

# THE SIXTH KONDRATIEFF - The Growth Engine of the 21st Century

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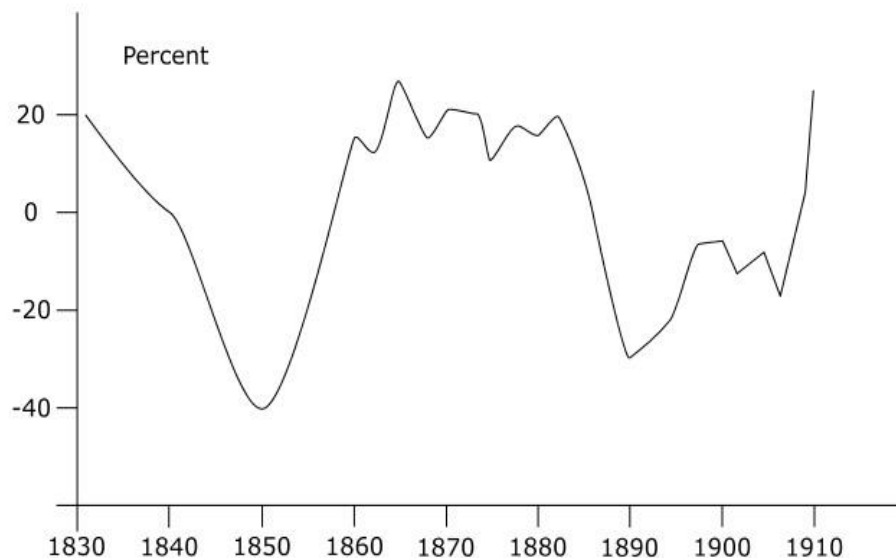
## Abstract

Is it possible to accurately forecast a long upswing? The following talk introduces a method that is able to predict a long upswing with the help of the Theory of Long Waves or Kondratieff cycles. This method was first published in 1996 (Nefiodow 1996).

The first part of the talk contains a short introduction to the Theory of Long Waves. In the second part we present the method to identify a Kondratieff cycle. In the third part we describe the new, the sixth Kondratieff, which began at the turn to the 21st century.

## PART I. SHORT INTRODUCTION INTO THE THEORY OF LONG WAVES

In the 1920s, Nikolai Kondratieff was the Director of the Institute of Business Cycles in Moscow. They say, Stalin ordered him to demonstrate scientifically that capitalism is going to collapse. To carry out this task, he studied the history of the largest capitalist countries based on time series. He published his findings 1922 in Russia and in 1926 in the West and showed that capitalism develops in long waves and though it often falls into deep crises, it does in fact not collapse – much to the regret of communists – but instead recovers after every recession with a new long upswing.



**Illustration 1:** Long Wave of Coal Consumption Source: Kondratieff, 1926.

Kondratieff's publication was the impetus for a new scientific discipline, the Theory of Long Waves. In honour of him and based on Joseph Schumpeter's suggestion, these long waves are called Kondratieff cycles.

Kondratieff has demonstrated the existence of long waves, but he was unable to answer one important question: why do these long waves exist? What causes them?

Joseph Schumpeter asked himself this very question and answered it in his book *Business Cycles*. According to Schumpeter, the long waves are caused by innovations. It is the entrepreneurs and their creativity, who keep inventing new products and services, launch them into the market as innovations and thus trigger the short-term, medium-term as well as the long-term economic fluctuations.

There are still other explanations for the development of long waves, but Schumpeter's classification of innovations as the trigger of long waves is generally accepted and in our opinion is the most convincing explanation. However, his description of the long waves is too narrowly restricted to pure economic (endogenous) factors. He neglects the social environment. He views research and development for instance as exogenous and only marginally considers them. But if we don't consider research and development, we cannot understand how innovations come about. Actually, the analysis of research priorities is an excellent indicator to be able to rate the significance of innovations.

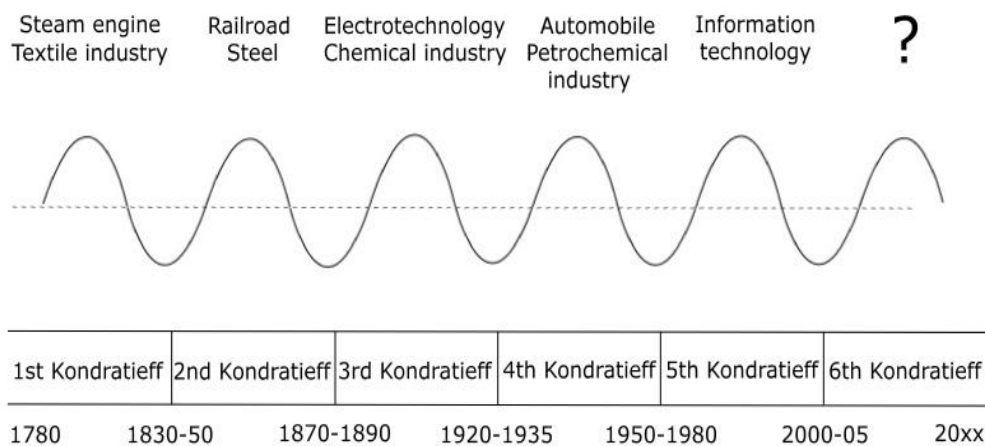
Thanks to Christopher Freeman and his team at the Science Policy Research Unit (SPRU) at the University of Sussex, the Theory of Long Waves was expanded. Together with John Clark and Luc Soete, he introduced the scientific, technological, organizational and social factors into the description of the long waves. It became apparent that during a Kondratieff cycle, it is not just many new companies, new jobs, new products and new services that emerge, but also new research focal points, new management methods, new types of work organization, new teaching methods and curriculums.

However, Freeman and his team were not able to convincingly explain, which mechanisms effect the described changes in the economy.

This is where the Venezuelan social scientist Carlota Perez, who was part of Freeman's team, made a major contribution: she illustrated that a Kondratieff cycle is only able to properly develop when the technical-economic system – as she calls it – and the socio-institutional environment interact with each other and if there is a good match between technical and economic innovations on the one hand and the social environment on the other. Society needs to positively and actively embrace the Kondratieff cycle, for instance by active demand, through an appropriate general political framework, through expansion of the legal and the education system and by creating the necessary new infrastructure. When this happens, the Kondratieff cycle is also able to develop dynamically.

### **The five Kondratieff cycles**

Kondratieff cycles are reorganization processes of economy and society with the objective of opening areas of large demand by means of groundbreaking innovations (basic innovations). Those who identify a Kondratieff cycle early are able to gear themselves towards the future, take the lead in economic and social development and benefit the most from its momentum.



**Illustration 2:** The Five Long Waves of Economic Development (Illustration 1.1)

Source: Nefiodow, Leo and Nefiodow, Simone 2014.

The 1st Kondratieff cycle begins towards the end of the 18th century. The trigger is the steam engine. The most important application takes place in the textile industry. The 2nd Kondratieff is the era of big steel and the railroad. Thank to the domination of these two Kondratieff cycles Great Britain became the world power of the 19th century.

Two major new industries develop during the 3rd Kondratieff: the electrotechnical and the chemical industry. The 3rd Kondratieff ends with the world economic crisis of the late 1920s and early 1930s. The 4th Kondratieff started at the same time, which was supported by the automobile and the petrochemical industry. This long cycle drew to an early end due to the massive crude oil price increases of the 1970s. The USA and Germany benefit the most of these two cycles. Thanks to its huge petrochemical energy reserves the Soviet Union became a world power during the 4th Kondratieff.

The 5th Kondratieff is carried by modern information technology. The USA and Japan were the leading nations in this cycle. It ended at the turn of this past century. This was the reason for the global recession of 2000-2004.

And now this begs the question: what comes next? Which new inventions are going to trigger and carry the 6th Kondratieff?

## **PART II. CRITERIA TO IDENTIFY AND PREDICT A KONDRATIEFF CYCLE**

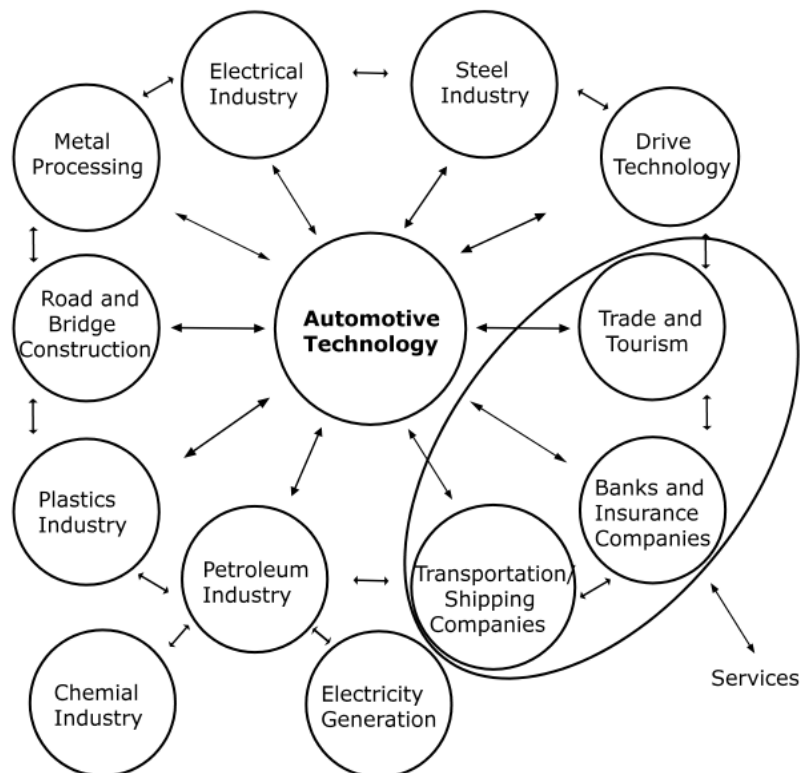
Before we answer this question, I would first like to define several terms that are of vital importance for describing the long waves:

1. *Basic innovations.* They are – as already mentioned – the trigger for Kondratieff cycles. The steam engine was the basic innovation during the 1st Kondratieff for instance; during the 5th Kondratieff, it was information technology.

2. **Leading industry.** This is the industry, which newly develops thanks to the basic innovation. This was the textile industry during the 1st Kondratieff and the information technology industry during the 5th Kondratieff.

3. **Value chain.** It is made up of the leading industry and all other industry sectors that benefit from the basic innovation.

I would like to explain these three terms in more detail using the example of the 4th Kondratieff (Illustration 3).



**Illustration 3:** Value Chain Automobile/Fourth Kondratieff (this list is not exhaustive)

Source: Nefiodow, Leo and Nefiodow, Simone 2014.

The basic innovation of the 4th Kondratieff was the automobile. Those industries that immediately utilize a basic innovation are the leading industries – in the case of the car they were the automotive industry and the petrochemical industry. However, the car also plays an important role in other industry sectors: in retail and mass tourism; insurance companies and banks make money with cars, the construction industry profits by building roads, freeways, bridges and repair shops. A brand-new legal system emerged: traffic law. Many automotive experts, lawyers, repair shops and judges make their living from it. (Added to the mix are suppliers: the electronic industry delivers the necessary batteries, the metal industry delivers the required sheet metal)

To sum it up you can say, the leading industry and the industry sectors that benefit from the basic innovation of the automobile create a value chain, and this value chain represents the

Kondratieff cycle. What we can also see is that the use of the basic innovation shapes almost all economic events and creates countless jobs and new companies. During the 4th Kondratieff, every 5th job in the U.S. was directly or indirectly tied to the automobile, in Germany it was every 7th job.

Now we arrive at the sixth Kondratieff. How do I spot the new basic innovations that will trigger and carry it? To differentiate these new basic innovations from other innovations, they need to meet four criteria:

To identify a Kondratieff cycle, it should be searched on five levels:

1. The technological level (Criterion 1).
2. The economic level (Criterion 2).
3. The social level (Criterion 3).
4. The time level (Criterion 4).
5. The main barriers (Criterion 5).

The first four criteria are described below with the example of the fifth Kondratieff.

**Criterion 1.** The first criterion is the search for those innovations that are able to trigger and support a Kondratieff cycle. Here we follow and acknowledge Schumpeter (1961). To distinguish them from other innovations, we call them basic innovations. A basic innovation most notably differs from other innovations by the following characteristics: it triggers the Kondratieff cycle, definitively shapes the innovation process for several decades, creates a large new market, extensively alters society and has a life cycle of 40–60 years.

Information technology was the basic innovation of the fifth Kondratieff (Illustration 2). Over five decades, it shaped technological, economic and social changes in the developed countries and turned the world into a global village in terms of information. The scientific foundation was primarily supplied by informatics and computer science. No other technology was able to even remotely exhibit comparable economic dynamics and widespread effect during the second half of the 20th century (Nefiodow 1991).

**Criterion 2.** The second criterion pertains to the economy and consists of identifying the leading industry and the value chain. The leading industry is the industry, which newly develops thanks to the basic innovation. And it is also the one that benefits the most from the basic innovation. This leading industry acts as an engine of growth for the overall economy for the duration of the Kondratieff cycle. During the first Kondratieff, this was the textile industry, during the fifth Kondratieff it was the information technology industry.

For an industry to be classified as a leading industry it needs to be an economic heavyweight. As emanates from Table 1, due to its above average growth, the information technology

industry skyrocketed from zero to the first place among globally manufacturing companies during the fifth Kondratieff.

Industry Sector	Total Revenue in 1997 Globally in Billion US-\$
Information Technology	1730
Automotive	1190
Oil	1010
Chemical Industry (incl. Pharmaceutical Industry)	460
Food and Beverage Industry	340
Mechanical Engineering/Plant Engineering & Construction	300
Steel/Metal Production	200
Aerospace	150

**Table 1.** The major industries in the manufacturing sector.

Source: Nefiodow, Leo and Nefiodow, Simone 2014.

The leading industries affect the economic system like a locomotive affects a train: they put all wagons of the train in motion. Joseph Schumpeter (1961) called this phenomenon ‘the Bandwagon Effect’. If we stay with the image of a train, the individual wagons represent the sectors of the economy, which benefited from the basic innovation and its leading industries.

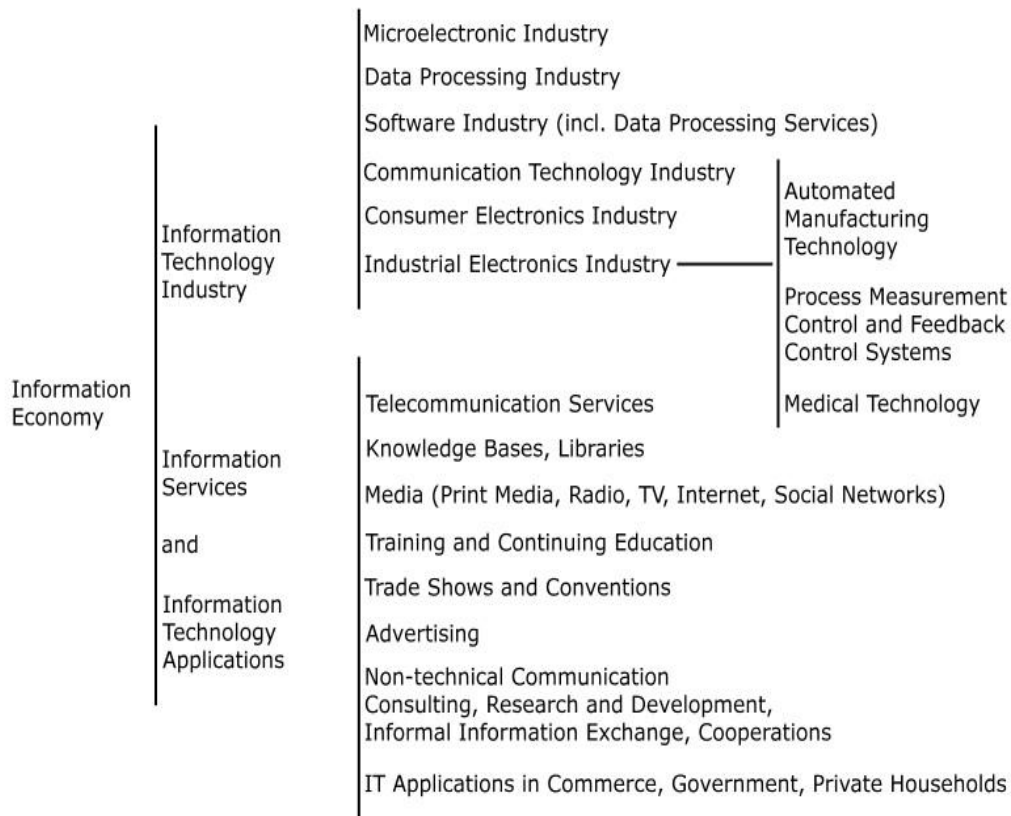
The value chain is made up of the leading industry and all other sectors that benefit from the basic innovation. Whereas the basic innovation triggers the Kondratieff cycle, the value chain is its actual carrier. This can be illustrated by the example of the fourth Kondratieff (Illustration 3). The car was the basic innovation, the automobile and petrochemical industry sectors were the leading industries and the value chain was made up of the leading industries and all other industrial sectors that benefited directly or indirectly from the automobile.

The value chain of the fifth Kondratieff is illustrated in Illustration 4. When we add the contributions to growth of the value chain including information services such as education, business consulting services, media, advertising, etc., whose development during the fifth Kondratieff was significantly determined by information technology, then the fifth Kondratieff determined more than 70 percent of U.S. growth during the 1990s.

**Criterion 3.** The third criterion pertains to society. The value chain that is caused by the basic innovation leads to a far-reaching reorganization of society.

Observance of this criterion is being checked by determining the diffusion of the basic innovation in society:

– A brand-new infrastructure develops thanks to the basic innovation. Examples: water routes in the first Kondratieff for coal transportation; the railroad network during the second Kondratieff; connecting society to electrical networks in the third Kondratieff; road and highway networks during the fourth Kondratieff; the telecommunications network of the fifth Kondratieff.



**Illustration 4.** The value chain of the fifth Kondratieff.

Source: Nefiodow, Leo and Nefiodow, Simone 2014.

– Thanks to the basic innovation, more efficient work as well as management that is more efficient and organizational concepts are possible in companies.

– In the field of education, it creates new occupations, new areas of expertise, learning contents and studying techniques.

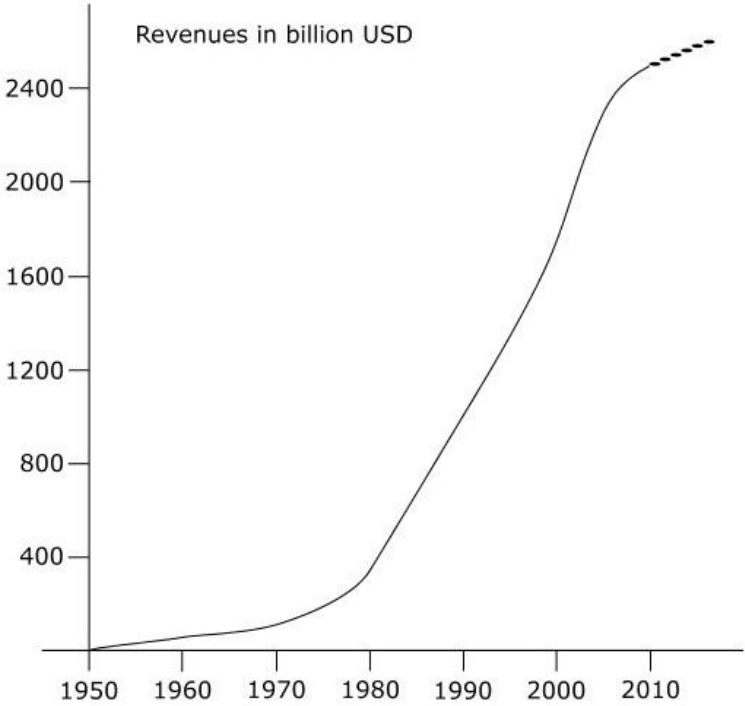
– To ensure controlled handling of the basic innovation, new legal controls have to be created (e.g., data protection acts during the fifth Kondratieff).

– At the stock exchange, the basic innovation guides capital investments to those companies that have specialized in its production and application.

– New forms of leisure, communication and entertainment emerge from the basic innovation.

**Criterion 4.** The fourth criterion pertains to the life cycle. The basic innovation and its leading industry must average a 40 to 60 year life cycle.

The innovation life cycle can be described by the S-curve. The S-curve is determined for instance by accumulating the quantity of the basic innovation (e.g., the number of registered cars in a country) or the value added of the information technology industry and illustrating it over time (Illustration 5). During the life cycle, the basic innovations and leading industries display an above average growth.



**Illustration 5.** The life cycle of the information technology industry in the fifth Kondratieff

Source: Nefiodow, Leo and Nefiodow, Simone 2014.

The 40–60 year duration of a Kondratieff cycle only applies to the pioneers. Latecomers like China or Brazil were able to catch up with the previous Kondratieff cycles in a shorter amount of time, because they utilized the experiences of leading countries through cooperative efforts.

**Criterion 5.** The barriers of the new Kondratieff cycle.

At the end of a Kondratieff cycle, the previous growth pattern has been mostly exhausted. Before you begin to search for the new basic innovation, you need to first identify the primary growth barriers that conflict with the new Kondratieff cycle. After all, of all the potential innovations, only those that reduce the barriers the most can be classified as basic innovations. Those barriers can be adherence to outworn concepts, a lack of willingness to innovate, fear of the future, lack of infrastructure, etc.



The recession at the end of the first Kondratieff for instance occurred, because companies back then were confronted with a growth barrier. Regional market opportunities had exhausted during the course of the first Kondratieff and transportation costs back then did not allow expansion on a grander scale. High transportation costs were the barrier to the second Kondratieff. This problem was solved with the introduction of the railroad. It cut costs by a factor of 200 and now companies were able to get into mass production, reduce piece costs and export to larger areas.

The growth barrier of the fifth Kondratieff was the lack of a highly productive information processing technology. The number of information and service professions had steadily increased during the fourth Kondratieff, but the technology that was available at the time – the phone, the telegraph, teleprinter and typewriter – was not efficient enough. This barrier was overcome with the invention of the computer.

What growth barriers are we facing today? What impedes sustainable economic growth today in Europe, Japan and the USA?

Every Kondratieff cycle faces its own barrier. Based on our analyses, there are two main barriers when it comes to the sixth Kondratieff; we call the first one the entropic sector.

### **Barrier No. 1: Worldwide Social Entropy**

Entropy is a term taken from physics that describes the disorder of a physical system. Here the term is used to demonstrate the global social disorder.

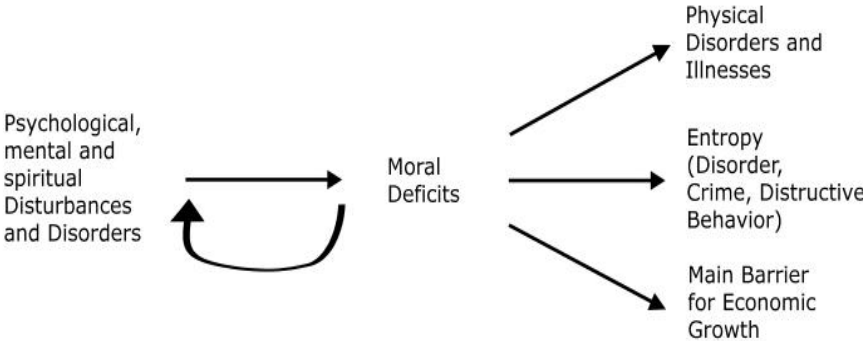
Let us take the USA as an example. Statistically speaking, every fifth male American of working age is a criminal. Fourteen percent of adults are considered severely mentally ill and about 50 percent of all marriages end up in divorce. Every fourth American student is being bullied; at least 160,000 children skip school every day for fear of being bullied and 280,000 students are being physically attacked in high schools each month. Almost every tenth adolescent person smokes marijuana; many of them regularly have a joint. Every third U.S. scientist cheats in his/her publications. Social inequality broke a record in 2009. The net income of the top one percent of income earners increased from 1979 until 2009 by 277 percent; the net income of the poorest fifth, however, only increased by 18 percent to where 0.1 percent of high-income earners made more money than the 120 million people on the bottom. This list could go on and on.

Disorder has become a worldwide mega problem and a mega market. Global money laundering has increased twentyfold from 1990 until 2009 and had almost reached 2,000 billion U.S. dollars. Corruption and bribery are at a record high all over the world and in 2009 caused at least five percent of all economic costs. The large banks manipulate interest rates (e.g., Libor and Euribor rates) for pure profits interests at the expense of the general public. Millions of people all over the world work for illegal and criminal organizations.

In the following section, the global disorder is conceptualized as an entropic sector. If we add up the damages, losses and costs that accumulate every year in this sector, we get an amount of at least 14,000 billion U.S. dollars for the year 2006 (Nefiodow and Nefiodow 2014). That was more than the United States gross national product. Based on our own calculations, global entropy has increased to 18,000 billion U.S. dollars in 2013.

The entropic sector plays a key role in the sixth Kondratieff, because the enormous losses, damages and costs that incur year after year in this instance have turned this into the most significant barrier for the economic and social development. This means that the first barrier is not a technological problem, not a problem of energy, but rather an ethical one.

This ethical barrier presented by the entropic sector can also be viewed from a different perspective. Ethical deficits can be seen as health deficits. This becomes apparent if you draw a comparison with the behaviour of healthy people. A psychologically healthy person does not cheat. A mentally healthy person has a good perception of reality and does not use drugs. A socially healthy person has a sense of community, does not rob other people's houses and advocates well-being of all people. A spiritually healthy person has a trusting relationship with God, strives for reconciliation, truth and peace and does not spread hatred and violence. Inner disturbances and diseases and the social misconduct caused by them are the deeper reasons for global entropy (Illustration 6).



**Illustration 6.** Causes of global entropy.

Source: Nefiodow, Leo and Nefiodow, Simone 2014.

**A New and Holistic Definition of Health**

The World Health Organization (WHO) definition of health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. In 1997, the Executive Board of the World Health Organization provided some food for thought with a broader definition of health, ‘Health is a dynamic state of complete physical, mental, social and spiritual well-being and not merely the absence of disease or infirmity’ (Khayat n.d.). This is likely the first time a prestigious international institution emphasizes the importance of spirituality for health. This was once again highlighted in the WHO 2005 Bangkok Charter for Health Promotion in a Globalized World, ‘Health is one of the fundamental rights of every human being and encompasses mental and spiritual well-being’ (WHO 2009). According to

the WHO, terms like disease and health are no longer limited to the body. They are systems concepts. There are also sick souls, social dysfunctions and diseases and sick families, companies and societies.

## **Barrier No. 2: The Traditional Health Care System**

Besides entropy, the traditional health care system is the second main barrier to the sixth Kondratieff (Illustration 7). It includes the pharmaceutical industry, medical technology and academic medicine with physicians, hospitals, pharmacies, health insurance companies, etc.

Over the past two centuries, the traditional health care sector made tremendous progress. Many diseases that were considered incurable or fatal in the past can now be effectively treated. Today acute medical care and surgery offer life-saving help even in extreme cases, which is something that was barely considered possible in the past. The history of medicine over the past two centuries was a real success story.

But this success story is about to end. Since the late 20th century, the new medical advances are no longer sufficient to adequately deal with the dynamics and complexity of modern life and its high demands on the physical, emotional and mental strength of human beings. Between 1980 and 2010, the global number of breast cancer incidence rates has doubled and, according to estimates by the United Nations, cancer rates in general are going to more than double during the 2000–2030 period. According to projections by the World Health Organization (WHO), depression is globally going to be the second most common cause of not being able to work and premature mortality by 2020. The increasing number of diseases is also reflected in spending. In 1965, health care spending as a percentage of the U.S. gross domestic product was 5.9 percent; in 2013, it had increased to 17.6 percent (US \$2.8 trillion).

Demographic development is not the only cause for this trend. Young and middle-aged people are also getting sick more often than before. Between 2000 and 2010, the number of mentally ill students in Germany has increased by 20 percent and adolescents and young adults under the age of 25 are among the group with the largest increase in depression. In 2000, every fourth adolescent in Europe suffered from allergies; in 2010, it increased to every third person. Every tenth European between the ages of 45 and 54 regularly takes antidepressants. In the USA, type 2 diabetes has risen tenfold in middle-aged adults during the past 20 years.

Pharmaceutical drugs are among the biggest shortfalls of the traditional health care sector. Most of them do not cure the disease; they only suppress its symptoms. What is more, drugs often remain ineffective, because their effectiveness has not been tested before the patient takes them. Migraine medications, for instance, only work for 50 percent of all patients, antidepressants for 40 percent, drugs to treat Alzheimer's disease for 30 percent and cancer therapeutic agents work for 20 percent of all patients at best.

Unwanted side effects are another downside. According to a study by the University of Toronto, using drugs as prescribed is the fourth leading cause of death in the United States.

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### **The traditional health care system**

- Medical technology.
- Pharmaceutical industry.
- Health services. (Doctors, non-medical practitioners, hospitals, health insurance companies, health insurance funds, pharmacists, public health services, medical care facilities.)
- Health spas/sanatoriums.
- Company health services. Health as a competitive factor, training and continuing education (e.g., in people skills), human resource development, health management.
- Other (health-related). Skilled trades (e.g., for orthopaedic products), sporting goods and sports facilities, health publications, medical EDP, etc.

#### **Illustration 7.** Value chain of the traditional health care sector.

Source: Nefiodow, Leo and Nefiodow, Simone 2014.

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What we call the traditional health care system today is in fact not a health care system at all. The system structures are not geared towards healing, but mainly towards the treatment of physical diseases. The correct label would be disease care system, since more than 95 percent of expenditures go towards the research, diagnosis, treatment, administration and management of diseases. And this disease care system costs more and more money. Today every sixth dollar in the United States flows into the traditional health care system. About 12,000 billion U.S. dollars were spent in this area throughout the world in 2013. Medical progress is the key driver of these expenditures. It generates approximately 70 percent of the cost increase (Schneider et al. 2014: 107). However, the costs of medical advances are not offset by obtained savings, which explains the permanent increase in costs.

In contrast, only limited means are available for prevention, preventive medical checkups and healing. Dementia is an example that shows us the consequences. In 2010, the U.S. federal health insurance programs Medicare and Medicaid spent approximately 140 billion U.S. dollars to treat dementia; but only 0.5 billion to research its causes. That is a ratio of 280:1.

The traditional health care sector is important; it will remain important and indispensable. It plays a key role today in the economy and society, but it uses up too many resources at this point while productivity is too low (Schneider et al. 2014).

### **PART III. THE SIXTH KONDRATIEFF**

How can those two barriers – big losses, expenses and damages of the entropic sector and the high costs and low productivity of the traditional health care system – be overcome? In the past, growth barriers were overcome by developing those basic innovations that were able to make the biggest contribution to reducing the primary growth barriers. And these new basic innovations do exist. The new basic innovations are biotechnology and psychosocial health and they come with an emerging new value chain. This new value chain will be the main carrier of the sixth Kondratieff (Illustration 8).

In the new value chain, biotechnology satisfies the most important criteria for identifying one of the basic innovations of the sixth Kondratieff cycle. It is not just a brand-new technology, it answers the question on how the second barrier, the low productivity of the traditional health care sector, can be overcome.

#### **Biotechnology as a Basic Innovation of the Sixth Kondratieff**

In the new value chain, biotechnology satisfies the most important criteria for identifying one of the basic innovations of the sixth Kondratieff cycle. It is not just a brand-new technology, it answers the question on how the second barrier, the low productivity of the traditional health care sector, can be overcome.

**Criterion 1.** One first-rate indicator is investments in research and development. How much biotechnology has globally shaped the research scene over the past few decades is evidenced by the fact that from 1999 to 2013 two-thirds of all Nobel Prizes in Medicine were awarded for findings in this area.

Within the research scene, private companies play a decisive role both in their research expenditures and in implementation of findings. Biotechnology companies lead the field. The companies in this industry that are listed on the stock exchange globally invested 20–40 percent of revenues in research and development. Biotechnology also obtained top priority worldwide quite early on when it comes to R&D government aid, not just in the USA, but also in Europe, Japan, the People's Republic of China, Australia and Singapore.

The large R&D expenditures become very noticeable in the health care sector. In 1995, less than ten cancer treatment products were in clinical trials in the USA, most being acutely toxic chemotherapy. Ten years later (2005), over four hundred cancer treatment products were in the human testing phase; more than 60 percent of these drugs came from biotechnology companies and most were designed to have minimum side effects. This proportion had increased in 2013 to over 80 percent.

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## The traditional healthcare system

- Medical technology, pharmaceutical industry.
- Health services. (Doctors, non-medical practitioners, hospitals, health insurance companies, health insurance funds, pharmacists, public health services.)
- Health spas/sanatoriums.
- Company health services. Health as a competitive factor, training and continuing education (e.g., in people skills), human resource development, health management.
- Other (health-related). Skilled trades (e.g., for orthopaedic products), sporting goods and sports facilities, health publications, medical EDP, etc.

## The newly emerging health care sector

- Biotechnology.
- Naturopathic treatments, natural products, all natural foods.
- Complementary/alternative medicine. Homeopathy, classic acupuncture, electroacupuncture according to Dr. Voll, kinesiology, bioresonance therapy, anthroposophic medicine, magnetotherapy, Dr. Rath's cellular medicine, biofeedback, quantum healing, traditional Chinese medicine, Ayurvedic medicine, Reiki, etc.
- Environmental protection (predominantly).
- Agriculture, diet, food.
- Wellness/fitness, tourism (health tourism).
- Architecture (healthy living), building and construction industry (healthy building materials), textile industry (allergy free and breathable fabrics and clothing), the senses (colour therapies, aromatherapies, music therapies).
- Self-medication and self-care. Participation of illness costs, rising self-care and self treatment.
- Workplace health management. Company health insurance funds, company sponsored fitness programs, cafeterias, welfare centres, health seminars, preventive medical checkups, good health bonus.
- Psychology, psychiatry, psychotherapy, psychosomatic medicine.
- Religion/spirituality.

### **Illustration 8.** Health value chain of the new emerging health care sector.

Source: Nefiodow, Leo and Nefiodow, Simone 2014.

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One impressive example on how biotechnology is able to reduce the second barrier of the sixth Kondratieff and significantly improve productivity of the traditional health care sector is personalized medicine, which emerged in the early 21st century. A little known fact, but

nonetheless true, is that pharmaceutical products are completely overrated in their effects today. This is not because the active ingredients are bad. In fact, this is because these active ingredients are used for every patient with the same diagnosis. The genetic makeup of the individual patients is completely disregarded. This results in the fact that 90 percent of drugs, for instance, work only for 30 percent of patients.

Personalized medicine will make it possible to prescribe drugs in terms of individual effectiveness and tolerance, to avoid medical malpractice, improve the detection and healing of diseases and to reduce the costs for new drug development and costs in the healthcare sector overall. According to American research, personalized medicine could save up to 50 percent in drug spending. Globally this would amount to just under 400 billion U.S. dollars annually. Personalized medicine should put an end to the era of one-size-fits-all drug policies. This is important, because their unwanted side effects are the second most common reason for emergency hospitalizations. Whatever paths personalized medicine will take, the possible improvements are tremendous.

**Criterion 2.** The basic innovation, its leading industry and its value chain are the most important drivers of economic growth.

The growth of biotechnology from 1980 to 2009 ranged between 10 and 20 percent. Even during the 2000–2002 and 2008–2009 crisis years, the sector grew at double-digit rates. In 2013, genuine, DNA-based biotechnology reached a global turnover of 150 billion U.S. dollars.

The economic significance of biotechnology cannot just be deduced from the turnover generated by genuine biotechnology companies. An assessment also needs to consider the revenues, the productivity improvements and the many impulses for new applications, which biotechnology induces in other business sectors, particularly in the industrial sector, in agriculture and nutrition as well as the healthcare sector.

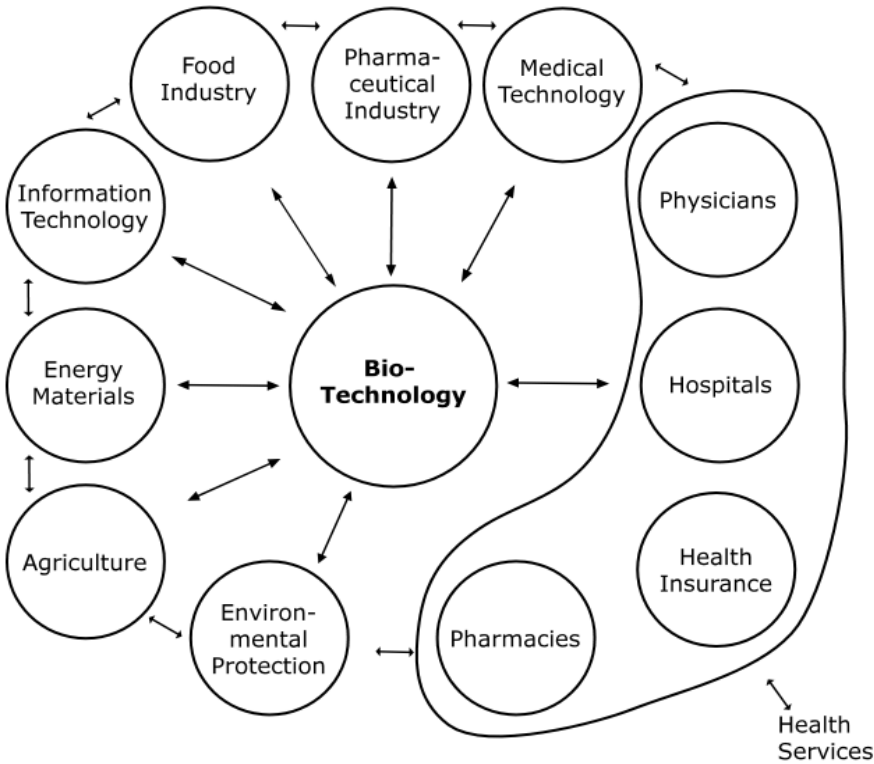
The European Union has highlighted the special importance of biotechnology by combining the individual sectors of biotechnology into one mega industry called 'bioeconomy' (this includes the food industry, agriculture and forestry, the fishing industry, the textile, cosmetic and pharmaceutical industries as well as the energy carriers from biomass). In Europe in 2013, this industry employed more than 23 million employees who generated annual sales of 1,8 trillion euro (European Union). There are no growth limits detectable over the next few decades.

**Criterion 3.** The basic innovation and its value chain is the driver of far-reaching changes in society as a whole.

The applications for biotechnology reveal that biotechnological applications are going to significantly change the entire society (Illustration 9): medical science, health, environmental protection, energy production, the chemical industry, agriculture, nutrition, raw material

production and biological information processing. Every year new applications are added to this (e.g., the production of artificial plants, microorganisms and brand-new creatures).

Biotechnology can improve the quality of life in many areas of society given a responsible approach. Science can broaden its horizon when it comes to understanding life, which improves the knowledge about human beings and nature. The environment can be protected more effectively and crime fought more successfully with genetic identification methods. Congenital physical disabilities and diseases will be successfully treated over the next 10–20 years. Productivity in the healthcare sector, industrial production, in nutrition and agriculture can be significantly improved, which reduces shortages in the world (hunger, unemployment, raw materials scarcity).



**Illustration 9.** The biotechnology value chain.

Source: Nefiodow, Leo and Nefiodow, Simone 2014.

However, a frivolous handling of this highly productive technology can result in considerable damages. Biotechnology could be abused for control purposes and discrimination (e.g., when career and life opportunities would be made contingent on genetic testing). By interfering in hereditary disposition, nature's balancing act can become unbalanced. The respect for Creation can be affected and thus opens the floodgates to manipulations of human beings. And it is also possible that the production of artificial microorganisms, plants and animals could create new diseases and epidemics.

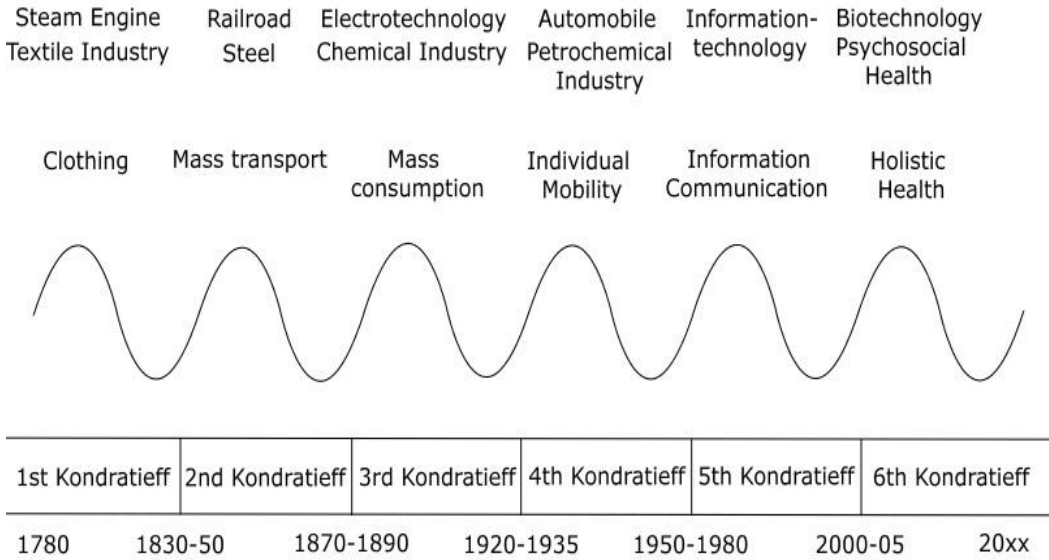
**Criterion 4.** The lifecycle of the basic innovation equates the length of a Kondratieff cycle.



The overall growth cycle cannot be exactly determined during the early phase of a basic innovation. Instead, one has to determine its respective state each year and estimate its further development. From the view of the early 21st century, one can assume that the potential of biotechnology will not be fully developed over the next two decades. At the same time, it is unlikely that the industry will maintain its above-average growth rates over the entire 21st century. Hence, its life cycle almost certainly should be between 40 and 60 years – and thus within the length of a Kondratieff cycle.

**Psychosocial Health as a Basic Innovation of the Sixth Kondratieff**

Psychosocial health is the second basic innovation of the sixth Kondratieff and the answer to the question on how its biggest barrier – global entropy – can be reduced most efficiently. It also meets the four criteria that are required for identifying a Kondratieff cycle (Nefiodow and Nefiodow, 2014).



**Illustration 10.** The six long waves in economic development.

Source: Nefiodow, Leo and Nefiodow, Simone 2014.

Moral factors frequently do not get high priority in politics and the economy. Yet the financial crisis of 2008–2010, the European debt crisis (2010–2014) and many other crises have shown what devastating consequences poor morals can bring. For a country to be able to renew and to be economically successful, it is not just enough to formally have the structures of democracy, a formally free market economy and a due process concept. What is crucial are the morals with which they are being practiced.

Klaus Schwab, the founder of the renowned World Economic Forum, where 1,600 top managers and 40 heads of state participated in 2012 in Davos, Switzerland, stated on the eve of the conference that capitalism in its existing state is no longer the economic model that is able to solve the global issues. Schwab (2012) asks for a new spirit of global social

responsibility (Grabitz 2012). His statements are noteworthy, since Schwab is a market economy expert and far from being an opponent of capitalism.

Brazil is one success story of how entropy reduction makes economic progress possible. In the 1980s, the country still ranked among the poor and underdeveloped countries. In the 1990s, thanks to conservative economic policy, it managed to keep hyperinflation in check; the country subsequently introduced active social policy. Yet at first, it did not amount to much. Crime gangs took money away from the poor, which was intended to pay for their children's education, health expenses and to create an independent livelihood. The country then used its armed forces. Three dozens of the worst slums were being occupied and the Mafia driven away. Now the residents were not just able to breathe a sigh of relief, but also invest in their future. From 2001 to 2011, Brazil's middle class grew by 93 percent; it made up almost half of all Brazilians in 2012 (Vèlez-Plickert In: Die Tagespost, 2013).

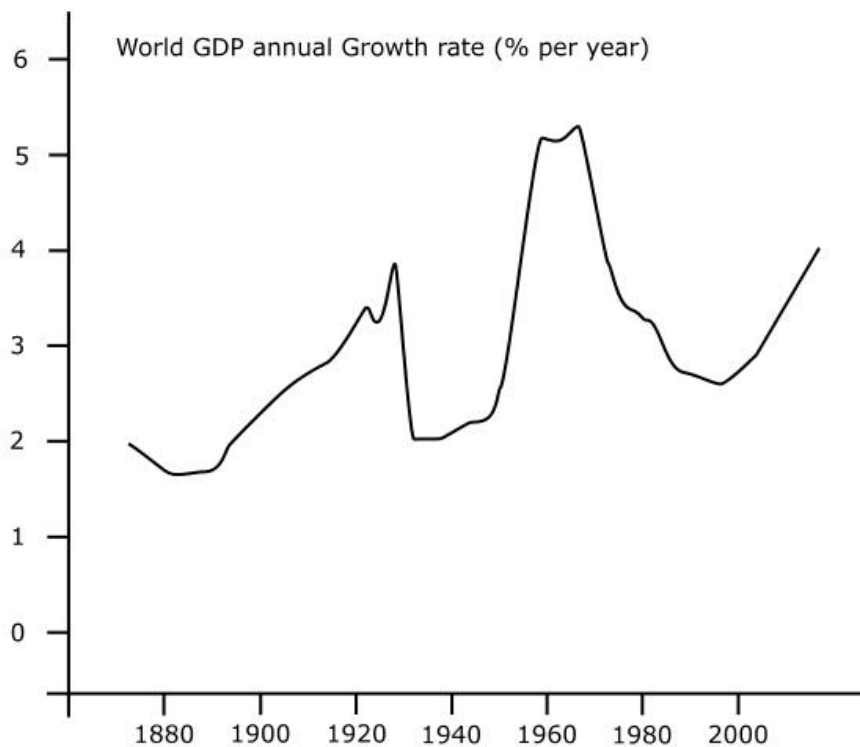
We would like to remind at this point that the free market economy is an economic system that, even though it does not stipulate specific morals for market participants, does not work without morals. To be able to work efficiently, the free market economy needs honest business people, incorruptible officials and politicians and unbribeable journalists and scientists.

### **Final Remarks**

A Kondratieff cycle represents a unique historical process. The fact that the sixth Kondratieff has already begun was proven on the macroeconomic level by Korotayev and Tsirel with the world gross national product (Illustration 11).

At the innovation level, each Kondratieff cycle has its very own pattern of development, produces new protagonists and satisfies new needs of people. What is so special about this sixth Kondratieff? What makes it so different from the previous cycles?

The sixth Kondratieff is a health-related cycle. This means that for the first time in history, the focus of economic and social development is not on a machine, a chemical process, energy or hardware technology, but rather the human being with his physical, mental, psychological, social, ecological and spiritual needs, problems and potential. We leave the growth patterns of previous Kondratieff cycles behind. Now the human being takes centre stage. This is the message of the sixth Kondratieff: the healing of man is the best program for the future.



**Illustration 11.** The development of the world gross national product.

Source: Korotayev A. V., and Tsirel S. V. 2010.

## Appendix

In economics and policy there are two main schools that dominate the discussion: the liberalism or neoliberals on one side and on the other side socialism, Marxism or social democracy. They differ from each other in the way they value the role of the state.

The theory of Long Waves is different to that. It is instead about basic innovations that will unlock huge needs in the society. The role of the state here is only to ensure that basic innovations are able to unfold dynamically and in a social responsible way. This means that there can be a huge intervention necessary from the state or only barely. The state obtains from the basic innovations concrete information where to invest, where to lighten up the regulations for investments, what kind of new laws became necessary and so on. Such concrete indications cannot be offered from any of the economic schools.

Today's problem is in fact that nobody knows how to invest the massively available money to achieve an upswing in the real economy. What it also needs is not only money, but instead groundbreaking innovations, basic innovations, because they trigger a significant increase in productivity and a long lasting upswing. Productivity is for the industrialized countries the most important source for growth. So far cheap money only created bubbles and meanwhile is going to create them again in the U.S.A, Europe, Japan and China, just because they do not realise where the new basic innovations lie. A special strength of the

theory of Long Waves is that the basic innovations do not create bubbles but in contrast make a long and sustaining upswing possible for the real economy.

Today the healthcare sector already makes the most important contribution to growth and employment in those countries that respond positively to the sixth Kondratieff. At 3.8 %, the health care sector in Germany, for example, grew almost twice as much between 2006 and 2011 than the overall economy (2.1 %) and the number of wage earners in health care was 5.7 million (2009). When you add those jobs that are indirectly allocated to the health care sector, the number of employees increases to 8.8 million. That amounted to 22 percent of all wage earners (BMW 2013; Ostwald et al. 2014). By comparison, the German automotive industry, the showpiece of German industry, only employed about 1 million people (2.5 %). Germany's sizable international reputation over the past years is closely tied to the successful devotion to the sixth Kondratieff.

The fact that the health care sector is a job creator can be also seen in the USA – even though the productivity potential of the health care sector is underdeveloped and the social potential is still being underestimated. In 2001–2012 more than half of all new jobs in the private sector were created in health care (Mandel 2008 and Our own calculations). The largest growth barrier for the USA as well as Japan and other countries is the wrong way of handling the health care sector.

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