

Time factor in macroeconomic analysis in theory and empirical research

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INTRODUCTION

Abstract

Purpose of the study The aim of the research is to present the role of time in economic theory and explain how time horizon and the adopted period of time lags between the variables determine the results of macroeconomic analyzes.

Methodology: In the paper were used research methods based on literature studies in the field of macroeconomics and finance as well as descriptive methods to explain how the change in the time horizon of the analysis affects the results of the research (short-term analysis and long-term analysis) and what influence the selection of a specific delay period has on the results time between the analyzed variables.

Main Findings: The research results confirmed the importance of the time factor, which is still underestimated in many economic analyzes.

Applications of this study: The research results can be used as a starting point for further analyzes regarding the importance of time in microeconomic analyzes and contribute to the development of new theoretical concepts concerning dynamic processes in the economy.

The originality of this study: In the economics literature, no comprehensive research has been carried out on the importance of time in economic analyzes. Hence, the paper can fill the existing gap in this area and realize the importance of time in economic research.

Time is a troublesome economic issue. There is an opposition between economic theory, which takes historical time into account, and dynamic models in which economic processes are framed in a uniform objective time. There is a difference between flow concepts and measures over time and between inventory concepts and point-in-time measurements. Although it has received unequal attention throughout the history of economics, the issue of time accounting has fostered continual reflection in many areas of economics, ranging from theoretical or applied macroeconomics to microeconomics, and from a positive and normative perspective (Samuelson and Nordhaus, 2008).

Thinking about the role of time in economics may result either from the theoretical development of the discipline and its major transformations or from historical and political necessities facing economies. For example, in the past twenty years, developments in behavioral economics have brought new insights into the perception of time and its likely consequences for economic rationality. At the same time, the urgent issues of global warming in the not so distant perspective have stimulated new reflections on intergenerational equality.

It is also known that it has long been a subject of discussion and the main source of division among economists. Beginning with the marginalist revolution in the nineteenth century - and its confrontation with the German school of history - there was persistent opposition between economists who advocated making historical time crucial to understanding the development of capitalism and those who advocated using logical time to model economic development (the Mitchell / Vining-Koopmans debate is the key climax of this debate.) Later neoclassical models of macroeconomic growth and dynamics have been criticized by economists such as <u>Georgescu-Roegen (1971)</u>, <u>Shackle (1967)</u>, and <u>Robinson (1980)</u> for being based on logical time and failing to adequately represent capital in economic processes.

Hence, the main aim of the research is to present the role of time in economic theory and explain how time horizon and the adopted period of time lags between the variables determine the results of macroeconomic analyzes.

LITERATURE REVIEW

Time is also critical to many sub-disciplines of applied economics, many of which are related to cost-benefit analysis and therefore make assumptions about discount rates over time. For example, consider a valuation of the life years saved in the health economy or an estimate of the time saved in the transport economy. In health economics, economists and health professionals have adopted health-adjusted life years as a criterion for allocating resources to hospitals. This requires different value judgments about the importance and comparability of the years to save and other trade-offs. In transport economics, time is a difficult problem when it comes to calculating social discount rates to determine the price of transport time saved (distinguishing between leisure and working time, type of transport used, etc.). These are just two examples of when time has specific content and meaning. Experimental methods have also been widely used in these



and other fields, leading to debates on alternative time value measurements (specific preferences, revealed preferences, field experiments, demonstrations, etc.).

A recurring problem from a methodological point of view is whether the different representations of time are consistent. Beyond measurement, time can itself become an object of value. So, in financial theory, and within the institutional and technical apparatus that directly derives from it, time has become an object of value, something that needs to be mastered, for example through the development of high-frequency computerized trading (Easley et al., 2012; Jarrow and Protter, 2012).

The discussion of time in economic theory inevitably leads to serious and enduring philosophical problems regarding cause and effect and the phenomenology of the perception of time. The current literature in the field of psychology and behavioral economics also provides new discoveries about the perception of time and possible distortions of time coherence on the part of economic agents. More recently, following alternative selection theories under uncertainty beyond the expected utility framework, the issue of time coherence has sparked new insights and analytical changes to integrate a more descriptively accurate and psychologically grounded representation of time, hence a renewed interest in intertemporal choices and their different motives. In particular, it has been argued that hyperbolic discounting is more descriptive than exponential discounting. Consequently, behavioral economists and decision theorists have detailed concepts such as dynamic consistency, impatience, time preference, and time discounting (Frederick, Loewenstein, & O Donoghue, 2002; Andreoni & Sprenger, 2012).

From a broader perspective, there is often an intermingling of normative and empirical time issues. First, you can think of the different cultural representations of time, firmly embedded in different theories of interest in Western and non-Western traditions (Islamic, Hindu, Confucian, etc.), each of which has an impact on the institutional setting and behavioral habits. Another way is to think of the growing literature dealing with socio-economic parameters as well as cognitive or emotional parameters influencing time preferences, echoing John Rae's original insights. Economists found that time preferences can vary based on socioeconomic status, culture, and level of development, and discussed the effects of emotion and happiness on intertemporal choices. All these elements in turn lead to policy recommendations that urge people to pay more attention to future performance or to avoid procrastination.

Finally, normative timing issues are also central to any consideration of intergenerational equality. It has been restored in the context of the projected effects of climate change on future generations and the required mitigation policies that the present generation should engage in. As a consequence, there has been an increase in the number of timely concepts such as purely time discounting, growth discounting or discounting of opportunity costs, with their respective influence on policy recommendations, thus questioning the possibility of constructing a simple normative principle to solve such intergenerational problems (Fleurbaey & Zuber, 2013; 2015).

Three research hypotheses were verified in the article:

H1: Short-term analyzes show weaker macroeconomic relationships between variables than in the long term due to the existing short-term price and wage rigidity (stickiness) and insufficient adaptation efforts of market participants in the short term.

H2: Taking the time lags between the variables into account results in stronger macroeconomic relationships between the studied variables, due to taking into account changes in a given factor in the long term.

H3: The phenomenon of hysteresis occurs in macroeconomic analyzes, because in practice long-term changes in the economy depend on changes occurring in a short period.

METHODOLOGY

In the article were used a research method based on literature studies in the field of macroeconomics and finance as well as descriptive methods to explain how the change in the time horizon of the analysis affects the results of the research (short-term analysis and long-term analysis) and what influence the selection of a specific delay period has on the results time between the analyzed variables.

FINDINGS / RESULTS

So far, in the Polish and foreign literature on the subject, no comprehensive research has been carried out on the importance of time in economic analyzes, both those of a microeconomic and macroeconomic nature. The few available publications treat time rather in philosophical and natural terms, while those of an economic nature concern only the dynamics of economic phenomena and the relationships between time and economic expectations. Hence, the main motive of the undertaken research is to fill the existing gap in this area and to realize the importance of time in economic research. Due to the huge area of research and the importance of the research issues, the analysis undertaken in the research project was limited only to the macroeconomic sphere. On the other hand, the issues concerning the importance of time in microeconomic research can be the subject of research undertaken in subsequent researches.

The research results answer some key questions. Namely, what is the role of time in economic theory and whether the research time horizon and the adopted time interval between the variables determine the results of macroeconomic analyzes. Moreover, the research helps in finding answers to the questions whether the existence of the hysteresis



phenomenon can be confirmed in macroeconomic analyzes and what is the significance of this phenomenon in economic practice.

Results of research confirmed that short-term analyzes show weaker macroeconomic relationships between variables than in the long term due to the existing short-term price and wage rigidity (stickiness) and insufficient adaptation efforts of market participants in the short term. Moreover, taking the time lags between the variables into account results in stronger macroeconomic relationships between the studied variables, due to taking into account changes in a given factor in the long term. Additionally, the phenomenon of hysteresis occurs in macroeconomic analyzes, because in practice long-term changes in the economy depend on changes occurring in a short period of time.

The research results contribute to changing the way time is understood in economic research and contribute to the development of new theoretical concepts concerning dynamic processes in the economy.

DISCUSSION / ANALYSIS

In economics, it is extremely important to understand the distinction between the short and long term. As it turns out, the definition of these terms depends on whether they are used in a microeconomic or a macroeconomic context. There are even different ways of thinking about the microeconomic distinction between the short term and the long term.

The long-term perspective is defined as the time horizon needed by the manufacturer to be flexible in all relevant production decisions. Most companies make decisions not only on how many employees to employ at any given time (i.e. amount of work), but also on what scale of operations (i.e. size of a factory, office, etc.) to collect and what production processes to use. Therefore, long run is defined as the time horizon necessary not only to change the number of employees but also to scale the factory size up or down and change production processes as needed.

On the other hand, economists often define a short period as a time horizon in which the scale of the operation is fixed, and the only available business decision is the number of employees. (Technically, the short term can also be a situation where the amount of work is constant and the amount of capital is variable, but this is quite rare.) The logic is that even taking different labor laws as data, it's usually easier to hire fire departments than is to significantly change the main production process or move to a new factory or office. (One of the reasons for this probably has to do with long-term leases and such.) Therefore, the short-term and long-term in terms of production decisions can be summarized as follows:

a) Short term: The amount of work is variable, but the amount of capital and production processes is constant (i.e. taken as given).

b) Long term perspective: The amount of labor, the amount of capital and the production processes are variable (i.e. variable).

The long term is sometimes defined as a time horizon where there are no sunken fixed costs. In general, fixed costs are costs that do not change with changes in production quantity. In addition, sunk costs are those that cannot be recovered once paid. For example, a company's headquarters lease would be a sunken cost if the company needs to sign an office lease. Moreover, it would be a fixed cost because once the scale of operation has been decided, the company will not need an additional head unit for each additional production unit it produces.

Of course, the company would need a larger headquarters if it decided to expand significantly, but this scenario relates to the long-term decision to scale up. In the long run, there are no really fixed costs as the company is free to choose the scale of operation which determines the level at which the costs are fixed. Moreover, there are no sunken costs in the long run as the company has the option of not doing business at all and incurring zero costs.

In summary, the short and long term cost perspective can be summarized as follows:

(a) Short period: Fixed costs are already paid and are not recoverable (i.e. "flooded").

b) Long term Fixed costs have not yet been determined and paid and are therefore not really "fixed".

Economists distinguish between the short and long term with regard to market dynamics as follows:

a) Short term: The number of firms in the industry is fixed (even though firms can "close" and produce zero quantity).

b) Long run: The number of firms in the industry fluctuates as firms can enter and exit the market.

The distinction between the short-term and the long-term has a number of implications for differences in market behavior, which can be summarized as follows:

Short term:

a) Firms will produce if the market price at least covers the variable costs because the fixed costs have already been paid and as such will not enter into the decision making process.

b) Profits of companies can be positive, negative or zero.

Long period:



a) Firms will enter the market if the market price is high enough to bring about a positive profit.

b) Firms will exit the market if the market price is low enough to make a negative profit.

c) If all firms have the same costs, the firm's profits will be zero in the long run in a competitive market. (Those companies with lower costs can maintain a positive profit even in the long run.)

In macroeconomics, the short term is defined as the time horizon within which wages and the prices of other inputs are "sticky" or inelastic, and the long term is defined as the period during which these input prices have time to adjust. The bottom line is that output prices (i.e. prices of products sold to consumers) are more flexible than input prices (i.e. prices for materials used to produce more products) because they are more constrained by long-term contracts and social factors. In particular, wages are considered to be particularly sticky in the downward direction as workers tend to become nervous as employers try to reduce compensation, even if the economy is generally experiencing a downturn.

The distinction between the short and long term in macroeconomics is important as many macroeconomic models conclude that monetary and fiscal policy tools have real effects on the economy (i.e. they affect output and employment) only in the short term and only affect variables in the long term nominal, such as prices and nominal interest rates, and do not affect the actual economic quantities.

The short term, long term and very long term are different periods in the economy.

a) Very short period - this is the period in which all production factors are constant (e.g. on one specific day, the company cannot employ more employees or buy more products for sale)

b) Short period - it is the period in which one factor of production (e.g. capital) is constant. This is less than four to six months.

c) Long period - this is the period during which all factors of production of the company are variable (e.g. the company can build a larger factory). Period longer than four to six months / one year

d) Very long period - this is the period in which all factors of production change, and additional factors beyond the company's control may change. A period of several years.

Time delay means the delay between the action and the event that likely caused it. Delays occur in several ways. First, there are delays in collecting, sorting and disseminating economic data. Second, even when data is available, economic policymakers often postpone action, waiting for more data, trying to judge whether the changes are temporary or permanent, or because there is disagreement on what the response should be. Third, even when decisions are made, it takes time to implement them: in some cases, such as opening a new factory in response to an increase in demand, the delay can be significant.

In the analysis of the time delay, we can distinguish several of its components ($\underline{Zivković}$, 1993). Implementation delay, which represents the time interval between when certain actions need to be applied and their implementation, and an operational delay, which is the time interval between the introduction of economic policy instruments and the time when their effects become apparent in the context of the objectives set. Other divisions of time delays can also be found in economic literature. Namely, there are internal and external lags.

The internal lag includes the following:

• Recognition delay - the time period between the moment when a need arises to use a given economic policy instrument and the moment when actions are taken by the relevant economic authorities of the country. For example, you should identify any problem before taking any action. Problem identification requires the collection and analysis of economic data. Data on unemployment and inflation are usually available for the previous month. Suppose the unemployment rate for January is available in February. GDP data is collected quarterly and is accompanied by a long delay. For example, GDP data for January, February and March are available in April and even May. After collecting the data, it is necessary to analyze them and determine with certainty the effects of the problems. This analysis often requires data collected over several months to identify trends and eliminate temporary statistical digressions.

• Action delay - this is the delay between the moment when the country's economic authorities react and the moment when the first effects of this reaction appear in the economy.

In turn, the external lag - is the time interval between the moment when the economy functions under changed conditions and the moment when enterprises and households adjust to new market conditions.

If we assume that the time interval between the moment when there was a need to introduce economic activities and the actual implementation of specific economic policy instruments is close to zero, then the internal delay is the result of a delay in recognition (Koopmans, 1960, 3-7).

Similarly, Wrightsman (1971) distinguishes the following forms of delaying the effects of economic policy:

(a) delay between the need for action and the implementation of specific actions;

b) delay between the implementation of certain activities by economic authorities and the effects of these activities in the real sphere.



<u>Crockett (1979)</u>, on the other hand, believes it is important to distinguish between the different types of lags based on the point at which changes in economic policy become necessary and the point at which these actions pay off. In this case, he distinguishes between:

(a) information delay, i.e. the time needed to gather information and present it to decision-makers that indicates future changes in economic policy;

(b) implementation delay, ie the time needed to formulate the appropriate changes to economic policy;

(c) the lag in the response of economic policy instruments, which occurs when certain economic variables do not respond immediately to changes in economic policy.

Also <u>Struthers and Speight (1980)</u> in their research concluded that the total delay consists of several separate sections that can be classified under internal and external delay. The internal delay includes recognition delay (time needed to decide which action to implement). The largest part of this delay is the information delay, which is due to the following reasons:

(a) economic decision makers require an accurate picture of the state of the economy, which requires time to collect and process the relevant statistical data. If policymakers had outdated and incomplete information, this could have serious economic consequences, depending on whether the situation is changing and how quickly;

(b) all variables that are interdependent on the same change pathways cannot be statistically reported;

c) some short-term economic changes may statistically indicate a new trend in the movement of the observed phenomenon, even if there is a temporary deviation from this trend.

Another internal delay is either an implementation or an administrative delay. It consists of a decision delay, which is the time needed to determine what is to be done, and an action delay, which is the time needed to take decisive action. On the other hand, the external lag is the period between the application of economic policy instruments and the impact of these changes on the final results of economic policy. Various financial lags should also be mentioned here: lag in interest rates when the quantity of money changes; time for banks and other financial institutions to adjust their wallets; counterparty delay in response to money or borrowing due to changes in interest rates; delay in the response of new securities in financial markets to changes in interest rates and the general economic climate.

Pierce (1984) gives three reasons for delays in economic activities, these are:

- a) recognition delay;
- b) implementation delay;

c) lags in the economy's response to changes in economic policy.

These three types of lags define the total time between the need to change the political course and the final effects on the national economy, the duration of the delay significantly reducing the ability of economic policy to stabilize the economy in the short term ($\underline{\check{Z}ivković} \& Ko\underline{\check{z}etinac}, 2008, 318-320$).



Figure 1: Time lags of economic policy instruments Source: (Živković & Kožetinac, 2008).



Hysteresis, a concept taken from the natural sciences, but with similar cases in economics, is a non-linear mechanism, often implying multiple (alternative) time and equilibrium trajectories. In a very broad perspective, a dynamic system can be considered hysteretic when the time trajectories of some or all of its variables show path dependency, which in turn also implies non-ergodicity. The very notion of multiple pathways to both socioeconomic and complex natural systems ultimately rests on the assumption that history is an essential part of the interpretation many dynamic phenomena. A property that is historically relevant is also closely related to the irreversibility of time, a situation where it is not possible, even theoretically, to "reverse the time arrow" and the system is still expected to remain unchanged properties.

In economics - at least in the dominant theory as opposed to, for example, economic history - the very concept of hysteresis was accepted only with some skepticism and often in the most restrictive interpretations. In the 1980s and 1990s, a stream of literature was faced with the challenge of non-linearity of growth processes and thus a multiplicity of alternative paths and related hysteretic properties (<u>Andreoni and Sprenger, 2012</u>).

Relationships between economic variables are often characterized by a situation in which the initial conditions and the earlier realizations of the economic variables matter. This means that the earlier (transitional) exogenous disruptions and the earlier states of the economic system have an impact on the present economic relationship. Typical examples are the dynamics of employment in business cycles and the dynamics of the link between the exchange rate and exports. Because the standard features of hysteresis are used - that is, the persistent effects of a temporary stimulus, resulting in a path dependent plural equilibrium - these economic phenomena are actually called "hysteresis". Empirical research in economics uses a variety of methods to capture path-dependent effects. The first econometric approaches tried to describe these effects using simple serial processes with unit (or zero) root dynamics. However, since the unit dynamics is not related to the real multiple equilibrium, but to the order of time series integration, these first attempts were extended to more advanced time series models integrating structural splits, threshold cointegration or non-linear, autoregressive distributed delay models. Another branch of empirical research tries to get closer to the original concept of macroloop by attempting to apply the Mayergoyz/Preisach explicit aggregation procedure for heterogeneous companies - if microeconomic information is available based on panel data - or by using simple algorithms analogous to a mechanical game to apply simple regression methods OLS on a filtered / transformed input-output relationship (Jarrow and Protter. 2012).

People are not indifferent to when they can meet their needs. They prefer to satisfy them sooner rather than later. As <u>Mises</u> writes, "There is no man for whom the difference between" earlier "and" later "does not matter." The fact that a person prefers to achieve the same satisfaction sooner rather than later is called a time preference. The time preference is always positive - that is, a person always prefers to achieve the same satisfaction sooner rather than later. What if the time preference was negative? Man would postpone consumption indefinitely. If he would postpone consumption for a year, he would postpone it for another year after one year. Such a situation is impossible because man has to consume in order to live. With negative preference, it would constantly accumulate, and never consume. Hence, we know that the time preference must be positive (Fleurbaey and Zuber, 2013).

The time preference is positive, but it can be high or low. To better understand the concepts of high and low time preference, imagine a society with infinitely high time preference. In such a society, all consumer goods would be consumed immediately. There would be no savings. Therefore, there would be no investment in better, more efficient, production methods. Such a society would exist on the animal level.

We can also imagine a modern society where there are many capital goods, in which all people would change their time preferences to an infinitely high overnight. Such a society would not initially live at the animal level, since it would have previously accumulated capital at its disposal. However, with time, with the immediate consumption of all consumer goods produced, and in the absence of any savings that would allow even the replacement of consuming capital goods, such a society would begin to regress in development and would eventually reach an animal existence.

Another idea is an economy in which no changes are taking place. <u>Mises</u> calls this mental construction a uniform economy. It is an economy in which, according to its participants, the allocation of capital is optimal. There are no changes in people's preferences. People's time preferences only allow for the replacement of capital, but no one saves anything more than that, because no one imagines that a new investment could contribute to the improvement of their existence. When time preference allows only capital replacement, the economy does not grow. There is no economic growth - and in the mental construction of a uniformly functioning economy - it is not needed because all needs are met. In the real world, however, people still have unmet needs and their preferences are changing. Zero growth is not a desirable situation for us, therefore at least some people have a low enough time preference to save and invest in improving productivity (Fleurbaey and Zuber, 2015).

If a person always prefers to achieve the same satisfaction sooner rather than later, what might cause him to postpone consumption? The prospect of greater satisfaction in the future. A person characterized by a low time preference will save and invest in order to enjoy higher profits in the future. As <u>Mises</u> wrote: "The sine qua non condition for extending the production process is savings, that is, a surplus of current production over current consumption. Saving is the first step to ensuring and increasing prosperity."



What is this lengthening of the production process and the associated increase in welfare? On the production of capital goods, that is, intermediate goods, which allow the obtaining of more consumer goods in the future. "Capital goods are intermediate steps in the path from the very beginning of production to its ultimate goal of consumer goods."

Of course, in society, not everyone has the same time preference. There are people with higher and lower preferences. The level of individual time preference depends on several factors (also external ones that are beyond the human control) and may change over time. Undoubtedly, however, individual factors of a psychological nature play an important role here.

The amount of time preference is determined by many factors that lie beyond the area of interest of economic theory. They include, among others age, level of education, affluence, etc. As a rule, children and the elderly have a high time preference, and affluent people have a low preference, although there are many exceptions. The time preference itself is a logical necessity to act and this is how it is treated by the theory of economics, one of the tasks of which is to present the cause-and-effect relationships between the level of time preference and the level of savings and investment.

CONCLUSIONS

The research results confirmed all three research hypotheses. Namely, it was confirmed that short-term analyzes show weaker macroeconomic relations between the variables than in the long term due to the existing short-term price and wage rigidity (stickiness) and insufficient adaptation efforts of market participants in the short term. Moreover, it was confirmed that taking into account the time intervals between the variables results in stronger macroeconomic relationships between the examined variables, due to the fact that changes in a given factor are taken into account in the long term. Finally, it was confirmed that in macroeconomic analyzes there is a phenomenon of hysteresis, because in practice long-term changes in the economy depend on changes occurring in a short period of time.

The results of the research are of macroeconomic importance as they contribute to a change in the understanding of time in economic research and contribute to the development of new theoretical concepts regarding dynamic processes in the economy. At the same time, it should be noted that the conclusions resulting from the above research cannot be automatically extended to microeconomic relationships, because in the case of microeconomic analyzes it should be taken into account that the reaction of individual enterprises or households to signals from the market is usually much faster than in the case of the entire group market participants. Hence, the results of the above studies can only be a starting point for further analyzes of the importance of time in microeconomic analyzes.

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