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Waves on Waves – Long Waves on the Seven Seas

Anttiheikki Helenius

Abstract

Kondratieff waves are an interesting subject of study and describe present global economic developments. The Global Financial Crisis of 2009 and the present economic situation have parallels with the Great Depression of the 1930s. Twice-in-a-century events are occurring again.

On the other hand, many important innovations have been introduced during the last decades. These innovations have changed people's lives in a revolutionary manner and have contributed very positively to the global development.

Study of the development of seafaring supports the claim of the existence of Kondratieff waves. Important innovations and milestones of development of seafaring coincided with the upswing phases of these waves. Moods of different eras manifest also in composition of shipping fleets and flotillas.

One needs new creative approaches to solve global challenges. The study of long waves allows compelling insights and provides timeless wisdom for the study of economics.

Keywords: *Kondratieff waves, long waves, global financial crisis, maritime economics, economic forecasting, philosophy of science and economics, Schumpeterian economics, time preference of consumption, Hayekian economics, cruise industry.*

General Introduction to the Long Waves and to the Subject of This Article

For my Doctoral thesis in Economics I studied the theory of Kondratieff waves. I used that theory in the practical context when analyzing the air transportation (Helenius 2003). A special vindication could be established for using a long waves approach for analyzing air transportation. Also I have used the long waves approach in recent conference papers (*Idem* 2009, 2010).

According to several leading mainstream economists and institutions, a so-called 'once in a half-century event' may be taking place in the world economy at the present moment. During the last couple of years it was popular to draw parallels between the Great Depression of the 1930s and current economic

situation. The long waves can be described as 'once in a half-century' developments.

Economic scientists may sometimes be notorious for having very different scholarly opinions. Despite that fact, economists often emphasize approaches using almost positivist theories. Economic development is influenced by many factors, which can be controlled by rational decision-making processes. Economic development is, however, determined to a great extent by coincidental and unknown variables. Hayek in his *Pretence of Knowledge* maintains:

> …in the social sciences often that is treated as important which happens to be accessible to measurement. This is sometimes carried to the point where it is demanded that our theories must be formulated in such terms that they refer only to measurable magnitudes. It can hardly be denied that such a demand quite arbitrarily limits the facts which are to be admitted as possible causes of the events which occur in the real world. This view, which is often quite naively accepted as required by scientific procedure, has some rather paradoxical consequences. We know, of course, with regard to the market and similar social structures, a great many facts which we cannot measure and on which indeed we have only some very imprecise and general information. And because the effects of these facts in any particular instance cannot be confirmed by quantitative evidence, they are simply disregarded by those sworn to admit only what they regard as scientific evidence: they thereupon happily proceed on the fiction that the factors which they can measure are the only ones that are relevant (Hayek 1974).

Kondratieff waves are often regarded with some suspicion by some members of academic community despite supporting evidence. Nikolay Kondratieff originally found evidence for the existence of long waves and these waves were named after him. Kondratieff analyzed for instance capital investment. Half a century later Jay Forrester analyzed investment behaviour again and became convinced about the existence of Kondratieff waves.

Joseph Schumpeter (1939) explained the waves by clustering innovations, periods of creative destruction and the role of entrepreneurs. Manfred Neumann (1997) wrote that changing generations possess different rates of time preference and that behaviour generates the long waves. Carlota Perez (1985) has spoken about changing techno-economic paradigms and changing technological styles, which characterize different eras.

In the big picture, different styles have followed each other in many areas of life, also including arts or architecture. World views, political orientation, strive for self-seeking and zeitgeist have changed over time. Different basic innovations have characterized different eras.

Each era had its own pioneering entrepreneurs. Periods of prosperity alternated with periods of creative destruction. 'Waves on waves' – waves of different length riding on each other – do exist according to Schumpeter.

Statistical research of long waves is complex and distortions may obscure the determination of turning points. Reijnders (1990) and other researchers have brought the merit of showing long waves in a statistical analysis. Forrester found undulations corresponding to long waves with his simulation model as he was not specifically looking for long waves. These statistical analyses have improved the argumentation. There has been discussion on the role of GDP statistics for long wave research, Nefiodow (Thomas and Nefiodow 1998: 324–325) has pointed out that innovations do not necessarily manifest appropriately in GDP data.

A more scientific-philosophical discussion on the role of Kondratieff waves might be important. An interesting notion about long waves comes from Don Roper:

> Various studies have questioned the existence of K-waves and even Kondratiev sees himself … as providing evidence for the 'long wave hypothesis' … This approach … is methodologically flawed. Long waves are not 'out there' in the world for us to find or not find … A long wave is a conceptual category for interpreting the data. The easier it is to see such waves in the data, the more compelling the category. But the real test of this theoretical construct concerns whether it facilitates predictive power (Roper 2011).

In my own work I understand long waves as a conceptual category, which allows an interpretation of projected data in a framework, which is different from many usual frameworks and allows creative analysis and understanding.

Full agreement on periods of long waves has not been established although many common elements are recognized. Historic crises like the Great Depression are facts, but their interpretation can differ. However, there is a significant agreement on the post-World-War-II upswing period of economic development among scholars of different schools.

Works by Neumann, Schumpeter and many others have influenced my own view of the waves. Thinking in long waves has advantages and weaknesses; I would like to emphasize a strongly symbolic meaning of this scheme for understanding economic and societal development. Cesare Marchetti has written that he can be satisfied only with an explanation of long waves as changing periods of moods (Marchetti 1998: 54). The idea of moods has been mentioned by other scholars, too, and it comes close with ideas behind Neumann's explanations in my opinion. Moods are connected with the domain of psychoanalysis and Marchetti has suggested further research also in that field (*Ibid.*: 113).

Revolutionary new technologies have emerged from the 1990s onwards and are mostly regarded as heralds of a new era. Internet, mobile phone and application of these and related technologies have changed our daily life in a positive way in many different spheres of life. Travel industries and international networking have benefited from these developments significantly.

Perez has coined a concept of mismatch between technological development and institutional development – that mismatch may be of critical importance for explaining the weakening tendencies of economy (Perez 1985).

Such a mismatch may be regarded an important cause of current global problems. Socio-institutional weaknesses or grave bureaucracy may slow down aspirations of individual scientists or entrepreneurs. On a large scale socio-institutional weaknesses, 'mismatch' or wrong understanding of economic development may even cause or facilitate financial misery and crisis. A moral hazard gets established in a society, where incentives and responsibilities are not in balance. One may argue that all these factors together with other causes of downswing shape the economic climate at the moment.

The new technologies and, on the other hand, economic or financial crisis are mostly mentioned when speaking about long waves. Our present age possesses all these components including the revolutionary technologies and economic downturn. The transformation of Russia and Eastern Europe and the emergence of new wealth in these countries can be described also as a Schumpeterian change in the framework of long waves.

In recent years, it has been popular among economists to draw parallels with the Great Depression of the 1930s. Any twice-in-a-century event opens up interpretations in the long waves context. A global financial crisis is often regarded as having burst in flame as the Lehman Brothers investment bank went into bankrupt in late 2008 although Lehman of course did not cause the downturn alone. Global economies recovered first, but developments especially in Europe have brought the greatest fears back again. Daily newscasts are full again of news concerning the economic situation with Greek debt and the problems of banking sector which are at the moment most important issues.

The global financial crisis damaged the credibility of mainstream economics at least in eyes of broad public and laymen, who always expect certain correct anticipations also from economists. The crisis had taken most leading economists and scholars more or less by surprise. An article published worldwide in tabloid newspapers told a story about a parrot making better investment decisions than a professional economist. This anecdote reflects the abrupt dissatisfaction people had with the narrative of economics.

In the present article, I will take a look at marine transportation, especially at passenger services, in the context of the long waves. One can say that modern sea transportation started with the first long wave. The important basic innovations shaping that industry were initially introduced mostly during

the long wave upswings. Steam engine was one of the great basic innovations in economic history and networked the mankind in an unprecedented way. Globalization was accelerated as passengers and cargos could be hauled more efficiently. One can also trace indicators of changing moods. Military development is generally excluded from analysis in this article.

In my paper Kondratieff waves and long waves are used synonymously whereby the spelling Kondratieff in accordance with Schumpeterian writings is used. This essay was written in a relatively short period of time. A prolonged period of study was not possible. My studies of long waves and maritime economics combined with long-lasting interest of seafaring form the basis of knowledge. I strive for contribution of new recognitions, impressions and understanding of long waves.

Kondratieff Waves

It is useful to adapt a scheme with exact description of the periods of long waves, so that developments can be observed in a framework. Adaptation of such scheme is not intended as an ultimate statement about exact running of the waves. I use combination of periods brought forward in works by Schumpeter, van Duijn and Mager (Schumpeter 1939; Van Duijn 1983; Mager 1987).

Table 1. Kondratieff long waves

Kondratieff waves	Upswing period	Downswing period
First Wave	1787–1813/14	1813/14–1842/43
Second Wave	1842/43–1872	1872–1892
Third Wave	1892–1929	1929–1948
Fourth Wave	1948–1973	? (1973–2003)
Fifth/Sixth Wave	?	?

Kondratieff Waves and Waterborne Transportation

I am not familiar with any large studies on the relationship between long waves and waterborne transportation; shorter analysis on that relationship can, however, be found in literature.

Freeman, for example, recognizes infrastructure improvements of ports, canals, ships and towed barges during the first wave and notes that iron was a key factor of the era. Freeman notes how the second wave brought the steam-engine and steamship and the third wave – the steel-ships (Freeman 1998: 139). Volkmann recognizes shipping as having a predominant role for the second wave and marks the introduction of steel during that period (Volkmann 1998: 223).

Tinbergen discusses a life cycle or lag cycle for pigs, coffee and ships:

> After a year of high freight rates more new ships were ordered, and after about a year these vessels were launched. Thus they tended to depress freights, and would continue to do so as long as they kept run-

> ning – on an average about 17 years for a Dutch shipowner, often succeeded by low-cost operators for another 17 years. A mathematical analysis reveals that the resulting waves have a length equal to about four times the time lag involved (Tinbergen 1984: 15–16).

Nakicenovic has studied the steel production and merchant marine fleet in the long wave context (Nakicenovic 1987: 81–86). According to him improvements of engineering allowed a growth of the size of ships: 'In fact, the number of vessels remained practically constant from the late eighteenth century until the 1940s at about 25,000 ships, doubling during the last three decades. During the same period the total registered tonnage of the merchant fleet increased by almost two orders of magnitude, implying that the average vessel is about 100 times larger today than in 1800' (Nakicenocic 1987: 84). According to Nakicenovic steamers counted for 1 per cent of the total tonnage in 1819, merchant shipping was dominated by sailing ships until the 1880s and by the 1920s steamships made already 90 per cent of world merchant tonnage. His conclusion is that it took a hundred years to replace the sailing ship.

Hampton has analyzed shipping and freight rates and has written that the long wave can influence shipping; the growing tanker fleet was absorbed by the 1947–1973 upswing (Shipping cycles revisited 1996).

Construction of ships has demonstrated a tendency for overcapacities in the past. According to some estimates, the periods of overcapacities were related to the long waves.

Seafaring before the Industrial Revolution

Water transportation has always been of great importance for the mankind. Navigation skills have made international cooperation and trade possible. Hegemony of nations has been established by sea power. Despite of later developments of air and land transportation, maritime transportation still remains the most important mode of cargo transportation over long distances. Until the Industrial Revolution at the end of the 18th century that carriage was completed by sailing ships and on land by animal-driven carriages.

Passenger carriage has served several functions throughout the history including travelling for duties and for pleasure. Pleasure function has generally grown in importance and is nowadays, perhaps, the most important drive behind lots of travelling.

The story of waterborne craft goes actually back even to archetypical origins in ancient sacred texts. Noah's Ark has been described with exact dimensions in Scripture; these numbers correspond in a modern measurement to a middle-sized vessel of around 20,000 grt.

Ancient Greeks and Romans built large fleets of different kinds of vessels for different purposes and sailed to far away destinations; some of the ancient ships were very large in size.

Three large vessels and great visions of the Hellenistic period were documented in Athanaeus's writings. The vessel *Syracusia* had a length of 55 metres, used predominantly rowing technology and sailed reportedly only once; she boasted luxuries like a pool, temple, garden and library and had been designed by Archimedes. *Thalamegos* was a huge luxurious palace barge of 115 m length floating on the Nile and used by the rulers. The third vessel was called *Tessakonteres*, a huge trireme of 128 m length and built for military purposes (Athanaeus). These vessels were built around 240–200 BC. The historians have not proven their existence, although at least *Syracusia* is thought to have existed for sure. Lucian of Samosata is another author reporting large vessels, he wrote about a Roman grain ship *Isis*, of 55 m length, having been sighted in Piraeus in 150 BC.

Archaeological findings have proven the existence of several ancient vessels. Caligula's large ship was 104 m long and was used probably for transporting of an obelisk (Lucas 2006). Caligula built two pleasure barges of over 70 m length for use on small Lake Nemi near Rome. These barges were recovered in the early 1930s, but were lost during the war by fire.

The ancient ships were used for different purposes whereby pleasure was to a minor extent one of these uses. The largest ancient ships had a length exceeded only by ships after the beginning of the Industrial Revolution. Most ancient vessels were, however, of quite modest size. The ancient shipbuilders had achieved great progress. Sailing and rowing had been developed further as propulsion technologies and together with towing these technologies dominated water transportation until the first Kondratieff.

The sailing wooden merchant vessel remained in many ways similar until the Industrial Revolution – the same basic innovations were applied for construction material and propulsion. Ships were small, often less than 30 m long. A ship of 300 register tons was considered as a large one as late as in the early 1800s (Pohjanpalo 1969: 130). The largest vessels in terms of length were some naval ships like the Scottish *Great Michael* or the Hanseatic *Adler von Lübeck*, both built in the 16th century and with a length of over 70 m.

Compass is mostly regarded as an important innovation and as an important device for navigation. Compass was introduced in Europe after 1100. Mariner's astrolabe came during the following centuries. Sextant and advanced chronometers improved navigation significantly later at the advent of the Industrial Revolution.

Many important incremental technological innovations were introduced, for instance, for rigging and steering. According to marine historians these innovations took place especially during the voyages of discovery. Different types and designs of ships were developed; ships remained relatively small until the Industrial Revolution, but the number of vessels of the merchant fleets of leading countries increased significantly. For example, in the 1630s Holland had a fleet of 35,000 ships (Pohjanpalo 1969: 94).

The history of seafaring is full of remarkable voyages performed by remarkable explorers. Christopher Columbus sailed to America in 1492 and explored the new world. Knowledge of our planet was widely expanded. *Santa Maria* was Columbus's flagship and the vessel with a length of only 23 m is one of the most famous ships of all ages. The age of discovery followed from the 15th to the 18th century. Schumpeter described a new way of doing things as an innovation (Schumpeter 1961: 91). The age of expeditions was a period of great innovative endeavour.

The major scientific paradigm shift of the Copernican revolution emerged in the 16th century, followed by the Scientific Revolution and later by the Industrial Revolution. That great era of progress was characterized by revolutionary shifts of paradigms. Explorations, trade and seafaring acted as initiators for many practical developments and new accelerating developments were opened up for sea trade.

During historical eras sea hegemonies rose, existed and subsequently declined. Vikings, the maritime republics of Venice and Genoa, Hansa and Byzantine Navy were important powers before Renaissance. Portugal established itself as a leader later. Spain, Holland and England succeeded as leaders after Portugal. Alternating sea hegemonies are often referred as evidence for long-term undulations of the era preceding the Industrial Revolution. Manfred Neumann writes (Neumann 1987: 2; Modelski 1978: 214–235; McNeill 1982; Kennedy 1987):

> In the 18th century, England, overtaking its rival France, succeeded in supplanting the Netherlands from its leading position, hitherto occupied in the late 15th century by Portugal and Spain … Thus, in historical retrospect, two phenomena are clearly discernible, namely long waves of economic activity and rivalry of nations and regions for economic leadership. We shall see that both phenomena are governed by similar laws.

One should also mention many significant seafarers from outside of Europe playing an important role over centuries before the Industrial Revolution. The Asian-Pacific civilizations including the Chinese and Japanese as well as the Arabs had many important seafarers. The role of these early seafarers has not been fully researched yet.

Prior to the start of the first Kondratieff, the propulsion style had remained the same ever since the ancient times. Of course, sails had been the primary method of propulsion. Rowing technology had been common even in larger vessels and barges were towed on inland waterways by draught animals and sometimes by people. Some curious technologies had been developed already quite early. Vitruvius described the Romans' paddle-wheel vessel, powered by using moving shipboard oxen. These technologies did not become important al-

though slightly similar technologies were used much later on a minor scale for pulling barges on some rivers, for example, on the Volga. The Romans experimented already with paddle-wheel.

Waterborne Transport during the First Kondratieff Wave from 1787 to 1842–1843

Introduction of machine power to waterborne transportation occurred during the first Kondratieff wave. The steam engine changed the style of seafaring. Scheduled services could be established as machine power was introduced. Sailing times were no longer subject to caprice of winds and weather. Steam power emerged slowly and there were many important milestones and many notable explorers helping that technology to make its breakthrough, steamboats were first experimented in Europe and the USA.

Clermont is generally regarded as the first commercially successful steamship. *Clermont* took over commercial passenger services in the USA in 1807 and was the brainchild of Robert Fulton; Fulton had been influenced by other early work in that field. *Clermont* sailed between New York and Albany (Lavery 2004: 170).

Steamboats became quickly popular on shorter routes, especially in the USA. By 1813 there were 60 steamers, by 1817 – 130 and by 1839 – 700 steamers. Steamships were introduced also in Europe, in 1812 first steamer sailed in Scotland. *Elizabeth* was called the second European steamer and she overtook services in 1815 in St. Petersburg in Russia. Subsequently sailings followed in many countries. Finland was served by steamer in 1821 and the first Finnish steamer came in 1833 (Pohjanpalo 1969: 120–123).

There were ambitions for transoceanic services from the very beginning and within a few decades such services were started. Regular Atlantic crossings were introduced in 1838 by Sirius and Great Western. In 1840 the famous *Cunard Line* opened regular steamer service between the UK and USA (Vierus 1995: 44–45).

Van Duijn mentions steamship as a major innovation. He marks 1783 as the year of invention and 1838 as the year for innovation of steamship (Van Duijn 1983: 176). The year 1783 refers to the successful first voyage of paddle steamer *Pyroscaphe* of marquis de Jouffroy d'Abbans on the River Saone in France, that trip lasted for 15 minutes. The year 1838 refers to the Atlantic crossing of *Sirius*.

The steamship was invented approximately at the beginning of the first upswing. Van Duijn recognizes the Atlantic crossing as the first innovation. In my opinion, the sailings of *Clermont* and rapid diffusion of technology on shorter routes could be accepted as time of innovation. If *Clermont* is regarded the first successful use of steamship, then this basic innovation followed during the upswing. If one takes the year Van Duijn refers to, then the time of innovation

comes actually very close to the turning point to the upswing of the second wave. The first successful commercial use of steamer followed on short-sea routes during the first upswing and on transoceanic routes during the second upswing. During the intermediate downswing the diffusion was going full on some shorter routes.

The first Kondratieff is often described as the era of canals. Andrew Tylecote writes about the water style and the immense meaning of canals for improvements in transportation. Basic inventions of inland waterways, like locks, had already been made earlier in history. By beginning of the first Kondratieff, rivers had already been made navigable in many places in England and continental Europe. Canals were developed as waterways. Tylecote (1992: 42) refers to canal transportation as a cheap transport and remarks that it was widely available already in the 1770s. 'Six or eight men … by the help of water carriage, can carry and bring back in the same time the same quantity of goods between London and Edinburgh, as fifty broad-wheeled wagons, attended by a hundred men, and drawn by four hundred horse' (Smith 1976; Tylecote 1992: 38). This example makes clear the difference of efficiency of these transport modes.

According to Carlota Perez, technological style or the best technological common sense describes the most efficient and profitable techniques of production and methods of organization. Cheap by past standards and potential all-pervasiveness defines the new ideal type of style (Tylecote 1992: 36).

When waterborne transportation is analyzed, then both steamships and canals characterize the period of the first wave as dominant technological innovations with great technological value. The role of canal transportation was, however, more pervasive than that of early steamships during the first Kondratieff. Steamship emerged during the first wave and had a 'childhood' during that phase. Steamer got popular on certain shorter routes, but that technology had not yet been established on oceans.

Seafaring during the Second Kondratieff Wave from 1842–1843 to 1892

The second long wave can be described as the real breakthrough of steam in waterborne transportation. The first regular Atlantic crossings had been introduced by steamers just before the Second Kondratieff started. Ocean steamship services gained much importance on certain routes. One could describe that upswing period as the first great diffusion period of steam technology on transoceanic services. Steamship had grown now to 'adolescence'.

The innovative steamship *Great Britain* came in 1845. She was build of iron and used a screw instead of paddlewheels. With a length of 88 m she was larger than period's ships (Marshall 1995: 173). *Great Britain* marked the beginning of a new era and became a model for a new generation of liners. Brunel was the engineer behind these vessels and his next revolutionary ship was

Great Eastern with a length of 211 m and tonnage of 18,915 grt. *Great Eastern*, built of iron in 1859, was the largest ship constructed so far. *Great Eastern* was used later in 1866 to lay the first transatlantic telegraphic cable – another notable innovation of that era (Abranson 1985: 81–83).

Steamships were then built for regular transoceanic sailings linking all continents as well as for many short-sea routes. Steamship became important for passenger and mail services, cargo services followed later. The diffusion of steam technology followed on grand scale during the second Kondratieff and in the early 1880s steamships were reported as for the first time having carried more cargo than sailing ships (Pohjanpalo 1969: 136).

It is said that development of sea transportation was delayed due to existence of a so-called sailing ship effect. Many owners held an opinion that a sailing ship was better than a steam ship. The sailing ship was developed further during the steam age and the most advanced windjammers, built of steel, were introduced as late as in the early 20th century. Kleinknecht writes: '…the emergence of a new competing technology can be considerably impeded by extra efforts to improve the established technology' (Kleinknecht 1987: 121). The sailing ship effect describes a more general tendency, which exists in economic life and in decision-making although a part of that effect may be explained by cheap costs of operation by sailing ships.

Although the first Atlantic crossings took place a couple of years before the turning point of the second wave, one could describe the introduction of transoceanic steamship services as an innovation of the upswing phase of the second Kondratieff. These services were also a new organizational way of doing things in Schumpeterian sense. Most of the famous traditional steamship companies were formed during the upswing phase of the second wave. Just prior to the turning point of a new upswing a bundle of companies had come, including Austrian Lloyd of 1836, P&O of 1837, Royal Mail of 1839 and Cunard of 1840. The following companies *inter alia* were formed during the upswing: Blue Funnel, British India Steam Navigation, French Line, Hamburg America Line, Hamburg South American, Inman Line, Messageries Maritimes, Netherland Line, Nippon Yusen, Norddeutscher Lloyd, and Union Line. Within some years at the beginning of downswing some further important companies were added like Holland America Line in 1873 and Rotterdam Lloyd and Union Steamship Co. both in 1875. These lines carried passengers, mail and cargo. During the downswing of the second wave less new transoceanic companies were formed. The upswing of the third wave saw again introduction of great names, for instance from Scandinavia, Italy, Portugal and the USA.[1]

[1] Kludas 1976 is a good reference work for ships and shipping companies and lists all passenger vessels of over 10,000 grt from 1858 until 1976. This source has been used in this text for providing a list of leading steamship companies of the golden age of passenger liners.

Passenger services were introduced during that wave all over the world, the ships grew larger and higher speeds could be introduced. Most ships had several different classes on board with 1st class being often very luxuriously appointed. During these decades lots of emigrants were transported. Emigrants used mostly 3rd class accommodation, which from our modern perspective was rather inconvenient and unsafe. Basic necessities and standards had been realized for 3rd class after government legislation had imposed standards for carrying passengers (Dawson 2005: 29).

On coastal routes, steamers provided often transportation to places, which had not yet become part of railway networks. As railway-networks grew larger, many of these steamer services ceased operations although some routes continued catering for pleasure trips. Europe is divided geographically by areas of water in many places and short-sea services grew vitally important here. These services have continued up to the present. Most large rivers became steamer services too.

Military developments are excluded from this essay, it remains to be mentioned that steam engine revolutionized also naval ships and the warfare at sea.

Steam driven cargo ships transported half of the cargo by the 1880s. Scheduled services not relying on wind could be established and sailing times were reduced. These developments combined with growing vessel size improved the efficiency of operations. Any vessel could carry now a multiple amount of cargo. Tugboats started to use steam engine very early; they belonged to the first successful seagoing steamers and replaced draught animals on canals. Chain steam shipping can be mentioned as a now almost forgotten curiosity of early days of steam.

Steam powered icebreakers appeared later and allowed winter navigation. The first icebreaker, *City Ice Boat* No. 1 was used in the USA in 1837. The first European icebreaker was the Russian *Pilote*, built in 1864 and used around Kronstadt (Pohjanpalo 1978: 63–66).

Steel production methods developed rapidly towards the end of the 19th century. The cost of steel reduced dramatically as new production methods were introduced. Ships had been built of wood since ancient times. First canal vessel built of iron was introduced already in 1787. Diffusion of use of iron for shipbuilding was slow. *Great Britain* is often regarded as the first large ocean-going ship, which was built of iron. After that vessel iron started to emerge gradually with more ocean-going ships were built of iron. One could say that the use of metal hulls and building of iron ships was an innovation of the upswing phase of the second Kondratieff. Steel ships were introduced from the 1880s onwards and they became quickly very popular. By the early 20th century 95 per cent of ships were made of steel and the rest – of wood. The weight of the ship could be reduced dramatically as wood was replaced by iron and steel (Pohjanpalo 1969: 129).

The second Kondratieff was the period of a large scale diffusion of steam technology, the period of transformation from wooden ships to metal ships and

the period of foundation of many steamship companies. The paddle wheels were replaced now by screws. Auxiliary sails were, however, used still often; their use became less common by the end of the period. Many of the revolutionary new developments of the period of the second wave seem to have occurred during the upswing.

Seafaring during the Third Kondratieff Wave from 1892 to 1948

By that time, the steamship had passed through the periods of 'childhood' during the first wave and 'adolescence' during the second wave. The third Kondratieff can be described finally as the 'renaissance' of the steamship. After the third wave the steam propulsion became gradually less important in shipbuilding as motor ships emerged and became the technological common sense.

The third Kondratieff brought the largest ocean liners. Diesel powered ships were introduced during the upswing phase. Already at the beginning of the third wave the steamships carried more freight than sailing ships and steel dominated as a construction material. The Industrial Revolution had been fully completed in marine transportation. Sailing ship effect still worked and many sailing ships survived on global trade routes. The Finnish ship-owner Erikson bought the last remaining windjammers and his fleet of sailing ships was the biggest in the world in the 1930s, surviving until the Second World War. These last commercial sailings were documented in many books written by adventurers, who participated in the sailings.

The ocean going passenger ships had been growing larger and faster. The largest, fastest and most luxurious liners ran on the North Atlantic route from different European ports to New York.

The North Atlantic Blue Riband had been established as competition for the fastest crossing of the Atlantic. I would like to list a few selected winning liners with details about their speed and tonnage. This list helps one to see, how the tonnage and speed developed during the era of Atlantic liners, the presented values are approximations.

Table 2. Selected winners of Blue Riband[2]

Year of record, vessel	Tonnage grt	Speed in knots	Travel time around
1	2	3	4
1838. Great Western	1,340	8.8	15 days, 5 h
1841. Britannia	1,140	10.0	14 days, 8 h

[2] Dawson 2005: 121, 131; Kludas 1976, 3: 210, 216; Kludas 1976, 5: 52; Pohjanpalo 1969: 161–164, 170; Vierus 1995: 30, 44–45, 52–54, 144–145. Mostly listed are first record-breaking Atlantic crossings. Later these vessels often broke their own records. Numbers are approximations. It should be noted that ships measurement in grt may have changed during the lifetime of the vessel.

Table 2 (continued)

1	2	3	4
1893. Campania	12,950	21.8	5 days, 12 h
1897. Kaiser Wilhelm der Grosse	14,000	21.4	5 days, 23 h
1909. Lusitania	31,550	25.9	4 days, 12 h
1935. Normandie	79,280	29.9	4 days, 3 h
1936. Queen Mary	80,770	30.6	3 days, 24 h
1952. United States	53,330	35.6	3 days, 10 h, 40 m

In the 1970s, the British, French and Russian liners operating between New York and the UK needed 5–7 days to cross the Atlantic (ABC 1974). Today the new Cunard liner *Queen Mary* 2 sails from Southampton to New York in 7 days.

Many basic innovations of modern age were introduced during the third wave. Electricity and telegraph were among such basic innovations. These innovations were integrated also to ships and one can only imagine how electricity improved the comfort and safety onboard as gas lamps no longer were needed for light. Wireless was very practical for seafaring as contacts from ship to shore could be established. The Cunard *Liner Servia*, built in 1881, claims to be the first passenger liner to have been lit by electricity. Wireless was presumably used for the first time in 1899 in a lightship and by 1904 many Atlantic liners had already a wireless.

New methods of propulsion were introduced to ships. Steam turbine came in the 1890s; the first ship demonstrating that technology was *Turbinia* built in 1894 in England. The benefits of that technology were recognized and turbines soon started to replace piston engines especially in larger ocean-going liners. Coal firing was replaced by oil firing from around 1910 onwards. There were many benefits in using oil instead of coal. Introduction of a new fuel was an innovation. Many improvement innovations allowed ships to become ever more comfortable and efficient.

Diesel motor was a revolutionary basic innovation. In the early 1900s that technology was ready for installation in ships. Many benefits could be provided by diesels. Diesel propulsion needed less room on board, however, sometimes caused vibrations. The widespread use of diesel engines as ship propulsion followed later, especially during the fourth Kondratieff. The first large ocean-going diesel vessel was the Danish cargo ship *Selandia* of 1912.

These ages were times of rapid technological developments as innovations like internal combustion engine, motor car, aeroplane and cinematography were introduced. This era has been described as an era of optimism and joyful feelings, such sentiments characterized lives of the middle classes at least in many large developed cities. The decades of rapid industrialization during the Second and Third Kondratieff is called sometimes as Gilded Age, Belle Époque and Roaring Twenties.

A Golden Age of technological and scientific development occurred during the third Kondratieff. Social reforms were introduced and status of lower classes of society started to improve although that status does not match present welfare of population of industrialized nations. The period of third Kondratieff was also an era of revolutionary political developments, totalitarian regimes and world wars, changing the world profoundly. Finland gained independence in 1917 and economic and societal development accelerated, modern industrialization and urbanization continued until well after the Second World War.

All continents were now connected by powered modern ships. The age of air transportation had not yet begun in full and liners lived a period of renaissance as the most important means of transport. Many short-sea routes had comfortable services and winter sailings were improved by introducing ice-breakers and vessels built to ice class.

Middle and upper classes of industrialized nations had more pastimes and first pleasure cruises started to emerge slowly. The first cruise took place when the British liner *Tagus* sailed from London to Black Sea in 1843 (Fairplay… 1987: 1). The first purpose built cruise ship was built in 1900 when Hapag from Hamburg introduced *Prinzessin Victoria Luise*, named after the daughter of the German emperor (Wiborg 2000: 63). Only a couple of purpose built cruise ships were built before the early 1970s. Many liners and other ships were used, however, for cruising during certain seasons.

Some notable pleasure vessels have been mentioned in this text earlier. Private yachts were introduced early, but in the late 19th century yachts started to get popular. Steam yachts were used by the royals and the wealthy class. Russian tzar had some of the largest steam yachts, like the *Standart*. Just before the First World War broke out there were 696 steam yachts in the world, 110 of these with a length of over 60 m whereby the longest were over 120 m. The owners were predominantly the British, followed by the US (Hofman 1970: 4). That era continued until the Second World War, now promoted mainly by the Americans. After 1945, most large yachts had gone and the building boom stopped for many decades. Large yachts were in vogue during the third long wave.

A new generation of large passenger liners had been introduced starting from the late 19th century onwards and many ships of different size entered service. This development epitomized in the introduction of *Titanic*, the largest passenger ship of that time with a tonnage of 46,000 grt. *Titanic* became one of the most well-known ships after sinking in the Atlantic in 1912. Over 1500 persons died in that tragedy (Lavery 2004: 280). One made the recognition that unsinkable ships cannot be built; that recognition seems to be at least partly true even now a hundred years later. The building boom of large vessels continued and ever more sophisticated liners were built. The final stage of that era came

just before the Second World War as the largest passenger vessels were introduced. The British *Queen Mary* and *Queen Elizabeth* and the French *Normandie* were the largest ships of the world. Both latter ones had a tonnage of over 80,000 grt, both had a length of 314 m, both carried over 2,000 passengers.

Seafaring during the Fourth Kondratieff Wave from 1948 Onwards

After the Second World War a long wave upswing lasted until the early 1970s. Lots of tonnage was lost during the war and a phase of new building started. Lots of surplus tonnage from the US emergency programs existed, too, and these vessels including Liberty-ships were acquired by ship-owners. Ships of rather traditional styles were built until the 1960s with certain modernizations being introduced. Navigation was improved by the use of radars, radio navigation and later by satellite navigation systems. The 1950s were still a heyday of ocean liner; in 1957 airplanes transported on the North Atlantic more passengers for the first time.

Some revolutionary elements started emerging in the 1950s. The size of tankers grew dramatically.

The first steam tankers of the world had been pioneered by Nobel brothers on the Russian waterways during the late 19th century. Tanker *Glückauf*, built in 1886 for Riedeman is mostly regarded as the first ocean-going tanker. *Al Malik Saud Al Awal* was built for Onassis in 1954 and was a ship of a new age with tonnage of 46,550 dwt. Tankers kept growing and at the turn of the 1970s supertankers of over 200,000 dwt started to get common.

Onassis was perhaps the most famous shipowner of that time and also a representative of the growing importance of Greek shipowning. Greek merchant fleet grew and became later the largest one in the world.

The first nuclear powered merchant ship, the US owned *Savannah,* made her maiden voyage in 1962. The first nuclear powered icebreaker *Lenin* had been built already in 1959 in the Soviet Union. Nuclear power did not make a breakthrough in merchant shipping although it is widely used by naval ships. Due to environmental concerns a new introduction of nuclear merchant ships is quite improbable.

Containerization changed the transportation of cargo. The first purpose built container ships were introduced in the 1950s. The age of containerization took off at the end of the upswing period as large ocean-going carriers were introduced in larger numbers. Around 2010 about 90 per cent of non-bulk cargos of the world were carried in container transport. The largest container vessels are those of Danish Maersk Group with a tonnage of 171,000 gt and length of 397 m, carrying each 15,000 TEU containers and operating with a normal crew of 13 (Maersk Line[3]). These numbers demonstrate the efficiency of the tech-

[3] URL: www.emma-maersk.com

nology. Containers need a minimum of work force per carried tons from door to door.

Cargo rates are historically very low at the moment and globalization and world trade benefit from these rates. It is profitable to import even very cheap items from faraway places. Raw-material can be shipped from Europe even to Southeast Asia for processing, after which the processed goods are returned to Europe. The cost of shipping is less than the savings in labour costs in such case. Containerization is an important innovation of the fourth wave as it really revolutionized the transportation of non-bulk cargos. In transport of crude oil and bulk cargos large vessel size was introduced during the upswing phase.

A revolution took place also in short-sea passenger services during the upswing. Passenger ship was replaced by the passenger ferry, which now carried passengers and motor vehicles.

Finnish owners were pioneers in the ferry business and the first ferry *Viking* was acquired in 1959. From the early 1960s ferries became more widespread and from the 1980s onwards they have grown to the size of ocean liners. The ferry business has profited from geographical position of Finland and of the possibility to sell duty-free items to large crowds. The largest passenger ferries are well over 50,000 gt. Among smaller craft hydrofoils and hovercraft were important innovations of that upswing period. Hydrofoils were very popular in the Soviet Union and hundreds of hydrofoils were built and used there. Introduction of high speed craft can be seen as another innovation of the upswing period.

Last traditional ocean liners were built in the 1960s. During the oil-price crisis of the 1970s many of these vessels became uneconomic. Industry experts said then that the age of a large passenger ship was over by the mid-1970s. Cruising had not been established yet on a large scale although older liners often served cruises. Established liner companies were withdrawing from passenger trade. Notable ownership of passenger vessels was held at that time also by countries like the Soviet Union or Greece.

The modern purpose built cruise liner represents an important innovation, introduced at the end of the upswing. Schumpeterian entrepreneurs from Norway and Israel were pioneers of modern cruise industry. These newcomers later acquired many competitors and established themselves as huge leading cruise corporations of the new era. History repeated itself again as newcomers came and took over the business. One of the first new cruise vessels, *Pacific Princess*, became famous worldwide as she was featured in the TV series 'Love Boat'. Such worldwide publicity helped the cruise industry to get better established.

The actual large boom of building big vessels started in the late 1980s. Shipyards in Finland established themselves as leading builders of these vessels together with yards from Germany, France and Italy. Almost all present cruise

ships were built in one of these countries. The largest cruise vessels of the world, *Oasis of the Seas* and *Allure of the Seas* have a capacity of 6,320 passengers, tonnage of over 225,000 gt and length of 361 m. They were built in Finland. Both vessels boast many extravagancies like huge open-air gardens running almost the length of the vessel (Helenius and Pagni 2011). Already in the ancient times a garden was added to the mythical *Syracusia* ship. That same feature has now made these modern vessels unique and has given the name – *Oasis* – to one of them.

A once in a half-century event can be observed, when looking at the development of large passenger ships. The first renaissance of the traditional ocean-going passenger vessel ended as aircraft started carrying more passengers over the Atlantic in 1957. The largest vessels and high speeds had been introduced already before the Second World War. As aircraft took over the intercontinental services, the significance of passenger ships diminished and by the 1970s the industry analysts believed that the era of large liners would now be over for ever. As happens often something went wrong also with these analyses. The second renaissance started in the 1990s.

The second boom of large passenger vessels was initiated by the introduction of the *Royal Princess*, of 44,300 grt, in 1984. Built by a shipyard in Finland and named by Diana, Princess of Wales, this vessel boasted such novel design features, which later became the new common sense for building of large cruise ships. This design saw cabins built in superstructure and having balconies and public rooms being built in hull. A market survey had been carried out before that vessel was constructed. According to that survey only one ship of such dimensions would likely find enough customers worldwide. There was room, however, for many more new ships.

In late 1970s there were only three active cruise ships of the tonnage of over 40,000 gt. These were *Queen Elizabeth 2*, *Canberra* and *Oriana*. Today in 2012 there are 170 cruise ships with a size of at least 40,000 gt. Of these 170 ships, 51 have a tonnage in excess of 100,000 gt.[4]

A mass-market for cruising has been established. Cruises are still consumed mostly by the English-speaking people and Americans although they are getting very popular also in Germany and in many other countries. According to an industry organization, representing the most cruise lines, 1.8 million cruise passengers were carried in 1985. There may have been passengers not

[4] These vessels are owned or operated by the following cruise lines: Aida, Carnival, CDF Croisières de France, Crystal, Celebrity, Costa, Cunard, Disney, Fred. Olsen, Holland America, Ibero, MSC, Nippon Yusen Kaisha, Norwegian, Oceania, Phoenix, P&O, P&O Australia, Princess, Pullmantur, ResidenSea, Royal Caribbean, Regent Seven Seas, Star, Thomson and TUI. Official websites of these cruise lines are directly available through Google and contain information of vessels. Vessels are listed also on website of M. Asklander www.faktaomfartyg.se. The figures presented do not include so-called cruise-ferries or inactive vessels.

counted in that figure, so that up to 3 million people were possibly carried in 1985 (Fairplay… 1987: 3). Around 19.2 million cruise passengers were carried in year 2011 according to official statistic (Cruise Market Watch[5]). There are at the moment more cruise ships than ever before and these vessels are on average bigger than earlier. A large number of specialized small vessels have been introduced to expedition voyages and river cruises.

A twice-in-a-century event has been taking place also in the ownership of large private yachts. The first boom lasting until the Second World War was mentioned earlier. According to my estimate in 1979 there were around 10–12 yachts of over 70 m length in use worldwide (O'Boyle 1992). A building boom took place and in 2012 there are already 137 yachts with a minimum length of 70 m (Superyachts[6]). The boom seems to be continuing even despite of economic downturns. The largest one, the *Eclipse*, is of 163 m length and another yacht with even greater length is being built at the moment for an unknown owner. *Eclipse* is owned by the Russian industrialist Roman Abramovich. Mostly Arabian royals, Russian industrialists and the US superrich own nowadays the largest yachts. These vessels are also symbols of unforeseen and sometimes very surprising evolution of economy.

Some Conclusions

If compared with the 1970s, there are now huge fleets of large cruise ships and large private yachts. That fact indicates that consumption is on a rather high level among middle and upper classes of the wealthy nations, especially if comparisons are made with the 1970s. A similar tendency to consumption, especially for high-end luxury consumption, could be observed in some cases before the Second World War.

Tendency for consumption describes a specific mood. Such tendency can be described as a rate of time preference for consumption, like in Neumann's theory of long waves. A tendency for high consumption can be observed during downswings and a tendency for savings during upswings according to Neumann. Consumption of cruises is a good indicator for mood and preferences. Luxury consumption has generally grown after the 1970s. The distribution of wealth is at the moment more uneven than several decades ago and that circumstance probably promotes consumption. Due to government actions more credit has been made available lately and getting financing has grown easier over the years; that fact may have influenced investment and consumption behaviour.

Travelling has, of course, many beneficial effects for travelers and for employees in many associated industries from more traditional tourism to shipyards. All types of travelling have grown much; cruises are a good indicator for

[5] URL: www.cruisemarketwatch.com
[6] URL: www.superyachts.com

the development of whole tourist industry. Innovative services like those of budget airlines have made tours accessible to wide ranges of people. One says that travelling widens your horizons and promotes international understanding. In that sense growth of travelling has brought new opportunities for people. Economics defines travelling, however, as a luxury product; one can conclude that travelling as luxury consumption is now available for more people from many more countries whereby consumption is, of course, simultaneously on a high level.

One can conclude that the development of shipping indicates that basic innovations of seafaring were introduced mostly during the upswing phases of the long waves although large scale diffusion continued during the downswing. Results of the observation of developments of seafaring support the hypothesis of the existence of long waves at least when Schumpeterian innovations are taken in consideration. High levels of consumption may be interpreted also as certain signs of present downswing tendencies. Consumption if not on a sustainable basis, as well as growth fuelled by excess of financial opportunities and by overcapacities may turn out to be a problem. Apart from tourism one can remark the growth of efficiency of cargo shipping with positive impulses for world trade.

The existence of long waves is determined by big picture developments on the levels of macro economy and innovations. The developments of seafaring are marginal, but they are good indicators for more general developments, for economic climate and for moods; observation of developments of seafaring provides recognitions, which may be of a compelling category. Indicators for twice-in-a-century events and for the existence of Nikolay Kondratieff's long waves do exist.

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