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A CAPITAL-BASED THEORY OF SECULAR GROWTH

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Abstract: Roger Garrison (2001) provides a welcome diagrammatic exposition of Austrian, capital-based macroeconomics. The exposition attempts to account not only for Austrian Business Cycles (ABCs), but also for long-run, secular growth. Secular growth is a focus of mainstream growth theory that has arguably been neglected by Austrian analysis. However, Salerno (2001) argues that the type of secular growth described by Garrison (2001, p. 54) is implausible. He argues that, in the absence of technological or institutional change, time preferences must be falling over time for net capital accumulation to be sustainable. This paper outlines a capital-based theory of secular growth based on the consideration of intangible capital. The nonrivalrous nature of intangible capital goods allows for external effects. The technology becomes available to firms and individuals that (a) are not forced to wait through the innovative stages of production and (b) do not compensate those firms and individuals that do. Furthermore, (c) innovative stages of production may be viewed not only as aimed towards the production of consumption goods, but also towards further innovation—"standing on the shoulders of giants." The theory presented here reconciles Garrison's exposition to the Salerno critique. It also provides a bridge between many insights of mainstream,endogenous growth theory and Austrian, capital-based macroeconomics.

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> *[O]ne should not limit oneself to a purely technological viewpoint. These new factors of production, too, are achievements of labor and natural gifts which have been used previously. If one thinks of these factors of production as the result of using originary factors of production, then the essence of this process lies in the fact that these originary factors of production were used at an earlier point in time.*
>
> Richard von Strigl (2000 [1934], p. 6)

1. INTRODUCTION

Roger Garrison (2001) provides a welcome diagrammatic exposition of Austrian, capital-based macroeconomics.[1] Besides being valuable as a comprehensive, diagrammatic restatement of Austrian Business Cycle Theory (ABCT), Garrison's exposition also shares enough common pedagogical elements with popular mainstream textbook treatments to serve as an effective bridge between the mainstream and Austrianism.[2] For example, Garrison's exposition claims to account not only for business cycles, but also for long-run, secular growth. This is a focus of mainstream growth theory that, arguably, has been neglected by Austrian theorists.

However, Joseph Salerno (2001) contends that the type of secular growth described by Garrison (2001, p. 54) is inconsistent with capital-based macroeconomics:

> [Growth] occurs without having been provoked by policy or by technological advance or by a change in intertemporal preferences. Rather, [in Garrison's analysis,] the ongoing gross investment is sufficient for both capital maintenance and accumulation.

Salerno argues that, in the absence of technological or institutional change, time preferences must be falling over time for capital accumulation to be sustainable. Furthermore, Salerno's argument echoes one of the primary conclusions of neoclassical growth theory (Frank Ramsey [1928], Robert Solow [1956], David Cass [1965] and Tjalling Koopmans [1965]). As Robert Lucas (2002, p. 29) summarizes: the theory "emphasizes a distinction between 'growth effects' . . . and 'level effects.' . . . [C]hanges in savings rates are level effects (which transposes in the

[1]Garrison (2001) is the culmination of several papers extending and elaborating on ABCT—notably see Garrison (1978, 1986, and 1988).

[2]For an overview of some applications of the Garrison model to recent macroeconomic questions see John P. Cochran (2001).

present context to the conclusion that changes in the discount rate, ñ , are level effects)." In the absence of technological change, only a continually *rising* savings rate (*falling* rate of time preference) can result in secular growth.

Salerno's point of view is focused on the observation that, "an immediate inference from what Mises (1998, pp. 480–81, 533–34) calls 'categorical' time preference—the preference for present over future satisfaction that is expressed in every action—is that an actor's 'period of provision' can never be infinite and must come to a close within a definite period of the future" (Salerno, pp. 48–50). In other words, with a given set of technologies, to increase the *level* of goods and services production in an economy requires increasing the amount of waiting—*the average period of production*—which requires a lower *level* of time preference.[3] To attain sustained increases in the level of goods and services requires sustained increases in the average period of production (and associated increases in productivity) and, therefore, sustained decreases in individuals' time preferences.

At the risk of imprecision, the neoclassical point of view can be contrasted to Salerno's by thinking of it in terms of capital-*widening* rather than *deepening*. Neoclassical growth theory does not explicitly consider roundabout production techniques, but rather focuses on an increase in the stock of (homogenous) capital goods as an argument in aggregate production possibilities. However, with a given set of technologies, the assumption of diminishing returns ensures that capital accumulation will end with investments of a marginal productivity just equal to the rate of time preference. If that rate remains constant, capital accumulation will cease at that point and a steady-state will be achieved.

Either Salerno's argument or that of neoclassical growth theory poses a challenge to Garrison's theory of secular growth. Furthermore, despite their differences, there is little, if anything, contradictory between the two arguments. Most Austrians are not uncomfortable with diminishing returns, and neoclassical growth theorists would not likely deny that more capitalistic methods of production are also more time-consuming.

In mainstream macroeconomics, new (or *endogenous*) growth theory (e.g., Paul Romer 1986; Lucas 2002, chap. 1) overcame the need to assume exogenous technological change by making it the result of profit-oriented behavior on the part of firms and individuals, by making it the

[3]For all of its shortcomings, in this context the average period of production seems a useful concept for presenting Salerno's argument.

result of—or take the form of—*intangible investments*. The theory presented in this paper draws on several insights of endogenous growth theory, demonstrating that they are also relevant for an Austrian, capital-based macroeconomics. Specifically, the recognition of external effects and the cumulative nature of innovation (e.g., Philippe Aghion and Peter Howitt 1998, chap. 2) makes secular growth through capital accumulation plausible despite constant rates of time preference.

The theory also has parallels to the insights of Friedrich Hayek (1935 and 1937). Hayek (1937, p. 175) emphasizes that, "the static proposition that an increase in the quantity of capital will bring about a fall in its marginal productivity . . . when taken over into economic dynamics and applied to the quantity of capital goods, may become quite definitely erroneous." Hayek stresses chains of investments and how earlier investments in the chains can increase the return to the later, complementary investments. However, Hayek is primarily concerned with applying those insights to business cycle phenomena. Also, Hayek never took the additional step that endogenous growth theory has in highlighting the effects of complementarities across intangible investments in the production of ideas and/or knowledge. Indeed, Hayek (1936, p. 205) explicitly excludes their consideration:

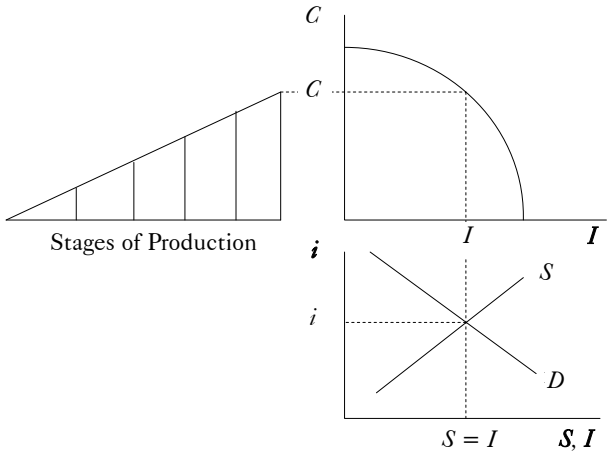
> It should be quite clear that the technical changes involved, when changes in the time structure of production are contemplated, are not changes due to changes in technical knowledge. . . . It *excludes* any changes in the technique of production which are made possible by new inventions.

This paper is organized as follows. Section 2 briefly outlines the Garrisonian theory of secular growth along with Salerno's critique and also demonstrates the parallels that would arise in a critique based on neoclassical growth theory. Section 3 then proposes an alternative theory of secular growth based on capital accumulation that recognizes the nonrivalrous nature of intangible capital goods and the cumulative nature of innovative efforts. Section 4 concludes.

2. GARRISONIAN SECULAR GROWTH AND THE SALERNO CRITIQUE

The presentation of Garrison's (2001) macroeconomics here will be considerably compressed for the sake of brevity; readers should refer to his text—especially chapters 3 and 4—for the more comprehensive presentation of the basic framework.

Figure 1
The Garrisonian Macroeconomic Framework



Source: Garrison 2000, p. 50

Figure 1 presents the three-diagram exposition of a capital-based macroeconomics. The top-right diagram represents the production possibilities in terms of feasible combinations of consumption (C) and investment (I) goods. The amount of investment is determined in the loanable funds market, represented by the bottom-right diagram at the intersection of supply (of savings: S) and demand (for investment), which also determines the interest rate (i). Given production possibilities, the equilibrium level of investment determines the equilibrium level of consumption and, implicitly, the savings rate. The savings rate determines the equilibrium capital structure, represented by the top-left stages of production diagram. The vertical leg represents the output of consumption goods which is an increasing function of the "roundaboutness" of production (i.e., the number of stages; time consumed in production). The roundabout nature of production is representative of the capital structure of the economy.

Based on this framework, Garrison (2001, p. 54) makes the claim that, "the ongoing gross investment is sufficient for both capital maintenance and capital accumulation." Figure 2 depicts the case of secular growth driven purely by capital accumulation. It is worthwhile to quote Garrison's (2001, p. 54) description of the process at length:

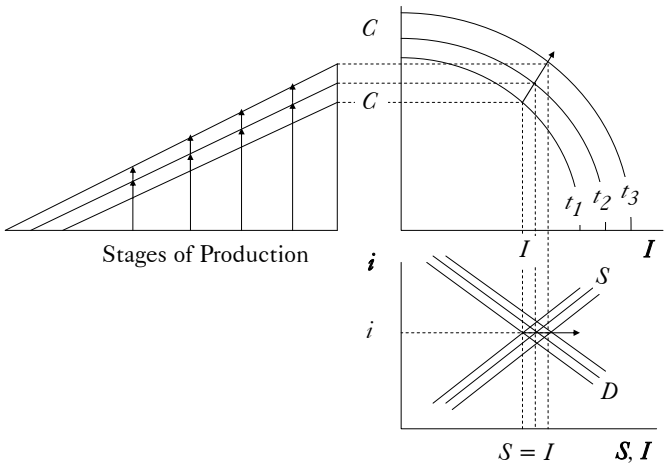
> [T]he growth [in Figure 2] is depicted by outward shifts in the PPF—from t_0 to t_1 to t_2. But we now see what must be happening with the other two elements of the interlocking construction. The rightward shifts in both the supply *and demand* for loanable funds are consistent with the absence of any intertemporal preference changes. Savers are supplying increasing amounts of loanable funds out of their increasing incomes; *the business community is demanding increasing amounts of loanable funds to maintain a growing capital structure and to accommodate future demands for consumer goods that are growing in proportion to current demands*. [my emphases]

With both supply and demand for loanable funds shifting outward—proportionately, but only by assumption—the equilibrium interest rate remains constant.

Furthermore, as the level of investment increases, the capital structure of the economy *widens* while the ratio of investment to consumption (by implication, the savings rate) remains constant.

In Garrison's description quoted above, the shifts in the demand for loanable funds and the reasoning for those shifts are emphasized. Salerno's (2001) critique of Garrison's theory of secular growth can, to great extent, be phrased in terms of calling into question those shifts. However, to see this it is useful to first examine Salerno's (2001, p. 55) comments on what is occurring to the level of savings:

Figure 2
Secular Growth through Capital Accumulation



Source: Garrison 2000, p. 54

> [W]hy should consumers save more out of their growing incomes unless their relative valuations between present and future goods have indeed changed? . . . [T]o accommodate additional savings, the discounted rents of the original factor services must be bid up, causing a contraction in the price margins between the stages of production and, hence, a fall in the natural rate of interest.

Salerno's issue is not that, *ceteris paribus*, people will not increase their savings proportionately to their incomes. Rather, he is noting an additional factor making *ceteris* not *paribus*: namely, that, as savings increase, the interest rate falls, and this puts a break on the increase in savings.

Garrison gets by this by "positing a simultaneous and proportional shift in demand for loanable funds" on the part of entrepreneurs (Salerno 2001, p. 55). However, "if the interest rate on the loanable funds market does not diverge from the natural rate of interest in production, what is the incentive for entrepreneurs to borrow and invest the additional funds?" (Salerno 2001, p. 56) In other words, Garrison appears to confuse shifts in the demand for loanable funds with movements along the demand curve. Salerno's comment is perhaps too strong because, as additional savings are offered, bidding the interest rate down, that decrease in the interest rate *is* an incentive for increased borrowing. However, the increase will not be proportionate to the increase in incomes because the falling interest rate ensures that the increase in savings will not be proportionate. So the income growth cannot, itself, generate investment enough to sustain net capital accumulation and secular growth.

The above has parallels to a critique that would arise from neoclassical growth theory. Beginning with an increase in income, savings would increase along with investment. However, in neoclassical growth theory, *even if the increase in savings is proportional to income*, this cannot lead to sustainable secular growth.[4] This is due to be basic assumptions of neoclassical production possibilities:

$$Y = F(K);\ dF/dK > 0;\ d^2F/dK^2 < 0,$$

Where Y is the output of goods and services—equal to income—and K is the capital stock. If investment (dK) equals savings, diminishing returns will ensure that an increase in income, allowing for a proportionate increase in investment, will then yield, through a larger capital stock, an increase in income smaller than the initial increase, etc. The

[4]Indeed, increases in income always result in proportionate increases in savings in the basic Solow (1956) model where a constant savings rate is assumed: $S = s^*Y$ *where* $0 < s < 1$.

falling marginal productivity of capital also results in a fall in the interest rate, similar to in the Salerno critique.

Salerno (2001, pp. 56–57) proposes that a capital-based theory of secular growth (i.e., one that does not assume technological and/or institutional change, or increases in the amount of other resources) can be obtained by assuming falling time preferences. However, this theory suffers from two related shortcomings. First, assuming that individuals—including different individuals over succeeding generations—have persistently falling time preferences is counterintuitive and neither confirmable nor deniable by praxeological analysis.[5] Second, *ceteris paribus*, it implies a falling—rather than trendless—interest rate, contradicting one of Nicholas Kaldor's (1961) enshrined, stylized facts.

To recreate a constant interest rate scenario like that of Figure 2, Salerno (2001, pp. 58–59) assumes that there are also increases in the population: "an increase in the labor force . . . *ceteris paribus*, will increase the demand for present goods in the form of money savings, raising the natural interest rate." Foreseeing increased demand from a larger population, the demand for loanable funds increases. Along with falling time preferences and the increasing supply of loanable funds, the interest rate can remain constant as investment grows over time. However, if there are constant returns to scale in labor and capital inputs (as in neoclassical growth theory), Salerno does not present a plausible theory of secular growth in the *per capita* amount of goods and services. By Salerno's own description above, capital accumulation and population growth would be proportionate, leading to stagnation of goods and services in *per capita* terms; and if capital accumulation were to be more than proportionate, then diminishing returns would set in.[6]

3. A CAPITAL-BASED THEORY OF SECULAR GROWTH

One of neoclassical growth theory's most well-known and powerful implications is that capital accumulation alone cannot be an engine of secular growth. Rather, sustained technological change must occur. However,

[5]I do not mean to deny an inverse relationship between income and/or wealth and time preferences. However, secular growth is a long-run phenomenon without foreseeable end; one reasonably suspects that time preferences are bounded from below. On the empirical, rather than apodictic, nature of the relationship see Walter Block, William Barnett, and Joseph Salerno (2006).

[6]This at least implies that Salerno's alternative theory is not one that is at odds with neoclassical growth theory. One feature of the theory of secular growth presented in section 3 below is that it does not have to violate any of the main assumptions of neoclassical growth theory.

endogenous growth theory replaced the exogenous technological change of the neoclassical theory with externalities associated with knowledge.[7] For example, in Romer (1986, p. 1003):

> [N]ew knowledge is assumed to be the product of a research technology that exhibits diminishing returns. That is, given the stock of knowledge at a point in time, doubling the inputs into research will not double the amount of new knowledge produced. In addition, investment in knowledge suggests a natural externality. The creation of new knowledge by one firm is assumed to have a positive external effect on the production possibilities of other firms because knowledge cannot be perfectly patented or kept secret.

According to Lucas (2002, p. 6), "the most basic reason for emphasizing external effects must be the classic observation that much of the return to an idea—virtually all of it for a really important idea—accrues to people other than the originator." A straightforward example: Guttenberg captured a ridiculously small share of the total benefits that have been associated—and continue to be associated with—with the printing press.[8]

So even if, for a particular innovator, there are diminishing returns to the production of new knowledge, the *non-rivalrous* nature of knowledge implies that the economy-wide benefits may be greater than that innovator's yield.[9] Furthermore, endogenous growth theory also focuses on the fact that some innovations are necessary for subsequent innovations (or make their realization easier). As Aghion and Howitt (1998, p. 173) note:

> [E]very innovation is fundamental to some extent and secondary to some extent. Even Newton claimed to have benefited from standing the shoulders of giants, and people often find inspiration in the most mundane creations.

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[7]Aghion and Howitt (1998) provides a comprehensive overview of the basic strands of endogenous growth theory.

[8]This does not consider discounting the flow of benefits from the temporal perspective of Guttenberg, but in this context it is more important to consider how the benefits are realized to other given individuals at other particular times.

[9]Given that learning-by-doing effects are often posited as channeling external effects across firms, one interpretation is that physical (tangible) capital is both rivalrous and excludable, but that the knowledge embodied in it is often not. Also, assuming that knowledge is, relative to tangible capital, easily adapted into production processes for which it was not initially planned, then it is fair to say that intangible capital is highly "versatile" (Lachmann 1947) or has considerable "multiple specificity" (Lachmann 1956). I thank an anonymous referee for pointing out the preceding insights.

Again, while there may be diminishing returns to the production of new knowledge from a particular innovator's perspective, additional benefits occur economy-wide due to that knowledge's contribution to further innovations.

From the vantage point of mainstream macroeconomics, endogenous growth theory explains how technological change results from optimizing behavior by economic agents facing diminishing returns in their own production of goods, services, and knowledge; the resulting technological change accounts for economy-wide constant or increasing returns. From the vantage point of Austrian, capital-based macroeconomics, the insights of endogenous growth theory provide a reconciliation of secular growth in Garrison's framework with Salerno's criticisms *without assuming falling time preferences*.

To see how capital accumulation can (alone) drive secular growth and how this is represented in the Garrison's diagrammatic framework, the concept of capital considered must be broadened beyond physical capital to include what will be generally referred to as *intangible capital*. Intangible capital will here refer to knowledge that is achieved by *devoting time and other resources to discovering new knowledge* rather than to devoting them to achieving present consumption of goods, services, and/or leisure.

Intangible capital, as here defined, encompasses such (often not mutually exclusive) concepts as human capital, innovative capital, intellectual capital, research and development (R&D) capital, and organizational capital that are often considered in economic research. Empirically, the value of intangible capital in the U.S. economy is large. Carol Corrado, Charles Hulten, and Daniel Sichel (2005 and 2006) find that business intangible investment was about one trillion dollars in 1999, roughly equal to investment in physical capital during the same year. As well, excluding intangible capital means understating the business capital stock by $3.6 trillion.[10] (These measures do not even include the human capital investments embodied in employees and accumulated during their own educations.)

Since endogenous growth theory is well-known for elaborating on the technological change that is exogenous in the neoclassical growth model, it is worth stressing that the theory is best interpreted as one of intangible investments and associated externalities. Dale Jorgenson and

[10]Corrado et al. (2005 and 2006) include software as intangible capital as software expenditures by businesses were not treated in the NIPAs as investment until 1999. Notwithstanding Austrian concerns about the possibility of measuring aggregate capital stocks, the dollar values reported by Corrado et al. clearly suggest than intangible capital is of considerable importance in the U.S. economy.

Kevin Stiroh (1999, p. 109), in discussing research on the information technology (IT) revolution, note the economist's "counterintuitive and paradoxical" concept of technological change:

> What do economists mean by 'technical change' and how could this exclude the substitution of a more IT-intensive production process for one that is less IT-intensive? Substitution represents movement along a given production function, while technical change corresponds to a shift in the production function. Substitution takes place if the introduction of computer-intensive equipment produces benefits that are fully captured or internalized by the users of IT and their suppliers. Technical change occurs only if more output is produced from the same inputs (e.g., if some of the benefits spill over to third parties).

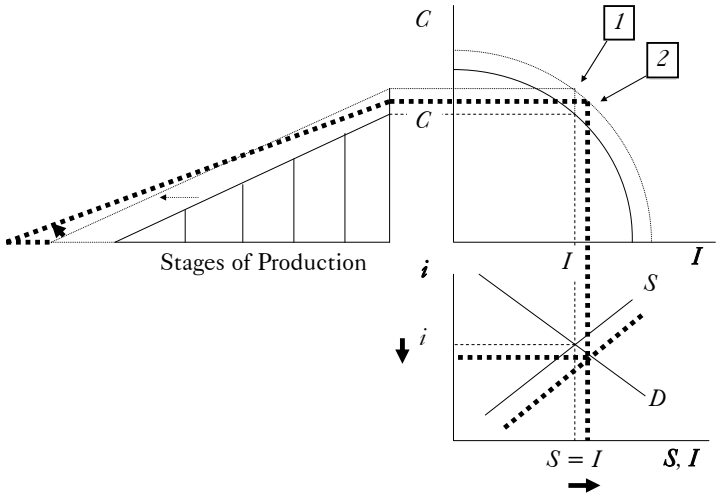
What laypersons would refer to as technical change is, to the economist, investment if it is internalized by the innovator(s) and externalities if it is not. In attempting a capital-based theory of secular growth, the view that technological change is necessary or desirable misses the point that such change is predominantly the external effects associated with intangible investments.[11]

Consider how the insights of endogenous growth theory play out in terms of the capital-based framework where temporal structure of production is explicit. Figure 3 begins from the point where, say, intangible investments are part of total investment in a stationary economy. Net investment is zero and, as the economy is stationary, there are no external effects associated with the intangible investments.

Now assume that externalities arise in association with intangible investments, *à la* Romer and Lucas. Entrepreneurs in the economy are able to benefit from the intangible investments without making like investments themselves (since the knowledge embodied in intangible capital is non-rivalrous). These external effects are represented as technological change in Figure 3, shifting the production possibilities outward and allowing for, *ceteris paribus*, additional consumption and capital-widening (point "1").

[11]Exceptions are in principle possible. One thinks back to the Reese's Peanut Butter Cup commercial where two consumers of peanut butter and chocolate, respectively, bumble their way into the knowledge that the two treats are wonderful together. But innovations are rarely manna from heaven as in that case; they come from purposive investments of time and other resources by innovators and then create spillover effects captured by other individuals.

Figure 3
External Effects Associated with Non-Rivalrous Intangible Investments

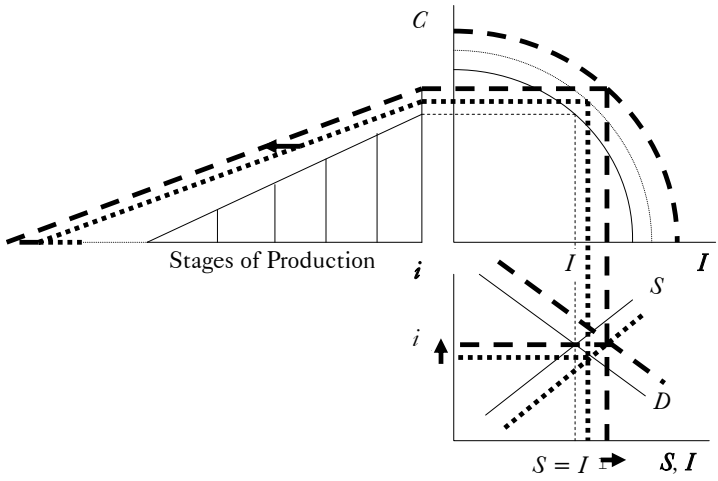


Since individuals have higher incomes, their savings increase, lowering the interest rate and allowing for increased (net) investment and a lengthening of the average period of production (i.e., capital-deepening) (point "2"). Some of the new investments will be intangible investments with associated external effects. However, one may ask at this juncture whether this type of scenario, if sustained, results in a violation of one of the Kaldor stylized facts, i.e., will there be an upward or downward trend in the interest rate. (Indeed, a continuously falling interest rate would resemble what occurs in Salerno's falling time preferences case.)

Figure 4 continues the analysis by considering innovations from intangible investments serving as the "shoulders" upon which further innovations can be built. If investors (innovators) can *stand on the shoulders of giants*, then investment demand will increase *without a further lowering on the interest rate.* This is because they can pursue investments (both intangible and tangible) for which some of the opportunity cost—some of the *waiting*—has already been absorbed by previous investors.[12]

[12]In working on this theory of secular growth, the graphs and discussion above make clear that part of the total investment in the theory was absorbed by Garrison and Salerno; the present theory stands on their shoulders. For whatever worth this theory ultimately has, part of its "long time coming" was "waited out" by these two scholars. Therefore, the present author does not need time preference low enough

Figure 4
Standing on the Shoulders of Giants



Furthermore, as investment demand increases, the interest rate will also rise. Despite this, the average period of production need not fall. Because the previous investors already absorbed part of the waiting, the e*ffective rate of discount* on the part of subsequent investors can remain constant.[13]

Figures 3 and 4 represent a capital-based theory of secular growth. The processes depicted and described are sustainable as long as new knowledge in the form of innovations—the result of intangible investments—is to be had. Furthermore, as depicted in Figure 3, the theory also allows that secular growth is accompanied not only by capital-widening (which is the case in Garrison's (2001) exposition of capital-based or technological change-based growth) but also capital-deepening. The economy's production processes can become more capitalistic over time as secular growth proceeds. This is arguably a more plausible depiction of real economies.

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to justify him developing Garrison's diagrammatic framework, Salerno's critique, and incorporating insights from endogenous growth theory; he only needs preference low enough to justify working out the last part.

[13]It could rise or fall, depending on how much the interest rate has risen and how "high" are the "shoulders," but, importantly, we need not assume that the average period of production necessarily contracts.

4. CONCLUSIONS

This paper presents a theory of long-run, secular growth that is capital-based in the Austrian tradition. The theory is laid out in terms of Garrison's (2001) diagrammatic exposition of a capital-based macroeconomics. A fundamental contribution of this paper, as such, is a reconciliation of Garrison's popular macroeconomic framework and the criticisms leveled by Salerno (2001) against the possibility of secular growth with constant time preferences.

Another contribution of the theory is that it provides a bridge between the insights of the mainstream, endogenous growth theory and Austrian capital theory. By highlighting the importance of intangible investments in innovation and the acquisition of knowledge, and the external effects that are associated with them, the theory can be viewed as an amendment to the ideas of complementarity across investments in the time structure of production as espoused by Hayek (1935 and 1937).[14] Whereas Hayek (1936, p. 205) explicitly excludes technological change from the discussion of changes in the time structure of production, this embraces technological change as the output of intangible investments and, therefore, a capital-based engine of sustainable secular growth.

An appealing feature of this theory of secular growth is that it does not rely on the assumption of falling time preferences. While a positive relationship between income and savings is plausible, it is unclear how quantitatively important it is in "developed" economies. For example, U.S. savings rates have not been rising since the Great Depression while sustainable economic growth has continued. Also, some authors have questioned to what extent the relationship holds even for developing nations, e.g., Stephen Parente and Edward Prescott (2000, p. 39) report that in 1993 industrialized nations invested 19.4 percent of GDP; developing nations invested 23.3 percent of GDP; and Africa considered alone invested 18.8 percent. Lastly, secular growth can seemingly (and hopefully) go on indefinitely while one reasonably assumes that savings rates are bounded from above at some point. (Nor would indefinite secular growth be very appealing if savings rates approached unity).

Hopefully this theory will provide Austrian macroeconomists with a fruitful perspective from which to analyze secular growth. Also, by providing its exposition in Garrison's diagrammatic framework, the theory will hopefully provide economists and their students with an easily-accessible interpretation of endogenous growth theory in terms of Austrian, capital-based macroeconomics. This should serve to both demonstrate

[14] I thank Roger Garrison for suggesting this interpretation of the theory.

the common ground between Austrians and the mainstream as well as make clear the important differences.

Though this paper is focused on long-run issues of growth, there may be important insights available to the study of business cycles as well. Recent empirical/historical documentation of ABCT has stressed sectoral effects at the point(s) of monetary injections (e.g., Cwik 1998; Keeler 2001; Mulligan 2006; Powell 2002). An interesting issue is the extent to which mal-investment in intangible capital may extend (across both sectors and time) a boom and subsequent bust. That, however, is beyond the scope of the present paper and best left for future research.

REFERENCES

Aghon, P., and P. Howitt. 1998. *Endogenous Growth Theory*. Cambridge, Mass.: MIT Press.

Barro, R.J., and X.X. Sala-i-Martin. 1995. *Economic Growth*. Cambridge, Mass.: MIT Press.

Block, W., W. Barnett, and J. Salerno. 2006. "The Relationship between Wealth or Income and Time Preference is Empirical, not Apodictic: A Critique of Rothbard and Hoppe." *Review of Austrian Economics* 19 (1): 69–80.

Cass, D. 1965. "Optimum growth in an aggregative model of capital accumulation." *Review of Economic Studies* 32 (4): 233–40.

Cochran, J.P. 2001. "Capital-Based Macroeconomics: Recent Developments and Extensions of Austrian Business Cycle Theory." *Quarterly Journal of Austrian Economics* 4 (3): 17–25.

Corrado, C., C. Hulten, and D. Sichel. 2005 and 2006. "Measuring Capital and Technology: An Expanded Framework." In *Measuring Capital in the New Economy*. Corrado, Haltiwanger and Sichel, eds. Chicago: University of Chicago Press.

Cwik, P. 1998. "The Recession of 1990: A Comment." *Quarterly Journal of Austrian Economics* 1 (3): 85–88.

Garrison, R.W. 1978. "Austrian Macroeconomics: A Diagrammatical Exposition." In *New Directions in Austrian Economics*. Louis Spadaro, ed. Kansas City: Sheed Andrews and McMeel.

———. 1986. "The Hayekian Trade Cycle Theory: a Reappraisal." *Cato Journal* 6 (2): 437–53.

———. 1988. "The Austrian Theory of the Business Cycle in Light of Modern Macroeconomics." *Review of Austrian Economics* 3 (1): 3–29.

———. 2001. *Time and Money: The Macroeconomics of Capital Structure*. London: Routledge.

Hayek, F.A. 1935. "The Maintenance of Capital." *Economica* 2 (7): 241–76.

———. 1936. "The Mythology of Capital." *Quarterly Journal of Economics* 50 (2): 199–228.

———. 1937. "Investment that Raises the Demand for Capital." *Review of Economic Studies* 19 (4): 174–77.

Jorgenson, D.W., and K.J. Stiroh. 1999. "Information Technology and Growth." *American Economic Review* 89 (2): 109–15.

Kaldor, N. 1961. "Capital Accumulation and Economic Growth." In *The Theory of Capital*. Lutz and Hagues, eds. New York: St. Martin's Press.

Keeler, J.P. 2001. "Empirical Evidence on Austrian Business Cycle Theory." *Review of Austrian Economics* 14 (4): 331–51.

Koopmans, T.C. 1965. "On the concept of optimal economic growth." In *The Econometric Approach to Development Planning*. Amsterdam: North-Holland.

Lachmann, L.M. 1947. "Complementarity and Substitution in the Theory of Production." *Economica* 14 (May): 108–19.

———. 1956. *Capital and Its Structure*. London: Bell and Sons.

Lucas, Robert E. 2002. *Lectures on Economic Growth*. Cambridge, Mass.: Harvard University Press.

Mises, Ludwig von. 1998 [1949]. *Human Action: A Treatise on Economics*. Auburn, Ala.: Ludwig von Mises Institute.

Mulligan, R.F. 2006. "An Empirical Examination of Austrian Business Cycle Theory." *Quarterly Journal of Austrian Economics* 9 (2): 69–93.

Parente, S.L., and E.C. Prescott. 2001. *Barriers to Riches*. Cambridge, Mass.: The MIT Press.

Powell, B. 2002. "Explaining Japan's Recession." *Quarterly Journal of Austrian Economics 5* (2): 35–50.

Ramsey, F.P. 1928. "A Mathematical Theory of Saving." *Economic Journal* 38 (152): 543–59.

Romer, P.M. 1986. "Increasing Returns and Long-Run Growth." *Journal of Political Economy* 94 (5): 1002–37.

Salerno, J.T. 2001. "Does the Concept of Secular Growth Have a Place in Capital-Based Macroeconomics?" *Quarterly Journal of Austrian Economics* 4 (3): 43–61.

Solow, R.M. 1956. "A Contribution to the Theory of Economic Growth." *Quarterly Journal of Economics* 70 (1): 65–94.

Strigl, Richard von. 2000. *Capital and Production*. Auburn, Ala.: Ludwig von Mises Institute.