# Capital Theory and the Process of Inter-Temporal Coordination: The Austrian Contribution to the Theory of Economic Growth

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**Abstract** Appreciation of the necessity of the inter-temporal coordination of heterogeneous capital goods is the chief contribution of Austrian economics to the theory of economic growth. Austrian theory illustrates why an institutional environment of freely formed prices predicated on private property is essential for economic growth. This leads Austrians to have a unique take on Solow growth theory, the financing gap model, national economic planning, and aggregative development measures.

## Introduction

There is no sharp divide between microeconomics and macroeconomics in Austrian economic theory. All of Austrian economics is methodologically individualistic and traces out the consequences of individuals responding to changes in information and incentives. Austrian capital theory provides the bridge that connects and unifies micro and macroeconomics.[1] In the context of the business cycle it is distortions to the interest rate price signal that cause a mismatch between the heterogeneous capital structure and consumer desires that lead to short run economic slumps. In the context of long run economic growth, the problem involves the creation of an environment that, in addition

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[1]For more on how capital theory serves as the bridge between the "micro" and the "macro" in Austrian economics, see Garrison (1984), Garrison and Bellante (1988) and Horwitz (2000).

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to incentivizing individuals to save and accumulate capital, also provides them with the right information signals regarding what heterogeneous capital to accumulate.

In this article, we briefly summarize the unique aspects of the Austrian theory of growth. The next two sections summarize Austrian views on inter-temporal coordination and capital heterogeneity. The penultimate section is our main contribution. It shows how the Austrian theory of growth differs from other neoclassical theories and the relevance of this difference for understanding differences in the performance of nations. The final section concludes.

## Time Preference, Savings and Economic Growth

In a modern economy, the resources or producer goods available for allocation consist of land, labor, and a bewildering variety of capital goods produced and carried over from the past.[2] The available stocks of these resources can be allocated in various temporal patterns. They can, for instance, be devoted solely to satisfying the wants of the near future, with no resources being devoted to the replacement of the available capital goods as they wear out. Therefore, this leads to a decline in living standards in the more distant future when the flow of consumer goods contracts as a result of the inevitable depreciation of the capital goods. Alternatively, the existing resources can be allocated to ensure that the stream of consumer goods available in the near future is maintained in the more distant future, or to not only maintain but also add to this flow by expanding the stock of capital goods. The stocks of capital goods that already exist can be increased, and new, heretofore unproduced capital goods can be manufactured, both of which would ensure a flow of consumer goods that yields increased utility in the more remote future.[3]

The adoption of a temporal pattern of allocation that caters more to the needs of the future as compared to the present involves a trade-off. On the one hand, it requires lower rates of time preference and a greater desire to save, i.e., a greater willingness to sacrifice present for future satisfaction. On the other hand, it yields, as a reward, a flow of consumer goods that provides increased utility in the future.[4] Moreover, regardless of the temporal pattern of resource allocation adopted in the past, a "wisely chosen…extension" or a lengthening of the production structure, i.e., a wisely chosen re-allocation of resources away from the production of consumer goods in the near future and toward the production of capital goods that will yield consumer goods in the more distant future, will ensure "higher productivity," or increased utility in the future (Böhm Bawerk 1959b: 2). In other words, in any given situation, a reduction in the rate of time preference and the ensuing increase in savings, if wisely invested, can result in economic growth.

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[2] Following Rothbard (2009 [1962]: 483–88; 496–500) and Hayek (2009 [1941]: 50–65), we can define "land" as consisting of all the nature-given, material factors of production as well as the previously produced factors that are physically permanent and need no maintenance or replacement. Capital goods, on the other hand, consist of the previously produced, physically impermanent resources and thus need maintenance and eventual replacement. Stated differently, they eventually wear out.

[3] This increased utility can consist of a greater quantity of the goods produced by the shorter processes already adopted or of goods that yield greater utility and are thus more highly valued but are impossible to produce using shorter processes.

[4] For a more detailed analysis of the trade-offs involved in any lengthening of the structure of production in both a Robinson Crusoe setting as well as in a modern economy, see Böhm Bawerk (1959a: 102–118), Mises (1998 [1949]: 476–499) and Rothbard (2009 [1962]: p. 47–70 and 390–409).

In any modern economy, it is the decisions of the entrepreneurs that govern the temporal allocation of the existing resources; it is they who decide whether or not to engage in an inter-temporal re-allocation of resources or a lengthening of the production structure. Moreover, given the existence of the division of labor, the entrepreneurs are making these decisions not on the basis of their own rates of time preference but on the basis of the time preferences of consumers.

This fact creates the problem of inter-temporal coordination, which ensures that the chosen temporal allocation of resources yields not only the right consumer goods but the right consumer goods at the right time. In other words, the temporal pattern of allocation of the available producer goods should be in line with the time preferences of the consumers. Entrepreneurs should not, for instance, make the error of devoting resources toward the satisfaction of the wants in the distant future that would be more optimally utilized for the satisfaction of wants in the nearer future. They should not embark on lengthening the structure of production if the disutility that consumers attach to waiting is so high that it makes them prefer the stream of consumption goods offering less utility available in the nearer future instead.

On the market, this process of inter-temporal coordination is facilitated by the price system. There exists, in any modern economy, a time market, i.e., a market where time is priced. This market, where present money is exchanged for promised sums of future money, includes not only the loanable funds market where the available savings are loaned out to prospective investors but also to the entire structure of production, for the payments made by an entrepreneur to the owners of the various producer goods utilized in his production process are inherently inter-temporal in nature.[5] Given that all production takes time, the entrepreneur forwards present money in exchange for revenue that will accrue only sometime in the future, when the product has been produced and is available for sale.

The rate of interest that emerges out of these inter-temporal transactions on the time market reflects the social rate of time preference. The existence of this positive interest rate governs the temporal pattern of allocation of the existing factors of production by limiting the ability of entrepreneurs to adopt longer production processes that ultimately yield a flow of consumer goods, a flow that, *ceteris paribus,* provides greater utility and therefore higher monetary revenues per unit cost incurred. Given the prevailing array of prices we can, following Böhm Bawerk, distinguish between "two zero points" for the profitability of longer processes that ultimately yield consumer goods: a "relative zero point so that an investment merely yields the prevailing (interest) rate and nothing more", i.e., it just breaks even, and an "absolute zero point," a point at which the longer production process fails to yield any increase of revenue from the sale of consumer goods per unit of the costs incurred.[6] As Böhm Bawerk (1959b: 6) explains,"… between the two points there lies an extraordinarily wide zone in which a lengthening

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[5] On the time market and its relationship to the production structure, see Rothbard (2009 [1962]: 367–452) and Böhm Bawerk (1959a: book IV).

[6] The phrase "production process" here refers to the entire process culminating in a consumer good. On the market, this process is seldom undertaken by a single entrepreneur, unless the entire production process of a consumer good is completely vertically integrated. Instead, each such process is sub-divided into many sub-processes, each of which is carried out by one entrepreneur. It follows that the "two zero points" are calculated from the revenues derived from the sale of the consumer good that ultimately flows from this process and the costs incurred on all the resources utilized from start to finish in its production.

of the existing structure of production brings about a flow of consumer goods that yields higher revenues per unit cost, but an increase that is smaller than the market rate of interest."

Moreover, on the market, a lowering of the social time preference rate, which represents an increased willingness to save, results in more funds being available for entrepreneurs to invest on the loanable funds market, lowering the rate of interest in the process. This increment of savings does not, however, flow into the industries producing consumer goods and lower-order capital goods, for the increased willingness to save necessarily goes hand-in-hand with a reduction in the amount of consumption expenditure and a decline in the prices of consumer goods.[7] This trend of falling prices trickles through the production structure, affecting the prices of the lower order goods, i.e., the capital goods that stand closest temporally to final consumption. Thus, these sectors of the economy now appear less profitable to the entrepreneurs seeking an outlet for the increased savings.

The higher-order capital goods industries (including industries with orders of goods so high that they are as yet unproduced), meanwhile, appear relatively more profitable due to the lower rate of interest. As a result, the greater savings are invested in these industries, resulting in a lengthening of the structure of production. Thus, entrepreneurs, guided by the price system, re-allocate resources away from industries which cater more to the satisfaction of wants in the nearer future and toward those sectors of the economy that produce goods that will ultimately contribute to the generation of a flow of consumer goods that provides greater utility in the future. Stated differently, a lowering of time preference provides the required resources to kick-start a process of economic growth via the adoption of longer, more productive production processes.[8]

## Capital Heterogeneity and Economic Growth

Consider a tractor and a hammer. Both of them are capital goods valued solely on the basis of their ability to contribute indirectly to the satisfaction of wants. They can either be used to produce consumer goods directly or can be utilized to produce other capital goods that contribute to the production of consumer goods. But although both of them are capital goods, they usually serve different purposes. A tractor, for example, can be used to plow a field or pull a trailer, whereas a hammer could be used by a carpenter to build a house or by an automobile mechanic to fix a car. Thus, these goods are heterogeneous in two senses: first of all, they are physically heterogeneous– they differ with respect to their physical properties. More importantly, however, they are also heterogeneous in use, i.e., they are heterogeneous with respect to the purposes that they are fit to serve and thus are valued differently with respect to the satisfaction of wants.

Along with being heterogeneous in use, capital goods also exhibit multiple specificity in that each of them is capable of fitting into more than one production plan. Their heterogeneous and multiple specific nature implies that, along with the task of inter-

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[7] For more on the categorization of goods into various orders and the concept of stages of production, see Menger (2007 [1871]: 52–77, Böhm Bawerk (1959a: 169) and Rothbard (2009 [1962]: 8–10).
[8] For a detailed exposition of how a lowering of the rate of social time preference leads to a lengthening of the production structure and therefore economic growth, see Hayek (1967 [1931]), Garrison (2001: 57–83) and Rothbard (2009 [1962]: 517–527).

temporal coordination, another major task needs to be accomplished in any market economy: that of coordinating the numerous plans of consumers with the nearly countless ways in which the existing capital goods can be combined to satisfy these plans. Stated differently, existing capital goods need to be allocated to their best use in that each of them needs to be assigned toward satisfying the highest valued end. This would ensure a capital structure, or a structure composed of capital goods of various orders, that is optimally aligned to satisfy consumer wants as efficiently as possible.[9]

As in the case of inter-temporal coordination, this mammoth task of coordination is also facilitated by the price system of the market economy. Guided by the profit and loss system generated by the prevailing array of prices, the decisions of entrepreneurs give rise to a streamlined capital structure, where the underlying tendency is for each capital good to be allocated in an optimal manner vis-à-vis consumer wants. Given that more than one capital good is needed to undertake most production processes, this structure consists of a set of capital combinations, or combinations of complementary capital goods. In fact, not only does each such combination consist of capital goods that are used together to produce a product, but the various combinations themselves are complementary to one another. Together these combinations form an investment chain, producing the goods of various order that compose the prevailing structure of production, the sole purpose of which is to ultimately yield a flow of consumer goods.

The heterogeneity of capital goods also implies that the process of economic growth causes significant changes in the composition of the stock of capital goods. As seen in the previous section, growth results from a fall in the social rate of time preference and the ensuing investment of the additional savings made available. During this process, which involves a lengthening of the prevailing production structure, the various industries engaged in the production of capital goods are not affected in identical fashion. The industries producing lower order capital goods witness a decline in profitability and investment, with resources utilized here being re-allocated to the sectors of the economy producing capital goods of higher orders. Thus, the stock of capital goods available undergoes a corresponding change in composition.

Moreover, the heterogeneous and multiple specific nature of the existing capital goods implies that the new capital goods produced as a result of this saving and investment process serve as substitutes and thus compete with some of them and share a complementary relationship with others. In the words of Lachmann,

"Once we allow for heterogeneity we must also allow for complementarity between old and new capital. The effect of investment on the profitability of old capital is now seen to depend on which of the various forms of old capital are complementary to, or substitutes for, the new capital. The effect on the complements will be favorable, on the substitutes unfavorable" (1956: 6–7).

Thus, the process of economic growth witnesses a revolution in the capital structure of an economy. The existing capital structure morphs into one composed of different capital goods. This process does not imply that all capital good industries witness either

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[9] The classic exposition of capital heterogeneity and its implications is Lachmann (1956). For a more recent treatment of the same see Lewin (2011).

a profit or a loss simultaneously. Instead, there are winners and losers; the process of growth is dynamic in nature.

## Differences between the Austrian and Neoclassical Approaches to Economic Growth

The *sine qua non* of economic growth according to economists of the Austrian School is the availability of savings. The existence of time preference, and the barriers that it places on the desire to save, limits the ability to lengthen the production structure and the extent of economic growth. Thus, the lower the prevailing social rate of time preference and the market rate of interest, the greater the available pool of savings and the greater the ability to undertake longer, more productive production processes.

This "Austrian" recipe for economic growth clashes with that provided by modern neoclassical economics, which gives pride of place to the "state of the arts" or the prevailing technological knowledge as the engine of economic growth.[10] However, as Rothbard notes,

> "…while knowledge is a limit, capital (the available amount of savings) is a narrower limit. It is logically obvious that while capital cannot engage in production beyond the limits of existing available knowledge, knowledge can and does exist without the capital necessary to put it to use. Technology and its improvements, therefore, play no *direct* role in the investment and production process; technology, while important, must always *work through* an investment of capital" (2009 [1962]: 542).

Rothbard's point is obvious when one studies the economic conditions of poorer countries. Consider, for instance, Mises' description of the obstacles that lay in the path of Romania's economic development circa 1860. As Mises notes, "What was lacking was not technological knowledge;" entrepreneurs in Romania did not lack knowledge of the more advanced technological methods employed in the developed nations. Instead, these methods "were described in innumerable books and taught at many schools…the elite of Rumanian youth had received full information about them at the technological universities of Austria, Switzerland and France." What was lacking, however, "was the capital goods needed for a transformation of the backward Rumanian apparatus of production, transportation and communication according to Western patterns" (Mises 1998 [1949]: 493). The provision of these capital goods required savings and a reduction in present consumption in order to free up labor, land, and the previously produced durable capital goods for the production, operation and maintenance of modern plants with state of the art machinery, mines, railroads, etc.[11]

Along with this emphasis on the importance of savings, the focus on the heterogeneity of capital also differentiates the Austrian and the neoclassical approach, for the

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[10] In this regard, the conclusions of the Austrian theory of growth differ from those of the famous Solow model (Solow 1956).

[11] For an excellent exposition of how the Austrian theory of growth provides the necessary theoretical lens for understanding the historical growth process, see Shenoy (2007, 2010).

Solow growth model and most neoclassical growth models typically sum the monetary value of these heterogeneous capital goods and reduce them to a single homogenous stock "K." In doing so, they often forget that underlying this homogeneous stock is a vast array of goods—everything from beer barrels to blast furnaces and trucks to yards of telephone wire—and thus assume away one of the greatest coordination tasks an economy has to solve, namely that of ensuring that the capital structure is perfectly aligned with all the underlying preferences of consumers, including their time preferences. Moreover, given that the price system plays a key role in this process of coordination, and given that a well-functioning price system requires a certain institutional arrangement, namely, established and well-enforced private property rights in all goods and services, neoclassical growth theory ignores the institutional pre-requisites that are necessary for economic growth to take place.

Indeed, as the Austrian economists Mises (1990 [1920]) and Hayek (1948: 77–92,119–181) pointed out during the course of the famous "socialist calculation debate" that raged in the inter-war years, a rational allocation of resources is impossible in a centrally planned economy. Given the collective ownership of the means of production and the absence of all exchange and prices for these goods in a socialist economy, engaging in any process of economic calculation becomes impossible. In other words, in such an economy it is impossible to calculate profit and loss and determine whether resources have actually been allocated to their highest valued uses or not. As a result, there is no way of knowing which capital goods to combine in which proportions to produce the final consumer goods most economically and no way of coordinating the temporal pattern of the production structure to the time preferences of the consumers.

Thus, without the existence of private property and exchange, the existing pool of savings will be misallocated and will not lead to an increased supply of goods in line with consumer preferences. However, this fact is often overlooked by popular models in the literature on economic growth, such as the financing gap model, which may very well be the most implemented growth model by the World Bank during the last 60 years. The fundamental idea behind this model is that poor countries are in a low-growth equilibrium; a situation in which they do not have enough savings to finance capital accumulation. The conclusion arrived at is that these countries require more foreign aid for investment and the growth of a homogeneous capital stock—$K$.

The model, however, fails to fully appreciate the importance of private property and prices for successful economic growth. Poor countries do not simply need "investment." They need investment in capital that complements the existing structure of production. Investments need to be made on the basis of expected profit and loss. Private investment accomplishes this. Aid for investment often takes the form of infrastructure investment or other projects that are not bought and sold on the market. Therefore much of the investment financed by the financing gap model has been outside of the sphere of economic calculation. The impact of poor incentives created by aid for investment programs has been well documented (Easterly 2001). The calculation and ensuing resource allocation problems associated with using aid to finance the right heterogeneous capital have been less emphasized but are no less real.

National economic development planning is another area where an appreciation of the importance of the price system for growth has led Austrians to conclusions that differ from those arrived at by some other economists. Advocates of state development planning do not assume that capital is homogenous. In fact, their rationale for planning

is that capital is heterogeneous but that planners can select the capital better than the market. But by selectively promoting some industries, they enable those industries to bid capital away from other industries, and by doing so they interfere with the very process that reveals the relative scarcity of the heterogeneous capital goods (Lavoie 1985; Powell 2005).

When the state actively plans development, it forces heterogeneous capital goods into particular industries. The decision-makers in the government planning bureau have no method to evaluate the opportunity cost of another industry's potential use of those capital goods. The opportunity cost is the subjective loss suffered by the person who would have received resources if the government had not interfered with the market process. Since the planning bureau has no way of evaluating this loss, it cannot determine if the loss in output from other industries caused by promoting one industry is greater or less than the benefit produced; it has no way of knowing if it is promoting development or reducing it.

The above considerations make Austrian economists leery of using a highly aggregative concept like GDP as a measure of economic growth for economies that are centrally planned or where government consumes a large share of GDP. For in such an economy, GDP growth may not indicate any improvement in the living standards of the masses, since the former can increase as a result of the wrong capital goods being produced. Given the lack of a well-functioning price system and the consequent impossibility of any rational allocation of resources, economic planners might erect a capital structure that does not in any way conform to consumer preferences. There might, for instance, be a lot of rapid industrialization in the higher-order capital goods but no proportional investments made in the capital goods of the lower orders, implying that the investment chains remain incomplete and do not yield the desired flow of consumer goods. Sub-optimal capital combinations may also be created such as combinations resulting in consumer goods that consumers do not value highly or combinations producing technologically outdated consumer goods of poor quality.

As Nutter (1962) and Boettke (1990) have shown, GDP growth was indeed a poor indicator of economic progress in the erstwhile Soviet Union. As the former observed, despite recording dizzying rates of GDP growth, many of the consumer goods produced in the USSR were of poor quality and far behind the standards set in the freer West (Nutter 1962, p. 80). Similarly, Higgs (1992) has argued convincingly that the American economy during the Second World War, despite rapid GDP growth, failed to generate any appreciable improvement in the economic well-being of its citizens. More recently, in his analysis of the Indian economy under central planning, Manish (2010, 2013a, b) has shown that periods of high GDP growth did not generate significant improvements in the living standards of the broad masses. Instead, the rapid industrialization that characterized these periods only resulted in the production of technologically outmoded consumer goods that were far removed from mass consumption.

Thus, the 1980s is held up as proof of the efficacy of widespread import substitution because of the high rates of GDP growth recorded during this period (Rodrik and Subramaniam 2005). The decade witnessed a huge increase in the production of consumer durables like refrigerators, air conditioners and televisions that only entered the consumption baskets of an elite minority while there was much slower growth in the output of mass consumption items like food and clothing (Manish 2013a: 9–15). Moreover, the consumer goods that were produced were in most cases technologically

obsolescent. Thus, as a result of government policy, 75 % of the total televisions produced, even at the end of the decade, consisted of black and white televisions at a time when most consumers, including those in other comparable developing countries, were switching over to color televisions. Similarly, whereas the rest of the world was rapidly abandoning outdated mechanical watches in favor of electronic watches, more than 90 % of the watches produced in India as of 1990 consisted of the former (Manish 2013b: 253–259).

Although the socialist calculation debate illustrates the importance of markets for determining the capital structure, much of the world does not face a stark choice between "pure capitalism" and "pure socialism." The more freely capital prices are formed on the market, the more rational economic calculation will be and the more productive society will become. All governments interfere with this process to varying degrees. The Economic Freedom of the World Annual Report (Gwartney et al. 2011) provides an approximate measure of how free the various economies of the world are. The overwhelming conclusion of the vast literature on economic freedom is that freer countries are not just wealthier and grow faster than less-free countries, but they outperform them on most other margins (literacy, life expectancy etc.) people care about.[12] That literature also shows that more free countries attract higher levels of investment. Importantly, and consistent with the Austrian theory described above, they also find that a given level of investment increases growth more in a freer country than in a less free country. Thus as prices are less tampered with by the government, economic calculation becomes more accurate leading to creation of the "right" heterogeneous capital, one that is most productive in promoting economic growth.

## Conclusion

Economic growth involves the inter-temporal coordination of resources. Private property, prices, and profit and loss allow for the incentives and information necessary to coordinate the plans of savers, investors, and future consumers in accumulating the right mix of heterogeneous capital goods. Thus, Austrian theory illustrates that, although savings and capital formation are the proximate causes of growth, an institutional environment supporting economic freedom is the underlying cause of growth.

Although the Austrian approach to growth has commonalities with new institutional economics (North 1990), it would be a mistake to equate the two. Much of the new institutional literature finds correlations between "legal origins" (Glaeser and Shleifer 2002), "colonial origins" (Acemoglu et al. 2001), or some other measure of institutions and current economic performance without precisely identifying the endogenous process that generates economic growth. Austrian theory, on the other hand, through its capital theory and description of the process of inter-temporal coordination, specifies why institutions supporting economic freedom are necessary for the process of development. These could be formal institutions of governance or informal institutions (Williamson 2009), but the important factor is that they let property rights, prices, and the profit and loss system dictate resource allocation.

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[12] See Berggren (2003) for a somewhat dated survey of this literature and www.freetheworld.org for a website with many of the more recent papers using the index.

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