Working Paper

**DYNAMICS OF THE FOREST SECTOR:
PROBLEMS AND POLICIES**

Wolf Dieter Grossmann
Lars Lönnstedt

August 1983
WP-83-72

International Institute for Applied Systems Analysis
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FOREWORD

The objective of the Forest Sector Project at IIASA is to study long-term development alternatives for the forest sector on a global basis. The emphasis in the Project is on issues of major relevance to industrial and governmental policy makers in different regions of the world who are responsible for forestry policy, forest industrial strategy, and related trade policies.

The key elements of structural change in the forest industry are related to a variety of issues concerning demand, supply, and international trade of wood products. Such issues include the development of the global economy and population, new wood products and substitution for wood products, future supply of roundwood and alternative fiber sources, technology development for forestry and industry, pollution regulations, cost competitiveness, tariffs and non-tariff trade barriers, etc. The aim of the Project is to analyze the consequences of future expectations and assumptions concerning such substantive issues.

The research program of the Project includes an aggregated analysis of long-term development of international trade in wood products, and thereby analysis of the development of wood resources, forest industrial production and demand in different world regions. The other main research activity is a detailed analysis of the forest sector in individual countries. Research on these mutually supporting topics is carried out simultaneously in collaboration between IIASA and the collaborating institutions of the Project.

The purpose of this paper is to serve as a background paper both for detailed national forest sectorial analysis as well as for the analysis of the global development. The paper discusses substantive issues related to the evaluation of the forest sector. A set of policy alternatives for coping various problems (in particular those related to dynamics) have been discussed as well.

Markku Kallio
Project Leader
Forest Sector Project

ABSTRACT

The dynamic behaviors of the forest sector are generated by the acting together of economic, ecological, social, and biological parts. characteristics and by geographical distribution such as of the forest industrial complexes, of the resources, and of the customers. These dynamics are influenced by and in turn are influencing factors such as wood availability, possible uses of wood, processing technologies, and economic activities. The first chapter of this paper deals with how to depict and how to evaluate such interrelationships and changes causing both problems and opportunities for the forest sector.

In the discussion of the uncertainties in the future of the forest sector and of possible actions, it is necessary to specify different possible future dynamic developments for the above mentioned factors. This is done in some scenarios in the second chapter. The impacts of these factors and their future dynamics impacts can be evaluated with respect to cost competitiveness and wood availability for the individual company as well as for the structural change of the whole sector, for example, with respect to the location of the forest industry and the characteristics and distribution of the forest resources.

A set of scenarios as a base for discussions with representatives of the sector can serve to find out the desirability of those developments and to help specify actions to change the undesired developments. At the end of the paper some actions are listed to deal with poor cost competitiveness and shortage of wood.

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DYNAMICS OF THE FOREST SECTOR: PROBLEMS AND POLICIES

Wolf Dieter Grossmann and Lars Lönnstedt

DYNAMICS OF THE FOREST SECTOR

Forests and its products are among the most valuable resources available to mankind. Forests supply raw materials for many products and provide many services such as opportunities for recreation. But forests must be managed carefully. The use of the forests all over the world has always experienced large structural changes due to development of society and technology. Economic fluctuations also have a substantial impact on the forest sector. The utilization of forests has limits; increasing demand and limited forest resources easily come into conflict. Until now, experience has been the experience of mankind. Hence transition towards a balanced utilization is difficult. This transition is further complicated by the irreversibility of the destruction of virgin forests in many countries which happens either due to conflicts in land use (agriculture, settlements, industry), or due to desperate striving for fuelwood and resulting in over-exploitation of the forest resource, e.g., Sahel region and Nepal (Eckholm 1975).

A short general overview of problems facing the forest sector in developed countries can be found in Andersson (1982). For developing countries see Buckingham et al. (1983). Some of these problems change rather fast, as the use of the forest all over the world has always experienced large structural changes due to development of society and technology. Economic cycles also have a substantial impact on the forest sector.

1. Forest Resources

An upper limit for supply of wood raw material is set by the land area available for forests. This limit is, on the one hand, decreased by deforestation due to growth of settlements and economy, due to expansion of agricultural areas and overexploitation of the forest resource (by harvesting of fuelwood or other cutting), and on the other hand, increased by afforestation, new or more intense silvicultural techniques (Farnum et al., 1983) and more efficient use of the raw materials (Weeks 1983).

Increasing demand will become bounded by this dynamic upper limit enforcing a transition towards a dynamic state of fluctuations around an equilibrium between supply and demand. Some sources predict a 50% increase in demand up to the year 2000 (see Table 1).

In Scandinavia, this upper limit of use of the forest resource has been reached; some sources say forests are in full use on a sustained yield basis (Ryti 1981), other sources deny the sustainability of the use there (Global 2000). At best, a limited expansion in yield seems possible.

In Western Europe there still is some growth potential. Afforestation is done or planned in Spain, Great Britain and several other countries. Ryti (1981) predicts that Europe as a whole might become more and more dependent on imports of forest products, whereas FAO (1976) says that "forest is one of the few major natural resources in which Europe can expect to remain reasonably self-sufficient."

In North America there seems to be additional growth potential. The U.S. South is an area with a well developed economy and industrial infrastructure. According to Ryti (1981) rapid expansion of the forest industry seems likely, according to the US Forest Service (1974), the US commercial forest area will be 6 million hectares smaller by the year 2000.

Table 1. Wood removals and potential increase by region (Removals include merchantable wood, residues and non-commercial wood. Source: Ryti 1981).

Region	Removals 1970	Removals 2000	Total increase 1970-2000	Annual increase
	— mill. m^3 ub/a —			%
Scandinavian (Finland, Norway, Sweden)	128	136	8	0.2
EEC	78	102	24	0.9
Western Europe outside EEC	74	91	17	0.7
US South	184	286	102	1.5
Canada, British Columbia (softwood)	68	83	15	0.7
Brazil (hardwood)	13	50-90	37-77	4.5-6.5
Indonesia (hardwood)	13	40-60	27-47	3.7-5.1
Western Africa (hardwood)	15	20-30	5-15	1.0-2.3

Some developing countries, in particular Brazil in its more temperate southern (Savannah) parts, have a considerable potential for expansion. Any expansion there can only be based on plantation forests. Plantations have been started, but the infrastructure for harvesting and transport is not available. Here, as in many developing countries, the future availability of forest resources depends on government development policies, as well as on afforestation policies aimed at participation of the population. ("Forests for the people" or "social forestry"). Participation of the population is most important for densely populated countries, e.g., most of the South-east Asian countries. Hence, it is in Brazil, for instance, only important in only a few regions. Eckholm (1975) reports about successful afforestation programs in South Korea and India. In India, this program seems to have spread from only Gujarat (Eckholm 1975) to the whole country (Buckingham et al. 1983).

The discussion up to now should have revealed that even for developed countries, there is considerable uncertainty about the future supply of forest resources. Even the forecasts for afforestation and deforestation can change considerably within the next few years. Given these changes, the most recent figures are not always the best ones.

The figures in Table 1 are furthermore uncertain due to factors such as changing attitudes towards forests or possible environmental impacts and large scale breakdowns. For example, many private forest owners in Scandinavia, Western Europe, and in parts of the USA have decreased harvests far beyond sustainable yield (Schneider 1982; Seppälä 1982). An example for damage by pollution is provided by West Germany: 560,000 ha of forests are visibly damaged by pollution, that is 8% of the total forest area (Wentzel 1982). The area of forests damaged less than visible is naturally even higher. Future expectations are bleak, for example the Prince Bismark Forest Administration projects the total death of the famous "Sachsenwald" within 15 years. At present, this forest is not damaged much above average (Fürstlich Bismarksche Forstverwaltung 1982). Ulrich predicts a 50% breakdown of all forests in West Germany by the year 2000 (Johansson 1983). Forests damaged by pollution often are susceptible to pests, windthrow and snowbreak. Mayer (1977) reports about "exponentially increasing large-scale catastrophes in monoculturous plantations" in Austria. In the 1960s and more so in the 1970s there have been damages on hundreds of thousands of hectares due to such events in West Germany (Brunig 1981). Sometimes the forest industry increases this danger as some of the present forest resource upgrading processes (in particular production of pulp and paper) generate large environmental problems.

The upper limit for consumption of forest resources is extended by recycling. Some wood products have a short lifetime. In principle all wood products can be reused quite often. Recycling may increase the availability of forest resources several times. Japan has increased her recovery rate for paper and paperboard from 34.2% in 1960 to 47.3% in 1981, in absolute figures from 1.47 million tons to 8.04 million tons (Japan Paper Association 1982). When fibers finally become too worn out for recycling their energy content may still be used, for example by burning or for generation of biogas or to support decomposition of sludge.

2. Use of Wood

Throughout history wood has been used for many purposes and we have probably not seen the end of all possible uses The earliest uses of wood were for energy and construction. Later on paper and paperboard were developed for storing and transferring information and for shielding and carrying other products. In recent years fiber board and particle board have become available on a broad scale. These different uses of the forest resource compete with each other in a situation of limited raw material supply causing a steady redistribution of the resource within the forest sector (Figure 1).

It is an undeniable fact that a physical limit on wood supply exists and that in some areas for example in North America and in Scandinavia, use of the forest resource is close to this limit (compare Section 1). Therefore the reallocation of wood between different uses will as well be an important process in the future and will impose a dynamic boundary on any increase of use of wood for a specific purpose, for example, for energy production. (The introduction of energy forests may loosen this condition significantly, but then conflicts in land-use and/or ecological problems may occur.)

Moreover, forests are fulfilling many more objectives than only providing raw material. Examples are ecological services like preservation and purification of groundwater, protection of soil, preservation of wild life, or societal services like providing recreational areas and tourist resorts (TIME, 1973, Brunig 1976, Clawson 1978, Krutilla and Haigh 1978, Grossmann 1979, Andersson 1982, Buckingham et al. 1983).

All these products and services are on different stages of their life cycle. Ecological and societal services often are on a very early stage. The stages also vary from region to region and from country to country. Depending on the stage, certain markets give better profits and increase more rapidly, gradually acquiring a higher share of the raw materials. Demand will be satisfied up to that level of output which still covers costs or that is required by law in the case of societal services. This level changes with the existing production capacity and the production costs per unit. This consideration is partially also true for the societal and ecological use of the forests. This is expressed quite well in a title of an article by Bowes and Krutilla (1982): "Multiple-use forestry and the economics of the multi-product enterprise". The demand for "products" such as recreation has increased considerably in nearly all developed countries.

In the raw material sector, wood competes with many other materials. For construction, aluminum, steel, bricks, concrete, gypsum and plastics compete with wood. Even more competing materials will be developed. The alternatives differ in properties and prices. The cost of production of the materials, as well as the cost in using them and the cost of maintenance are of importance. Inside the wood market, fiberboard and particle board are competing with sawnwood. For the main uses and competing materials of tropical wood see Table 2.

Competitive substitutes will not necessarily be materials. Telematics can (and does) replace paper but at the same time computers have created additional demand for paper. The French Post Office has started to replace telephone books by telematics terminals (TIME 1982).

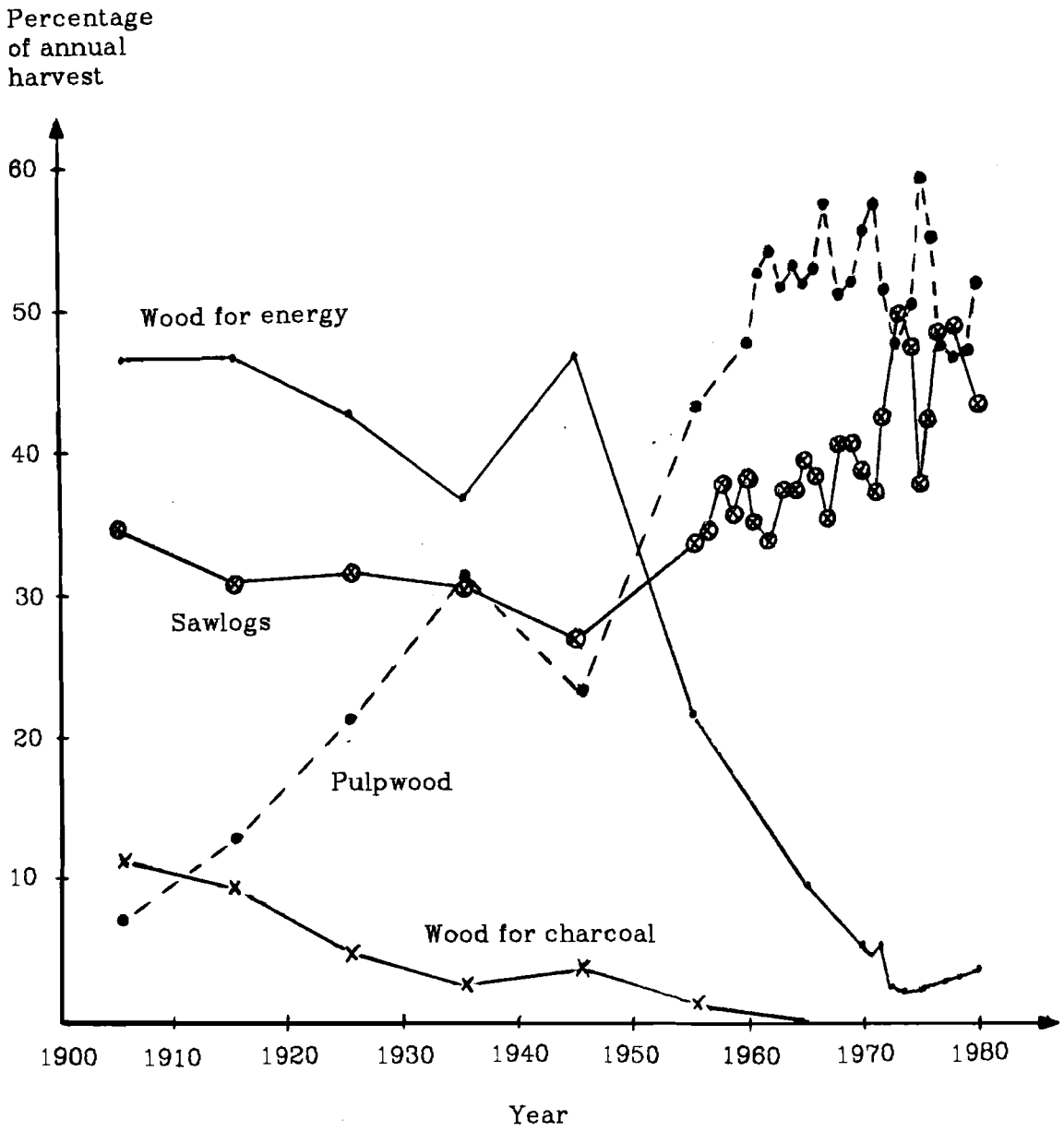

Figure 1. The distribution of annual cut between different uses in Sweden, 1906-1980. (Sources: Arpi 1959, and SOS Annual Forest Statistics.)

Table 2. Tropical wood products, main uses and substitutes (source: Kumar 1982).

Wood product	Main uses	Wood substitutes	Non-wood substitutes
Sawnwood	Construction (structural building elements, flooring, walls, joinery, panelling, scantling, lining) Engineering (bridges, wharves, piers, piling, railway sleepers, mining timbers) Packaging (boxes, crates, pallets, dunnage) Manufacturing (furniture, boats, toys)	Veneer, plywood (mainly in panelling, joinery, furniture, flooring) Paper, paperboard and fiberboard (mainly in packaging and particle-board)	Concrete, bricks steel, aluminum (construction, engineering) Plastic (furniture, packaging)
Veneer and plywood	Construction (walls, doors, decorative panelling) Packaging (crates, boxes, tea chests) Manufacturing (furniture, boats, caravans)	Sawnwood (as above) Paper overlay (panelling and packaging)	Polyester overlay, fiber-glass, concrete (construction), plastic (manufacturing and packaging) Steel, aluminum (construction)
Particle-board and block-board	Construction (building elements, walls, panelling, weather boarding) Manufacturing (furniture boards) Packaging (boxes, crates)	Sawnwood, veneer and plywood (packaging, construction and manufacturing)	Steel, aluminum and concrete (construction) Plastic (furniture and packaging)

Information can either be provided on paper or via telematics on a screen. People need the service or the function, not a special form how this function is fulfilled. More concrete: people need the information, for example the telephone number, not the paper, and they prefer the most convenient way for fulfillment of this function (Vester 1976). Utilities in the US have started to supply the service of "keeping warm a customer's house" by either supplying energy (e.g., gas or electricity) or supplying less energy but insulate the house, control air exchange, etc. The customer is billed for the total "service" not for its specific form. The service

principle is of utmost importance, as it can effect a total substitution of one resource.

In many countries appreciation of books, magazines and newspapers is decreasing, while that of video, personal computers and telematic-based information is increasing. To survive this scene of functional replacement, many publishers have established or bought video distributors. For example, the publisher McGraw Hill has bought out "the Source" the largest corporation which supplies information via telematics.

Electronics, such as telematics, do not only compete with wood products. Instead, microcomputers and microcomputer-controlled robots can greatly ease and improve the handling of wood as it is a diverse and complicated material, compared to its rather simple and streamlined competitors like metals, glass, etc. Cheaper and easier handling may significantly improve the competitiveness of wood and wood based products.

Moreover, diverse materials such as wood-based products are often more appealing to people than more obviously artificial materials like metal or plastics. At least, this is the present trend which has a good chance to last for some time as people try to flee "alienation" and pollution by use of more natural products and by eating "whole food". Therefore, competitive and profitable new wood-based products with new life cycles are emerging, while other products like pulp and paper will decline in accordance with their present position in their life cycle. Some promising new products, for example tissue paper, may be banned for ecological reasons (von Bismarck 1981).

There has been a new interest in wood as a source of energy. Wood competes with oil, coal, nuclear, hydro power, direct solar, wind, waves, geothermal, and ocean thermal. As was mentioned before, there is also immaterial competition (by utilities beginning to to sell services such as keeping homes warm, keeping industrial processes going, providing information, etc. rather than to sell some special form of energy). This is again functional replacement which is offered in the markets as a direct competition to established forms of energy. In the energy sector the service principle may become the most effective competitor of wood for energy and at the same time it may create new market opportunities for wood. The service principle is definitely a new kind of competition as the service is often marketed by the very companies that used to sell those products, that now are in danger of being replaced by a service. One further example is the paper manufacturers in West Germany who try to participate in the information distribution via television, the so-called "Video-Text" (Becker 1983). Different energy forms differ in the cost of extraction and distribution, cost and ease of use, availability, environmental and health risks, security of supply, and efficiency of conversion and use. The total costs of a unit of energy or of the fulfillment of the respective function is one of the prime factors of competition between different forms of energy. As relative prices change, the energy sources (or the functional fulfillment) that are becoming cheaper will strengthen their relative position. From 1973 until the beginning of the 1980s, all energy sources have improved their position relative to oil. Wood became a stronger competitor in some countries and may have the potential for becoming a major energy source. In developing countries wood is the

major energy source for most parts of the population; 90% of all wood is used for energy purposes (FAO 1982).

For some products and for many circumstances it is not sufficient to look only at costs and competitiveness. For example, Hungary has banned burning of coal in the city of Budapest to decrease the danger of smog, although coal is the cheapest fuel there (Todt 1983). Some people (opinion leaders) often prefer a novel resource if it is somehow appealing to older ones even if the new resource is more expensive. In West Germany for example, solar heating of houses spreads although it is not yet competitive. Such shifts in preference away from one resource towards a new resource may open up new markets in spite of pure economical considerations (even opposed to them), until at last the new resource may even become competitive and therefore widely accepted. The shift towards renewable resources for heating is only possible if it is complemented by a drastic improvement in insulation, etc. But as insulations are widely improved specific demand decreases, and an old market slowly gets lost.

3. Technological Development

Even in times of fast and radical change, the conventional products will occupy the bulk of the markets for a long time. Therefore the future development will for some time be dominated by the past patterns.

Developments in the Pulp and Paper Sector

The development has been from use of only one resource (spruce) to use of all species for most requirements (Table 3). The use of other ligno-cellulose materials like bamboo, date palm, oil palm, rubber trees, and bagasse, esparto grass, flax shives, and other agricultural residues has become possible (UNIDO 1983; Weeks 1983) A scarcity of wood will cause an increase in the use of other ligno-cellulose materials. Use of micro biology is on the way to open up even more new perspectives for the processing of wood to pulp and paper.

Developments in the Construction Sector

As in the pulp and paper sector there has been a development from usefulness of only a few species for low quality products to usefulness of many species for high quality purposes. In general, an equivalent service requires ever less wood resources. Particle boards are already produced out of most ligno cellulose materials mentioned above (Weeks 1983). In principle, construction materials with embedded carbon fibers can achieve higher specific strength than steel, better resistance against corrosion than aluminum and with much better specific insulation against cold than bricks. The beautiful composite floor in Helsinki airport is however still too expensive relative to substitutes. Skies are an example where composite materials based on wood successfully have been utilized. Again not only price will decide about the use of such materials but as well desire for architectural individuality etc. Hence, as in the case of

Table 3. Technological development for pulp processing

Time	name	application	resource
1840	groundwood process	production of low quality printing paper	spruce
1857, 1872	sulphite process	manufacturing papers and boards of low strength	spruce
1884	sulphate process	packaging materials	all species
early 1950s	bleaching sulphate pulps	many papers and board grades	softwood and hardwood

solar heating in Germany, not economics but feelings, aesthetics, and desire for intellectual leadership may open up new markets. Such materials may reduce considerably the specific resource demand. But burning of materials containing carbon fibers causes pollution similar to Asbestos: both fibers are capable of triggering cancer, so recycling becomes a must (TIME 1978b).

4. Fluctuations of the Economy

During most of the 1970s and the beginning (at least) of the 1980s discussions and newspaper articles gave the impression that the problems of the economy and of the forest sector in particular were novel; unique and very difficult. With an increasing pace sector after sector developed for the worse; costs rose and the new economic upswing which should finally restore the profitability of all branches and of the forest sector sometimes seemed to come but never did. Only very slowly does this long economic slowdown forge human memory to recall past experiences.

In this chapter the view is taken that the economy has overlapping and interfering cyclical behaviors. Three different types of cycles are discussed in the literature; (i) capital sector cycle (40-60 years), (ii) investment cycle (15-20 years), and (iii) business cycle (3-6 years).

(i) Capital Sector Cycle

Historical analysis shows a very long economic cycle with 40-60 years' intervals between two booms. Every boom is followed by a 20 years' decline with negative or at best low increase in GDP. The latest example is the long decade after 1920 with the 1930s as the turning point. The increase during the following 30 years reached its top in the late 1960s and early 1970s. If the historical trend of a 60-year cycle

continues, the economy will be depressed for 10 to 20 more years. The expectation of depressed economy is not only based on this trend, but also on analysis of innovation patterns by Schumpeter (1934), and Mensch (1975), elaborated by Marchetti and Nakicenovic (1979) and empirically widely ascertained by Marchetti (1981, 1983). Analysis of innovation patterns as well as the results of dynamic models (Forrester 1976, 1978, Graham and Senge 1980, Robinson 1982), exhibit strong reasons for a long term economic cycle whose downswing has now occurred and will last several more years. Marchetti (1983) and Brody (1982) present reasons that this downswing may last until about 2000.

In the 1920s the Russian economist Nikolai Kondratieff empirically and statistically distilled time series quantitatively supporting the existence of the long term cycle (Figure 2) overlaid by shorter cycles and irregular events. In 1926, Kondratieff predicted the crisis of the 1930s and the following long term economical growth.

Therefore the capital sector cycle is also named Kondratieff cycle. It has the same phase in different countries. The peaks of the cycle have been around 1815, 1870, 1920 and 1970 with the bottoms 15-20 years later. This cycle seems fairly regular although it is a very complicated phenomenon: the bottom of the cycle can arrive five or ten years earlier or later than expected. The situation during the late 1970s and early 1980s with uncertainty, weak increase of production, and temporarily fast increases in prices fits surprisingly well into this dynamic concept.

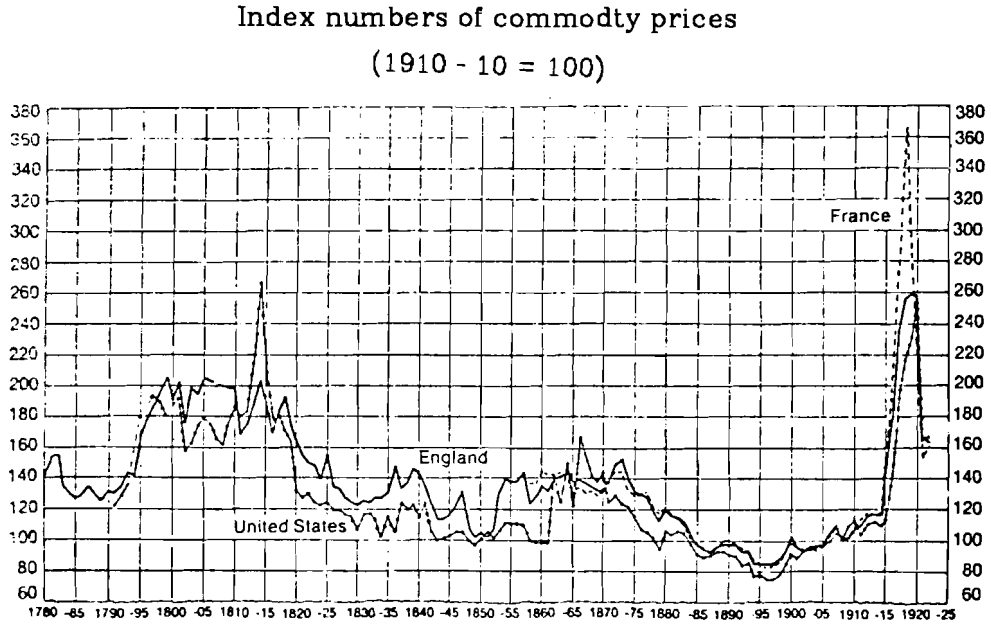

Figure 2. The development of the commodity prices 1780-1922 (Source: N.D. Kondratieff 1935).

One explanation of the Kondratieff cycle is based on the concept of "basic innovations." which caused the last four waves: cotton (1780-1840), railroads (1840-1896), automobiles (1900-1934), cheap energy and cheap credits (1934-1975). Each of these basic innovations needed a vast support industry. The industrial complex centered around each basic innovation absorbed all available capital, work force, industrial land area and human preoccupation. Although new inventions occurred quite regularly they were only competitive if they fitted into the present dominating technology. Once the dominating technology was worn out, new inventions got their first chance to successfully compete. The following text is cited from Watt and Craig (1982);

> Also, it is noteworthy that each wave seems to be stimulated by the problems and opportunities generated by the previous wave. The enormous growth in cotton transport completely supersaturated river barge and horse-drawn inland systems by about 1830; a technological innovation in goods transportation was necessary. The capacity of the train to service low-density, wide-area cities was taxed to the limit by the 1890s, and a new transportation system better geared to a real, rather than linear population distribution patterns was necessary. The car, in turn, required vast amount of crude oil. The industry that supplied the necessary gasoline could also provide feedstocks for fertilizer, pesticides, plastics, medicines, and a host of other chemicals.

The assumed acceleration of technological development has not changed the length of this cycle because the length is partially determined by human psychology and human perception.

(ii) Investment Cycle

A medium term cycle swings between about ten years of overcapacity to about ten years of undercapacity. This cycle is named after Simon Kusnetz. Its phases seem to be different for different branches — probably because of different linkages to the capital sector. The different cycles interfere, so that the Kusnetz cycle is difficult to find in aggregated statistics.

In Figure 3 the capacity and production of the Canadian newsprint paper industry is depicted. The years before 1926 and the period 1946-1956 are periods of full utilization of capacity. The period 1926-46 and the years after 1956 and the 1960s are marked by overcapacity. A boom occurred just before the middle of the 1970s. The next boom of this cycle ought to come in the beginning of the 1990s but it may be prevented by changes in the composition of the population (ratio of different age classes) and by the advent of telematics and cheap microcomputers. Some economists say that a a simultaneous downswing of the Kondratieff cycle and the Kusnetz cycle during most of the 1970s and for at least part of the 1980s,ais responsible for the present especially unfavorable economic conditions.

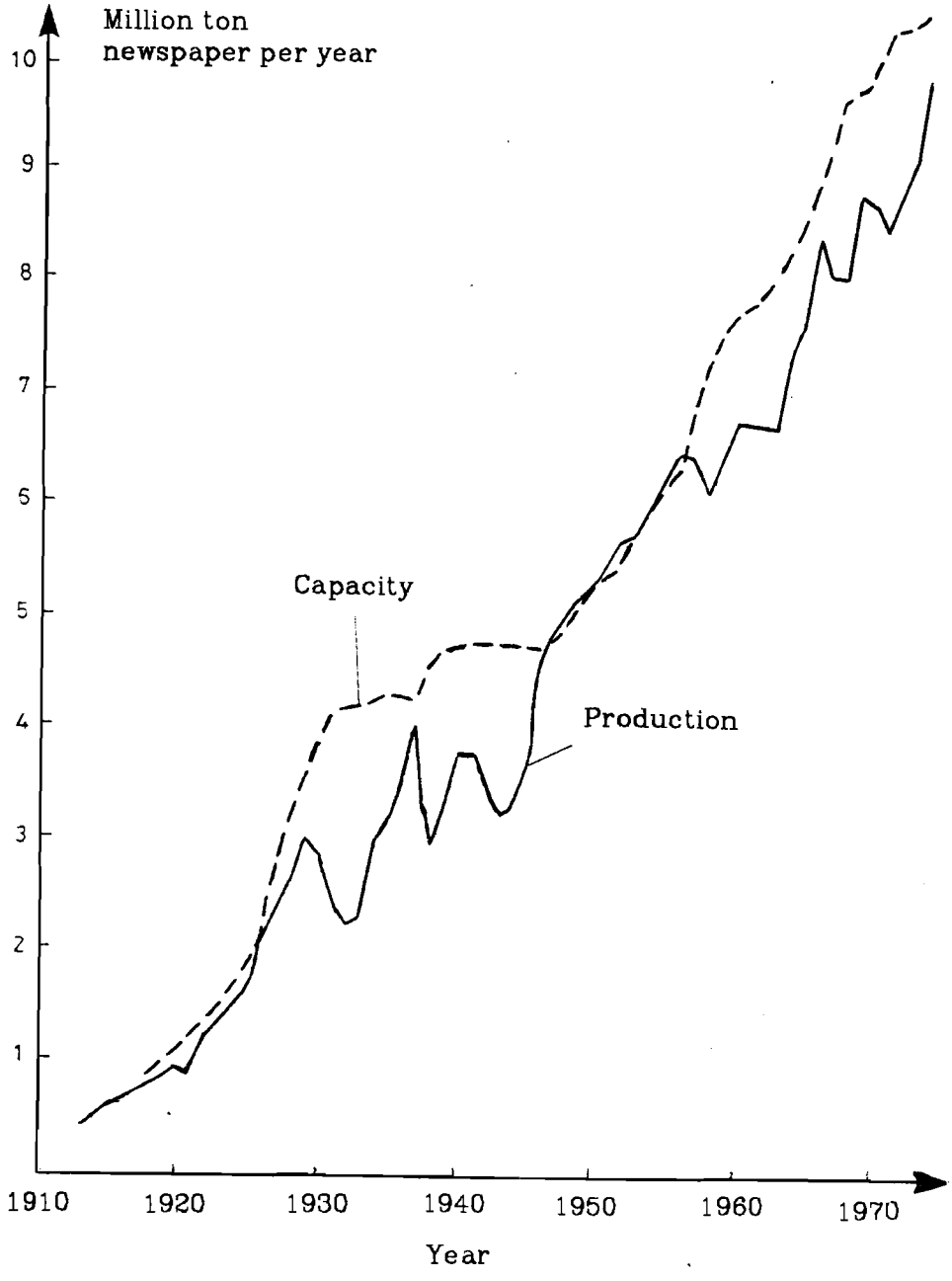

Figure 3. Development of Canadian newsprint 1914-1974 (Source: Randers, J. 1978. About the economical development within 10-15 years (in Norwegian), Bergen Bauh).

One explanation of the investment cycle is as follows: new capacity ordered several years ago (in a period of perceived shortage) will gradually come on line after 4-6 years. The volume of new capacity added increases and slowly the market moves from excess demand to excess supply. At the same time there is an attempt to control the short-term supply with capacity utilization. The addition of new capacity complicates this short-term control and causes a tendency towards inventories higher than the average of several business cycles. The result is a long-term trend towards declining profitability. This decline reveals the existence of over capacity, but due to long lifetimes of plants, immediate reaction is difficult but eventually older plants are closed down. It may take ten years before increasing demand combined with close-downs brings about a new situation marked by excess demand, by high prices, and by high profitability leading to a new wave of ordering new capacity.

(iii) The Business Cycle

The best known cycle, although perhaps the least important in the long run, is the so-called business or inventory cycle with a length of 3-6 years (Figure 4). In an economic upswing prices are increasing and inventories are decreasing. Capacity utilization reacts with an increase and usually overreacts. Eventually inventories will have become too large gradually driving down the prices. Lower prices cause lower profitability leading to lower production achieved by lower capacity utilization, and causing a gradual and finally too deep decline in inventories. Hence prices increase again and a new cycle begins. In periods of small overcapacity the changes in production are smaller because adjustments in capacity utilization are limited. The

managers first have to observe the increase in inventories. Then they have to realize that this is a lasting trend, making necessary actions to reduce the production. Correspondingly an increase in the utilization of capacity will not occur before managers have become convinced that an excess demand exists.

Every branch has its own business cycle. However, the connections between the domestic branches are strong enough for forcing the inventory cycles into similar phases. This trend has been true in the recent history and is now even more true due to increased connection between different branches. For a country with a big export share the economical ties over the boarders may be so dominating as to force the domestic business cycle into the same phase as that of the trading partners, although with some delay.

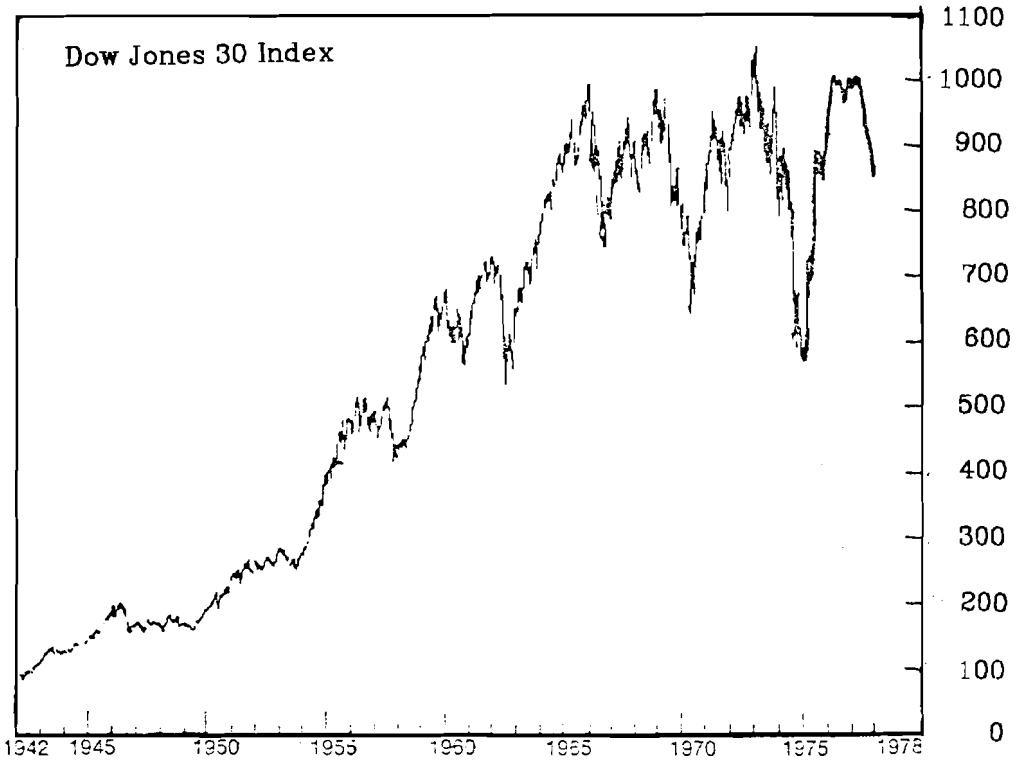

Figure 4. Development of Dow Jones share index 1942-1977 (Source: Time Magazine, 13 January 1975, Financial Times, September 1978).

SCENARIOS

It is important, after depicting factors resonsible for the dynamic behavior of the forest sector (as given in Chapter 1), to outline the expectations of the future developments and generate a set of scenarios. These scenarios support the discussions about the future of the sector and actions to control the development. In the beginning of this chapter, assumptions necessary for scenarios are discussed, then an example of one scenario is given. In the next chapter, some policies affecting the dynamic behavior of the sector will be presented.

A scenario can be based on the assumption that recent trends will continue. As the previous chapter shows, this is not likely. More likely is that scenarios for the next 20 to 30 years can be based on assumptions about dynamic developments as indicated in Table 4. Basic assumptions about both the global economic development and that of different regions and countries are necessary in order to specify the demand for forest products. Other factors to be considered are the possibility and probability of introduction of substitutes for forest products including functional replacement. Estimates regarding the development of production costs and the appeal of substitutes can improve the scenarios. New forest products, for example, chemical products extracted from forests may considerably change many conditions of the forest sector. New products are usually based on research and development, which also affect processing

Table 4. Example of assumptions about dynamics of the forest sector.

Population	Change of the population (composition, number, education, skills, wealth) Changes in attitudes, behavior and fashion Political changes
Economic activity	Change of the capital investment Change of GDP Change of factor costs (including oil prices) Exchange rates
Consumption of forest products	Functional replacement of forest products Substitutes, prices and attractiveness New forest products, e.g., medicines, oils, biological pesticides, and other chemicals Considerable increase in demand for social and ecological services
Technological development	Considerable increase in efficiency in factor use New resources (e.g., bagasse, bamboo, grass) Decrease in investment costs due to decrease in economies of scale
Forest resources	Availability, reliability of supply Increase in pollution, exponential increase in catastrophes Better control in land use Considerable increase in recreation and tourism Widespread use of management schemes such as agroforestry and forest farming

technology. (For example, will the research on micro biology provide new pulping technologies?)

The industry, especially the fiber-based industry, is capital intensive. Considerable evolution has occurred over the years in sizes of production units and their technical details, but there have been very few revolutionary changes in technology. Hence today manufacturing technology is based on well-known principles and readily available machinery. In this case, success of a company can be based on its own technical innovation only to a limited extent and more on a quick adaption of new equipment. But this may change as the capital intensity may decrease considerably if microelectronics really increase productivity of small lot manufacturing by 70 to 80% as predicted by Cook (see Hamrin 1981).

Both forest resources and wood availability are very unevenly distributed over the world and within countries. Abundant wood is only valuable if it is accessible and if fitting to existing production processes. Increased consideration must be given to the possibility of catastrophes due to a continuing decrease in the diversity of stands, due to application of narrowly optimizing management practices and increases in pollution and environmental disruptions. Pollution now damages many forests. In many parts of the world the industrial use of forests may further be restricted due to increased multiobjective use of the forest, in particular for societal and ecological services. Many forests are planted for just these reasons, in particular, for protection of watersheds.

One further factor of utmost importance are the human beings and their steady changes in attitudes, desire, and objectives. Changes in fashions have often influenced, in quite unexpected and unpredictable patterns, demand, supply, prices, production, etc. Changes may not only be short and fluctuating but instead thorough and long lasting. At about the end of the eighteenth century in some European countries the continuing deforestation slowly was reversed into a continuing afforestation. Since that time Germany for example has increased her area of densely stocked forests from a few percent to about thirty percent. Now there is a general new appreciation for forests with afforestation programs in South Korea, India, Peoples Republic of China, Australia, Now Zealand, US, Chile, Great Britain, Spain, Hungary, etc. (Eckholm 1975, Buckingham et al. 1983). In Brazil the attitude at present seems to change from destruction of the rain forests towards partial preservation (TIME 1982).

Another scenario could be based on the assumption that the forest sector of many nations will have to survive more hard years. The general economic activity will be low implying a low demand for forest industry products. On many markets and for many products the situation will be characterized by overcapacity. But wood as a renewable natural resource is valuable. Therefore regionally the competition for wood between the traditional forest industry and new users as chemical industries, biological and energy use may increase. The traditional forest industrial products will also face an increasing competition from substitutes such as telecommunication and steel rods, but due to microcomputers will also become more competitive. Due to this, the developing countries will follow another path in per capita consumption path for paper and other simple products than the industrial countries. Environmental regulations will increase.

The scenario on the global level assumes a shift of the location of the forest industry and the utilization of the forest resources away from regions that are not competitive and have low wood availability to regions that are competitive and have an abundance of wood. Patterns of trade will shift accordingly. Trade barriers will adapt to this new situation. Transport costs in general help to preserve economical niches (comparative advantage) for local producers. Within today's cost structure and distribution of wood resources, this scenario would imply a continued decrease of the pulp and paper industry in Western Europe. Considerable new capacity will be built in the southern USA and in Brazil, some new industry in South East Asia.

Rapidity and impact of this shift will be determined by the conditions of the dynamics of the forest sector. Fast business development as that of during the 1960s eases transition because it reduces frictions between employers and employees, and makes management comparatively simple. But fast development would certainly encounter societal, ecological, and resource limits. On the other hand, slow economical development, combined with hard competition from substitutes and additional ecological damages in some Western European forest can speed up a transition towards novel products and novel organization implying rapid and dramatic changes.

This scenario on the global level assumes that new uses for wood will be found. Given the present very rapid development of technology, in particular in the information sector, these will most probably be high-technology products. The structural change can be:

(i) either shift of the production of the bulk of the traditional forest products to the developing countries where labor and resources are cheap but skilled labor for the production of the new sophisticated products is not available. The wood resources in the developed countries will be utilized for producing the new products because there, skilled labor is available; or quite on the contrary,

(ii) the forest resources in the developing countries are more appropriate for production of the new products. The developed countries will continue the production of conventional products. Due to limited wood resources in Western Europe, any expansion of capacity due to increasing consumer demand will take place somewhere else, so that Western Europe does not participate in the production of the new products.

All structural changes can be supported or delayed, or prevented by political actions such as incentives for research, subsidies, or trade barriers, and customs duties.

It is most deceptive that all these scenarios of drastic change seem to be irrelevant for an individual company as long as it seems to manage to adapt to a changing environment. The president and his staff can take *ad hoc* actions to exploit the economic framework within which they are operating; the same is true for politicians. (In the next chapter we will outline such actions directed towards cost competitiveness and wood availability). Unless, however, the individual companies and the whole sector do not adapt to the main stream of change, they will end up in a kind of niche, which most probably will narrow down and eventually will disappear as did ship building in Western Europe or the production of consumer electronics, steel, etc. in both Western Europe and the US. Therefore these policies for improving cost competitiveness, outlined in the next chapter, are although important, only a first step towards survival in the present scene of change and turbulence.

POLICIES

This chapter deals with some policies which affect the development of the forest sector and may help to change undesirable scenarios. Table 5 is (i) a list of policies for improving cost competitiveness and increasing wood availability, and (ii) a list of those responsible for actions.

The present conventional economic behavior is as follows: Problems with cost competitiveness are met by policies such as -- improving the utilization of input factors (labor, wood, chemicals, and energy); decrease production costs constantly and somewhat faster the competitors; decrease processing costs and harvesting costs. This requires use of cost decreasing technology and use of the cheapest input factors, in particular continued mechanization of harvesting and silvicultural processes, and utilization of increasing scales of economies for the industrial processes, such as vertical integration. A quite different and forward-directed policy, which aimed at new products and appropriate new technology, is based on research and development.

Conventional policies that can be adopted by governments are reduction of taxes and charges for the forest sector, or direct subsidization and reduction of indoor and outdoor environmental regulations. The present environmental situation, however, already endangers the sustainability of the resource. Low economic activities have reduced the willingness and possibilities of many governments to take expensive actions. Should the economic downswing continues, governments might become totally unable to give any financial help. Trade barriers may increase, as they are a cheap way for the governments to help the industry for some shorter period of time but negative longer term consequences may be detrimental (Corden, 1971).

There exist several policies to increase wood availability —the longer the time span the more possibilities. The possibilities vary between regions.

Partially opposed to those policies listed in Table 5 are policies regarding societal and ecological issues such as ecological balance and recreational aspects. Here governments can act by legislation, regional planning, afforestation, taxes, charges, subsidies, and education of the public.

Nearly all of the above mentioned policies are of a rather conventional nature. We suspect that very different actions may be needed for decreasing those dangers observed for the environment and for using the opportunities created by technology and science. Already a new and different interest in the forests and forest based industries can be felt. The renewability of the forest resource is reappraised as one possible basis for a sustained living. Due to better understanding of complex systems and due to a new attitude towards complexity and catastrophes, novel concepts for management of the forest resource and the forest sector are emerging and old concepts are reinvented like agroforestry, vertical agriculture, and multiobjective use of forests including societal use; for example, to let forests burn in some U.S. forests ("Let 'Em Burn", TIME 1974).

Table 5. Examples of *conventional* policies directed towards cost competitiveness and wood availability.

	Policy	Responsible for implementation
Cost competitiveness	Establishment of larger economical units, integration, accelerated structural rationalization (scale changes)	Industry, forest managers
	Increase of mechanization	Industry, forest managers
	Reduction of factor prices	Forest managers, labor unions, government
	Increase of R & D	Government, industry, forest managers
	Decrease of taxes, charges and obligations	Government
	Increase subsidiaries	Government
	Introduction of tariffs, duties, and other trade barriers	Government
Wood availability	Increase of production by fertilization, use of pesticides, quicker regeneration	Forest managers
	Increase of forest area	Forest managers
	Use of fast growing species	Forest managers
	Increase of harvesting	Forest manager
	Improved utilization of fibers	Industry
	Improvement of use of increment (use of whole trees, all spices use)	Industry, forest managers
	Recycling	Industry, government
	Increase of imports, decrease of exports	Industry, forest managers Government
	Increase of R & D	Forest managers, Government

Therefore, the present severe economic decline which could last for ten more years, and the present and looming future dangers such as acid rain or climatic changes can well set the scene for new management schemes, for use of novel technologies such as microcomputers, robots, telematics, microbiology, and for implementation of new plantation policies like more diverse or (worse) much wider spaced stands instead of the old "dense monoculturous plantations causing exponentially increasing large-scale breakdowns" (extracted and translated from Mayer (1977) in a report about Austrian Forests). The same situation is true for West Germany. As these two countries have among the oldest planted forests in the world the present events there may well be the future events in countries with a shorter tradition in planted forests.

Implementation of new policies, perception of new opportunities, and development and marketing of novel products all require appropriate people, once the scene is set by the present development. Local availability of the appropriate people is crucial and depends, among other factors, on the regional attractivity towards people. Forests may play an important role in enhancing such regional attractivity. Hence, the forest sector itself has a responsibility as well as an opportunity to preserve and improve the scene in which its own future is decided.

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