Future Forests | Working Report

# Forest products markets

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*Future Forests analyzes conflicting demands on forests systems*
*to enable sustainable strategies under uncertainty and risk*

# Content

# 1. Introduction

Global net demand for forest products, influencing the profitability of the Swedish forest products industry, has fundamental implications for land-use, forest management and silvicultural decisions in Sweden. This paper elaborates on some of the major factors influencing global forest products markets, many of which are inter-related, and discusses the impacts of global forest products supply and demand on the Swedish forest sector as well as the interactions between the global markets for forest products and other drivers of change considered in the *Future Forests* scenarios.

Historical trends as regards global forest products markets are reviewed, possible developments for the factors determining forest product demand and supply and the overall implications of these developments are discussed. Following summary and conclusions, four alternative scenarios for global forest products net demand (production minus consumption) and Swedish supply are presented. In the appendix, the interactions between global forest products markets and other drivers of change considered in the *Future Forests* project is elaborated.

The current paper considers wood products only. The terms wood products and forest products are used alternately throughout the paper. Ecosystem services and wood for energy purposes are dealt with in depth in other driver papers.

# 2. Global Forest Products Markets and the Swedish Forest Sector

Sweden is amongst the World's largest exporters of forest products; the second largest exporter of pulp, paper and sawnwood in 2006 (Swedish Forest Industries Federation, 2008). Consequently, developments in the global forest products market are of crucial importance for the Swedish forest sector. Global net demand for forest products and wood fibre, influencing the profitability of the Swedish forest industry, has fundamental and far-reaching implications for land-use, forest management and silvicultural decisions in Sweden.

The main factors affecting long-term global net demand for wood products, many of which are inter-related, comprise economic growth, demographics, scientific and technological developments, globalisation, global climate change, and environmental policies and regulations (FAO, 2009A; UN, 2005).

- *Economic growth* is probably the most influential driver of change as regards the forest products markets. Economic growth leads to increases in trade, investment and personal income, thus resulting in growth in the demand for all forest products and services. Long-term economic growth is in turn driven by growth in population, capital and total factor productivity, according to neo-classical exogenous growth theory and endogenous growth theory alike. However, whereas neoclassical economics contends that technological progression and other external factors (external in exogenous growth theory) are the main sources of economic growth (see, e.g., Solomon, 1956; 1957), e*ndogenous growth theory* maintains that the enhancement of a nation's human capital will lead to economic growth by means of the development of new forms of technology and efficient means of production (see, e.g., Aghion & Howitt, 1998; Rivera-Batiz & Romer, 1991). Further, human needs can be arranged into a hierarchy, starting with basic needs such as food, shelter and security, followed by other activities that are less of a "need" and more of a personal pleasure (Ernst, 1978). As personal incomes increase, individuals tends to spend a higher proportion of their income on activities that are higher up in this hierarchy and less on satisfying their basic needs. Increasing incomes may thus lead to more subtle changes in the demands placed on the forest sector. Hence, as incomes rise, countries will move up the hierarchy towards a pattern of demand that will focus more on higher needs. Thus, for example, there will be more demand for fashionable, well designed forest products with a greater range of choice and consumers will focus less on price in their purchasing decisions. Wealthier societies will also put more emphasis on forest services such as conservation and recreation relative to the production of forest products whereas, in product markets, consumers will be more interested in the environmental credentials of wood products. (UN, 2005).

- *Demographics* affect forest products markets in various ways. Population increases result in economic growth and increased demand. In terms of housing demand, the number of households is even more decisive than population size (BBR, 2004). In addition to total population and number of households, the degree of urbanisation influences the forest products markets. Increased urbanisation tends to increase society's demand for non-wood forest products and services relative to wood products (UN, 2005), while at the same time reducing wood products harvests as forest management is affected far beyond the urban boundary (see, e.g., Vickery et al., 2009; Munn et al., 2002). Further, increased urbanisation, by reducing the rural workforce, leads to difficulties in attracting people to work in forestry (Blombäck et al., 2003), thereby putting upward pressure on labour costs. Changes in the age structure of the population also have potentially important effects on forest products markets. Hence, income levels and consumer preferences change as people

get older (see, e.g., Nicholls & Bumgardner, 2007; Robb et al., 2007). Further, an aging population has important implications for the demand for forest products in end-use industries such as the construction industry. First of all, studies show that the proportion of the population above 75 years of age has a significant negative effect on residential construction volume (Lindh & Malmberg, 2005), due to the increasing burden on the working population. Secondly, an ageing population entails a shrinking workforce, thereby speeding up industrialisation in the construction industry in order to reduce labour costs; more components will be factory made (Shuler & Adair, 2003). To a degree these effects could, of course, be offset by immigration to the countries (mainly in the industrialised world) with severely ageing populations. Finally, an increasing proportion elderly people will also have a dramatic impact on the design, layout, use and construction of houses. In Japan there are already signs of this development, e.g., barrier-free access and larger bathrooms to accommodate wheelchairs (Cohen, 2001).

- *Scientific and technological developments* within the areas of silviculture, forest management, harvesting, transport, and processing of wood products are the most influential as regards forest products markets. Within these areas, development generally focuses on: reducing costs and increasing productivity; developing new products; conserving resources (including improving energy efficiency) and reducing adverse environmental impacts (FAO, 2009a).

- For the forest sector, the principal effect of *globalisation* has been reduced transport costs, which has led to increased forest products trade and the creation of a truly global market for forest products (UN, 2005). Globalisation has reduced the dependence of the forest industry on local supplies of raw material, the natural advantages of forest resources have become less important and the development of the forest industry has been driven more by the comparative economic advantages, including labour costs, levels of research and technology, and access to capital (Whiteman, 2005). Intensively managed forest plantations are increasingly replacing natural forests as the raw material resource. These changes eliminate the traditional ties between forest processing and locations with abundant natural forests (Bael & Sedjo, 2006). Forest industry functions are spatially separated, i.e., companies now utilise materials from different sources, and as a consequence can locate manufacturing in different locations all along the value chain from the forest to the consumer (UN, 2005).

- *Global climate change, and policies, regulations and customer preferences linked to climate change*. A change in the world's climate will significantly affect every aspect of the environment and the economy (Aulisi et al., 2008). Changing temperature and precipitation pattern will produce a strong direct impact on both natural and modified forests (Kirilenko & Sedjo, 2007). First of all, global climate change affects growth rates and alters the optimal locations for different tree species (see, e.g., Sohngen & Sedjo, 2005). Besides these *flow effects*, *stock effects*, i.e., disturbance mechanisms such as forest fires, pest infestations, severe drought or windthrow, also have economic implications (Ibid.). In addition to these biological determinants, public policies aiming at climate change mitigation and the promotion of the development and use of bio-energy will affect forest products markets. Finally, climate change will probably affect consumer attitudes, e.g., increased customer preferences for "green products" (Aulisi et al., 2008) and bio-energy (Kirilenko & Sedjo, 2007). '

- *Environmental policies and regulations* have a potentially strong impact on wood supply as well as the production, consumption and trade of wood products; e.g., more emphasis on nature conservation and protected areas would tend to reduce removals and the production of wood products (Thoroe et al., 2004). Various studies on the role of forests show that the preservation of the natural environment and biodiversity, as well as the

protective functions of forests, are widely recognised and highly valued by the European public (Rametsteiner & Kraxner, 2003).

# 3. Looking Back

## Prices of wood products

Globally, historical trends as regards the prices of wood products show a great deal of fluctuation. In nominal terms (i.e. unadjusted for inflation), prices peaked at the start of the 1970s at the time of the first oil price shock (as did the prices of many other commodities). From this point until the 1990s, trends in prices have varied by product and region. Since the 1990s, prices of wood products have generally remained about the same or fallen in nominal terms at the global level, leading to significant falls in real prices, i.e., prices adjusted for inflation (UN, 2005). In Western Europe, Sweden's most important export market for forest products, real prices in general exhibit a declining trend the last three decades. The real prices of wood products in Eastern Europe are converging with those of Western Europe, i.e., they have been rising the last three decades (Ibid.).

The general decline in (real) prices for forest products over time can be understood in the light of increases in plantation forests, faster growing tree varieties, technological change and cost efficiencies, resulting in a relative abundance of virgin wood fibre (Roberts et al., 2004). This trend is expected to continue (Ibid.)

## Production and consumption of wood products

In general terms, the production and consumption of wood products can be said to be shifting from North America and Western Europe to tropical regions and emerging economies. Hence, the growth of the forest products markets has slowed considerably in North America and Western Europe but has grown substantially in China, Southeast and South Asia, and Eastern Europe (Aulisi et al., 2008).

### *Sawnwood*

Long-term annual global growth in production and consumption of sawnwood was about one percent between 1970 and 1990, but declined dramatically between 1990 and 2000, mostly as a result of falling production and consumption in the former Soviet Union and Eastern Europe. Prior to 1990, Eastern European and CIS countries accounted for nearly half of Europe's sawnwood production. Political changes in the 1990s led to a drastic decline in their production and consumption of sawnwood. With the transition to market economy, production shifted to more processed products such as wood-based panels (FAO, 2009A). Sawnwood production and consumption also declined in Asia during this period. Since 2000, though not reaching the same level as 1990, sawnwood production and consumption has begun to recover, in Europe and Asia as well as globally (Table 1). The prevalent trend, however, is substitution of wood-based panels for sawnwood (FAO, 2009a).

Table 1. Production and consumption of sawnwood

| | Amount (million $m^3$) | | | | | Annual change (%) | |
|---|---|---|---|---|---|---|---|
| | 1970 | 1980 | 1990 | 2000 | 2007 | 1970-1990 | 1990-2007 |
| **Production** | | | | | | | |
| Africa | 5 | 8 | 8 | 8 | 9 | 3,0% | 0,6% |
| Asia | 77 | 95 | 105 | 62 | 82 | 1,5% | -1,5% |
| Australia & New Zealand | 5 | 5 | 5 | 8 | 9 | -0,1% | 3,3% |
| Europe | 203 | 189 | 193 | 130 | 149 | -0,2% | -1,5% |
| Northern America | 83 | 98 | 126 | 142 | 137 | 2,1% | 0,5% |
| Latin America and the Caribbean | 16 | 26 | 29 | 37 | 45 | 3,0% | 2,7% |
| **World** | **389** | **421** | **466** | **386** | **431** | **0,9%** | **-0,5%** |
| **Consumption** | | | | | | | |
| Africa | 6 | 10 | 10 | 11 | 13 | 3,0% | 1,2% |
| Asia | 79 | 98 | 112 | 79 | 102 | 1,8% | -0,6% |
| Australia & New Zealand | 6 | 6 | 6 | 7 | 8 | 0,1% | 1,4% |
| Europe | 204 | 191 | 202 | 121 | 125 | -0,1% | -2,8% |
| Northern America | 79 | 91 | 114 | 136 | 137 | 1,8% | 1,1% |
| Latin America and the Caribbean | 16 | 26 | 28 | 35 | 39 | 3,0% | 1,8% |
| **World** | **390** | **422** | **473** | **389** | **424** | **1,0%** | **-0,6%** |

Source: FAO, 2009b

Between them, Europe and North America account for about two-thirds, Asia nineteen percent, and Latin America and the Caribbean ten percent of global sawnwood production. Europe and Latin America and the Caribbean are the main net exporting regions, while Asia is the main net importing region. Sweden was the third largest export nation in the World as regards sawnwood (nearly all softwood sawnwood) in 2007, after Canada and the Russian Federation (Source: FAO, 2009b). Swedish imports of sawnwood are minor in comparison; around 410 000 $m^3$ in 2007 (Ibid.). The main markets for the Swedish sawnwood exports are UK, Denmark and Germany. In 2007 these countries accounted for about twenty-five, twelve and seven percent of the Swedish sawnwood exports respectively (Source: Swedish Forest Industries Federation, 2008). While Swedish sawnwood production increased annually by two percent between 2000 and 2007, exports increased by less than 0.4 percent (Figure 1).

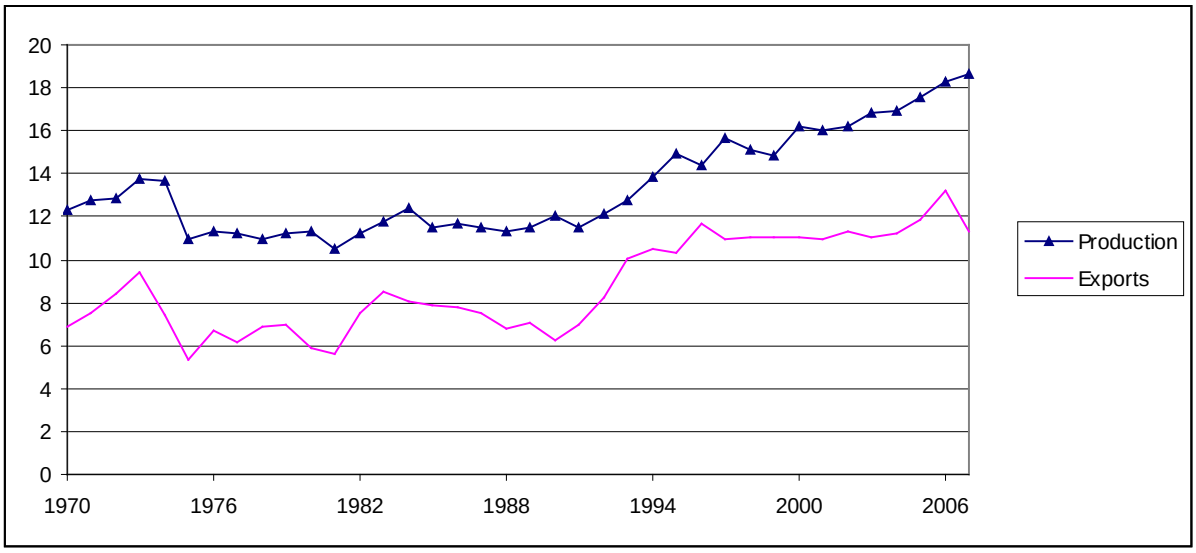


Figure 1. Swedish production and exports of sawnwood (in million $m^3$). Source: FAO, 2009b

## *Wood-based panels*

While production and consumption of wood-based panels were only slightly more than 60 percent of those of sawnwood in 2007, their growth rates are much higher. Long-term annual global growth in production and consumption of wood-based panels was around three percent between 1970 and 1990, and increased to over four percent between 1990 and 2007. Production and consumption of wood-based panels in Asia increased with over eight percent per annum between 1990 and 2007; particularly in China growth has been staggering.

In 2007 Asia accounted for around thirty-nine percent of the production and thirty-seven percent of the consumption of wood based panels (China alone accounted for around a quarter of global production and consumption), Europe accounted for a little less than a third of global production and consumption, and Northern America accounted for around a fifth of global production and about a quarter of global consumption. Asia, Europe, and Latin America and the Caribbean are the main net exporting regions (Table 2). Sweden is not a major actor when it comes to wood-based panels, neither as a producer nor as a consumer.

Table 2. Production and consumption of wood-based panels

| | Amount (million $m^3$) | | | | | Annual change (%) | |
|---|---|---|---|---|---|---|---|
| | 1970 | 1980 | 1990 | 2000 | 2007 | 1970 - 1990 | 1990 - 2007 |
| **Production** | | | | | | | |
| Africa | 1 | 2 | 2 | 2 | 3 | 3,3% | 3,2% |
| Asia | 13 | 19 | 27 | 49 | 105 | 3,8% | 8,3% |
| Australia & New Zealand | 1 | 1 | 2 | 3 | 4 | 3,8% | 5,3% |
| Europe | 28 | 44 | 50 | 61 | 84 | 3,1% | 3,0% |
| Northern America | 26 | 31 | 43 | 61 | 56 | 2,5% | 1,5% |
| Latin America and the Caribbean | 2 | 4 | 5 | 9 | 15 | 5,8% | 6,9% |
| **World** | **70** | **101** | **129** | **185** | **266** | **3,1%** | **4,4%** |
| **Consumption** | | | | | | | |
| Africa | 1 | 2 | 1 | 2 | 3 | 3,8% | 4,6% |
| Asia | 10 | 17 | 25 | 53 | 95 | 4,4% | 8,2% |
| Australia & New Zealand | 1 | 1 | 1 | 3 | 3 | 3,0% | 5,0% |
| Europe | 28 | 45 | 54 | 59 | 81 | 3,3% | 2,5% |
| Northern America | 28 | 31 | 43 | 63 | 62 | 2,1% | 2,2% |
| Latin America and the Caribbean | 2 | 4 | 5 | 8 | 12 | 5,5% | 5,9% |
| **World** | **70** | **101** | **129** | **188** | **257** | **3,1%** | **4,1%** |

Source: FAO, 2009b

There is an increasing shift from plywood to reconstituted panels (particleboard and fibreboard) within the category of wood-based panels (FAO, 2009a). This shift began in Europe, where reconstituted panels have gradually increased in importance, and has continued in North America. This shift appears to have increased over the last decade, perhaps due to the introduction of new types of panel product such as medium density fibreboard and other engineered wood products (UN, 2005). Particleboard and fibreboard accounted for around 90 percent of the panel market in Europe in 2007 and about 70 percent in North America. This shift from plywood to particleboard and fibreboard has only recently begun in Asia, where plywood accounted for almost half of the production and around 40 percent of the consumption of wood-based panels in 2007. China's production made up two-third of Asian plywood production in 2007, followed by Malaysia (about eleven percent) and Indonesia (around seven percent). In consumption terms, China, accounting for almost 60 percent in 2007, took first place again, followed by Japan (around eighteen percent) and India (about five percent) (Source: FAO, 2009b).

## *Paper and paperboard*

In almost all parts of the world, the demand for pulp and paper has been the most rapidly expanding forest product, based on the rise in population and incomes (Aulisi et al., 2008). Growth has slowed down somewhat the last decades, partly as a result of the expansion of electronic media and the ensuing slowing down of the growth of consumption and production of newsprint (FAO, 2009a). Hence, the annual growth rate has decreased from 3.3 percent between 1970 and 1990 to 2.8 percent between 1990 and 2007 (Table 3). Paper and paperboard is one of the most globalised commodity groups, i.e., a high share of production is exported and a high share of consumption

imported (FAO, 2009a). International trade grew significantly in the 1990s, particularly in Europe (Ibid.).

Table 3. Production and consumption of paper and paperboard

| | Amount (million tonnes) | | | | | Annual change (%) | |
|---|---|---|---|---|---|---|---|
| | 1970 | 1980 | 1990 | 2000 | 2007 | 1970 - 1990 | 1990 - 2007 |
| **Production** | | | | | | | |
| Africa | 1 | 2 | 3 | 4 | 4 | 5,8% | 2,6% |
| Asia | 18 | 30 | 57 | 95 | 142 | 6,0% | 5,5% |
| Australia & New Zealand | 2 | 2 | 3 | 4 | 4 | 3,1% | 2,3% |
| Europe | 45 | 58 | 77 | 100 | 115 | 2,8% | 2,3% |
| Northern America | 57 | 70 | 88 | 107 | 102 | 2,2% | 0,8% |
| Latin America and the Caribbean | 4 | 8 | 11 | 14 | 17 | 5,6% | 2,6% |
| **World** | **126** | **169** | **239** | **324** | **384** | **3,3%** | **2,8%** |
| **Consumption** | | | | | | | |
| Africa | 2 | 3 | 4 | 5 | 7 | 4,4% | 3,3% |
| Asia | 19 | 33 | 62 | 103 | 148 | 6,1% | 5,3% |
| Australia & New Zealand | 2 | 2 | 3 | 4 | 5 | 3,0% | 2,2% |
| Europe | 44 | 56 | 75 | 90 | 105 | 2,7% | 2,0% |
| Northern America | 53 | 65 | 84 | 103 | 96 | 2,3% | 0,8% |
| Latin America and the Caribbean | 5 | 10 | 12 | 20 | 22 | 4,0% | 3,7% |
| **World** | **125** | **168** | **239** | **325** | **383** | **3,3%** | **2,8%** |

Source: FAO, 2009b

North America dominated global production of paper and paperboard until year 2002, by which time the region was passed by both Europe and Asia. Particularly in Asia growth has been staggering, and in 2007 Asia accounted for almost thirty-seven percent of global production, followed by Europe (thirty percent) and North America (twenty-seven percent). In Europe, production growth has been driven partly by expanding exports; Europe is the largest exporter of paper products (FAO, 2009a). Europe's competitive advantage in paper production is based on close high-demand markets, the availability of recovered paper and technological sophistication for production of high-quality paper. Europe is also one of the largest investors in the pulp and paper sector in Asia and Latin America, where European companies benefit from matching their technological, marketing and managerial skills with the low labour costs, rapidly expanding planted forests and growing demand (Ibid.). Over the last decade, the production of pulp and paper in Latin America has expanded rapidly; resulting in a six fold increase in net exports (Aulisi et al., 2008). North America has also lost its hegemony in consumption terms; Asia became the largest consumer region in 2000 and in 2007 Asian consumption made up almost thirty-seven percent of global consumption, followed by Europe and North America with twenty-eight and twenty-five percent respectively. China alone accounted for one fifth of global production and consumption of paper and paperboard in 2007; production and consumption doubled between 2000 and 2007. In sum, the demand for paper has shifted from the mature western markets to the emerging markets in the east and south (Aulisi et al., 2008). Differences in growth between the regions reflect the composition of the paper and paperboard market (Table 4):

- Currently global newsprint production is fairly evenly distributed among Asia, Europe and North America. Growth is slowing as a result of the rapid expansion of electronic media. Annual long-term global growth of newsprint production was less than one percent between 1990 and 2007, and was even negative between 2000 and 2007; minus half a percent (Source: FAO, 2009b).

- Production of other paper and paperboard is by far the highest in Asia, while Europe and North America produce equal amounts. Annual long-term global growth of other paper and paperboard production was around three percent between 1990 and 2007. The growth rate increased marginally between 2000 and 2007 (Source: FAO, 2009b).

- Asia and Europe produce far more printing and writing paper than North America. Long-term annual growth was around three percent between 1990 and 2007, on a global scale. The corresponding figure for the period 2000 – 2007 was about two percent (Source: FAO, 2009b).

Table 4. Production in North America, Asia and Europe, share of global production

| | 1970 | 1980 | 1990 | 2000 | 2007 |
|---|---|---|---|---|---|
| Newsprint North America | 51,8% | 50,6% | 46,0% | 40,3% | 29,1% |
| Newsprint Asia | 11,8% | 13,9% | 15,9% | 21,4% | 32,0% |
| Newsprint Europe | 32,5% | 30,5% | 31,7% | 32,8% | 33,7% |
| Other paper + paperboard North America | 45,6% | 40,9% | 36,2% | 33,3% | 27,1% |
| Other paper + paperboard Asia | 14,7% | 18,4% | 25,1% | 31,5% | 39,3% |
| Other paper + paperboard Europe | 34,1% | 33,0% | 30,8% | 27,3% | 26,6% |
| Printing + writing paper North America | 39,6% | 37,2% | 34,1% | 29,9% | 24,6% |
| Printing + writing paper Asia | 14,6% | 17,5% | 25,0% | 27,9% | 33,8% |
| Printing + writing paper Europe | 42,3% | 39,3% | 35,8% | 37,0% | 35,7% |

Source: FAO, 2009b

Sweden, seventh in production terms, was the fifth largest exporter of paper and paperboard in the World in 2007, accounting for nine percent of the World total (source: FAO, 2009b). Swedish imports of paper and paperboard are much smaller in comparison. The main markets for Swedish paper and paperboard exports are Germany, UK and France. In 2007 these countries accounted for about twenty, fourteen and five percent of Swedish paper exports respectively (Source: Swedish Forest Industries Federation, 2008). Figure 2 depicts the composition of the Swedish paper and paperboard exports. The relative importance of other paper and paperboard and newsprint in Swedish paper exports has decreased significantly the last twenty years. The opposite holds for printing and writing paper.

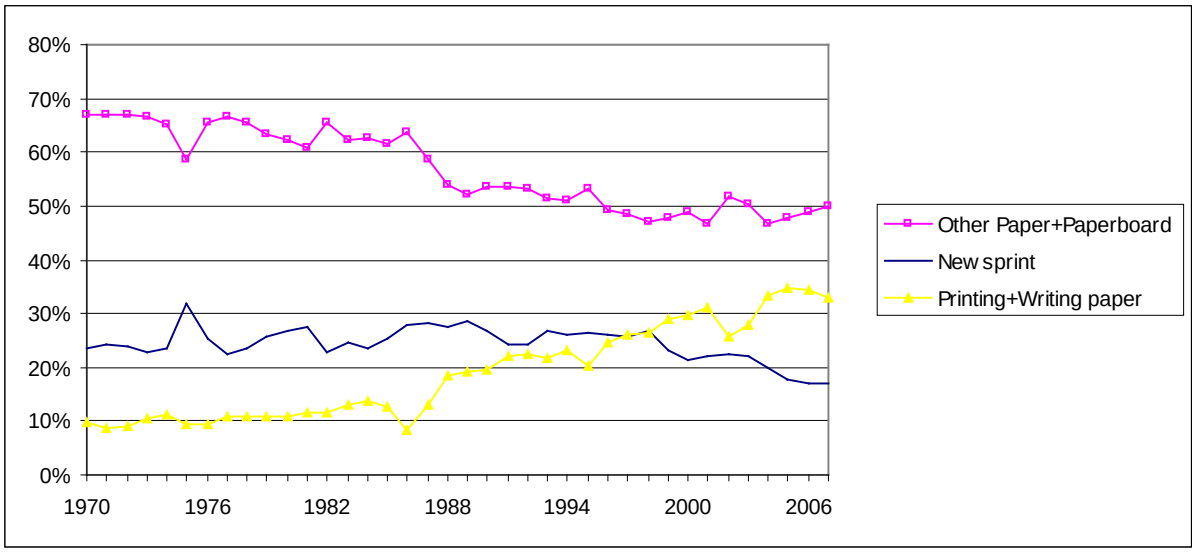


Figure 2. Structure of Swedish paper export: share of total paper exports. **Source**: FAO, 2009b

### *Industrial roundwood*

Industrial roundwood demand is derived from demand for, and hence production of, end products: sawnwood, wood-based panels, and paper and paperboard. These products have varying wood requirements depending on technology used and the potential to use wood and fibre waste; e.g., growing sawnwood production increases the demand for industrial roundwood, whereas increased production of reconstituted panels increases the potential to use wood residues and fibre waste, thereby reducing industrial roundwood demand. In 2005, global derived demand in wood raw-material equivalent (WRME) was about 2.5 billion cubic metres: 1.7 billion cubic metres were industrial roundwood; 0.5 billion cubic metres came from recovered paper; the remainder from wood-processing residues, recovered wood products and other sources (FAO, 2009).

In a number of northern countries, notably Finland, Sweden and Canada, the proportion of pulpwood production in total industrial roundwood production has fallen over recent decades. This trend can be explained by improvements in sawmilling technology, allowing sawmills to produce sawnwood from smaller tree sizes. Another impact of this development has been an increase in the production of wood chips from sawmills, to be used in the production of reconstituted wood panels, wood pulp, or for bio-energy. Thus, the type of wood used for pulp and paper production has gradually shifted away from pulpwood towards wood chips and residues. For the countries in the South, on the other hand, the share of pulpwood in total industrial roundwood production has increased in many countries in the last decades. This is probably partly due to increasing demand for pulpwood in these countries, but it is also a reflection of the fact that the area of forest plantations grown on short-rotations specifically for pulpwood production has increased in recent years in countries such as Brazil, China and, more recently, Indonesia (Whiteman, 2005). In 2007, forest plantations accounted for just under 5 percent of the world's forests, but supplied 50 percent of wood and fibre needs (FAO, 2007).

Long-term annual global growth in production and consumption of industrial roundwood was 1.4 percent between 1970 and 1990, but declined between 1990 and 2000, as a result of falling production and consumption in Europe, notably in the former Soviet Union; the substitution of other materials for wood; the global growth of recycling; and the industrialized economies' slowing consumption (Reid et al., 2004). Since 2000, industrial roundwood production and consumption has picked up somewhat, and were in 2007 at the same level as 1990 globally. The main increases in production and consumption of industrial roundwood between 2000 and 2007

took place in Europe, Asia, Latin America, and the Caribbean. Production and consumption in Europe are yet to reach the levels of 1990 (Table 5).

Table 5. Production and consumption of industrial roundwood

| | Amount (million $m^3$) | | | | | Annual change (%) | |
|---|---|---|---|---|---|---|---|
| | 1970 | 1980 | 1990 | 2000 | 2007 | 1970 - 1990 | 1990 - 2007 |
| **Production** | | | | | | | |
| Africa | 39 | 50 | 57 | 69 | 69 | 1,9% | 1,2% |
| Asia | 172 | 233 | 258 | 231 | 240 | 2,1% | -0,4% |
| Australia & New Zealand | 19 | 26 | 29 | 44 | 47 | 2,1% | 2,9% |
| Europe | 567 | 561 | 645 | 483 | 576 | 0,6% | -0,7% |
| Northern America | 430 | 478 | 583 | 620 | 586 | 1,5% | 0,0% |
| Latin America and the Caribbean | 49 | 97 | 121 | 159 | 183 | 4,7% | 2,4% |
| **World** | **1 276** | **1 446** | **1 696** | **1 608** | **1 705** | **1,4%** | **0,0%** |
| **Consumption** | | | | | | | |
| Africa | 33 | 45 | 53 | 63 | 66 | 2,4% | 1,3% |
| Asia | 189 | 253 | 287 | 264 | 294 | 2,1% | 0,1% |
| Australia & New Zealand | 18 | 25 | 27 | 37 | 40 | 2,2% | 2,3% |
| Europe | 568 | 564 | 646 | 473 | 547 | 0,6% | -1,0% |
| Northern America | 418 | 465 | 562 | 614 | 580 | 1,5% | 0,2% |
| Latin America and the Caribbean | 48 | 96 | 118 | 156 | 180 | 4,6% | 2,5% |
| **World** | **1 274** | **1 448** | **1 696** | **1 609** | **1 707** | **1,4%** | **0,0%** |

Source: FAO, 2009b

Sweden, sixth in production as well as export terms, was the fifth largest importer of industrial roundwood in 2007 (Source: FAO, 2009b). The most important markets for Swedish roundwood exports, consisting mainly of sawlogs, in 2007 were Germany, Norway and Finland, whereas Swedish roundwood imports, dominated by pulpwood, comes largely from Latvia, Russia and Estonia (Source: Statistics Sweden, 2009). Sweden has been a net importer of industrial roundwood since 1975. Production and consumption of industrial roundwood in Sweden, which did not change much in quantity between 1970 and 1990, grew steadily between 1990 and 2007; the annual average growth rate was 3.6 percent. The peak in production and consumption in 2005 is due to hurricane Gudrun that resulted in massive wind throw of timber in southern Sweden that year (Figure 3).

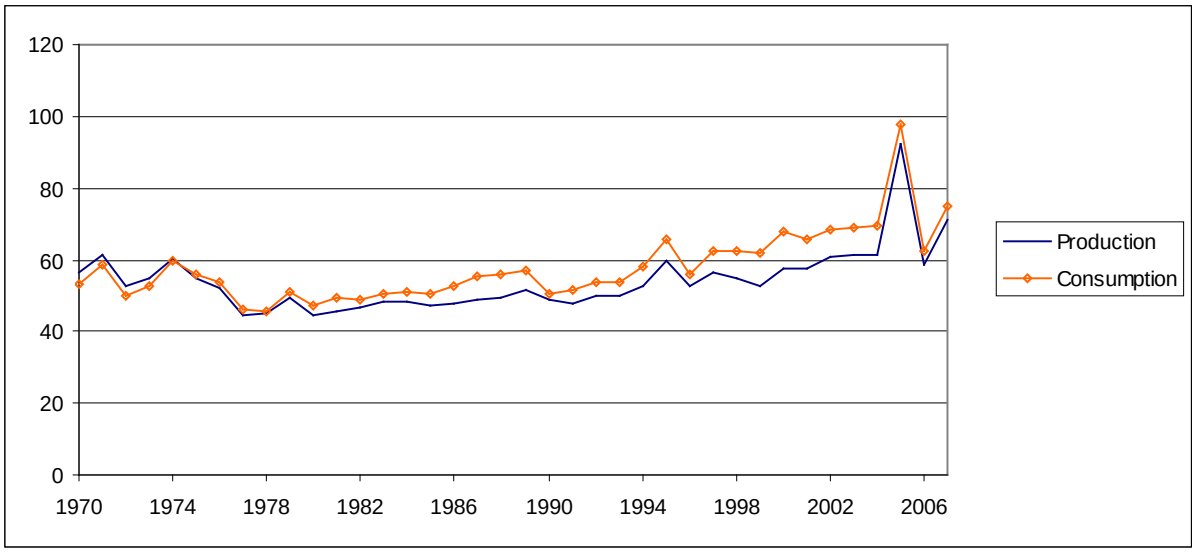


Figure 3. Swedish production and consumption of industrial roundwood (in million $m^3$). Source: FAO, 2009b

# 4. Looking Forward

According to projections by the FAO (2008), global GDP will increase from around US$47 trillion in 2005 to almost US$100 trillion in 2030 (at 2005 prices and exchange rates). Economic prospects are, however, especially at this time of financial crisis, surrounded by considerable uncertainty. While developed economies accounted for most of the global GDP in the period 1970-2005, the rapid growth of developing economies, especially in Asia, will swing the balance significantly in the future. In Western Europe, Swedish most important export market as regards forest products, the rate of economic growth is much lower than in developing regions, and is expected to slow further. In Germany, e.g., real GDP growth, projected to be slightly less than two percent per annum during the period from 2010 until 2020, will decrease to about 1,3 percent during the period from 2010 to 2030 (Source: FAO, 2008). The global demand for forest products will thus continue to grow, but mainly so in China, India, Brazil, and other developing countries in line with the growth in population and income. In Sweden's main market Europe, the relatively high income is reflected in a demand emphasising quality. High investments in science and technology in Europe, most Western European countries have a research and development outlay of more than two percent of GDP (European Commission, 2007), will favour the transition to a knowledge-based post-industrial "green" economy, based on sustainable use of resources (FAO, 2009a). Thus, for the Swedish forest products industry to continue to prosper and grow; it will need to increase its market share in developing countries and the degree of value-added in a production based on sustainable forest management practices.

The world's total population is projected to increase from 6.5 billion in 2005 to 8.3 billion in 2030 before stabilising at slightly over nine billion in 2050. In contrast, total population in Europe is expected to decrease from 730 million in 2005 to about 710 million in 2030 and then further to around 660 million in 2050 (Source: UN, 2008). This projected fall in population partly explains the expected slow economic growth in Europe. Declining labour supply will necessitate labour-saving technologies and will encourage increased immigration and shifting production to low-wage economies (FAO, 2009a). The number of households in Europe is projected to increase as households are becoming smaller; the number of European households is thus expected to be twenty percent higher in 2030 than in 2005 (EEA, 2005). This implies continued demand for housing as well as furniture and other wood products, and thus for sawnwood and panel products, (Ibid.).

Ageing of the population is evident on the global scale as well as in Europe and Sweden. Hence, the percentage aged 65 or older in 2050 is expected to be about three times higher on the global and European level and two times higher in Sweden than in 1970 (Figure 4). People aged 65 or older will account for around a quarter of the total population in Europe as a whole as well as in Sweden by 2050. As mentioned earlier, ageing of the population affects the construction industry, and hence sawmills and panel producers adversely. Further, the resulting shrinking workforce and ensuing industrialisation in the construction industry will increase the demand for factory made, panellised construction components, as has already been the case in Japan (see Cohen, 2001; Roos, 2000). The Swedish solid wood products industry is not well positioned for this development, and could be adversely affected, should it fail to adapt to these trends and shed its commodity orientation.

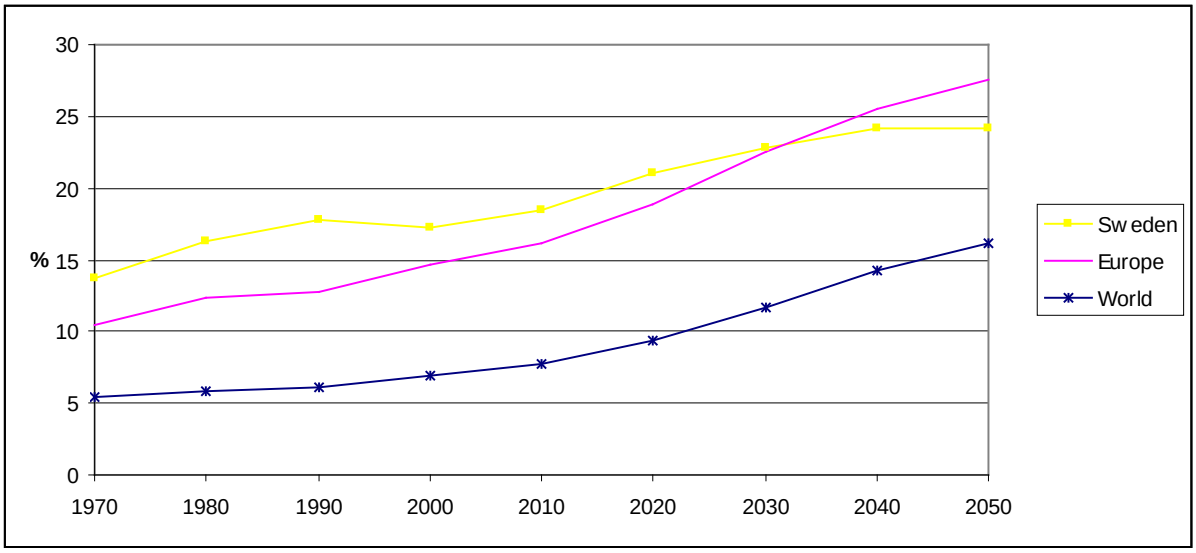


Figure 4. Percentage aged 65 or over (%). Source: UN, 2008 (Note: UN medium fertility variant)

Urbanisation has increased since 1970 and is expected to increase further; globally as well as in Europe and Sweden. In the world as a whole the rate of urbanisation, increasing from less than 50 percent in 2005 to almost 70 percent in 2050, is projected to be almost double that of 1970. The share of the population in Sweden and Europe living in urban areas, already high by 1970, will also continue to increase (Figure 5), albeit at a slower pace. The net effect on net global demand for wood products is equivocal, since, as already mentioned, increased urbanisation tends to decrease the demand for wood products relative non-wood forest products while at the same time reducing wood products harvests.

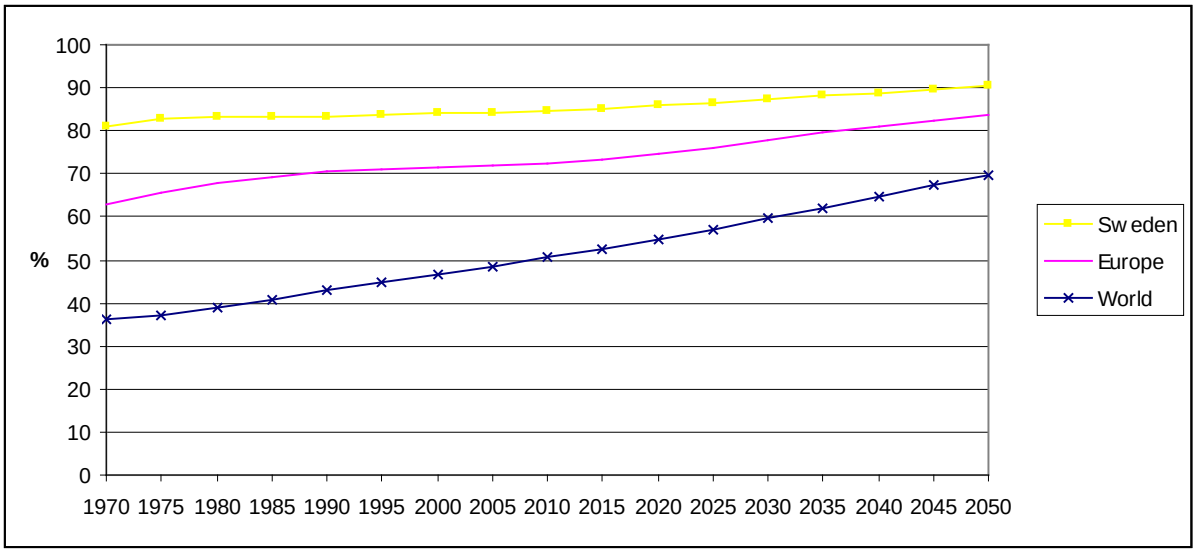


Figure 5. Percentage urban population. Source: UN, 2008

Globally, research within the areas of forest management and silviculture has focused on planted forests and short-rotation species. Research here aims primarily to increase growth rates and wood quality as well as the ability of forests to withstand adverse environmental conditions, pests and diseases. This focus on fast-growing species relates to demand from pulp and paper and

reconstituted wood-panel producers. Enormous productivity gains have been obtained for species such as eucalypts and tropical pines (FAO, 2009a). New possibilities, though controversial, for improving production and quality are provided by research within gene transfer technology and tree genomics (see, e.g., Evans & Turnbull, 2004). These developments will contribute to increasing the supply of roundwood for the wood processing industries.

Technological improvements in wood processing have: made the use of tree species formerly not considered useful small-dimension sawlogs possible; improved the rate of recovery through improvements in the production of reconstituted panels; increased recycling, e.g., recovery of paper. Further, research efforts in mainly Europe and North America have led to the transformation of pulp and paper units into bio-refineries, i.e., integrated industries that produce ethanol, starch, organic acids, polymers, oleochemicals, bioplastics and several food and feed ingredients from wood-processing residues. These bio-refineries could be central in the creation of a "green economy", by reducing dependence on fossil fuels (see, e.g., van Ree & Annevelink, 2007). This development should benefit the profitability of the pulp and paper industry, by increasing value addition. Large-scale establishment of integrated bio-refineries will increase the use of forest raw materials, at the same time potentially increase the efficiency of the raw material use. In the future, nanotechnology is expected to result in further advances in material and energy efficiency, from production of raw materials to composite and paper products (Reitzer, 2007; Roughley, 2005). This increased efficiency will contribute to a dampening of global demand for wood fibre.

Globalisation will continue to shift the focus of the forest products industry from North America and Western Europe to tropical regions and emerging economies, *ceteris paribus*. The comparative advantage in wood production is thus moving away from countries with large forest resources in the Northern Hemisphere toward countries where trees grow quickly (Whiteman, 2005). The future supply of wood and fibre will thus depend on the availability of land for forest plantations, and their environmental and social costs (Ibid.). In the USA, e.g., there have been virtually no new investments made in the forest products industry over the past decades. The Nordic forest industries follow a similar pattern and invest increasingly in southern countries like China and Brazil. Lower energy prices and the availability of cheap labour and raw materials are the main driving forces behind this development (Jordbruksaktuellt, 2007). For countries like Sweden and Finland, succeeding in the global competition on a domestic basis alone is not possible (Finnish Forest Industries Federation, 2005). Consequently, in the coming years Nordic forest companies like Stora Enso will continue to invest in forest plantations and pulp mills in South America (see Jordbruksaktuellt, 2007), whereas paper and board machines will be located in Asia, especially China (Finnish Forest Industries Federation, 2005), where demand is growing most rapidly. This development will, of course, affect employment in the Swedish forest products industry adversely. The implications for Northern Sweden are particularly serious; here raw material based industries such as the forest industry often provides the only means of employment (Jakobsson, 2009). Swedish forest owners will also face negative consequences, as cheap hardwood pulp from the southern hemisphere will put downward pressure on the price of Swedish softwood pulp. The Swedish sawmill industry, however, is not facing the same direct threat, as the forest expansion in the South hemisphere mainly focuses on the pulp and paper production. In addition, the Nordic sawmill industry is believed to have competitive advantages compared with wood from fast growing plantations (Jordbruksaktuellt, 2007). Further, as low transport costs have been a major driving force behind globalisation of the forest products industry, drastically increased transport costs due to higher fuel prices could stall, or even reverse, further globalisation. Climate change policy is likely to directly or indirectly raise the price of energy from fossil fuels (Aulisi et al., 2008). In addition, decreasing real prices of virgin wood fibre would make it more difficult for forest plantations to compete with alternative land-uses; cattle production and non-wood sources of bio-fuel such as sugarcane, soybeans and palm oil (see Roberts et al., 2004). The most productive regions for plantation forestry, the tropics and the sub-tropics, are also well suited to produce bio-energy feedstocks (Aulisi et al., 2008).

Climate change is expected to improve forest productivity on a global scale while regional variability increases, thereby complicating the relationship between supply and asset appreciation (Aulisi et al., 2008). In boreal regions, such as Sweden, climate change is generally expected to increase timber production over the coming century through a polarward shift of the most important forestry species and accelerated vegetation growth caused by a warmer climate, longer growth seasons and elevated atmospheric $CO^2$ concentrations (see, e.g., Scholze et al., 2006; Sohngen & Sedjo, 2005; Schroeter, 2004; Solberg et al., 2003; Cramer et al., 2001). Though these *flow effect*s have potentially large economic implications in the longer term (Aulisi et al., 2008), for the shorter term, up to 2025, Sohngen & Sedjo (2005) suggest that timber harvest levels will not change substantially in the boreal forests of North America, Europe, or Russia. *Stock effects*, however, have potentially important impacts in the near and medium terms (Sohngen & Sedjo, 2005.). Hence, increased frequency of extreme events such as strong winds, droughts, etc., aggravated by insect outbreaks and wildfires, can bring massive losses to commercial forestry (Kirilenko & Sedjo, 2007). Ensuing salvage logging is projected to increase short-term timber supply and reduce prices (Sohngen & Mendelsohn, 1998), whereas longer term timber supply would decrease. Modelling results by Perez-Garcia et al. (2002) and Sohngen et al. (2001) suggest that the trend of boreal forest becoming relatively less and less important globally as global timber harvests shift towards subtropical plantation regions will continue over the medium term (up to 2065). The impacts of lower world prices will outweigh the benefits of rising forest productivity in boreal regions (Perez-Garcia et al., 2002). Potential future water supply threats to plantation forests, as in, e.g., Latin America (see, e.g., Mendes, 2007)), could work against this development. However, wood producers in subtropical regions are predicted to be less vulnerable to climate change due to high growth rates and short rotation periods, providing opportunities for adaptation (Aulisi et al., 2008).

Public policies aiming at climate change mitigation will affect forest products markets by, e.g., promoting, the use of energy-efficient, renewable construction materials, as, e.g., the Code for Sustainable Homes in the UK (see DCLG, 2006) and *national funding opportunities* for *Green Building* in the USA (see EPA, 2009). This will possibly boost global demand for construction timber, thus benefitting the Swedish solid wood products industry. However, the way major green building standards are formulated will greatly influence to what degree sustainable wood products will be preferred over competing materials based on lifecycle carbon emissions (Aulisi et al., 2008). Public policies will also affect global forest products markets by promoting the development and use of bio-energy and bio-fuel, e.g., the new targets for renewable energy in Europe passed by the European Commission in 2007 (European Commission, 2008): a 20% share for renewable energy of energy consumption in the EU and a binding 10% target for the share of renewable energy in transport petrol and diesel by 2020. These targets have already stimulated an increasing demand for wood as an energy source, and particularly for wood pellets as a substitute for fossil fuel in small-scale heating and electricity production (Peksa-Blanchard et al., 2007). Bio-energy, as well as providing opportunities for new markets, will pose challenges to traditional forest products manufacturers, by increasing raw materials costs and thereby reducing competitiveness with substitute materials (Aulisi et al., 2008). Hence, the wood-based panel industry will face more competition for all its raw materials, i.e., slabs, chips, sawdust and roundwood, while at the same time having no secondary products to be fed into the energy markets (Engelbrecht, 2006). Sawmills, on the other hand, should benefit from the development of wood-based bio-energy markets, as saw logs have a high value and no competition from energy uses, and will obtain a higher price for the secondary products (slabs, chips, and sawdust) demanded by bio-energy markets (Ibid.). Chemical pulp producers might profit from a growing bio-energy industry since, as already mentioned, they can manufacture new, high-value products at an integrated bio-refinery. Mechanical pulp producers cannot do this, however, and will be hurt by higher prices for raw materials and electricity (Ibid.). Landowners will benefit from the development of bio-energy, as a result of increased competition for and hence prices of roundwood (see, e.g. Roberts, 2007).

Bio-energy and bio-fuel can also be produced from annual plants, thus increasing the competition with forests for land-use, as mentioned earlier.

Climate change is expected to lead to increased consumer preferences for "green products", particularly in the construction sector. Consumer preferences for bio-energy and bio-fuel are also expected to increase, in the face of rising energy prices (Kirilenko & Sedjo, 2007). As the climate change benefits of sustainable forest products are not widely understood, there is an opportunity for the industry to improve its consumer relations (Aulisi et al., 2008); paper and wood have the lowest energy consumption and the lowest carbon dioxide emissions of any commonly used packaging or building materials (Frühwald et al., 2003).

Future developments as regards environmental policies and regulations deemed most likely by policy experts are: greater emphasis on nature conservation and promotion of biodiversity and more emphasis on nature oriented forest management (see Thoroe et al., 2004). In Germany, e.g., the aim for 2020 is to increase the share of forest area without interventions to 5% (BMU, 2007). Greater emphasis on nature conservation and promotion of biodiversity is expected to reduce removals and wood production in Europe (Ibid.). Verkerk el al. (2008), on estimating the impacts of biological and landscape diversity protection on wood supply in Europe, found that around 68 million $m^3$ could not be felled from these protected areas. Policy measures emphasising nature oriented forest management, including the elimination or reduction of clear-cutting in favour of more selective harvesting, will presumably also lead to a reduction in wood supply (see Thoroe et al., 2004). Hence, the net effect of a future greater emphasis on nature conservation, biodiversity and nature oriented forest management in Europe will most likely be increased net demand for roundwood and wood products in Western Europe in particular, something which should benefit the Swedish wood products industry. Swedish wood supply could, however, possibly also decline as a result of policy measures in Sweden emphasising conservation and nature oriented forest management.

# 5. Summary and conclusions

The future developments as regards the factors determining global forest products demand, and their impacts on the Swedish forest sector, are equivocal:

- The main growth in global demand for forest products are expected to take place in developing economies, such as China and India, in line with growth in population and income. In the Swedish forest products industry's most important export market, Western Europe, the rate of economic growth is much lower. The relative high income in Europe is reflected in a demand emphasising quality and sustainable resource use.

- The world's total population is projected to increase before stabilising at slightly over nine billion in 2050, a development which will increase the demand for forest products. In Europe, though total population is expected to fall up to 2030 and beyond, the increasing number of households implies continued demand for housing and thus for wood products. Ageing of the population, evident on the global scale as well as in Europe and Sweden, will affect the construction industry, and hence solid wood products, adversely. Further, the resulting shrinking workforce and ensuing industrialisation in the construction industry will increase the demand for factory made construction components.

- Urbanisation is expected to increase, globally as well as in Europe and Sweden. Increased urbanisation tends to decrease the demand for wood products relative non-wood forest products, while at the same time reducing wood products harvests.

- Research on forest management and silviculture will increase potential wood fibre supply. At the same time, technological improvements in wood processing will increase the efficiency of the raw material use and hence contribute to a dampening of the demand for roundwood. Both these developments will support an abundance of wood fibre globally, by contributing to an increase of the supply and a decrease of the demand, respectively.

- Globalisation will result in a continuous shifting of production and consumption of forest products from the Northern hemisphere to tropical regions and emerging economies; lower energy prices and the availability of cheap labour and raw materials being the main driving forces. However, as low transport cost is the main driving force behind the globalisation of the forest products market, large increases in transport cost due to rising fuel prices could stall, or even reverse, further globalisation.

- Climate change is expected to increase forest growth, globally as well as in boreal regions such as Sweden. In the shorter term, the frequency of extreme events, such as strong winds and droughts, is expected to increase. Ensuing salvage logging is projected to increase short-term timber supply and reduce prices, whereas longer term timber supply will decrease. Modelling results suggest that lower world prices will outweigh the benefits of rising forest productivity in boreal regions, and hence the trend of global timber harvests shifting towards subtropical plantation regions would continue.

- Public policies aiming at climate change mitigation will possibly boost global demand for construction timber by promoting the use of energy-efficient, renewable construction materials. Public policies will also affect global forest products markets by promoting the development and use of bio-energy and bio-fuel. This has already stimulated an increasing demand for wood as an energy source. A large-scale bio-energy industry may pose challenges to as well as providing opportunities for traditional forest products industries; by increasing raw materials costs on one hand and, on the other hand, by providing new markets.

- Climate change is expected to lead to increased consumer preferences for “green products”, particularly in the construction sector. Consumer preferences for bio-energy and bio-fuel are also expected to increase. The not widely understood climate change benefits of sustainable forest products offer an opportunity for the industry to improve its consumer relations.

- The net effect of a future greater emphasis on nature conservation, biodiversity and nature oriented forest management in Europe, the future developments as regards environmental policies and regulations deemed most likely by policy experts, will seemingly be increased net demand for roundwood and wood products in particularly Western Europe. Swedish wood supply could, possibly, also decline as a result of policy measures in Sweden emphasising conservation, biodiversity and nature oriented forest management.

As can be seen above, there are factors supporting an increase as well as a decrease in the global net demand for wood fibre. The same goes for the Swedish wood supply. The net effect depends on the relative strength of these factors. In general, no future scarcity of wood fibre globally is foreseen. Factors that might result in global scarcity of wood fibre are, above all, continued rapid economic growth in Asia, major calamities such as insect outbreaks, and the development of large-scale bio-energy markets (see, e.g., Roberts, 2007).

The overall future of the Swedish solid wood products industry looks bright if it succeeds in shedding its commodity orientation and increase the value-added by accommodating the growing demand for factory made construction components produced using energy-efficient and renewable construction materials. Furthermore, the development of prominent bio-energy markets should mainly benefit the sawmill industry; obtaining a higher price from secondary products with very limited competition from bio-energy markets as regards raw materials. In addition, the Swedish sawmill industry is not facing the same direct threat from globalisation as the pulp and paper industry; the expansion in the South hemisphere focuses mainly on the pulp and paper production.

The prospect for the pulp and paper industry in Sweden is mixed. Globalisation is increasingly shifting production and consumption to the Southern hemisphere, affecting employment as well as forest owners (through decreased demand for pulpwood) in Sweden adversely. Further, pulp and paper could both benefit as well as suffer from the development of bio-energy. Hence, chemical pulp producers might profit from a growing bio-energy industry since they can manufacture new, high-value products at integrated bio-refineries. Mechanical pulp producers cannot do this, however, and will suffer by higher prices for raw materials and electricity. Forest owners should, in general, benefit from the higher prices for woody bio-energy feedstocks. Wood fibre for energy purposes can, however, be imported to Sweden from countries with huge biomass potentials, even faraway, such as Brazil and Canada. As an example, the main single supplying country for Swedish wood pellets imports in 2006 was Canada (Hektor, 2007)

## Four scenarios

Below, four different scenarios of global forest products markets and the Swedish forest sector are presented. The scenarios are distinguished principally by divergent futures as regards two important factors: (1) climate change and mitigation efforts and (2) globalisation vs. regionalism (see Figure 6).

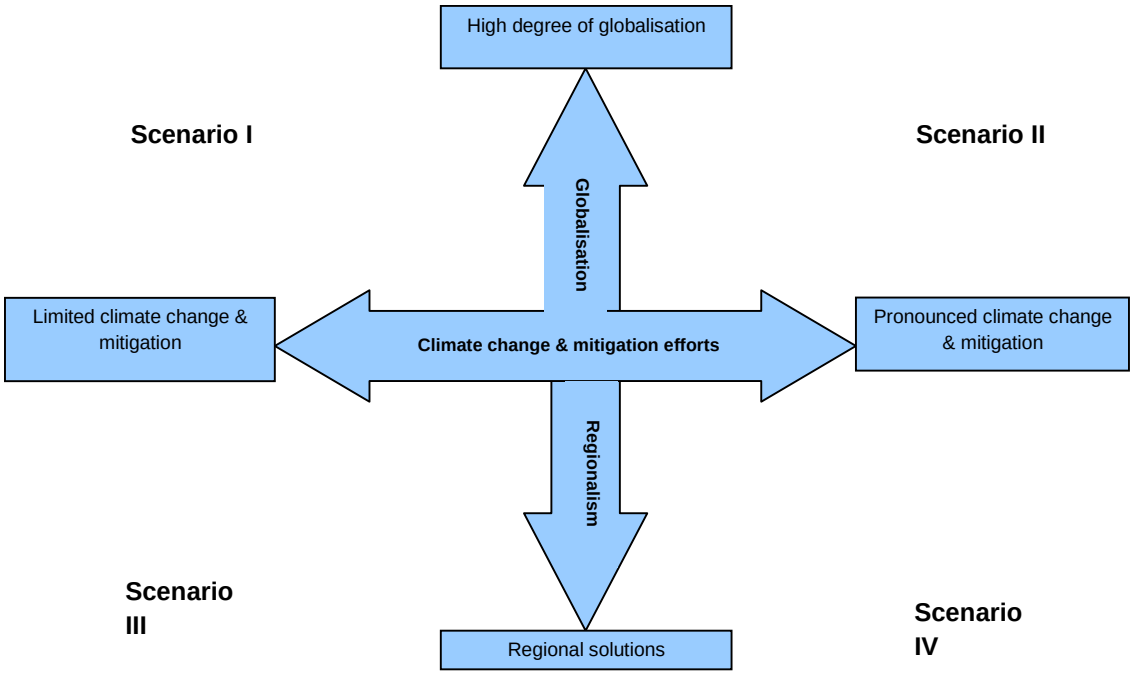


Figure 6. Scenarios

I. This scenario is characterised by unabated globalisation, moderate climate change and little in the way of global mitigation efforts, low environmental concern, relatively low transport and energy costs, and very rapid global economic growth. Global population has stabilised, while the population in Europe is declining and ageing. Bio-energy markets globally have developed but modestly, even so in the European Union (EU) after the bio-energy targets for 2020 were reached. Recycling rates have not risen above today's levels. Cheap wood raw materials as well as commodities are imported to the EU, leading to continued falls in real prices. As a result, annual harvest levels in the EU have gone down and there is little investment in forest management. For Sweden, net global demand for wood products is relatively low. The total supply of wood fibre in Sweden has not increased significantly compared to today's level. Employment in the Swedish forest sector is lower than today; a result of technological progress as well as the predominantly extensive forest management regimes. Forest owners in Sweden are in a difficult position financially due to low wood prices. The real value of forest land is lower than today. The solid wood product industry in Sweden and Europe in general has invested a lot in technical development; integrated production units now supply high-tech timber construction components (including composites produced with nanotechnology) to meet the demands of an industrialised construction industry. The Nordic pulp and paper industry has seen further mergers. Cheap wood fibre has increased profits, but the bulk of pulp and paper is produced in the Southern Hemisphere. The pulp and paper industry still based in Sweden focuses on supplying value-added products. As a result of continued expansion of electronic media, newsprint production as well as consumption and exports have gone down dramatically.

II. As in scenario I, scenario II is characterised by a high degree of globalisation and rapid economic growth (albeit slightly slower than in scenario I). In scenario II, however, climate change and mitigation efforts are prominent Worldwide. There is also a high degree of environmental concern amongst the public as well as policy-makers. Transport

and energy costs are higher than in scenario I, but not drastically so due to continuous and successful substitution of bio-energy and bio-fuels, including those from woody biomass, for fossil fuels. Global population has started to decline, due partly to decreasing agricultural production in some areas (mainly the tropics) adversely affected by climate change. European population is declining and ageing. Plantation forests in the Southern hemisphere is increasingly being used to produce bio-energy feedstocks, and are the same time facing increased competition from alternative land-uses; agricultural production and non-wood sources of bio-fuel. Real prices of forest products have increased compared to today's levels. Global recycling rates have risen dramatically. In spite of reduced imports of wood raw materials and the fact that forest productivity in general has risen, harvest levels in the EU are, on average, not higher than today's levels, due to greater emphasis on nature conservation and biodiversity. Harvest levels fluctuate a lot on a yearly basis though, as a result of climate related calamities and ensuing salvage logging. Sweden faces an elevated net global demand for wood products. Although there is a strong focus on environmental issues also in Sweden, the annual harvest level in Sweden has increased significantly compared to today's level; forests exempt from conservation are intensively managed and rotations have been shortened. However, forests, mainly those with low wood production potential, are also managed for ecosystem services to a greater extent than today. In spite of technological improvements, employment in the Swedish forest sector is higher than today; a result of the elevated demand for wood and the growth of ecosystem services. Forest owners in Sweden have benefited from the development of bio-energy and the resulting increased competition for and hence prices of roundwood. The real value of forest land is significantly higher than today. High-tech sawmills benefits from the increased demand for energy-efficient, renewable construction materials, and obtains higher prices for secondary products due to expanding bio-energy markets. The wood-based panels industry, on the other hand, is not faring well due to intense competition for all its raw materials from the bio-energy sector. The Nordic pulp and paper industry has seen further mergers. Chemical pulp and paper units turned into bio-refineries are thriving. Mechanical pulp production, on the other hand, suffering from a growing bio-energy industry through higher prices for raw materials and energy while not experiencing any advantages, has all but vanished in Sweden and the rest of Europe. The same applies for Newsprint.

III. In this scenario, increased international conflicts as regards natural resources have resulted in a shift away from free trade and globalisation to a regime of strong regional trading blocs. The EU has consolidated its influence. The scenario is further characterised by moderate climate change and little mitigation, low environmental concern, relatively low transport and energy costs, and intermediate levels of economic growth and technological progress. Global population has stabilised, while the European population has already started to decline. Though climate change mitigation efforts are rather limited, the bio-energy markets in the EU have developed dramatically, as a result of an urge (and need) to be less dependent on fossil fuel imports. EU recycling rates are higher than today as imports of raw materials has decreased. Drastically reduced wood imports to the EU in combination with the high demand for wood in construction and for energy purposes increases the demand for European wood. As a result, harvest levels in the EU are considerably higher than today and forests are intensively managed. Real prices of forest products have increased compared to today's levels. For Sweden, net global demand for wood products is high. The annual harvest level and employment in the forest sector in Sweden are considerably higher than today. Forest owners in Sweden have benefited from increased roundwood prices. The real value of forest land is also higher than today. Sawmills benefit from the increased demand for energy-efficient, renewable construction materials, and obtains higher prices for secondary products due to expanding bio-energy markets. The wood-based panels industry, on the other hand, is in dire straits due to intense competition for all its raw materials from the bio-energy sector. The Nordic pulp

and paper industry is dependent on Nordic forest resources. The demand for paper, especially newsprint, has decreased. Only those pulp and paper units turned into bio-refineries make any profits.

IV. As in scenario III, globalisation has been replaced by regionalism. In scenario IV, however, climate change and mitigation are much more pronounced. There is also a high degree of environmental concern amongst the public as well as policy-makers. Transport and energy costs are higher than in scenario III. Global population has started to decline. The European population is declining and ageing. The economic growth is the lowest of all scenarios, and technological progress, centred on the development of bio-energy, is moderate. Drastically reduced fossil fuel imports and climate change mitigation have resulted in rapidly growing bio-energy markets. Real prices of forest products have seen massive increases, as has recycling. Recovered paper is increasingly being used for energy rather than in paper production. Since wood imports to the EU have virtually stopped, pared with the high demand for wood for energy purposes, the demand for European wood has increased tremendously. Due to adverse impacts of climate change and greater emphasis on nature conservation and biodiversity, harvest levels in South and Central Europe have, on average, not increased compared to today's levels. As a result, the demand pressure on Nordic wood resources has increased dramatically. Hence, Sweden faces an elevated demand for wood raw materials and wood products. Although there is strong environmental awareness, annual harvest levels in Sweden have increased significantly compared to today's level, as forests are intensively managed and rotations have been shortened. However, forests, mainly those with low wood production potential, are also managed for ecosystem services to a greater extent than today. Employment in the Swedish forest sector is much higher than today; the combined result of the elevated demand for wood, less mechanisation of forest operations, and the growth of ecosystem services. Forest owners enjoy high roundwood prices, and the real value of forest land has increased considerably. Sawmills prosper as a result of the combination of elevated demand for energy-efficient, renewable construction materials and rising prices for secondary products due to expanding bio-energy markets. The wood-based panels industry, on the other hand, is all but gone due to intense competition for its raw materials from the bio-energy and sawmill sector. The Nordic pulp and paper industry is dependent on Nordic forest resources. The demand for paper, newsprint in particular but also printing paper, has decreased. Only chemical pulp and paper units turned into bio-refineries are surviving.

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# Appendix 1. The effect of global forests products markets on other forest sector drivers

| Driver | How global forest products markets affects the driver |
|---|---|
| Norms & values | Changing land-use as well as forest management practices may lead to increased interest in nature conservation and biodiversity |
| Governance | Forest management may incite policy measures emphasising nature conservation and biodiversity |
| Climate change & policy | Limited influence except through emissions of greenhouse gasses via land-use conversions |
| Demographics | No influence |
| Land-use claims | Growing forest products markets and hence wood supply may lead to conflicts over land-use |
| Geopolitics | Limited influence, but globalisation could possibly provoke trade barriers in countries/regions loosing in competitiveness |
| Scientific & technological development | Little direct influence |
| Ecological catastrophes | Little direct influence, forest management may however exacerbate calamities, e.g., monocultures are prone to insect attacks and wind throw. |
| Energy | Woody biomass may substitute for fossil fuels |

# Appendix 2. The influences of other drivers on global forest products markets

| Driver | How the driver affects forest products markets |
|---|---|
| Norms & values | Public concern as regards nature conservation and biodiversity affects forest management practices and wood supply and thereby the net demand for wood |
| Governance | Policy measures focusing on nature conservation and biodiversity impact forest management and thereby, possibly, also wood supply |
| Climate change & policy | Climate change will affect forest productivity (growth, disturbances, succession) worldwide. Mitigation policy could boost demand for construction timber and woody biomass for energy purposes |
| Demographics | Population increases/decreases, number of households, degree of urbanisation and changing age structure of the population all influence the demand for forest products, as has already been related |
| Land-use claims | Competition with alternative land-uses, e.g. cattle production and non-wood sources of bio-fuel, affects wood supply |
| Geo-politics/ Conflicts | E.g., trade barriers affecting forest product trade, land-use security |
| Scientific & technological development | Research within forest management and silviculture, increasing forest productivity, and technological improvements in wood processing, conserving resources, both contribute to a dampening of global wood fibre demand |
| Ecological catastrophes | Potentially strong impact on wood supply in the short and medium term |
| Energy & transportation | Climate change mitigation policies and rising fossil fuel prices should increase the demand for bio-energy and thereby also woody biomass, creating new market opportunities for forest land |