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*Stefano Di Bucchianico*

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# A Neglected Route to Krugman's Liquidity Trap Revival

Stefano Di Bucchianico

*University of Siena*

## Abstract

Krugman's 1998 seminal model that revived the liquidity trap theory stimulated a debate on its origins and differences with respect to Keynes' and Hicks's insights. The present paper illustrates and comments on a neglected line of thought innervating Krugman's model, which hinges on the presence of a negative natural rate of interest. This result is argued to ensue from theoretical premises analogous to those present in Samuelson's 1958 article on the overlapping generations model. In turn, Samuelson obtained a negative equilibrium interest rate by opportunely recasting Böhm-Bawerk's three causes for a positive rate of interest.

**Keywords:** three causes for a positive rate of interest; liquidity trap; negative natural rate of interest; Krugman; Samuelson.

**JEL Codes:** B13; B20; B30.

## 1. Introduction<sup>1</sup>

Krugman's (1998) article on Japan's long-standing stagnation has proven to be among the most important contributions in macroeconomic theory in the last decades. In Krugman's opinion, Japan was stuck in a liquidity trap, which implied the ineffectiveness of conventional monetary policy. Thus, to avert depressions, exceptional policy crack-downs were explicitly encouraged (Krugman 2000a, 2000b).

This seminal contribution became a cornerstone of the ensuing flow of publications devoted to the theory of monetary policy at the zero lower bound (ZLB). Following Krugman's intuition, a long list of contributions kept analysing monetary policy at the ZLB (Eggertsson and Woodford 2003, 2004; Eggertsson and Krugman 2012). Furthermore, the backbones of the Secular Stagnation Theory, initially coined by Hansen (1939) and lately resurrected by Summers (2014, 2018) can be seen to be inspired by the logical

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<sup>1</sup> I wish to thank Antonella Palumbo, Paolo Trabucchi and one anonymous referee for their useful suggestions and comments. Thanks are also due to Luca Zamparelli and Fabio Petri for the initial encouragement to pursue this line of research. Any errors are solely my own.

structure Krugman offered back in the day (Di Bucchianico 2020a, 2020b). This is no mystery, as Krugman himself has explicitly made the connection clear (Krugman 2013, 2018). Moreover, the renewed liquidity trap framework enjoyed so widespread a success that in sections devoted to monetary policy both highly specialised and intermediate textbooks invariably cite it (respectively, Woodford 2003; Romer 2018).

We are however interested not in the legacy of Krugman's liquidity trap, but rather in its sources of inspiration and influences. The 1998 article has stimulated several contributions in this respect as well. This hardly comes as a surprise, since in general terms Krugman's theoretical effort has caused the liquidity trap paradigm to regain relevance to an extent that was unseen in the academic debate since the years of the Neoclassical Synthesis. It is therefore natural to see reconstructions and discussions on the relationship between Krugman's (1998) paper, and, among others, Hicks's fundamental piece (1937), which in turn draws on Keynes's (1936) *General Theory*.

In the present paper, we want to offer a new perspective on the origins of Krugman's modern liquidity trap in the history of thought. According to our reconstruction, there is a neglected route to the 1998 reinstatement of the liquidity trap theory. The theory comes out of a marriage between two foundational elements. First, the general backbone of the argument is linked to Hicks's (1937) seminal contribution, putting Keynes's (1936) clues regarding the propensity to hoard and liquidity preference into the tremendously famous IS-LM model.<sup>2</sup> Second, the negative natural rate of interest (NNRI), out of reach because of the ZLB, emerges in response to assumptions which closely resemble the analytical background employed by Samuelson (1958), in turn hinging on the Böhm-Bawerk's famous (1889) 'three causes' for a positive rate of interest.

We, therefore, contend for a more comprehensive understanding of Krugman's liquidity trap to be achieved when this second (to the best of our knowledge, unnoticed) route, is taken into account. Nevertheless, we will maintain that Krugman's remarkable analytical enterprise did not allow for a robust advancement in the theory of the liquidity trap because his exercise retains some fundamental weak points when employing the natural interest rate category.

The article proceeds as follows: section 2 presents Krugman's model (1998) about Japan and reviews its central hypotheses and lines of argument; section 3 briefly recalls the discussion on the connection with the old-fashioned liquidity trap theory; section 4 examines the parallel connection with the three causes for a positive rate of interest; section 5 investigates whether and how Krugman has effectively brought the neoclassical examination of the meaning of an NNRI forward; section 6 concludes the article.

## **2. Krugman's model and the explanation for Japan's stagnation**

Krugman intended to revive, with suitable modifications, the Keynesian-Hicksian liquidity trap. The 2008 Nobel prize recipient aimed at recreating in a modern intertemporal

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<sup>2</sup> IS-LL in the seminal 1937 article.

two-period model a situation of Hicksian liquidity trap. This served to explain the long-lasting stagnation of Japan (Krugman 2000b).

According to Krugman, a ‘liquidity trap’ emerges when monetary policy can no longer steer the rate of interest by controlling the money supply. Indeed, controlling the money supply becomes useless when the interest rate falls to zero because in that situation money and bonds are perfect substitutes. The reason why the Central Bank should try to steer the nominal interest rate as low as possible lies in the presence of an NNRI. The natural interest rate is supposed to turn negative when potential output is assumed to decrease over time. Therefore, in a simple Fisher-equation description of the real interest rate, we see that:

$$r = i - \pi^e, \quad r^* < 0 \quad (1)$$

If the real interest rate required for equilibrium  $r^*$  is negative, the market real interest rate  $r$  needs to be negative as well. Given inflation expectations, one strategy might be for the monetary authorities to set a negative nominal rate of interest. Unfortunately, given the ZLB, the NNRI cannot be achieved through such a route. The alternative envisaged by Krugman contemplates management of inflation expectations. Even though the nominal interest rate is constrained by the ZLB, raising inflation expectations can generate an appropriately negative real interest rate, provided that the Central Bank’s policy is considered credible by agents. However, the public is convinced that monetary authorities will, sooner rather than later, revert to conservative policy. The Central Bank is hence compelled to ‘credibly promise to be irresponsible’, remarkably raising the inflation target and engaging in a ruthless crackdown to steer agents’ expectations in the desired direction.

### 2.1. A sketch of the model

Let us have a brief look at the 1998 model (for a more comprehensive discussion, see Di Bucchianico 2020a). The representative agent has a utility function of the following type:

$$U = \frac{1}{1 - \rho} \sum c_t^{1-\rho} \beta^t \quad (2)$$

where  $c_t$  is consumption,  $\rho$  is the relative risk aversion coefficient,  $\beta$  is the discount factor. The latter, as commonplace, is supposed to be positive but lower than unity to represent the lower weight individuals attach to future consumption. There are no savings, and consumption is the only component of output. The representative agent, subject to a ‘cash in advance’ constraint, trades cash for one-period bonds, for the sake of obtaining the only available consumption good. Money supply  $M$  is exogenous and the price level today  $P$  is given by the Quantity Theory equation

$$P = \frac{M}{y} \quad (3)$$

where output today (equal to endowment today)  $y$  is given. The velocity of circulation of money is (implicitly) supposed to be unity. In strict analogy, the price level tomorrow  $P^*$  is fixed at  $P^* = M^*/y^*$  once both  $M^*$  and  $y^*$  are given.

From (2), by exploiting the Euler equation for optimal intertemporal consumption allocation, Krugman links the price level today and the nominal interest rate:

$$1 + i = \frac{P^*}{\beta P} \left( \frac{y^*}{y} \right)^\rho \quad (4)$$

In equation (4) there are five givens: the discount factor and the relative risk aversion coefficient (preference parameters); the two endowments for today and tomorrow (output); and the future price level. When the current price level rises, the nominal interest rate falls.

To derive the natural interest rate, we rearrange equation (4). The natural real interest rate  $r$  is exogenously set given preferences and endowments:

$$1 + r = \frac{1}{\beta} \left( \frac{y^*}{y} \right)^\rho \quad (5)$$

The natural rate of interest turns negative when future output is expected to shrink sufficiently when compared to current output. Assuming the relative risk aversion coefficient equal to one for simplicity, the condition boils down to:

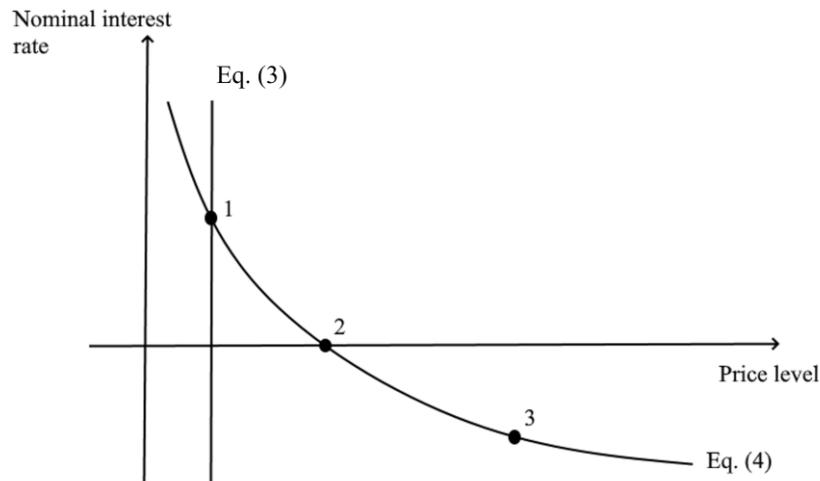
$$\frac{y^*}{y} < \beta \quad (6)$$

Condition (6) entails that the marginal utility of consuming tomorrow is higher than today since future output is lower than current output. Hence, the interest rate becomes a price to pay if one wants to postpone consumption.

The other element to be taken into account is the non-negative constraint on the nominal interest rate set by the ZLB

$$i \geq 0 \quad (7)$$

The Central Bank can fix the price level in (3) by injecting an appropriate amount of money and, indirectly, the nominal interest rate in (4) as well. Nevertheless, this mechanism operates, in the graph below, down to point 2 at most (the ZLB). If the economy is characterised by an NNRI, point 3 cannot be achieved.



**Figure 1** – The liquidity trap in the flexible price model. *Source:* Krugman (1998, p. 145).

In a flexible price environment, Krugman argues, the price level today would drop, thereby raising inflation expectations: the NNRI can be achieved despite the ZLB. However, if a rigidity on the current price level is introduced, price stickiness prevents the economy from hitting the NNRI through deflation. We thus have all the pieces needed in (1) to describe Krugman's intuition synthetically: an NNRI, the ZLB, and, with given prices today and tomorrow, a fixed  $\pi^e$ . Since price rigidity prevents deflation, the system is stuck in an underemployment equilibrium. The ensuing policy prescription is thus in favour of an effort to raise  $P^*$ : if it can be increased aptly, the required inflation expectations allow to hit the NNRI despite the ZLB.

Krugman (1998, pp. 150-151) then introduces investment in a stylised overlapping generations example. In it, the young cohort cultivates land and uses the proceeds to buy it from the old. The elder cohort consumes what it earns from selling the land. The expected rate of return  $r_t$  on buying land is:

$$1 + r_t = \frac{R_{t+1} + q_{t+1}}{q_t} \quad (8)$$

where  $R_{t+1}$  is the marginal product of land and  $q_t, q_{t+1}$  are the prices of land today and tomorrow. Krugman states that a sufficient population decline, causing the price of land to fall, can make the rate of return negative:

$$r_t < 0: q_t - q_{t+1} > R_{t+1} \quad (9)$$

thereby showing the possibility for an NNRI to emerge even when investment is introduced.

## 2.2. The assumptions made by Krugman

Let us now list, among the assumptions of the 1998 article, those that play, in our view, the most significant role. We will use them, later on, to point out the analogy with the contributions of other authors about the nature and sign of the natural rate of interest.

Krugman reaches the fundamental result of an NNRI in an intertemporal, two-period model. The economy is supposed to be poorer tomorrow than today, given that consumption endowments decrease in the second period. Agents strictly prefer consumption today to consumption tomorrow, as they are characterised by a positive (and lower than one) time discount factor  $\beta$ . Lastly, in the model there is only one consumption good; no capital is present.

The following case-study introduces an overlapping, two-generation structure. The price of the only product of the economy is supposed to decrease tomorrow. Again, agents systematically prefer consuming today rather than tomorrow. In this case, there is an attempt to deal with a productive asset such as land, delivering a positive marginal product.

## 3. The established route to Krugman's liquidity trap

Krugman's (1998) model has received over the years a great deal of attention. A plea of papers has further developed its basic intuition. Among others, we find Eggertsson and

Woodford (2003, 2004).<sup>3</sup> It also opened the way to the renewed Secular Stagnation theory, built on the supposition of an NNRI out of monetary policy reach because of the ZLB (Summers 2014, 2018). We can also appreciate how much it permeates mainstream thought on monetary policy as it is frequently cited in university textbooks, too, when it comes to discussing these issues (Woodford 2003, pp. 250-252; Romer 2018, pp. 615-629).<sup>4</sup>

When dealing with the origins of the contribution to the history of thought, it is hard not to connect it with the outstandingly famous ‘liquidity trap’ concept. After all, this is what Krugman himself states at the very beginning of his article, where Hicks, the IS-LM model, and the liquidity trap concept are all mentioned. What we can indeed see in the literature devoted to the connection between Krugman (1998) and Hicks (1937) is a list of contributions reconstructing the thread of influence and criticising the American author on several points.

Boianovsky (2004) reconstructs the history of the liquidity trap from the Keynesian/Hicksian origins until Krugman’s 1998 novelties. After a historical overview of the many developments of the basic Hicksian IS-LM framework, Boianovsky discusses Krugman’s innovations (pp. 112-120). According to him, one of the essential features of the old Hicksian trap was the role of the ‘elasticity of price expectations’ (a concept that Hicks will fully develop only in *Value and Capital* [1939]), in other words, how sensitive are the expectations about the future level of prices to prices changes today. Such a concept, as seen above, is fundamental also in the Krugmanian reappraisal. In it, since the Central Bank is unable to govern agents’ price expectations, equilibrium can only be reached by deflation, provided that current prices are flexible. Boianovsky argues that when the elasticity of expected future prices to current prices is zero, as it is the case in Krugman’s model, a change in today’s prices will be compensated by a substitution mechanism reinstating intertemporal equilibrium. He further points out that this kind of reasoning is taken from Hicks.<sup>5</sup> Then Boianovsky (p. 120) remarks:

By focusing analytically on the short-rate minimum, the recent literature is led to stress deflationary expectations (just like some pre-Keynesian authors) or a negative natural rate of interest as necessary conditions for the emergence of a liquidity trap.

The second element, the NNRI, and its origin, is what we will address in the next section, where we look at it in connection to the renewal of the liquidity trap.

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<sup>3</sup> The author himself has been elaborating on it. Krugman (2014) has coined the term ‘timidity trap’ to describe a situation in which a Central Bank that is too prudent in setting its inflation target can end up guaranteeing its failure at stimulating the economy. Eggertsson and Krugman (2012) used a very similar analytical strategy to illustrate the possibility of a debt-deflation crisis due to deleveraging.

<sup>4</sup> In this respect, it is interesting to note the mounting relevancy it has been regaining. In Romer’s well-known macroeconomic textbook, we see a shift from the 4<sup>th</sup> edition in which Krugman (1998) is addressed in a section of a few pages only (2012, pp. 549-550) to the 2018 5<sup>th</sup> edition, in which there are fifteen pages entirely devoted to reconstruct and employ Krugman’s model to explain monetary policy at the ZLB.

<sup>5</sup> Such a process is frustrated when the elasticity is one (or higher) since a change in today’s prices causes cumulative dynamics. In that case, the presence of nominal wage rigidity may prevent endless deflationary spirals (Boianovsky 2004, pp. 94-95).

Kregel (2003) contests Krugman's attempt in several aspects. Especially relevant to our reconstruction are those related to some misconceptions about the relationship between Krugman's proposal and the original Keynesian insights.

First, according to him, the 1998 model is heavily informed by the Quantity Theory of Money, far from Keynes' emphasis on liquidity preference.<sup>6</sup> Second, the overall framework is said to be inspired by Irving Fisher's vision in which the nominal rate of interest is determined by the real rate of return adjusted for the rate of change in the price level. The ensuing policy targeting inflation, Kregel states, is analogous to the suggestions Fisher delivered to Roosevelt during the Great Depression. Third, Krugman neglects Keynes' criticism against Fisher's contention that the nominal interest rate incorporates a perfectly anticipated rise or fall in the price level, for this would overlook the impact of a rise or fall in interest rates on the capital value of existing stocks of financial assets.<sup>7</sup> In a similar vein, Taylor (2014) claims that Krugman's model is not genuinely Keynesian. First, he accuses Krugman of considering the price level only as a nominal rigidity without referring to Keynes' use of a cost function based on the money wage level. Second, he is dissatisfied with expected inflation to be determined via a universally shared probability distribution of future price changes, *contra* Keynes's suggestion not to rely on those kinds of probabilistic formulations of expectations. Third, Taylor deems the whole model to be based on some rigidity hindering convergence to full employment, which is not the central Keynesian message.<sup>8</sup> Finally, also the reliance on a natural rate of interest to bring into equilibrium savings and investment adds to the whole schema an element extraneous to Keynes's thought.

On the policy side, both Kregel (2003) and Taylor (2014) are sceptic about the focus on unconventional monetary policy, given that public expenditure and income redistribution would, in their opinion, be more effective. In this respect, they find the agreement of, among others, Akram (2016) and Sau (2018). The latter two authors have brought a Post-Keynesian view on the analysis of liquidity trap cases – respectively, the case of Japan and the Eurozone, criticising at the same time Krugman's (1998) proposals and the ensuing literature.

These important contributions highlight the fact that the relationship between the original Keynesian insights and the modern Krugmanian liquidity trap theory has been thoroughly examined.<sup>9</sup> Therefore, we close this section by drawing what has been thus far

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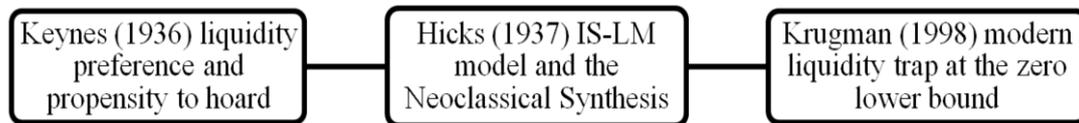
<sup>6</sup> The reason for the emergence of the liquidity trap is then the failure of money growth to raise prices as postulated by the traditional quantity theory. This failure is explained by the inability of the Central Bank to make credible its intention to generate inflation.

<sup>7</sup> These are not the only contributions of the author on this subject. Kregel (1998) shows that by grounding on Keynes's way of dealing with expectations, it is possible to develop a foundation for a Post-Keynesian theory of finance that would integrate the more general analysis of modern monetary production economies. Kregel (2011) dwells on the similarity between the Bank of Japan and Federal Reserve extraordinary monetary interventions and the recommendations Keynes made in his *Treatise on Money* (1930). The author contends that those policies provide a sort of test for Keynes's beliefs; accordingly, the emphasis on fiscal policy present in the *General Theory* (1936) was more appropriate than the previous position.

<sup>8</sup> For a critique of the ZLB economics, see Bertocco and Kalajzić (2018), Palley (2019).

<sup>9</sup> This connection is also reinforced by the broader relationship existing between Krugman's economic thought and Keynesianism. On this particular aspect, namely the connection between Keynes and Krugman, see Harcourt (2008) and Steele (2012).

considered the main line of inspiration for Krugman (1998). It goes back to Hicks's (1937) formalisation of the IS-LM schema, reaching to Keynes's (1936) *General Theory*. We are here, of course, pointing out only the main line of connections, without referring to all the authors involved. It would be indeed difficult not to associate to that line of enquiry the works of, for instance, Modigliani (1944) and Tobin (1947), among others. We make use of a simple sketch to fix the idea, as it will be later integrated with another line of thought:



**Figure 2** – The established route to Krugman's modern liquidity trap. *Source:* own elaboration.

#### 4. The neglected route to Krugman's liquidity trap

There is, in our opinion, another line of inspiration for the 1998 reinstatement of the liquidity trap theory. We believe our take on the issue not to be a 'historical' reconstruction as defined by Blaug (2002, p. 213-214):

A historical reconstruction [...] attempts to recover the ideas of past thinkers in terms that they, and their contemporaries, would have recognised as a more or less faithful description of what they had set out to do; it tries to see the past as the past saw itself.

We aim to highlight the resurgence over time, and specifically in Krugman's (1998) seminal paper, of the issue of what causes the interest rate to be either positive or negative. Hence, we consider Krugman to be a prominent example of the attempt to describe the case for an NNRI starting from premises which we can trace back to other eminent authors. Given the absence of explicit linkages in the articles of Krugman to this line of thought, ours cannot but be a 'rational' reconstruction.<sup>10</sup>

A complete reconstruction of the debate is beyond the scope of this paper, that aims at pointing out the similarity between Krugman's reasoning and that of Böhm-Bawerk and Samuelson. In particular, while the origin of the enquiry on the three causes can be traced back to Böhm-Bawerk (1889), Samuelson (1958) has expounded the discourse by showing the possibility to start from those causes and get an NNRI. Therefore, the general structure of the model proposed by Krugman back in 1998 draws heavily on Hicks's 1937 reasoning in terms of intertemporal price elasticity and money/bonds substitutability (let alone the choice of renovating the liquidity trap concept). However, the case involving an NNRI may have been borrowed from Samuelson's 1958 path-breaking article, which set forth an overlapping generations analysis. Let us, therefore, try to reconstruct the rationale for our claim.

Böhm-Bawerk, in his *The Positive Theory of Capital* (1889) deemed the origin of a positive rate of interest to be owed to three causes (Blaug 1997, pp. 480-488): (i) better

<sup>10</sup> In a sense not strictly analogous to that of Blaug (2002).

provision for wants expected in the future than in the present, (ii) undervaluation of future wants, and (iii) the superiority of more roundabout methods of production. 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 refers to the psychological feature according to which people typically 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 relates to the technical fact that, by giving up consumption today, it is possible to free resources to be invested in more roundabout and mechanised processes that tomorrow will yield a higher amount of output.

What is the link between Böhm-Bawerk's three causes for a positive rate of interest and our enquiry on the rationale of Krugman's (1998) modern liquidity trap? To start with, the tasks the two authors had in mind were opposed. Whereas Böhm-Bawerk wanted to understand why the rate of interest is generally positive, Krugman's target was to place an NNRI at the core of his theory.

To initially get acquainted with how the three causes can be changed and mixed, we consider an example where there is a zero rate of interest. We do so by referring to Blaug (1997, p. 487), who argued that:

Summing up, the rate of interest can only be zero when (1) the flow of income is constant through time; (2) time preference is neutral; and (3) the net product cannot be increased by postponing consumption for the sake of future production.

We postpone the discussion of how to make the three causes interact to the next section. What matters now is to focus on the fact that, while the three causes (and their interactions) have been generally employed to study the positivity of the rate of interest, at the logical level some peculiar assumptions may make the final result different. In this case, from a positive rate of interest, under the hypotheses listed by Blaug, the rate of interest can be zero. We now move to the case in which the rate of interest becomes negative.

Samuelson (1958, see esp. pp. 468-469), attempted to determine the equilibrium interest rate in an economy in which, along the years, different generations overlap and the equilibrium interest rate is obtained in a market among generations in which loans are demanded only for consumption.<sup>11</sup> The main assumptions of the model were:

- i) each cohort of agents experiences a three-period 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 any labour income. Thus, later years will not be wealthier but poorer;
- ii) the arguments of the ordinal utility function of the representative consumer are the three-period dated consumptions quantities, but there is no formalisation for the subjective discount factor;
- iii) no good can be used as a store of value because none keeps through time (in his words, an "extreme assumption").

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<sup>11</sup> Without further additions, we would like to single out the similarity between this structure and a recent overlapping generations model used to study Secular Stagnation (Eggertsson et al. 2019). For a critique of such a model, which also recalls Samuelson (1958), see Spahn (2016).

During the introduction to the formal setup of the model, Samuelson recalls the three causes envisaged by Böhm-Bawerk for the appearance of a positive rate of interest. He then states the problem in these terms:

(Thus Bohm's second cause of interest may or may not be operative; it could even be reversed, men being supposed to overvalue the future!) In addition to ignoring Bohm's second cause of systematic time preference, I am in a sense also denying or reversing his first cause of interest[...] Finally, recall our assumption that no goods keep, no trade with Nature being possible, and hence Bohm's third technological cause of interest is being denied. Under these assumptions, what will be the equilibrium time path of interest rates (p. 469)?

We can see now how 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 higher weight attached to present consumption with respect to future consumption disappears since the utility function of the individual agent has no 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 stylised economy the interest rate can be seen as a by-product of human fertility (in his words, a "biological theory of interest"), because the rate of interest is equal in magnitude to the rate of growth of population, Samuelson also analyses 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* (p. 479, emphasis in the original on 'poorer').

The theoretical picture drawn by Samuelson appears clear. Given the nature of his assumptions, which either reverse or set aside the three causes, the NNRI follows straight. Once the possibility of an NNRI has been acknowledged in such a simplified model, the author calls for successive possible improvements over the basic framework he laid out. Specifically, Samuelson suggests to introduce (i) technological investment possibilities, (ii) technical innovations raising incomes on a secular basis, (iii) a subjective discount factor, (iv) imperfect competition, (v) uncertainty (p. 479) and to take into account an intertemporal framework in models with capital (p. 482).<sup>12</sup>

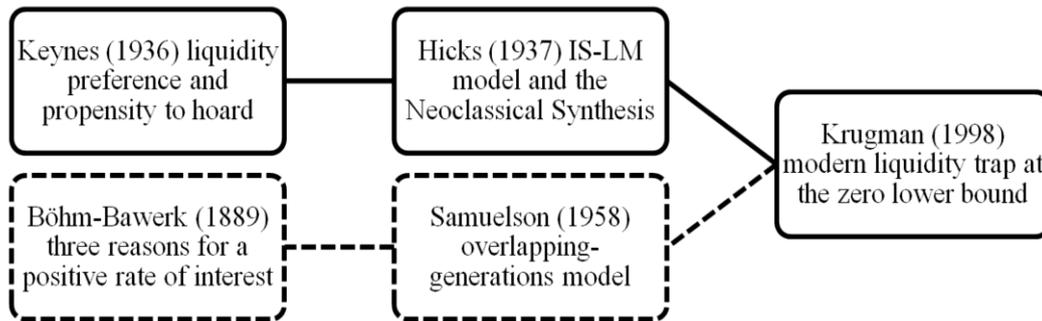
It is now time to relate Samuelson's 1958 article to Krugman's 1998 contribution. The Krugmanian model, it can be shown, may indeed host an NNRI precisely because of two reasons listed by Samuelson (cf. section 2.2). In it, in the basic version, the natural interest

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<sup>12</sup> And therefore, to reintroduce the third cause for the existence of a positive rate of interest described by Böhm-Bawerk. This is what Diamond (1965) and Samuelson (1962) did. For a broader perspective on Samuelson's theoretical enterprise, see Kurz (2010).

rate is arrived at in an economy with only consumption, through the intertemporal maximisation of utility by the representative agent. As in the case explored by Samuelson, the first cause envisaged by Böhm-Bawerk for a positive rate of interest existence was reversed, as the future level of endowments was assumed to be lower than today's level. On the contrary, the second reason is present, because agents systematically prefer consuming today rather than tomorrow. Again, like for Samuelson, technological concerns were set aside because there was neither a production function nor investment; Böhm-Bawerk's third cause for the appearance of a positive interest rate was neglected. However, in the following example, the introduction of land cultivation can be considered as the attempt to address point (i) of the list above, e.g. the possibility of investment.

We shall deal with the novelties explored by Krugman (1998) in the next section. Here we want to stress the (so far unnoticed) red line connecting Krugman (1998) to Samuelson (1958), and going back to Böhm-Bawerk (1889). This constitutes the second line of enquiry which, in our opinion, complements the line displayed in section 3, where Krugman's liquidity trap was shown to be linked to Hicks (1937), and back to Keynes's (1936) seminal book. The graph in Figure 2 can be drawn by integrating Figure 1 with an additional line of thought.



**Figure 3** – The neglected route to Krugman's modern liquidity trap. *Source:* own elaboration.

In order to better grasp the analogy we want to draw among the authors we have been treating, we also summarise their arguments in the following table:

	<b>Böhm-Bawerk (1889)</b>	<b>Samuelson (1958)</b>	<b>Krugman (1998)</b>
<b>First cause</b>	Future income higher than today	Future income lower than today	Future income lower than today
<b>Second cause</b>	Systematic preference for consumption today	Neutrality between consumption today and tomorrow	Systematic preference for consumption today
<b>Third cause</b>	Superiority of more roundabout processes	Technological superior possibilities ruled out	Technological superior possibilities ruled out
<b>Rate of interest</b>	<i>Positive</i>	<i>Negative</i>	<i>Negative</i>

**Table 1** – A synoptic table of Böhm-Bawerk, Samuelson and Krugman approaches to the three causes. *Source:* own elaboration.

Obviously, as in the discussion of the ‘established’ route, the reconstruction of this second line of thought cannot be reduced to a straight avenue running from Böhm-Bawerk to Krugman through Samuelson. There are several other authors who engaged in a discussion of the ‘three causes’. One of the preeminent examples is Wicksell (1954, pp. 106-119) who, besides discussing the issue, also reinstated the problem, transforming the ‘three causes’ framework “into an explicit theory of interest as the marginal productivity of waiting, coordinate with the marginal productivity theories of wages and rent” (Uhr 1951, p. 844). In addition to this, Boianovsky (1998) illustrates Wicksell’s and Ramsey’s various objections to Böhm-Bawerk’s formulation. These are examples of authors who enjoy a major role in our ‘neglected’ route; their contributions, however, will not be analysed here.

## **5. Where does Krugman’s work leave the neoclassical discussion on the three causes?**

After having introduced the connection between Krugman, Samuelson and Böhm-Bawerk, we will now further elaborate on their relationship. Before starting, it is important to note that Krugman’s reasoning is always carried on dealing with a dynamic economy, not a stationary condition. Blaug (1997, pp. 480-489) carefully differentiates the discussion of these two different cases. We note that were the economy stationary the interest rate would be determined given the discount factor of the representative agent, as pointed out right away (Krugman 1998, p. 144).

Keeping the non-stationarity assumption in mind, let us refer to the list of possible improvements suggested by Samuelson. We will treat each of them in an order coherent with Böhm-Bawerk’s three reasons and not with Samuelson’s list. Point (ii), linked to the first cause, has been left where Samuelson did sixty years ago: Krugman assumes endowments tomorrow to be lower than today. Therefore, as in Samuelson, the first cause for a positive rate of interest has been reversed, and there is no presence of technical innovations raising incomes in the longer run. It can be noted that the neglect of this aspect invalidates Krugman’s hypothetical NNRI. Even remaining confined to a Neoclassical growth framework such as Solow’s (1956) model, shrinking population growth rates can be reconciled with a growing potential output if considering technical progress (Di Bucchianico 2020a). Thus, neglecting Samuelson’s suggestion makes the presence of an NNRI unwarranted.<sup>13</sup>

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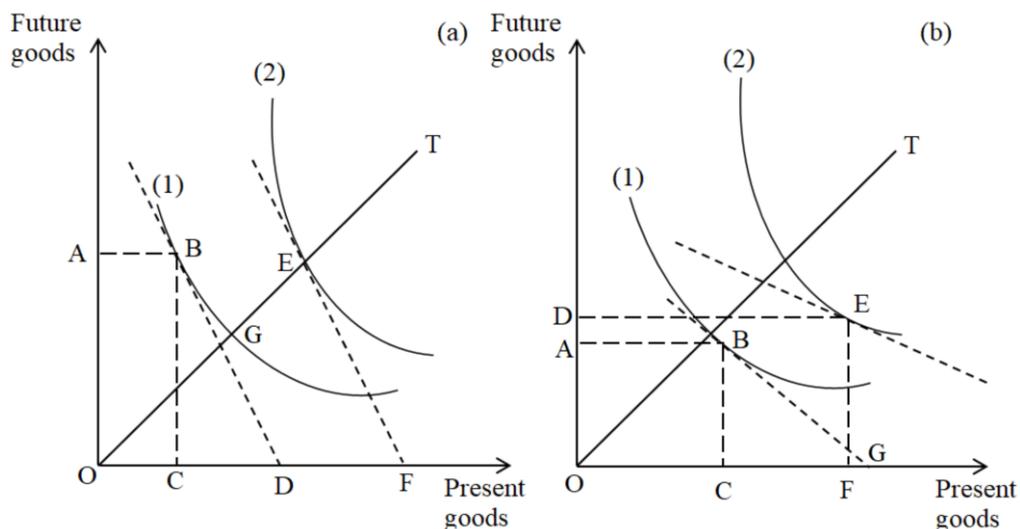
<sup>13</sup> Without elaborating further, we point out the very different viewpoints of the respective authors when discussing their results. Indeed, Samuelson looked at the solution involving an NNRI as a sort of basic result obtained under overtly restrictive assumptions, an initial step to be integrated with a long list of improvements. Krugman, as seen, basically retains Samuelson’s framework. Nevertheless, while Samuelson was not keen on providing any concrete policy recommendation, Krugman wished to take a firm stance on the explanation of the causes for the Japanese lasting stagnation.

Since the beginning of his enquiry, Krugman introduced point (iii), namely “strong biases toward present goods and against future goods”, which is nothing else than the beta discount factor in equation (2). In the extensive literature on Neoclassical consumption theory, such a discount factor takes values positive but lower than one, following its theoretical content. Such an improvement makes the condition about the realisation of an NNRI stricter than what would have been otherwise, as we can see by recalling equation (6):

$$\frac{y^*}{y} < \beta$$

If no particular systematic preference for present consumption over future consumption characterises the preferences of the representative agent, the beta factor is equal to one. In this manner, present and future consumption carry the same weight for the agent. Therefore, in equation (6) an NNRI emerges for whatever endowments tomorrow lower than today. When a systematic preference is introduced, i.e. a beta lower than one, the decrease of future endowments has to be sufficiently strong as to make the ratio between future and present endowments to be lower than the discount factor. Thus, we can say that Krugman’s insertion of a systematic preference for present consumption deals with Samuelson’s point (iii): such a factor renders the condition for the appearance of an NNRI more stringent. However, in light of Krugman’s analysis on the presence of an NNRI in the Japanese economy, this feature does not make a great deal of difference. The fundamental hypothesis remains the one seen before, i.e. the supposition of a poorer economy tomorrow. What changes is how strong the rate of decrease has to be.

We now summarise the discussion on the first two causes by using the graphical representation in Figure 4. We elaborate on Negishi (1982, Section 3, pp. 165-167) who utilised a useful graph to better grasp Böhm-Bawerk’s take on the first two causes:



**Figure 4** – A graphical sketch of the first two causes, (a) in the case of Böhm-Bawerk, (b) in the case of Krugman. *Source:* own elaboration on Negishi (1982, p. 166).

The graph on the left, case (a), represents the conventional Böhm-Bawerk rationalisation of the first two causes. Line OT has slope 1: this means that along this line, the amount of available present and future consumption goods is the same. A situation like that would be represented by drawing a square whose diagonal is the OG line. The slope of the indifference curve (1) in point G would thus be 1 in absolute value. A Böhm-Bawerkian's provision (point B) such that OA is longer than OC causes the slope of the line DB to be higher than 1 in absolute value, and this is due to the positive rate of interest emerging in such a context. The case of indifference curve (2) is different. Despite line FE having the same slope as line DB and point E being on the OT line, a positive rate of interest emerges. This is due to the systematic preference for consumption today, which makes a positive rate of interest possible even when relative endowments are equal. This feature can be recognised considering that the second indifference curve is steeper than the first one.

The graph on the right, case (b), depicts the Krugmanian version. If we can expect with certainty that the provision of goods will be lower tomorrow, line OC is longer than OA, and in point B the slope of the indifference curve (1) (line GB) will be lower than 1 in absolute value. This is due to the emergence of a negative rate of interest. However, in the absence of a systematic preference for consumption today, even a slightly smaller endowment today (as in the graph) suffices to let a negative interest rate emerge. When, on the contrary, we have a steeper indifference curve which conveys the presence of the second cause, in order to obtain a slope lower than 1 in absolute value we have to suppose a higher rate of decrease of endowments tomorrow. In the graph, line OD is considerably shorter than the line OF, and in point E, the slope of the indifference curve (2) is lower than 1 in absolute value. The last consideration regards the meaning of the interest rate in a model with only consumption. Let us suppose that the whole reasoning made by Krugman holds. Nonetheless, the kind of interest rate he discusses carries issues even in terms of interpreting its theoretical relevance. The interest rate, in that case, is the by-product of the reasoning involving dated quantities of delivered amounts of a single consumption good. Indeed, it can be maintained that the interest rate calculated in that scenario (resembling the Arrow-Debreu model in the use of dated commodities) is not a proper rate of interest, but rather an 'own' rate of interest, expressed by the relative price of a single item between the current period and the subsequent point in time (Fratini in Bellino *et al.* 2017, Fratini 2020a, Fratini 2020b).

Let us now bring the third cause back into the discussion. As seen in section 2.1, Krugman also briefly tackles the introduction of technological investment possibilities, Samuelson's point (i).<sup>14</sup> We note that the exercise is done by supposing a model with labour and land, the latter being a factor of production utterly different with respect to capital. It is in fact given in fixed supply and yields rent instead of interest. One might thus say that point (i), referring to the third cause, has been disregarded. Be it as it may,

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<sup>14</sup> There seems to be no clear-cut distinction between the discussion of the difference between a rise 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. However, the point appears of minor relevance in the present context.

we discuss the example and consider the fact that in equation (7) there is a marginal product of a particular asset. We take this to indicate that in the economy there is the possibility to use present goods in such a way that tomorrow a higher amount of goods is delivered. In a stationary state, it would not be possible for Krugman to speak of an NNRI. Indeed, in equation (7), once the price of land is supposed to remain constant, capital losses are ruled out. Hence, only negative marginal productivity of land would cause an NNRI. Nevertheless, this would be a reversion of the third cause. While it is legitimate to start with examples without investment, once the latter is introduced, to suppose negative marginal productivity of a factor of production appears much less legitimate. This point is particularly evident in the recent reappraisal of the Secular Stagnation theory (Summers 2014, 2018), where an NNRI is considered despite the presence of capital and its marginal product. Nonetheless, the possibility for such a case to be acceptable as plausible and logically consistent is hard to defend (Di Bucchianico 2020b).

In the case considered by Krugman, the analysis is placed outside a steady-state. An NNRI comes about because of the decrease in the price of the asset between periods. Therefore, Krugman can obtain an NNRI despite the presence of the third cause because he implicitly differentiates between net productivity in *physical* and *value* terms.<sup>15</sup> The economy thus hypothesised can, by abstaining from consumption today, deliver tomorrow a physical product that is more than what has been saved. Nevertheless, the value of what is supplied tomorrow is lower with respect to what we subtract to consumption.

While this casts serious doubts on the relevance of Krugman's elaboration as a possible explanation for the stagnation of Japan (Di Bucchianico 2020a), our analysis brings to the fore a different consideration. It seems in fact that without the shortcut just illustrated — separating physical and value productivity — the third cause would invalidate the possibility of an NNRI. In fact, given constant prices, positive net asset productivity would ensure that more goods will be available tomorrow. With a utility function representation, the ensuing decreasing marginal utility, due to higher consumption tomorrow, will suffice to bring about a positive rate of interest. In this respect, the second cause could not run against such a result either. As seen above, it can only make the requirement necessary to get an NNRI stricter. Once the third cause is operative, the only way in which it may serve to oppose the emergence of a positive interest rate is by supposing a systematic preference for consuming tomorrow. Blaug (1997, p. 486) assesses such a case to be possible, yet unlikely. We believe a supposition like that to be too farfetched.

## 6. Conclusions

Two crucial conclusions emerge from our discussion of Krugman's attempt to justify the presence of a negative natural rate of interest in modern macroeconomic modelling. In the first place, in our opinion, it is possible to integrate the discussion on the origins and influences that helped Krugman to give birth to his modern liquidity trap. Needless to

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<sup>15</sup> Blaug (1997, pp. 480-481) argues that Böhm-Bawerk had to justify the fact that more physically productive roundabout methods bring about also an increase in the product's value.

say, the modern version is related to the insights of Keynes, Hicks, and the subsequent refinements made during the ‘neoclassical synthesis’ years. What we want to add to the available reconstructions is the possibility that the crucial feature, namely the negative natural rate of interest, originates elsewhere. The fundamental authors, in our line of thought, are Samuelson and Böhm-Bawerk. Indeed, back in 1958, dealing with the establishment of what is now labelled the overlapping generations model, Samuelson derived a negative natural rate of interest by proposing a set of assumptions which we have also found in Krugman’s seminal work. The analytical exercise of Samuelson is directly rooted, as he explicitly states, in either ignoring or reverting Böhm-Bawerk’s three causes for a positive rate of interest. Other authors who may enter this route given their discussion of the three causes are, for instance, Wicksell and Fisher.

Second, we have also shown how the list of assumptions needed to get the negative natural rate of interest does not allow Krugman’s proposal to provide a substantial advancement to the theory of the liquidity trap. The use of a natural rate of interest implies severe problems when one wants to explain relevant economic phenomena.

Given the great deal of attention that Krugman’s model (rightfully) garnered over the years and its enduring influence on theories such as the renewed Secular Stagnation hypothesis, we claim a more comprehensive understanding of the origins of the results therein contained to be of utmost importance. We also claim that this hitherto unnoticed route to the modern reinstatement of the liquidity trap helps shine a light on some non-negligible hypotheses which have been the target of long-lasting debates and are still employed in modern theories.

## References

- Akram, T. (2016), Japan’s liquidity trap, *Levy Economics Institute Working Papers Series*, Working Paper 862.
- Bellino, E., Bidard, C., Fratini, S. M., Harcourt, G. C., Opocher, A., Steedman, I., and Kurz, H. D. (2017), *Symposium on Arrigo Opocher and Ian Steedman, Full Industry Equilibrium. A Theory of the Industrial Long Run*, Cambridge, Cambridge University Press / *Metroeconomica*, 68(4): 586-624.
- Bertocco, G. and Kalajzić, A. (2018), The zero lower bound and the asymmetric efficacy of monetary policy: A view from the history of economic ideas, *Italian Economic Journal*, 4(3): 549-566.
- Blaug, M. (1997), *Economic Theory in Retrospect*, Cambridge, Cambridge University Press.
- Blaug, M. (2002), Misunderstanding classical economics: the Sraffian interpretation of the surplus approach, in Nisticò, S. and Tosato, D, *Competing Economic Theories*, London, Routledge: 96-112.
- Böhm-Bawerk, E., (1889) [1959], *The Positive Theory of Capital*, South Holland, Illinois.

- Boianovsky, M. (1998), Wicksell, Ramsey and the theory of interest, *Journal of the History of Economic Thought*, 5(1): 140-168.
- Boianovsky, M. (2004), The IS-LM model and the liquidity trap concept: From Hicks to Krugman, *History of Political Economy*, 36(5): 92-126.
- Di Bucchianico, S. (2020a), A note on Krugman's liquidity trap and monetary policy at the zero lower bound, *Review of Political Economy*, 36 1-22.
- Di Bucchianico, S. (2020b, *forthcoming*), Discussing Secular Stagnation: A case for releasing good ideas from theoretical constraints?, *Structural Change and Economic Dynamics*.
- Diamond, P. A. (1965), National debt in a Neoclassical growth model, *American Economic Review*, 55(5): 1126-1150.
- Eggertsson, G. B. and Krugman, P. (2012), Debt, deleveraging, and the liquidity trap: A Fisher-Minsky-Koo approach, *Quarterly Journal of Economics*, 127(3): 1469-1513.
- Eggertsson, G. B. and Woodford, M. (2003), Zero bound on interest rates and optimal monetary policy, *Brookings Papers on Economic Activity*, (1): 139-233.
- Eggertsson, G. B. and Woodford, M. (2004), Policy options in a liquidity trap, *American Economic Review*, 94(2): 76-79.
- Eggertsson, G. B., Mehrotra, N. R., and Robbins, J. A. (2019), A model of secular stagnation: Theory and quantitative evaluation, *American Economic Journal: Macroeconomics*, 11(1): 1-48.
- Fratini, S. M. (2020a), Interest, profit and saving in Arrow-Debreu equilibrium models, *Department of Economics-University Roma Tre*, 0254.
- Fratini, S. M. (2020b), Incomes from capital in alternative economic theories, *Centro Sraffa Working Papers*, 42.
- Hansen, A. H. (1939), Economic progress and declining population growth, *American Economic Review*, 29(1): 1-15.
- Harcourt, G. C. (2008), On Paul Krugman on Maynard Keynes' General Theory, *History of Economics Review*, 47(1): 125-131.
- Hicks, J. R. (1937), Mr. Keynes and the "Classics". A suggested interpretation, *Econometrica*, 5(2): 147-159.
- Hicks, J. R. (1939), *Value and Capital: An Inquiry into Some Fundamental Principles of Economic Theory*, Oxford, Clarendon Press.
- Keynes, J. M. (1930), *A Treatise on Money, Vol. II: The Applied Theory of Money*, London, Macmillan.
- Keynes, J. M. (1936), *The General Theory of Employment, Interest and Money*, London, Macmillan.

- Kregel, J. A. (1998), Aspects of a Post Keynesian theory of finance, *Journal of Post Keynesian Economics*, 21(1): 111-133.
- Kregel, J. A. (2003), Krugman on the liquidity trap: Why inflation will not bring recovery in Japan, in Arena, R., and Salvadori, N. (eds), *Money, Credit, and the Role of the State: Essays in honour of Augusto Graziani*, Burlington, Ashgate.
- Kregel, J. A. (2011), Was Keynes's Monetary Policy, a Outrance in the Treatise, a Fore-runner of ZIRP and QE? Did He Change His Mind in the General Theory?, *Levy Economics Institute*, 11(04).
- Krugman, P. (1998), It's baaack: Japan's slump and the return of the liquidity trap, *Brookings Papers on Economic Activity*, (2): 137-205.
- Krugman, P. (2000a), *The Return of Depression Economics*, London, Penguin.
- Krugman, P. (2000b), Thinking about the liquidity trap, *Journal of the Japanese and International Economies*, 14(4): 221-237.
- Krugman, P. (2013), Secular stagnation, coalmines, bubbles, and Larry Summers, *The New York Times*, Accessed 26-05-2019. URL: <https://krugman.blogs.ny-times.com/2013/11/16/secular-stagnation-coalmines-bubbles-and-larry-summers/>
- Krugman, P. (2014), Four observations on secular stagnation, in Baldwin, R., and Teulings, C. (eds), *Secular stagnation: Facts, causes and cures*, Centre for Economic Policy Research-CEPR: 61-68.
- Krugman, P. (2018), It's Baaack, Twenty Years Later, *City University of New York*.
- Kurz, H. D. (2010), Aiming for a 'Higher Prize' Paul Anthony Samuelson (1915–2009), *European Journal of the History of Economic Thought*, 17(3): 513-520.
- Modigliani, F. (1944), Liquidity preference and the theory of interest and money, *Econometrica*, 12(1): 45-88.
- Negishi, T. (1982), Wicksell's missing equation and Böhm-Bawerk's three causes of interest in a stationary state, *Zeitschrift für Nationalökonomie/Journal of Economics*, 42(2): 161-174.
- Palley, T. I. (2019), The fallacy of the natural rate of interest and zero lower bound economics: why negative interest rates may not remedy Keynesian unemployment, *Review of Keynesian Economics*, 7(2): 151-170.
- Romer, D. H. (2012), *Advanced Macroeconomics*, Fourth edition, McGraw-Hill.
- Romer, D. H. (2018), *Advanced Macroeconomics*, Fifth edition, McGraw-Hill.
- Samuelson, P. A. (1958), An exact consumption-loan model of interest with or without the social contrivance of money, *Journal of Political Economy*, 66(6): 467-482.
- Samuelson, P. A. (1962), Parable and realism in capital theory: the surrogate production function, *Review of Economic Studies*, 29(3): 193-206.

- Sau, L. (2018), Coping with deflation and the liquidity trap in the Eurozone: A post Keynesian approach, *Journal of Post Keynesian Economics*, 41(2): 210-235.
- Solow, R. M. (1956), A contribution to the theory of economic growth, *Quarterly Journal of Economics*, 70(1): 65-94.
- Spahn, P. (2016), Population growth, saving, interest rates and stagnation: Discussing the Eggertsson-Mehrotra model, *Hohenheim Discussion Papers in Business, Economics and Social Sciences*, No. 04-2016.
- Steele, G. R. (2012), Keynes, Keynesianism and Krugman, *Economic Affairs*, 32(1): 64-67.
- Summers, L. H. (2014), US economic prospects: Secular stagnation, hysteresis, and the zero lower bound, *Business Economics*, 49(2): 65-73.
- Summers, L. H. (2018), Secular stagnation and macroeconomic policy, *IMF Economic Review*, 66(2): 226-250.
- Taylor, L. (2014), Paul Krugman's 'liquidity trap' and other misadventures with Keynes, *Review of Keynesian Economics*, 2(4): 483-489.
- Tobin, J. (1947), Liquidity preference and monetary policy, *Review of Economics and Statistics*, 29(2): 124-131.
- Uhr, C. G. (1951), Knut Wicksell: A Centennial Evaluation, *American Economic Review*, 41(5): 829-860.
- Wicksell, K. (1954), *Value, Capital and Rent*, London, George Allen & Unwin.
- Woodford, M. (2003), *Interest and Prices: Foundations of a Theory of Monetary Policy*, Princeton university press.

**Author contact information:**

Stefano Di Bucchianico

Department of Economics and Statistics, University of Siena.

53100 – Siena (Italy)

[stefanodibucchianico@gmail.com](mailto:stefanodibucchianico@gmail.com)