

Boianovsky, Mauro

Working Paper

Wicksell, secular stagnation and the negative natural rate of interest

CHOPE Working Paper, No. 2016-25

Provided in Cooperation with:

Center for the History of Political Economy at Duke University

Suggested Citation: Boianovsky, Mauro (2016) : Wicksell, secular stagnation and the negative natural rate of interest, CHOPE Working Paper, No. 2016-25, Duke University, Center for the History of Political Economy (CHOPE), Durham, NC

This Version is available at:

<https://hdl.handle.net/10419/155454>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Wicksell, secular stagnation and the negative natural rate of interest

Mauro Boianovsky (Universidade de Brasilia)

mboianovsky@gmail.com

Third draft (October 2016)

Abstract. Knut Wicksell's concept of the natural (or neutral) rate of interest, introduced between the end of the 19th and beginning of the 20th centuries, has played an important role in modern monetary macroeconomics, especially after the development of inflation targeting policy in the 1990s. More recently, the revival of Alvin Hansen's 1939 secular stagnation hypothesis by Lawrence Summers and others has brought to the fore the notion of a negative natural rate of interest, in the sense that there is no positive rate of interest able to equilibrate saving and investment at full-employment income. The present paper investigates whether the negative natural rate of interest may be found in Wicksell. It also examines in what extent the idea of secular stagnation is compatible with his original theoretical framework.

Key words. Wicksell, secular stagnation, natural rate of interest, Hansen, population growth

JEL classification. B13, B22, E32, E40

Acknowledgements. I would like to thank Hans-Michael Trautwein, Ingo Barends, Geoff Harcourt, Michaël Assous and (other) participants at the 14th Nordic History of Economic Thought Meeting (Lund, 25-26 August 2016) and at the seminar series "Histoire de la macroéconomie et des theories monétaires" (Maison des Sciences Économiques, Paris, 14 October 2016) for helpful comments.

In bad times this demand [for new capital] is practically nil, though saving does not nevertheless entirely cease (Wicksell [1906] 1935)

1. From Hansen to Wicksell

The “secular stagnation” hypothesis, put forward by Alvin Hansen (1939) in his 1938 Presidential Address to the American Economic Association, is back in the macroeconomic research agenda, after Lawrence Summers (2014a,b; 2015; 2016) and others argued for its relevance to interpret economic trends in the American economy and elsewhere since the 2008-09 crisis. In its revival, a widely deployed “workable definition” (Teulings and Baldwin 2014, p. 2) of secular stagnation is that negative real interest rates are needed to equilibrate saving and investment at full employment income. As put by Summers (2016), “following the Swedish economist Knut Wicksell, it is common to refer to the real interest rate that balances saving and investment at full employment as the ‘natural’ or ‘neutral’ real interest rate. Secular stagnation occurs when neutral real interest rates are sufficiently low that they cannot be achieved through conventional central-bank policies”. In particular, if the saving and investment curves at full employment are such that the resulting natural interest rate is negative, the zero lower bound on the nominal market interest rate prevents the latter from falling to its neutral level in full employment equilibrium. Adjustment will then take place through the multiplier mechanism and reduced output, which may remain indefinitely at its low stagnated level. The possibility of a negative Wicksellian natural rate of interest was occasionally acknowledged in the inflation targeting literature of the 1990s and early 2000s, but it was regarded a temporary phenomenon caused by preference shocks, since the model implied a positive average level of the natural rate determined by the rate of time discount of the representative agent (see e.g. Woodford 2003, p. 251).

There have been no attempts by secular stagnation theorists to connect the notion of a negative natural rate of interest to Wicksell’s own original framework. The extensive literature on Wicksell’s monetary and capital theories is largely silent on the matter. Two important exceptions are Carl Uhr (1960, pp. 252-53) and David Laidler (2006, pp. 156-57), who argued, respectively, that Wicksell neglected the

limitations imposed on central bank policy by the possibility of a negative (or very low) natural rate, and by the zero lower bound on the nominal interest rate. In a similar vein, C. Christian von Weizsäcker (2013, p. 43) has asserted that Wicksell (under Böhm-Bawerk's influence) disregarded the possibility of a negative natural rate of interest. The present author (Boianovsky & Trautwein 2006, pp. 178-79; Boianovsky 2013, p. 213; Boianovsky 2016, pp. 278-79), on the other hand, has maintained that Wicksell was aware of the zero lower bound and of a negative natural rate in the depression, even if such topics are not conspicuous in his research agenda. This paper provides an enlarged treatment of how Wicksell dealt with those issues, and how they link up with the secular stagnation theme. As documented below, he discussed those topics from three different perspectives: Böhm-Bawerk's first ground for the existence of interest, the possibility that expected deflation exceeds the rate of interest (expressed in commodities), and excess saving at nearly nil investment in the downward phase of the business cycle.

According to Paul Samuelson (1976, pp. 27-28), the origins of Hansen's approach to economic fluctuations go back to the Continental business cycle tradition, which may betray Hansen's interest in his own "Scandinavian background" (Hansen was born in South Dakota to Danish immigrants). His "mentors" were the German economist Arthur Spiethoff and Wicksell, from whom Hansen borrowed the notion that economic oscillations are essentially a function of economic progress determined by irregular technical changes, population growth, the opening of new territory and the discovery of natural resources (Samuelson, *op. cit.*). Indeed, Spiethoff and Wicksell are the authors Hansen (1939) mentioned most in his famous article (three times each). Keynes is mentioned just once, in connection with his 1937 *Eugenics Review* piece on population dynamics. However, Keynes's (1936) major impact is evident in Hansen (1939, 1941), especially in respect with the consumption function and the multiplier.

Despite influence from Continental business cycle literature and Keynes's theory of income determination, Hansen clearly presented his secular stagnation hypothesis as new (see Backhouse & Boianovsky 2016). He did not define secular stagnation by a negative natural rate of interest, but in historical-institutional terms as "sick recoveries which die in their infancy and depressions which feed on themselves and leave a hard and seemingly immovable core of unemployment" (Hansen 1939, p. 4). That pattern was brought about by an apparent chronic excess of desired saving

over investment demand caused by the declining pace of population growth and capital-intensive technical progress, which is broadly consistent with the modern notion of secular stagnation. From Hansen's perspective, his new hypothesis was an attempt to make sense of unemployment from the "long-run, secular standpoint" instead of a temporary phenomenon as in the 19th and early 20th centuries business cycle literature. Whereas Wicksell, Spiethoff and other business cycle theorists provided a necessary starting point, they were unable, according to Hansen (1939, pp. 3-4; 1941, p. 249), to devise secular stagnation as an analytical problem, for both historical and theoretical reasons: (i) the economy was supposed to reach full employment in the upswing, a view inspired by the 19th century experience, when, in contrast with the 1930s, "the forces of economic progress were powerful and strong, [and] investment outlets were numerous and alluring"; (ii) they lacked the consumption function "powerful tool", and therefore "could never quite reach the port" (Hansen 1946, p. 183).¹ Some parallels and contrasts between Hansen and Wicksell are drawn below. Both paid careful attention to the interaction between population changes and macroeconomic dynamics. Although Hansen did not follow Wicksell's approach to capital, the two economists shared the view that "the time element in production ... is the very essence of the capital concept" (Hansen 1939, p. 6) and that there are strong diminishing returns to capital deepening leading to "capital saturation" in the absence of technical progress and population growth.

2. Capital accumulation, the rate of discount and hoarding

The current description of secular stagnation in terms of a negative real rate of interest goes back to A. C. Pigou's (1943, 1947) first attempts to model Hansen's (1939, 1941) hypothesis and what Pigou called "Keynes's day of judgement". Unlike the stationary state of J.S. Mill and other classical economists, Hansen's argument implied that full employment and stationary state equilibrium – in the sense of zero population growth and nil net investment – could under certain circumstances only be reached together if the rate of interest was negative (Pigou 1943, pp. 345-47).

¹ In a similar way, Summers (2014a, p. 29) has ascribed the inability of (most) current macroeconomics to grasp secular stagnation to its focus on cyclical fluctuations while the average level of output and employment over a long period is taken as given.

However, the “representative man’s” rate of discount (determined by his “myopia” about future needs), which decides the rate of interest in the stationary state, cannot be nil or negative. A way out of that analytical problem, according to Pigou, is the introduction of other motives for saving, such as “the desire for possession as such, conformity to tradition or custom and so”, which would account for positive saving at zero or negative interest rates. As explained by D. H. Robertson ([1957, 1958, 1959] 1963, pp. 235-36), Pigou expressed these other motives as a direct rate of return, in terms of utility, of saved income. By subtracting from the rate of discount a correcting factor based on these direct returns, one can obtain what Robertson called a *net* rate of discount, which may in some cases be negative, in the sense that the direct enjoyment factor may overshadow the “myopia factor”. But, in stationary state equilibrium, pointed out Pigou, the rate of interest must be the same whatever commodity is used to express it. In particular, the rate of interest measured in money – a commodity that can be held with negligible storage costs – cannot be negative. Hence, (what we now call) the zero lower bound to the rate of interest makes it impossible for the economy to reach full employment equilibrium, and Hansen’s case against classical economics seems to be vindicated.² The demand for money becomes infinitely elastic at zero interest rate, with an ensuing shrinkage of money income caused by the inconsistency between saving and investment at any positive rate of interest.

Pigou’s reformulation of the secular stagnation hypothesis differed from Hansen’s original presentation, based on the Keynesian consumption function with a marginal propensity to consume lower than unity. According to Hansen (1941, pp. 249, 306), the “customs, habits, and institutional arrangements” that determine consumption as a function of income are firmly “imbedded in the social structure”. As net investment falls off in the depression (to zero or near zero levels), consumption will not fill the gap, since saving comes down in smaller proportion than the fall in income. Therefore, aggregate spending declines and the multiplier brings the economy toward an equilibrium “self-perpetuating income level far short of full employment”. Moreover, from Hansen’s (1941, pp. 331-32) perspective, the effect of the rate of interest on saving decisions is indeterminate.

² As it is well known, it was in that context that Pigou (1943, 1947) introduced the effect of falling price level on real wealth and consumption (the so-called “Pigou effect”) as an attempt to rescue classical full-employment stationary state.

Recent efforts to model secular stagnation are closer to Pigou than to Hansen, in the sense that they have faced the problem that a negative rate of discount makes the maximization problem of the representative agent intractable, as the intertemporal budget constraint “explodes”. The alternative is the introduction of heterogeneous agents, particularly in the form of overlapping generation models of saving over the life cycle (Eggertsson and Mehrotra 2014; Pagano and Sbracia 2014, appendix). Overlapping generations, life expectancy and retirement age are also behind the modified Austrian model elaborated by Weizsäcker (2013), who claims that, given current demographic and production parameters, capital market equilibrium requires a negative natural rate of interest, with perverse implications for price level stability.³

The notion that heterogeneous agents and life cycle saving may bring about a negative equilibrium real interest rate was advanced by Alfred Marshall in the 1895 edition of his classic *Principles*. The progressive economic conditions of the world economy at the end of the 19th century were such that “few ... care to save a large part of their incomes; and ... many openings have been made for the use of capital in recent times by the progress of discovery and the opening up of new countries“. Consequently, the “supply of accumulated wealth [is] so small relatively to the demand for its use, that that use is a source of gain” in the form of interest (Marshall [1890] 1990, p. 483). However, instead of stressing that “familiar truth”, Marshall pointed out

How small a modification of the conditions of our own world would be required to bring us to another in which the mass of the people would be so anxious to provide for old age and for their families after them, and in which the new openings for the advantageous use of accumulated wealth in any form were so small, that the amount of wealth for the safe custody of which people were willing to pay would exceed that which others desired to borrow; and where in consequence, even those who saw their way to make a gain out of the use of capital, would be able to exact a payment for taking charge of it; and interest would be negative all along the line (Marshall [1890] 1990, p. 483, n. 2; added in the third 1895 edition; see also pp. 192-93 for a similar passage, and Boianovsky 2004, p. 115).

³ Samuelson’s (1958) seminal paper on overlapping generations featured a negative interest rate under zero population growth.

The different world imagined by Marshall resembles in many aspects the world contemplated in modern secular stagnation debates. However, the Cambridge economist did not draw implications for unemployment, output or price level stabilization from that setup. This may be explained by the fact that, as D.H. Robertson ([1957, 1958, 1959] 1963, p. 390) suggested, Marshall did not seem to realize that the market rate of interest could not become negative so long as it was possible to hold money at no cost, as it would be more profitable to hold money than to accept a negative rate of interest on bonds. However, in fairness to Marshall, he did refer in a related passage to the example of “some of our own forefathers, who accumulated small stores of guineas” which they carried into the country, when they retired from active life. The care of the guineas “cost them a great deal of trouble” and they would be willing to pay a small charge to anyone who would relieve them from the trouble without causing any risk (Marshall [1890] 1990, p. 192). Hence, money holding (for long periods) seemed to entail significant costs according to Marshall, which would make sense of his notion of a (monetary) negative interest rate.

Irving Fisher (1896, p. 30) was probably the first to enunciate that “the rate of interest in a money which can be hoarded (without trouble, risk or expense) can never sink below zero”. According to Fisher’s (ibid) formula, in perfect foresight equilibrium

$$1 + j = (1 + a) (1 + i)$$

where j is the rate of interest measured in a commodity (“wheat”), a is the expected rate of appreciation of money (“gold”) relatively to wheat, and i is the rate of interest in money. The restriction $i \geq 0$ is therefore equivalent to the condition $a \leq j$. The same cause – hoarding – that prevents the interest from being negative, also curbs the expected rate of appreciation. Such limits come from the possibility of hoarding money without loss. If money were a perishable commodity⁴, the limits to i would be negative. Interest could also conceivably be negative if a “dollar” was defined as consisting of a constantly increasing number of grains of gold. In that case, such dollars “cannot be hoarded without growing fewer with time”, and interest will be

⁴ Such as a fruit (“strawberry”), suggested in Böhm-Bawerk’s ([1889] 1891, pp. 252, 297) illustration, quoted by Fisher in that connection. Fisher (1930, p. 192) would state that “there is no absolutely necessary reason inherent in the nature of man or things why the rate of interest in terms of any commodity should be positive rather than negative”. However, he based that statement on the same strawberry illustration deployed in 1896, regarded as a very particular case.

negative (ibid, pp. 32-33). This is not far from Silvio Gesell's later proposal to establish a tax on money holding, called "stamped-money" by Keynes (1936, pp. 353-38).⁵

Wicksell probably came across Marshall's discussion of negative interest and was certainly acquainted with Fisher's treatment of the measurement of interest in different standards (see the next section). However, the main reference for Wicksell's approach to the determination of the rate of interest is Eugen v. Böhm-Bawerk's 1889 *Positive Theorie des Kapitaless*. Böhm-Bawerk ([1889] 1891, pp. 250-52), in the chapter about his "first reason" for the existence of interest, entertained the possibility of a negative rate of interest on grounds similar to Marshall, but dismissed it in the end. Under Böhm-Bawerk's usual assumption that the income stream is rising through time, the law of diminishing marginal utility of income implies a preference for present over future goods. If, on the other hand, economic agents expect their income to come down in the future (because of e.g. old age), they will in principle value future goods higher than present ones. Böhm-Bawerk, however, denied the validity of this counter-example to his first reason, on the grounds that those who expect a less abundant satisfaction of their needs in the future can always hoard money (precious metals) for later use: "Most goods, and among them, particularly, money, which represents all kinds of goods indifferently, are durable, and can, therefore, be reserved for the services of the future".⁶

That passage caught Wicksell's critical attention. He agreed that economic agents could hoard money in order to avail themselves of goods with higher marginal utility in the future, but rejected Böhm-Bawerk's inference that this would assure positive time preference and rate of interest.

But this cannot by itself lead to a *positive* superiority (agio) for the present goods; it can only ensure that the difference of value in the *negative* direction does not fall below the costs or risks of storing these objects [precious metals]. It is quite conceivable that those who for this reason want to dispose of present goods (to assure themselves of the future goods) are *more numerous* than those who wish to do the opposite, and in such a case ... a "marginal pair's"

⁵ See Fisher (1933)'s "stamp script". On Gesell and the recent growing literature around his proposal see Nielsen (2016).

⁶ See also Potuzak (2016), who however overlooks the fact that Böhm-Bawerk denied the possibility of a negative rate of interest even if the income stream is declining, unless there are no durable goods able to function as stores of value.

estimate of this difference would in any case be near zero, possibly less (Wicksell ([1911] 1958, p. 181; see also [1901] 1934, p. 170; and Boianovsky & Trautwein 2006, pp. 178-79).

Assuming the costs or risks (including the risk of inflation, as Wicksell observed) of hoarding money are negligible, the market rate of interest can fall as low as zero, which Böhm-Bawerk (like Marshall after him) missed. The overall aggregate effect of saving performed in the form of money hoarding is the contraction in money income and a falling price level, so that, if everybody saves uniformly, individuals “will continue to obtain just as many commodities for their remaining income as if they had not saved and were in fact not compelled to restrict their consumption” (Wicksell [1906] 1935, pp. 8-9). When hoarded money is returned to circulation, prices will rise and savers will not be able to increase their consumption. “Thus saving will not have involved any sacrifice, and the result will prove to be exactly nothing” – a nominal version of the so-called “paradox of thrift”, based on the quantity theory of money instead of the multiplier.⁷

Wicksell’s approach to the determination of the rate of interest in an economy with positive saving (as opposed to most of his capital theory, developed for a stationary economy with constant capital stock) should be understood as a by-product of his analytical effort to make precise the interaction between Böhm-Bawerk’s three reasons for a positive rate of interest (Wicksell [1911] 1958, [1914] 1997; see Boianovsky 1998, section 2). Under “dynamic equilibrium” there is a permanent difference between the interest rate determined by the return on productive capital (Böhm-Bawerk’s third reason, or the marginal productivity of capital as reformulated by Wicksell) and the undervaluation of future needs (the second reason, called “myopia” by Marshall and Pigou, which decides the rate of time discount). The gap between the two is filled by means of Böhm-Bawerk’s first reason. “Capital accumulation and saving are constantly pushed to the limit where the *underweight* of present supply, and hence the *overweight* of present marginal utility, exactly corresponds to this difference” (Wicksell [1914] 1997, p. 36).

⁷ Such effects will not happen if money is hoarded by a group of individuals as protection against want in old age in an economy with constant population, for, in that case, over against those age groups there will be other classes which are “obliged to encroach on pre-existing savings”, as in overlapping generations schemes (ibid, p. 9).

If, for instance, the expected rate of return on capital is 5% and the subjective underestimation of the future is 3%, “then saving does not stop until the level at which present marginal utility is 2% higher than the future level. The dynamic equilibrium will be expressed by the equality $5 = 3 + 2$ ” (ibid). The rate of interest in this illustration of “dynamic equilibrium” is therefore 5%, not 3% as in the stationary state. The present marginal utility of consumption in equilibrium is 2% higher than the marginal utility of consuming at the next moment a permanently higher amount of consumption goods - that is, the rate of decline of the marginal utility of consumption is 2% at that moment.

Wicksell’s formulation of dynamic equilibrium corresponds exactly to Ramsey’s (1928, p. 554) equation $[du(x)/dt]/u(x) = - [(df/dK) - \rho]$ where $u(x)$ is the utility function, f is the production function, K is capital and ρ is the rate of time preference. It is the Euler equation describing behavior on the optimal path.⁸ His discussion of capital accumulation in part III of the first volume of the *Lectures* is fully consistent with that framework, even though the formula for dynamic equilibrium is not yet deployed. Although economic growth was regarded the norm, Wicksell ([1901] 1934, p. 213) considered the possible effects on interest rate of a reduction in expected income and productivity (that is, a sufficiently negative z in the expression reproduced in footnote 7; see also Pagano and Sbracia 2014, p. 10). “If a country for some reason, such as the successive exhaustion of the land, passes from a *higher* to a *lower* degree of productivity and prosperity, then the same quantity of commodities will have, on the average, a higher marginal utility, and consequently a higher subjective value, in the future than in the present”. Under those circumstances, the mere holding of consumption goods for future use is advantageous, although it cannot bring about increased productivity and therefore “cannot, in the usual sense, yield any interest”. This is consistent with Wicksell’s ([1911] 1958) discussion of the possibility of a negative rate of interest in his treatment of Böhm-Bawerk’s first reason. Market clearing will require a negative natural rate of interest if the marginal utility of consumption in the future is higher than in the present when future output is expected to be significantly lower (Krugman 1998, p. 147; Boianovsky 2004, p. 115).

⁸ The steady-state rate of interest in modern Ramsey-growth models is given by the similar equation $f'(k) = \rho + \theta z$, where k is capital per effective worker, z is the growth rate of total factor productivity, and $\frac{1}{\theta}$ is the reciprocal of the elasticity of intertemporal substitution (see Barro & Sala-i-Martin 1995, chapter 2).

The notion of a negative natural rate of interest may be also found (implicitly or explicitly) in Wicksell's monetary macroeconomics under conditions of developed credit systems, as discussed next.

3. Business cycles, expectations and excess saving

Expectations of price level changes play an important role in Wicksell's definition of the natural rate of interest as an equilibrium variable, both in upward and downward cumulative processes of price change. Unlike the increase of bank rates in order to take into account inflationary price expectations, created during the upward process, adjustment after the development of deflationary expectations may be problematic (Wicksell 1897, pp. 235-36, 239-40; [1898] 1936, pp. 96-97). The expected rate of deflation (4% in his example) may *surpass* in absolute value the height of the natural rate (3%) "calculated in commodities".⁹ The delay of credit institutions in preventing a downward cumulative process – caused by a decline in the natural rate of interest following continuous capital accumulation – with an opportune reduction of the bank rate could have "serious consequences" if deflationary expectations arise: "no rate of interest, even the lowest or interest-free loan, would be able to awake the spirit of enterprise" (1897, p. 239). Even if the bank interest rate is nominally zero, credit operations will bring about losses on account of the 4% deflation rate. Only if the bank rate of interest is "negative, paid by the creditor to the debtor, will loans be made without losses for the latter" (p. 240). R. G. Hawtrey [1913] 1962, pp. 186-87) described the situation when "the [expected] rate of depreciation of prices is *greater* than the natural rate of interest" as "stagnation of trade", which he distinguished from "normal" depressions, when banks are not restricted by the zero lower bound and can therefore affect the demand for credit. Robertson ([1922] 1948, p. 177) considered the same scenario, adding the remark that "the bank has yet to be seen which will lend money for nothing or for a negative rate of money interest".

Surely, negative bank rates of interest were not part of monetary history experienced by Robertson or Wicksell. Since 2014, for the first time ever negative interest rates – applied to deposits held by commercial banks at the European Central

⁹ That is, $a > j$ in Fisher's (1896) terminology reproduced above, which the American economist considered impossible in equilibrium. See also Boianovsky (2013, p. 213).

Bank, and at the Swedish, Swiss and Danish central banks – have been pushed below zero (see World Bank 2015). This may pose problems if negative rates are paid on bank deposits as well and costumers prefer to demand cash in order to avoid the burden, an issue known as the “cash-problem” in the literature dealing with negative nominal rates and stamped-money (see Nielsen 2016). Such “cash-problem” would not exist in a pure-credit economy of the kind devised by Wicksell ([1898] 1936). This is clear from Erik Lindahl’s (1939) discussion of a setup similar to Wicksell’s (1897), with a potentially negative nominal bank rate. Lindahl had in the early 1920s pointed out that the rate of deflation announced and implemented by the Swedish central bank could not exceed the natural rate of interest because of the zero lower bound. However, such a restriction does not apply to a pure-credit economy (as assumed by Lindahl in most of his *Studies*). The zero lower bound is “not valid under the special assumption made here, that there are no cash holdings in the society. For in this case there is nothing to prevent the general application of a *negative* rate of interest” (Lindahl 1939, p. 149, n.). Hence, from this perspective, Wicksell’s (1897) mention of pushing bank rates to negative territory may be not just a purely fictional or unrealistic remark, even if seen as difficult to implement at the time.

Strong deflationary expectations may be seen as a sufficient but not necessary condition for a negative natural rate of interest in Wicksell. The Swedish economist distinguished the study of cumulative changes in the price level (which occupied most of his monetary macroeconomics) from the investigation of cyclical fluctuations in employment and output (Wicksell [1906] 1935, pp. 209-14; [1907] 1953; [1908] 2001; see Boianovsky 1995, and Boianovsky & Trautwein 2001). Oscillations of the natural rate of interest (even if accompanied by corresponding changes in the bank rate), caused mainly by the irregular pace of technical progress, constitute the “essence of good and bad times” ([1906] 1935, p. 208), which Wicksell illustrated elsewhere with his well-known “rocking horse” metaphor. New discoveries, inventions and other improvements shift the demand for fixed capital upwards, since the “conversion of large masses of liquid into fixed capital” is now profitable. And symmetrically in the downswing:

If, again, these technical improvements are already in operation, and no others are available, or at any rate none which have been sufficiently tested or promise a profit in excess of the margin of risk attaching to all new enterprises, there will come a period of depression; people will not venture to

the capital which is now being accumulated in such a fixed form, but will retain it as far as possible in a liquid available form (ibid, p. 212).

By “liquid form” Wicksell did not mean money but circulating capital kept as inventories of goods for later use in the upswing. In contrast with the fluctuation of fixed capital investment, saving was supposed to be relatively steady over the business cycle. The demand for fixed capital is “practically nil” in the depression, but saving continues possibly at the same pace as in the preceding boom, since “although profits are smaller on average and occasionally completely absent, the general scale of production has risen, due to the increase in population that has occurred in the meanwhile and the many new investments made during the boom” (Wicksell [1908] 2001, p. 340). Ensuing excess saving is accumulated as inventory production in the downswing.

Wicksell’s concept of capital saturation in the depression is built on the notion that the reduction of the bank rate of interest all the way to zero is unable to encourage investment in fixed capital so as to match saving – that is, investment demand is inelastic even at low interest rates prevailing in the downswing. He rejected the view that opportunities for fixed capital investment are not lacking in bad times, if only people would be satisfied with the lower rate of interest that then prevails. “But here it is forgotten that the investment of capital for a longer period of time is always accompanied by risk and the risk does not necessarily become less simply because the chances of gain are small” (Wicksell [1907] 1953, p. 67).¹⁰ That piece of criticism was aimed at Cassel’s 1904 essay on business cycles, as it is clear from Wicksell’s manuscript notes of his 1907 lecture, where Cassel is mentioned in that connection (Wicksell 1907, p. 6). Cassel ([1904] 2005, p. 27) argued that there always are “inexhaustible” possibilities for a profitable use of capital, just “waiting for a decrease in the interest rate to be realized”, especially in the form of durable capital goods. “These possibilities of profitable placement of capital are what is keeping the interest rate from dropping below a certain limit. In other words, there is profitable use for all the waiting in the loan market”.

Cassel’s claim about the high elasticity of the demand curve for investment at sufficiently low interest rates is developed in greater detail in his well-known 1903

¹⁰ Just like Wicksell, Hansen (1941, p. 330) regarded “risk” as the main influence on investment decisions in the depression.

book. Wicksell ([1901] 1934, p. 209) agreed that, under normal circumstances, every fall in the rate of interest causes a number of long-term investments to become profitable, but maintained that Cassel's (1903, chapter 3) argument sets no *limit* to the downward trend of the rate of interest, but only relates to its *tempo*. Critical reactions to Hansen's secular stagnation hypothesis in the 1940s and later would lead to further development and endorsement of Cassel's contention, especially by Henry Simons (1942), Martin Bailey (1962, pp. 107-14 and 123-30) and Axel Leijonhufvud (1968, pp. 176-77, 189).¹¹ The publication in 1947 of Lawrence Klein's *Keynesian Revolution* brought to center stage the issue of the interest-elasticity of saving and (especially) investment functions. Klein's diagram (reproduced, among others, by Patinkin 1948) forcefully illustrated his claim that, given available empirical evidence, those functions are highly interest-inelastic, with the implication that there may be no positive rate of interest able to equilibrate saving and investment at full-employment. This is indicated by the solid lines in figure 1, which depict saving and investment curves at full employment income Y_0 . If there were unlimited investment opportunities, the investment function would be infinitely elastic at low interest rates – as Cassel claimed – and by that always intersect with a non-horizontal savings schedule at a positive interest rate.

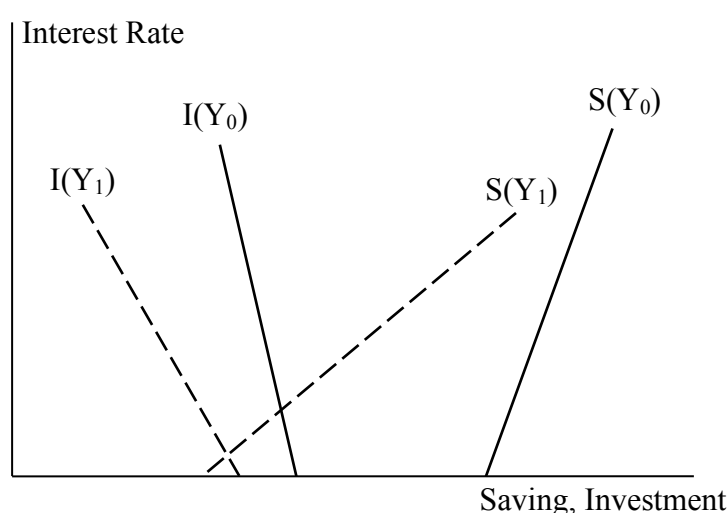


Figure 1. KLEIN'S SAVING-INVESTMENT INCONSISTENCY
Source: Klein (1947, p.85).

¹¹ Frank Knight (1944) rejected the very concept of the “stationary state”, on the grounds that there is no tendency to diminishing returns to capital accumulation, so that, from the long-run perspective, the demand for capital is infinitely elastic. See also Backhouse & Boianovsky (2016).

Adjustment will take place through the multiplier mechanism, until the reduction of income to Y_1 brings about equilibrium between saving and investment at a positive interest rate. This is consistent with Hansen's (1939, 1941) secular stagnation hypothesis, although, as Klein (p. 273) observed, Hansen's argument applied strictly to a long-run stationary state with no net investment and exact replacement of all existing capital equipment. Unlike modern literature, Klein did not deploy Wicksell's term "natural rate of interest" to describe the rate of interest that equates saving and investment at full employment income. This is explained by the fact that, according to Klein (pp. 26-27), Wicksell did not incorporate into his system the notion – based on the multiplier – that saving and investment can be in equilibrium at various levels of employment. From Klein's perspective, Wicksell related the natural rate of interest to the equilibrium or stability of the price level only, regardless of the level of income. Klein's point about multiple natural rates echoed Keynes's (1936, pp. 242-43) reinterpretation of Wicksell's natural rate of interest concept and suggestion that it should be replaced, as the goal of monetary policy, by what he named the "*optimum* [interest] rate", defined as "the natural rate ... which is consistent with *full* employment".

Nevertheless, just as in Klein's diagram, Wicksell's description of "bad times" entailed excess saving at (nearly) zero bank interest rates, so that the natural rate that equilibrates the market for goods may be seen as negative. Wicksell, like some of his contemporaries, sought an answer to the question "what happens to saving in the depression?" (see Boianovsky 1995, section 4). "In a period of depression ... investment in fixed capital hardly pays, but saving continues, though perhaps at a slower pace. The process of capital accumulation is here not a little enigmatic. It *must* continue in some real form, since there is no other; but in what?" (Wicksell [1901] 1934, p. 218). The (by now) familiar Keynesian answer – that excess saving is eliminated through the multiplier mechanism and falling income – was not open to Wicksell.¹²

Instead, he argued that excess saving is accumulated in the form of inventories of goods, reflecting general overproduction in the depression (see also Hansen 1951b,

¹² The equilibrating mechanism through income change may be found already in Wicksell's contemporary F.B. Hawley. See Boianovsky (1996) for comparisons between Hawley and Wicksell in that regard, including how the notion of a consumption function eluded the Swedish economist.

one of the very few references in the literature to Wicksell's hypothesis that inventories move contra-cyclically). Production for stock acts as a stabilizer not only of income and employment, but also particularly of the falling price level in the downswing, as it reduces the rate of deflation that equilibrates the goods market. Under the assumption that producers expect prices to go back to "normal" in the upswing – unlike Wicksell's usual assumption of unitary elasticity of price expectations made in the cumulative process of price change – a sharp reduction of the bank rate of interest, even if unable to encourage investment in fixed capital, may turn production for inventory into a profitable enterprise, since real interest rates (in Fisher's sense) for loans are negative (Wicksell [1906] 1935, p. 213; [1907] 1953, pp. 68-69; [1908] 2001, pp. 341-42).

Interestingly enough, after stating that Wicksell was not aware of the restriction imposed on monetary policy by a negative (or very low) natural rate of interest, Uhr (1960, p. 254) speculated whether "it may have been in recognition of this possibility that Wicksell suggested his buffer-stock and credit subsidy plan, which was to operate in the downturn". The textual evidence provided here indicates that that was precisely the case.

4. Demography, technical progress and "the beginning of the end"

Toward the end of his 1907 lecture, Wicksell [(1907) 1953, p. 70) wondered "whether at present we have come to the 'beginning of the end'", in the sense of convergence to a stationary state with no population growth and nil net investment. Steady and positive population growth, as witnessed in Europe and most non-European countries for more than a century, was perceived as a "peculiar and rare exception to the general rule", which should in the course of the 20th century "prepare the way for much slower progress and possibly for completely stationary conditions" (Wicksell [1898] 1936, p. 195; [1901] 1934, p. 214). The great increase of population throughout the 19th century was an exceptional case, dependent on single events such as the revolution in European agricultural methods at the end of the 18th century and the exploration of limited energy resources like coal. "A stationary population – or rather alternating increases and decreases, resulting in a very slow growth – has at all times and in all countries been the principal demographic rule and we must imagine it

to remain so even in the future” (Wicksell [1910] 1979, p. 136; see also [1907] 1953, p. 70).¹³

Writing in the 1930s, Hansen (1939, p. 2) agreed with Wicksell’s Malthusian perspective that the “prodigious growth of population in the 19th century was something unique in history” and a continued demographic growth at the same pace “would rapidly present insoluble problems”. However, whereas Wicksell ([1898] 1936, pp. 195-96) welcomed the classical stationary state as an opportunity for increase in welfare and for progress in the “*qualitative*” sense, Hansen worried about the “serious structural adjustments” associated with the drastic shift represented by the swift decline of the American rate of population growth at the time. It was the “great transition” in 20th century demographic trends as compared to the 19th century that concerned Hansen (1939, p. 15), as he made clear in a letter of 27 February 1940 to his former student P.A. Samuelson, who seemed to miss the point that it was not a matter of comparing equilibrium positions.

The real problem is the problem of transition from a rapidly growing society which developed a very high investment-saving economy to the one in which population growth is ceasing. It is the shift over from this extremely high investment-saving economy to a more slowly growing economy with the concomitant requirement of a high propensity to consume which sets the problem (Hansen, 1940).

A shift from rapidly growing population to a stationary or declining one affected “capital widening” negatively, which could be hardly compensated by “capital deepening” brought about by a fall in interest rates (these correspond approximately to Wicksell’s notion of “horizontal” and “vertical” dimensions of the capital structure advanced in his *Lectures*). Together with the declining pace of technical progress (especially in its capital intensive form), this explained the failure of the 1937 American recovery to reach full employment, Hansen (1939, p. 11) claimed.

Wicksell’s ([1901] 1934, part III) purely theoretical model of convergence to the stationary state abstracted from Hansen’s transitional issues. Imagining an economy habited by (what we now call) a representative agent – an “individual who

¹³ At the beginning of the 20th century, signs of the demographic transition in Western Europe were already visible and noticed by Wicksell in other works (see Boianovsky 2001).

never ages or dies” and does not discount the future – Wicksell ([1901] 1934, p. 209) argued that capital accumulation continues at a diminishing rate until the economy reaches the stationary state, with maximum permanent consumption and nil net investment at zero interest rate.¹⁴ The analysis changes significantly when population growth is taken into account. “If the growth of population is accompanied by an increased demand for all kinds of production ... and by an increased supply of labour available in the future ... than a capital accumulation which might have brought down the rate of interest to practically nothing under stationary conditions will not now be sufficient to do so” (ibid, p. 213). The (natural) rate of interest may be very high if, apart from population growth, the increase in productivity brought about by technical progress raises the marginal utility of present goods, as illustrated by North American colonies in the 18th century. Such effects may go together, since population growth may bring about, up to a point, improved methods of production – this is an element of Wicksell’s ([1901] 1934, p. 123; [1910] 1979) “optimum population” hypothesis (see Boianovsky 2001), to which Hansen (1939, p. 9) subscribed.

Because of diminishing returns to both capital accumulation and to the increase in the number of workers, caused by relative scarcity of natural resources, the tendency to the stationary state with zero interest rate can only be counteracted if there is sufficient technical progress. This is the starting-point of Wicksell’s approach to business cycles. “Every invention, whether large or small, can only contribute to the expansion of our productive potential within definite, more or less narrow, limits, and consequently a constant stream of new technical and economic advances is necessary if a growing population is to escape the operation of the law of diminishing returns” (Wicksell [1908] 2001, p. 338). Wicksell assumed in effect that there are *diminishing returns on research activity*, in the sense that making progress becomes more and more difficult as technology advances.¹⁵

If one looks at the number of patents applications granted, then there is no lack of inventions, but the great, epoch making, inventions, which substantially

¹⁴ This is equivalent to Ramsey’s “Bliss”, as it should be evident from Wicksell’s ([1914] 1997) Ramsey-like equation for the rate of interest with diminishing returns to capital accumulation (see Boianovsky 1998 and section 2 above). Capital accumulation will stop short of Bliss if $\rho > 0$.

¹⁵ This concept has played an important role in discussions about secular stagnation and economic growth alike (see Pagano and Sbracia 2014, p. 32; Jones 1995; and Griliches 1990 on data comparing population growth and the number of patents).

raise humanity's ability to produce, are palpably less frequent. And even if an invention gives rise to a whole train of others ... then it is no less the case that a successful invention actually closes the road for others in the same field (Wicksell [1907] 1953, p. 66).

The introduction of the blast furnace was a case in point. It brought about an extraordinary saving of productive power, "but once this is done it can subsequently only be a question of being able to save a fraction of the fraction by means of inventions which may by themselves perhaps be very ingenious" (ibid, p. 67). Wicksell inferred from that the stream of new, great inventions is necessarily not as steady as population growth, but sporadic. The upshot is that convergence to the stationary state takes place by means of cyclical oscillations, until the economy runs out of significant innovations. As put by Wicksell ([1908] 1997, p. 259), "every crisis also means a renewed ... reminder that all economic progress is fundamentally in vain, if our ideal of society still continues development chiefly *in breadth*, instead of deepening and raising the prosperity of the existing population".

However, the immediate effect of a lower rate of population growth is to shift the natural rate of interest downwards. Whereas a higher rate of population growth increases demand for capital in excess of saving (see e.g. Wicksell [1898] 1936, p. 150; [1906] 1935, p. 206; quoted approvingly by Hansen 1951, p. 325, n. 5), a decline has symmetrical effects on the natural rate.¹⁶ In particular, the long deflation period between 1873 and 1896, discussed in detail by Wicksell in his *Interest and Prices*, featured continuous capital accumulation, accompanied by slower population growth and lack of profitable opportunities for conversion into fixed capital (such as railways). The natural rate fell accordingly, but remained above zero: "We are to suppose that capital is continuously accumulated and that, though possibly with some delay, the efficiency of production is always increasing (that is essential – for otherwise the natural rate would soon sink to zero)" (Wicksell [1898] 1936, p. 151). The increase in real capital served rather to raise real wages and the rewards of other factors of production. The natural rate of interest consequently "fell everywhere" (ibid, p. 175). Progress in that period, as measured by the expansion of output and

¹⁶ The decline in the rate of population growth contributed to the overall stagnation of the European economy in the interwar period, according to Svernilson (1954; see also Boianovsky 2012).

population, was less rapid than earlier in the 19th century, while labour productivity continued to increase (ibid, pp. 194-95).

Hansen (1941, p. 34; 1951a, p. 61) referred positively to Wicksell's account of price level movements in the 19th century put forward in the "famous chapter XI in *Interest and Prices*". Significantly, Hansen (1951a, p. 73) found similarities between Wicksell's interpretation of the "long depression" of the last quarter of the 1800s and poor economic performance in the 1930s. "In the long sweep of technological developments, the decade of the 1930s was in many respects not unlike the fourth quarter of the 19th century, with its deep depressions of the seventies and the nineties." Yet, although the two decades of deflation dealt with by Wicksell ([1898] 1936) did bring some distress, it could hardly be described as a general stagnation (see Laidler 2006, p. 157). Indeed, as Wicksell (pp. 194-95) observed, the depression of 1873-1896 had "its own peculiar relations to the popular catchphrase 'economic depression'", as the enormous growth of national and communal budgets – "an unmistakable sign of increasing welfare" – illustrated.

5. Conceptualizing the negative natural rate of interest

The modern formulation of the secular stagnation thesis is based on the notion that the zero lower bound on the nominal interest rate may short-circuit the balance between saving and investment through the price (interest rate) channel and bring in output reduction as the equilibrating variable instead. Rates of interest cannot fall below zero because people would substitute holding currency for holding debt instruments that have a negative yield. Wicksell's natural rate of interest concept has also attracted the attention of the inflation targeting literature. As suggested by Barsky, Justiniano and Melosi (2014), Wicksell's concept referred to a full-employment economy with flexible prices and wages (which is also its meaning in the modern secular stagnation literature). Barsky et al define the natural interest rate as the real rate that would have prevailed in an economy with flexible prices and absence of price and wage markup shocks. Their estimation of the natural interest rate in a DSGE standard model indicates that it has been *negative* since the 2008 crisis. This is explained mainly by the increase in precautionary saving induced by a negative persistent shock in the consumer's Euler equation.

In a similar vein, Wicksell's discussion of (cyclical) depression and unemployment was based on the view that, under certain circumstances, there is no rate of interest able to equate saving and investment at full employment. The convergence mechanism of the market interest rate down to its natural or equilibrium level that operates in the usual Wicksellian downward cumulative process – through the effects of the contraction of money income on bank reserves – is ineffective at the bottom of the depression. Whereas Wicksell did not disregard the (non-cumulative) reduction in employment that accompanies the cumulative fall of the price level, his approach to unemployment focused on cyclical depressions featuring general overproduction and excess saving at virtually nil net investment in fixed capital and (nearly) zero market interest rates (see also Boianovsky & Trautwein 2003). As mentioned above, Wicksell toyed briefly with the possibility of the bank interest rate breaking through the zero lower bound, but it was his former student Erik Lindahl who pointed out that market interest rates could go into negative territory in a pure credit economy without currency.

Although, as Hansen (1951, p. 328) observed, Wicksell lacked the multiplier concept, the notion of secular stagnation is consistent with the latter's hypotheses of diminishing returns to technical progress and to capital accumulation alike.¹⁷ The concept of "dynamic equilibrium" applied to the "past one hundred years", when the economy was anything but stationary (Wicksell [1914] 1997, p. 36). However, the diminishing rates of population growth and (capital-intensive) technical progress led the Swedish economist to consider the strength of the tendency to the stationary state, as revealed by recurrent cyclical depressions. From that perspective, he came relatively close to Marshall's "different world" of higher saving and few opportunities for investment, as indicated by his critical discussion of Böhm-Bawerk's treatment of the first reason for the existence of interest. Wicksell, however, did not articulate that with his assumption of relatively steady saving in the downswing, probably because of the dominant influence of income and employment (as compared to time preference) on saving decisions over the business cycle.

Wicksell's notion of a negative natural interest rate in depressions is only implicit, though (see Boianovsky 2016, pp. 278-79). In fact, he was generally shy of

¹⁷ As put by Hansen (1951a, p. 327), Wicksell contended that the "investment schedule is relatively interest-inelastic", since "investment of boom proportions will lead rapidly to saturation".

using the concept of natural (or normal) rate of interest in his discussion of the business cycle (as distinct from *crises*, which reflect speculative behaviour induced by price level movements in his view). This has to do with Wicksell's ([1906] 1935, pp. 192-93) definition of the natural rate as the rate at which the demand for loan capital and the supply of saving balance each other, which corresponds to the "expected yield on newly created capital".¹⁸ "Capital" is not used in the sense of capital fixed or tied up in production (buildings, ships, machinery etc.), but mobile capital in its free and uninvested form. Again, such "free capital" does not consist of stocks of goods (as in the classical concept of capital as a wage-fund). It does not have any material form at all, "quite naturally, as it only exists for the moment". Wicksell's notion of the natural interest rate as the (expected) marginal productivity of capital applies strictly to a capital structure in equilibrium. "The operation of the laws of capital depends upon the assumption of a constant adjustment of concrete capital goods in an endless repetition of the same process of investment and production. But this is only of practical importance in capital investment of relatively short duration", that is, circulating capital (Wicksell [1901] 1934, p. 186). In periods of great industrial development – when "large quantities of circulating capital are converted into fixed capital and it is not possible to replace the former quickly enough" – such equilibrium is conspicuous for its absence (p. 187). In the subsequent depression period, "there is plenty of circulating capital, but it is no longer *profitable* to convert it into fixed capital" (*ibid.*).

Wicksell's treatment of the dynamics of capital accumulation throughout the business cycle differs in two important aspects from his model of cumulative processes of price change. Both factors contribute to make Wicksell's natural rate of interest concept not precisely defined in that context. Firstly, business cycles are associated to the production of fixed capital goods of long duration, also called "rent-earning goods". An expansion in the production of such goods will take place "when their earnings increase or when the rate of interest falls, so that their capital value now exceeds their cost of reproduction" (Wicksell [1898] 1936, p. 134). The "main characteristic of a stationary state" is that capital value corresponds to the cost of

¹⁸ This is not the same as the definition given in his *Interest and Prices*, which is the real general equilibrium rate that clears both goods and factor markets. The equilibrium condition $I = S$ is strictly related to the goods market only (see Siven 1997, p. 206).

reproduction (ibid). Moreover, part of circulating capital takes the form of (unsold) stocks of goods accumulated in the depression. Hansen (1949, p. 89) interpreted the natural rate of interest on the basis of that passage from *Interest and Prices* about the production of durable capital goods, which he considered identical with Keynes's "marginal efficiency of capital" concept and, therefore, did not associate it to full-employment equilibrium (see also Myrdal 1939 for a definition of the natural rate on those terms). Despite the theoretical problems entailed by the application of Wicksell's natural rate of interest concept(s) to cyclical fluctuations, it is clear that he grasped the restrictions posed to the formulation of monetary policy in periods of relative economic stagnation.

References

- Backhouse, R.E. and M. Boianovsky. 2016. Secular stagnation: the history of a macroeconomic heresy. *European Journal of the History of Economic Thought*. 23 (6).
- Bailey, M. 1962. *National income and the price level*. New York: McGraw-Hill.
- Barsky, R., A. Justiniano and L. Melosi. 2014. The natural rate of interest and its usefulness for monetary policy. *American Economic Review*. 104: 37-43.
- Barro, R. and X. Sala-i-Martin. 1995. *Economic growth*. New York: McGraw-Hill.
- Böhm-Bawerk, E. von [1889] 1891. *The Positive Theory of Capital*. Tr. by W. Smart. New York: Stechert.
- Boianovsky, M. 1995. Wicksell's business cycle. *European Journal of the History of Economic Thought*. 2: 375-411.
- Boianovsky, M. 1996. Anticipations of the General Theory: the case of F.B. Hawley. *History of Political Economy*. 28: 371-90.
- Boianovsky, M. 1998. Wicksell, Ramsey and the theory of interest. *European Journal of the History of Economic Thought*. 5: 140-68.
- Boianovsky, M. 2001. Economists as demographers: Wicksell and Pareto on population. In *Economics and interdisciplinary exchange*, ed. by G. Erreygers, pp. 117-49. London: Routledge.
- Boianovsky, M. 2004. The IS-LM model and the liquidity trap concept: from Hicks to Krugman. In *The IS-LM model: its rise, fall and strange persistence*, ed. by

- M. De Vroey and K.D. Hoover, pp. 92-126. Annual supplement to *History of Political Economy*. Durham (NC): Duke University Press.
- Boianovsky, M. 2012. Svernilson and the Kaldor-Verdoorn law. In *Macroeconomics and the history of economic thought: Festschrift in honour of Harald Hagemann*, ed. by H. Krämer, H. Kurz and H.-M. Trautwein. London: Routledge.
- Boianovsky, M. 2013. Fisher and Wicksell on money: a reconstructed conversation. *European Journal of the History of Economic Thought*. 20: 206-37.
- Boianovsky, M. 2016. Wicksell, general equilibrium, and the way to macroeconomics. *Journal of the History of Economic Thought*. 38: 261-84.
- Boianovsky, M. and H.-M. Trautwein. 2001. Wicksell's lecture notes on economic crises (1902/05). *Structural Change and Economic Dynamics*. 12: 343-66.
- Boianovsky, M. and H.-M. Trautwein. 2003. Wicksell, Cassel, and the idea of involuntary unemployment. *History of Political Economy*. 35: 385-436.
- Boianovsky, M. and H.-M. Trautwein. 2006. Wicksell after Woodford. *Journal of the History of Economic Thought*. 28: 171-85.
- Cassel, G. 1903. *The nature and necessity of interest*. London: Macmillan.
- Cassel, G. [1904] 2005. Of crisis and bad times. Trans.by M. Bkorklund. In *Business cycle theory: selected texts 1860-1939*, vol. 6, ed. by M. Boianovsky, pp. 11-49. London: Pickering & Chatto.
- Eggertsson, G.B. and N.R. Mehrotra. 2014. A model of secular stagnation. NBER Working Paper Series # 20574.
- Fisher, I. 1896. *Appreciation and Interest*. New York: Macmillan.
- Fisher, I. 1930. *The theory of interest*. New York: Macmillan.
- Fisher, I. 1933. *Stamp script*. New York: Adelphi.
- Griliches, Z. 1990. Patents statistics as economic indicators: a survey. *Journal of Economic Literature*. 28:1661-1707.
- Hansen, A.H., 1939, Economic Progress and Declining Population Growth. *American Economic Review*. 29: 1-15.
- Hansen, A.H. 1940. Letter to Paul Samuelson, 27 February 1940. Samuelson Papers, Duke University Library.
- Hansen, A. H. 1941. *Fiscal Policy and Business Cycles*. London: Allen and Unwin.
- Hansen, A. H. 1946. Keynes and the General Theory. *Review of Economics and Statistics*. 28:182-87.

- Hansen, A.H. 1949. *Monetary Theory and Fiscal Policy*. New York: McGraw-Hill.
- Hansen A.H. 1951a. *Business Cycle and National Income*. New York: Norton.
- Hansen, A.H. 1951b. Review of *Inventories and Business Cycles* by M. Abramovitz. *American Economic Review*. 41: 705-8.
- Hawtrey, R. [1913] 1962. *Good and bad trade*. New York: Kelley.
- Jones, C. 1995. R&D-based models of economic growth. *Journal of Political Economy*. 103: 759-84.
- Keynes, J. M. 1936. *The General Theory of Employment, Interest and Money*. London: Macmillan.
- Keynes, J.M. 1937. Some economic consequences of a declining population. *Eugenics Review*. 29: 13-17.
- Klein, L.R. 1947. *The Keynesian Revolution*. New York: Macmillan.
- Knight, F. H. 1944. Diminishing returns from investment. *Journal of Political Economy*. 52: 26-47.
- Krugman, P. 1998. It's baaack: Japan's slump and the return of the liquidity trap. *Brookings Papers on Economic Activity*. No. 2: 137-205.
- Krugman, P. 1999. The return of depression economics. *Foreign Affairs*. 78 (Jan/Feb).
- Laidler, D. 2006. Woodford and Wicksell on *Interest and Prices*: the place of the pure credit economy in the theory of monetary policy. *Journal of the History of Economic Thought*. 28: 151-59.
- Leijonhufvud, A. 1968. *On Keynesian Economics and the Economics of Keynes*. New York: Oxford University Press.
- Lindahl, E. 1939. *Studies in the theory of money and capital*. London: Allen & Unwin.
- Marshall, A. [1890] 1990. *Principles of Economics*. London: Macmillan.
- Myrdal, G. [1939]. *Monetary Equilibrium*. New York: Kelley.
- Nielsen, T. 2016. From anarchy to central bank policy: Silvio Gesell, negative interest rates and post-crisis monetary policy. Unpublished paper presented at the 14th Nordic History of Economic Thought Meeting, Lund, August 2016.
- Pagano, P. and M. Sbracia. 2014. The secular stagnation hypothesis: a review of the debate and some insights. Banca D'Italia. Occasional Papers # 231.
- Patinkin, D. 1948. Price flexibility and full employment. *American Economic Review*.

- 38: 543-64.
- Pigou, A. C. 1943. The classical stationary state. *Economic Journal*. 53: 343-51.
- Pigou, A.C. 1947. Economic progress in a stable environment. *Economica*. 14: 180-88.
- Potuzak, P. 2016. What can we learn from the Böhm-Bawerkian theory in the world of zero interest? Unpublished paper. Presented at the 2016 Paris ESHET meetings.
- Ramsey, F. 1928. A mathematical theory of saving. *Economic Journal*. 38: 543-59.
- Robertson, D.H. [1922] 1948. *Money*. London: Nisbet.
- Robertson, D.H. [1957, 1958, 1959] 1963. *Lectures on economic principles*. London: Fontana Library.
- Samuelson, P. A. 1958. An exact consumption-loan model of interest with or without the social contrivance of money. *Journal of Political Economy*. 66: 467-82.
- Samuelson, P. A. 1976. Alvin Hansen as a creative economic theorist. *Quarterly Journal of Economics*. 90: 24-31.
- Simons, H. C. 1942. Hansen on fiscal policy. *Journal of Political Economy*. 50: 161-96.
- Siven, C.-H. 1997. Capital theory and equilibrium method in Wicksell's cumulative process. *History of Political Economy*. 29: 201-17.
- Summers, L. 2014a. Reflections on the "new secular stagnation hypothesis". In C. Teulings and R. Baldwin (eds), pp. 27-38.
- Summers, L. 2014b. US economic prospects: secular stagnation, hysteresis, and the zero lower bound. *Business Economics*. 49: 65-73.
- Summers, L. 2015. Demand side secular stagnation. *American Economic Review*. 105: 60-65.
- Summers, L. 2016. The age of secular stagnation: what is and what to do about it. *Foreign Affairs*. 95 (March/April).
- Svennilson, I. 1954. *Growth and Stagnation in the European Economy*. Geneva: UN Commission for Europe.
- Teulings, C., and R. Baldwin. (eds) 2014. *Secular stagnation: facts, causes and cures*. London:CEPR.http://www.voxeu.org/sites/default/files/Vox_secular_stagnation.pdf.
- Teulings, C. and R. Bawldwin. 2014. Introduction. In C. Teulings and R. Baldwin (eds), pp. 1-23.

- Uhr, C. G. 1960. *Economic doctrines of Knut Wicksell*. Berkeley: University of California Press.
- Weizsäcker, C.C. von. 2013. Public debt and price stability. *German Economic Review*. 15: 42-61.
- Wicksell, K. [1893] 1954. *Value, capital and rent*. Translated by S.H. Frowein. London: Allen & Unwin.
- Wicksell, K. 1897. Der Bankzins als Regulator der Werenpreise. *Jahrbücher für Nationalökonomie und Statistik*. 68: 228-43.
- Wicksell, K. [1898] 1936. *Interest and prices*. Translated by R.F. Kahn. London: Macmillan.
- Wicksell, K. [1901] 1934. *Lectures on political economy*, vol. I. Translated by E. Classen. London: Routledge & Sons.
- Wicksell, K. [1906] 1935. *Lectures on political economy*, vol. II. Translated by E. Classen. London: Routledge & Sons.
- Wicksell, K. 1907. Krisernas Gåta. Unpublished. Wicksell Papers, Lund University Library.
- Wicksell, K. [1907] 1953. The enigma of business cycles. Translated by C. Uhr. *International Economic Papers* # 3, pp. 58-74.
- Wicksell, K. [1908] 1997. Why are factory operations being curtailed? Translated by T. Chamberlain. In *Knut Wicksell – selected essays in economics*, vol. I, ed. by B. Sandelin, pp. 253-60. London: Routledge.
- Wicksell, K. [1908] 2001. A new theory of crises. Translated by V. Homolka. *Structural Change and Economic Dynamics*. 12: 335-42.
- Wicksell, K. [1910] 1979. The theory of population, its composition and changes. Trans. by G. Öhlin. In *The theoretical contributions of Knut Wicksell*, ed. by S. Strøm and B. Thalberg, pp. 123-51. London: Macmillan.
- Wicksell, K. [1911] 1958. Böhm-Bawerk's theory of capital. Trans. By R.S.Stedman. In *Knut Wicksell – selected papers on economic theory*, ed. by E. Lindahl, pp. 176-85. London: Allen & Unwin.
- Wicksell, K. [1914] 1997. Lexis and Böhm-Bawerk. Trans. by J. Sundqvist. In *Knut Wicksell – selected essays in economics*, vol. I, ed. by B. Sandelin, pp. 26-40. London: Routledge.
- Wicksell, K. [1919] 1934. Professor Cassel's system of economics. In vol. I of *Lectures on political economy*, pp. 219-73.

Woodford, M. 2003. *Interest and prices: foundations of a theory of monetary policy*. Princeton: Princeton University Press.

World Bank. 2015. Negative interest rates in Europe: a glance at their causes and implications. Box 1.1 in *Global economic prospects*. Washington (DC): World Bank.