_i \qquad (98)$$

The dependent variable of equation 98[177] is simply the t-statistics t_i utilized to check whether the null hypothesis that is under scrutiny can be rejected or not, and is given by the ratio between the coefficient estimate e_i and its relative standard error SE_i . On the right hand side we find the coefficient β_0, which represent the mean value that can be calculated from the sample constituted by the coefficients found in the surveyed literature. It ought therefore to represent the value for the supposed relationship under enquiry. If it is statistically significant, it means that the supposed relationship that the authors wants to study tends to be confirmed in the available empirical literature. The β_1 coefficient represents instead the tool to be used to check for the presence of publication bias: if it is significant, it singles out the fact that the studies tend to be systematically placed only on one tail of the distribution, and tend not to distribute randomly. Finally, ε_i is the usual error term of the regression.

The two main inspirations for our empirical exercise are the studies of Card and Krueger (1995) and Gechert (2015). The 1995 work was a meta-analysis reviewing the results of empirical works about the relationship between the minimum wage policies and their effects on employment since the '70s in the United States, while the 2015 piece looks at the estimated size of the fiscal multipliers. The work of Card and Krueger was mainly aimed at checking for the presence of a systematic tendency to publish studies confirming a negative and statistically

[177] The original version of the meta-regression equation was written having on the left hand side simply the coefficient estimated, and on the right hand side the standard error of the coefficient. The version we present, and that Lavoie argues to be the one actually employed in the meta-regression studies involves, as we will see soon below, the use of the t-statistics and of the inverse of the standard error in order to control for the presence of heteroscedasticity. Anyway the rationale behind the description of the various terms entering the equation goes unmodified.

significant relationship between the minimum wage policies and employment. The explanation they tend to back up in the conclusions is that in the literature they had been reviewing there are reasons to believe that researchers tried to employ each time the econometric technique that allowed them to just get an acceptable result in terms of likelihood to be published. The meta-analysis upon fiscal multipliers has yielded some major result, summarized by the author in a list of main findings. The major outcomes of that analysis are that fiscal multipliers are consistently positive and close to one in value, direct public investment has systematically a stronger effect than tax cuts and transfers and is moreover the most effective tool at disposal of fiscal authorities, and that specification, estimation strategy and time horizon tend to deliver results which vary widely among different choices, there seems to be some trace of negative publication bias, in the sense of a disincentive to publish works reporting high multiplier values. In what follows we are going to check for publication bias as well as these two pieces, and from the article about fiscal multipliers we will take inspiration for the developing of an analysis of how the research methodologies impact the final outcomes of the enquiries we have reviewed.

- *Our econometric exercise*

What we are going to do below is to employ the meta-regression technique we have described in the previous paragraph on the dataset we have built in order to study the relationship between the interest rate and private investment. In addition to this, we will then check what are the main common elements featuring the empirical studies we have reviewed, and how they impact the size of the reported coefficients. Such a relationship is not simply relegated to empirical works directly dealing with price variables effects on investment, but can be traced back to several other contributions aimed at detecting a variety of aspects. Generally speaking, one can expect to find out interest rate elasticity coefficients of investment in the literature about production function parameters estimations, different (and sometimes competing) investment functions specifications, financial constraints to investment and cash flow impact on firms decisions, monetary policy transmission mechanisms and effectiveness, long run pattern of distributive shares, etc. This fact *per se* gives a first glance impression about the pervasiveness and importance of the topic under discussion: a well-behaved investment schedule with a significantly sensitivity with respect to the interest rate is a cornerstone of the mainstream analytical and policymaking apparatus.

For the sake of gathering evidence, we have taken the parameters from all the study typologies above mentioned. One important choice to point out is about the years of publication of the selected studies: as we have already said, since what in the literature has been deemed a cornerstone for this strand of research is the article of Chirinko (1993), and so far an updated review employing our chosen method appears to be missing, we have been utilizing only coefficients from studies published after the above mentioned seminal review. On the one hand, this choice gives to the 1993 piece is due share of recognition, in the sense that the results to be therein found are taken as received knowledge that we are taking as a starting point for our study. On the other hand, since in the last years newer estimating techniques have been massively employed (let us just mention the cointegration techniques as an example), and the explosion of data availability has made the case for turning the attention more closely to microdata, the decision to look only for more recent studies appears to be justified.

We have been reviewing thirty-one empirical studies from which one hundred thirty-one parameters have been selected. This broad sample encompasses a smaller subsample which is constituted by the observations which are accompanied by the relative standard error. We have indeed not always found in the literature the standard error of the coefficient which has been reported. This smaller subsample has been drawn on a subset of twenty-four studies (among the already mentioned thirty-one reviewed), and involves ninety-seven observations. This latter sample will therefore be the one that we are going to use to check for the presence of publication bias, while the broader dataset will be utilized to have insights about if and how some features common to the various empirical studies tend to systematically shape the results obtained.

The research has been carried over by starting from basic Google Scholar search employing “investment determinants”, “investment interest rate elasticity”, “investment user cost elasticity”, and so forth. Then the cross referenced studies have been looked up afterwards. Our sources are both academic journals and papers from established research centres such as the NBER and the ECB. It is important to signal that in the latter two cases the papers are not always subject to peer review before being published. Nonetheless, since for instance a big deal of research upon investment price variable elasticity is conducted in order to get clues about monetary policy effectiveness, it would have seemed inappropriate to exclude papers coming up under the label of some major institutions concerned with analysing that topic. The main groups of studies (and a brief description of their main targets) can be sorted in these broad categories:

- the first group encompasses studies about the monetary policy transmission mechanism. Therefore, they have as object the analysis of how the monetary policy conduct of Central Banks can impact the real economy through the effect on various variables, among which we often find private investment. They are: Schaller (2006, 2007) looks at the long run user cost capital stock elasticity in the first study while in the second tries to disentangle the various contributions to its results coming from the different components of the user cost for Canada (1962 – 1999), Chatelain, Generale, Hernando, Vermeulen, von Kalckreuth (2003a, 2003b) study the user cost elasticity of investment for firms in Germany, France, Italy, Spain, Austria, Luxembourg since the middle '80s to the end of the '90s, Butzen, Fuss, Vermeulen (2001, 2003) focus on the investment elasticity with respect to the interest rate for firms in Belgium (1985 – 1998), von Kalckreuth (2003) investigates the investment user cost elasticity for firms in Germany (1988 – 1997), Chatelain, Tiomo (2001) look at the investment user cost elasticity for French firms (1990 – 1999), Gaiotti, Generale (2002, 2003) carry out an analysis of Italian firms (1989 – 1999) investment elasticities in an accelerator and error correction models, Deleidi (2017) examines the interest rate relevance for firms and households demand for bank credit, Angeloni, Kashyap, Mojon, Terlizzese (2002) look at the monetary policy effects on investment in the Euro area (1971 – 2000)[178];
- the second group involves the studies devoted to the analysis of the various investment determinants. They are: Chirinko, Fazzari, Meyer (1999) analyse the investment user cost elasticity for USA firms (1981 – 1991), Chirinko, Schaller (2001, 2011) study in the first piece the role of financial bubbles in Japanese aggregate investment decisions (1968 – 1991) and in the second the role of market misvaluations for USA firms investment decisions (1980 – 2004), Guiso, Kashyap, Panetta, Terlizzese (2002) are interested in the capital stock interest rate and user cost elasticity for Italian firms (1990 – 2000), Alexiou, Tsaliki, Tsoulfidis (2016) want to empirically test the investment determinants of a panel made up of 13 EU countries (1980 – 2013), Kothari, Lewellen, Warner (2016) study the US aggregate investment patterns (1952 – 2010), Bertola, Caballero (1994) aim at

[178] We have taken only the results for Finland and Luxembourg from here, since for countries such as Germany, France, Spain they reported results from articles that had been already scrutinized during our research.

studying the role of irreversibility on US investment at the macro level (1954 – 1986), Luporini, Alves (2010) enquiry the Brazilian (1970 – 2015) macro investment determinants, Servén (2003) targets the role of real exchange rate volatility for the behaviour of investment in 61 developing countries (1970 – 1995), Tevlin, Whelan (2003) concentrate on discerning the determinants of the US investment boom of the '90s (1950 – 1997), Dwenger (2014) looks at the firms' user cost elasticity of the capital stock in Germany (1987 – 2007), Caballero, Haltiwanger, Woodford, Hall (1995) analyse the US aggregate investment pattern (1972 – 1988), La Cava (2005) reports results from the study of the investment determinants in Australia (1990 – 2004), Ellis, Price (2004) bring evidence for the UK investment user cost elasticity (1972 – 2001), Mojon, Smets, Vermeulen (2002) investigate the investment determinants for Germany, Spain, Italy, France (1985 – 1998);

- the third group includes the empirical works aimed at estimating the production functions that may describe the production process of an economy. They are: Chirinko, Fazzari, Meyer (2011) investigate the capital/labour substitutability for US firms (1972 – 1991), Antras (2004) provides estimates for a Cobb-Douglas production function for the US (1948 – 1998), Felipe, Adams (2005) estimate a Cobb-Douglas aggregate production function for the US (1899 – 1922), Klump, McAdam, Willman (2007) ran a CES production function estimation for the US (1953 – 1998).

Before going to show the results of the enquiry conducted on the dataset built on the list of articles we have just mentioned, let us single out four elements that have to be taken into account since they have been matter of reflection prior to the construction of the dataset. Firstly, we have deliberately left aside one kind of widespread analysis: the study of the models based upon the Tobin's Q, which are usually employed to ascertain the cash flow responsiveness of firms' private decisions to invest. Two main reasons drove the decision: firstly, it is not always clear whether to include the Q as a price variable on the same footing of what can be done with the interest rate and the user cost of capital.[179] In the literature are present various specifications of the Q, and even at the theoretical level the connection with the marginal productivity/efficiency

[179] Cfr. below for the use of the user cost of capital in the regression estimations.

of capital, although being undoubtedly present, is not as clear as in the case of the interest rate.[180] Furthermore, in many specifications, since the use of Q is widespread in micro data analysis upon groups of firms, the financial conditions of borrowing are taken together with other characteristics common to the whole sample, and are therefore frequently not reported separately.[181]

Secondly, we want to single out a distinction about the choice of the main price variable which is employed in the enquiry: while the most natural choice could appear to be the real interest rate since it directly follows from theory, in the last decades the user cost of capital has gained a great deal of relevance, somehow replacing the interest rate as the main factor to be looked at. The reference point for modelling the user cost of capital is the seminal contribution of Jorgenson (1963) where a maximization of net worth exercise is set forward:

$$\begin{gathered} W = \int_0^{\infty} e^{-rt}[R(t) - D(t)]dt \\ R = pQ - sL - qI \\ D = u[pQ - sL - (v\delta q + wrq - x\dot{q})K] \end{gathered} \tag{99}$$

in which W is net worth, t is time, $R(t)$ are revenues before taxes, $D(t)$ are direct taxes, r is the interest rate, p is the price of output, s is the nominal wage, q is the price of one item of capital (with the dot its rate of variation with respect to time), Q is total output, L is the amount of labour employed, I is investment, u is the rate of direct taxation, v is the ratio between replacement chargeable income to income for tax purposes, w the proportion of interest, x the ratio of capital losses chargeable against income, K is the capital stock, δ the rate of depreciation. The first order conditions for such a maximization deliver as result the marginal productivities of both labour and capital; from the latter condition Jorgenson gets the formula for the user cost of capital:

$$c = q\left[\frac{1-uv}{1-u}\delta + \frac{1-uw}{1-u}r\right] \tag{100}$$

[180] Cfr. Tobin (1969) for the first contribution on Tobin's Q, Hayashi (1982) for an analytical treatment of the relevance of such a variable for aggregate investment, Petri (2004, Ch. 7) for a critique about the analytical solidity of the variable.

[181] For future possible developments of the present study finding a way to have this other variable involved in the analysis may turn out to be useful in order to get a more comprehensive understanding about what the literature has found out so far about investment determinants.

In it we have that the interest rate is one of the several components entering the formula; together with it, we have also the price of capital, the depreciation rate, and taxes. Given its composition, it allows to gather information about a variety of relative price factors, while at the same time generating some ambiguity about the relevance of the single components within it.[182,183] A further development of the study may involve differentiating for the effect of each single component; in what follows we will only distinguish between the effect of the interest rate and the aggregate user cost of capital.

The third point regards the strand of empirical literature looking at firm level micro data, that has become increasingly popular in recent years. This is due to both theoretical reasons, since the study of the effect of financial constraints and firms' size on investment has gained appeal, and to the availability of vast datasets for such purposes, while before macro data were much more diffused and readily obtainable. Such a novelty, while surely enlarging the borders of research and knowledge on the issue, opens up other sources of discussion. Some of the questions that may be asked are, for instance: moving within a micro environment can be considered tantamount to the macro level when focusing to the investment-interest rate relationship? The interest rate that is exploited at the micro level can be reckoned as satisfactorily approximating the interest rate set at the macro level? Controlling for the differences between the two levels of analysis appears to be an interesting task to accomplish with. Yet, we are not going to discuss the point at the theoretical level, but we will ascertain what difference makes the level of aggregation at which the analysis is conducted in terms of the outcomes obtained.

Lastly, we want to point out a feature that is not going to be taken as something discriminating among different studies, but still has to be mentioned: the econometric methodology employed to carry out the regressions. Even if the various papers differ remarkably in terms of estimation strategy (error correction models, autoregressive distributed lag, generalized method of moments, etc.) the common concern is in finding out a long run significant

[182] There is a strand of literature which has focused on the relevance of the tax component within the user cost specification of the price variable; cfr. Cummins, Hassett, Hubbard (1996), Hassett, Hubbard (2002) among others.

[183] An interesting attempt which is often found in the sub-group analysing the monetary policy transmission mechanisms is to estimate the effect of a change in the interest rate set by monetary authorities on the magnitude of the user cost of capital, especially when the latter is in turn seen as the price variable chosen to carry out the study.

elasticity. Sorting out the different methods beyond a purely narrative account would need a separate enquiry in the econometric differences among them, the more so in light of the fact that it appears difficult to arrive at a proper classification. Let us make an example: there are estimations simply carried over by utilizing either a GMM estimator or an ECM, as well as panel GMM and panel ECM are present. how to classify them can be rather tricky; in fact, in that case it would not be obvious which categorization would be more appropriate, whether to sort a panel/non panel approach or a GMM/ECM. In terms of methodology it has been judged to be sufficient to sort the studies out according to their main object of analysis and their level of aggregation.

- *Empirical evidence*

In this section we are going to show the main results obtained in our estimation exercise. A preliminary analysis involving some summary statistics and visual inspection of the collected coefficients is presented. In the graphs below we are showing the so called 'funnel plot', which is a graph that displays the distribution of the estimated coefficients related to their measure of precision, which is the inverse of their standard errors. We have utilized the full set of ninety-seven observations which are reported in the literature with their standard error, and therefore we can calculate for them the precision parameter. Here there are the summary statistics for the coefficient estimates, the standard errors, the t-statistics and the precision parameters, plus the funnel plot:

Variable	Obs	Mean	Std. Dev.	Min	Max
Estimate	97	-.3947425	.3339975	-1.2	.245
StErr	97	.1752101	.2023448	.0011	1.27265
tstat	97	-5.211698	8.568161	-31.84211	24
reversese	97	29.44335	93.9289	.785762	909.0909

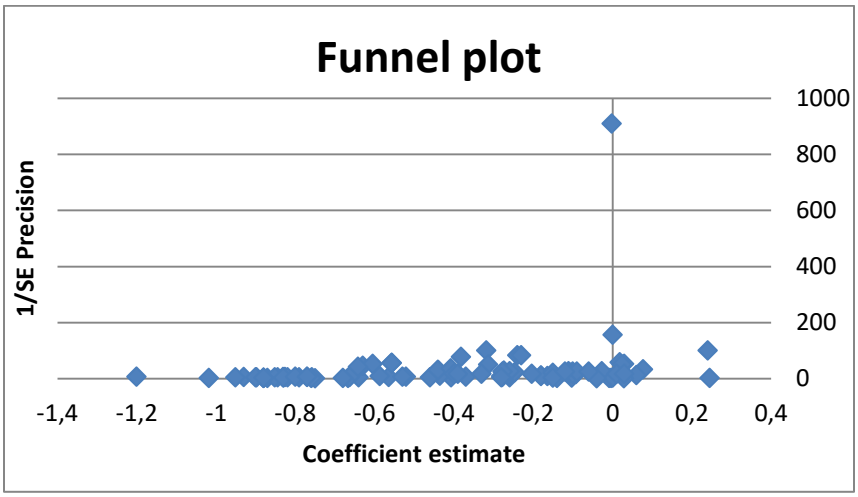


Figure 15 – Summary statistics, and funnel plot of the coefficient estimates from the sample of 97 observations for which the relative precision parameters can be calculated, own elaboration.

As it is evident, the presence of a parameter taking up a value of 909 immediately signals the presence of an outlier that can obscure the true average dispersion of the coefficients. Therefore, we have acted in the following manner: we have removed that observation since it constitutes a neat outlier, we have recalculated the averages in the sample and we have removed the observations which exhibited a value for the precision parameter higher than the mean plus three times the standard error.[184] The new summary statistics and funnel plot are herein reported:

Variable	Obs	Mean	Std. Dev.	Min	Max
Estimate	93	-.4108628	.3291296	-1.2	.245
StErr	93	.1824501	.2035634	.012	1.27265
tstat	93	-5.33199	7.694924	-31.84211	2.566667
reversese	93	17.10915	18.97706	.785762	83.33333

[184] This led us to keep on working on the a sample with 93 observations; the outliers detected had a precision coefficient of respectively 909, 150 and 100 two times. The coefficient estimates did not show any particular worrisome outlier value, and therefore we have not excluded any observation because of its coefficient value.

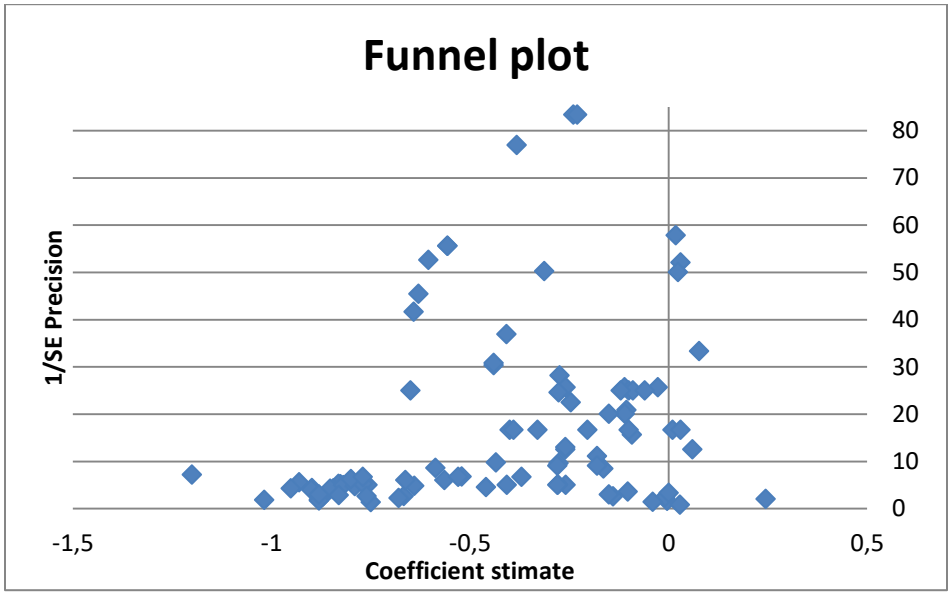


Figure 16 – Summary statistics, and funnel plot of the coefficient estimates from the subsample of 93 observations that do not exhibit the presence of outliers, own elaboration.

What we can point out now that we can get a clearer picture of the coefficient dispersion is that there appears to be, at low levels of precision, a neat concentration of observations to the left hand side of the distribution, in correspondence of the interval ranging from -0,8 to -1. This makes us suspect about the possibility of a publication bias in the sample we are analysing, but this is only a visual inspection that needs a more robust confirmation. Let us therefore go on employing the meta-regression analysis carried out by running the regression based on equation 98 presented above; we show below the results of the regression in which the t-statistics is the dependent variable and the precision coefficient is the independent variable:[185]

[185] The regressions ran with OLS technique, and the standard errors are robust with respect to the presence of clusters. The latter feature means that we have controlled for the fact that not each observation comes from a different paper, but the observations tend to be grouped in clusters; a single publication may contain several parameters. The cluster analysis avoids biases arising because of this issue. The F-test for the joint significance of the parameters exhibits a high significance of the whole estimation.

```
Linear regression                               Number of obs =      93
                                                F(  1,    22) =    9.18
                                                Prob > F      =  0.0062
                                                R-squared     =  0.4723
                                                Root MSE      =  5.6207

                                  (Std. Err. adjusted for 23 clusters in cluster)
------------------------------------------------------------------------------
             |               Robust
      tstat |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  reversese |  -.2786526   .0919675    -3.03   0.006    -.4693817   -.0879236
      _cons |  -.5644799   .8278377    -0.68   0.502     -2.28131    1.15235
------------------------------------------------------------------------------
```

Figure 17 - Regression results from the meta-regression analysis, own elaboration on Stata 12 software.

Let us recall the logic behind this econometric exercise: we want to check on the one hand whether the constant coefficient is significant, and on the other hand whether the coefficient associated with the precision coefficient is significant. We can firstly see that the constant coefficient shows a p-value of 0.502, which means that the null hypothesis of a coefficient not significantly different from zero cannot by far be rejected. Therefore, recalling the discussion of the meta-analysis coefficients developed by Lavoie, we can in the first place state that the literature that we have analysed does not exhibit a significant relationship between the interest rate/user cost of capital and the amount of private investment. The study of the coefficient associated with the precision of the estimates, that is given by the inverse of the standard error, displays on the contrary a high significance even at the 1% level. Indeed, a p-value of 0.006 leads us to reject the null hypothesis that the observations do not tend to systematically be skewed and tend to randomly distribute around the average value given by the constant. Therefore, we can claim that the meta-regression displays evidence for arguing that the reviewed literature exhibits a publication bias.

It is now the moment to analyse if some peculiar characteristic of the studies we have been reviewing tend to systematically have an impact on the estimated coefficients. The model chosen to ascertain whether we can extract from the dataset some significant element in this respect is the following:

$$e_j = e + X_j\beta + \varepsilon_i \qquad j = 1, \dots, N \; i = 1, \dots, M \tag{102}$$

where e_j is the coefficient taken from the j[th] study, e is the reference value for the coefficient to be calculated from our dataset, X_j is a set of dummy variable regressors describing the characteristics of interest for each j[th] coefficient, β is the vector of coefficient relating the characteristics of interest to the e_j set of estimates. The dimension of N is 131, the number of coefficients of the sample, while the dimension of M is 31, the number of studies reviewed. The inclusion of a control for the fact that the coefficients may suffer from being related within a cluster is necessary: not all the coefficients come from a different work, as some of them involved the estimation of several models or specifications. Estimating a regression in which the coefficients are clustered allows to take into account the fact that some study may have a heavier weight than others in determining the final results from our regression.

The characteristics that have been deemed to be worth of enquiring are three, coming from the previous sections' discussion:

- 'Variable' is a dummy which takes up value 0 if the study employs as a price variable the interest rate, and 1 if the study employs the user cost of capital;
- 'Mainconcern' is a dummy with value 0 if the reference article has as main target the estimation of the responsiveness of investment to price variables, 1 if the coefficient of the interest rate/user cost is only one among the several control variables inserted to have a more precise estimation;
- 'MacroMicro' is a dummy variable that in the 0 base case signals that the analysis has been conducted exploiting a dataset made up of aggregate level data, while the alternative value of 1 is assigned if micro data are the source of information.

The regression has been ran with OLS and as said the control for the presence of clusters allows to get reliable standard errors. The regression model thus encompasses the constant, the three chosen fundamental characteristics of the papers and the control for the cluster component. In the following figure we show the results of the econometric exercise:

Linear regression

Number of obs	= 131
F(3, 30)	= 4.08
Prob > F	= 0.0153
R-squared	= 0.1406
Root MSE	= .30305

(Std. Err. adjusted for 31 clusters in Cluster)

Estimate	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
Variable	-.2003601	.0703647	-2.85	0.008	-.344064	-.0566563
Mainconcern	-.3370566	.1533182	-2.20	0.036	-.6501742	-.0239391
MacroMicro	-.0205364	.0905138	-0.23	0.822	-.2053902	.1643173
_cons	-.155905	.0942312	-1.65	0.108	-.3483508	.0365407

Figure 18 – Econometric model testing how the single characteristics of the study affect the coefficients estimated, own elaboration on Stata 12 software.

The outcomes shown in figure 18 can now be analysed. Of the three main regressors of our interest, namely the Variable, Mainconcern, MacroMicro the first two are significant, the first at the 1% level and the second at the 5% level, while the last one is strongly not significant. The F-test controlling for the joint significance of all the parameters taken together strongly backs up the hypothesis of having built an overall model structure in which all the components interact in a well behaved manner. The interpretation of the result is the next step to carry over. Given the different specifications employed in the several studies, the fact that not in all cases the coefficient is a simple elasticity, that in some study the standard error was not available and so on, one should be careful not to append to the constant found in our dataset the meaning of a true average coefficient for the responsiveness of investment to price variables. Yet, its coefficient of -0,156 depicts a basic effect of the price variables on private investment which is not particularly strong, or at least not as important as neoclassical theorists would suppose it to be. The regressor Variable, besides being significant at the highest precision, has a remarkable coefficient value of -0,2 which exhibits the expected sign. On average in fact we have that the studies which employ as reference price variable the user cost of capital in place of the interest rate tend to deliver a higher responsiveness values, that in our work takes up a magnitude of -0,356 (summing up this latter coefficient to the already discussed constant). The coefficient arrived at for Mainconcern shows a value of -0,337 which can be interpreted as particularly puzzling: when the authors are mainly concentrated on estimating an investment function (which means that the dummy is set at zero) the interest rate exhibits a not particularly relevant parameter, but when the enquiry

employs the interest rate or the user cost just as a control variable among others (therefore, the dummy takes up the value of one), its relevance rises dramatically. In our dataset we would find a coefficient value of -0,493, by summing its negative coefficient to the constant. In other words, in our scenario the inverse relationship between the price variables and private investment is higher when the authors do not try to directly estimate an investment function in which the price variables are the main candidates to be the chief determinants of private investment. This may seem to be in contrast with the evidence shown above with respect to the issue of publication bias, but let us here recall that in the present econometric exercise we are only evaluating the effect of the chosen strategies in terms of the size of the coefficients, while in the previous analysis we have been weighing the coefficient by their standard errors, something that is much more relevant since, as we have seen, scholars may tend to strive to get a significant estimate, not just a specific value for the coefficient. Still, this regressor exhibit a sign that we would not have expected, since our supposition was that a study directly targeted at estimating an investment function would have delivered higher values (with negative sign) for the coefficient relating price variables to the amount of private investment. Our last coefficient of interest is the one relative to the MacroMicro dummy; it displays a size of -0,20. It means then that when the dataset employed to run the estimation models are microdata, the study tends to deliver outcomes which are higher than the ones found with macrodata. Specifically, one would on average end up having a coefficient of -0,176. This is consistent with what is generally claimed in the literature focusing on microdata from a panel of firms, namely that by means of that choice the supposed negative relationship between investment and price variables is easier to detect and shows more satisfying results. Yet, such a result is not generally valid since this coefficient does not have a systematic significant effect on the estimates; indeed, we cannot reject the null hypothesis that it is equal to zero.

What has to be made as a final remark is that an important concern for future developments of the present analysis would be in the first place enlarging the dataset. Even though our estimates appear to pass the commonly used tests for significance and absence of major issues such as heteroscedasticity due to clusters of observations, a wider dataset may better cover the existing literature and provide even more satisfying and comprehensive results. In order to get the best approximation possible, the available degrees of freedom may be enlarged by including additional studies in our sample. Even going outside the econometric realm, a wider

database would allow for more variety in the characteristics that could be introduced in the study. One major example is the inclusion of short run statistical techniques utilized to test the validity of Q or Euler equation models, while in our sample we have in practise tested almost exclusively works looking at long run trends by means of cointegration techniques. This additional work may also give more definite insights about the presence of a publication bias. Our results appear to strongly unveil the presence of such an issue within the reviewed empirical literature, but a conclusive statement involving a very heavy claim about the way in which these studies have been conducted requires the inclusion in the analysis of all the empirical relevance available. Lastly, by covering a wider segment of the literature can be of interest because even though our results run against the assignment of too much relevance to price variables, it is not possible to a-priori discard the possibility that future research may find results more in line with neoclassical theory.

Conclusions

The demand side Secular Stagnation theory is grounded on one main supposition: private investment and growth patterns in the Western economies have been seriously tamed by the fact that the natural real interest rate has turned negative. This feature of that key variable, coupled together with the presence of a zero lower bound on the policy controlled nominal interest rate, has rendered Central Banks impotent, at least when they would be willing to stimulate real activity by lowering their reference interest rate. Despite the doubts that we have posed when analysing such a theoretical apparatus with respect to the validity of the notion of a steady state position in which the natural real interest is negative, the attempt made in the present chapter has been to try to reckon the plausibility of a different aspect of the theory. Indeed, another crucial general claim of the Secular Stagnation literature appears to be that, were it not for the rigidity on the nominal interest rate, the reliance on a well behaved demand schedule for investment and capital decreasing with respect to the interest rate could have been successfully exploited by monetary authorities to kick start real activity again. We have therefore tried to ascertain whether in the empirical literature on investment determinants there is a widespread acceptance of the role of price variables in stimulating private investment. The empirical literature we have been utilizing for such a task dates back from very recent years to the last widely cited survey upon the issue, namely Chirinko (1993).

The novelty we have attempted to introduce is the utilization of some strategy coming from the meta-analysis literature, that has gained considerable attention in the last decades. By taking from a set of empirical studies the coefficients estimated for the relation of our interest and their standard errors, we have set up a database upon which a regression model trying to assess the validity of the outcomes found in the literature has been ran. One relevant finding is the fact that within the dataset at our disposal the relationship between price variables and private investment decisions is found not to be significant. In addition to this, we have shown that in the reviewed literature there is evidence to argue for the presence of a publication bias. This means that there is evidence about the fact that the studies tend to be published after a selection process in which there is a search for the technique that best serves the purpose of finding a significant coefficient, that has also to be in line with the broad theoretical perspective.

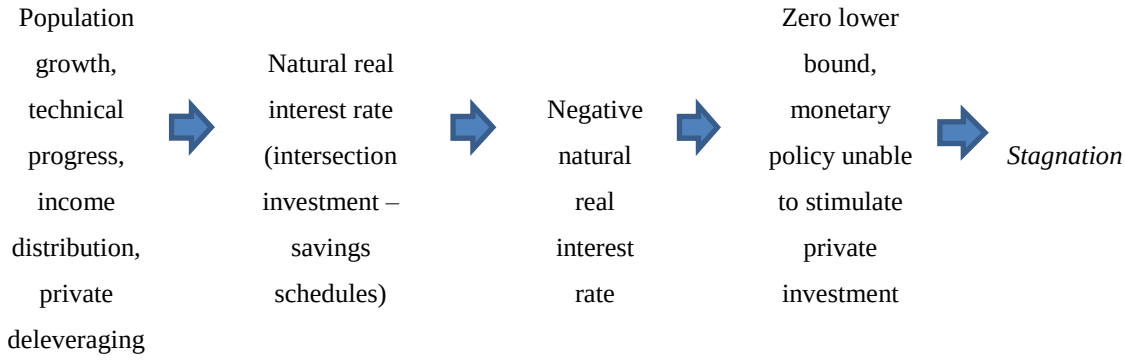
Furthermore, the regression model we have employed on a wider set of coefficients delivers some stimulating result: the chosen features of the studies seem to have a systematic effect on the results obtained. First of all, it has to be pointed out how, despite it is not possible to claim that the constant of the model is a true average of the coefficients making up the sample, the reference value of the price variable relevance for investment is not particularly large, thus conveying the impression that other factors such as aggregate demand growth may matter more. When the variable utilized in the literature is the user cost of capital instead of the simple interest rate the results of the estimates tend to be much higher in absolute value. When the main concern of the enquiries is not directly estimating the price variable elasticity of investment the coefficients arrived at are much higher, and this has been discussed as a feature rather puzzling. When the analysis is conducted at the micro level, price variables tend to be a more relevant element in shaping investment decisions, but such a characteristic of the study is not significant. At any rate, even when the single regressors add up to the base negative constant, they do not deliver investment responses that strongly support the hypothesis of a high responsiveness of investment to price variable impulses. Overall, we may sum up our findings in two respects. The final message of Chirinko (1993), namely the fact that commonly used neoclassical models of investment does not appear to fare well empirically has some additional confirm in our updated framework. Additionally, the Secular Stagnation apparatus, even supposing a perfectly coherent theoretical construct, does not seem to get credibility when looking at empirical data. In fact, even conceding to that strand of literature the entire validity of their theoretical arguments, there

is little empirical support in the literature to sustain that without the zero lower bound it would be possible to further stimulate private investment via monetary policy, since there is no strong evidence supporting the claim that the interest rate is a primary determinant of the investment decisions. Therefore, we can claim that there is room for an alternative view explaining the causes behind the emergence of a long lasting stagnation that does not rely on the neoclassical alleged inverse relationship between the interest rate and the amount of private investment.

General conclusions

The main target of the present thesis has been the discussion of the neoclassical demand side Secular Stagnation theory. The two aspects of our interest have been the discussion about the plausibility of a theoretical long run equilibrium position in which the natural interest rate is negative, and an assessment of the role that aggregate demand plays in the explanation of the phenomenon of stagnation. We have started the analysis by a reconstruction of the Wicksellian explanation of the determination of the natural interest rate and of the role of the financial frictions that can temporarily hinder the attainment of an equilibrium position. This served as a benchmark to illustrate also the theory of Summers, the main advocate of the demand side Secular Stagnation theory. Indeed, we have seen that in this theory the Wicksellian natural interest rate is supposed to be nowadays negative, and the zero lower bound on the nominal interest rate acts as a financial friction that does not consent the realization of a full employment equilibrium situation.

In the course of the general reconstruction of the various aspects of the theory we have formalized a chain of reasoning that can in our opinion well describe the backbones of the theory, which is the following:



Therefore, we have studied how the first step of the theory is based on the notion that various aspects characterizing the evolution of the major advanced capitalist economies in the last decades have contributed to shift the schedules of the demand for investment and the supply of savings, at the intersection of which the neoclassical theory determines the natural interest rate. Despite the fact that in our opinion the Cambridge capital debates have abundantly shown the untenable logic beneath such a determination of the natural interest rate, we have chosen to set

that kind of criticism aside, and therefore not to question the validity of the broad theoretical framework within which the demand side Secular Stagnation theory is placed. What we have tried to ascertain is the plausibility of the second step of the theory, which states that the downward pressure put upon the natural interest rate by the patterns of population growth, technical progress, income distribution and private deleveraging has rendered it negative.

In this respect, we have argued that the contributions of Summers, Krugman, Eggertsson, Mehrotra and Robbins that we have critically analysed do not fare well when it comes to sustain that an equilibrium position in an economy with capital and production can host a negative natural interest rate. In fact, what we have found in the literature are several attempts to give credibility to such a concept, but for various reasons they do not successfully address the issue. The model of Krugman provides a rationale for the emergence of a negative natural interest rate for an economy without capital, which is set forth in an overtly stylized example with only labour and land, arriving at the targeted result running through a long list of *ad hoc* assumptions, which in our opinion deprives the theoretical setup of relevance. The model of Summers, who sets forward the argument in a traditional IS – LM framework, does not address the problem at all. We have argued that in that framework the production functions commonly utilized in the literature do not seem to be capable of hosting a negative natural interest rate, and that in any case the rationale decisions of entrepreneurs would suffice to rule out the emergence of that possibility. The model of Eggertsson, Mehrotra and Robbins tries to bring to the fore the elements of imperfect competition and riskiness in order to explain how it is possible to justify the divergence between the positive valued marginal productivity of capital and the negative valued natural interest rate. We have discussed both elements; overall, their role appears to be that of elements of last resort to sustain the implausible equilibrium position featuring a negative natural interest rate. In fact, we have seen that the brief recourse to the role of the mark-up element is not only unable to explain why the natural interest rate ought to be negative, but in general the recourse to that explanation appears to be in contrast with the role assigned to it in the broad neoclassical literature. The riskiness factor required a more detailed discussion, which has brought us to the conclusion that both the logic behind the most important model arguing that the positive marginal productivity of capital can coexist with a negative natural interest rate is open to criticism, and also that it can be argued that the element of risk cannot have a role in how the distributive variables are arrived at. A digression through models with and without capital,

formalized in a IS – LM fashion or in a OLG fashion, with and without riskiness and imperfect competition has been necessary to show the solidity of our statement: even without questioning the existence of a natural interest rate, it is not possible to coherently argue that a neoclassical framework of analysis can encompass a long run equilibrium position in which the natural interest rate is negative. Therefore, our evaluation about the demand side Secular Stagnation theory in this respect is that one major weak point that can be found in it regards the reliance on the negative natural interest rate concept for the sake of explaining the origin of a prolonged stagnation. Thus, even the second step in the chain of reasoning that we have reconstructed appears to be hardly defensible.

The other major aspect that we wanted to evaluate, as said, regards the role of aggregate demand. Indeed, we have seen that within the neoclassical strand of analysis there is an alternative theory falling under the label of supply side Secular Stagnation. We have therefore distinguished between the two neoclassical versions. The supply side Secular Stagnation theory points the attention to the role of population growth and technical progress: according to this strand of analysis, since these two factors have been showing slower growth rates, the evolution of the potential output itself cannot but be slackening. This feature alone consents to explain the economic stagnation, without the need to resort to demand side issues. The demand side version instead argues that there is a persistent lack of private investment that does not consent to absorb the entire amount of savings supplied into the economy. What we wanted to understand was what features of the demand side approach allowed the relative authors to claim that a lack of demand lies at the heart of the stagnation situation. The schema shown above can helps us even in this discussion, which is complementary to the one about the negative natural interest rate plausibility. In fact, what we have found in the three neoclassical models that we have studied is an explanation in which the aggregate demand shortage is only the final result of a process started elsewhere. In our reconstruction, the aggregate demand issue comes indeed about only at the very end, when the zero lower bound on the policy controlled nominal interest rate enters the picture. Once the various pressures exerted upon the natural interest rate have render it negative, then the zero lower bound constraints the effectiveness of monetary policy. Given the inverse systematic relationship between the interest rate and the amount of private investment, a rigidity hindering the correct operation of monetary policy is the principal responsible for the impossibility to stimulate investment by the required degree.

What we have argued is that, even if the demand side version of the theory hosts the concept of a lack of investment, aggregate demand does not play a true role in this strand of literature. Since the impediment to the realization of the full employment output is the impossibility to reach the negative natural interest rate, the ultimate causes of the economic stagnation have to be traced back to the elements pushing it downwards. In the course of our investigation we have seen that among the various factors that interplay and concur to this progressive drop of the natural interest rate, there is one that stands out as the most important driver: it is the population growth rate. Indeed, this factor is the prominent one in the explanation of Krugman about the Japanese stagnation, it is greatly emphasized by Summers, and is the main element that Eggertsson, Mehrotra and Robbins mention when presenting their results from the simulation of their OLG model. In light of our enquiry, we can therefore conclude that the demand side Secular Stagnation features a shortage of private investment demand that is not a cause of the stagnation, but rather the last consequence of a logical chain which mainly hinges on a supply side shock that cannot be absorbed by monetary policy because of a financial rigidity called zero lower bound. Hence, the ensuing lack of investment and the persistence of an 'excess' of savings into the economy. This way of looking at the subject of stagnation has an impact also on the way in which the suggested remedy, that in this literature is deemed to be a deficit spending fiscal policy aimed at moving upwards the investment schedule, is considered. Rather than being a policy targeted at sustaining aggregate demand, a deficit spending plan is primarily advocated because it helps moving back the natural interest rate in the positive territory. When this happens, monetary policy can be again effective.

After the study carried out in the first three chapters, we have claimed that the two main lines of research that we were willing to follow had arrived at a conclusion: according to our opinion, the demand side Secular Stagnation theory, despite its undeniably interesting proposed explanation, cannot be a solid theoretical guide because it cannot describe a plausible equilibrium position towards which the economy ought to converge, and involves only an altogether secondary role for aggregate demand in the elucidation of what can be the causes of the weak economic performances of advanced capitalism.

Far from being discouraged by these theoretical results, we were ready to turn the attention towards explanations coming from a non-neoclassical perspective. An interesting theoretical experiment that we have tried to carry out has been to distinguish, within some of the

heterodox contributions we have brought into the study (without any presumption to be exhaustive), between the attempts to explain stagnation with tools that are similar to the ones employed within the demand side Secular Stagnation theory and the proposals that do altogether away with that strategy. In our opinion, the interesting critique that we have found in some post – Keynesian contribution, aimed at criticizing the relevance that the neoclassical demand side stagnation theory attributes to the role of the zero lower bound singles correctly out the poverty of a reasoning that wishes to explain a wide scale phenomenon by means of a rigidity on the nominal interest rate. The issue is that at the heart of that alternative explanation there continues to reside the idea that a long term equilibrium position featuring a negative marginal efficiency of capital would be attained by lowering the policy controlled interest rate below zero. Accordingly, it would be thus possible in principle to do so by exploiting the inverse relation between the interest rate and the amount of investment, but such a policy cannot be successful because of the presence of non-producible assets. Yet, we have argued that the reliance on a decreasing marginal efficiency of capital schedule, and the replacement of the zero lower bound with the presence in the economy of non-reproducible assets leaves basically unchanged the overall picture, and it is subject to critiques that are analogous to the ones directed towards the demand side Secular Stagnation theory. Therefore, we have recalled some of the contributions about stagnation and economic growth that have been taken from the post – Keynesian and Sraffian literature that have touched upon the matter without any reference to neither some negative valued equilibrium variable, nor to some kind of rigidity preventing the attainment of such an equilibrium. In light of this literature, this is our contention, the stagnation of the advanced economies can be read by looking at the long term trend of the aggregate demand components that drive growth, with a particular regard for the role of public expenditure and the pattern of income distribution. We have seen for example contributions that can depict what happens when a growth strategy is based upon credit financed consumption, as in the case of the US before the Great Recession. When a financial turmoil takes place, the impossibility to keep on relying on that component of demand leads directly to a slowdown of growth, which in turn cannot be restarted unless another strategy, for instance one based on public expenditure, is implemented. Thus, there is room in the heterodox literature to have a truly demand side explanation of stagnation that has no need to be bound to the negativity of an allegedly existing natural rate of interest. In addition to this, there is room to describe the pattern of income distribution in the last decades, and its impact on both

economic growth and the rise of households' private debt, without forcing these aspects within models that can give to them importance only inasmuch as they contribute to push downward the natural rate of interest. Finally, in this alternative framework the deficit financed public expenditure policies can be given their fair share of relevance in shaping the short and long term performances of the economy: we do not need them only temporarily, when the natural interest rate has to be pushed back into the positive territory.

Overall, our enquiry upon the demand side Secular Stagnation theory does not add to the existing heterodox literature upon stagnation. Rather, it aims at strengthening the heterodox side of the debate by showing the weak points that we have deemed of major relevance within the neoclassical viewpoint. We felt indeed that while the heterodox side of the debate was already able to propose an alternative valid viewpoint, not enough had been done to directly tackle the mainstream theoretical apparatus. Despite the indisputable final word that the Cambridge capital critiques had already posed upon the issue of whether a natural interest rate exists or not, the neoclassical theory has survived and can still enjoy its prominent role in the academy. Thus, we felt that it was not sufficient to dismiss the demand side Secular Stagnation theory by resorting to those critiques in order to point out that the natural interest rate does not exist, and hence the debate about the plausibility of its fall below zero is of no relevance.

The whole discussion had been developed thus far on a purely theoretical level. Our final claim has been that there seems to be sufficient reasons to believe that the theoretical construct of the demand side Secular Stagnation theory cannot satisfyingly provide a rationale to explain the issue of stagnation, and thus it would be better to turn to alternative theories of growth. What we finally wanted to investigate was a long lasting matter of dispute on the empirical side: does the available literature about the relationship between the interest rate and private investment show a systematic and strong inverse relationship between the two variables? In our opinion an enquiry trying to answer to such a question would have already been relevant in its own terms, the more so since it is strictly connected to our line of research. In fact, the third milestone of the demand side Secular Stagnation theory argues that the zero lower bound prevents monetary policy from being effective in stimulating investment. After the conclusion of the theoretical discussion, we have thus chosen to question the theory even on this ground: is it true that the zero lower bound is the real reason why monetary policy becomes ineffective? By carrying out a meta-analysis about the recent empirical literature about the relationship between the interest rate and private

investment, we have concluded that there is no clear evidence for arguing that between the two variables an inverse systematic relation exists. Yet, our results need further investigation, since we cannot claim to have covered the whole available literature. Still, the analysis carried forward so far shows that even at the empirical level there appears to be no room to claim that the zero lower bound ought to have a relevance in explaining stagnation. In fact, there seems to be no way to advocate that a lower interest rate set by the Central Bank is effective in stimulating investment, being the zero lower bound constraint effective or not. Therefore, our study cannot support the demand side Secular Stagnation theory in any respect, neither theoretical nor empirical.

Seen in hindsight, the demand side Secular Stagnation theory may appear as a noteworthy attempt to advocate the implementation of active fiscal policies, without abandoning the straitjacket of the neoclassical theory. As we have illustrated, in fact, the other neoclassical alternative to look at stagnation would entail saying that there is no aggregate demand problem at all, since the whole situation could be read as a result of a pure supply side phenomenon. In this respect, the demand side theory has the merit to direct the attention to the role of fiscal policy as a fundamental tool for policymakers. Therefore, remaining confined within the neoclassical realm, we do not have any hesitation before saying that the demand side Secular Stagnation theory is by and large preferable to the supply side alternative. Yet, if we enlarge our viewpoint, we might perhaps rationalize the process that has conducted to the emergence of this strand of literature as an attempt to justify the slow economic performances witnessed in the advanced economies even when the Central Banks had already set their reference interest rates very close to zero. The fact that investments and growth did not recover up to a satisfying level let a crossroad suddenly came about: does the problem lie in the theory we are using to evaluate the current economic situation, or the general theoretical apparatus is sound, but something new has in the meanwhile materialized? The demand side Secular Stagnation theory could thus represent the perfect bond between the two needs: the necessity to propose to temporarily intervene in the economy in order to sustain aggregate demand without questioning the validity of the theoretical schemata beneath this policy prescription. This feature of that strand of literature may be perhaps recognized as not particularly surprising. Indeed, if we recall that its two main proposers are Larry Summers and Paul Krugman, it is difficult not to link the message proper of the demand side Secular

Stagnation theory to the broader new – Keynesian analytical framework. Within the latter, in fact, one of the main targets has always been the conciliation between a long term theory of growth that relies on the supply side factors typical of the neoclassical theory with a short run in which the economy may suffer from aggregate demand shortages due to several kinds of price rigidities that hinder the realization of the potential output. Little surprise can then be expressed in ascertaining how these main features resurfaces even within the way in which these authors try to explain the long lasting stagnation experienced in recent years by the advanced capitalism.

Yet, given the weak points that we think to have unveiled within this stagnation theory, and the abundance of alternative theoretical strands of thought that do not suffer from these issues, our final opinion can thus be summarized in the following manner: if our suggestions about the birth of the demand side Secular Stagnation theory are correct, then the answer had not to be found in the search for novel features to be added to the theory such as the negative natural interest rate and the zero lower bound, because the real problem rests in the very same mainstream theory that is employed to look at economic phenomena, which is the neoclassical theory.

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