Annex 1: Methodical Approach to Globalization Literature Review

Approach

Review of scientific literature and available studies on the main global trends and individual factors affecting forestry in the EU, discussion of major findings in general and in relation to EU forestry. The resulting "Globalization Factors and Trends" should be those most relevant for the forest sector in the EU and its development. As the results of this task set the stage and built an input for a number of follow-up tasks, including a more in-depth discussion of regional effects of globalization, the draft was sent to the Globalization Expert Panel for review and comments.

Methodology

Review and discuss relevant literature and results of studies of national and international organizations, research institutes, and universities. The work was implemented in three steps:
. Interpretation/scoping of "globalization" and database, literature ,and study review based on a literature review, focusing on the economic dimension of "globalization" rather than the wider socio-cultural dimension.

The literature review on economic globalization factors (see list of reviewed studies, Part A and B) showed consistently, that the following four factors are considered as the key factors of economic globalization.

1. Foreign direct investment,
2. Economic activity, including employment
3. Trade
4. Technology/know-how

A "**factor**" is understood as an "aspect that contributes to a certain issue in question," in this case "globalization."

On the basis of this literature review, the initial set of globalization factors originally included "institutional arrangement" was deleted as a globalization factor from the further analysis. The Task 0 output (methodological framework) was adjusted accordingly to allow subsequent consistency in implementation throughout subsequent tasks.

For each of these globalization factors, the most frequently discussed and/or measured dimensions were used as further sub-structuring elements. These were called "**indicators.**". These indicators, wherever possible measurable and quantifiable, were used as consistent reference within each of the factors in three different sub-sections per factor:
1. Globalization in general
2. Forest-based-industry-specific
3. Forestry-specific

Again, on the basis of the literature review, the initial set of globalization factor indicators in the initial output on indicators was adjusted accordingly to allow subsequent consistency in implementation throughout subsequent tasks. The initial output on indicators originally included a range of indicators and excluded other dimensions not originally considered as

indicators. In particular, a considerable number of indicators was adjusted to the most appropriate phrasing of the respective indicator content.

The secondary data and literature review on "Globalization Factors and Trends" covers scientific literature, particularly journal special issues on globalization (see list of literature), databases and reports on individual globalization indicators, including outlook studies. Literature and studies selected addressed the "Globalization Indicator—Forestry State and Development Indicator Impact Matrix." This covers the majority of the studies. It has the globalization indicators at its hard, quantitative core, but also extends to more qualitative aspects that are to be covered in descriptive form.

Other relevant globalization indicators and dimensions that are not covered by the indicators, particularly international institutional arrangements (e.g., global/multilateral agreements on trade [WTO], forestry certification schemes, and phytosanitary regulations), *were not taken into further consideration, as "institutional arrangements" was excluded from the set of globalization factors, following the literature review results (see above).* This was subsequently confirmed, as none of the literature on the other economic globalization factors in general or on the forest sector in particular puts explicit emphasis on these.

However, some members of the Globalization Expert Panel (see below) and the European Commission felt that these should be covered, even though they do not fall into the direct scope of the study, which is economic globalization. *Institutional factors were therefore included in the revision of the first draft report on the globalization literature review.* To be consistent, "institutional arrangements" are not discussed as an economic globalization factor (which they are not usually considered to be), but as changes in the context of **dimensions (or forces)** possibly or actually **driving** globalization as a whole or one of its main factors. These dimensions (or forces) are methodically mirrored through the PESTE framework:

1. Policy (understood to include institutional arrangement),
2. Economic (covered under economic globalization factors)
3. Social (including socio-demographic)
4. Technology (covered under economic globalization factors)
5. Environment

The PESTE framework was also used to cover other "Forestry State and Development Indicators" that characterize status and trends in forestry and their importance to the national economies; but they are not covered by the set of globalization factor indicators as described above. These include energy and environmental issues in particular, as well as policy/institutional change in the context of societal change.

2. The results of the literature review is described according to the structure outlined in step 1 above (i.e., for each globalization factor, the literature review results are presented consistently—as far as possible and where literature is available—according to a set of indicators for each of the three areas: general globalization, forest-based industry, forestry. The description of "Globalization Factors and Trends" covers, *as far as the literature is available*, presently observed effects, where and how in general are likely to impact on EU forestry overall, trends, and through case studies, where useful or where little hard quantitative data is available on specific important developments.

The resulting "Globalization Factors and Trends affecting Forestry in the EU" draft document describes the available literature findings on those factors and trends that are most relevant for

the forest sector in the EU and their development. They comprise factors characterized and described by quantitative state and trends as well as qualitative description of common sets of issues and developments.

The resulting "Globalization Factors and Trends affecting Forestry in the EU" draft of approximately 15 pages was reviewed by the Globalization Expert Panel, consisting of a total of 14 experts. Of these, seven persons responded. All well-recognized experts worldwide, commended the good quality and well-structured nature of the draft report, particularly given the limited time available. All made excellent suggestions for minor modifications. These mainly were:

1. To discuss the following additional aspects:
    - impacts of vertical integration,
    - global diffusion of common values and standards (see discussion on "institutional arrangements" above),
    - environmental issues as drivers of globalization (see discussion on "institutional arrangements" above)
    - the increasing role of R&D globalization
2. Comment on assertions made on specific aspects, including
    - trends in forest-based industry investments (also domestic, in new fields such as bio-refineries) and innovation competition
    - drivers for FDI, particularly downward prices for commodity products, but also increasing consumption in, for example, China
    - wood-revenue-based financing of European forestry and emerging alternative funding
    - the simultaneous competitiveness and complementarity of wood use for products and energy
    - the issues of carbon- and energy-related developments
    - expected future trends for mergers and acquisition in forest-based industry
    - request to add key references to substantiate key findings (experts were provided only with the 15-page document, not the Annex with references)

In addition, a number of specific further literature sources were provided by several experts.

Annex 2: Indicators

Note: This is a draft set of indicators outlining areas of relevance and interest regarding globalization issues. It is not a set of indicators where data or even information were necessarily expected (often, in fact, it is not). The set is adapted to tasks, as appropriate.

A2.1. Forest ownership and management

- Status and trends in forest ownership and management
- Status and trends in resource use
  (a) forest area available for wood supply
  (b) balance increment and removals

A2.2. Investment

- Status and change in investments in forestry
- Status and change in foreign direct investment

A2.3. Economic Activity (value added, growth, employment, profitability)

- Status and trends in value added and economic growth
  (a) status and change in value added.
- Status and change in productivity
  (a) status and change in productivity
  (b) labor productivity per hour worked
- Status and change in employment
- Status and change of cost structures
  (a) status and change of raw material cost
  (b) status and change in unit labor cost
  (c) status and change in energy costs
  (d) status and change of transport costs
- Status and trends in profitability and price structures
  (a) status and change in product and service price structures.
  (b) profitability and return on investment.

A2.4. Technology and Know-How

- Status and trends in technology use, by forest ownership size classes
  (a) role of ICT in the production process
  (b) technology vintage
- Human capital investment, by forest ownership size classes
  (a) categories of labor skills (high, high-intermediate, low labor skill)
  (b) sector-specific education
- Innovation and research investment , by forest ownership size classes
  (a) expenditure on innovation and R&D

A2.5. Trade

- Import
- Export
- Trade balance

Annex 3: Detailed Results Tables

A3.1 Foreign Direct Investment and globalization

A3.1.1. Investment and factors affecting FDI

	Status and trends
Outward FDI	- Over the period 1990–2000, foreign investment grew at a significantly more rapid pace than either international trade or world economic production generally. In 1982 the global total of FDI flows was US$57 billion. By 2000 that number had grown to US$1.271 billion—nearly 20 times the level of two decades earlier (Globalization101). - After World War II and until the early 1990s, the main source of external financing for developing countries was ODA provided by the governments of high-income countries. However, the fast growth of private capital flows to developing countries has overtaken ODA. Today, net private capital flows are a multiple of ODA. The structure of private flows also changed notably, shifting from a predominance of bank loans to FDI and portfolio investment, driven by rapid growth of transnational corporations and encouraged by liberalization of markets and better prospects for economic growth in a number of developing countries. The distribution of FDI among developing countries remains extremely unequal, with over one-third going to just two big countries—China and Brazil (World Bank, 2004). - After a peak recorded in 2000 (€437 billion), EU FDI outflows decreased continuously reaching €115 billion in 2004, 74% lower than in 2000. The FDI intensity of the EU15 followed the boom and bust of the stock market in the period 1995–2005: the direct FDI flow of the EU25 was €430billion in 2005, increasing from €330 billion in 2001, 70% of which went into services. The shares of EU FDI in 2003 were 41% to North America, non-EU Europe 23%, Asia 14%. (EUROSTAT). - China and India have become significant sources of FDI for both developing and developed countries. India's outward FDI stock grew from $US0.6 billion in 1996 to $US5.1 billion in 2003. China and India now occupy positions 54 and 72, respectively, (out of 132 economies) in terms of outward FDI performance (World Bank, 2007). - Cross-border M&As, especially those involving companies in developed countries, have spurred the recent increases in FDI (UNCTAD, 2006). - FDI is accelerated by technological innovations in communications and data processing
Inward FDI	- Inflows of FDI were substantial in 2005. They rose by 29%—to reach US$916 billion—having already increased by 27% in 2004. South, East, and Southeast Asia are still the main magnets for inflows into developing countries. Inflows to developed countries in 2005 amounted to $US542 billion, an increase of 37% over 2004 while to developing countries they rose to the highest level ever recorded—$US334 billion. In percentage terms, the share of developed countries increased somewhat, to 59% of global inward FDI. There was spectacular increase in investment to Asia (South, East, and Southeast Asia), as well as to Central and Eastern Europe, modest increases to Japan and the EU, and relatively smaller gains to all other areas of the world (UNCTAD 2006) - Services gained the most from the surge of FDI, particularly finance, telecommunications, and real estate (UNCTAD 2006) - The major destination of EU FDI flows among the Candidate Countries in 2004 was Romania with €2.6 billion and Turkey in 2003 with €1.1 billion (31% of Candidate Countries' total). Regarding the new member states, the first place was held by Hungary with €6.7 billion (63% of new member states' total), followed by Poland with €4.4 billion (42% of new member states' total).
General investment	- The global financial system is likely to change dramatically over the course of the next 25 years, as technological innovations and even greater integration of markets expand the reach of global financial intermediaries, with private equity and related investing having a time horizon of 5 to 10 years. New financial instruments with broad market access and fewer transaction costs are likely (UNCTAD 2005).

Factors	Additional drivers and issues
Policy	- The practice of granting certain kinds of tax and other regulatory exemptions to international investors through Export Processing Zones (EPZs) as well as regulatory exemptions to international investors in financial markets. - Continuing liberalization of exchange controls and market access and the attempt to draft a Multilateral Agreement on Investment (MAI), and its failure. - Further restructuring of public enterprises (via total or partial privatization) and foreign investment. - Liberalization continues, but some protectionist tendencies are also emerging (UNCTAD 2006).
Social	- Demographic shifts and consumption/investment power shifts, including investment and spending patterns according to age.
Environ-ment	- Risk, investment, and climate change as increasingly visible issues.

A3.1.2. Investment, globalization and forest-based industry

Indicator	Status and trends
FDI (outward and inward)	- The forest sector worldwide went through a strong restructuring process during the 1990s, influenced basically by globalization. The restructuring process was based mainly on the consolidation process through M&A operations. Despite the relative importance of DI in the forest sector, the data available on such investments are limited. An IMF article has made reference to the role of private investments in the forest sector in comparison with other sources. The article pointed out that the total amount invested in 1993 in the forest sector worldwide (US$21.5 billion) was concentrated in private (46.5%) and domestic public investments (46.5%) and that ODA was responsible for only 7% of the total (Tomaselli, 2006). - According to UNCTAD data, the worldwide FDI in agriculture, forestry, hunting, and fishing activities combined reached US$1.8 billion in 2001–2003, representing around 3.5% of the total FDI worldwide in the primary sector. The worldwide entry of FDI into the forest industry (wood and wood products manufacturing) reached US$2.3 billion in 2001–2003, which represented 4.5% of the FDI in the secondary sector and only 1.4% (2001–2003) of the total global FDI (primary, secondary, and tertiary sectors). Over the years DIs have generally contributed more than 90% of the total value invested, amounting to around US$60 billion per year (Tomaselli, 2006). - Total direct private investment (in the forest sector) rose from US$30,000 million in 1992 to US$118,000 million in 1998 and then went down to an estimated US$98,000 million in 1999. More significant is the fact that in 1992 private direct investment accounted for only 19% of total net resource flows from OECD/DAC countries and multilaterals, while it had reached more than 50% by 1999. Crossley *et al.* (1996), as cited by Greig-Gran, suggest that overall capital flows to the forest-based sector in developing countries is in the billions of dollars. (Gregersen and Contreras, 2001). - Private FDI in the forest sector considerably exceeds public official development assistance (ODA). In recent years, forest financing has been characterized by an increase in FDI in developing countries to approximately US$8–10 billion a year, and a decline in ODA to about US$1.75 billion a year (PROFOR 2003). - Most of the future investments in the forest industry will continue to be concentrated in the pulp and paper segment. To a lesser extent, but also importantly, investments will continue to flow to the reconstituted wood panel segment, mainly for MDF and OSB production. (Tomaselli, 2006). - DI in the pulp and paper segment in the short and medium run will be driven to maintain the growth in production observed in the past few years. DI will be concentrated in countries with a low cost of wooden raw material and high market potential, for instance, Brazil, China, Russia, and some Eastern European countries. The perspective is that FDI flows predominantly from the USA toward Latin America and from Western Europe toward Eastern Europe and Russia. The expectation is that the international trade may grow strongly in the coming years for forest product exports from Eastern European countries, Russia, and Brazil (Tomaselli, 2006). - M&A in the forest industry will likely continue in the future, but at a slower pace than observed in the past, given the changes in the world economy and competition regulations. The

	latter will in the short term be a strong barrier for the M&A. As for newsprint, for instance, the top five world producers already account for 85% of the production capacity in Western Europe. In the case of magazine (couche) paper, the top two world producers control 50% of the European market. Within this context, it is important to consider that regulation of competition will certainly call the attention of European companies to investing outside the region, primarily in Asia and in South America (IADB, 2004). - In the United States, the industry has been divesting itself of its ownership of forestlands. In the past 25 years, industry lands have been reduced by 50%, with nearly half of that decline in the past decade. Simultaneously, the industry has increased its ownership of offshore forestlands (Bael and Sedjo, 2006). - In Russia, current investments are largely focused on the development of basic production capacity, such as production of logs and timber for export. Longer-term development is likely to turn to production of value-added products. A current effort to establish large-scale wood processing facilities along the Russian–Chinese border provides an indication of what the future may hold (Taylor, 2004). - Other countries that are currently building capacity in the forestry and wood products sector include several countries in the Asia and the Pacific region, a number of countries in Eastern Europe, and several countries in Latin America, most notably Brazil and Chile. The key producing countries in the southern hemisphere (Argentina, Australia, Brazil, Chile, Indonesia, Malaysia, New Zealand, and South Africa) have slowly but steadily raised their contribution to global wood products exports over the past four decades, from under 6% to more than 16% (Whiteman, 2003). In tropical countries there is a clear trend toward development of capacity for production of primary processed and secondary processed products, with most of the output intended for export markets (Johnson, Adams and Miyake, 2003; Bowyer 2004). - In the EU net flow in FDI was negative in 2003–2004, with about €1 billion inward investment per year in wood, publishing, and printing (EUROSTAT). - FDI in pulp and paper products tends to be around 10 times higher than FDI in other woodworking industries (e.g., US FDI [year 2000] in wood products is US$1.5 billion compared to US$15 billion in paper products). - In 2004, 68.2% of the investment in Stora Enso was of a transnational nature (US$15,467 million in foreign assets). The company is number 85 in the world's top 100 non-financial TNCs, ranked by foreign assets (UNCTAD, 2006). - Globalization has also taken many companies in the forest cluster overseas. They have internationalized at least as rapidly as companies in the paper field. Outward (outside EU) investments are expected to be in the billions of euros. For example, Finnish forest companies had already invested nearly €2 billion in China by 2005 (FFI, 2005). - Inward investment particularly in United Kingdom publishing and printing in 2003–2004 (EUROSTAT). Metso, a Finnish supplier of paper machines, says that over one-third of its present order backlog is from China (FFI, 2005). - European forest-based-industry investments have been made and the capacity is expected to increase by some 10% for the pulp and paper industry, by some 13% for the panels industry, and by nearly 15% for energy plants within the next five years, representing an additional need for 30 million m^3 of wood in that period. One reason for this growing capacity is the expected increase in the consumption of paper and board and other wood-based products, mainly because of opportunities offered by the accession of Central and Eastern European countries to the EU. Apart from this result an extra amount of some 80 millions m^3/year is estimated to be needed to meet EU commitments in the field of renewable energy sources by 2030. (CEPI study, Galembert, Brasov 2003).
Domestic investment	- Numbers on domestic direct private investment in forestry and related forest-based activities are unavailable on an aggregate basis. Grieg-Gran *et al.* (1998) indicate the same point related to portfolio investment in forest-based activities (Gregersen and Contreras, 2001). - According to estimates the amount of DI (direct investment) in the forest sector on a global scale exceeds US$60 billion a year, which represents about 1% of total DI in the world. In the forest sector, following the general trend, DDI (domestic direct investment) has a predominant share (Tomaselli, 2006).
Factors	**Drivers and issues**
Policy	- EU integration is driving investment in new accession states. - FDI into Russia is being held back because of ambiguous legal systems; difficulties in negotiating with local authorities; unfair tax enforcement; and general political instability as the main impediments to FDI in the sector. The main limitation so far is represented by limited

	investment. Total investment in Russian FDI is less than half that in Finland, and only a negligible part of this is represented by foreign investment, as foreign investors remain wary of the overall business climate of the country and its geopolitical risk. This could change. - Effects of energy strategy and bio-energy directive on investment.
Social	- Effects of demographic shifts on consumption.
Environ-ment	- The Global Forest Vision 2050 (PROFOR, 2004) study predicts that by the middle of the 21st century, 40% of global forests will be managed primarily for the protection of biodiversity and other forest environmental services. - Effects on restrictions to resource access (Natura), EFSOS etc. - Effects of climate risk assessments in investment decisions.

A3.1.3. Investment and forestry

A3.1.3.1. Direct and indirect through the forest-based industry

Indicator	Status and trends
Outward and inward FDI	- The emergence of regions with large forest plantations with the availability of fast-growing, low-cost raw materials has attracted capital investments and promoted the development and expansion of a forest industry. New important players in wood products manufacturing and consumption include China, other Asian countries, Russian Federation, Eastern European countries, and some Latin American countries (Tomaselli, 2006). - Considering economic profit and lack of proper incentives, under the given circumstances, the response to investing in SFM has been worse than investing in other land uses. Some trends in development financing suggest that SFM faces a change in the financial environment but, unfortunately, nothing indicates that official flows would reach the required levels in the short or medium term (Tomaselli, 2006). - Under current conditions, "mainstream" international financial forest investors are not even close to considering investments in natural forests in poor countries. There were only three significant new international investments in sustainable management of natural tropical forests: the Precious Woods investment in the Amazon, the GMO investment in Gethal Plywood in the Amazon, and the Candlewood Timber Group investment in Northwest Argentina. There has also been a major initiative for a fund and a major investment in the temperate Notofagus forests of Southern Chile and Argentina. The largest and most important initiative to date is the Precious Woods Company, whose biological assets in Costa Rica are valued at US$29 million while those of Brazil are valued at US$12.5 million (2002 data) (Schmidt, 2003). - DI concentrates mostly in developed countries and on forest plantations and related downstream industrial processing and trade projects. This has resulted from the nature of the investment projects with their focus on economic returns. Of the total invested, around 30% is driven toward SFM (forestry) and the remaining 70% to forest-based industries and trade (Tomaselli, 2006). - FDIs concentrate on the improvement of the economic return of transnational corporations, mostly from the pulp and paper segments, and in M&A. Trends in the latter have been on investments in the southern hemisphere (e.g., Brazil, Uruguay, Chile, New Zealand). Information on the percentage of FDI actually applied in SFM is scarce (Tomaselli, 2006). - In the past few years, forestlands and especially forest plantations have been the main target for FDI. Within such a context, it is important to consider the role of TIMO (Timberland Investment Management Organisations), which have been outstanding in terms of DI, both as DDI, or FDI (Tomaselli, 2006). - There has been very rapid and continuous growth in investment in timberland from financial sources in the USA, growing from almost nothing to timberland assets valued at US$11 billion by 2002 over the last 15 years. Investments occur in both plantations and natural forests in the USA. The ultimate sources of most of this capital are large pension funds and endowments. The motivation is financial: to improve the risk/return profile of a portfolio. There are two major forestry-related shifts associated with this investment. First, large tracts of forest land in North America are being transferred from timber products companies to financial investors. Second, fast-growing plantations in six countries in the southern hemisphere are expanding rapidly and providing supply for the growth in global pulp consumption. It is reasonable to assume that this kind of financial investment could spread

	globally. From 1960 to 2000 timberland investments produced an annual return of 13.8%. The S&P 500 Index for equities (US and multi-national) for the same period was 11.6%. During the 20th century southern and northwestern United States softwood stumpage prices increased at about the same rate as the S&P 500 (Schmid, 2003). - Forest assets usually have value added lower than in the forest industry. As previously mentioned, FDI in forest assets have been mainly directed toward developing countries. In this case, some Asian and Latin American countries have been a target of FDI. In Indonesia, for instance, the Swedish-Finn Stora Enso Oy invested around US$100 million in fast-growing acacia plantations. In Brazil and Uruguay, heavy investments in eucalyptus and pine plantations have been under way or announced, in several cases by some global private companies such as International Paper and Stora Enso (in Brazil) and Botnia and Weyerhäuser (in Uruguay). Moreover, it is important to single out the FDIs being made in large-scale fast-growing forest plantations through TIMOs in North and South America, some European countries, and Oceania particularly: in the USA, Canada, New Zealand, Argentina, Brazil, Chile, and Uruguay, (IADB, 2004). - The total investments in the forest sector are expected to continue at the same level observed in the recent past. DI (private sector, DDI, and FDI) will continue to be responsible for the largest share (about 90%), and ODA will probably have its importance gradually reduced. Innovative financing approaches may become a focus of investments and contribute to filling in the gap left by the reduction on ODA SFM funding (Tomaselli, 2006). - DI in the forest sector will likely maintain its current level of investment but will probably be redirected toward southern hemisphere countries, given their comparative advantages (e.g., high forest productivity, low labor costs, available resources, others). The new class of forest assets (timberlands) will continue to gain importance, and TIMOs will increase their role in developed and developing countries. TIMOs will be mainly concentrated in forest plantations and will be the predominant form of FDI from the USA (and a few other developed countries) toward Latin America (Argentina, Brazil, and Chile) and Asia/Oceania (New Zealand, Australia, and China). Investments by TIMOs in most cases do not represent, in principle, investments in forest base expansions, but rather the control of already existing forest resources. In view of the reduction in investment options, TIMOs may anyway be driven to greenfield forest projects, therefore contributing to expanding forested areas (primarily fast-growing plantations) (Tomaselli, 2006).
Effects of domestic investment on forestry in the EU	- There will be further pressure on restructuring of public enterprises (via total or partial privatization) and access to foreign investment. - Decreased demand is expected for raw material for respective industries as pulp and paper investments in production facilities and tree plantations. - There will be pressure on prices of raw material from globalized industries, as business development will be guided by cheap or fast-growing wood resources and rapidly growing paper markets.

A3.2. Economy – A globalizing economy

A3.2.1. General economic activity

A3.2.1.1. Value added, productivity, profitability

Indicator	Status and trends
Value added	- The size of the global economy is set to double between 2005 and 2030, in real terms, while developing countries' aggregate output would triple, raising their share in the total from 23 to 33% (at constant market prices) (World Bank, 2007). - Industry value added is around 28% of GDP (World Bank Development Indicators).
Industry structure	- According to estimates, transnational companies (TNCs) now comprise some 77,000 parent companies with over 770,000 foreign affiliates. In 2005 these foreign affiliates generated an estimated US$4.5 trillion in value added, employed some 62 million workers, and exported goods and services valued at more than US$4 trillion. The TNC universe continues to be dominated by firms from the Triad—the EU, Japan, and the United States—home to 85 of the world's top 100 TNCs in 2004 (UNCTAD, 2006).
Production	- Increasingly global sourcing of resources (material, energy, skills, and services). Increasingly global sourcing of low to high services due to falling telecommunication costs and greater

	openness to FDI enable different parts of the services value chain to be performed in different locations around the globe, increasing service competition. While absolute numbers to date are not large, growth rates have been high and global sourcing of services is expected to grow by 30% per year over 2003–2008 (World Bank, 2007). - Increasingly, interdependency and global competition resulting in business model changes and changes in system of production: core-competency specialization in differentiated products with an increasingly large technological content, cooperation agreements, and networks/clusters to generate synergy. - Increasing innovation competition, as a key source of variations in productivity and economic growth between countries—innovation competition drives the market even more than price competition but innovation moves around the world and its pace is quickening. Fear of failure even more than hope of profit drives the constant striving for innovation. This is an inherent feature of competitive market systems (a "hard-wired" feature of competitive capitalism). - Realization that it is not about entire "sectors" of an economy prospering or being out-competed and whole classes of workers being affected (blue collar workers), but rather individual tasks. International competition plays out not just at the industry or even the firm level, but right down to the level of individual tasks—assembly, packaging, data entry—that cut across whole sectors of the economy.
Productivity	- Over the past decade, labor productivity in the world increased by almost 11%. This was mainly driven by the impressive growth in labor productivity in East Asia (75% between 1993 and 2003), but also in South Asia and Southeast Asia, which have experienced considerable increases in their labor productivity levels (37.9% and 21.6%, respectively). Labor productivity growth in the industrialized economies also surpassed world productivity growth with an increase of 14.9%. The transition economies have experienced impressive labor productivity growth rates since 1999 and have thereby contributed to the world's recent growth in productivity. Over the past ten-year period labor productivity grew by 25.4% in that region. (ILO, 2005) - Higher incomes are produced in the long run primarily through productivity growth rather than factor accumulation. With declining labor forces in some countries and declining labor force growth in all, productivity will play a more prominent role in maintaining economic growth over the next 25 years (World Bank, 2007). - Increasing productivity pressure spurred by open markets and trade, very rapid total factor productivity (TFP) growth in the 1960s, followed by a decade of stagnation coinciding with the energy crisis of the 1970s, recovery to an estimated rate of 0.8% per year in the 1980s and 1990s, and an acceleration in the 2000s. There have been large variations across regions and time (World Bank, 2007). - The struggle regarding labor cost competition will prevail in the coming years. The strategies most widely used are mainly reactive (i.e., cost reduction through automation and enhanced labor productivity). The new member states will, in the very near future, exploit their existing cost advantage but will lose it faster than competitors outside Europe. Without their own innovation capacities for absorption and enhancement, this foreign direct investment will just pass through these member states in a decade. In any case, outside and within Europe labor-cost competition is characterized by job losses in manufacturing (FHI, 2005).
Factors	**Additional drivers and issues**
Policy	- Expected continuing removal of obstacles to market access. - Regulations creating a demand pull for eco-sustainable manufacturing based on new products, new materials, competition with energy, and, last but not least, advanced product service systems (FHI, 2005).
Social	- Effects of demographic shifts on consumption.
Environ-ment	- Energy scarcity and energy risk as issues. - Climate risk as production/location risk.

A3.2.1.2. Economic activity, globalization, and forest-based industry

Indicator	Status and trends
Value-added and economic growth	- Total gross value added in the (formal) forest sector has not changed much during the 1990s, with an average value of US$342 billion per year (in real terms) and annual figures within +/- 5% of this average. In 2000 total gross value added in the forest sector amounted to US$354 billion. Among the three subsectors, the pulp and paper industry makes the largest contribution to GDP, accounting for about half of the total gross value added in the forestry sector. The wood industry is the next largest contributor, with a 30% share of the total, while forestry activities account for the remaining 20%. This distribution of the value added across subsectors remained stable in the 1990s (FAO, 2004). - The forest-based industries account for about 8% of the total value added in the manufacturing industries in the EU. The pulp and paper industry together with the paper converting industry has a value added of about €50 billion per year, while the value added in the printing industry is about €45 billion and about €30 billion in the woodworking industry (EU comm. consult., 2006). - Value added per unit of output has generally increased or remained about the same in the forestry and wood industry subsectors, but has declined in the pulp and paper industry (because of falling real prices). The major exceptions to this are Western Europe and the developed Asia–Pacific regions, where value added per unit of output has declined in the forestry and wood industry subsectors, because of increased competition from neighboring regions (FAO, 2004). - During the last decade, the contribution of the forestry sector to GDP has declined from just under 1.6% in 1990 to just over 1.2% in 2000. This decline has occurred because the global economy has expanded (i.e., global GDP has increased by 30% over the last decade) while value added in the forestry sector has not increased at all. At the regional level, most regions display the same downward trend, except Eastern Europe and the Latin America and the Caribbean region (FAO, 2004). - The wood products industry is currently moving increasingly toward niche markets and value-oriented growth instead of relying on volume-oriented growth and low-cost strategies (EU comm., 2006).
Production economic growth	- With some exceptions, the trend in consumption over 1961–2000 is upwards for all regions and wood product categories. The main exceptions are for roundwood and sawnwood because of reduced consumption in both Japan and the former USSR (FAO, 2004). - World production of processed wood products has been increasing since the 1960s for each of the four main product categories: sawnwood, pulp, paper and panels, with paper and panels showing the highest rates of growth. Sawnwood production has been more cyclical, such that current production levels are only slightly higher than at the beginning of the 1980s (FAO, 2004a). - Increasing population, greater urbanization, and rising incomes will result in continued strong growth in global consumption of most products. It is anticipated that consumption will grow most rapidly in developing countries where many countries may move from being net exporters to net importers in some forest product categories (FAO, 2004). - Softwood sawnwood production in Europe is expected to continue to increase reaching nearly 105 million m^3 in 2010. However, overall annual growth is estimated to be slower than that seen during the last decade because of restricted consumption growth in Western Europe and key overseas markets. Overall consumption is expected to increase by approximately 7 million m^3 by 2010. Hardwood sawnwood production is expected to increase moderately until 2010 reaching close to 15 million m^3. The softwood sawnwood industry is characterized by an increasingly consolidating industry, where the top ten producers increased their share of production from nearly 15% in 1995 to over 20% in 2002 (JPC, 2004). - Plywood production in Europe is expected to experience only a slight decline. Overall consumption is predicted to decline slightly as OSB continues to take market shares. MDF production in Europe is expected to grow significantly to 2005 and 2010 (JPC, 2004). - The production of wooden furniture is expected to increase to around €60 billion by 2010 from the current €54 billion. The growth in Western Europe is predicted to be moderate whereas Eastern Europe is expected to face strong development (JPC, 2004). - The demand for wood fiber is increasing, with industry alone expected to need 1.9 billion m^3 per year by 2015. Demand for paper-making fiber is projected to increase by 126 million tons,

	with recovered paper expected to meet approximately 70% of that demand. Recovered paper supply is tight, raising the demand for hardwood (PROFOR, 2004). - The main market for the forest industry is still Europe, and is likely to remain so (high "self-sufficiency," high share of value-added production in Europe. - Structure of industry, particularly the share of micro enterprises and SMEs will likely follow the trend of larger companies, internationalization being an increasingly attractive option for all size classes. -Increasing costs for wood raw material and energy in the EU would enhance the advantage of locating additional production to third countries rather than in the EU itself. In particular, pulp production can achieve substantial relative cost advantages with production localized in tropical and subtropical areas. The EU industry would also have to consider the possibility of increasing competition from Russia which has vast forest resources. For the printing industry, there are also signs that globally integrated printing and publishing markets are being created, underpinned by technological change (EU comm., 2006). - There is a very interesting situation in Eastern Europe that has arisen because of the profound social, political, and economic changes that have taken place there during the last decade. Forestry sector employment has fallen but is still relatively high given the overall size of the forestry sector in this region. Exports are significant and have increased dramatically over the last decade. The main problem in this region is that the level of value added in the sector is comparatively low and has fallen significantly over the last decade (although it has started to rise again in recent years). A comparison of the figures for employment, value added, and trade suggest that there is substantial potential for development of the forestry sector in this region. However, there is also a significant need for investment in new technology, improved marketing, and an upgrading of human resources. The challenge for policymakers and the forest industry in this region will be to assess whether to follow the development model of the developed regions (i.e., substituting capital for labor) or to pursue expansion of the sector on all fronts (FAO, 2004).
Productivity	- In particular, labor productivity in the pulp and paper industry has increased significantly over the last decade, perhaps because of increases in the scale of operations. The one exception to these general trends is Eastern Europe, where labor productivity has fallen in the forestry and wood industry subsectors. This follows from the significant fall in production in this region over the last decade, which has not been matched by the fall in employment numbers (FAO, 2004). - Productivity increases in the wood industries are -3 to 6 and 3 %/worker/year. In the pulp and paper industry they are 1 to 6 and 4%/worker/year. High rates of increase have been sustained over rather long periods of time in some countries. This is expected to continue (UNECE/ILO, 2003).
Industry structure change	- Wood products manufacturing activity is beginning to shift from developed to developing regions. At the same time, industrial wood products consumption is growing in the developing regions. In view of the many factors underlying these changes, future wood products production and consumption patterns are likely to be driven much more significantly by developments in China, elsewhere in the Asia and the Pacific region, Latin America, South Africa, the Russian Federation, and Eastern Europe than by industrial growth in countries long recognized as the most economically developed. Several of the largest emerging global economies, most notably China, appear to have targeted this sector as a focus of employment and industrial growth. Other regions have moved aggressively to create plantations of fast-growing trees and to position themselves for future forest-sector development (Bowyer, 2004). - The developed countries will continue to maintain market share through attention to technology and product design, but it is expected that the burgeoning technical capacity in developing nations, coupled with low wages, ample natural resources, and policies directed toward value-adding processing will continue to drive the shift toward exports in processed and SPWPs from developing nations. Developing countries such as Argentina, Brazil, Chile, China, Indonesia, and South Africa can be expected to become increasingly important world producers (FAO, 2004a). - The reemergence of the Russian forest sector will add substantial volumes of wood to the global supply. With more than 50% of world softwood resources and hardwood forests that cover a slightly larger area than the hardwood forests of the United States, the Russian Federation has the potential to provide very large new supplies of wood and wood products to world markets. The Russian government has recently estimated that its potential for annual production of timber is 559 million m^3 (Benin, 2004). Given the Russian harvest levels of

	recent years (172 million m^3in 2002 [Ekström, 2003]), over two-thirds of the potential Russian harvest represents new supplies for future export and wood products manufacturing (Bowyer, 2004). - The influence of the rich softwood log supplies from Russia is likely to be felt in several ways: (i) The Russian sawmilling and plywood industry keeps expanding. (ii) The new Russian sawmills and plywood mills are built to international standards, and have the additional benefit of inexpensive wood and labor costs (and possibly low energy costs, too). (iii) There will be plenty of FDI in this sector in Russia, as Western industry takes advantage of the favorable conditions. (iv) An oversupply of logs will remain, which can to some extent be exported to European markets (Indufor Oy, 2004). - China: One of the industries singled out for attention by Chinese planners is the wood products industry and the hardwood products segment, in particular (furniture, moldings, flooring, kitchen cabinet components, and paper and fiber products). As China has relatively little forest cover and much of it is off limits to harvesting, the country has turned to massive importation of both hardwood and softwood logs and timber, as well as waste paper to supply the growing wood products industry. Chinese waste-paper imports have increased by an estimated 19 to 34% over the past three years (Fales, 2003). The upward trend of imports is expected to continue. Other countries are losing market share to Chinese manufactured wood products and are likely to continue to do so. For instance, partly as a result of a 2,366% increase in the value of Chinese furniture exports to the United States from 1993 to 2003, hardwood timber consumption by the United States furniture industry has been reduced by over 60% in just the past five years (Meyer, 2004) (Bowyer 2004). - China: From a total output value of US$157 million in 1978, Chinese furniture production expanded to US$16.9 billion in 2001 involving 50,000 enterprises and nearly 5 million employees (FAO, 2004). - Overall, the woodworking industries present a more fragmented industry structure and smaller corporate entities than is found in key competing materials industries, such as steel and cement. There are significant variations in the level of secondary wood product industry fragmentation and consolidation among different European countries. Although the majority of the secondary processing industries in Europe consist of a large number of SMEs, there are a growing number of large companies in the joinery, building, and construction components, as well as parquet industries that are increasingly dominating national market but are also gaining ground at the pan-European level (JPC, 2004). - The Scandinavian sawmill industry will face increasing difficulties in domestic log procurement, resulting in stagnating output, whereas producers in the British Isles (low capacity utilization) as well as in Eastern and southern Europe (greenfield investments) are expected to have an increasingly significant role in European supply. Further capacity increases are expected in Eastern Europe partly resulting from wood raw-material sourcing by large integrated forest companies in the Nordic countries and also from domestic industries exploiting the production cost advantages. However, tightening raw material supply in some regions (e.g., in the Baltic countries), will drive the expansion to Central and Southeastern Europe. The increasing share of capacity under Western ownership drives the shift toward further processing and consequently enhances the (price and) export outlook/opportunities. The leading supply countries, Sweden, Finland, and Austria, are expected to retain their roles as the major net exporters in Western Europe. Hardwood sawnwood production is expected to shift from west to east following the gradual move of the secondary processing industry which is the main driver for the hardwood sawnwood business. Consequently, production of traditional hardwood sawnwood, mainly oak and beech, in both France and Germany, is expected to decrease. The consolidation, internationalization, and forward integration of the softwood sawnwood-producing industry is expected to continue over the coming years, but the majority of production capacity will still reside within small and medium-sized businesses with one or only a few production units and processing operations tied to a specific country or region (JPC, 2004). - Plywood production decreases in Western Europe are expected to be balanced by increases in Eastern Europe. Further rationalization in France and Italy, plus the contraction of German industry (both structural and nonstructural plywood), is offset to some extent by the strong production of Scandinavia (mainly structural). The lower cost of beech in Romania erodes German cost-competitiveness (mainly non-structural). Latvia is now the largest producer of (mainly structural) plywood in Eastern Europe (JPC, 2004). - The Nordic and central European businesses are increasingly expanding processing into

	Eastern Europe, utilizing the benefits of low-cost production resources and growing markets (JPC, 2004). - A significant contraction and consolidation of the distribution and retail sectors of the wood products trade have taken place over the last decade in Europe. This development has been particularly apparent in the major markets for wood products, such as the UK and France, where the top ten companies in the builders merchant and DIY sectors hold between 55% and 75% market share and the number one company holds around 20% market share (JPC, 2004).
Cost structure	- As markets become more globalized, companies tend to rely more on plantation forests than on natural ones, particularly in the southern temperate and Asian countries, where labor and materials tend to cost less (MEA, 2005). - Falling transportation costs, spurred in part by increased trade in manufactured commodities, help lower shipping costs for relatively low-value material, such as wood chips or other unprocessed fibers. Increasingly, chip exports are being based on plantation forests in subtropical and tropical regions instead of primary forests or low-value secondary forests in temperate regions (MEA, 2005). - To the extent that the cost of energy rises in response to fossil supply changes, forest product technologies that are energy-intensive will become less competitive, and raw material costs will rise, reflecting the relative increase in scarcity. Recycling mills have less opportunity to use biomass fuels (MEA, 2005). - According to a recent estimate, energy amounts on average to about 13% of total costs in EU paper and paper board mills (Jaakko Pöyry, 2006). Paper manufacturing based on virgin fibers requires 550–1000 kWh per ton, chemical pulp 400–750, mechanical pulp 1400–2900 and paper making based on recycled paper 20–300 kWh per ton (Chemical Pulping, Gullichsen, J. and Fogelhol, J; Jyväskylä, 2000). - As is well known, wood raw material is the largest cost element in most of the forest-based industries. In paper making more than 30% of total costs relate to wood (fiber) costs and in the sawmill industry, this is 65–70% (EU Comm., 2006). - Rising costs of raw material push the establishment of cost-efficient collection systems for used paper and wood products. - The increase in demand for wood for paper production has been limited because the share of paper production based on recovered paper products has increased substantially, currently amounting to almost 50% of total fiber input. - Forest industry companies have growing incentives to relocate their production to rapidly growing markets (e.g., Asia, Latin America, Russia) and to areas where raw material and labor are comparatively cheap. - In some segments EU manufacturers in the woodworking industry (including furniture) might be facing imports that are priced below production costs (EU Comm., 2006).
Profitability and price structures	- For nearly all (forest) products and countries (in the context of the EFSOS study), nominal prices in US$ per unit of forest product were rather stable from 1964–1973, increased until 1974 when they declined, then increased again until 1979. In 1982 there was a relatively steep decline, followed by an increase until 1989, then a strong decrease until about 1993, followed by an increase until about 1996, and then a decrease. Clear high-price years follow closely the consumption and production patterns observed in *Figures 1–5* and the economic growth shown (Solberg, 2005). - Market competition encourages firms to relocate production facilities or to buy production inputs in regions where there are lower labor costs, easier access to resources, higher timber yields, good governance, political stability, functioning logistics and service, availability of recycled fiber, or any combination of these factors, which can bring costs down and increase profits (MEA, 2005). - Increasing prices for fossil fuels are likely to encourage more rapid development of biomass-based fuels, and their emergence could provide outlets for low-grade timber products that currently lack markets. - Long term availability of raw materials (including recycled raw material flows). - Within the pulp and paper industry in particular, and also in parts of the wood panels industry, the number of producers selling on the global market is increasing (EU comm., 2006). - Consolidation as a consequence of low market performance caused by chronic excess supply: As the pulp and paper industry is characterized by pronounced economics of scale, production is dominated by large plants and large enterprises. Vertical integration is very common between pulp and paper production. Some of the larger EU pulp and paper corporations operate on a global basis with production units in Asia and North and South America, in addition to the

	European ones. In a global comparison, the largest European pulp and paper corporations were among the top five worldwide. However, the concentration level in many of the EU pulp and paper product markets is not very high. The other sectors of the forest-based industries are fragmented and dominated by small and medium-sized enterprises, the average-sized enterprise having less than 10 employees. Currently, the EU forest-based industries are competitive with, for example, labor productivity in the pulp and paper industry being about 20% higher than the corresponding industry in USA and the printing and publishing industry showing even higher advantage (over 30%), while the woodworking industry is on a par with the US industry. The North American pulp and paper industry is currently focusing on cost reduction and is divesting itself of non-strategic assets. A revival in capacity is not expected (EU Com, 2006).
Factors	**Additional drivers and issues**
Policy	- Developments in Russia, including forest rights and stumpage prices or export restrictions, have major effects on the present competitiveness of the EU FBI. Softwood pulp production in Russia is highly competitive and can be sold at half the price of French or Finnish pulp.
Social	- There are no major factors known to date that radically support a significant growth in the demand for wood products in Europe, despite the ongoing and increasingly positive development in Eastern Europe. Instead, demand drivers provide a moderate to weak outlook, and competition from substituting materials and products will increase. It is thus clear that active measures will be required to increase wood products and combat competition, to allow healthy development of the wood working industries (JPC, 2004). - Effects of demographic shifts on consumption.
Environ-ment	- Global wood demand by 2045/50 will be about 2 billion m^3 a year and supply should be about the same, with Asia contributing about 700 million m^3 and North America about 1 billion m^3 (FAO, 1998). The availability of logs from Russia is often acknowledged as one of the key strategic variables of the EU FBI. - Energy-intensive industries will face increasingly high pressure in the context of the climate regime. - As non-renewable fossil energy supplies decline and new sources of renewable energy are sought, the implications for the supply and consumption of forest products are significant. - Climate-change-related carbon accounting and harvested wood products. - Emissions from the global forest products industry value chain are expected to remain constant or decline slowly as the effects of increasing production are offset by improvements in the emissions intensity of manufacturing and reduced emissions from products in landfills. Carbon sequestration in products will become an even larger part of the industry's profile as the demand for forest products increases in response to population growth and increasing standards of living (Miner, 2006).

A3.2.1.3. Economic activity, globalization, and forestry

Indicator	Status and trends
Resource base and resource supply	<u>Forest resources/resource availability:</u> - The total world productive forest plantation area was more than 109 million hectares in 2005, which represented more than a 44% increase over the 76 million hectares of global productive forest plantations in 1990 (FAO FRA, 2006). - The emerging southern hemisphere plantations now supply about 500 million m^3/yr, and this is projected to grow to 1 billion m^3/yr. over the next 100 years when it will equal the supply from temperate forests (Sohngen *et al*., 2003). - The (World Bank/WWF Alliance) Vision of Global Forests for the Year 2050 predicts that by the middle of this century, 40% of global forests will be managed primarily for the protection of biodiversity and other forest environmental services. Community and privately owned woodland, which has more than doubled in area in the last decade, might be expected to double again. In 2050, 50% of industrial roundwood demand will be for pulp and paper. While much of the softwood needed for pulp and timber will come from Canada and Russia, increasing volumes of hardwood fiber will come from private-sector-financed plantations in countries of the southern hemisphere and in China. This would create increasing opportunities for smallholders and local communities to play a significant role in world pulpwood supply. There is growing recognition that there are real possibilities for the production of industrial wood to be combined with the protection of biodiversity, forest carbon, and water resources—a belief that is underscored in the Bank's 2002 Forests Strategy. This vision of global forests suggests

	that, notwithstanding the inevitability of the further transfer of forest land to agriculture, by 2050 the global forest area will be approximately the same as it is today (PROFOR, 2004). - Europe has experienced a quite steady general increase in forest area over the last 50 years (1950–2000). During the last 50 years the forest area in Western Europe has increased by almost 30%. The growth was significantly lower in Central and Eastern as well as in southern Europe, with about 20% and 16%, respectively. In the CIS and northern Europe, the overall increase in forest area was rather low at roughly 5% over the period analyzed. The increase in forest area in Russia amounts to more than 40 million hectares over the period analyzed. The growth in forest area has slowed down notably since the beginning of 1970s in all sub-regions, with the exception of Western Europe (Gold, 2003). - Over the period 1950–2000, the growing stock expanded much more than the forest area. Growing stock (per hectare) almost doubled in Western Europe. It has increased significantly in Central, Eastern and northern Europe and has even risen in southern Europe by more than 20%, while in the CIS the growing stock is generally still at the starting level (Gold, 2003). - Western Europe has an increased increment of roughly 80% over the period under analysis, whereas the increment in the other analyzed sub-regions show only a 20–30% increase (except the CIS with almost no increase) (Gold, 2003). <u>Roundwood supply:</u> - Overall, world industrial roundwood production fluctuated somewhat between 1980 and 2004, with a net increase of 14% from 1980 to 2004. The data show that most regions have increased their industrial roundwood production over this time frame. The one glaring exception is the former Soviet nations. At the time of the break-up of the Soviet Union in 1991 and in the ensuing transition years, production in these nations diminished significantly from a high of over 300 million m^3 in 1988–1990 to less than 100 million m^3 by 1994 (FAOSTAT database). - FAO estimates that the plantation share of roundwood production will grow from the current one-third to almost half of total global production by 2040. Roundwood production from plantation forests is likely to provide 906 million m^3 by 2045 compared with 331 million m^3 in 1995 (FAO 2000c, 2001a). In the near future, production from plantations will significantly increase because of the age structure of the current plantations. In 1995 it was estimated that some 55 million hectares of plantations were younger than 15 years, and some 22 million hectares were in the 0–5 year age class (Brown, 2000). Many of those plantations will be coming into harvest age between 2005 and 2010, and to the extent that they reflect the enhanced yields being pursued through improved varieties, fertilization, and other management improvements, their impact on markets will be significant. - Except for smaller reductions in 1966, 1968, and 1972, EU/EFTA had a rather stable increase in industrial roundwood harvest from 1964–1990 and from 1991/92–2000 (Solberg, 2005). - Assessing the future availability of roundwood with the EFISCEN model, Nabuurs *et al*. (2005) indicate an expected shortfall in Europe of 50 million m^3/year by 2020, and growth thereafter.
Value added, industry structure, and economic growth	<u>Value added:</u> - The forest-based industries account for about 8% of the total value added in the manufacturing industries in the EU. The pulp and paper industry, together with the paper converting industry, has a value added of about € 50 billion per year, while the value added in the printing industry is about €45 billion and about €30 billion in the woodworking industry (EU cons 2006). <u>Industry structure:</u> - Fragmentation of private forest ownership may be seen as a negative factor leading to higher cost in forest management and in the mobilization of wood (EU, 2006). -Hardwood production, primarily of fast-growing varieties, is tending to move to the southern hemisphere, but northern hemisphere natural coniferous forests, particularly in Russia, continue to be competitive suppliers of softwood (PROFOR, 2004) - Products requiring large volume of virgin fiber and those whose value can match high transportation cost continue to be produced in high-price countries. - Achieving a significant decrease in capital intensity and increased production flexibility through process innovations are a key challenge (FTP, 2006a). - Wood energy received a boost from record high oil prices and new government policies to promote renewable energy sources and mitigate climate change (UNECE, 2006). - The supply of direct wood energy (not including the expected contribution from industry residues or recovered wood) can be expected by policymakers to increase from about 160 million m^3 in 2003 to about 260 million m^3 in 2010, an increase of 100 million m^3 (60%) in seven years (Becker *et al*., 2007).

Productivity	- Productivity increases in forestry have ranged from negative to 10% per year with many countries at around 3–4%/worker/year (UNECE/ILO, 2003). - The European Technology Platforms observed that the European primary wood processing industry would have to work with considerably increased material efficiency and lower energy consumption to meet global competition, (UNECE, 2006). - High and increasing demand for raw material (maximum biological potential removals at about 780 million m^3 in 2020, ETTS V). - Newton (2003) suggests that volumes in planted northern conifers can be improved by 7–26% at rotation age through genetic improvement. - Labor productivity pressure to reduce cost; labor productivity will rise, but less than in forest-based industry. For example, from 1955 to the mid-1990s, labor productivity in logging in the USA increased by an average of 1.45% annually (Perry, 1999).
Employment	- Paper consumption is expected to increase at the fastest pace in Asia and especially China, over 4% a year. In Eastern Europe and Latin America, growth in demand will be nearly as fast. According to a study conducted by Jaakko Pöyry Consulting, between now and 2015, global demand for paper and board will increase by 120 million tons, with China's share estimated at 35 million tons. If the growth in demand is to be satisfied by paper machines located in China, during the next ten years, China will have to introduce eight 450,000-ton paper machines a year (FFI-2005). - Global wood demand by 2045/50 will be about 2 billion m^3 a year, and supply should be about the same, with Asia contributing about 700 million m^3 and North America about one billion (FAO, 1998).
Cost structure	- Pressure to mobilize resources, including practical cooperative measures, should be encouraged, as should the development of forest property markets. - EU forest owners are facing increasing difficulty in competing because their production costs are higher than those of low-cost competitors outside the EU. - To obtain an economic and environmental balance, key challenges would be to use forest biomass for products and energy, substantially improve the industry's energy efficiency, and develop and design products that can be recycled, reused, and finally converted to bio-energy (FTP, 2006a).
Profitability and price structures	- Economic incentives for the establishment of agriculture or forest plantations devoted to woody crops grown specifically for energy production and promotion of wood mobilization - Gradual further opening of the EU CAP regime, releasing large areas of land for competitive use. - In addition to the industry's need for raw material, there are other increasing demands on EU forest resources, resulting from policies concerning, for example, climate change, biodiversity, habitat conservation, the use of renewable energy, and recreational and other social activities. The value of environmental and social functions is not reflected in wood revenues.

A3.2.2. Employment

A3.2.2.1. Employment and labor

Indicator	Status and trends
Share of employ-ment	- The last decade has witnessed a decline in the share of the world's working-age population (15 years and older) in employment (known as the employment-to-population ratio). It stood at 61.4% in 2006, 1.2%age points lower than 10 years earlier (ILO, 2007). - In 2006 the share of employment in the service sector in the total global employment progressed from 39.5% to 40% and, for the first time, overtook the share of agriculture, which decreased from 39.7% to 38.7%. The industry sector represented 21.3% of total employment (ILO, 2007). - Below-replacement fertility prevails in the more developed regions and is expected to continue to 2050. Fertility is still high in most least-developed countries and, although it is expected to decline, it will remain higher than in the rest of the world. In the rest of the developing countries, fertility has declined markedly since the late 1960s and is expected to reach below-replacement levels by 2050 in most (UN WPP, 2005). - By 2030 China and India together will account for about 40% of the world's workforce, which will remain predominantly unskilled. By 2030 the world's labor force will number some 4.1 billion workers, 90% of whom will live in the developing world. The global labor force is predicted to grow by about 1% per year over 2001–2030 (World Bank, 2007).

	- Global competition is tight for the standard tasks for which global markets exist, both in manufacturing and services. As individual tasks can be offshored, globalization may help some workers in a given firm while harming others. - Close to 20% of total employment could potentially be affected by information and communications technology-enabled offshoring of services (OECD, 2005).
Wages	- The share of working-age population (20–65) without formal education will decline from roughly 30% to some 20% in 2020 (Lutz *et al*., 2004). - The pace of labor force and employment growth in the EU25 will be weakly positive over the next 15 years and will turn negative over the period 2018 to 2050. This is mainly the outcome of projected declining trends for the working-age population and a shift in the age structure of the population toward older, less economically active groups; a consequence of the baby-boom generation approaching retirement and the succeeding lower-birth-rate cohorts reaching working age (EU, 2005). *Globalization has generally been associated with rising average wages,* but it imposes adjustment costs on certain groups within countries, primarily through labor markets—by influencing wages and job security, by requiring retraining, and through the upheaval of moving between jobs. The unskilled have seen their wages worsen relative to skilled workers and their jobs become less secure. This is the case even in developing countries (World Bank, 2007). - All empirical studies, including those done by some of today's top trade economists (such as Paul Krugman of Princeton and Robert Feenstra of the University of California, Davis), show that the adverse effect of trade on wages is not substantial. Our own empirical investigation concludes that the effect of trade with poor countries may even have been to moderate the downward pressure on wages that rapid unskilled labor-saving technical change would have caused. Second, the same goes for the econometric studies by the best labor economists regarding the effects of the influx of unskilled illegal immigrants into the USA. The latest study by George Borjas and Larry Katz of Harvard also shows a virtually negligible impact on workers' wages, once necessary adjustments are made (Bhabgwati, 2007).
Skilled versus unskilled worker	- Globalization tends to place a premium on people with a high level of skill, high education level, and high entrepreneurship. There is competition for skills and talent within both industry sectors but, more importantly, among sectors. Most often the attractive industries are dynamic ones with high rates of innovation (higher competitiveness, higher wages). - While average wages rise more rapidly in open economies than in closed ones, increasing relative demand for skilled labor is widening the wage gap between skilled and unskilled workers in both developed and developing countries (World Bank, 2007). - There is a rotation in value added toward skilled workers, with their total share increasing from 11% to 17%; this is largely taken from the share of capital which declines to 47% from 59% in 2005. Some 30% of the increase is determined by the increase in unskilled wages and 15% by the increase in skilled wages (World Bank, 2007). - Agricultural workers will constitute a shrinking share of the world's labor force, declining from about 43% in 2001 to about 30% in 2030. While the share of agricultural workers will fall by about half in developed countries, the stark decline is from an already low base (from 4 to 2.6%) (World Bank, 2007). - The skill premium tends to increase in most regions. This reflects the assumption that skilled labor is a complement to capital, thus demand for it increases more rapidly than supply. The skill premium increases most rapidly in those countries with a high investment rate. A second factor is the relative glut of unskilled workers as the rural exodus—largely an unskilled phenomenon—continues (World Bank, 2007). - Pressures on unskilled workers will intensify in both developed and developing countries. Greater global competition, along with more rapid technological change and diffusion, can increase wage and employment volatility. Global sourcing of services exerts pressures in the same direction. Unlike displacement in low-skilled manufactures trade, the offshoring of services has the potential to destroy the previous investments of white-collar workers in firm-specific knowledge (World Bank, 2007). - It is not globalization but labor-saving technical change that puts pressure on the wages of the unskilled. Technical change prompts continual economies in the use of unskilled labor. Such technical change is quickly spreading through the system. This naturally creates, in the short run, pressure on the jobs and wages of the workers being displaced. But we know from past experience that we usually get a J-curve where, as increased productivity takes hold, it will lead to higher wages. The intensity of displacement of unskilled labor by information-technology-based change is continuous now. The pressure on wages is becoming relentless, lasting over

	longer periods than was the case in earlier experience of unskilled labor-saving technical change (Bhagwati, 2007). - Flexibility is the key to allowing Europe to seize the opportunities of globalization while minimizing the adjustment costs. Globalization's correlation between skill groups and winners and losers breaks down. Certain highly skilled tasks may turn out to be offshorable, while other highly skilled tasks are not. Increased offshoring will therefore not systematically help or hurt skilled workers (Baldwin, 2006).
Factors	**Additional drivers and issues**
Policy	Government measures for employment protection tend to have the effect of protecting only *some* workers (insiders, usually prime-age males) at the expense of others (outsiders, usually youth, women, and low-skilled workers). In the OECD countries, partial reforms have tended to reinforce labor-market inequality, with temporary contracts for new entrants (youth or women) but only limited access to more permanent jobs. (OECD 2005d, 2004). Policies shift the emphasis from measures designed to protect those in employment—which, as discussed earlier, can discourage job creation—to mechanisms aimed at ameliorating the potentially negative effects of greater labor movement (World Bank, 2007).

A3.2.2.2. Employment, globalization, and the forest-based industry

	Status and trends
Status and change in employ-ment	- Total employment in the (formal) forestry sector increased by about 4% over the last decade, from 12.4 million in 1990 to 12.9 million in 2000. At the global level, employment is divided roughly equally between forestry activities, the wood industry, and the pulp and paper industry. However, at the regional level, forestry activities are relatively more important than processing activities in developing regions (FAO, 2005). - In recent decades there has been a decline in the labor inputs required by the forest products industry, where employment has experienced similar declines to many other extractive and manufacturing industries[1] (MEA, 2005). - The current labor force in the forest industry cluster in Europe is about 3.9 million full-time equivalents. Pulp and paper is the smallest subsector in employment terms with just 27% of the total. Forestry and the wood industries share the balance about equally between them (UNECE/ILO, 2003). - Employment has been declining substantially. In the 1980s and 1990s this decline has mostly affected the countries of northern and western Europe. In the future, assuming continued increases in labor productivity, reductions in employment levels are expected to be largest in Central and Eastern Europe as well as in the CIS. The total workforce is expected to shrink by 6.9% between 2000 and 2010. It should be noted that values for individual countries and subsectors vary widely around this average (UNECE/ILO, 2003). - At the global level, the forest sector currently employs about 0.4% of the total labor force and this figure has fallen very slightly during the period 1990 to 2000. The contribution of the forestry sector to total employment is generally higher in the developed regions and Eastern Europe than in developing regions (FAO, 2004).
Level of education, wage, etc.	- Regarding employment quality, wage levels in the pulp and paper industry compare favorably with those in the other two subsectors and with manufacturing wages in general. Remuneration is typically significantly lower in wood industries and forestry. Female wages continue to be significantly lower than male ones (in the pulp and paper industry, 30–39% lower), a situation that needs to be remedied if the sector is to attract more female workers in the future (UNECE/ILO, 2003).

[1] Over the period 1997–2003 employment in the paper and paperboard production fell by one-third (US Bureau of Labor Statistics, 2004).

A3.2.2.3. Employment, globalization, and forestry

Indicator	Status and trends
Status and change in employ-ment	- Globally, reported employment in forestry declined slightly from 1990 to 2000, by about one million (or 10%) (FAO FRA, 2006). - Forest utilization continues to be intense, but much fewer local people benefit from it. - The scenario suggests that the rural exodus could be a significant factor in the years ahead, with the share of agricultural workers dropping from about 51% currently to less than 35% in 2030. This should raise average wages for rural workers (decreased urban wage premium) (World Bank, 2007). MEA-Timber: Mechanization of timber harvesting has reduced employment in the forestry sector, particularly in the tasks of felling trees and transporting logs. However, mechanization has been key to improving forest management and has led to reduced injury and mortality in the sector. - The continued decline in employment will further reduce the visibility of the sector and partly reduce its direct benefits to society. Rural livelihoods will be most affected as the losses are concentrated in forestry and in small firms in the other subsectors. If the forest industry is to make a contribution to rural development in Europe, growth patterns need to be reviewed and altered. Small enterprise development, including forestry contractors pursuing a strategy of quality and higher value added in addition to providing and marketing nontraditional goods and services, will be important elements of any strategy to address the withdrawal of the forest sector from rural areas and the continued shift toward capital intensive modes of production. Key players in the forest sector (in particular, those from Nordic countries) are acting more and more globally, shifting capacities toward Eastern Europe because of lower production costs and expected increases in the demand for forest products. This process depends on further stabilization in the policy framework as well as on the economic growth in these countries. This will have an additional impact on employment in the traditional producer countries. In spite of the decline in employment volumes, the sector is likely to be faced with difficulties in finding adequate employees with related timber qualifications in the future, not least because of demographic trends in Europe. These shortages may only affect the inability to attract new entrants with good qualifications and potential, or it may translate into absolute shortages. In some major producer countries, shortages are expected to limit the potential for growth in output. This issue would appear to merit closer scrutiny at the national and local level. Improvements in employment quality, such as wages, training, and career prospects, as well as working environment and safety, will be critical to maintaining adequate levels of new workers, in particular, women. (UNECE/ILO. 2003).

A3.3. Trade and Globalization

A3.3.1. Trade status and trends

Indicator	Status and trends
Share of total exports in GDP	- The tremendous growth of international trade over the past several decades has been both a primary cause and an effect of globalization. The volume of world trade since 1950 has increased by 20-fold from US$320 billion to US$6.8 trillion (globalization 101). - World trade has exploded since the early 1960s. World exports have grown from just under US$1 trillion a year (in dollars, year 2000 value) to nearly US$10 trillion a year, that is, annualized growth of some 5.5% per year. Exports are clearly outpacing global output, which increased at some 3.1% per year over the same period. Between 1970 and 2004, the share of exports relative to global output has more than doubled and is now over 25%. A large part of the opening of domestic economies can be attributed to unilateral decisions, as in China and India (World Bank, 2007). - Trade in services has been growing at a pace similar to trade in goods at the global level. Rising from US$358 billion in 1984 to US$2,000 billion in 2004, the share of services exports in total exports of goods and services has advanced modestly from 16% to 17.5% (World Bank, 2007). - Many countries that report to the IMF do not report service exports and imports, but those that do reported exports of $US1,885 billion and imports of $US1,887 billion in 2003 (IMF 2006). Of these countries, the 145 that reported both goods and services exports and imports reported

	exports of services that were 25.7% of exports of goods, and imports of services that were 25.4% of imports of goods (IMF, 2006), close to one-quarter (Lipsey, 2006). - Between 1970 and 2004, exports as a proportion of world output doubled to more than 25%; new technologies have diffused rapidly across the globe, and the total private financing of developing countries reached nearly US$1,000 billion in 2004. Globalization is likely to remain a driving force, with exports as a proportion of world output likely rising to 34% by 2030 (World Bank, 2007). - World merchandise exports rose 13% in 2005), for the first time exceeding the US$10 trillion mark. Commercial services exports rose by 11% to US$2.4 trillion in 2005 (WTO, 2006). - Trade integration will accelerate. The trade dimension of globalization has perhaps been the most prominent, especially with the emergence of Asia and the transition economies over the last two decades. Growth in trade has outpaced growth in output by a factor of two or more, and the causes behind this phenomenon are in place to sustain it over the next two decades. While the standard theory of trade has focused on comparative advantage, new trade theory places much more emphasis on the role of specialization through consumers' desire for greater varieties and through production networks that allow for the breaking up of the production process across multiple firms and/or countries (World Bank, 2007). - Product markets are rapidly integrating, with a geographical redistribution of manufacturing taking place. Two challenges are particularly demanding: one is the rise of China, India, and other emerging economies as manufacturing powerhouses, and the other is the emergence of global sourcing of services. India and China's sheer size raises the specter of surging new export competition. Many developing countries fear that exports from these large new players could swamp their domestic markets, squeeze them out of the global market, foreclose avenues of diversification in manufactures as a road to higher growth, and gobble up all the investment flows. And high-income countries worry that if the large emerging economies can readily acquire and master the newest technologies, their exports may soon take over high-tech markets. China as an emerging market offers enormous offsetting opportunities for other developing and developed countries. Accompanying the rising value of exports and domestic living standards in emerging economies will be rising wages (World Bank, 2007). - Production is further divided into separate fragments that can be spread around the globe, with an increasing "trade in tasks." As globalization has advanced, it has become easier to move some of these tasks offshore. The ease of trading a particular task is a matter of degree, not kind; and it is a variable, not a constant. Hence tasks that seem safe from foreign competition today may not be so tomorrow. Finally, the tradability of a task might bear no relation to the amount of skill it requires. There is an expanding feasibility of offshoring formerly non-tradable services (World Bank, 2007).

A3.3.2. Trade, globalization, and the forest-based industry

Indicator	Status and trends
Status and change in geographic timber trade flow patterns, volumes, relative trade balances	- Despite global expansions in international trade, the vast majority of all wood-based production is destined for consumption in the domestic markets of producing countries (FAO, 2004a). - Intraregional trade flows account for the bulk of world trade. In 1997, 78% of Europe's forest product imports in value terms came from within the region, up from 70% in 1962. Similarly, there was increasing emphasis on intra-regional trade in Asia and the Pacific, where in 1997, 81% of exports in value terms stayed within the region, compared with 55% in 1962 (Wardle and Michie, 2001). - The trends in industrial roundwood emphasize the rapidly expanding dimension of international trade. Export volume has almost trebled since 1961, with global exports of industrial roundwood exceeding 114 million m^3 in 2000 (FAO, 2004a). - The real value of forest products exports rose by nearly 50% over the last decade to reach a level of US$144 billion in 2000. Furthermore, international trade in forest products has generally expanded at similar rates in both developed and developing countries. At the regional level, exports of forest products are dominated by the three developed regions. For example, in 2000, Western Europe and North America together accounted for about three-quarters of global forest products exports, followed by the developing Asia-Pacific region (with a 10% share). Furthermore, most international trade in forest products is either trade among these three regions or among countries within each of these regions (FAO 2004a). - International trade in forest products has increased at a rate that is much faster than the increase in production. The global value of timber harvested in 2000 was around US$400

	billion, and around one-quarter of that entered world trade, representing some 3% of total merchandise traded. In constant dollar terms, global exports increased almost 25-fold between 1961 and 2000 (MEA, 2005). - The value of world trade in the main categories of wood products is estimated at approximately US$140 billion in 1997, with paper accounting for nearly half of this. An alternative estimate comes to US$155 billion (FAO, 2004a). -Trade is becoming more important— paper and sawnwood have both gone from less than 20% of production going to export at the beginning of the 1960s to around 30% in the late 1990s. Panels have become more of an export commodity since the mid-1980s, with over 30% of production now being traded internationally (FAO, 2004a). - Despite the rapid growth in international trade, the growth in forest products trade has been less than the growth of trade in other merchandise goods. The share of forest products in total merchandise exports declined from 2.9% in 1990 to 2.2% in 2000. This downward trend also appears in all regions except Eastern Europe, where recovery in the forestry sector has generally been more rapid and successful than in many other parts of the economy (FAO 2004). - Five countries—the United States, Germany, Japan, the United Kingdom, and Italy—imported more than 50% of world imports in 2000, while Canada, the United States, Sweden, Finland, and Germany accounted for more than half of exports. During the past decade, China has increased its imports of logs and wood products by more than 50% and, if unabated, this rate of increase will put significant pressure on wood supplies in many regions, particularly Russia and Southeast Asia (MEA, 2005). - China has become the world's largest log importer, producing primary and secondary processed products for domestic and export markets; Chinese exports compete with UNECE region producers (UNECE, 2006). - Central and Eastern European countries and Russia continue to accelerate out of the socio-economic transition period with increased exports, including value-added wood products (UNECE, 2006). - Global interregional wood raw material trade findings: (i) Wood raw material trade is becoming increasingly global; (ii) Chips and particles trade is on the increase, as is roundwood; (iii) Plantation wood is increasing faster than other sources of wood raw material; (iv) Europe has very many links with the external world and internally; (v) The EU15 has a very significant internal trade in wood raw materials; (vi) Russia is the largest single source for Western Europe's imports; (vii) The AC10 is a net exporter now, but local processing will soon be growing; (viii) Internal trade within the EU25 will be mostly from the East to the West; (Indufor Oy, 2004).
Factors	**Additional drivers and issues**
Policy	Although the EU itself has no import tariffs on pulp or paper products and generally low tariffs on wood products, EU industry is faced with significantly higher tariffs in some third countries (EU Com, 2006).

A3.3.3. Trade, globalization, and forestry

Indicator	Status and trends
Status and change	- Securing the availability of renewable raw materials, while supporting the varied uses of forests and safeguarding biodiversity through sustainable forest management is a key strategic challenge (FTP, 2006a).
Trade flows	- Seen from the context of resource peripheries, certification is part of an emerging regime of production–consumption relationships, where political barriers to trade, production, and investment are complemented by technical practices purportedly designed to codify wood and fiber quality. We would argue here that forest certification and ensuring standards represent a new basis of value creation and competition (Stringer, 2006). - Trade based on unsustainable practices in forest operations has been seen as a major factor contributing to deforestation and forest degradation, particularly in developing countries. In a number of tropical countries in Africa, Southeast Asia, and the Guyana Shield, export-oriented production has apparently accounted for a significant share of forest loss and degradation. In addition to direct impacts, indirect effects, such as opening up forest areas for encroachment,

	can become or can trigger underlying causes of deforestation (FAO, 2004a). - Between 1961 and 2000 production of wood forest products measured in roundwood equivalents grew by 1.12% per year while the volume traded increased by 3.88% per year (FAO, 2004a).

A3.4. Technology and know-how, and globalization

A3.4.1. ICT, logistics, knowledge production and R&D

Indicator	Status and trends
ICT use	- In the 1960s, transatlantic telephone lines could accommodate only 80 simultaneous calls between Europe and the United States. Today, satellites and other telecommunications infrastructure can handle one million calls at any one time (globalization101). - Technology has been advancing rapidly—particularly technologies that shrink the world, easing the flows of goods, capital, and technology. The improvements in telecommunications are the most striking example. The expansion of computer networking has vastly changed the way large companies organize production and has permitted the introduction of production networks that span the globe. These same networks also open up market opportunities for small firms that are no longer limited to regional markets. Improvements in transportation technology have also been impressive. The introduction of the container in the 1950s reduced the cost of loading a ship from US$5.83 per ton to 15.8 US cents, and even more savings came from the vast reduction of time ships spend in port for loading and unloading (see Levinson, 2006). - The evolution of communication through information technology is one of the key elements of globalization. The invention of new devices of communication like the fax machine, mobile phones, computer, and Internet have made the communication network much cheaper and more accessible to ordinary people. The efficient communication network played a vital role in the growth, productivity, and new employment opportunities. The micro processor and cheap memory revolutionized the communications industry in the 1980s. The rapid decline in the real price of telecommunications provides impetus to the global networking of computing through the Internet. - Innovations in several key areas in ICT development, namely, the Internet, mobile telephony, geographic information systems (GIS), and multimedia, have sparked a new "digital revolution." However, the full promise of the new ICT and the Internet has not been realized. ICT poses a "digital challenge" to governments in terms of its proper use in policy and administrative practice and the proper regulation and governance of ICT at the national and international level. Contentious issues range from intellectual property rights to security and taxation. Another challenge is the mastery of opportunities that ICT provides in the field of e-governance at the international level. A third area is the concern about the widening digital divide between developed and developing countries and regions (WSIS, 2003). - While the dissemination of information and communication technologies has been one of the most decisive factors in accelerating the process of globalization, the diffusion of technology at the global level may not have advanced at as swift a pace as international trade or direct investment (OECD, 2005).
Logistics	- Revolutions in transport and communications technologies have led to enormous reductions in cost, allowing tasks to be separated in time and space and weakening the link between specialization and geographic concentration. Instructions and information can be effectively conveyed over long distances and intermediate inputs can be transported quickly and much more cheaply than before. Thus, increasingly it is tasks, in addition to final goods and services, that are exchanged across national boundaries, resulting in global production networks of activity in a wide range of sectors (World Bank, 2007).
Innovation	-Global firms derive knowledge to develop their technology and innovate from a variety of information centers located in different countries. This is a phase dominated by the setting up of numerous research and innovation laboratories outside the countries of origin or the acquisition of existing laboratories. The greater the extent to which these laboratories produce new technologies for world markets, the more it advances the globalization of the firms and industries concerned (OECD, 2005). - Speeding up the transition of the sector from being largely resource-driven to being market- and knowledge-driven is integral to success. As a result, the sector needs to extend its

	knowledge base from being mainly technological to also include human sciences (FTP, 2006).
Share of international R&D expenditure	- In the early stages of development, economies compete price-wise. At these stages, what matters is to get the "basics" right. By "basics" we mean the institutional environment that guarantees basic property rights, physical infrastructures, and maintaining a minimum degree of macroeconomic stability and a good level of basic education and health. At intermediate levels of development, economies need to become more sophisticated. Thus, at that level we believe economies should make a greater effort to improve advanced levels of education and training, the efficiency of their labor, goods and financial markets, and adopt the most up-to-date technologies (even if these technologies have been invented elsewhere). Finally, in the most advanced stage of development, firms need to innovate in the sense of creating both new products and a more sophisticated business environment (with innovation in business practices) (WEF, 2007).

A3.4.2. Technology, know-how, globalization, and the forest-based industry

Indicator	Status and trends
Status and trends in technology use, by forest-based industry classes and size classes	- Despite many firms having high Internet access and a large proportion of employees using computers, the extent of firms using e-commerce is still very low, although it is increasing substantially. The proportion is smaller in the manufacturing sector (e.g., in the forest industry) than in the service sectors. E-commerce use is currently most significant in tourism, media and printing, banking, insurance, and ICT services and retail. Some of these sectors are important for the forest sector, which may therefore need to move faster in the direction of e-commerce (Hetemäki and Nilsson, 2005). - Summarizing ICT impacts on the forest sector to date, the following observations can be made. First, ICT implementation in the forest industry and wood production sector has been along "installation period" lines rather than making the kind of ground-breaking advances expected in the "deployment period." Perhaps the important exception is the globalization of the forest industry, which has been greatly enhanced by ICT development, with fundamental changes being made as a result to the industry's operating environment. Second, many ICT impacts on the forest sector are indirect. That is, ICT changes society in general which, in turn, changes the forest sector. There are also indirect ICT impacts within the forest sector itself, with many of the fundamental impacts relating to forest industries and their markets rather than to forests themselves. However, the changes in forest industries and markets have, in turn, important implications for how we use forests. The present study reflects that situation. It emphasizes the importance of having a good grasp of how ICT impacts on the forest industry and markets, before drawing conclusions about its impacts on forests (Hetemäki and Nilsson, 2005). - There has been a structural change in communication paper markets in a number of the countries of the OECD, and ICT has probably played a central role in these. The traditional market analysis and long-term consumption projections are also less useful here—and may even provide qualitatively false projections. In the OECD, the future trend is likely to favor electronic media at the expense of printed newspapers. Newsprint consumption in a number of OECD countries has already declined and is likely to do so even more in the future. In summary, the structural changes in communication paper markets due to ICT will probably be substantial both in terms of volumes and prices. We are at the beginning of the process of paper substitution due to ICT developments (Hetemäki and Nilsson, 2005).
Human capital employed	- There can be fundamental bottlenecks impeding technology adoption, the most important of which are insufficient knowledge and capacity within the recipient country (Indufor, 2003).
Innovation and research investment	- Engineered wood products are becoming increasingly common as a result of reductions in the availability of high-quality structural wood, competition from steel products, and cyclical wood prices. These products, derived from new technologies, essentially turn low-quality wood and wood residues into products valuable for construction and furniture (Enters, 2001). The use of engineered wood products in the North American market, for example, has grown at a rate of 20% per year since 1992, reaching more than 29 million m^3 in 1997 and is projected to rise to over 45 million m^3 by 2005 (Taylor, 2000). If the use of these technologies continues to spread, the pressure on some ecosystems and high-quality species will be eased (MEA, 2005).

	- The impact of ICT on consumption patterns for forest products has been an issue of great interest for a long time, especially on the future use and consumption of paper products. The possible impacts of ICT have been most clearly identified and are perhaps most significant for these products. The future prospect of a "paperless office" has already been predicted for decades, but has to date not materialized as foreseen (Hetemäki and Nilsson, 2005). - Engineered wood products, which are environmentally friendly and efficiently produced and used, have continued to make inroads into traditional wood products markets and to fend off competition for non-wood substitutes (UNECE, 2006). - A large number of innovation and R&D aspects are addressed in the Forest Technology Platform Vision 2030 document and Strategic Research Agenda, including advances in genetic materials, sorting and grading systems for roundwood, logistics, processed materials, and final products, all with potential for optimizing materials efficiency and making production more reliable. Technologies for producing new panel-type products and three-dimensional materials also have promise. These new wood-based products are for traditional applications and also for many uses outside the wood sector, including vehicles, textiles, medical, electronics, and food (FTP 2006a and b). - The EU is today the overall technological leader in the forest-based sector, although this does not mean that it has leadership in all technological areas. - The biomass refinery is poised to move quickly beyond the concept stage, with a major research effort now under way involving both the wood products and agricultural sectors in both the USA and Europe.
Factors	**Additional drivers and issues**
Policy	- In Europe, the European Commission has co-funded the establishment of the forest-based sector technology platform with a view to increasing R&D and a long-term strategic development of the sector (FTP 2006a, b) - In the United States, the federal government and the pulp and paper industry have cooperatively designed and funded research programs to develop new approaches. One result in North America is radical new thinking about the future nature of paper manufacturing. A transformation of the entire industry to a biochemicals, biofeedstock, bio-energy, pulp and paper industry is envisioned, with individual mills operating as integrated biomass refineries. Under this scenario, manufacturing centers will have the capacity to produce electricity, liquid fuels (such as ethanol), and a wide variety of biomass-derived chemicals and chemical feedstocks, in addition to pulp and paper (Bowyer, 2004). - In Europe, wood is expected to become more important as a source of energy, and policies to facilitate and guide the development of wood energy are being drafted.
Environ-ment	- Climate change will push technology development for reduced emissions and reduced energy intensity.

A3.4.3 Technology, know-how, globalization, and forestry

Indicator	Status and trends
Innovation and research investment	Research and technological development, diversification, innovation, and investment in job quality and human capital are needed to develop a strong and dynamic sector capable of meeting the challenges of global change (EU Com, 2005).

A3.5 List of Reviewed Studies

A. Globalization in general: introduction and definitions

– Manning, S. 1999. Introduction to Special Issue on Globalization. *Journal of World-Systems Research*. 5(2):137–41.

– Bata, M., Bergesen, A.J. 2002. Global Inequality: An Introduction to Special Issue on Global Economy: Part I. *Journal of World–System Research*. 8(1):2–6.

– Andersen, T.M., Herbertsson, T.T. 2003. Measuring Globalization. IZA Discussion Paper. 2003:817. Bonn: IZA

B. Overall globalization factors and trends

General
– World Bank 2007. Global Economic Prospects—Managing the Next Wave of Globalization, World Bank,
– Stiglitz J. 2006. Making globalization work; Norton, NY
– Wolf, M. 2004. Why Globalization Works; Yale Press, New Haven
– OECD 2005. Economic Globalization Handbook; Organization for Economic Cooperation and Development; Paris.

FB-I
- Bael and Sedjo 2006. Toward Globalization of the Forest Products Industry: Some Trends; Resource for the Future. Washington D.C.
- Nilsson S. 2006. Globalization and Economic Growth: Energy and Environmental Constraints; Paper to the Seminar on the Globalization Challenges for Europe, 17 August 2006 Helsinki, Finland
- Nilsson, S. 2004. Signposts for Tomorrow's Pulp and Paper Industry. Paper presented at the Confederation of European Paper Industries (CEPI) Annual Meeting, 2 December, Brussels, Belgium. International Institute for Applied Systems Analysis, Laxenburg, Austria.

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C. Globalization indicators

1) Investment

General
- UNCTAD World Investment Report 2006
- UNCTAD Handbook of Statistics 2005
- OECD Investment report 2005
- OECD Direct Foreign Investment Statistics data base
- World Bank IMF Financial Sector Assessment Program report
- World Bank 2004. Globalization and Foreign Direct Investment and Foreign Aid.
- Globalization101. no year. Investment and Globalization; www.globalization101.org: Carnegie Endowment Project
- EUROSTAT 2006. European Union foreign direct investment yearbook 2006;

FB-I
- Gregersen H. and Contreras A. 2001. Investing in the Future: The Private Sector and Sustainable Forestry Management. International workshop of experts on financing sustainable forest management. Oslo, Norway, 22–25 January 2001
- Schmidt R. 2003. Financial investment in sustainable forest management - status and trends. A Background paper for the Global Project: Impact Assessment of Forest Products Trade in Promotion of Sustainable Forest Management GCP/INT/775/JPN. FAO, Rome
- IADB 2004. IADB. Inter-American Development Bank. Estudio sobre inversión directa en negocios forestales sostenibles: Documento Conceptual. Project ATN/NP-8323-RS; STCP: Curitiba, 2004. Tomaselli I. 2006. Brief Study on Funding and Finance for Forestry and Forest-Based Sector. Final Report for the UNFF Secretariat, United Nations Forum on Forests,New York

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2) General economic activity—general

General
- World Bank World Development Report 2006
- World Bank Development Indicators 2006 report and database
- UNIDO Industrial Development Report 2006
- World Bank IMF World Economic Outlook 2006
- ILO 2005. World Employment Report 2004-2005. Employment, Productivity and Poverty Reduction. International Labor Organization, Geneva.
- WEF 2007. World Economic Forum Global Competitiveness Report 2006–2007.

- Economic reforms and competitiveness: key messages from the European Competitiveness Report 2006 COM(2006) 697 final.
- FHI 2005. ManVis–Manufacturing Visions: Policy summary and recommendations; Fraunhofer Institute for System and Innovation Research, Germany
- EC 2005. European Energy and Transport–Trends to 2030. Update 2005

FB-I

- FAO 2004. Trends and current status of the contribution of the forestry sector to national economies; Working Paper FSFM/ACC/07, FAO, Rome
- FAOSTAT database
- The Conference Board of Canada. 2006. CFIC Forest Science Policy Forum on Transformative Technologies Regional Workshops Summary Report. May 2006. The Canadian Forest Innovation Council.
- TEEC. 2004. Evaluation of the 'Communication on the State of Competitiveness of the EU Forest- Based and Related Industries'. Final Report. Volume I (Main Report). 27th October 2004. The European Evaluation Consortium, European Commission Directorate-General for Enterprise (DG ENTR).
- JPC 2004. Key Findings and Conclusions Market, Industry and Forest Resource Analysis as part of the Roadmap to 2010 Process; Jaako Poyry Consulting.
- Finnish Forest Cluster Research Programme Wood Wisdom (1998–2001). 2002. Final Report 2002. National Technology Agency Tekes. Academy of Finland. Ministry of Agriculture and Forestry, and Ministry of Trade and Industry of Finland.
- Niskanen, A. (ed.) 2006. Issues Affecting Enterprise Development in the Forest Sector in Europe. University of Joensuu. Faculty of Forestry, Research Notes 169: 253–279.
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- Indufor Oy 2004. Final Summary Report Indufor Work Packages Environmental Catalogue, Wood Supply, Perception Analyses; Cei-Bois Roadmap 2010 for the European Woodworking Industries; Brussels, Belgium
- UNECE/FAO in press. Schulmeyer EFSOS update; draft discussion paper.
- UNECE/FAO 2006. Forest Products Annual Market Review 2005–2006. ECE/TIM/SP/21; UNECE Geneva
- UNECE/FAO 2005. European Forest Sector Outlook Study Main Report. UNECE, Geneva
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- Hetemäki L., Harstela P., Hynynen J., Ilvesniemi H. and Uusivuori J. (eds.) 2006. The Contribution of Finland's Forests to National Prosperity and Wellbeing in 2015—A Report on Finnish Forest Sector Development and Future Scenarios. METLA, Finland.
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- FAO 2004. Trends and current status of the contribution of the forestry sector to national economies; Working Paper FSFM/ACC/07, FAO, Rome
- FAO 2006. Forest Resources Assessment 2005 Main Report, FAO Rome.
- EU Com. 2006a. Communication from the Commission to the Council and the European Parliament on an EU Forest Action Plan COM(2006) 302 final
- EU Com 2005. Council Conclusions on an EU Forest Action Plan, 2662nd meeting of the Agriculture and Fisheries Council, 30–31 May 2005.
- Becker G. 2006. Can Europe's Forests Satisfy the Increasing Demand for Raw Material and Energy under Sustainable Forest Management? Draft Background Paper for the UNECE/FAO MCPFE Workshop on Mobilizing Wood Resources, January 2007.
- Rametsteiner E., Weiss G., Kubeczko K. 2005. Innovation and Entrepreneurship in forestry in Central Europe; EFI Research Report 19, EFI Joensuu
- Niskanen A. (ed.) 2006.: Entrepreneurship in the forest sector. Final Report of COST 30;

	University of Joensuu, Finland. - United Nations Economic Commission for Europe 2006: The Condition of Forests in Europe. 2006 Executive Report. http://www.icp-forests.org/pdf/ER2006.pdf
2) General economic activity – employment	
General	- UN WPP 2005. World Population Prospects—Revised World Population Analytical Report and Database 2004 - ILO 2005. World Employment Report 2004–2005. Employment, Productivity and Poverty Reduction. International Labor Organization, Geneva. - ILO 2007 Global Employment Trends 2007. International Labor Organization, Geneva. - Bhagwati 2007. Globalisation, not technology, is driving wages down. Financial Times, Jan 03, 2007 - Baldwin 2006. The great un-bundling(s); paper to the Globalisation Challenges for Europe and Finland; Graduate Institute of International Studies, Geneva. - EU: Long-term labor force projections for the 25 EU Member States; Carone, Labor and Demography 0512006; European Commission. - EP 2004: Population trends in Europe and their sensitivity to policy measures; European Parliament Report: Doc. 10182 Committee on Migration, Refugees and Population
FB-I	- UNECE/ILO 2003. Employment Trends and Prospects in the European Forest Sector
Forestry	- UNECE/ILO 2003. Employment Trends and Prospects in the European Forest Sector
3) Trade	
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Annex 4: Supporting Data: Baseline State of EU Forestry and Development Patterns

A4.1. Forest Ownership and Management

Table A4.1. Forest ownership shares public–private. Source: FAO (2006).

	Public %	Private %
Portugal	7.3	92.7
Austria	19.6	80.4
Sweden	19.7	80.3
France	26	74
Slovenia	27.7	72.3
Denmark	28.4	71.6
Spain	30	67.9
Finland	32.1	67.8
Italy	35	65
United Kingdom	36.2	63.8
Belgium	43.5	56.5
Luxembourg	45.7	54.3
Netherlands	49.7	50.3
Germany	52.8	47.2
Latvia	54	45.1
Slovakia	52.4	43.2
Hungary	60.5	39.5
Ireland	64	36
Cyprus	61.2	38.8
Czech Republic	76.7	23.3
Lithuania	77.3	22.7
Greece	77.5	22.5
Estonia	37.5	22.4
Poland	83.2	16.8
Bulgaria	91,6	8.4
Romania	94.3	5.7
Malta	100	0

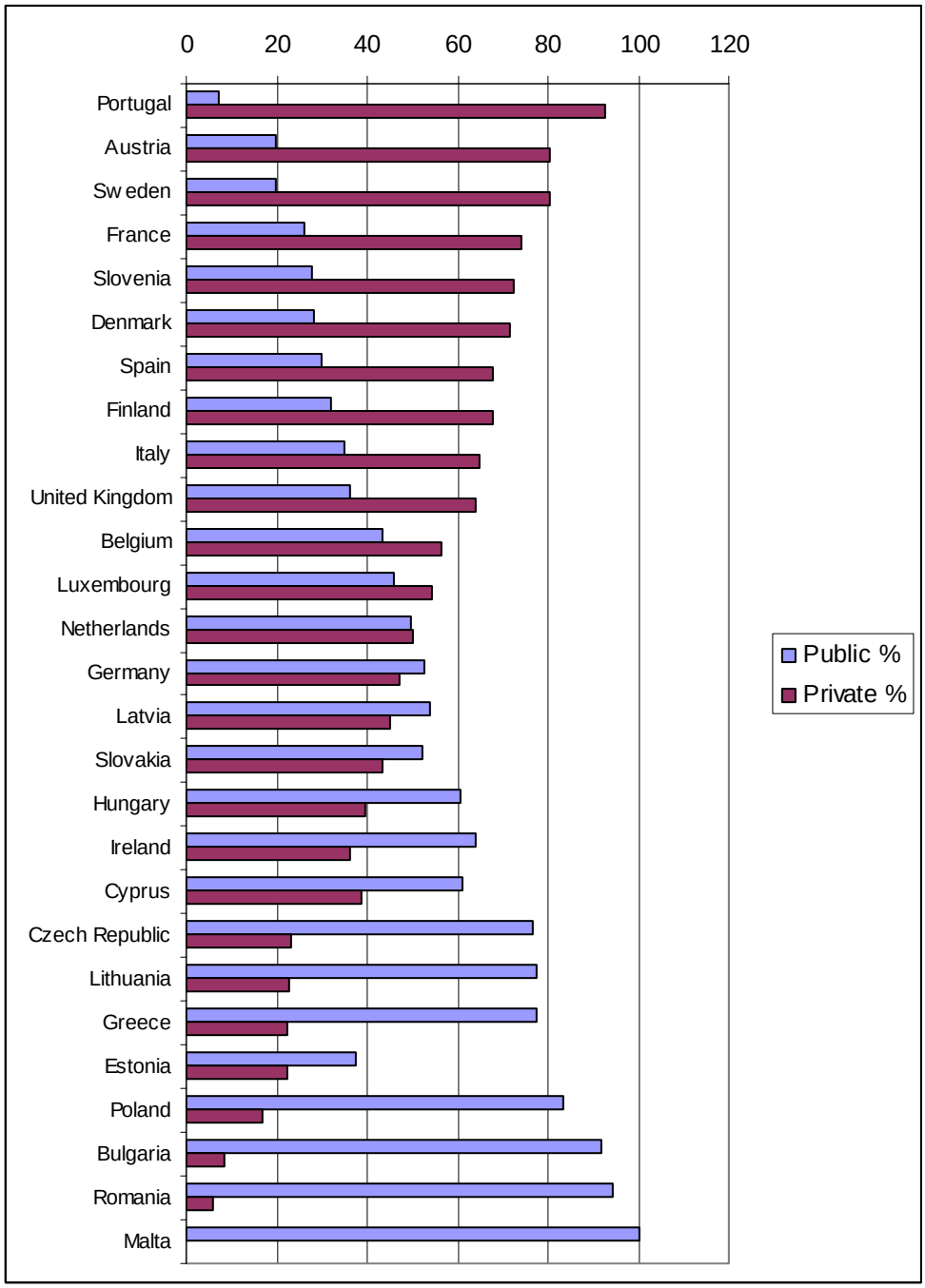

Figure A4.1. Forest ownership shares public–private. Source: FAO (2006).

Table A4.2. Average size of forest holdings (ha/holding). Source: MCPFE (2003).

	Public	**Private**
Lithuania	28,547	3.7
Bulgaria	22,051	0.0
Poland	16,308	8.9
Estonia	10,989	10.8
Latvia	2,918	11.2
Ireland	2,612	12.5
Greece	2,434	934.4
Slovakia	1,811	24.0
Italy	1,636	8.8
UK	1,594	16.4
Slovenia	1,394	2.8
Hungary	1,224	14.1
Spain	643	30.8
Czech Rep	484	3.0
Denmark	461	14.9
Sweden	455	93.6
Germany	442	14.2
Cyprus	390	
Belgium	343	2.5
France	265	3.7
Portugal	226	7.5
Luxembourg	139	3.4
Netherlands	68	5.7
Finland		36.7
Austria		18.8
Malta	17	
Romania		

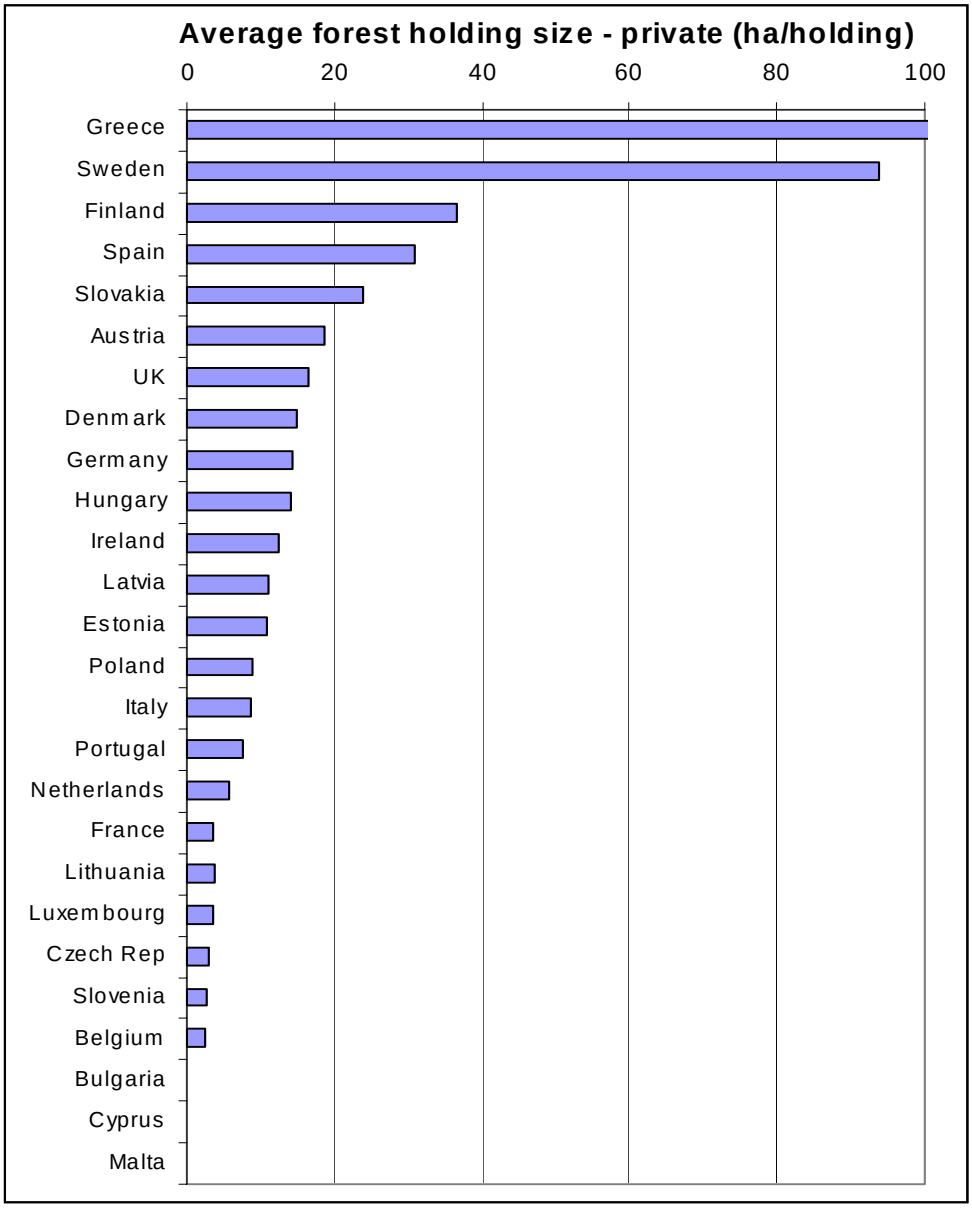

Figure A4.2. Average forest holding size (ha/holding). Note: Private forest holding size in Greece is out of scale with 934 ha/holding. Source: MCPFE (2003).

A4.2. Growing stock and balance of increment and fellings

Table A4.3. Total growing stock 2005. Source: FAO (2006)

	million m^3
Cyprus	8
Luxembourg	26
Ireland	65
Netherlands	65
Denmark	76
Belgium	172
Greece	177
Hungary	337
United Kingdom	340
Portugal	350
Slovenia	357
Lithuania	400
Estonia	447
Slovakia	494
Bulgaria	568
Latvia	599
Czech Republic	736
Spain	888
Austria	1,159
Romania	1,347
Italy	1,447
Poland	1,864
Finland	2,158
France	2,465
Sweden	3,155
Total	19,700

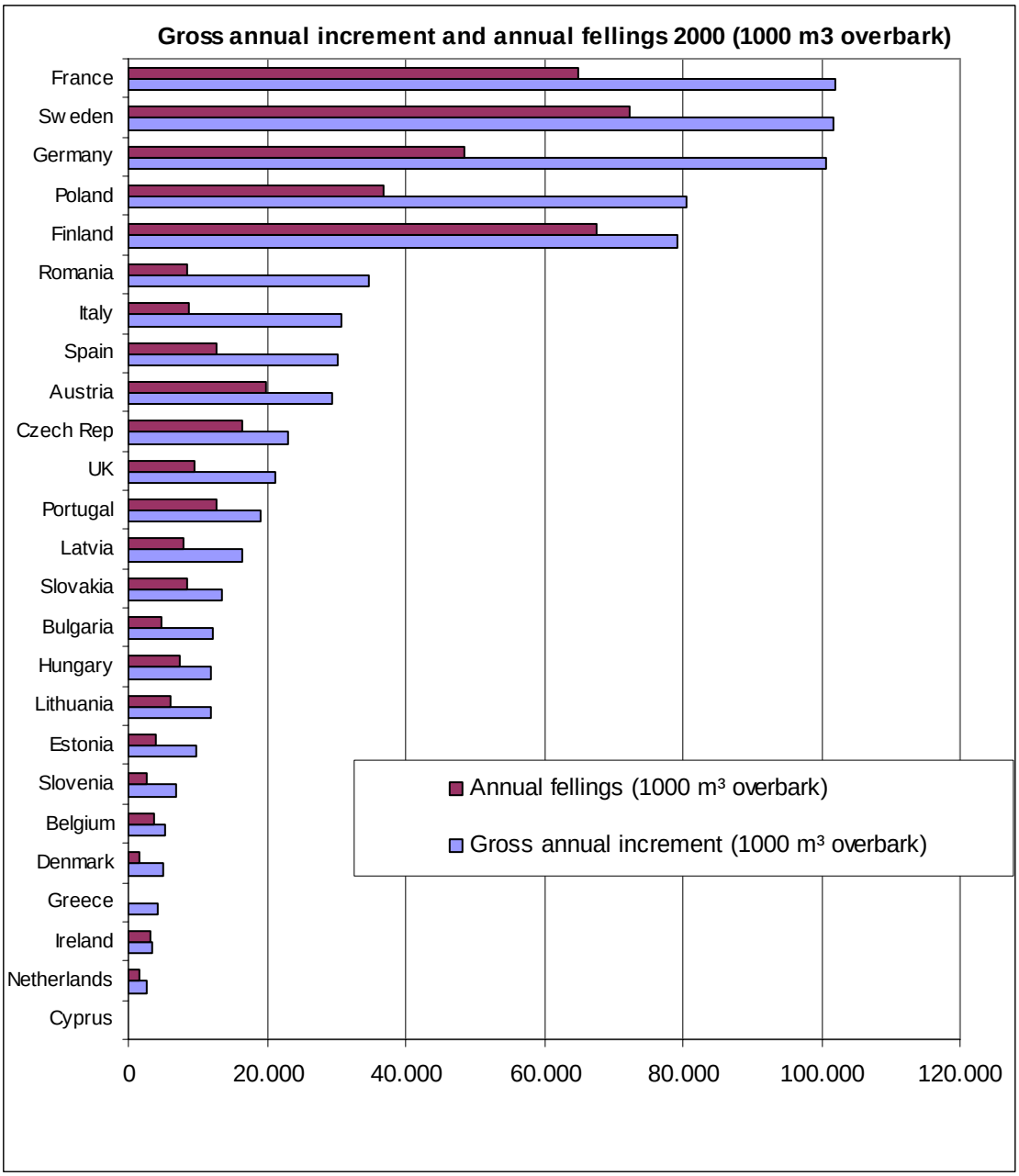

Figure A4.3. Gross annual increment and annual fellings. Source: MCPFE (2003).

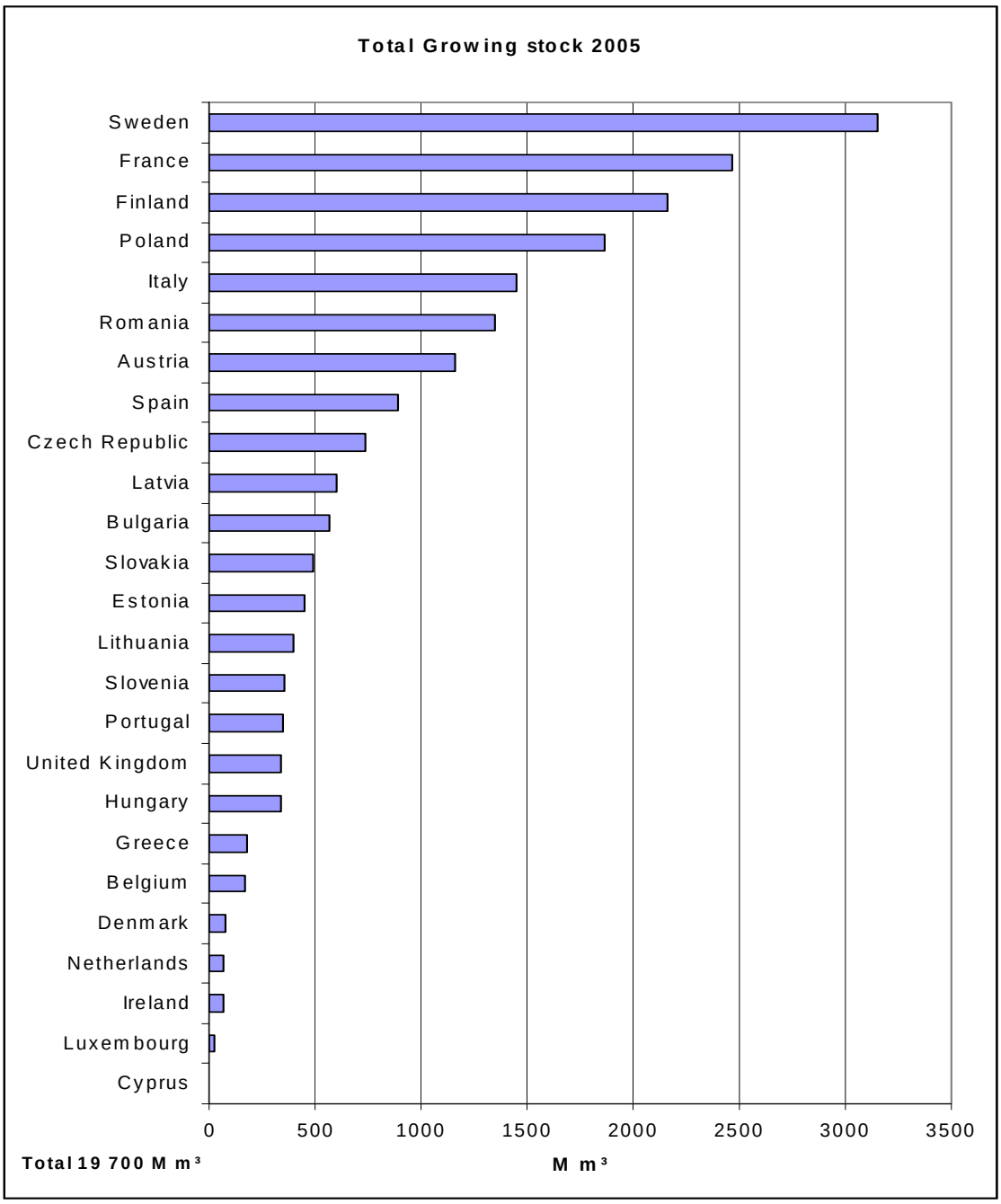

Figure A4.4. Total growing stock 2005. Note: Germany is missing. Source: FAO (2006).

Table A4.4. Growing stock by area 2005. Source: FAO (2006).

	m^3/ha
Cyprus	46
Greece	47
Spain	50
Portugal	93
Finland	96
Ireland	98
Sweden	115
United Kingdom	120
Italy	145
Denmark	153
Bulgaria	157
France	158
Hungary	171
Netherlands	178
Lithuania	190
Estonia	196
Poland	203
Latvia	204
Romania	212
Malta	231
Slovakia	256
Belgium	258
Czech Republic	278
Slovenia	283
Luxembourg	299
Austria	300

Table A4.5. Growing stock of which is commercial. Source: FAO (2006).

	%
Cyprus	39
Bulgaria	61.1
Portugal	66.3
Italy	70.1
Denmark	76.1
Sweden	76.8
Spain	77.6
Netherlands	80
Finland	84.1
Slovakia	84.7
Latvia	85.3
Lithuania	86
Greece	88.1
United Kingdom	88.2
Slovenia	91.3
France	93.5
Estonia	93.7
Poland	94.4
Czech Republic	96.7
Hungary	97.6
Austria	97.7
Romania	98
Belgium	100
Luxembourg	100

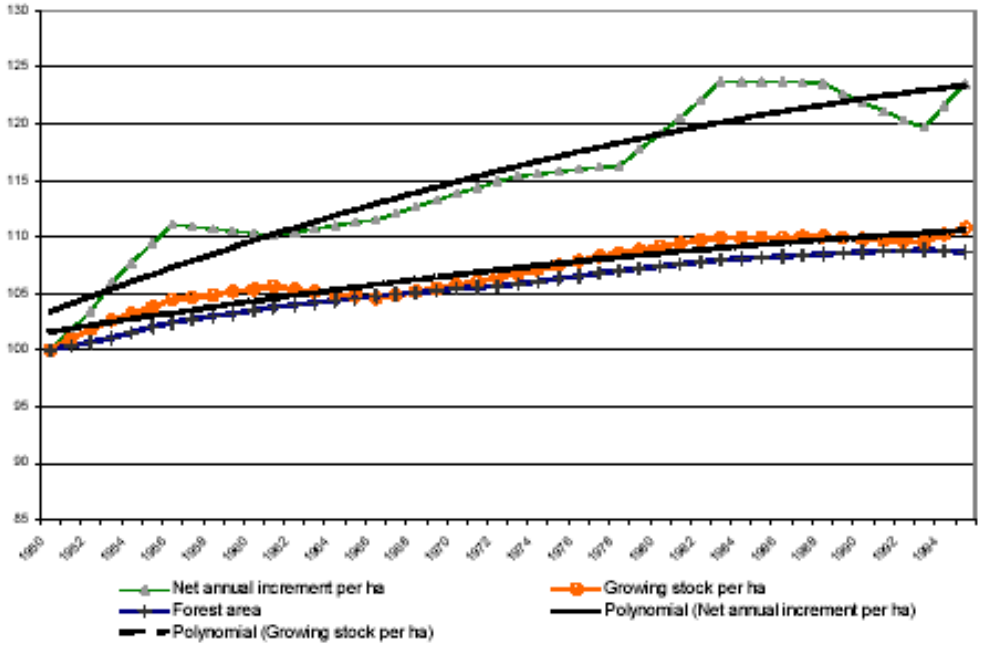

Figure A4.5. Development of forest area, growing stock (per ha) and net annual increment (per ha) in Europe 1950–1995 (1950 = 100%). Source: Gold (2003).

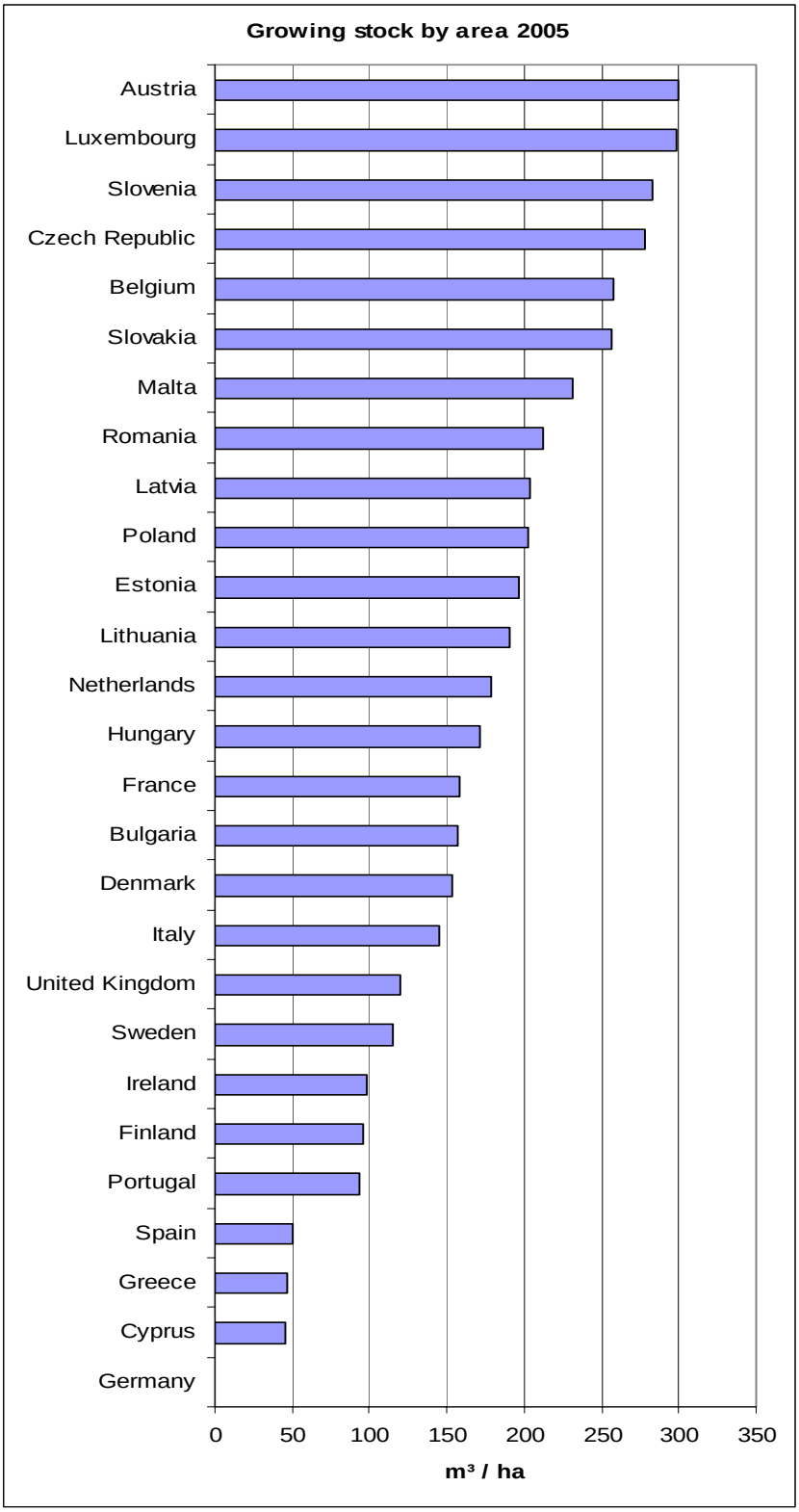

Figure A4.6. Growing stock (m^3) per ha forest 2005. Source: FAO (2006).

Table A4.6 Gross annual increment and annual fellings. Source: MCPFE (2003).

	Gross annual increment (1,000 m^3 overbark)	Annual fellings (1,000 m^3 overbark)
Luxembourg	0	0
Malta	0	0
Cyprus	109	35
Netherlands	2,538	1,561
Ireland	3,500	3,089
Greece	4,118	
Denmark	4,946	1,715
Belgium	5,289	3,701
Slovenia	6,925	2,614
Estonia	9,830	4,028
Lithuania	11,904	5,972
Hungary	11,973	7,287
Bulgaria	12,310	4,852
Slovakia	13,601	8,525
Latvia	16,500	8,010
Portugal	19,054	12,733
United Kingdom	21,300	9,500
Czech Republic	22,915	16,345
Austria	29,433	19,821
Spain	30,120	12,639
Italy	30,822	8,746
Romania	34,650	8,525
Finland	79,129	67,500
Poland	80,439	36,810
Germany	100,722	48,584
Sweden	101,598	72,345
France	102,096	65,006
European Total	***755,821***	***429,943***

A4.4. Investment

A.2.1 Domestic investment and gross fixed capital formation

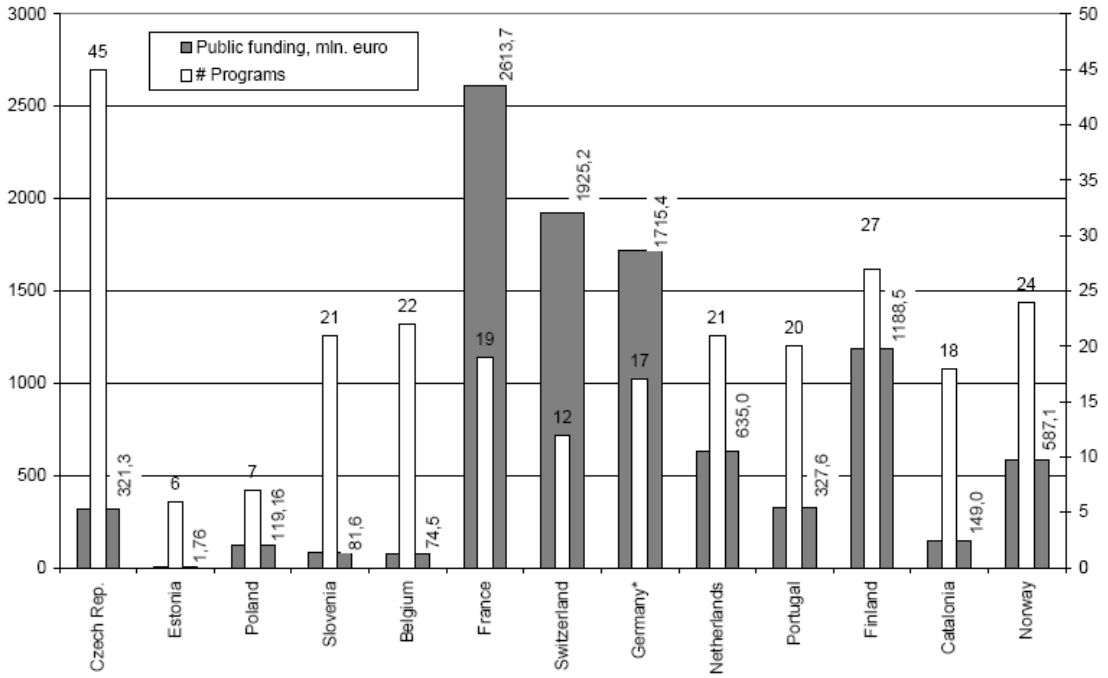

Figure A4.7. Public funding and number of programs (1990–99, million € in 1999 prices) (excluding tax concessions). Source: EFI (2005).

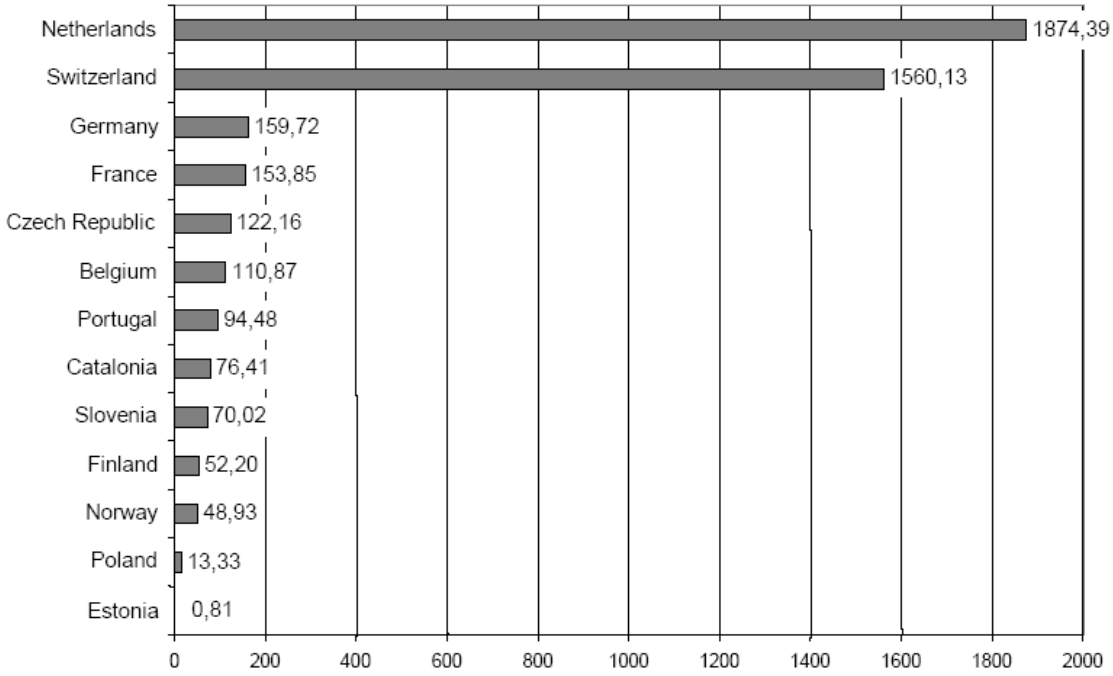

Figure A4.8. Public financing per hectare of forest (1990–99, €/ha in 1999 prices). Source: EFI (2005)

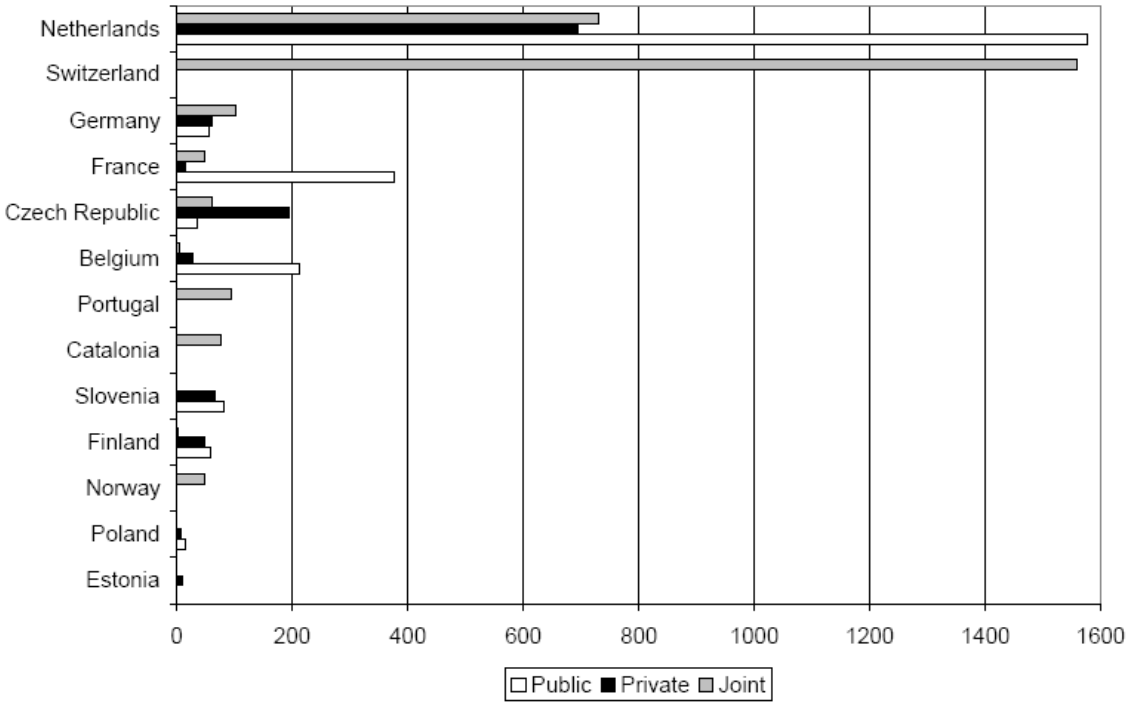

Figure A4.9. Public financing per hectare of forest for private and public ownership and the category of joint forestry programs directed to both private and public ownership (1990–1999, €/ha in 1999 prices). Source: EFI (2005).

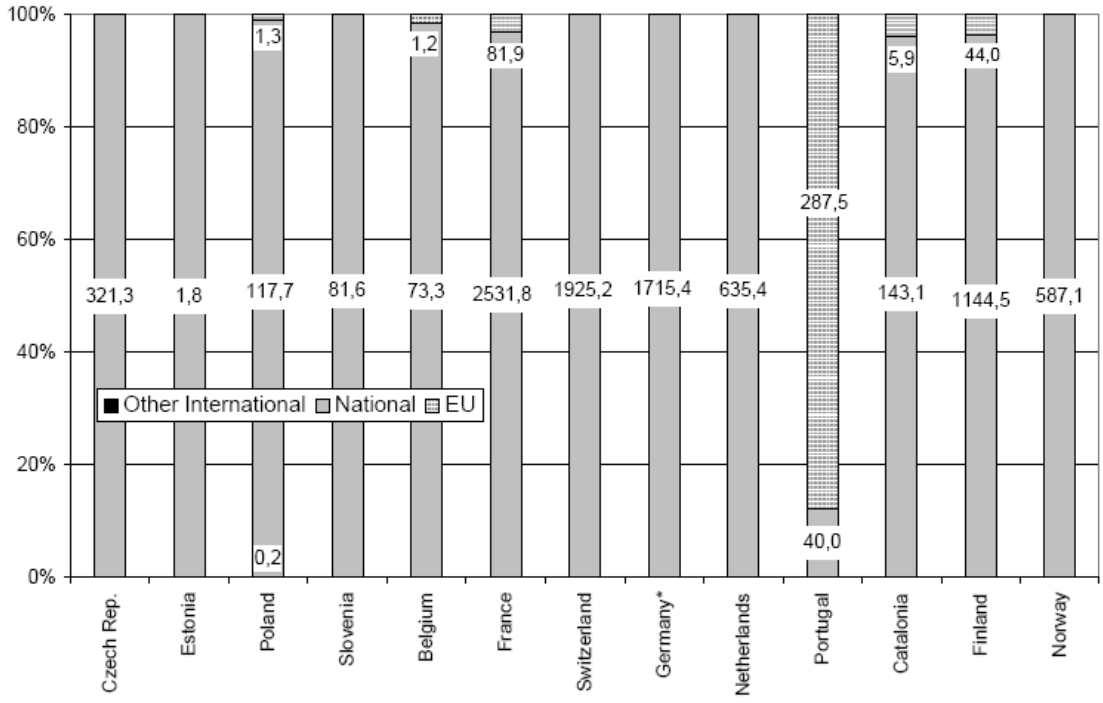

Figure A4.10. The sources of public funding (1990–99, million € in 1999 prices, %). Source: EFI (2005).

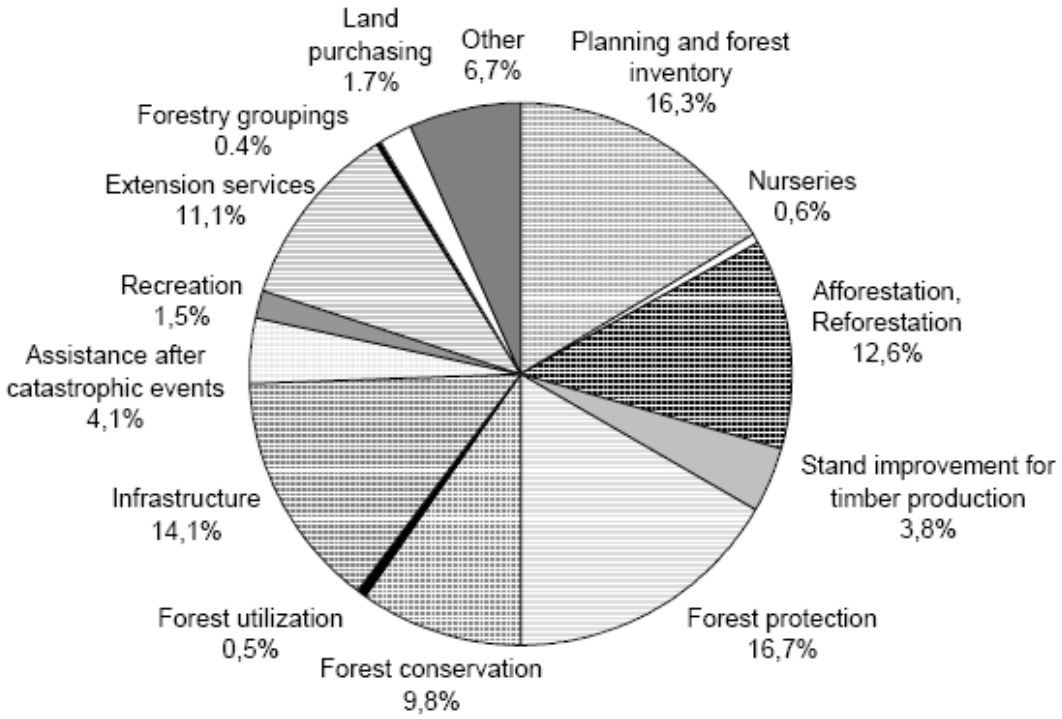

Figure A4.11. The aggregate distribution of public funding (1990–1999) by types of activities supported in 12 countries (Czech Republic, Estonia, Slovenia, Poland, France, Belgium, Germany, Switzerland, Netherlands, Finland, Norway, Catalonia). Source: EFI (2005).

Table A4.7. Investment of the forest industries in Finland 1975–2004 (woodworking and pulp and paper industries), million €. Source: METLA (2006a).

	Forest industries investment, million €
1975	343
1976	324
1977	413
1978	226
1979	311
1980	461
1981	565
1982	571
1983	456
1984	563
1985	701
1986	679
1987	883
1988	1,052
1989	1,460
1990	1,355
1991	1,054
1992	846
1993	795
1994	750
1995	984
1996	1,514
1997	1,041
1998	1,125
1999	851
2000	900
2001	1,498
2002	742
2003	751
2004	710

A4.4 Economic Activity

A4.4.1. Status and change in value added

Table A4.8. Gross value added at basic prices in million €.
Source: MCPFE (2003).

Economic accounts for forestry. Gross value added at basic prices in countries where data											
	were available		millions of euros, except millions of national currency for Sweden								
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Belgium						140,3	134,7	157,6	151,8	157,9	120
Finland	2204,1	1679,4	1596,8	1569,9	1921,7	2186,1	2057,5	2340,3	2528	2539,3	2656,2
France	2547,3	2520,9	2467,1	2253,5	2959,5	3142	2766,8	2935,7	3061,3	3011,2	2318
Greece						107,1	103,5	112,6	115,5		
Italy	296,5	338,4	370,1	377,3	419,1	393,4	464,2	467,6	470,9	448,9	416,7
Luxembourg						13,1					
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Sweden	14774,30	14293,58	13976,90	12925,10	16195,00	20890,20	16995,20	18400,20	18122,80	17333,90	

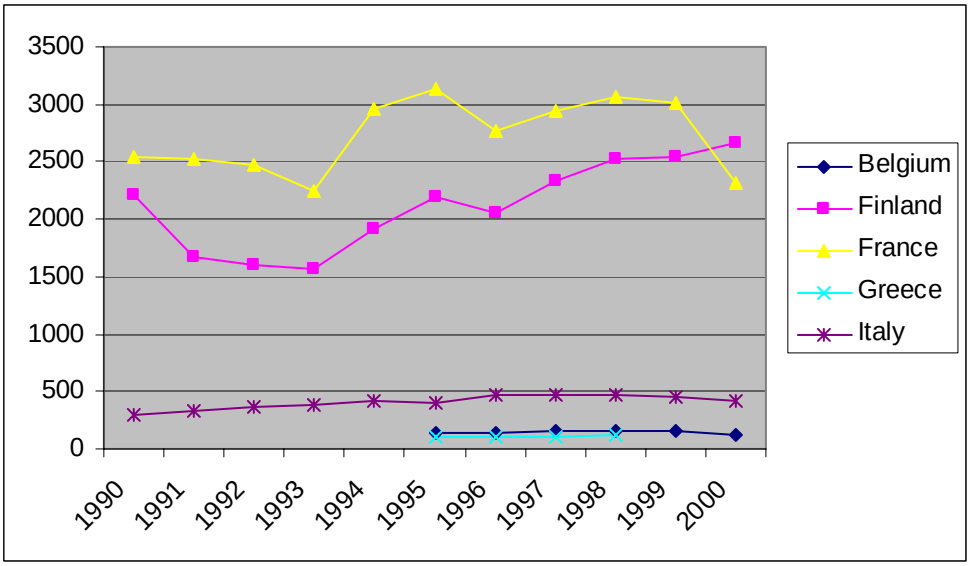

Figure A4.12 Gross value added of forestry at basic prices in million €. Source: MCPFE (2003).

A4. 2. Production statistics (roundwood, wood fuel, non-wood goods, services)

A4.2.1 Roundwood

Table A4.9. Production of roundwood 2000–2004. Source: FAO (2006).

Country	2000	2002	2004	change 2000–2004 (%)
Austria	13,276,000	14,846,000	16,483,000	24.2
Belgium	4,510,000	4,500,000	4,850,000	7.5
Bulgaria	4,783,890	4,832,890	4,832,890	1.0
Cyprus	20,580	15,430	10,058	-51.1
Czech Republic	14,441,000	14,541,000	15,601,000	8.0
Denmark	2,952,000	1,446,223	1,626,940	-44.9
Estonia	8,910,000	10,500,000	6,800,000	-23.7
Finland	54,261,855	53,011,000	53,799,662	-0.9
France	45,828,000	35,449,000	33,647,000	-26.6
Germany	53,710,000	42,380,000	54,504,000	1.5
Greece	2,244,935	1,591,297	1,525,588	-32.0
Hungary	5,902,000	5,836,400	5,660,300	-4.1
Ireland	2,673,100	2,646,100	2,562,035	-4.2
Italy	9,329,000	7,511,000	8,697,393	-6.8
Latvia	14,304,000	13,465,900	12,754,000	-10.8
Lithuania	5,500,000	6,115,000	6,120,000	11.3
Luxembourg	259,700	257,044	276,610	6.5
Malta	0	0	0	
Netherlands	1,039,000	839,000	1,025,724	-1.3
Poland	26,025,000	27,137,000	32,733,000	25.8
Portugal	10,831,000	8,742,000	11,553,000	6.7
Romania	13,148,200	15,154,000	15,809,000	20.2
Slovakia	6,163,000	5,782,000	7,240,000	17.5
Slovenia	2,253,000	2,283,000	2,551,000	13.2
Spain	14,321,000	15,839,000	16,290,000	13.7
Sweden	63,300,000	66,600,000	67,300,000	6.3
United Kingdom	7,811,000	7,802,000	8,273,000	5.9
Total	***387,797,260***	***369,122,284***	***392,525,200***	

Table A4.10. Roundwood removals 1990–2003 in 1000 m^3. Source: UNECE Timber Database (2004).

	Roundwood removals 1000 m^3													
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Austria	16773	15572	12849	12856	14960	14405	15609	15325	14033	14083	13276	13467	14846	17055
Belgium										4800	4510	4215	4500	4765
Bulgaria	4089	3650	3545	3547	2685	2838	3205	3041	3231	4351.66	4783.88	3991.88	4832.88	4832.88
Cyprus	62.8	53.8	44.8	52.9	47	48	45.1	41	35.34	36.45	20.58	18.31	15.42	11.99
Czech Republic			9800	10406	11950	12365	12600	13491	13991	14203	14441	14374	14541	15140
Denmark	2255	2309	2228	2281	2282	2282	2282	2207	1558	1560	2952	1613	1446	1446
Estonia			2146	2439	3550	3709	3901	5505	6061	6704	8910	10200	10500	10200
Finland	43230	34863	38482	42244	48745	50219	46272	51798	53660	53637	54261.9	52210	53011	53779
France	44713	43554	42396	39363	42242	36061	33143	34932	35526.7	36007.6	45828	39831	35449	36850
Germany		33618	32954	33152	39813	39343	37014	38207	39052	37634	53710	39483	42380	42380
Greece	2492	2546	2193	2096	2091	1961	2012	1885	1692	2214	2244.93	1915.52	1591	1673
Hungary	5973	5490	5006	4496	4527	4331	3652	4251	4167	5230.8	5902	5811	5836.4	5785
Ireland	1625	1670	1960	1821	2018	2204	2291	2180	2266	2584	2673.1	2455	2647	2684
Italy	7972	8327	8357	8818	9465	9736	9121	9146	9550	11138	9329	8099	7511	8219
Latvia			2471	4931	5700	6890	8080	8922	10030	14008	14304	12841	13465.9	12915.8
Lithuania				2329	3992	5960	5540	5149	4879	4924	5500	5700	6115	6275
Luxembourg										259	259.7	142.15	140	136
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	1420	1123	1253	1075	1043	1104	952	1109	1023	1044	1039	865	839	914
Poland	17617	17026	18778	18590	18776	20651	20287	21635	23107	24268	26025	25016	27137	28835
Portugal	11205	10809	10278	10207	9819	9350	8978	8978	8548	8978	10831	8946	8742	8742
Romania	12608	12961	12440	8840	11925	12178	12250	13529	11649	12703.5	13148.2	12424	15154	13961
Slovakia			4755	5249	5316	5323	5461	5943	5519	5795	6163	5787.9	5782	6355
Slovenia			1671	1065	1944	1866	1991	2208	2133	2068	2253	2257	2283	2591
Spain	15590	15188	13822	13757	15307	16075	15631	15631	14874	14810	14321	15131	15839	16105
Sweden	52871	51400	53520	54000	55900	63600	56300	60200	60600	58700	63300	63200	66600	67300
United Kingdom	6350	6372	6544	6764	7308	7555	7093	7482	7260	7482	7481	7559	7360	7566

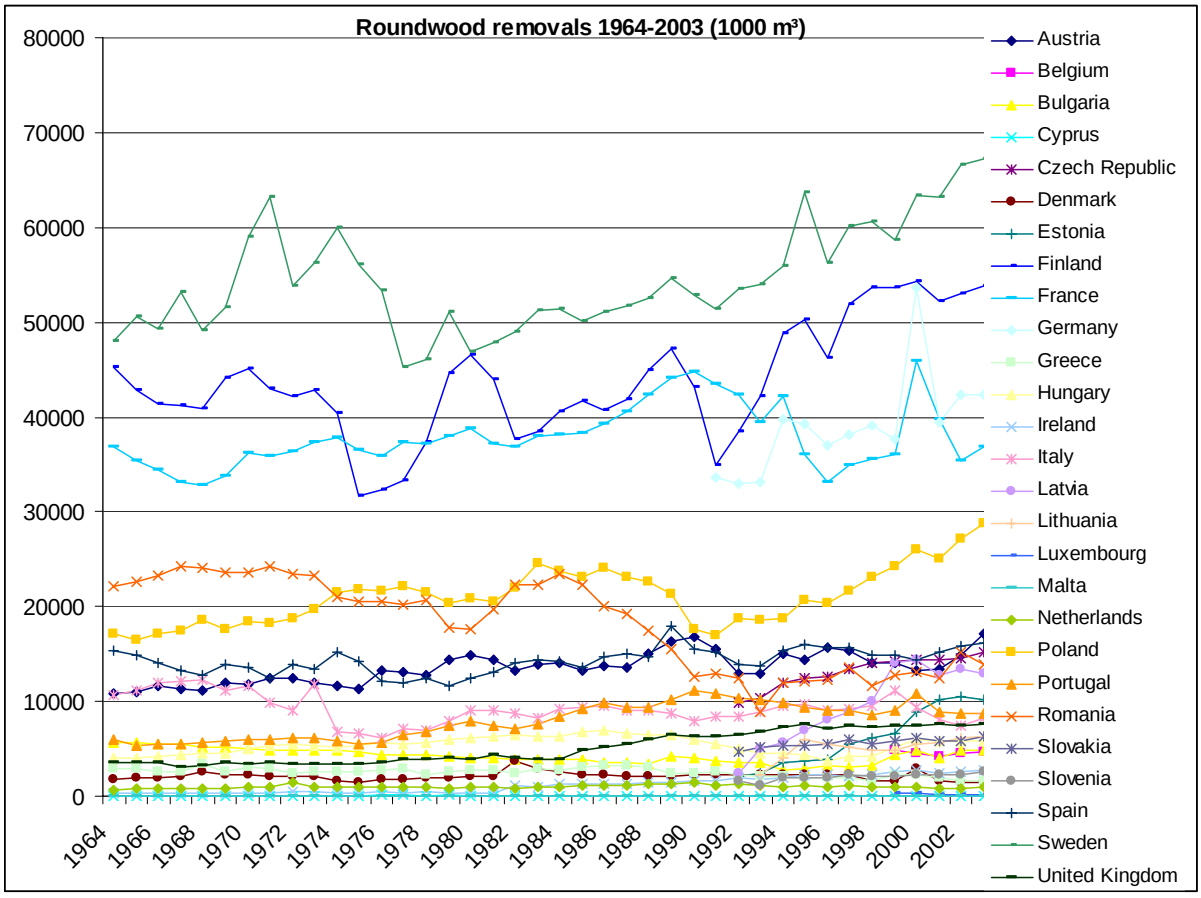

Figure A4.13. Roundwood removals 1964–2003 in 1000 m^3. Source: UNECE Timber Database (2004).

A4.2.2 Wood fuel and solid biomass for energy

Table A4.11. Wood fuel 1990–2003, including wood for charcoal removals in 1000 m^3. Source: UNECE Timber Database (2004).

	Wood fuel, including wood for charcoal removals 1000m³													
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Austria	2613	2437	2994	3149	3259	3059	3797	3423	3175	3095	2860	2905	3036	3336
Belgium										550	550	550	550	550
Belgium & Luxembourg	550	550	550	550	550	500	500	550	550					
Bulgaria	1503	1450	1870	1710	887	868	1185	1179	1388.33	1101	2107	1635	2187	2187
Cyprus	14.8	12.1	11.2	13.9	11.1	10.9	9.9	9.69	8.31	8.03	5.43	6.55	5.21	4.27
Czech Republic			980	700	778	649	718	610	820	840	940	1010	1007	1180
Denmark	449	450	485	463	485	485	485	563	492	324	460	617	657	657
Estonia			807	1048	544	573	604	1370	693	804	1640	1880	1900	1900
Finland	2984	2922	2878	4161	4101	4095	4094	4041	4119.11	4044	4114.78	4483	4482	4533
France	9800	9800	9800	9800	9800	2500	2500	2770	2809.03	2770.8	2388	2360	2713	2900
Germany		3795	3795	3795	3795	2429	2476	2719	2611	2571	2622	2981	4625	4625
Greece	1346	1350	1509	1397	1354	1330	1338	1236	1197	1403	1601.4	1400.59	1093	1074
Hungary	2455	2291	2175	2230	2066	1948	1852	1909	1871	2575.8	2596.9	2319	2398.2	2781
Ireland	50	50	50	57	60	64	66	63	73	73	73	32	34	30
Italy	3637	4239	4832	4698	5481	5263	4958	5222	5183	6925	5680	5150	4883	5580
Latvia			700	1100	1110	1200	2530	2865	2845	2490	1680	1580	1198	990.81
Lithuania				1780	1736	1090	1230	1149	1170	1124	1450	1480	1295	1320
Luxembourg										18	18	6.72	4	7
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	145	127	161	175	180	163	123	123	150	162	160	136	136	160
Poland	2068	2692	3058	2650	2065	1411	1463	1538	1314	1426	1536	1641	2142	2350
Portugal	500	500	500	500	500	500	550	550	600	600	600	600	600	600
Romania	1883	2000	2000	1100	2285	2163	2809	3692	3020	3220	3032.2	2618	3062	2399
Slovakia			552	490	628	436	505	339	249	261	277	268	259	304
Slovenia			520	107	235	227	362	546	539	505	532	295	280	359
Spain	1800	2200	2198	2338	2317	3078	3198	3198	1710	1650	1600	1855	1989	2030
Sweden	3800	3800	3800	3800	3800	3800	3800	3800	5900	5900	5900	5900	5900	5900
United Kingdom	225	250	230	232	232	232	232	232	233	234	234	234	233	233

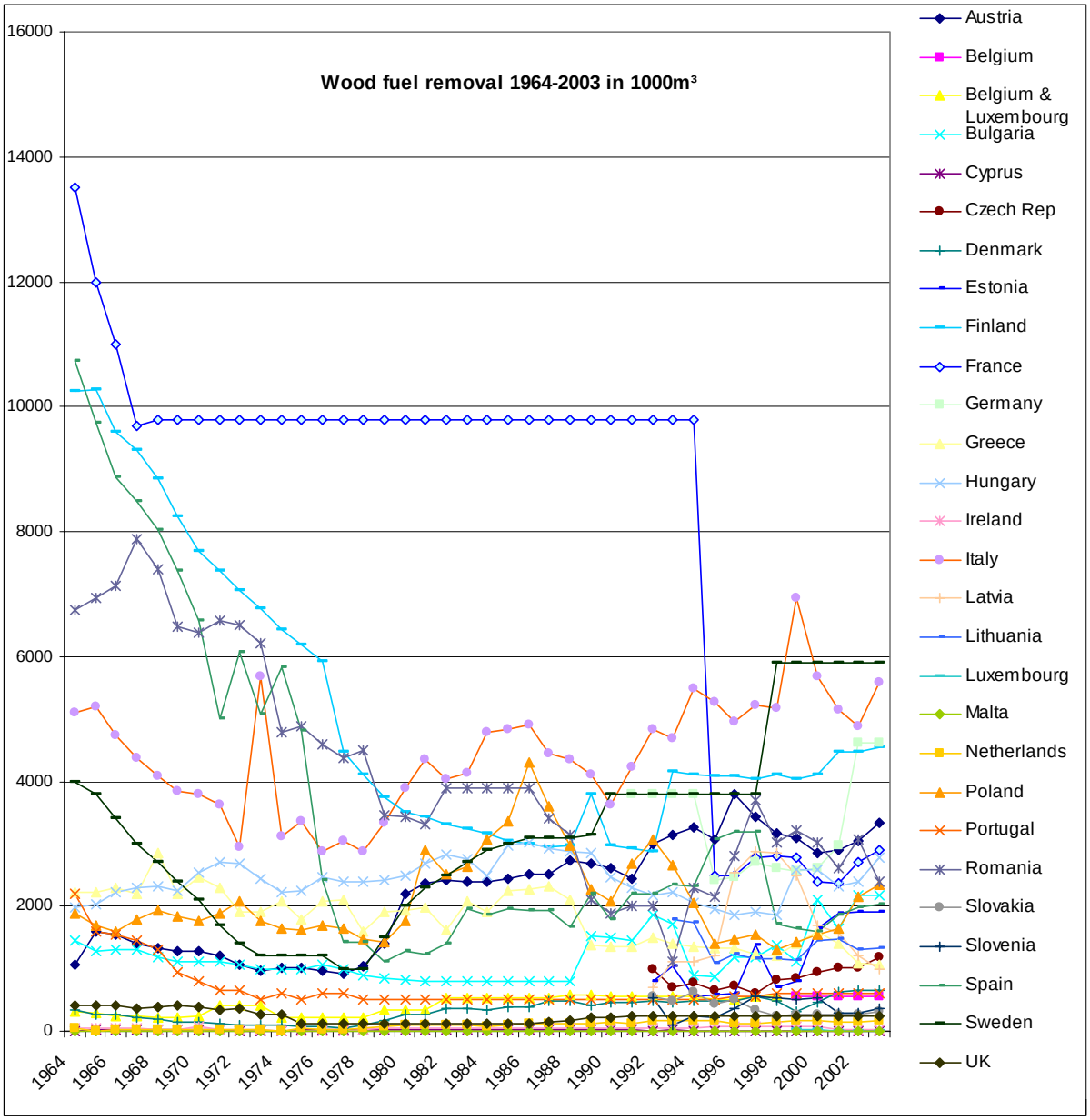

Figure A4.14. Wood fuel removal 1964–2003 in 1000 m^3. Source: UNECE Timber Database (2004).

Table A4.12. Primary energy production of solid biomass in the EU in MToe. Source: EurObserver (2007).

Country	**2004**	**2005**	**Growth**
France	9.68	9.67	0.00
Sweden	7.47	7.94	0.00
Germany	6.13	7.86	0.28
Finland	7.36	6.61	0.00
Poland	4.1	4.3	0.1
Spain	4.137	4.176	0.90%
Austria	3.25	3.507	7.90%
Portugal	2.683	2.715	1.20%
Czech Republic	1.418	1.46	3.00%
Latvia	1.394	1.394	0.00%
Denmark	1.2	1.264	5.30%
Netherlands	0.724	1.142	57.70%
Hungary	0.821	1.112	35.50%
Italy	0.942	1.005	6.70%
Greece	0.917	0.957	4.40%
Lithuania	0.705	0.736	4.40%
United Kingdom	0.704	0.719	2.10%
Estonia	0.597	0.597	0.00%
Belgium	0.368	0.528	36.60%
Slovenia	0.463	0.467	0.90%
Slovakia	0.345	0.398	15.40%
Ireland	0.186	0.217	16.40%
Luxembourg	0.015	0.015	0.00%
Total	***55.587***	***58.783***	***5.7%***

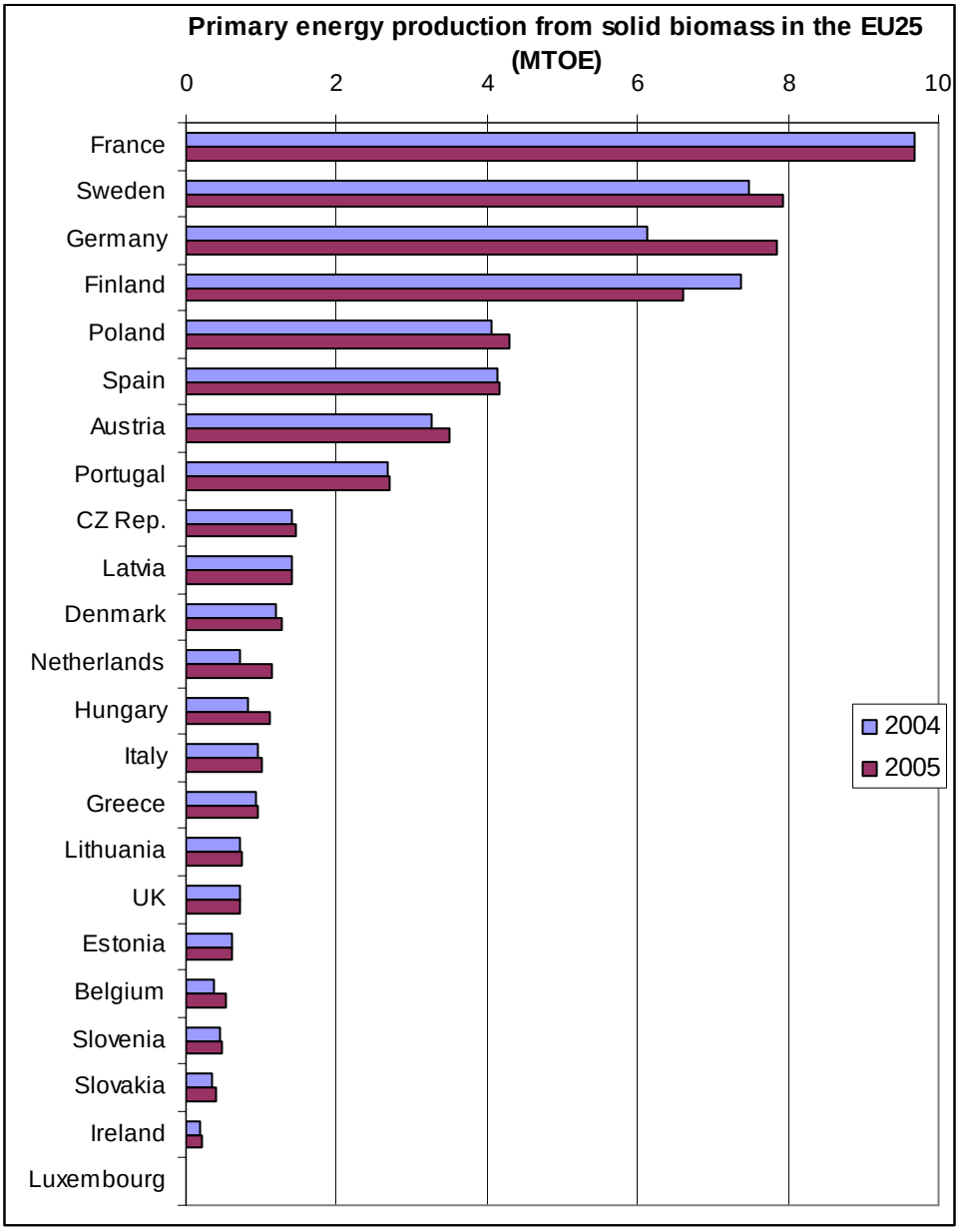

Figure A4.15. Primary energy production of solid biomass in the EU in MToe. Source: EurObserver (2007).

A4.2.3. Non-wood forest products

Table A4.13. Removals of non-wood forest products as percentage of industrial roundwood value.

	Removals: NWFP value as % of Industrial RW value
Denmark	401.5
Spain	57.8
Netherlands	51.5
Slovenia	44.6
United Kingdom	29.7
Czech Republic	17
Sweden	7.2
Finland	5.9
Slovakia	3.8
Poland	2.6
Estonia	1.8
Lithuania	1.1

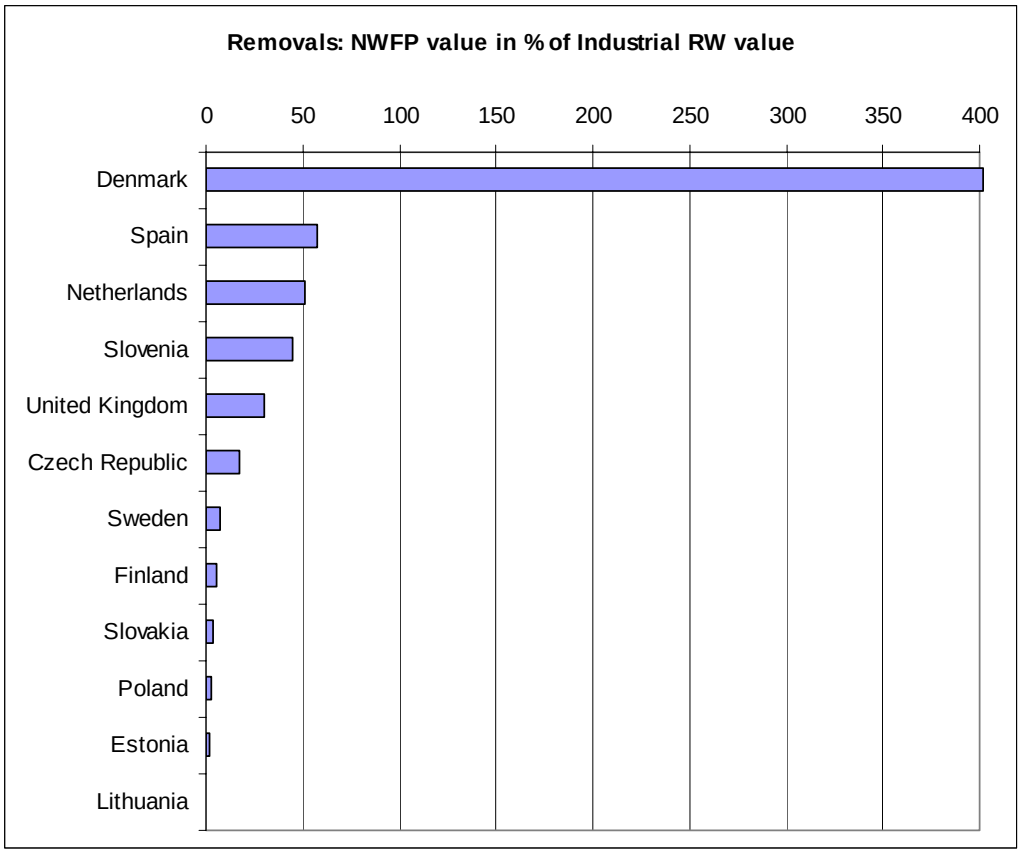

Figure A4.16. Non-wood forest products removals in % of industrial round wood value Source: FAO (2006).

A4.3. Productivity

Table A4.14. Labor productivity in m^3 wood/person/year, calculated from FAO (2006).

	m^3/person/year
Sweden	4151
Finland	2525
Austria	2104
France	1667
Estonia	1240
Portugal	955
Belgium	882
Slovenia	849
United Kingdom	706
Germany	697
Ireland	695
Spain	619
Latvia	609
Denmark	525
Netherlands	574
Czech Republic	512
Poland	498
Hungary	492
Lithuania	441
Romania	304
Italy	279
Slovakia	228
Bulgaria	55
Cyprus	28

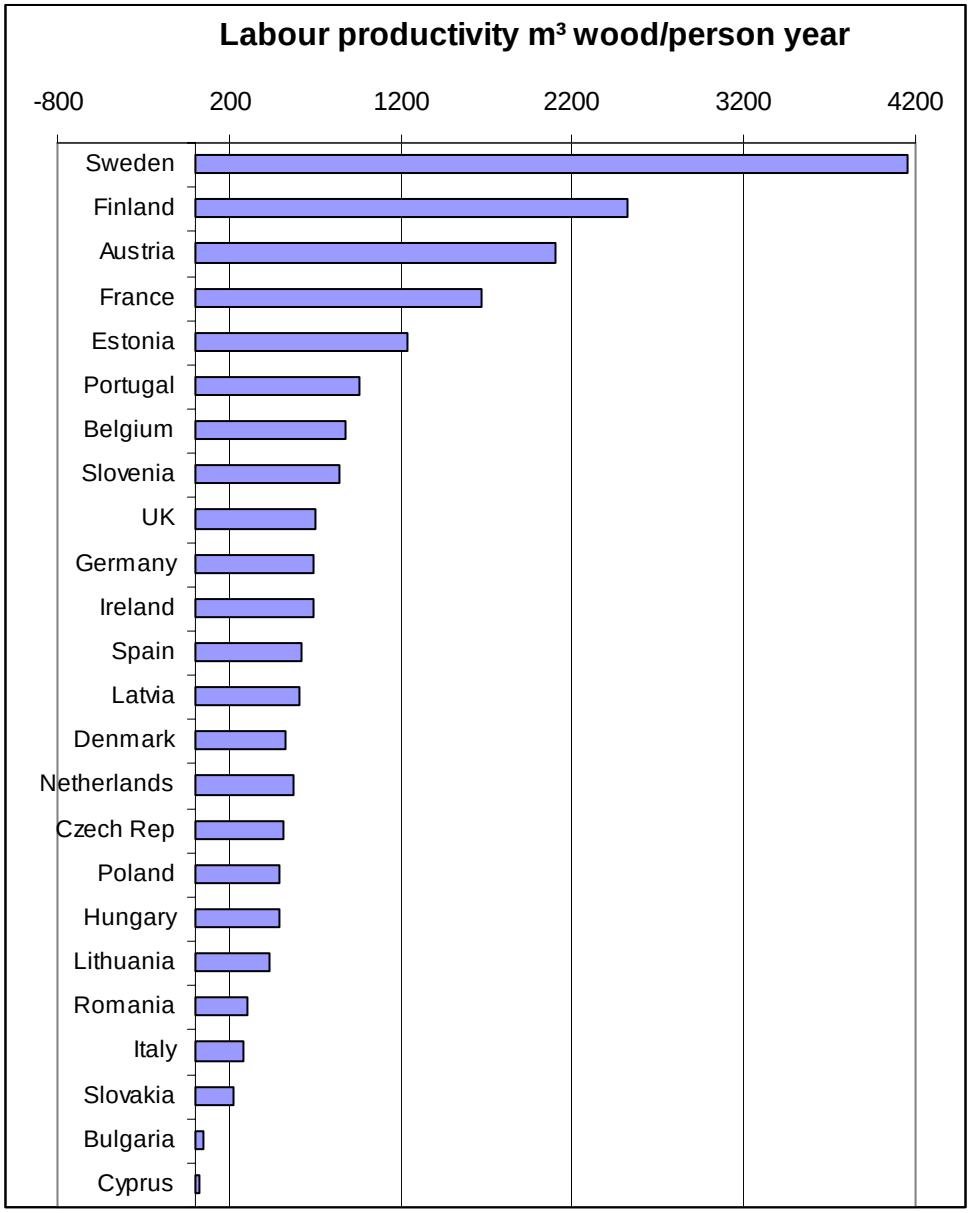

Figure A4.17. Labor productivity in m^3 wood/person/year, calculated from FAO (2006).

A4.4. Employment

Table A4.15. Employment in forestry 1990 and 2000 in 1,000 person-years. Source: FAO (2006).

	1990	2000
Germany		70
Bulgaria		69
Poland	134	60
Romania	89	47
Italy	56	36
France	33	35
Czech Republic	52	31
Spain	36	29
Slovakia	36	27
Finland	39	24
Latvia	15	19
Sweden	34	17
Lithuania	15	14
Hungary	46	12
United Kingdom	19	12
Portugal	16	11
Estonia	11	9
Austria	10	8
Belgium	4	4
Denmark	4	4
Ireland	3	4
Slovenia	6	3
Netherlands	2	2
Cyprus	1	1
Greece		
Luxembourg		
Malta		

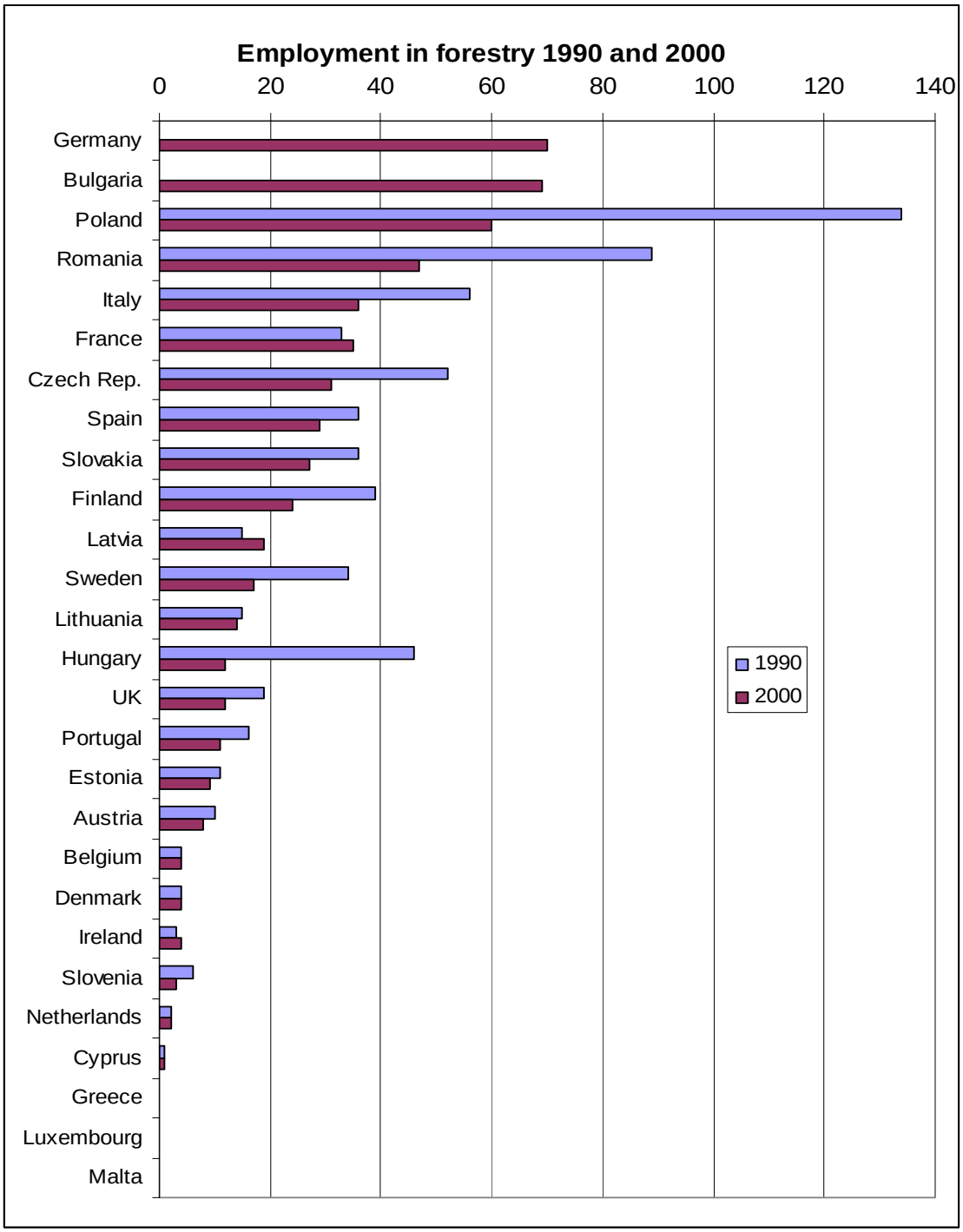

Figure A4.18. Employment in forestry in EU27 in 1990 and 2000 in 1,000 person-years. Source: FAO (2006).

Table A4.16. Employment in forestry as proportion of total labor force. Source: FAO (2004).

Country	1995	1998	2000
Austria	1.4	1.7	1.6
Belgium & Luxembourg	0.8	0.8	0.7
Bulgaria	1.3	1.4	1.2
Czech Republic	1.6	1.6	1.3
Denmark	1.0	1.0	1.0
Estonia	3.3	3.9	4.1
Finland	3.6	3.5	3.5
France	0.8	0.6	0.6
Germany	0.9	0.8	0.9
Greece	0.5	0.4	0.5
Hungary	1.1	0.9	0.9
Ireland	0.8	0.8	0.8
Italy	0.9	0.9	0.9
Latvia	2.3	3.2	3.7
Lithuania	2.0	1.7	1.6
Malta	0.3	0.3	0.0
Netherlands	0.5	0.5	0.5
Poland	0.9	0.8	0.8
Portugal	1.6	1.6	1.5
Romania	1.8	1.5	1.3
Slovakia	1.9	1.7	1.6
Slovenia	2.1	2.0	2.0
Spain	0.9	0.9	1.0
Sweden	2.1	2.1	2.1
United Kingdom	0.8	0.7	0.6
European average	***1.4***	***1.4***	***1.4***

Note: Expressed as percentage of the total labor force, as defined in ISIC Division 02.

Table A4.17. Employment in forestry 1990 and 2000. Source: MCPFE (2003).

1000 person-years	Total	Total
	1990	**2000**
Austria	10	8
Belgium	4	4
Bulgaria	-	69
Cyprus	1	1
Czech Republic	52	31
Denmark	4	4
Estonia	11	9
Finland	39	24
France	33	35
Germany	-	70
Greece	-	-
Hungary	46	12
Ireland	3	4
Italy	56	36
Latvia	15	19
Lithuania	15	14
Luxembourg	-	-
Malta	-	-
Netherlands	2	2
Poland	134	60
Portugal	16	11
Romania	89	47
Slovakia	36	27
Slovenia	6	3
Spain	36	29
Sweden	34	17
United Kingdom	19	12

A4.5. Cost and price development

Table A4.18. UK Forestry Commission Funding public forests—Net expenditure 2001–2006. Source: Forestry Commission (2006).

	2001–02	2002–03	2003–04	2004–05	2005–06
Forest management and development	57.8	77.6	61.8	53.4	56.1
Recreation, conservation, and heritage	18.5	21.5	25	30.6	32.4
Harvesting and haulage	42.7	43.4	41.9	42.4	39
Total	***119.0***	***142.5***	***128.7***	***126.4***	***127.5***

A4.5.1 Case: Profitability of forestry in UK

Table A4.19. UK Three-year rolling annualized returns from forestry 1992–2005, % per annum total return. Source: Forestry Commission (2006).

	Total return %/year
1992–95	4.4
1993–96	9.9
1994–97	7.9
1995–98	4.5
1996–99	-3
1997–00	-5.2
1998–01	-5.4
1999–02	-3.2
2000–03	-1.7
2001–04	1.9
2002–05	8.2

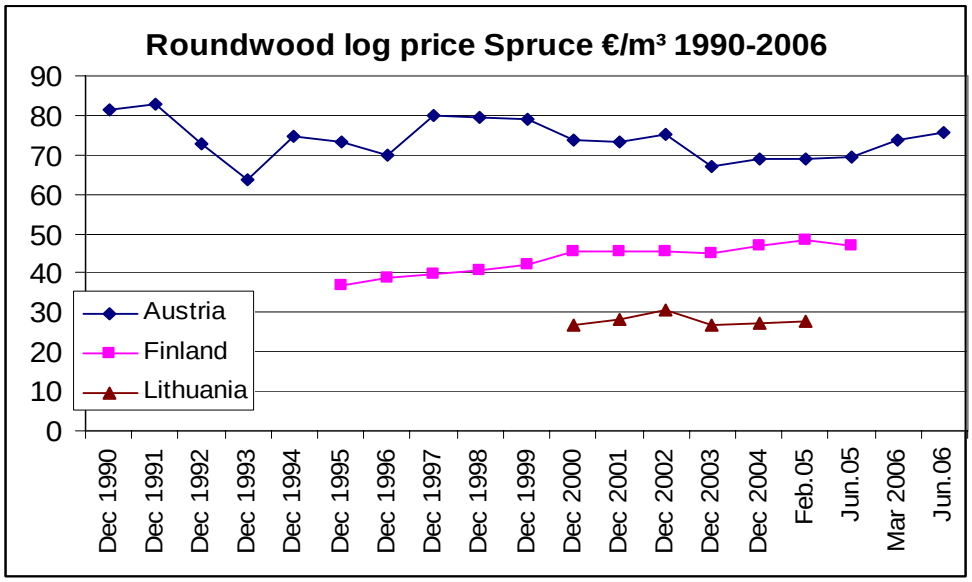

Figure A4.19. Roundwood nominal log price for spruce 1990–2006 in €/m^3. Source: UNECE/FAO Price Database (2004).

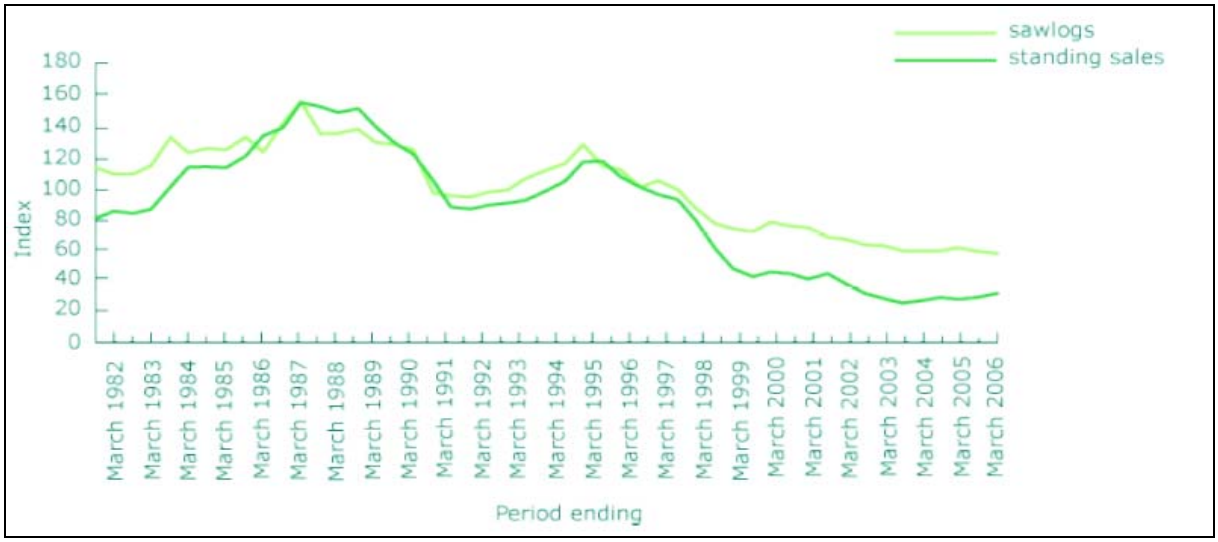

Figure A4.20. UK Coniferous standing sales and sawlog price indices in real terms 1982–2006. Source: Forestry Commission (2006).

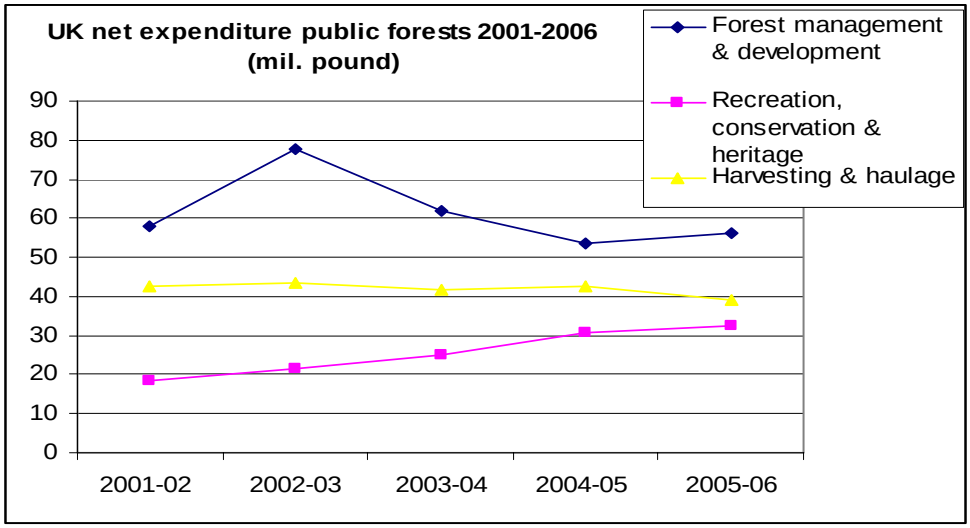

Figure A4.21. UK Forestry Commission Funding public forests—Net expenditure 2001–2006. Source: Forestry Commission (2006).

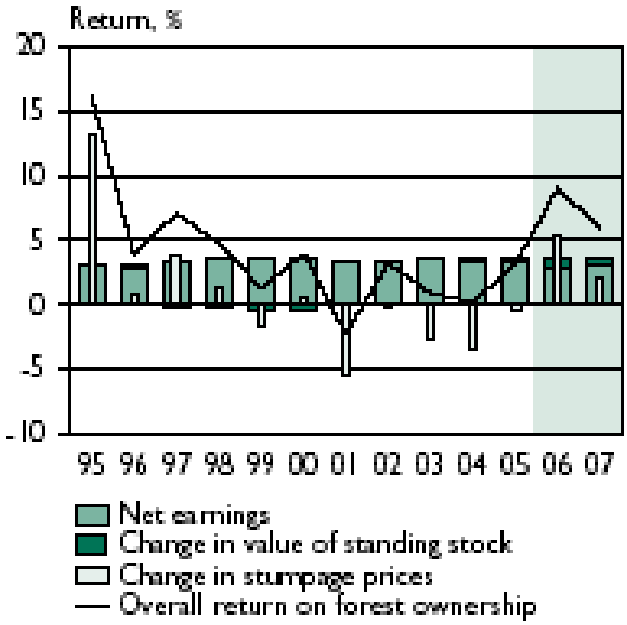

Figure A4.22 Finland: Overall real return on timber production, 1995–2007 at 2005 prices. Source: METLA (2006b).

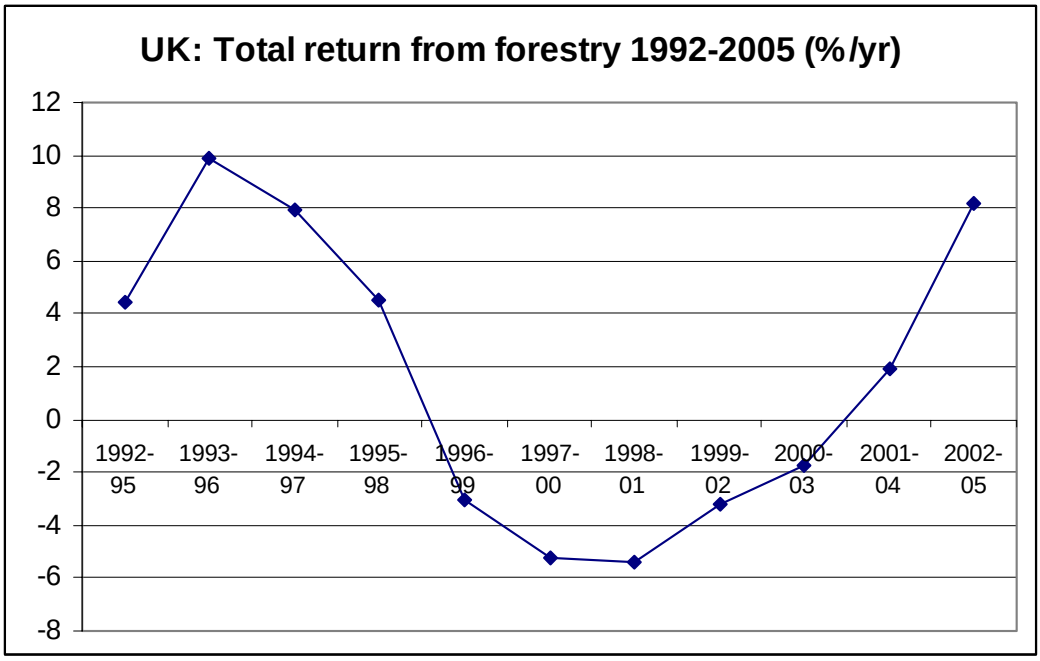

Figure A4.23. UK Three-year rolling annualized returns from forestry 1992–2005, % per annum total return. Source: Forestry Commission (2006).

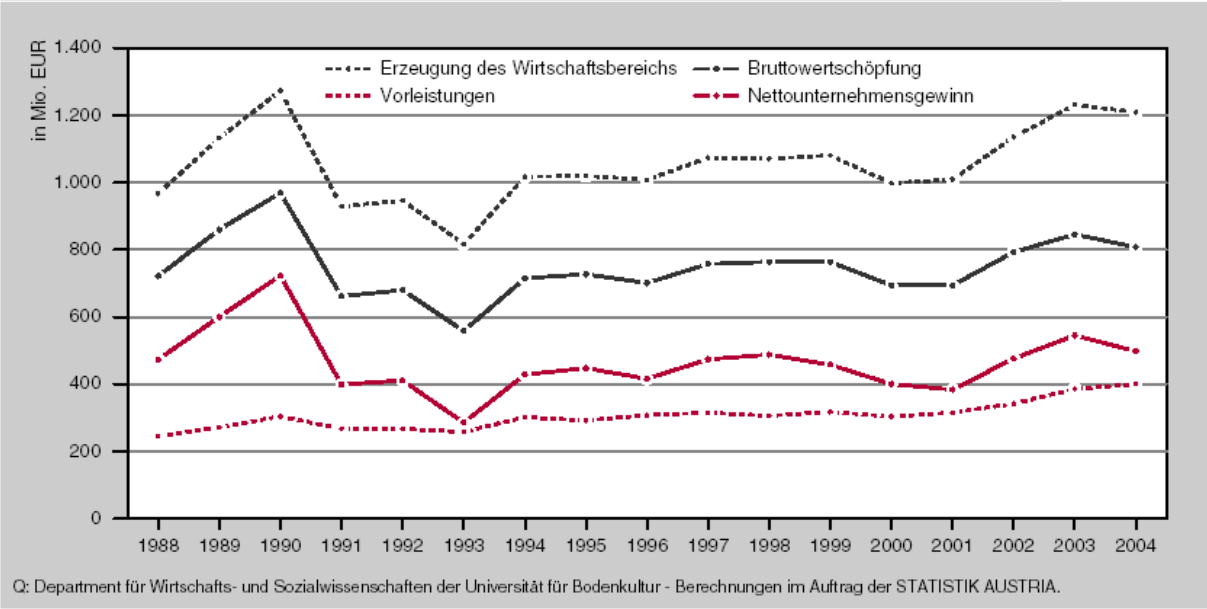

Figure A4.24. Austria: Production, gross value added an net entrepreneurial income at current prices 1988–2004, in million €. Source: Sekot (2005).

A.4.6 Trade

A.4.6.1 Import

Table A4.20. Roundwood Import 1990–2003 in 1000 m^3. Source: UNECE Timber Database (2004).

Roundwood import (1000 m3)														
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	4076.9	5662.9	4902	4786	5081	4618	4747	5433	5237	7210	8590	7666	7659	7929
Belgium										3410	4024	4545.4	2684	2779
Bulgaria	68.19	68.89	63.99	0.21	2	2	2	2	0	51	105	124.06	71	71
Cyprus	2.9	3.2	2.02	2.21	4.3	3.5	3.7	13.8	0	0	2.1	3.1	2.28	2.28
Czech Republic			120	358.05	275	335	218	505	784	817	954	976	994	597
Denmark	308	310.6	350.46	222	484.4	680.5	653	866	804	753	637	533	596	877
Estonia			0	3	18.89	13.8	34.9	110	298.1	380.24	346.48	582.88	639.06	941.1
Finland	5714.3	5071.5	5950	5502	6787	9389	6613	6775	9347.1	10301	10005	11993	12688	13043
France	1453	2106	1971.3	1465.3	2000	2350.5	1605.1	1815.5	1996.2	2175.7	2043.2	2008.8	2020	2254
Germany		2190.4	2322.9	1156.7	2782	1776	1304	1815	2304	2756	3596	3566	2703	2530
Greece	300.6	322.8	366.23	72.55	23.41	24.9	24.6	93.2	500.1	515	445.37	631.89	459.76	493
Hungary	958	1191	1147.1	349.6	141.69	239	228.7	294.39	320.7	361.2	353.7	317	332	530
Ireland	6	6	5.11	48.24	63	50	3	78	112	322	107	100.02	143	273
Italy	6134	6003	6137	4873.8	6223	5058	5156	4742	5456	5320	6295	5721	5308	4994
Latvia			1.37	0.03	0.5	50.5	7.3	38.5	81	145	136.03	213.59	387.31	464.98
Lithuania			0.95	0	7.3	16.2	18.89	102.7	90.1	77.86	60.57	96.29	103.7	78
Luxembourg										458	763.8	706.58	943.42	1527
Malta	0.3	0.3	0.47	1.2	4.3	2.2	1.5	0.8	0.57	1.19	4.33	4.38	4.36	4.36
Netherlands	661.59	668.9	735.14	542	499	465	413.9	463	590	491	388	440.8	539	402
Poland	54.2	74.3	72.02	1.31	27.03	379.6	393.5	288	371.5	591.2	732.4	882.2	726.6	668.6
Portugal	741.4	519.1	561.8	420.86	1108	1638	1067	1680	2123.9	1433	1342.1	1152	1080	1080
Romania	70	67	50.56	30.25	17.5	79.8	65.3	25.7	1.6	2	20.39	25	88	21
Slovakia			0	1.05	21.9	8.69	3.4	287.29	138.4	127	129	1828	134	160
Slovenia	0	0	216.45	131.22	289	324	258	333	293.89	490.83	495.91	439.72	423.76	485.51
Spain	2542.8	2229	2126	1432	1522.6	2265.4	1973.8	2136.5	4150	3243	3789.3	4201	3380	3319
Sweden	3645.7	4002	4585.4	4310	6677	7667	5066	7745	9300.7	10428	11898	9660.8	10171	9697
United Kingdom	144.6	139.2	210.8	254	321	673	848	587	468	317	309	363.4	496	712

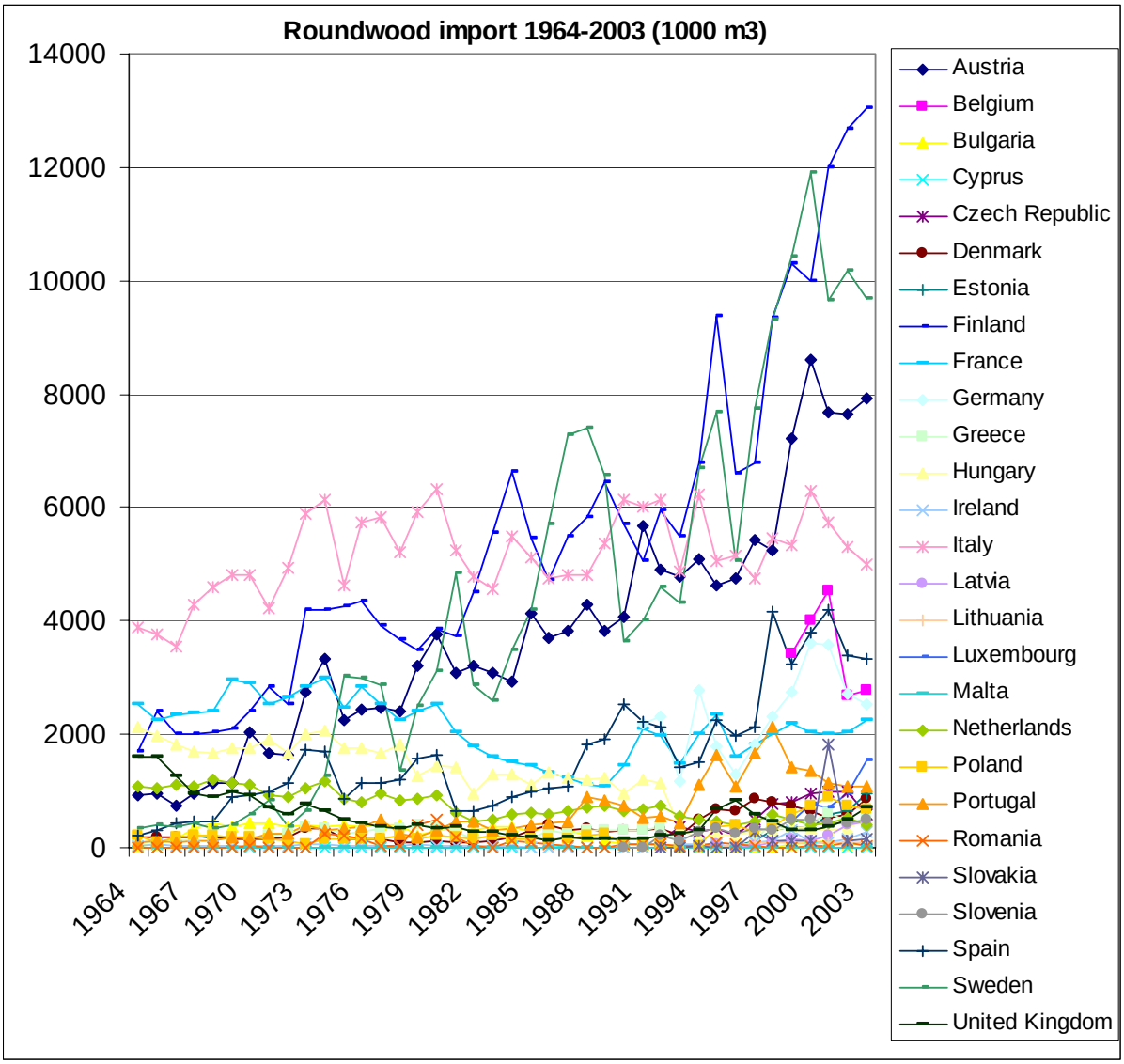

Figure A4.25. Roundwood import 1964–2003 in 1000 m^3. Source: UNECE Timber Database (2004).

Table A4.21. Wood fuel imports 1990–2003, including wood for charcoal in 1000 m^3. Source: UNECE Timber Database (2004).

Wood fuel imports, including wood for charcoal (1000 m3)														
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	215	245	283.11	303	253	164	296	156	124	117	139	173	224	299
Belgium										17	32	40.93	31	25
Bulgaria	0	0	0.69	0	0	0	0	0		0	0	0	0	0
Cyprus	0	0	0.02	0.02	0	0	0	0			0	0.03	0.03	0.03
Czech Republic			0	0.05	8	5	5	1	3	2	4	4	3	0
Denmark	17	26.6	40.46	40	36	26	104	104	75	89	107	85	139	290
Estonia				3	1.9	0.6	0.6	1.2	1.1	0.12	0	0.03	0.09	0.04
Finland	29	58	21	34	26	36	38	41	112.5	141	129.39	123.84	102	175
France	6	17	16.3	19.3	11	5.5	4.09	9.5	16.6	21.66	30.96	15.22	27	31
Germany		26.4	23.5	30.7	40	33	41	45	49	34	47	73	80	86
Greece	0.1	0.1	43.53	0.88	0.52	1.9	1.6	0.2	217	223	206.05	267.08	146.67	145
Hungary	0	0	0.1	2.6	0.5	0.4	10	36.2	2.6	3.3	9.3	8	12	41
Ireland	0	0	0.11	0.24	0	0	0	1	0	2	1	1.01	1	1
Italy	418	559	322	204	155	122	220	238		368	490	510	605	636
Latvia				0	0	0	0	0.5		0	0.15	0.03	0.03	5.78
Lithuania				0	0.1	1	0.4	2.9	3.8	2.43	0.56	0.14	0.1	1
Luxembourg										0	10.4	27.34	41.42	51
Malta	0	0	0.17	0.1	1.9	0.1	0	0.1		0.1	0.07	0.11	0.1	0.1
Netherlands	1.5	4	6.74	1	2	2	4.9	61	64	63	5	5.7	8	9
Poland	0	0	0.02	0.03	0.03	3.7	0.4	0	0.5	1.1	0.1	0.2	0.2	5.9
Portugal	0	0	2.4	1	3	6	2	1	2.1	1	1.71	43	13	13
Romania	0	0	0.56	0.07	0	0	0	0	0	0	0	0	0	0
Slovakia			0	0.02	0	0	0	4.4	0	0	0	278	0	0
Slovenia			2.45	1.22	9	9	10	4	9.69	17.76	1.5	0.89	0.63	1.09
Spain	4.8	2	145	151	96.6	73.4	71.8	20.5	14	15	18.31	73	6	24
Sweden	0.5	3	2.42	37	11	14	48	90	128.69	148	177	155.84	466	676
United Kingdom	1.9	2.8	2	8	10	11	12	11	8.8	3	20	10.1	3	3

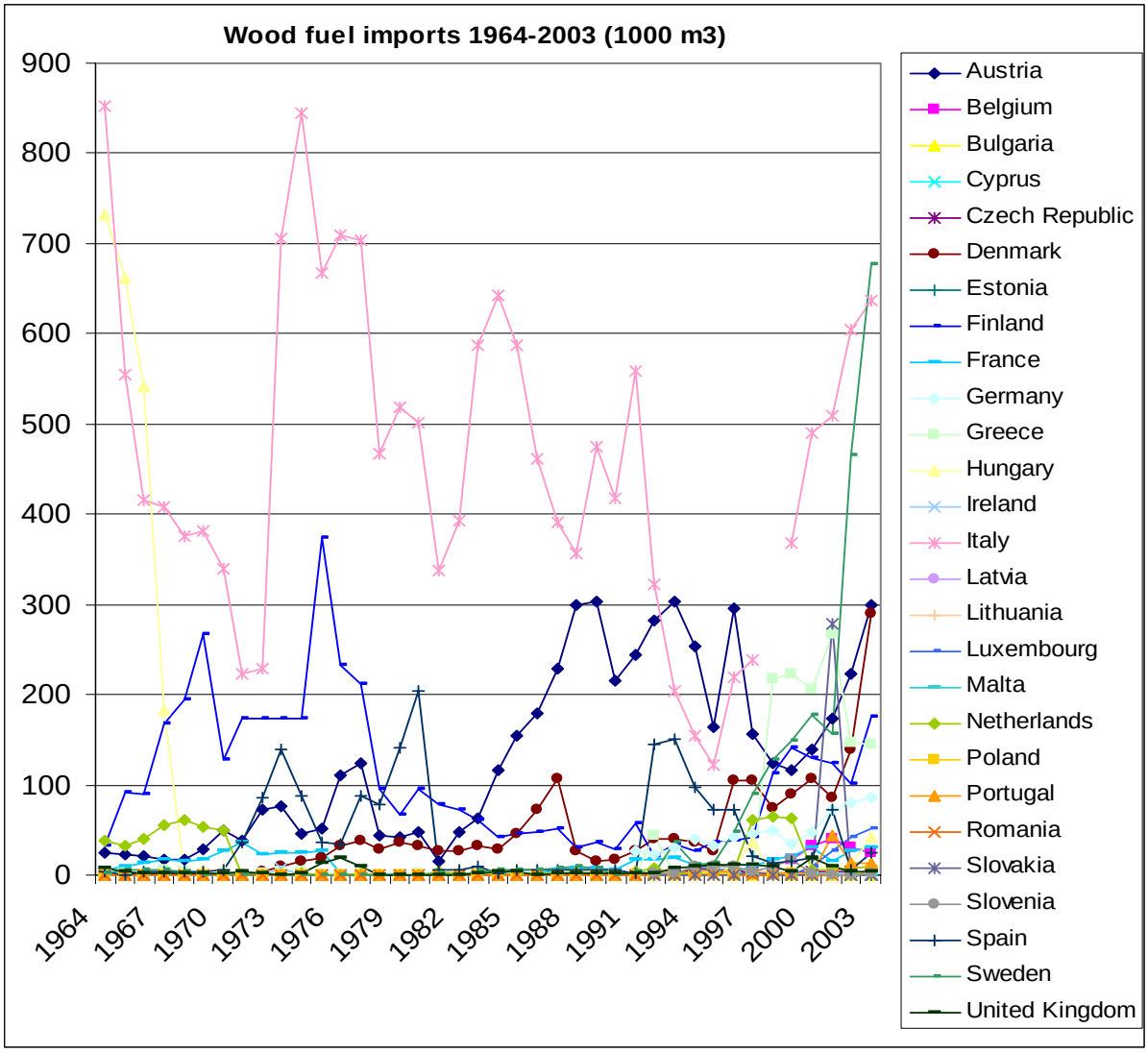

Figure A4.26. Wood fuel imports 1964–2003 in 1000 m^3. Source: UNECE Timber Database (2004).

A.4.6.2. Export

Table A4.22. Roundwood export 1990–2003 in 1000 m^3. Source: UNECE Timber Database (2004).

Roundwood export (1000 m3)														
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	1070.9	766.9	745.16	553	637	498	638	828	803	1050	942	957	1069	1098
Belgium										1268	1181	1041.1	1086	1117
Bulgaria	106.5	82.69	142.9	202	23	92.19	243.9	256.1	256.1	227	360	308.04	224.27	224.27
Cyprus	0	0	0.17	0	0	0	0	0	0	0	0	0.06	0	0
Czech Republic			270	1263	725	2335	2817	2827	2661	2798	2030	2485	2514	3174
Denmark	407.4	506.1	449.02	197.35	292	324.8	222	236	288	290	877	726	574	615
Estonia	0		531.31	1108.6	1745.6	2657.3	1927	3041	3874.8	4016.2	4432	3682.9	3359.5	3365
Finland	283.59	147.8	331.6	912.6	1445	866	582	644	716.8	768.36	533.27	404.09	408	442
France	5189	5031.1	4302.6	2286.1	2824.9	2935.9	2573.4	2654.6	3257.5	3441.8	5859.1	5429.2	4619	4338
Germany		8461	6578	4417	4740	4983	3046	4063	4902	4598	5604	4954	4932	4125
Greece	43.2	47.6	42.66	28.58	63	59.6	59.6	57	223.4	232	9.84	3.7	16.09	28
Hungary	1307	1164	1334.8	802.4	609.4	694.7	804.8	858.9	1418.9	1331.9	1593.4	1515	1575	1753
Ireland	271	274	415.13	188.85	124.2	304	250	262	91	176	42	51.5	129	92
Italy	27.69	38.4	46.44	21.85	9.5	5	7	10	16	15	24.38	23	16	11
Latvia	0		478.08	1219.5	2665	2820	1946	3139	4251	3751	4353.2	4095.5	4468.6	4461.1
Lithuania	0		285.29	285.44	889.4	1769.5	955.59	767.2	793.2	939.74	1202.9	1324.7	1436.5	1407
Luxembourg										291	228.35	267.77	210	283
Malta	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Netherlands	555.6	485.29	528.37	444	395	391	290.6	321	333.5	291	242	430.5	386	414
Poland	595.5	862.9	1047.2	593.46	759	239.2	237.39	288.7	362.6	390.8	347.2	310	723.3	1008.5
Portugal	402	429	563.56	401.24	643	798	471.5	646	585.4	557	570.1	812	807	807
Romania	2	2	0.05	1.15	0	0	0	13	161	603.4	535.1	112	94.6	211
Slovakia			0	322.17	1110	919	567	1081	735	1232	1612	1828	1286	1189
Slovenia			354.95	206	212	173.7	182	301	324.89	325.47	303.97	321.19	361.5	384.5
Spain	31.5	21.5	28.09	69	332.2	536.7	250.9	532.29	584	387	369	508	256	255
Sweden	802.3	748	649.91	843	1068	1738	1631	1404	1454.5	1335	1461.8	1340.4	1785	1533
United Kingdom	123.9	150.19	143.7	38	50.3	62.4	54.4	70	356.3	289	362	266.96	233	481

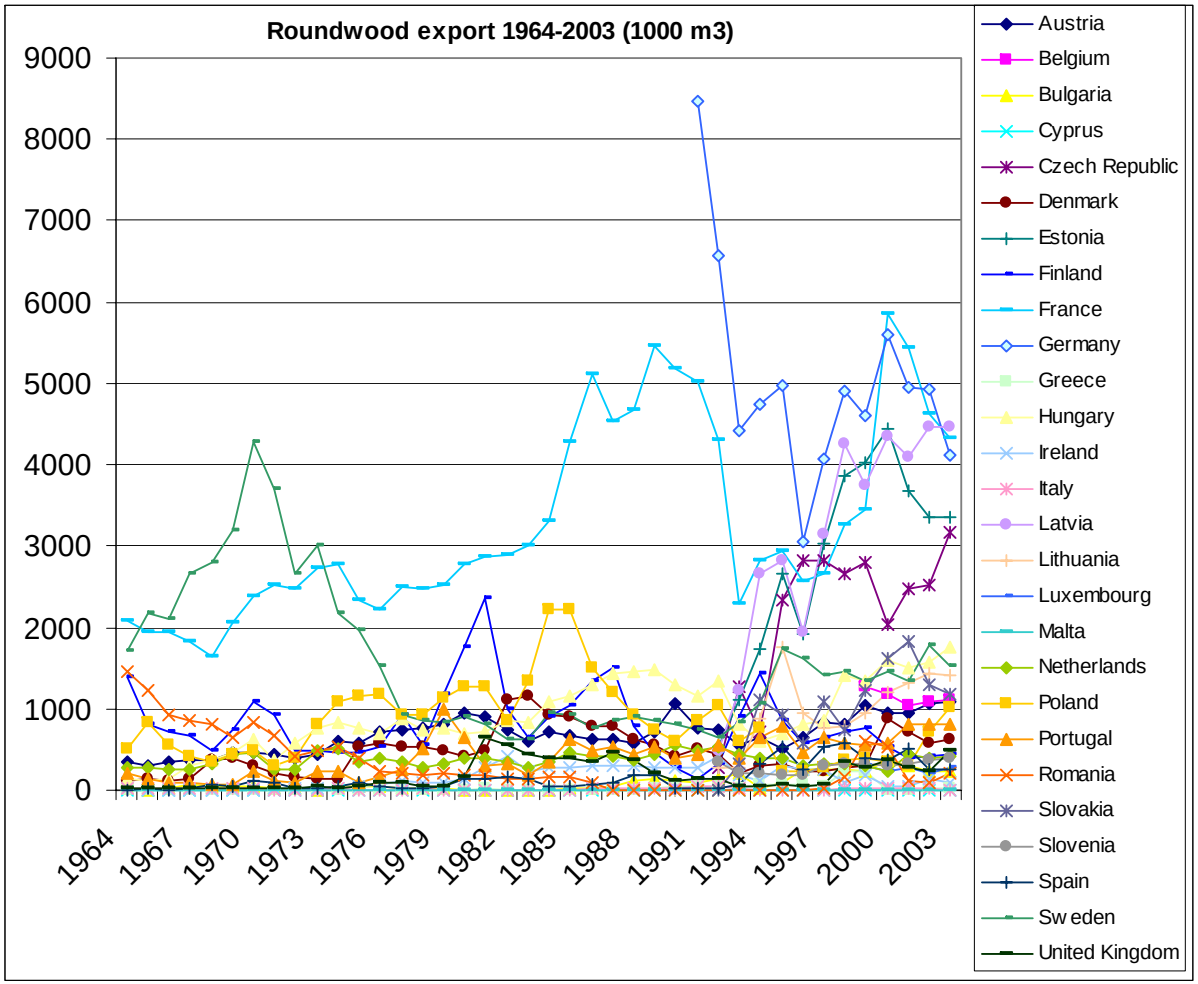

Figure A4.27. Roundwood export 1964–2003 in 1000 m^3. Source: UNECE Timber Database (2004).

Table A4.23. Wood fuel export 1990–2003, including wood for charcoal in 1000 m3. Source: UNECE Timber Database (2004).

Wood fuel export, including wood for charcoal (1000 m3)														
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Austria	3.6	3.6	5.86	2	6	16	13	9	11	11	18	25	58	137
Belgium										22	12	40.21	83	66
Bulgaria	0	0	64.2	100.3	5	24.6	58.9	56		1	73	27.04	29.27	29.27
Cyprus	0	0	0.17	0	0	0	0	0			0	0	0	0
Czech Republic			0	77	120	174	130	170	164	172	173	209	212	219
Denmark	4.4	2.1	3.02	2.48	4	6.8	4	25	9	1	1	0	1	1
Estonia			1	12	27	20.39	29.3	126	83	113.45	175.35	200.67	227.48	335.58
Finland	1	0.1	0.6	0.6	1	1	3	4	5.6	10	13.79	4.67	4	10
France	44	98.1	123.56	120.1	391.9	460.9	346.4	373	400.3	348.81	336.67	313.05	375	379
Germany		4.3	5.76	14	42	64	54	31	31	46	46	48	25	10
Greece	0	0	0.06	0	0	0	0	0	220.5	229	9.39	2.95	16.05	15
Hungary	148	148	338.77	290	158.19	132.4	250	158	214.9	252.9	311	288	365	387
Ireland	0	0	17.13	5.85	2.2	0	0	0	0	0	0	0.7	3	2
Italy	0.7	1.4	9.44	3.07	1	1	3	4		0	0.38	0	0	0
Latvia			3.08	19.54	236	391	479	1015	1491	798	163.45	105.4	244.03	539.32
Lithuania			0.02	0.44	1.4	0.7	3.8	2.2	0.8	1.52	3.15	10.75	16.5	54
Luxembourg										0	9.64	64.8	82	65
Malta	0	0	0	0	0	0	0	0			0	0	0	0
Netherlands	22.2	22.5	22.07	22	21	11	16	19	43.9	29	22	14.8	20	33
Poland	0	0	9.84	9.95	7	12.1	18.5	15.4	17.2	23.8	25.2	35.6	46.9	66.7
Portugal	0	0	14.46	40.24	14	20	19.5	19	13.4	14	13.18	3	2	2
Romania	2	2	0.05	0	0	0	0	0	0	1	4.3	3	7.6	89
Slovakia			0	38.33	200	160	38	231	21.2	39	62	278	99	155
Slovenia			74.54	71	102	74	110	111	89.1	75.35	61.79	54.61	60.42	77.76
Spain	8.5	8.5	12.09	17	44.2	66.7	83.9	83.3	76	65	84	125	71	87
Sweden	7.7	5	13.92	10	14	13	10	11	34.1	20	30.75	37.58	30	13
United Kingdom	0.8	2.9	1.8	1	0.3	1.4	1.4	30	142.5	137	233	162.77	112	345

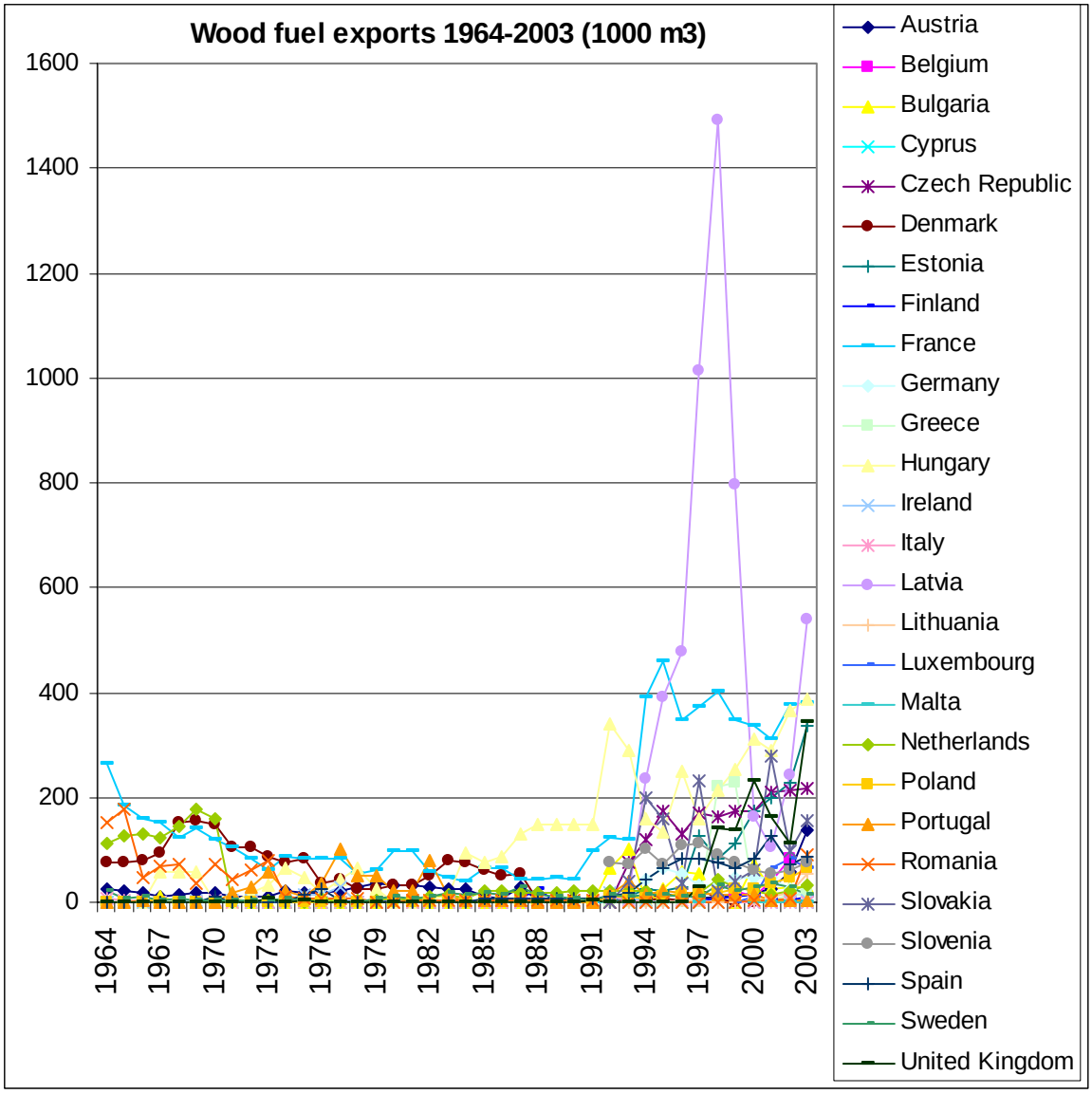

Figure A4.28. Wood fuel exports 1964–2003 in 1000 m^3. Source: UNECE Timber Database (2004).

A.4.6.3. Trade balance

Table A4.24. Net Trade of Roundwood 1999–2005. Source: FAOSTAT (2007).

	Import minus Export 1999	Import minus Export 2001	Import minus Export 2003	Import minus Export 2005
Austria	6,160,000	6,709,000	6,853,000	8,000,000
Belgium	2,142,000	3,504,340	1,550,383	2,092,843
Bulgaria	-176,000	-183,977	-153,273	-508,304
Cyprus	0	-20,915	781,000	493,000
Czech Republic	-1,981,000	-1,508,999	-2,577,000	-2,054,000
Denmark	463,000	-193,000	620,841	471,459
Estonia	-3,635,999	-3,100,010	-2,423,869	-39,840
Finland	9,532,411	11,588,823	12,601,196	15,458,265
France	-1,266,154	-3,420,376	-2,238,120	-1,858,490
Germany	-1,842,000	-1,388,000	-1,999,000	-3,033,000
Greece	283,000	-3,070,106	474,294	148,044
Hungary	-970,700	-1,198,000	-1,223,000	-767,000
Ireland	146,000	48,520	-178,060	-105,006
Italy	5,305,000	5,698,000	4,948,091	5,604,924
Latvia	-3,606,000	-3,881,880	-3,996,386	-3,178,949
Lithuania	-861,887	-1,228,400	-1,375,000	-884,838
Luxembourg	167,000	438,810	1,242,475	55,862
Malta	1,191	14,336	184,000	20,000
Netherlands	200,000	10,300	-129,300	-171,500
Poland	128,400	572,200	-339,900	1,441,600
Portugal	876,000	340,000	-550,000	-917,000
Romania	-601,400	-87,000	-190,000	177,000
Slovakia	-1,105,000	0	-933,000	-1,755,000
Slovenia	165,356	118,520	100,974	-5,396
Spain	2,856,000	3,693,000	2,934,000	3,238,463
Sweden	9,093,000	8,320,390	8,164,007	5,723,081
United Kingdom	28,000	96,436	263,820	-250,042

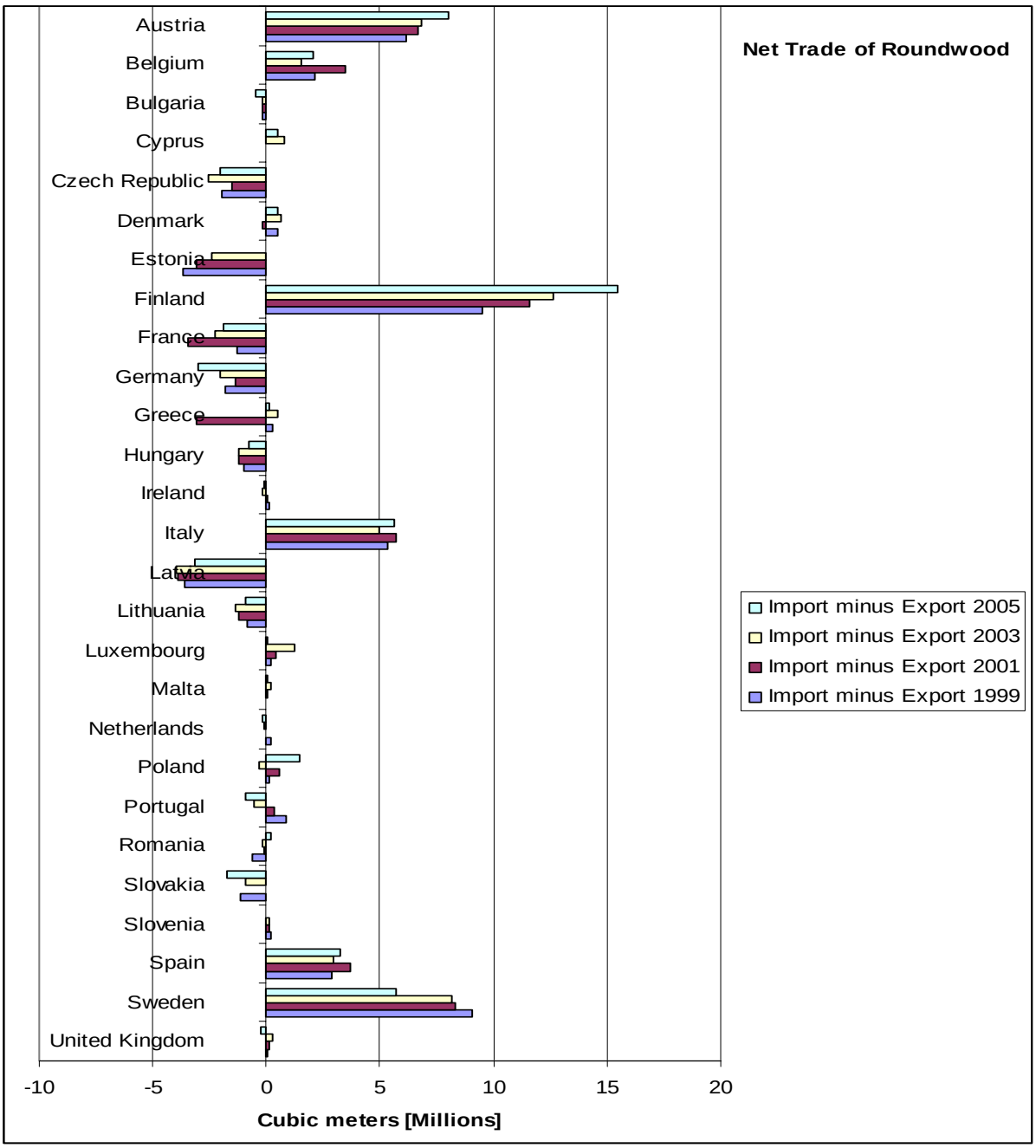

Figure A4.29. Net trade of roundwood 1999–2005. Source: FAOSTAT (2007).

Table A4.25. Net trade of wood fuel 1999–2005. Source: FAOSTAT (2007).

	Import minus export 1999	Import minus export 2001	Import minus export 2003	Import minus export 2005
Austria	106,000	148,000	124,000	207,000
Belgium	-5,000	720	-39,296	-15,541
Bulgaria	-1,000	-227,045	-29,273	-123,000
Cyprus	0	30	110	325
Czech Republic	-170,000	-205,000	-219,000	-259,000
Denmark	88,000	85,000	287,384	268,048
Estonia	-113,330	-200,650	-335,532	-117,175
Finland	131,000	119,164	164,550	175,411
France	-327,154	-297,833	-377,121	-407,541
Germany	-12,000	25,000	74,000	217,000
Greece	-6,000	264,133	129,600	29,988
Hungary	-249,600	-280,000	-346,000	-133,000
Ireland	2,000	310	-994	298
Italy	368,000	510,000	635,583	864,079
Latvia	-798,000	-105,360	-533,533	-342,243
Lithuania	895	-10,610	-74,000	-13,748
Luxembourg	0	-37,460	-14,241	-23,500
Malta	101	120	184	20
Netherlands	34,000	-9,100	-26,400	-26,600
Poland	-22,700	-35,400	-60,800	-9,000
Portugal	-13,000	40,000	0	-5,000
Romania	-1,000	-3,000	-89,000	-68,000
Slovakia	-39,000	0	-59,000	-119,000
Slovenia	-57,595	-53,720	-76,662	-135,798
Spain	-50,000	-52,000	-63,000	-76,608
Sweden	128,000	118,260	662,559	132,000
United Kingdom	-134,000	-152,670	-333,023	-191,003

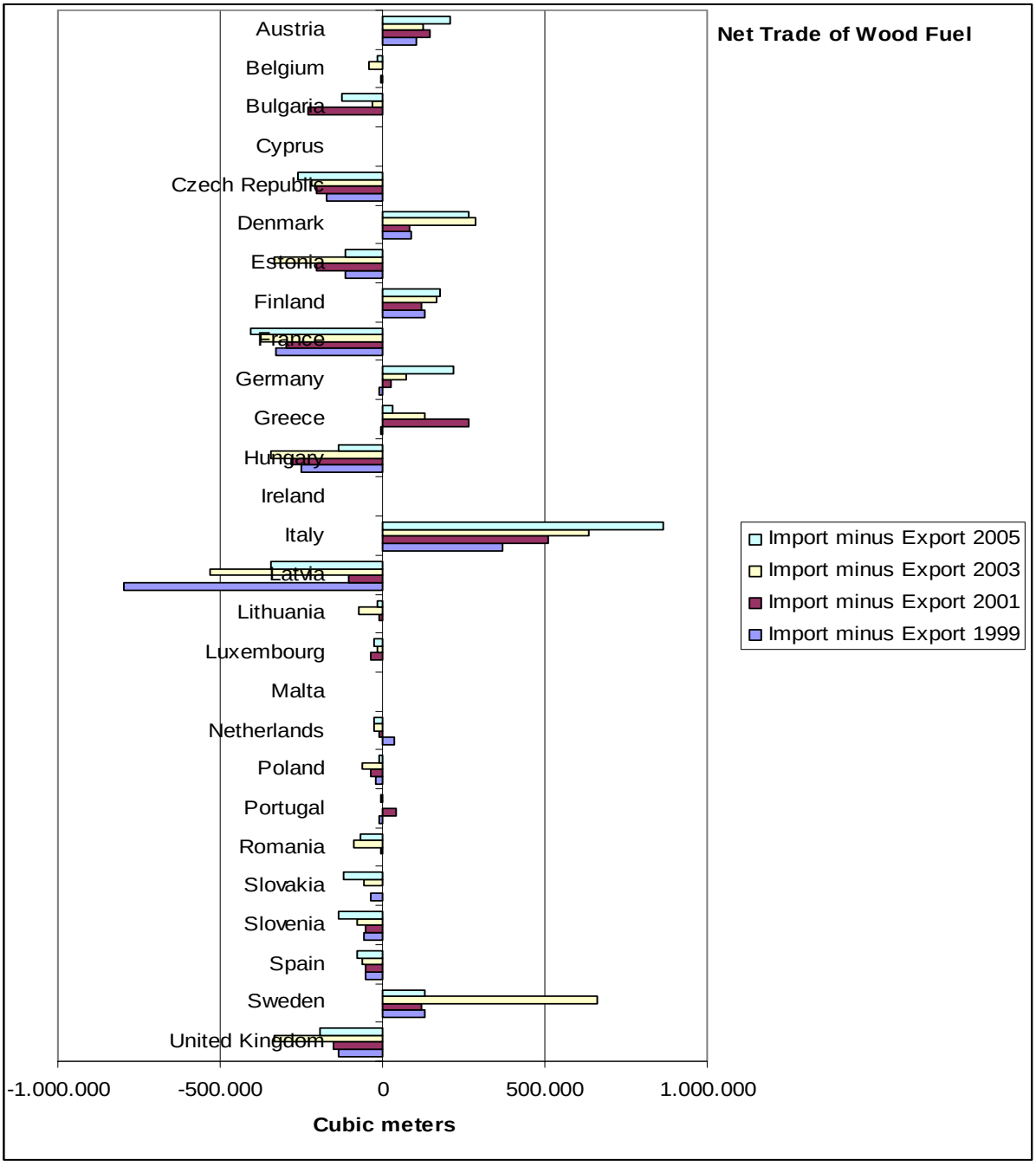

Figure A4.30. Net trade of wood fuel 1999–2005. Source: FAOSTAT (2007).

A4.7. Technology and Know-How

A4.7.1. Technology use in forestry, including ICT

Table A4.26. Employment per 1000 ha forest (person-years/1000ha), calculated from FAO (2006).

	employment/ha forest
Bulgaria	20.44
Slovakia	14.06
Czech Rep.	11.76
Denmark	8.23
Romania	7.38
Lithuania	6.93
Poland	6.62
Latvia	6.59
Ireland	6.57
Germany	6.32
Hungary	6.29
Belgium	6.00
Cyprus	5.78
Netherlands	5.56
UK	4.30
Estonia	4.01
Italy	3.81
Portugal	3.07
Slovenia	2.42
France	2.28
Austria	2.08
Spain	1.76
Finland	1.07
Sweden	0.62

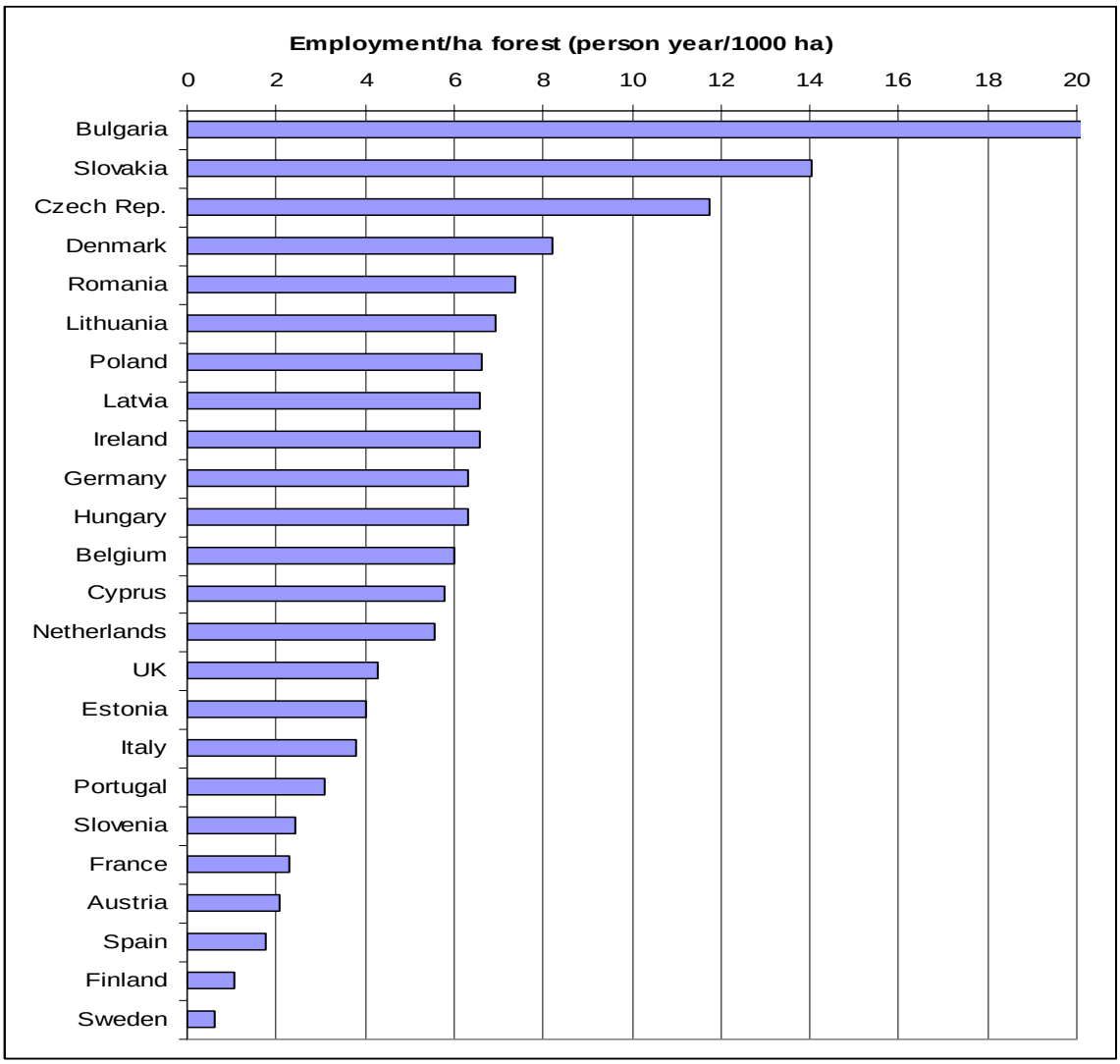

Figure A4.31. Employment per 1,000 ha forest (person-years/1000 ha), calculated from FAO (2006).

Annex 5: Model Descriptions

4DSM

The 4DSM (Forestry Demand Supply Model) is a static economic equilibrium model for the global forest sector where demand and supply are equilibrated under a global trade regime. The market equilibrium refers to the condition where regional market prices are established through competition such that the amount of forest products sought by buyers is equal to the amount of forest products produced by sellers in a number of global and European regions. Essentially, 4DSM is a global trade model. When the price of a forest product is above the equilibrium point there is a surplus of supply; when the price is below the equilibrium point there is a shortage in supply. Different Constant Elasticity of Substitution (CES) supply curves and different demand curves were calibrated to mimic the 2005 global forest market. The functional form is $P = P(Q) = FQ^{1/E}$, where E is positive for supply schedules and negative for demand, respectively. The static global multi-market balance is established for two final products categories, sawnwood and paper and paperboard products. These final product markets are linked to regional roundwood markets of sawlogs and pulpwood logs. All forest products are traded, and the market balance is established simultaneously for all product categories.

The model is regionally differentiated in five European regions and nine global regions. It starts from the FAO data and other secondary sources for quantities and prices of sawnwood logs and pulp logs and of sawnwood and pulpwood. For production cost estimates of these products, for example, mill costs, an internal IIASA database and purchased data were used. Trade costs and quantities were approximated from various literature sources. Each of the 14 regions has its own elasticity according to expert estimations and known data about the regions. Based on the production and trade costs, the model calculates the amount and price of the primary and final forest products and the trade among the regions. Depending on all these data (supply and demand quantities and elasticities, supply costs, demand prices, production costs, and trade costs) the model calculates the optimal supply and trade quantities plus prices on these curves assuming "perfect market conditions." In order to mirror the actual trade in the base year (2005) the model is calibrated to these trade matrices (for logs and final forest products).The model can be calibrated by the use of Positive Mathematical Programming (PMP) techniques to match 2005 market conditions according to FAO statistics. However, it was found that the input parameters of the supply and demand functions were so well calibrated that the model could be run unconstrained, which allows for a much better assessment of the plausible future development trajectories of the global forest sector under globalization and given a number of development options, such as technological change scenarios (see scenario description). The scenarios are assessed by providing exogenous shift variables to supply and demand parameters.

The model is a non-linear optimization model and was written in GAMS (General Algebraic Modeling System).

BFSM

Background and Purpose of BFSM modeling

The Bilateral Forest Sector Model (BFSM) served a number of purposes in this study. First, the model was used to carry out detailed sensitivity analyses of the dynamic interactions of various elements of the entire supply chain and their interactions with changes on the supply

side. Sensitivity analysis helped to distill the most important driving and impact factors of the dynamic system at hand. Using the knowledge from sensitivity runs, the more detailed models were constructed. Second, first estimates of orders of magnitudes of impact factors were assessed. Third, BFSM focused on the dynamic behavior of the possible futures of the global forestry sector, while the other assessment tools are essentially static. Fourth, the model is easily tractable for non-modelers but might be tested and further improved and augmented during the course of the full project. The model was implemented on a VENSIM modeling platform and would be ideally suited for online modeling for targeted stakeholder workshops aiming to contextualize and quantify expert knowledge.

Basic Description of the Model

The BFSM is a system dynamics model of the global forest sector modeling trade between Europe and the Rest of the World. This aggregated representation of the global forest sector allows the model to track in a sufficiently simple way the dynamic interactions of a number of elements within the forest sector which, for reasons of complexity reduction, have to be omitted in more geographically resolved models (like YDSM). BFSM focuses on the dynamic interaction of changes in the final demand pattern of paper products and sawnwood, with all major elements influencing the forest products supply chain involved, including technological change and innovation in the conversion industry, all the way to issues of competition over wood resources further down the supply chain. Changes in demand patterns are driven by population dynamics consistent with the revised IPCC marker scenarios (A2, B2, B1, and their respective climate policy constraint worlds: see Detailed Analysis Framework Specification), changes in economic affluence measured in gross domestic product (GDP), and changes in consumption patterns due to lifestyle changes. The latter include modeling of dematerialization or resource sparing by consumer behavior due to changes in consumption patterns such as substitution of online newspaper reading for newsprint.

Technological change in the woodworking industry is modeled by two factor learning curves involving increasing/diminishing returns on R&D investment and accumulated experience stocks of respective technology vintages. The model also traces physical flows, including trade of wood chips from sawmills to pulp and paper industries, as well as the impacts of increased paper recycling or alternatives used in the energy sector.

International competitiveness is measured by a “cost vector” whose elements are pure costs, but also proxy indicators of product and service quality. The “cost–competitiveness ratio” between Europe and RoW determine domestic and RoW investment rates and thus dynamically reveal the comparative advantages of new technological vintages in the forest sector. Total investments in the respective regions are distinguished between investment in new capacity for export grades or for local production. The evolution of this vintage structure is monitored throughout the simulation period. Competitiveness is assessed for the entire wood chain and not only at the conversion stage. Information on shortages in wood supply is transmitted via increased wood prices to final product markets. Modeling competitiveness also includes assessments of strategic investments mimicking market imperfection phenomena, such as the formation of oligopolistic market structures and barriers to technology transfer.

In the model, three separate but linked product markets for wood are distinguished:

1. Pulpwood market
2. Sawlog market
3. Wood for energy market

To satisfy demand for final products, wood is delivered from a renewable forest resource stock that can roughly be divided into an existing forest resource stock and an afforestation stock that is to be newly built. Policies that aim at wood mobilization, tree improvement programs, or other silvicultural measures enhancing wood supply of any of the three grades can be captured by the model. The model was implemented with the software VENSIM (www.vensim.com).

BEWHERE

BeWhere is geographically explicit static spatial partial equilibrium model driven by exogenous price and demand schedules. BeWhere is a linear mixed integer programming model whose aim is to determine the optimal geographic locations and sizes of sawmills, pulp and paper mills, and bio-energy plants. Optimal locations and sizes are found by the minimization of costs with respect to biomass and final forest product production and transport, investments for the production plants, and sales outlets. Hence, the model covers competition at all levels of the production chain, including supply of biomass, wood conversion, and demand for final products.

BeWhere was used because cost-competitiveness crucially depends on the detailed costing of the entire supply chain field-wheel involving optimal location, scaling, and logistics. In this study BeWhere was dual-purpose: 1) informing the parameterization of current and future CES supply schedules for the aggregate regions of the 4DSM model; and 2) downscaling of 4DSM results to real geographic space. The latter turned out to be a powerful tool for presenting results and a valuable tool for validating model results through visual interpretation.

The model is a mixed linear optimization model and is also written in GAMS.

Annex 6: Classifying Innovation and Innovation Support Measures

A **product innovation** is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user-friendliness, or other functional characteristics.

A **process innovation** is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment, and/or software.

A **marketing innovation** is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion, or pricing.

An organizational **innovation** is the implementation of a new organizational method in the firm's business practices, workplace organization, or external relations. An organizational innovation is the result of strategic decisions taken by management. Organizational innovations in *business practices* involve the implementation of new methods for organizing routines and procedures for the conduct of work. Innovations in *workplace organization* involve the implementation of new methods for distributing responsibilities and decision making among employees for the division of work within and among firm activities (and organizational units), as well as new concepts for the structuring of activities, such as the integration of different business activities. New organizational methods in a firm's *external relations* involve the implementation of new ways of organizing relations with other firms or public institutions, such as the establishment of new types of collaborations with research organizations or customers, new methods of integration with suppliers, and the outsourcing or subcontracting for the first time of business activities. As "business model innovation" is not an explicit category in the OECD definition and classification, it should be included under this category.

Besides the above classified types of innovation that refer to innovations at the firm level, the concept of **institutional innovations** is of increasing relevance when analyzing policies and institutions. Institutions are understood here to denote "the rules of the game." Institutional innovations refer to innovations in the public/policy sphere. Institutional innovations may include new or adaptation of existing organizations, new or significantly modified rules as laid down in laws, decrees, or policies, as well as new or significantly modified procedures in developing and implementing policies.

Innovation support can take many forms from direct funding of research and development activities to the support of the diffusion of innovations, improving the knowledge base and interaction of actors, and adapting framework conditions. Some of these support measures are targeted directly at fostering concrete innovation activities; others are of structural character. These measures may be introduced without the explicit aim of fostering innovation.

Research and Development: This includes innovation support in a narrower sense, that is, financing of basic and applied research, development of new products or processes, pilot projects, demonstration projects, and support for the commercialization of innovations.

Support for research and development generally aims at innovations that are new to the sector (forest sector), namely, products, processes, and marketing and organizational methods that have not been introduced to a particular sector in a particular country before.

Diffusion of innovations: This includes support for the early and broad adoption of named, already known goods, services, and processes by enterprises in a sector in a specific country. It excludes support to standard managerial processes or late adoption (e.g., species diversity support or road building in forestry or standard IT in SMEs).

Strengthening the knowledge base of forest owners/managers: The innovation capabilities of a firm, sector, or economy strongly depend, among other things, on the availability and quality of human capital, namely, individual know-how, skills, and motivation of entrepreneur and employers, and level of qualification and competencies of employers. Further, access by firm and forest managers to research, education, and training institutions and exchange of information and knowledge with them, influences the propensity to innovation.

Promoting interaction/managing interfaces: Firms do not innovate in isolation. Rather a range of other actors/organizations contribute in different ways to innovations, for example, other firms/competitors, research organizations, extension services, interest groups, etc. Policy may foster innovation by strengthening the interaction among different key actors in the forest sector, among other things, through promoting cooperation among forest holdings, cooperation along the forestry wood chain and across other sectors, promoting public–private partnerships, research institutions–enterprise cooperation, and promoting interaction with users (customers and consumers).

Public demand creation for innovation: The demand side is crucially important for the promotion of innovations. Policy may not only promote innovations by supporting the input side but also by inducing demand for innovation. This is often applied in the case of environmental/sustainable innovations. The following activities may be implemented to strengthen the demand for innovation: reorientation of public procurement policy (creating consumer demand), support for lead users, or public agencies acting as lead user, clear demand expression through communication.

Improving frame conditions: General framework conditions including institutions such as laws, regulations, standards, taxes, or access to financing have a crucial influence on firms' decisions to innovate. Changing framework conditions is often not in the responsibility of sectoral policies. The following list comprises a selection of policy activities to improve framework conditions for innovation:

- Institutional reforms (e.g., change of forest law, property rights reform, support for the establishment of new organizations);
- Adaptation of tax laws (e.g., corporate taxes);
- Improving access to financing (e.g., by providing guarantees); and
- Adaptation of standards and norms (e.g., in the construction sector).

Annex 7: Perceived Importance of Innovative Actions among Forest Policymakers and Forestry Associations

Two recent surveys jointly undertaken by the EFI PC INNOFORCE, the UNECE, and the CEPF explored how innovation is seen and addressed by forestry administrations and forest owners' associations across Europe (Rametsteiner and Bauer 2007). In cooperation with UNECE a first survey was conducted among representatives of ministries responsible for forestry (forest administration) in Europe. The standardized questionnaire was sent out by e-mail to 32 countries in August 2005. The questionnaire was returned by representatives of the forestry administrations of 18 countries (i.e., around 56% of the target group). A second survey targeting forest owners' associations was undertaken in cooperation with the CEPF from January to March 2006. The questionnaire was sent to forest owners' associations in 26 countries, of which 14 or around 54% returned the questionnaire.

The figures below (*Figures A7.1* and *A7.2*) show the combined rating of the importance of areas of innovation by forestry administrations and forest owners' associations. The most important areas for innovations in goods and services are considered to be wood for bio-energy and environmental services. When looking at the areas for process innovations, organizational innovations dominate the picture. Both the cooperation between forest owners and the cooperation along the forestry wood chain are given equally high importance by the respondents. The most important technological innovation is the use of information technology in forestry.

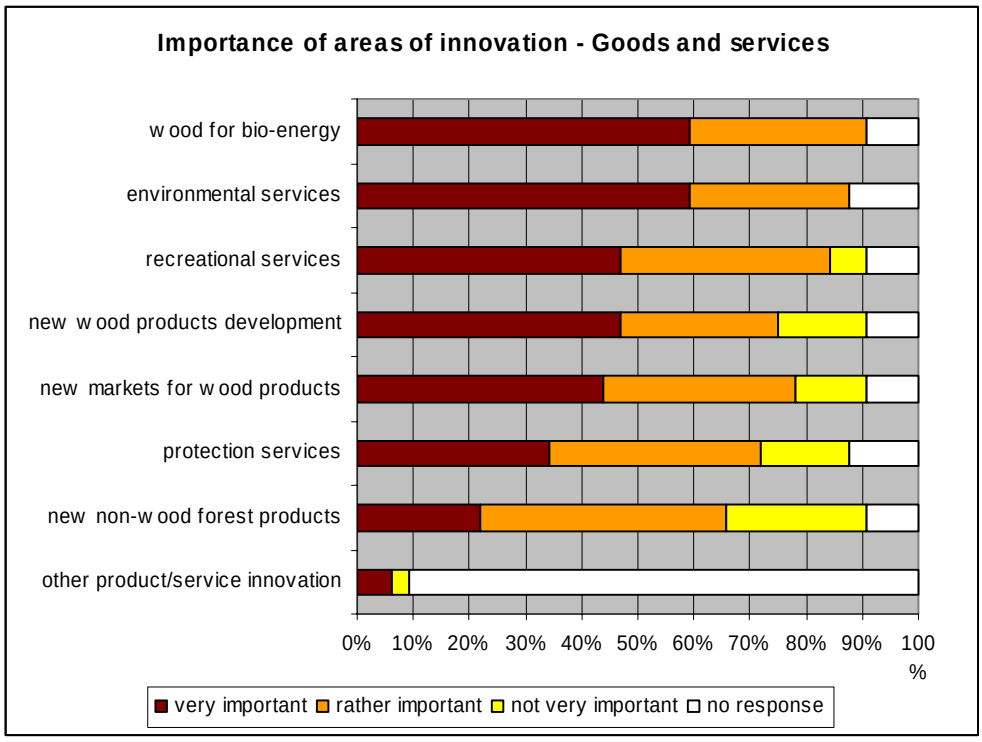

Figure A7.1. Importance of areas of innovation—Goods and services

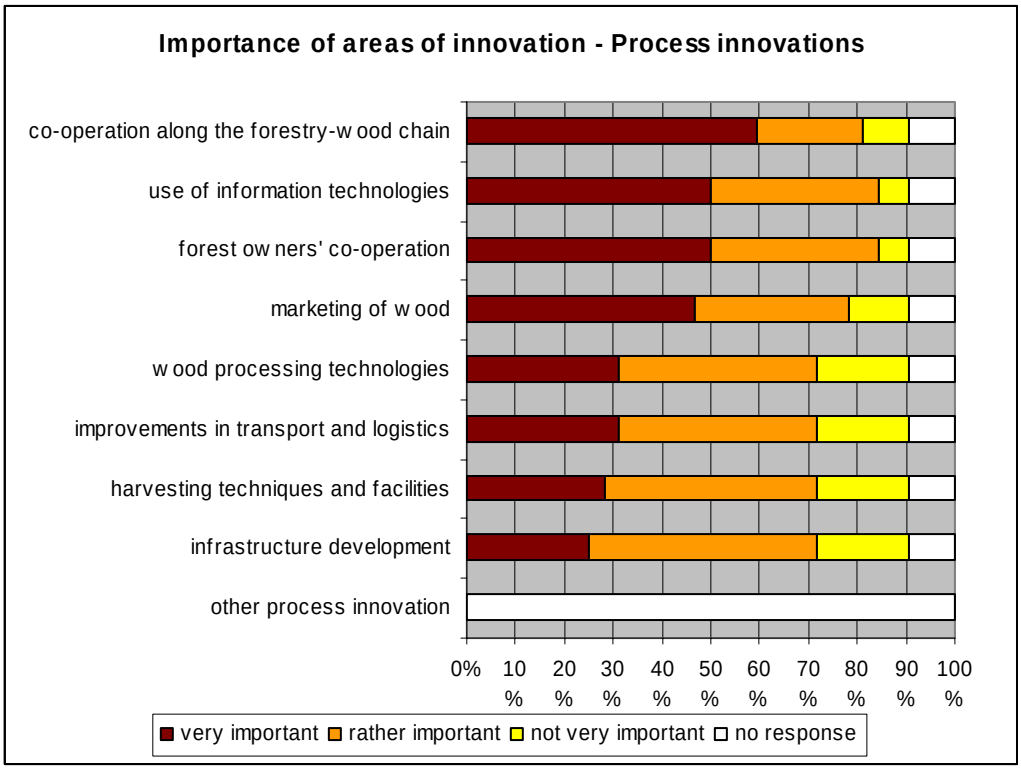

Figure A7.2. Importance of areas of innovation—Process innovations

The order of the areas of innovation does not differ much between forestry administrations and forest owners' associations. While for forestry administrations, environmental services are the most important product innovation, forest owners' associations assess wood for bio-energy highest. For forestry administrations, the cooperation among forest owners and the cooperation along the forestry-wood chain are the most important process innovations; for forest owners' associations it is the marketing of wood.

Differences become visible when differentiating between countries with a longer market tradition and countries with economies in transition. While in countries with a longer market tradition, environmental services are clearly ranked highest by forestry administrations,(over 70% stated that it is very important), forest owners' associations in this country group assess this area less important compared to other areas. For them wood for bio-energy clearly ranks highest. Within process innovations, forest owners' associations in countries with a longer market tradition regard marketing of wood as highly important, while forestry administrations put this area at the end of the list. In countries with economies in transition, in contrast, forest owners' associations rank environmental services much higher than forestry administrations do.

While environmental services are regarded as a highly important area for innovations in forestry by many respondents, institutional support for developing markets for environmental services is largely missing. Forestry interest groups and other actors are focused on averting demands for services that are free of charge rather than on actively supporting new developments. Further, skepticism regarding the market opportunities for environmental services prevails among forestry actors. Finally, there is a lack of trust among the relevant actors in forestry regarding environmental services. These factors result in only few activities being undertaken to develop the environmental services, even though this is stated to be very important.

Annex 8: Case Studies

The following provides a range of more in-depth cases in addition to the examples given in the main body of the text. To better show the broad range and diversity of innovations in the different innovation categories, it was decided to expand the number of in-depth cases, originally planned to cover five examples, while shortening the individual descriptions. The sequence of cases follows the sequence of the regional types.

Case Study 1: Finnish Thermowood Association

To produce thermowood, the wood material is heated to a temperature of at least 180°C while being protected by steam. Besides providing protection, the steam also affects the chemical changes taking place in the wood. As a result of the treatment, environmentally friendly Thermowood is created. Its color darkens, it is more stable than normal wood in conditions of changing humidity, and its thermal insulation properties are improved. If carried out at a sufficiently high temperature, treatment also makes the wood resistant to decay but decreases the bending strength. For thermowood, an association of producers was formed in Finland in 2000 to cooperate in standardization, quality control, and research, in order to enhance the use of the products. It developed two standards for treatment classes for the ThermoWood® trademark, Thermo-S, and Thermo-D. 'Thermo-S' stands for 'stability', 'Thermo-D' for 'durability'.

Source: Finnish Thermowood Association, others

Case Study 2: Finnish Networked Center of Expertise for Wood Products

Currently, the Finnish government is renewing its national Centers of Expertise program to better address the innovation challenge of different industrial clusters. Among the 19 selected, the Forest Industry Future initiative will bring together the best research and development centers in the wood-processing industries. Another center will focus upon the use of wood in living and construction, and thereby promote more customer-oriented innovation and increase the value to wood products.

The Networked Center of Expertise for Wood Products, as it exists today, is a service structure that covers various areas of expertise in the forestry and wood products business chain and offers customized expertise and promotion for research and development projects. The Center also functions as a contact point for actors from different parts of Finland via which companies can increase their knowledge in the field and abilities to act as a developer of the regional economy.

The Center of Expertise for Wood Products is a network of 55 actors. Its core consists of universities and research centers that coordinate seven specific areas of expertise and perform research and development in the wood product industry. These actors are evenly distributed geographically and also serve as engines of regional development.

Networked Operational Model Strengthening Development Culture

The areas of expertise of the Center of Expertise for Wood Products cover the entire spectrum of the needs of the business chain. The Center of Expertise combines both national and regional experts into a comprehensive network. The most significant achievement of the Center of Expertise for Wood Products during its first years of operations has been building of well functioning network among

experts in the area of wood production as well as with the users of newest knowledge and expertise. Cooperation within the Wood Finland Program enables active transfer of expertise and also allows solutions to be found to the problems of small and medium- sized companies in the future.

The networked operational model has strengthened the development culture in the field and has made research and development into factors of success. The level of expertise has improved and the knowledge base has extended, as experts have been able to concentrate on their own areas of competence and those transferring technology have been able to focus on increasing their intellectual capital.

Over 100 research centers, over 200 companies, and approximately 40 other bodies have participated in the projects. The most important permanent structure is the cooperation network that incorporates all Finnish wood production research centers. The network has enabled regional actors to create regional clusters of expertise, at, for example, Oulu, Tampere, Seinäjoki, Kuopio, Joensuu, Kotka, and Mikkeli.

The most significant achievements have taken place in the product development projects where further processing developments have resulted in new wood products. The most significant achievements include:

- Modern wooden town;
- Structure systems for multi-purpose buildings and large wooden structures;
- Open timber construction system for wooden buildings;
- Products for the construction of external areas and landscapes;
- Wooden interior decoration products; and
- Products made from processed birch wood.

Entire Business Chain Covered

The Center of Expertise for Wood Products intensifies expertise transfer, development of new expertise, and the creation of showpieces of wood construction in its strategic focus areas that cover the entire chain from market to forests.

Modern wooden town and wood engineering expertise areas promote the use of wood in construction. Expertise in living with wood and design includes interior structures and environmental design of both public and private premises. The field of expertise in diversification of wood utilization focuses on techno-economic issues of hardwood processing and use of wood from thinnings. These four areas of expertise follow current industry demands.

The following three areas of expertise offer the resources required for the creation of new expertise and businesses. Business-based technology development acts as the developing and transferring agent for the wood industry. The area of new concepts aims to develop the management, business concepts, and cooperation of companies. The developer forum strengthens the knowledge base and promotes information transfer between companies and the Center of Expertise.

Future Focus on Combining Different Areas of Expertise and on International Networks

In the future, the Center of Expertise for Wood Products will focus on combining different areas of expertise. This enables the creation of new products, manufacturing processes, services, and relevant business models. Breakthroughs will originate from concentration on new business concepts, design and architecture, development of knowledge transfers and the internationalization of expertise and business networks both in the area of construction and consumer goods.

National networking provides a good foundation for international networking. The focus of the Center of Expertise for Wood Products in 2003–2006 will be on internationalization, which means close cooperation with other research and development programs for the wood industry such as the Wood Europe campaign and the Wood Wisdom research program.

Source: http://www.oske.net/, MTI

Case Study 3: Sports and adventure services by an outdoor recreation company (Norway)

Troll Mountain AS is an innovative firm organizing adventure packages in the local forest area. Various key actors, a part from the entrepreneur, are playing an important role in providing the recreational services:

- The local neighbors;
- The "European outdoor life" network;
- Local communities;
- Agder Energy, which controls the flow of water.

Troll Mountain AS has organized its activities in two different municipalities. With one of the municipalities there is a problematic relationship, but the other municipality is helpful and knows the value of the activities for them. Neither of the municipalities nor local business activity in the local community has triggered an innovation process within the firm.

A lack of cooperation among businesses and with public actors is seen as a restraining factor when it comes to the creation of a common strategy of tourism activity within the area. The entrepreneur knows of many landowners who offer their own products without any willingness to cooperate within the same geographical area. The most important area of cooperation would come from tourist accommodation, adventures, and culture.

(Source : B. Vennesland, Norway)

Case Study 4: Biomass District Heating Micro-nets with Wood Energy Contracting, Austria

In the small Styrian village of Ottendorf a group of four farmers run a biomass district heating (BDH) system which provides a couple of public and private buildings in the village center with heat. The plant of 340 kW was established in 1998/99 and is situated on one of the partners' properties. As the farmers were able to do much of the construction work by themselves (e.g., the digging works) the costs for the construction were relatively low. The group received the know-how from the consulting organization *Regionalenergie Steiermark* ("Regional Energy, Styria") and applies their "wood energy contracting " model. Subsidies were granted for 50% of the investment. Since 2000 the group has been running a second installation of 60 kW and since 2002 another of 90kW in newly constructed residential buildings in the same village. In these cases, the boilers and storage rooms are situated within the apartment buildings.

In 1992 a private initiative founded the association *Regionalenergie Steiermark* with the purpose of promoting wood heating systems. In the beginning the focus was on single households, and later on micro-nets, as was described in the above examples. The association offers information and advice and is mainly financed by funds from the provincial government. Today, the association is affiliated with the Forest Association of Styria and receives additional support from the chamber of agriculture. The association development, which is the model for "wood energy contracting" ("Holzenergie

Contracting"—a registered trademark), provides a legal–commercial framework, especially for micro-nets, for carriers of small BDH systems. It regulates the relations among the partners in the business and between the business and their clients. The farmers have become energy traders.

Fostering factors

- Know-how of *Regionalenergie Steiermark.*
- Financial support for the *Regionalenergie* by the provincial government and the chamber of agriculture and subsidies for erecting BDH systems.
- Farmers in search of additional sources of income because their farms are too small.
- Local farmers that run the business (farmers from neighboring villages would not be so easily accepted by the local people).
- Good public image of regional resources.

Impeding factors

Relatively low prices for gasoline since the 1990s.
Some potential customers prefer to have their own heating system and do not want to be dependent on an external supplier.
For housing companies the modern biomass technology and the wood energy contracting model are still unknown.

Conclusions: A powerful diffusion system

BDH systems are successfully promoted in Styria because all the functions of an IS are covered by a number of institutions: information (*Regionalenergie*), conflict management and coordination (*Regionalenergie*; municipalities), incentives (subsidies for BDH; provincial support for *Regionalenergie*). In all cases it is important to convince farmers in the first place and then the communes about the idea. The lobbying of *Regionalenergie* was also successful with regard to housing regulations at the provincial level and other regulations.

(Source: G. Weiss, AT)

Case Study 5: Forest Enterprise Topoľčianky, Slovakia—Packaging and Marketing of Venison

The company and the innovation

The State Forest Enterprise Topoľčianky with an area of 32,429 ha of forest stands was established in 1920 for forest and game management. Breeding and hunting of game is the secondary economic activity of many state forest enterprises. The venison is the product of a relatively high market value. The innovation idea was to modernize and expand the capacity for venison processing in compliance with the relevant EU standards. The company constructed a new building for processing; the central installation is a vacuum-packing machine with an annual processing capacity of 80,000 kg.
Actors involved in the innovation process

- The management of the Regional State Forest Enterprise Topoľčianky, which designed and implemented the project, and the General Directorate, which co-financed the investment;
- Production designer, construction company, and technology supplier;
- External suppliers of venison;
- Customers, consumers (Czech Republic and Austria);
- Bank, by providing an interim credit (no long-term structural loan);
- State Veterinary and Food Inspection, which assists in achieving compliance with Slovakian and EU hygiene standards; and
- Consultations concerning EU requirements with the European Commission.

Fostering factors

- Interest of the management of the Forest Enterprise in tackling related risks, information problems, and technological aspects of a non-typical forestry activity;
- Assistance provided by the State Veterinary and Food Inspection with fulfillment of the EU requirements and acquisition of the certificate of compliance; and
- Tradition in the processing of venison, but a new investment was needed for compliance with the EU requirements.

Impeding factors

- Limited information availability on EU hygiene standards;
- High

Outcome and future prospects

The business offers five seasonal work positions. The currently processed volume of 30,000 kg of venison remains at the margin of return; however, a better market price has been achieved. The company intends to certify the venison as an ecologically produced food and to develop leather processing.

Conclusions: Information is precious

The innovation process described reflects a relatively stable internal environment in the state forest, although insufficient market analysis was identified as a weak point. The entrepreneurs have reported having insufficient institutional support in the implementation of the EU food production standards in Slovakia. The two major weak points concern information: market information and information about EU regulations.

(Source: J. Salka, R. Vinca, M. Pálková, SK)

Case Study 6: "Bergwald" Cooperation of Large Forest Holdings

The cooperation

The forest owners' cooperation (FOC) "Bergwald" was founded in the year 2000 by seven larger Styrian forest holdings as an association. The initiative came from the forest managers, who used the looser cooperation that existed beforehand to build it up. Support by institutional actors was not needed. The total forest area of all the members is some 70,000 ha, and the yearly harvest accounted for 400,000 m^3. As the aim of the closer cooperation is to make use of synergies in the input and output fields of forest management, the cooperation comprises production as well as marketing. The members provide mutual support in all commercial and official issues. According to the president, the aims of the FOC Bergwald are:

Cooperation in forestry production (timber harvest and transport): Members may specialize in certain harvest technologies and machinery.

Cooperation in timber and game marketing: Forest products are marketed in common. An IT-supported logistic system is in development.

Internal benchmarking: Internal business data are open to the members for comparison.

Common "foreign affairs" and common lobbying: The companies' policies and communications are coordinated, for example, with regard to political and legal questions of nature conservation, hunting, forest law, logistics, etc.

Foundation of the Forest Service Ltd.

A recent project of the FOC was the foundation in 2003 of the Forest Service Ltd. together with the Styrian Forest Association, an association of farm forest owners. Through the company the members of the FOC "Bergwald" expect to gain access to small forest holdings. It offers all kinds of services as

contractors. The offers range from forest planning and harvesting to marketing, as well as a total forest management package for "absentee forest owners."
The Forest Service Ltd. itself is a horizontal cooperation (two partners who are in forest owners' cooperations themselves). For the development of logistic system the Forest Service Ltd. cooperates with research institutions, the Styrian Wood Cluster Ltd., and sawmills (vertical cooperation).

Fostering factors
High level of professionalism and know-how among staff.
Market pressure for rationalization.
Buyers demand better logistics.

Impeding factors
Unwillingness of forest owners to give up independence.

Outcome and future prospects
According to the president and the manager of "Bergwald" the cooperation, overall and in the important marketing segment is fruitful. There are better marketing opportunities not necessarily because larger quantities of timber are offered, but because service is better (e.g. logistics). The Forest Service Ltd. is too new to be evaluated.

Conclusions: large forest owners have their own robust capacities for networking
The member managers see an urgent need for closer cooperation, even among larger forest companies. Better cooperation is necessary within and across the forest and wood sectors as well as with research institutions. In this case the IS was especially helpful in the support of networking along the wood chain through the Wood Cluster Ltd.

(Source: G. Weiss, AT)

Case Study 7: Scottish Forest Industries Cluster

The Scottish Forest Industries Cluster encompasses all those companies, organizations, and industries involved with the planting, management, and harvesting of forests, through sawmilling, pulp, paper and board production, to the production of higher value manufactured goods. It incorporates input from the chemicals and machinery sectors, as well as from business support and education institutions.

The Cluster was established initially as a partnership between the Forest Industries Development Council (FIDC) and Scottish Enterprise (SE), the UK government's economic development agency for lowland Scotland. In October 2004 FIDC's business activities were taken over by the new representative body for the forest industries, the Confederation of Forest Industries Ltd (ConFor), with which SE is now in partnership.

The forest products industry is very much influenced by globalization and industry restructuring. Scotland has the potential to develop global companies; at present it plays host to a number of these, for example, UPM Kymmene plc, Norbord Ltd, and Egger (UK) Ltd. The industry is subject to global price, supply, and quality fluctuations and this makes its business very cyclical. The capital-intensive nature of investment in the industry makes the industry cautious; however, this also means that the investments that are made do tend to last.

The Scottish Forest Industries Cluster is well-established with a strong supply chain and forward linkages from growers through processors to the construction, paper, printing and publishing, furniture, timber, and board products industries. There are weaker backward linkages to the chemicals and equipment sectors. Scotland's forests form a significant part of the landscape, as well as contributing more directly to tourism through amenity provision and accommodation. Increasingly, linkages are developing with the power generation industry and with agriculture through biomass

projects. There are strong links with the training and education sectors through accreditation and certification schemes.

(Source: Scottish Forest Industry Cluster)

Case Study 8: IEFC—Research into plantation forestry development in Northern Iberia and Southwest France

The creation of the European Institute of the Cultivated Forests within the framework of action 5 (forests of the south of Europe and sustainable development) is still working. Indeed, the multi-thematic network of IEFC on the sustainable management of the forests is starting to be recognized by EU actions and the IEFC is now developing a project, Interreg III B.

The members of the IEFC have now acquired the reflexes of the work in partnership around several research orientations and developments (testing of the Indicators of Sustainable Forest Management in Pilot Areas, guides to forest pests and diseases, growth models) follow-up for which is available on the site of the Institute: www.iefc.net.

The contributions in the medium term of the Eurosilvasur project should result in the pooling and modernization of the tools for professional use, consolidation of the relations among the companies of the sector, acquisition of a greater transparency in the wood trade, and the opening up of the market. These activities shows that the USSE understood how to make the sector more dynamic and communicate to each company the need for more dynamic development.

IEFC organizes programs of cooperation among the laboratories, and with the USSE and professional organizations, for instance, the program, FORSEE (Sustainable FOReSt management: a nEtwork of pilot zonEs for operational implementation).

(Source: C. Pinaudeau, FR)

Case Study 9: Tourism—Germany: The "Adventure Forest"

The company and the innovation
Within a privately owned forest enterprise of 400 ha the concept of an "adventure forest" was developed to market recreational services. The property is owned by a corporate group without business ties to the forestry industry. The forest enterprise is managed as an independent unit. In the "adventure forest" the company offers two different types of services:

1. Daily events for tourists such as guided walking tours, guided tours through the forest enterprise, illustration of scenic features and endangered species, and rock climbing in an old quarry.
2. Events of several days duration for corporate clients: the seminars aim to further team formation and to illustrate the relationship between ecology and economy. The schedule of events is arranged in advance with the enterprise.

The innovation process
When the forester retired, the profitability of hiring a full-time forester was questioned. The owners decided to search for a candidate with strong ideas for new businesses for the site. The concept of the "adventure forest" was introduced by the new forester.

Roles of actors
- The sole responsibility for the forest enterprise and the "adventure forest" lies in the hands of the forester. The owners give him plenty of room to make decisions.

- Local tourist information offices arrange daytime visits to the "adventure forest" for tourists. The local community supports the project because it offers another major attraction for the region and encourages tourism.
- Some very attractive conference locations (e.g., castles) lie in the surrounding region. Most of the corporate clients that visit the "adventure forest" combine this visit with a conference (or vice versa)
- Local suppliers (firms or farmers) are responsible for the food supply, installing bathrooms and the plumbing, etc.
- Local nature conservation groups are supported (e.g., through the construction of wooden footbridges through a nature reserve (swamp) etc.)

Fostering factors
The innovation considerably benefits from an exceptional location in a scenic region and with good infrastructure due to the conference locations.

Outcome and future prospects
The investments for the innovation thus far have only been promotional flyers, a homepage, and certain pieces of equipment. Yet the main objectives, additional revenue and reduced dependence on the timber market, have been fully achieved. The "adventure forest" contributes to business volume by 30%. The upward trend has already allowed for an additional part-time position.

Conclusions: Adventure pays
Besides the attractive natural and commercial regional environment the main success factors for the innovation lie within the company and through cooperation with partners.

(Source: L. Pickenpack, GER)

Case Study 10: Mountain bike routes offered by the UK Forestry Commission (FC)

The case study explores the development of mountain biking trails at a state-owned forest at Coed Y Brenin in mid-Wales. The development involved the construction of specialist mountain bike routes in the forest and associated services both on and off site, for example, food and drink, bike hire, bike cleaning facilities, and accommodation. The product was new to the UK, but an innovative approach to trail building was also taken which resulted in an internationally renowned building technique that is also environmentally sustainable. In 1999 the site, which is regarded as one of the best in the world, injected around £1 million into the local economy, which has supported already established businesses and new enterprise.

The initiation of the trails came from mountain bike riders, (one of whom was the local forest ranger for the FC) and a local mountain biking organization (North Wales Mountain Bike Association). The adoption of the innovation depended on the support of the FC, the forest manager at Coed Y Brenin, who provided the rugged and robust terrain necessary for the trails. Funding for the trails was provided through European Objective 1 finances, FC funds, as well as sponsorship from high profile companies like Red Bull and Karrimor. Information from mountain bikers and mountain bike organizations was central in determining the design of trails. The project was coordinated by the FC in close partnership with other public organizations. Later, a broader range of stakeholders, for example, local tourism service providers, local communities, and tourists boards, were brought in to provide complementary services such as accommodation, food, and drink, to reduce conflict between uses and users and to market the enterprise. The Welsh Mountain Bike Initiative was central to the Welsh Tourist Board Cycle Tourism Strategy and the tourist board played a central role in the marketing of the sites by funding the Mountain Bike Wales Web site (www.mbwales.com). As the mountain biking community is relatively close-knit, the passage of information through users and their representative organizations has been critical in raising awareness and use of the trails. Local tourism businesses also market the trails as a way of attracting clients.

(Source: S.Martin, Forest Research, UK)

Case Study 11: Harvester Services in Slovenia

The carrier of the innovation

The innovator owns a 40 ha farm, of which 30 ha are forests. He holds a license for forestry services of cutting, skidding, and road transportation of wood as an independent entrepreneur. The employees are his son and himself. Although a certified mechanic, he always had an affinity for forest work. He gave up stockbreeding and after purchasing equipment for timber transportation he became professionally involved in the forestry service.

Development and implementation of the innovation

The innovation is to carry out timber production with a harvester in Slovenia. Until 2001, the innovator offered a wood transportation service. He was considering the idea of harvesting for about a year. When his son graduated and joined the transport business he made the decision to purchase a harvester. He acquired information from leaflets and through the Internet. The decisive factor was his private connection with a Swedish friend. In Sweden he observed harvester work, selected the machine, and took a course in operating the machine. He bought a 6-year-old Valmet 911 harvester. In the first year he cut only about 6,000 m^3, which is approximately 10% of the maximum capacity of the machine. The majority of works were clearings of forests for land-use change. As a result he decided to purchase a new tractor in 2002, with an attachment for crushing tree stumps. That way he will be able to offer a complete clearing service.

The actors

Before his purchase, the entrepreneur consulted local foresters, but the most decisive factor was his association with a friend in Sweden. He was trying to find partners who would purchase a forwarder and equipment for crushing tree stumps. So far he has failed to make such arrangements. Purchasing a harvester carried a considerable legislative risk.

Fostering factors

- Forest administration advice
- Professional friend abroad

Impeding factors

- Restrictions by legislation for forest work
- Lack of demand from forestry

Outcome and future prospects

The purchase of a harvester carried a considerable risk because legislative directives for forest work limit the range of possible operations. The prevailing forest policy in Slovenia is oriented at a low density of fellings on the forest area. Furthermore, the average size of forest properties is very small. Therefore, a major problem is to acquire work and clients for harvester operations. The forestry profession failed to make progress in the technology area during the last 10 years. Use of a harvester is an unfamiliar technology in privately owned forests, and that is why there is no demand for such services. In public forests, work efficiency and the reduction of costs are not encouraged. The entrepreneur says that he would probably not now buy a harvester, considering the difficulties in obtaining clients throughout the last year. However, he is going to continue for another year.

Conclusions: the difficulties of a frontrunner

While in many European countries harvester technology is already standard, in Slovenia the entrepreneur who purchased the harvester is a frontrunner. He faces a situation where potential demand has not yet developed. The institutional forestry system does not yet know about the technology and therefore does not promote It.

(Source: B. Papac , M. Sinko, SL)

Case Study 12: Nature-based tourism development, Romania

Until recently, Romanian forests were to 90% public. Now, after three phases of restitution a balanced ownership structure has been reached with roughly half public forests, half other forest owners (private individuals, private entities, forest communities) and proprietors (the communes). The use of forests for recreational purposes is free of charges, irrespective of ownership and irrespective of whether the recreational activities are private or organized (commercial). An agreement with the land' owner is required only in the case of commercial-based harvesting of forest products, such as berries or mushrooms. All the forests inside the National Park where the innovation is located are in public ownership.

The innovation here regards the development of commercial private recreation services on public land. In 1998 the owner of a local business started to cooperate with the Carpathian Large Carnivore Project, leading at that time the ecotourism program "Wolves, Bears, and Lynx in Transylvania." One year later the owner launched his own tour operation (Carpathian Tours). The innovative aspect in the development of nature-based tourism is not just to offer accommodation, as there are many other tourism structures, in the near area, as well as wildlife observation services and organized forest-based recreational activities. The tour operator receives around 500 tourists yearly.

The key actors are from outside forestry, except the national park administration. The idea for the innovation came from the ecotourism program developed by the Carpathian Large Carnivore Project which was very active in providing knowledge and coordination. The national park administration (a public forest management structure) provided its services for wildlife discovery and of the pursuit of nature-based activities. The local branch of ANTREC (National Association for Rural, Ecological and Cultural Tourism) also played an important coordination role. Members are owners of small accommodation structures mainly in rural areas (guesthouses). The innovator also is a non-forester. He brought to the area the experience he had previously gained in business management abroad. The financial resources involved were exclusively private (the innovator's own investment). The innovation did not need special infrastructure, except the buildings for tourist accommodation. The natural capital played an essential role. Without the beautiful landscape and the presence in the area of the large carnivores, the innovation would have been impossible.

(Source: L. Bouriaud, ROM)

Case Study 13: Building private forest owner associations and services in Lithuania

The process of building cooperation among private forest owners in Lithuania is rather slow and is having to overcome many obstacles. However, considerable efforts and progress was made in Lithuania, mainly based on private initiatives. A typical forest owner's cooperative in Lithuania is small, with up to 10 members and about 20 clients who are service recipients. The main objectives of cooperatives are to develop a membership base, and the provision of services to their members in particular on timber harvesting and marketing. To convince private forest owners to join cooperatives, these cooperatives are forced to develop business models that meet the needs of private forest owners, which usually requires services that show a concrete contribution to higher profit for the members.

(Source: A. Gaizutis, LT, other)

Case Study 14: LEADER+ and forestry: "Wood Competence Center," Germany

Declining timber sales in a specific region reflected a "need for action". The deputy chief district forester had the idea of building a wooden house made of regional pine *(pinus sylvestris)*. His consultations with the regional LEADER manager led to an "integrated forest-related idea." Provided that regional timber and labor could be used, a wooden house, trend-setting in design and energy-balance was constructed. The LEADER manager convinced an architect specialized in timber construction and building biology to design the house. The architect turned out to be a "strong promoter" of the project. He achieved sustained success in monetary terms as well as for nature conservation. In 2005 this prototype house was constructed and has been used as an educational showroom promoting wood as a renewable resource.

"Strong allies" were won for the project. The co-financer and builder is a small city in the LEADER region, represented by its mayor. There is a "win–win situation" for both the region and the forestry actors. Forestry actors benefit from timber valorization, tending of woods, as well as benefiting from public relations for forestry and wood processing. The new house is located on the property of the local youth hostel which uses this attraction for educational purposes. The house is fundamental for increasing tourist trade and improving the quality of life in the region. Furthermore, it increases the awareness of wood for the next generations of home buyers. Serial production for national sales is intended.

The positive project development was greatly influenced by "strong interceders." Early in the process the local agency for rural development realized the potential of the project for the region. It supported the LEADER management in applying for EU project funds. The president of the state forest service, members of the EU parliament, and members of the state parliament (officials living this electoral district) used the house's opening ceremony to become associated with this project. In return for this public marketing exercise, all the officials gave good feedback about the project in their own constituencies.

A regional company sponsored the fitted kitchen for the house. To date there have been two follow-up projects (non-LEADER projects). The kitchen company plans a new kitchen made of regional pine. Another company producing urban furnishing products plans to build benches and other furniture. .

(Source: M. Böcher, GER)

Annex 9 (i). Globalization in Chile

Tybout, de Melo and Corbo (1991) analyze a large set of Chilean microdata in an effort to measure the effects of trade liberalization on productivity. They take advantage of the fortuitous fact that Chile's trade liberalization of 1974–1979 was preceded and followed by industrial census, the first in 1967 and the second in 1979. Their sample is the universe of manufacturing plants with five or more workers, numbering 7,060 in 1967, 6,771 in 1979, and classified, in each year, into 21 three-digit ISIC (International Standard Industrial Classification) industries. They calculated total factor productivity (TFP) of each plant by fitting a Cobb-Douglas production function to data for each industry and year. Unexpectedly, they found no evidence of an improvement in *overall* industrial efficiency between the two census years. But the researchers did find that plants in industries subjected to the greatest reductions in protection became more productive *relative* to plants in other industries: "industries undergoing relatively large reductions in protection experienced relatively large improvements in average efficiency levels, and relatively large reductions in cross-plant efficiency dispersion." Chilean manufacturing between these two census years suffered many shocks other than trade liberalization, including hyperinflation in 1973, a major recession in 1974–1976, and large increases in real interest rates. Individual plants are not identified in the data base, so it is not known how many of those operating in 1967 were still operating in 1979, nor how many new plants entered each industry.

Pavcnik (2002) also uses plant-level data, but assembles an unbalanced panel from annual industrial surveys from 1979 through 1986. Though not a census, each survey includes, in principle, all manufacturing plants with 10 or more employees. The author's main contribution is to correct for the selection bias induced by plant exit and for simultaneity bias resulting from the fact that productive plants with high TFP have every incentive to expand, hiring more workers and contracting more capital. To correct for simultaneity, she uses the Olley-Pakes (1996) technique with investment as an indicator of the unobserved plant level productivity.

Pavcnik estimates a production function on a two digit ISIC (International Standard Industrial Classification) level for each of eight industries: food, textiles, wood, paper, chemicals, glass, basic metals, and machinery. These are very broad "industries." Wood (ISIC 33), one of the more narrowly defined industries, includes sawmills and varied wood products such as furniture. Paper (ISIC 34) comprises pulp, paper, paper products, and printing and publishing. The heroic assumption is that "plants producing various four digit ISIC goods within a … two digit ISIC classification use the same factor proportions." Output, in common with all studies of this type, is necessarily not physical output, but rather the monetary value of production deflated by a price index of the output of the four-digit industry to which a plant is assigned. Trade orientation is also measured at the four-digit level (38 industries).

Plant exit was very important in Chile over the sample period, especially during the severe recession of 1982–1983. More than 35% of plants active in 1979 had ceased to produce by 1986. These exiting plants had employed 25% of the 1979 labor force and accounted for 13% of 1979 investment and 16% of the output.

Pavcnik estimates that aggregative total factor productivity increased by 19% between 1979 and 1986. Most (12.7%) of the increase is due to reallocation of resources from less to more efficient producers and only 6.6% due to increased productivity within plants. She divides her sample into three parts, separating the plants into those classified in non-tradable, exportable

and import-competing industries, and finds that aggregate productivity grew least (6%) in the non-tradable group and most (32%) in the import-competing group of plants. This is evidence that trade liberalization enhances productivity in Chilean manufacturing.

Pavcnik also regresses plant-level productivity on time, trade orientation, interaction between time and trade orientation, industry dummies, and a plant exit indicator. There is a negative coefficient on the exit variable, the size of which suggests that exiting plants are 8.1% less productive than surviving plants. She finds that plants in the import-competing group become more and more productive relative to plants in the non-traded goods group over the 1980–1986 period, but plants located in industries producing exportable goods fail to experience productivity improvements. Though she does not say so, this may be due to the fact that only a minority of plants export, even in industries producing exportable goods, and she has no information on exports at the plant level.

Bergoeing *et al*. (2006) analyze the same source of data as Pavcnik (the annual industrial survey), but they use a much longer series—1980–2001—and estimate production functions at the three digit rather than the two digit level of the ISIC. They analyze a total of 26 industries, as two (tobacco and petroleum refining) are organized as monopolies, with too few plants for estimation of production functions. Bergoeing *et al*., like Pavcnik, use the Olley-Pakes (1996) estimation procedure to correct for simultaneity, but they use electricity rather than investment as a proxy for unobserved plant level productivity. Once again, total factor productivity (TFP) is estimated at the plant level as a residual.

Bergoeing *et al*. (2006, p. 3) pay particular attention to plant entry and exit. Entry rates average 5.6% and exit rates 6.3% and both rates rise significantly over the sample period. They find that:

> although newly created firms display lower productivity than incumbents at the time of entry, entering survivors quickly improve their productivity. After one period only, the productivity of a new plant is statistically equal to that of an incumbent. Moreover, exiting plants experience a downward trajectory of productivity prior to exit. Thus, on average, inefficient plants are replaced by firms that are more efficient and that experience rapid improvements in productivity.

It should be emphasized, however, that a plant can exit from the sample and remain in operation, albeit with fewer than ten employees. It is not known how many of the "exiting" plants in reality have downsized rather than closed operations.

In contrast to Pavcnik's 2002 study, Bergoeing *et al*. find that for the entire 1980–2001 period, TFP gains of 42.8% are driven almost entirely by entry of new plants. TFP accelerates around 1988. For the 1988–2001 period, within-plant efficiency gains become very important, accounting for 46.4% points of the total TFP gain of 80.1%. Schumpeterian creative destruction (entry and exit of plants and, to a limited extent, reallocation of inputs across incumbent plants) accounts for the remaining TFP gain.

Bergoeing *et al*. divide their 26 industries into four types of trade orientation: export-oriented (export/sales >10%), import competing (imports/apparent consumption>20%), other traded (both conditions satisfied) and non-traded (all other industries). In the evolution of TFP over time, firms in traded sectors steadily increase their advantage over firms in the non-traded sector, although the dynamics are not strictly monotonic (there are several downturns,

followed by recovery). This is generally true for each of the three traded categories. The researchers conclude (p. 11) that their findings:

> suggest that plants did respond to an intensified foreign competition. Possibly the enhancement of within-plant productivity is a result of a reduced cost of foreign capital and intermediate materials, self-selection into international markets, and learning from international buyers, sellers and competitors.

Annex 9 (ii). Globalization in Brazil

Moreira and Correa (1998) examined the impact of trade liberalization over the 1989–1996 period in 39 manufacturing industries, but did not look at individual firms or plants. Moreira (2002) extended the analysis to 1998, increasing the number of industries to 49. A key finding is that the economy responded with intra-industry trade and specialization: there was a generalized increase in import penetration *and* export ratios in all industries. For manufacturing as a whole, the import penetration ratio (imports as a share of apparent consumption) increased from 4.5% in 1989 to 19.3% in 1998, with particularly high increases in electronics, machinery and equipment, motors and vehicle components, chemicals, tractors, automobiles and trucks, wheat milling, and non-ferrous metals. The share of exports in production rose more modestly from 8.8% to 14.8% with notable gains in "other vehicles," lumber, sugar, footwear, motors and vehicle components, tobacco, tractors, machinery and equipment, and electronics. A shift/share analysis reveals that output gains and losses over the period owed more to changes in domestic demand than to the impact of trade liberalization.

Ferreira and Rossi (2003) also look at broadly-defined manufacturing industries rather than firms or plants, but their work is more analytical and less descriptive than that of Moreira and Correa. In particular, Ferreira and Rossi estimate total factor productivity of each industry as the residual of a single, cross-industry production function. There was no information on value added by industry, so the researchers used gross output (in constant prices) as a proxy. They constructed an annual series for output, labor and physical capital from survey data for 16 of 21 Brazilian manufacturing industries from 1985 to 1997. The coefficients of the production function are assumed constant across time and across industries, but the residual, interpreted as a measure of total factor productivity, is allowed to vary by year and by industry. The researchers correct for simultaneity bias (the residual is correlated with capital and labor), using the rental rate of capital and real wages as instruments for instrumental variable (IV) estimation. Even though the dependent variable in the production function is gross output, input variables are limited to labor and capital; implicitly, material input/output ratios are assumed constant so that changes in the value of final output proxies changes in an industry's contribution to GDP.

The Ferreira/Rossis estimates of TFP follow the same trend as labor productivity and the two measures are highly correlated: productivity declined in all 16 industries between 1985 and 1990, while 1991–1997 trends were positive in all industries but one (pharmaceuticals). The average growth rate of TFP jumped from -3.83% in 1985–1990 to +2.65% in 1991–1997. When TFP growth rates are regressed on nominal or effective tariffs, the coefficients are significantly negative, consistent with the hypothesis that trade reform resulted in increased efficiency in Brazilian manufacturing.

Hay (2001) was the first study to look at the productivity of firms rather then industries. Specifically, he seeks to "analyse the degree to which changes in sales productivity (that is, sales per worker) can be explained by changes in the level of protection across different sectors after 1990." He assembles data for a balanced panel of 318 large manufacturing firms operating in the period 1986–1994. Data for 1991 are missing because the annual survey of manufacturers was suppressed that year for budgetary reasons. He estimates a single Cobb-Douglas production function, with sales per worker as the dependent variable. Independent variables are the value per worker of the capital stock of each firm (balance sheet data), the effective rate protection for the industry, year dummies, and industry dummies. "Workers" refer to end-of-year workforce; no information is available for average number of workers

employed by each firm, nor their quality (educational levels). Each firm's total factor productivity is calculated as a residual (actual minus the sales per worker predicted by the production function).

In a second stage, Hay regresses total factor productivity on import protection, the real exchange rate, year dummies, and a full set of firm dummies. It is not clear why he included effective protection as an independent variable in the production function, for this presumably affects his estimates of total factor productivity, obscuring any relationship between that variable and effective protection. In any case, coefficients on the protection variables are significant with the expected negative sign, but the impact is reduced very much when year dummies are included in the regression. Hay concludes that even though it is difficult to distinguish between the effects of trade liberalization and the effects of other policy changes in the post-1990 years, "the greater part of the gains should be attributed to trade liberalisation." The real exchange rate variable is totally without significance in the regressions. In additional analysis, Hay shows that the "very large total factor productivity gains … were accompanied by large falls in market shares and profits."

Schor (2004) analyzes survey data for 4,484 manufacturing firms, selected from a total of 9,130 firms with at least one year of positive sales in the period 1986–1990 or 1992–1998. (The annual survey of all large firms and a random sample of medium-sized firms was not carried out for 1991.) The 50% reduction in sample size resulted from elimination of outliers, firms with fewer than two consecutive observations, and those with "clearly misreported values."

Schor classified the unbalanced panel of firms according to the 27 industries of nivel 100 in the Brazilian classification system, roughly equivalent to the three-digit ISIC classification. She estimates a Cobb-Douglas production function for each industry and calculates productivity (efficiency level) of the firm as the difference between observed output and output estimated by the production function. Output is measured gross, as the value of all production, and inputs are administrative workers, production workers, physical capital, and other inputs (raw materials and intermediate goods). She corrects for simultaneity bias by using the Olley-Pakes (1996) technique with inputs of labor, capital and other inputs to indicate the unobserved plant level productivity. It was not possible to use investment for this purpose because of a large number of zero values for investment. She does not explicitly correct for selection bias because there is no way of knowing if a firm has ceased production or if it is a case of missing data.

The results of this exercise show a surprising amount of heterogeneity among manufacturing enterprises, and productivity fluctuates a great deal from year to year in most industries. Nonetheless, comparing 1998 with 1990, 20 of the 27 industries register an increase in productivity levels, which is consistent with the hypothesis that globalization has increased the efficiency of Brazilian manufacturing.

To test more directly the effect of trade liberalization, Schor regresses total factor productivity of a firm on the nominal tariff of an industry, using year dummies to control for changes in macroeconomic policy and industry dummies to control for time-invariant characteristics of the political economy of trade liberalization (given that the rank order of protection by industry changed very little). The period examined begins in 1990 (the effective beginning of trade reform) and ends in 1998, so there are a total of 23,589 observations—an average of fewer than 3,000 firms each year—in the full regression equation. Without the industry

dummies, the coefficient on the nominal tariff is positive and highly significant. With industry dummies added, the coefficient becomes negative (the expected sign), but is not statistically significance. The regression produces a statistically significant, negative sign only when 4,484 "firms' fixed-effects were included to correct a bias that may arise because the production function is estimated for each industry and not for each firm." Adding a variable for tariffs on inputs to the equation lowers the magnitude, but not the sign nor statistical significance, of the coefficient on nominal tariffs. The coefficient for tariffs on inputs is negative and statistically significant, indicating that, along with increased competition, greater access to imported inputs also contributes to enhance productivity following trade liberalization.

In further analysis, Schor runs quantile regressions—one for each decile of the productivity distribution—and finds a significantly negative coefficient on input tariff for each decile, but after three deciles the negative coefficient on nominal tariff loses significance, and by the sixth decile becomes positive and significant. This could well reflect selection bias: Firms at the lower end of the productivity distribution have to increase productivity a great deal in order to compete with imports; those who fail to increase productivity exit from the market and are not sampled. In contrast, firms with high productivity, as some inputs are fixed, face a reduction in productivity as they lose market share to imports, but are able to survive without exiting given their still high levels of productivity.

The fact that selection bias is ignored is a major shortcoming of the study in question. The sample of firms is not random, as it necessarily excludes those that cease production, and the characteristics of these exiting firms are not known. A key finding is that the response of firms to globalization is very heterogeneous, even within industries. But, as Schor (p. 392) herself admits, "the results are in general not very robust to different specifications."

Muendler (2004), examines the same set of annual industrial survey data as Schor, but does not delete observations, so his unbalanced panel contains 9,500 medium and large manufacturing firms operating in the 1986–1998 period. Muendler estimates firm-level productivity, inferred from Cobb-Douglas production functions for 27 industries estimated with three alternative procedures: ordinary least squares (OLS), firm-fixed effects, and an extension of the Olley-Pakes (1996) procedure. All three procedures produce similar estimates of total factor productivity at the level of the firm. The production function that Muendler estimates is similar to that of Schor, except that Muendler divides physical capital into two parts (equipment and structures) and adds variables for share of imported equipment in total equipment and share of imported intermediates in total intermediates. He retains the blue collar/white collar distinction used by Schor. Like Hay (and unlike Schor), he includes measures of trade liberalization in the production functions, namely import penetration and nominal tariff protection. Uniquely, he adds an aggregate demand variable to each production function. There is no discussion in the text of this variable, but presumably it measures aggregate consumption of the products of an *industry* demand (i.e. industry output plus imports).

Production function estimates are reported for five of the 27 industries—those with the largest number of observations—and the coefficients of the trade liberalization variables are erratic, significantly positive, or significantly negative, depending on the industry. Muendler (2004, p. 13) concludes that "the effect of competition variables on productivity should be revisited." Interestingly, the coefficient on the shares of imported capital equipment and imported intermediate goods, for the most part, do not differ significantly from zero. When significant,

imported inputs exhibit a negative effect on output, suggesting "that the mean firm may not succeed in putting more expensive foreign equipment [and intermediate goods] to sufficiently effective use during the sampling period" (p. 13). Estimated TFP for the aggregate of the 27 industries shows a large drop in the 1980s, reaching a trough in 1990, and increasing steadily by roughly 5% over the next five years. Results by industry are not reported.

Muendler next regresses firm-level productivity on a wide variety of variables in order to assess the relative importance of three separate channels by which trade liberalization might increase productivity, which he calls 1) *competitive push*, 2) *foreign input push,* and 3) *competitive elimination*. He finds the first channel—competitive push—to be by far the most important. Even though his sample is not representative (small firms are excluded and large firms are over-represented), once a firm is in the sample, it remains there until it ceases production, regardless of its size. This allows Muendler to explicitly control for the selection bias of exiting firms, which have 8.2% lower productivity than survivors, on average.

To determine the importance of the competitive channel, Muendler regresses firm-level productivity on nominal tariffs and import penetration, using instrumental variables to correct for endogeneity and simultaneity. He also controls for firm-level variables such as imported inputs and relative firm size. Interestingly, he finds that "firms that start to use more foreign inputs suffer a slowdown in productivity in the subsequent year" because "they face implementation costs, may need to retrain workers and carry out adjustments to the production process" (p. 20). Lower tariffs and import penetration induce firms to improve efficiency. These effects are significant even without addressing endogeneity and simultaneity issues, but the effects are much larger with estimates that take this bias into account. This is consistent with the existence of a positive bias in the coefficient on tariffs (inefficient industries are targeted with low tariffs) and a negative bias in the coefficient on import penetration (inefficient industries are attractive markets for foreign suppliers). "Had there not been an increase in competitive pressure due to foreign imports, Brazilian manufacturers would have continued their 'quiet lives' and productivity would have improved more slowly" (p. 16).

Regarding the foreign input channel, a careful analysis of the behavior of the two import share variables in the production functions leads to an unambiguous conclusion that there is little or no evidence that technology embodied in imported equipment or imported intermediate goods are sources of immediate productivity change. Possibly for this reason, 80.4% of all manufacturing firms surveyed in 1986–1995 used no imported equipment and 56.9% in 1996–1998 used no imported intermediate inputs.

The competitive elimination channel is a significant, though small, source of productivity gains. The unconditional exit probability of a non-exporter increases after 1991 from 2.8% to 5%. The lower a firm's total factor productivity (TFP), the more likely a firm will exit, unless the firm is an exporter, for TFP does not affect the exit likelihood of exporters, whose TFP is already high. Exiting firms are 8.2% less productive than survivors on average, but the probability of exit is rather low, so the effect on aggregate TFP is small. One must keep in mind, however, that small manufacturers are excluded from this sample. The probability of exit of small firms is likely much higher, so the importance of the competitive elimination channel would no doubt be greater in a full or representative sample of manufacturing firms in Brazil.

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