# LONG TERM CYCLICAL WAVES AND STRATEGIC BEHAVIOR OF ECONOMIC ACTORS

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**Abstract**

The paper aims to show how long term cyclical fluctuations can depend on changes in optimizing strategies of individual actors in the economy. Apart from re-interpretation of existing long term cyclical waves theory under optics of the theory of strategic cycle, the authors offer also a concise analysis of so-called ultra-long waves with period of 300 years in order to show their impact on long waves. The ambition is not predictive, as most economic cycle models have, while it is rather explicative. Authors use examples of China, USA and Europe to show interaction of long and ultra-long waves. The paper concludes that cyclical changes in strategy mix necessarily influence cyclical development of product. We find that strategic cycle theory can offer a good explanation for long term cyclical waves, because, as we assume, diverse strategies adopted by different generations result from changing circumstances for decisionmaking while framing their life strategies.

**Key words:** strategic behavior, economic cycle, long term cyclical waves, ultra-long term cyclical waves

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## Introduction

This paper expands and applies our previous research in area of strategic behavior of economic subjects which in our opinion might be the cause of business cycles (Čermáková, Vorlíček, 2015, 2017) in the long run. We use different approaches to divide economic cycles than the traditional one known from mainstream economic books. The cycles in our research are divided into two groups. Exogenous cycles, which are caused by factors outside the economy in the first group and endogenous cycles caused by behavior of economic subjects in the second group. Endogenous cycles are further divided into two subgroups. The real cycles that are caused by economic activity without interaction between economic subjects e.g. Schumpeter's theory of innovation cycle (Schumpeter, 1939), theory of real cycle e.g. Kydland a Prescott (1990). Innovation is in both listed theories creating an investment wave, which consists both

boom in the beginning and recession in the end of the wave. The more significant innovation is, the bigger is the induced investment wave and so is the economic boom. This way we can explain why are individual phases of cycle irregular in occurrence in time and different in size of fluctuation of product. And since innovation is the cause of economic growth the theory of innovation cycle interconnects economic cycle with economic growth. Economic cycle in growing economy is manifested by fluctuation in tempo of growth of product. And since it is an investment cycle, we are talking about fluctuation of output and not fluctuation of welfare. Period of investment boom requires higher sacrifice on welfare in terms of higher savings thus lower present consumption, higher workload and lower amount of free time. Each different phase of cycle doesn't hit all the economic subjects in the same way. Consequences of economic downturn after exhaustion of investment wave are not manifested as equal decrease in amount of work of all the members of society, but on contrary as job loss of subjects that were working on those finished investments. The fact that amount of work is decreasing and so amount of free time is increasing might be a positive phenomenon for society. But with ongoing recession the unemployment rate grows and instead of positive perception of investment downturn as the increase of amount of free time, the society has rather negative perception of recession due to fear of losing the income, which is the most important part of their welfare. The problem of innovation (investment) cycle only exists in modern economy and as a structural problem.

If we look at business cycle in terms of strategic behavior of economic subjects with mutual interaction, we can see that the cycle could by caused by certain social institutions e.g. central banks, as is the case in the theory of monetary cycle of Austrian School of Economics, von Hayek (1933) and Mises (1953) or Wicksell (1936), or the case of Political-Budget cycle e.g. Nordhaus (1975) and Tufte (1974). If those specific social institutions didn't exist, the cycles wouldn't happen. This group of economic cycles can be described as institutional economic cycles and we discussed those earlier on the previous conference. (Čermáková, Vorlíček, 2015)

Formal apparatus in older business cycle theories does not provide any options to explain the creation and changes of strategies of economic subjects using game theory. But it is the game theory that allows us to explain strategic behavior as a cause of business cycle. The nature of business cycle based on strategic behavior of economic subjects can be summarized as follows: proportion of various strategies that are used by individual economic subjects in society cyclically changes and it causes the cyclical development of product of the whole society. This thought can be easily demonstrated on following example, where we illustrate the situation on bird population. Members of this population are divided into two groups: group of

doves that choses the strategy of peace, which means that they share hunting ground without any harm and a group of hawks that choses the strategy of conflict which results in a fight with only one winner and one defeated, who suffers harm. If we mark yield as R and harm as B, then during the encounter of two doves using the peaceful strategy, they both get 1/2R. In case of an encounter of two hawks one gets R and the other gets B and if we assume that all hawks have the same capabilities, then there is a 50 % chance for every hawk to get either R or B. Hawk gets R when he meets a dove but dove doesn't get B because she refuses to fight and flies away. The situation is presented in matrix below:

| Cooperation: | | subject B | |
|---|---|---|---|
| | | Yes (dove) | No (hawk) |
| subject A | Yes (dove) | ½R : ½R | 0 : R |
| | No (hawk) | R : 0 | ½(R–B) : ½(R–B) |

With $B \leq R$ there is no place for dove strategy in the population, with $B > R$ the costs are too high for hawks. It is obvious that the higher are the costs of conflict compared to yield from conflict the less will be the hawk strategy represented in the population and thereby the more will be the dove strategy represented in the population. This applies only for large population. Infinite population is commonly used in theory but 100 and more subjects in population are sufficient in practice. Mathematical proof of this claim presented by e.g. Chvoj (2013).

With zero transaction costs i.e. with perfect information and with zero cost of a change of a strategy a ratio of hawks in population levels off on the value of R/B from which it would not deviate. But because there are not zero transaction costs in real economy, the ratio of individual strategies fluctuates and thereby the size of each group fluctuates as well. When R=2 and B=4 the matrix looks like this:

| Cooperation: | | subject B | |
|---|---|---|---|
| | | Yes(dove) | No (hawk) |
| subject A | Yes (dove) | 1 : 1 | 0 : 2 |
| | No (hawk) | 2 : 0 | - 1 : - 1 |

And the payoff matrix looks like this:

| Ratio dove: hawk (in %) | 45 : 55(crisis) | 50 : 50 | 55 : 45(boom) |
|---|---|---|---|
| Average outcome of dove | 0,45 | 0,5 | 0,55 |
| Average outcome of hawk | 0,35 | 0,5 | 0,65 |
| Relative outcome of population (in %) | 79 | 100 | 119 |

We can interpret data from the table as follows: When the population is 10 million, where every individual meets with 20 randomly selected individuals from this population and if there is 45 % of doves and 55 % of hawks in the population, then every bird will meet 9 doves and 11 hawks, where every dove gets 9 points from meeting all the other doves and 0 points from meeting all the hawks. Meanwhile every hawk gets 2 points from meeting with all the doves and 1 point from meeting all the other 11 hawks. Total outcome (product) of economy would be 158 points. If the ratio of strategies in population is 50 % to 50 %, then the product would be 200 points and if the ratio of strategies in population is 55 % (doves) to 45 % (hawks), then the product would be 238 points. We can see the fluctuation of product during the changes of ratio of strategies in population. The economy goes through cycle, where boom is caused by growth of portion of dove's cooperating strategy and decrease of portion of hawk's aggressive strategy and in the case of recession the portion of cooperative strategies decreases and the portion of aggressive strategies grows.

We can conclude from the given example that ratio of individual strategies in population has influence on the total output (product) of the whole society and that the economic cycle is caused by its changes. Reality in which economic subjects find themselves is much more complex than the presented thought and it is possible to play many more different games with many different strategies. Variability of strategies could explain the existence of many unique cycles with different time periods and characteristics. We assume that this thought is suitable to explain speculative bubbles on stock exchange and to understand long term cycles, where it is possible to use this theory to explain the cycle by changes of strategies across generations as we are trying to show in this paper.

## 1 Long waves as the result of changes of strategies across generations

Long waves are called e.g. Kondratieff's K waves (Kondratieff, 1935) with period 40-60 years. Schumpeter (1939) included into long waves even the shorter cycles such as Kuznetz's cycles with period 14-25 years and Juglar's cycles with period 7-11 years. Our subject of interest is Kondratieff's cycle.

Strategic behavior of individuals is closely connected to social institutions that define major part of rules and economic subjects form their strategic behavior within those rules. In reality the decision making is not always happening within the set of rules. Subjects develop pressure towards change of social institutions that gradually adapt. Institutional changes are complicated and they also have huge inertia. Those changes are usually not compatible with dominant set of individual strategies. Influence of social institutions towards individual strategies is dominant on real course of short term cycles and influence of individual strategies towards social institutions is dominant when we speak about real course of long term cycles.

Let's see how this mutual interaction of cyclical influencing works. Changes of individual strategies influence institutions and conversely the institutions influence set of individual strategies used in population in certain time. Let's observe how institutions accelerate or slow down the cycle in certain phases on contrary with situation where institutional framework doesn't change and where it is neutral towards interests of individual subjects and their strategies. On basis of previous thought, it is possible to identify long waves i.e. K waves using not only economic indicators but also by changes in set of strategies used in population.

Put simply, we can say that upward phases of K waves are connected to growth of "active" strategies in society. In institutional area with some level of deregulation which stood out the most in previous phase so called bottom turn which tends according to certain circumstances to have less rapid progress in different places. The downward phases on the contrary are connected to growth of "passive" strategies. In institutional framework, with increase in societal regulation preceded by impulse in previous phase of upper turning of the wave, is the goal of the regulation to ensure certain privileges (they are called social rights nowadays) that seem to be, according to majority of society in the upper phase of the wave not only desirable but also possible. Goal of deregulation is the opposite and so to limit or to abolish such privileges because they are in the bottom phase of the wave where they are considered undesirable or desirable but unrealistic and unsustainable as the pessimism culminates.

These K waves took place in human history so far on basis of van Dujin's analysis (Dujin, 1983):

1. K wave: beginning in 1789-95 and peak in 1809-29;
2. K wave: beginning in 1842-50 and peak in 1868-73;
3. K wave: beginning in 1892-98 and peak in 1912-24;
4. K wave: beginning in 1934-46 and peak in 1965-70.

Let's take a look at some common features of turning points of both upward and downward phases of K waves. All the bottom turning points are connected to certain level of frustration of the society related to existing conditions. This frustration leads to certain degree of liberalization and deregulation which can be revolutionary. It was the French revolution in 1789, spontaneous revolutionary movement that hit practically whole Western and Central Europe in 1848, beginning of second world war in 1939 and collapse of repressive regimes in Eastern Europe in 1989 when wave of deregulation, that was rather stormy in England, hit the Western Europe and the USA. Only bottom of K wave in 90's of 19th century (turn of second and third K wave) wasn't accompanied by significant political changes.

All the upper turning points are conversely connected with peaking optimism in society and we can characterize them with term "bursting the optimistic bubble" and with reconsolidation of societal regulation that are sometimes and somewhere connected with socialist revolution that rather preceded than followed the peak. Internationally organized socialist movement arises in 60's of 19th century in its modern form. It had turned into revolution only in France in 1870/71. France was in specific situation that was related to lost Franco-Prussian war and to political turbulence caused by establishing of new political regime and Empire was turned into Republic. First world war starts in 1914 and it was motivated by exaggerated optimism and belief in own strength of participated nations (btw.: it was supported by social democratic parties from all participated countries regardless their international ideology). It is a good example of that ideologies can affect society but strategic behavior of each subject is much more important. Socialist revolution happens in some countries afterwards (1917 in Russia and in Mexico). The second world war was motivated by quite the opposite, it was motivated by pessimism and frustration. We can see movements interested in human rights getting stronger and stronger in 60's of 20th century. Mostly it wasn't the case of political rights like it was with the liberal movements in 19th century but it was the case of social – material rights. Year 1815 is some sort of exception because it is connected to reaction of several governments to the end of Napoleonic wars which was relatively specific situation. Socialist movement as we know it today didn't exist back then and arises in growing phase of 2nd K wave.

## 2 Ultra-long waves and their impact on long waves

It is necessary to understand that cycles tend to synchronize in globalized world, but very significant events in 1789, 1815, 1848, 1873, 1914, 1939, 1968 a 1989 managed to impact whole Europe and by extension the whole world. Various places have their differences, which significantly influenced the course of the cycle at those places and that is why the upturns, peaks, recessions and downturns were all manifested with different strength, intensity and with different time deviation. It is also important to take into consideration that cycles that originated from different causes with different time duration also influence each other. We will not further discuss the influence of short waves on K waves but we can't ignore the influence of longer cycles, that are little reflected by economic theory because of lack of valid data. Even the theory of K waves is more questionable. After all, the statistic in 19th century certainly wasn't on level that would allow more than just an estimation of product of society. Available data that allow us to look even further in the past are even more problematic. Nevertheless, it is possible to make at least some conclusion based on those data. E.g.: the phenomenon that we are going to call ultra-long cycle – U wave, that manifested in China due to China's specific nature as dynastic cycle that lasted for 300 years. This U wave was also identified in Europe but not in dynastic form. On this ultra-long cycle we can well prove that they were completely unsynchronized, because the Chinese and European civilization evolved separately with minimal contact. There was a descending phase of ultra-long wave in China in 19th and in first half of 20th century. The phase hit bottom around the mid-20th century. We can describe the present phase in China as ascending. In Europe, the reverse is true – 19th century was the phase of ascending U wave and now it is in descending phase. That would explain why did China lose in 19th century against relatively underdeveloped Europe even though it was the most advanced, productive and the richest part of the world. Technological breakthroughs made in Europe can't be the only explanation – technologies are easy to copy, so the place of origin is important only temporarily. What is important is whether social conditions support their implementation. This was the case of Europe in ascending phase of ultra-long cycle. In our terminology, if we ignore short-term fluctuations caused by the course of cycles with shorter time periods, then we can say that the portion of active optimistic strategies in Europe was growing. It was quite the opposite in China that was in descending phase of ultra-long cycle. The conditions were different from Europe – so again, if we ignore short-term fluctuations caused by the course of cycles with shorter periods, then we can say that the portion of passive pessimistic strategies grew, which creates adverse environment that can make implementing of technological breakthroughs almost impossible. As we can see, the situation is quite opposite now – portion of passive pessimistic strategies grows in Europe to which European institutional

environment adapts and that makes implementing of innovations more expensive. So, Europe's and America's economy grew faster in 19th century than China's economy and nowadays it is the other way around. Sociological surveys also show us that the situation in so. third world is similar to situation of so. first world in 19th century. Conversely, the situation in Europe and America now is much more similar to passive situation of China in 19th century.

With regard to the fact that we only have very raw data to analyze U waves as stated above, we can't make more than a conservative estimation. Conclusion based on conservative estimation can be of great use to analyze K waves. We can deduce that individual phases of K waves won't be symmetric but systematically asymmetric thus that they are skewed to the left (longer K boom and shorter K recession) in ascending phase of ultra-long cycle and skewed to the right (Shorter K boom and longer K recession) in the descending phase of the U wave. Testing of this hypothesis is quite difficult because the data are too raw in time horizon of K waves to identify turning points with precision. Authors usually differ by years in their estimations even though they use time intervals. Globalization causes close interaction with countries in different phase of U wave which means that they will influence K waves in world economy in opposite direction.

## Conclusion

Theories of cycle usually try to find the means to make a precise prediction of cyclical development of the economy especially when it comes to prediction of beginning of recession. Theory of strategic cycle doesn't have such ambitions. We assume that we would need data, which we can't get upfront to make a precise prediction. Data that we have are raw and they don't allow us to make general conclusion. Moreover, K waves were identified ex post in historical data. Model of long waves is rather explicative than predictive. Predictions made on basis of this model i.e. especially estimated arrival of 5th K wave in 90ies of last century with peak around 2020 are still disputed. Some authors assume that 5th K wave haven't started yet and they speak about delayed onset of this wave. On contrary, we assume that 80ies of 20th century had all the aspects of the bottom turning point i.e. social pressure that led to some sort of liberalization and deregulation of economy – Thatcher, Reagan, disintegration of eastern block and following relative boom in 90ies. We also believe that we have also passed through upper turning point and that we are in descending phase right now that should end in 30ies of this century. This of course doesn't necessarily mean that the performance of the economy will fall it could just slow down the growth rate. Scientific-technical revolution created a phenomenon of institutionalization and automatization of innovative process including a certain

degree of scientific freedom that is necessary for the research. Especially in natural science and in technical fields of study, that are essential for development of economy. This is unfortunately not the case of social sciences and it is expected that the pressure on "political correctness" will get stronger soon, which will make discussion on some topics nearly impossible. Even though we will witness growth of number of passive strategies in society and growth of pessimism, regulation and bureaucratization, which would conserve current situation, according to presented theory, it will also conserve the tempo of scientific progress, which can be considered optimistic.

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