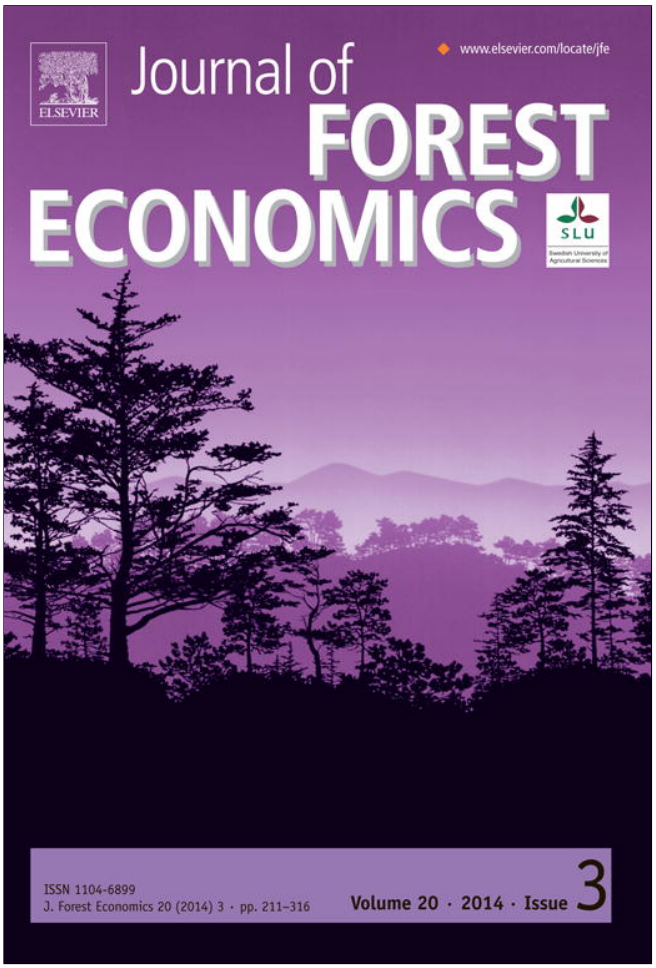

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# Potential impact of a Transatlantic Trade and Investment Partnership on the global forest sector

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ABSTRACT

The effects of a transatlantic trade agreement on the global forest sector were assessed with the Global Forest Products Model, conditional on previous macroeconomic impacts predicted with a general equilibrium model. Comprehensive tariff elimination per se had little effect on the forest sector. However, with deeper reforms and integration consumption would increase twice as much in percent in the US as in the EU. Net trade decreased in the US more than in the EU while it increased in Asia. Consumers and producers' welfare increased by $7000 million in the EU and $14,000 million in the US, but decreased in some third countries, especially in Asia.



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## Introduction

The United States (US) and European Union (EU) combined account for over 45% of the world GDP in nominal value and 38% in terms of purchasing power parity (World Bank, 2013). Foreign direct investment is intense between the two regions and more than a third of the trade consists of intra-company trade, between subsidiaries of companies established both in the EU and in the US (EC-Trade, 2013). Within the forest sector, the European Union and the United States account for around 40% of the world production of industrial roundwood, sawnwood and paper and paperboard, and for 30% of the world production of panels (FAO, 2012).

In 2010 the United States exported $3.5 billion worth of forest products to the European Union, or 15% of its exports to all countries. Meanwhile, the European Union exported $2.1 billion worth of forest products to the United States, or 6% of its total exports. However, Canada and China are the United States first trade partners for import and export of forest products in value (Table 1). China is the main destination of EU exports, and the United States is the EU main source of forest product imports (Table 1). Thus, while the relationship between the US and the EU is substantial, it cannot be considered independently of the rest of the world. In investigating the potential impact on the forest sector of a trade agreement between the United States and the European Union, which is the subject of this study, it is important to place it in a global context.

Agreements to remove trade barriers aim at reducing dead-weight costs and at increasing net social gains from international trade. The World Trade Organization (WTO) was established with the mandate to lower trade barriers among its 159 member countries through rounds of trade negotiations. The WTO's principle of "Most-favoured nation" (WTO, 2013) states that preferred treatment of one country "must be extended to all other members of the WTO". However exceptions to this principle are frequent due to the complexity of multilateral negotiation. There are hundreds of regional "free trade agreement", sometimes called "preferential trade agreements" (Bhagwati and Panagariya, 1996) as a reminder that third countries are excluded from the free trade gains.

The project of trade agreement between the US and the EU, also known as the Transatlantic Free Trade Area (TAFTA, Hamilton and Schwartz, 2012) or the Transatlantic Trade and Investment Partnership (TTIP, Felbermayr et al., 2013a) began with the 1995 Madrid Agreement on a Transatlantic Agenda, followed by various resolutions and negotiations by and between the US and the EU (Transatlantic Policy Network, 2007). In a recent report, the EU–US "high level working group on jobs and growth" (HLWG, 2013) analyses a range of options far beyond simple tariff removal, including: elimination of non-tariff barriers to trade in goods, services and investment, enhanced compatibility of regulations and standards and improved cooperation to achieve shared economic goals.

Studies of how such deep agreements between the EU and US would influence the economies of the two regions and of the rest of the world vary greatly in terms of geographic coverage and quantitative

**Table 1**
Value of forest products trade between the European Union and the United States, and other major countries in 2010.[a]

| | 1000 million $US | Share[b] | | 1000 million $US | Share[b] |
|---|---|---|---|---|---|
| US exports to | | | US imports from | | |
| China | 4.8 | 20% | Canada | 12.6 | 62% |
| Canada | 4.2 | 17% | EU | 2.2 | 11% |
| EU | 3.5 | 15% | China | 1.3 | 7% |
| Mexico | 3.2 | 13% | Brazil | 1.2 | 6% |
| Japan | 1.6 | 7% | Japan | 0.4 | 2% |
| EU exports to | | | EU imports from | | |
| China | 4.1 | 12% | United States | 3.5 | 16% |
| United States | 2.1 | 6% | Brazil | 3.3 | 15% |
| Switzerland | 2.1 | 6% | Russian Fed. | 2.0 | 9% |
| Turkey | 2.0 | 6% | Norway | 1.7 | 8% |
| Russian Fed. | 1.7 | 5% | Switzerland | 1.7 | 8% |

[a] *Source*: FAOSTAT, forestry trade flows, aggregated trade values in 2010 of roundwood, sawnwood, chips and particles, wood based panels, wood pulp, recovered paper, paper and paperboard.
[b] Share of total EU or US exports.

estimates of impacts on economic growth, employment and trade. For example, the OECD report on "the benefits of liberalizing product markets and reducing barriers to international trade and investment" (OECD, 2005) suggests that the annual growth rate of gross domestic product (GDP) per capita would increase by between 1% and 3% for the US and between 2% and 3.5% for the EU. Meanwhile, the Bertelsmann Foundation report (Felbermayr et al., 2013a) estimates that a comprehensive agreement including removal of non-tariff trade barriers would, over one decade, raise the US GDP by up to 13% and the EU GDP by 5%. And, the Centre for Economic Policy Research (Francois et al., 2013) predicts that a free trade agreement would accelerate GDP growth by between 0.01% and 0.39% for the US and between 0.02% and 0.48% for the EU by 2027.

All studies foresee a small impact of removing trade barriers alone, and a larger impact of eliminating non-tariff barriers. Some disagree on the potential impact on third countries. While the OECD (2005) suggests that reducing barriers to trade between the EU and US will have mostly positive spill over effects on third party countries such as Canada, Mexico, Turkey and Japan, Felbermayr et al. (2013a) estimate that third party countries will lose market share in the US and the EU due to the increased trade between the two regions, and that this will have a negative effect on their economies. Additionally Felbermayr et al. (2013a) foresee a decrease in trade within EU countries, for example a 23% decrease in trade between France and Germany.

Most national and international studies on the macroeconomic impact of transatlantic trade agreements are based on general equilibrium approaches, such as the Global Trade Analysis Project (GTAP) model (Berden et al., 2009; Francois et al., 2013; OECD, 2005). Felbermayr et al. (2013a) combine the GTAP database with trade gravity models (Egger and Pfaffermayr, 2011) into a general equilibrium model to project macroeconomic impacts of the TTIP in the US, the EU, and third countries.

The objective of this study was to use these macro general equilibrium results to predict their impact on the forest sector. The next section of the paper describes the theory, methods, and data used to this effect. This is followed by the results for the main countries and regions, by product group, consumption, production and prices, value added in industries, and welfare of producers and consumers. The conclusion summarizes the main results, some of their policy implications, and the limitations and potential improvement of the study.

## Methods

### *Theory*

The theoretical framework used for the study assumed competitive world markets for the demand, supply, and trade of forest products. The situation with and without a TTIP is sketched in Fig. 1 for one single product, wood. Without the TTIP, the world demand, $D_w$, is the sum of the US and EU demand,

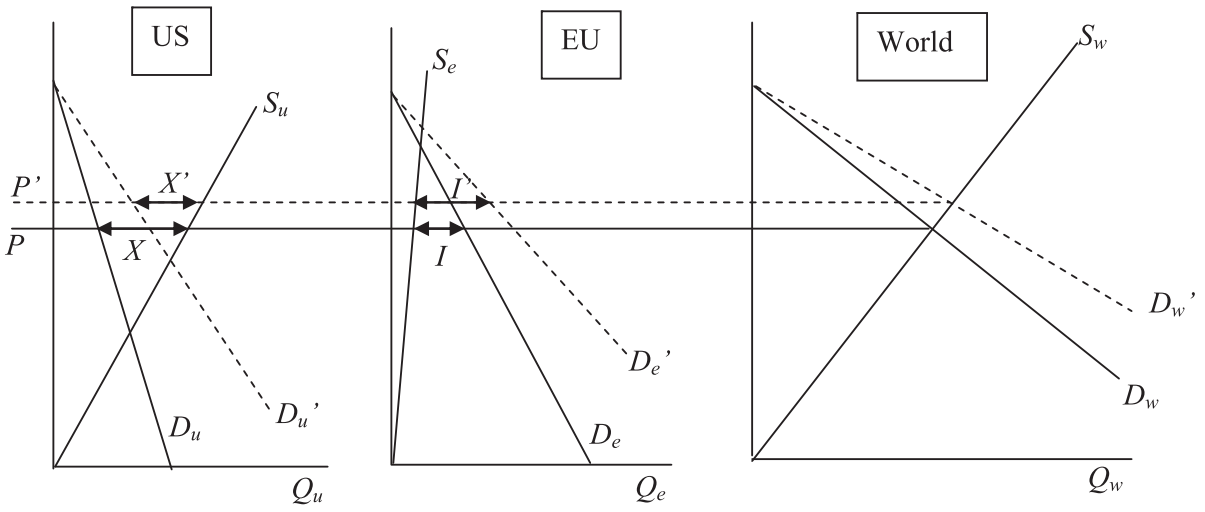


**Fig. 1.** World demand, supply, and trade of wood, with and without a Transatlantic Free Trade Agreement.

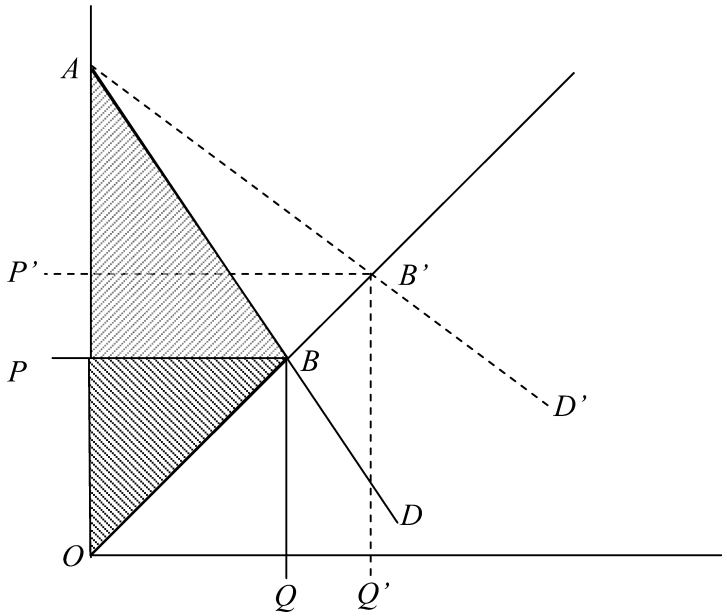


**Fig. 2.** Consumer and producer surplus without a Transatlantic Free Trade Agreement (area OAB) and with TTIP (area OAB').

$D_u$ an $D_e$, and of the rest of the world demand. The world supply, $S_w$, is the sum of the US and EU supply, $S_u$ and $S_e$, and of the rest of the world supply. The price $P$ equilibrates world demand and supply (transport and other costs are ignored in the diagram as they do not affect the argument). At price $P$, the US is a net exporter by the amount $X$, and the EU is a net importer by the amount $I$. $X$ and $I$ need not be equal due to trade of the US and the EU with the rest of the world. The TTIP stimulates the economies of the US and the EU and also affects the rest of the world. The net result is a shift of world demand from $D_w$ to $D_w'$, due in part to the demand shifts in the US from $D_u$ to $D_u'$ and in the EU from $D_e$ to $D_e'$. The new global equilibrium is at price $P'$. At that price, the US is still a net exporter, but by a lesser amount, $X' < X$, and the EU is still a net importer, but by a greater amount, $I' > I$. The diagram illustrates the possibility of a decrease of net trade (exports minus imports) due to the TTIP, in both the US and the EU, in the presence of the rest of the world. Ignoring the rest of the world would instead force the US net trade change to be the opposite of the EU net trade change, in a zero-sum game.

The total impact of a TTIP on the world forest economy was summarized by estimating the consumers and producers surplus, or welfare change (Varian, 1992, pp. 222–224), with and without an agreement. Fig. 2 symbolizes the procedure for the world economy and one product, wood. Point $B$ is the equilibrium without TTIP, at quantity $Q$ and price $P$. Point $B'$ is the equilibrium after the positive shift of global demand induced by the TTIP. The area of the triangle $ABP$ measures the consumers' surplus without the TTIP, the difference between the total value of wood consumption, measured by the area under the demand curve from $O$ to $Q$, and the expenditure on wood, $P \times Q$. The area of the triangle $OPB$ is the profit, or producers' surplus without the TTIP. The effect of the demand shift induced by the TTIP is to increase the price to $P'$, and the consumption and production to $Q'$. Since the supply curve is unchanged, the price increase and the quantity increase raise the producers' surplus by the amount measured by the area $PBB'P'$. However, the consumers' surplus, measured by the area of the triange P′B′A may be larger or smaller than without the TTIP depending on the elasticity of demand.

### *Global Forest Products Model*

The Global Forest Products Model (GFPM) was used to quantify the effects sketched in Figs. 1 and 2. The model was described originally in Buongiorno et al. (2003) and updated in Buongiorno and Zhu (2013a,b). The GFPM represents the dynamic evolution of demand, supply, and trade of fourteen commodity groups in 180 countries linked by trade. The model computes the global market equilibrium for all products in any given year and simulates the evolution of this equilibrium over time to project

the future state of the sector. Following Samuelson (1952), the equilibrium in a given year is obtained by maximizing the sum of the consumers and producers surplus for all products and countries:

$$\max\left(\sum_{i,k}\int_0^{D_{i,k}} P_{ik}(D_{ik})dD_{ik} - \sum_{i,k}\int_0^{D_{i,k}} P_{ik}(S_{ik})dS_{ik} - \sum_{i,k}\int_0^{D_{i,k}} m_{ik}(Y_{ik})dD_{ik} - \sum_{i,j,k} c_{ijk}T_{ijk}\right) \quad (1)$$

where $i$ and $j$ refer to countries, $k$ to products, $P$ is the price, $D$ is the end-product demand, $S$ the raw material supply, $Y$ the manufactured quantity at marginal cost $m$, and $T$ is the quantity transported at cost $c$, including tariff and taxes. Thus, the first integral measures the value the end products to consumers, the second and the third the cost of production, and the last part is the transport cost. The optimization is subject to the following demand-supply equilibrium constraint for each country and product:

$$\sum_j T_{jik} + S_{ik} + Y_{ik} = D_{ik} + \sum_n a_{ikn}Y_{in} + \sum_j T_{ijk}, \quad \forall i, k \quad (2)$$

where $a_{ikn}$ is the input of product $k$ per unit of product $n$. The left part of the equation is the sum of the imports, domestic supply, and manufactured quantity of a product in a country, while the right part is the sum of the domestic demand for the end products, the demand for input in manufacturing other products, and the exports to other countries. The primal solution of this constrained optimization gives the quantities consumed, produced, and traded, while the dual solution gives the equilibrium price for each product and country.

For this study the model was re-calibrated for the base year 2010, following the procedure described in Buongiorno and Zhu (2013b), using the three year average of 2009–2011. The data on production, imports, exports, and prices were obtained from the FAOSTAT database (FAO, 2012). The elasticities of demand and supply were the same as those estimated in the USDA Forest Service Global Outlook Study (Buongiorno et al., 2012). After following this calibration procedure, the GFPM solution for 2010 closely replicated the observations for the same year.

The dynamic part of the GFPM describes the shifts of demand and supply over time due to economic and demographic growth, and changes in forest area and forest stock. Here, the projected changes of gross domestic product (GDP) and GDP per capita were obtained from USDA-ERS (2012). The parameters of the equations predicting changes of forest area, forest stock, and forest supply (Turner et al., 2006), were as in Buongiorno et al. (2012).

### *Effects of the TTIP*

The GFPM model was used to project the evolution of the global forest sector from 2010 to 2030, with and without the TTIP. Since the tariffs on forest products in the US and the EU were small, the maintained hypothesis was that the direct effect of tariff elimination would be negligible. This is in accord with previous findings that the macroeconomic effects of only eliminating tariffs, in all sectors, are quite small (Felbermayr et al., 2013a; Francois et al., 2013). Thus, the main effect on the forest sector would be indirect, through the impact of the GDP growth brought about by the TTIP on the demand for forest products in the EU, the United States, and other countries.

In the GFPM, the demand for forest products in a given year is represented by econometric equations of the form (Buongiorno and Zhu, 2013a):

$$D_{ik} = D^*_{ik}\left(\frac{P_{ik}}{P_{ik,-1}}\right)^{\delta_{ik}} \quad (3)$$

where $D^*$ is the current consumption at last year's price, $P_{-1}$, and $\delta$ is the price elasticity of demand. $D^*$ depends on last period's consumption, and the growth of GDP in the country:

$$D^* = D_{-1}(1 + \alpha_y g_y + \alpha_0) \quad (4)$$

**Table 2**
Assumed impact of the TTIP on annual percent growth rate of GDP in world regions and selected countries, derived from Felbermayr et al. (2013a) low and high impact scenarios.

| | High impact (%) | Low impact (%) |
|---|---|---|
| Africa | −0.24 | −0.15 |
| North/Central America | 0.94 | 0.05 |
| United States | 1.26 | 0.07 |
| South America | −0.24 | −0.02 |
| Asia | −0.26 | −0.04 |
| Oceania | −0.70 | −0.06 |
| Europe | 0.42 | 0.01 |
| EU-28 | 0.62 | 0.03 |
| Austria | 0.27 | 0.01 |
| Finland | 0.61 | 0.04 |
| France | 0.26 | 0.02 |
| Germany | 0.46 | 0.02 |
| Italy | 0.48 | 0.03 |
| Spain | 0.64 | 0.03 |
| Sweden | 0.71 | 0.03 |
| United Kingdom | 0.93 | 0.04 |
| World | 0.33 | 0.00 |

where $g_y$ is the GDP annual growth rate, $\alpha_y$ is the elasticity with respect to GDP, and $\alpha_0$ is an optional annual trend.[1] With this structure, the effect of the TTIP was obtained by setting the GDP annual growth rate to what it would be with or without the agreement.

*Macroeconomic scenarios*

The magnitude and the range of the total impact of the TTIP on GDP were taken from Felbermayr et al. (2013a) who give estimates for the United States, the 27 countries of the European Union, and 98 countries of the rest of the world. With their macro general equilibrium model, Felbermayr et al. (2013a) consider two scenarios. A "low impact" scenario calculates only the direct effect of reducing trade costs by eliminating existing tariffs in all sectors. The "high impact" scenario adds the removal of non-tariff barriers and projects the impact of the increase in trade activity on investments and economic growth.

For the purpose of the present study Felbermayr et al. (2013a) projections of the cumulative change in GDP with the low or high scenario were converted into annual growth rates over a decade, the time needed for almost full impact (Felbermayr, 2013). It was further assumed that the effect of the TTIP on GDP would begin in 2015 and end in 2025, but the simulations continued until 2030 to absorb any residual dynamic effect on the forest sector.

Table 2 shows the effects of the TTIP on the growth rate of GDP implemented in the GFPM, according to Felbermayr et al. (2013a).[2] Countries of the European Union experience an average increase in their annual growth rate of GDP averaging between 0.03 and 0.62% depending on the scenario, while for the United States it is approximately between 0.07 and 1.26%. In other regions, the TTIP depresses growth due to "losses in market share from intensified competition on the EU or US markets" (Felbermayr et al., 2013a), in particular annual GDP growth is 0.04–0.26% lower in Asia, and 0.22% lower in Russia in both scenarios. In the high scenarios the annual growth of the world GDP is 0.33% higher (i.e. about 3.3% higher over a decade) with the TTIP than without it, while in the low scenario the TTIP has practically no impact at the global level, although it does have an effect on the US and the EU.

[1] In the numerical solution, each demand curve equation [3] is approximated by its tangent, $P = a + bD$, at the point $(D^*, P_{-1})$, with $b = P_{-1}/\delta\, D^*$ and $a = P_{-1}(1 - 1/\delta)$. Thus, the effect of GDP growth as in [4], which sets $D^*$, is to change the slope, $b$, inducing a rotation of the demand curve as in Fig. 2.

[2] For countries that are in the GFPM but not in Felbermayr et al. (2013a) it was assumed that the TFTA would have no effect on the growth rate of GDP per capita. Consequently, the world effect in Table 2 differs slightly from Felbermayr et al. (2013a).

**Table 3**
World prices of forest products in 2030 and differences due to the TTIP, predicted with the GFPM model under the high impact scenario.

| | Base[a] | Difference with high impact scenario |
|---|---|---|
| | $/m$^3$ | |
| Industrial roundwood | 94.1 | 0.7% |
| Sawnwood | 244.9 | 0.5% |
| Veneer and plywood | 679.3 | 0.1% |
| Particleboard | 362 | 0.2% |
| Fiberboard | 581.9 | 0.1% |
| | $/t | |
| Mechanical pulp | 632.2 | 0.3% |
| Chemical pulp | 724.1 | 0.2% |
| Other fibre pulp | 1357.7 | −0.1% |
| Waste paper | 199 | −0.9% |
| Newsprint | 648.3 | 0.1% |
| Printing and writing paper | 967.3 | −0.1% |
| Other paper and paperboard | 1090.3 | −0.1% |

[a] In constant $US of 2010.

## Results

### *Price effects*

The effects of the TTIP on world prices, at constant US dollars of 2010, are summarized in Table 3. In this version of the GFPM all countries export to a world region and import from it. For each commodity, the world price is the unit value of total world exports. Table 3 shows the predicted world price in 2030 with the base scenario, i.e. without a TTIP, and the percentage difference in price with the high-impact and low-impact scenario of Felbermayr et al. (2013a). Under the high-impact scenario, the demand shift of end products tended to increase slightly (less than 1%) the prices of roundwood and of the products that depend heavily on roundwood: sawnwood, wood-based panels, and wood pulp. The price of printing and writing paper and other paper and paperboard was barely lower with the TTIP under the high-impact scenario. This was due mostly to a decrease in the price of waste paper, an important input in the manufacture of paper and paperboard, induced by the increased supply

**Table 4**
Differences in industrial roundwood consumption, production, and net trade in 2030 due to the TTIP, predicted with the GFPM model under the high and low impact scenarios.

| | High impact (1000 m$^3$) | | | Low impact(1000 m$^3$) | | |
|---|---|---|---|---|---|---|
| | Consumption | Production | Net trade | Consumption | Production | Net trade |
| Africa | −258 | 219 | 477 | −39 | −58 | −19 |
| N/C America | 4354 | 2101 | −2253 | 67 | −88 | −155 |
| United States | 3152 | 703 | −2449 | 66 | −58 | −124 |
| South America | 667 | 696 | 28 | −68 | −62 | 6 |
| Asia | 57 | 1082 | 1025 | −454 | −316 | 139 |
| Oceania | 203 | −137 | −340 | −11 | 6 | 17 |
| Europe | 2720 | 3783 | 1063 | −112 | −100 | 12 |
| EU-28 | 3027 | 2613 | −414 | 10 | −69 | −79 |
| Austria | 279 | 72 | −207 | 15 | −2 | −17 |
| Finland | 372 | 274 | −98 | 33 | −9 | −42 |
| France | 565 | 239 | −327 | −20 | −8 | 12 |
| Germany | 480 | 480 | 0 | −4 | −4 | 0 |
| Italy | 220 | −1 | −221 | 7 | −1 | −8 |
| Spain | 121 | 103 | −18 | −4 | 1 | 5 |
| Sweden | 337 | 461 | 124 | 11 | −16 | −26 |
| United Kingdom | 70 | 70 | 1 | −5 | −4 | 1 |
| World | 7743 | 7743 | 0 | −618 | −618 | 0 |

of waste paper due to higher consumption of paper and paperboard (see Table 8 below). Under the low-impact scenario of the TTIP there was hardly any difference in the world price of forest products in 2030, relative to the base scenario.

### *Effects on industrial roundwood*

Under the TTIP high-impact scenario, the world consumption and production of industrial roundwood was nearly 8 million $m^3$ higher in 2030 than with the base scenario (Table 4). This increase occurred largely in North America and Europe. Consumption was higher both in the United States and in the EU by about 3 million $m^3$, but it was slightly lower in Russia. Production increased by 2.6 million $m^3$ in the EU and less than 1 million $m^3$ in the US. As a result, the trade balance of industrial roundwood deteriorated much more in the US than in the EU. This was compensated by an improvement of net trade in other countries, in Europe outside the EU (mainly Russia) and in Asia.

With the low-impact scenario, the world consumption and production of industrial roundwood were less than 1 million $m^3$ lower in 2030 than without the TTIP. There was only a small increase of consumption in the EU and the US, while production decreased, leading to a decrease of net trade in both regions.

### *Effects on sawnwood*

According to GFPM projections for the high-impact scenario, the TTIP agreement raised the world sawnwood consumption and production in 2030 by 1.4 million $m^3$ (Table 5). However, it lowered consumption in countries outside of Europe and North America. In the US consumption was nearly 2 million $m^3$ (3%) higher. This additional consumption was not accompanied by a higher production but rather by a degradation of the US net trade. In the EU sawnwood consumption was 0.9 million $m^3$ (1%) higher with the high-impact TTIP, an amount more than compensated by the EU additional production. In other regions, due to the lower consumption in Asia, South America, and Africa, their trade balance improved.

The low-impact scenario had a negligible effect on world production, consumption, and trade of sawnwood. While the TTIP increased consumption slightly in the EU and the US, it decreased it more

**Table 5**
Differences in sawnwood consumption, production, and net trade in 2030 due to the TTIP, predicted with the GFPM model under the high and low impact scenarios.

| | High impact (1000 $m^3$) | | | Low impact(1000 $m^3$) | | |
|---|---|---|---|---|---|---|
| | Consumption | Production | Net trade | Consumption | Production | Net trade |
| Africa | −100 | 29 | 129 | −57 | −8 | 50 |
| N/C America | 1478 | 598 | −881 | 64 | 0 | −64 |
| United States | 1954 | −40 | −1994 | 109 | −6 | −115 |
| South America | −212 | −174 | 38 | 6 | 14 | 8 |
| Asia | −411 | 88 | 499 | −139 | −138 | 1 |
| Oceania | −107 | −22 | 85 | −10 | −3 | 8 |
| Europe | 771 | 902 | 131 | −19 | −20 | −2 |
| EU-28 | 885 | 977 | 91 | 46 | −27 | −74 |
| Austria | 29 | 66 | 37 | 2 | 0 | −2 |
| Finland | 52 | 139 | 87 | 3 | 16 | 13 |
| France | 57 | 199 | 142 | 4 | −5 | −9 |
| Germany | 185 | 187 | 3 | 8 | 10 | 2 |
| Italy | 67 | 57 | −10 | 4 | −1 | −5 |
| Spain | 42 | 31 | −12 | 2 | 3 | 2 |
| Sweden | 80 | 85 | 6 | 3 | −2 | −5 |
| United Kingdom | 165 | −73 | −237 | 7 | −10 | −17 |
| World | 1420 | 1420 | 1[a] | −155 | −154 | 1[a] |

[a] World net trade may not add up to 0 due to round-off errors.

**Table 6**
Differences in wood-based panels consumption, production, and net trade in 2030 due to the TTIP, predicted with the GFPM model under the high and low impact scenarios.

| | High impact (1000 $m^3$) | | | Low impact (1000 $m^3$) | | |
|---|---|---|---|---|---|---|
| | Consumption | Production | Net trade | Consumption | Production | Net trade |
| Africa | −50 | −33 | 17 | −38 | −12 | 26 |
| N/C America | 1751 | 1103 | −649 | 85 | 66 | −18 |
| United States | 2181 | 1055 | −1126 | 121 | 58 | −63 |
| South America | −156 | −90 | 66 | −2 | −20 | −18 |
| Asia | −654 | −211 | 443 | −210 | −189 | 21 |
| Oceania | −87 | −11 | 77 | −9 | −20 | −11 |
| Europe | 1094 | 1139 | 46 | −46 | −44 | 2 |
| EU-28 | 1243 | 1220 | −23 | 66 | 43 | −23 |
| Austria | 16 | 129 | 113 | 0 | 17 | 17 |
| Finland | 17 | −15 | −32 | 1 | −5 | −6 |
| France | 60 | 124 | 64 | 5 | −8 | −12 |
| Germany | 238 | 246 | 8 | 11 | 2 | −9 |
| Italy | 117 | 112 | −5 | 6 | 8 | 2 |
| Spain | 55 | −19 | −74 | 3 | −10 | −13 |
| Sweden | 53 | 27 | −26 | 2 | 4 | 2 |
| United Kingdom | 232 | 170 | −61 | 9 | 9 | 0 |
| World | 1898 | 1897 | 0 | −221 | −220 | 1[a] |

[a] World net trade may not add up to 0 due to round-off errors.

in other regions, especially in Asia, leading to a slightly lower world consumption and production in 2030.

*Effects on wood-based panels*

Three product groups distinguished in the GFMP model are aggregated here under wood-based panels: Veneer and plywood, fiberboard, and particleboard. With the high-impact scenario of the TTIP the world consumption of wood-based panels was 1.9 million $m^3$ higher in 2030 than with the base scenario, but it was 0.7 million $m^3$ lower in Asia, and also lower in South America, Oceania, and Africa (Table 6). Consumption was 6% higher in the US and 2% higher in the EU. Increased consumption was supplied by an increase in production in the EU, leaving net trade practically unchanged. Meanwhile the US witnessed a nearly equal increase in production and net imports. Asia lowered more consumption of wood-based panels than production with an attendant improvement in the trade balance.

With the low-impact scenario the largest effect was lower consumption and production in countries outside the TTIP by 2030, mostly in Asia, while there was a slight increase in both production and consumption in the EU and US.

*Effects on wood pulp*

The GFPM model simulates the transformation of industrial roundwood into sawnwood, wood-based panels, and into intermediate products for the paper industry: mechanical pulp and chemical pulp. These intermediate products, together with other fibre pulp and waste paper are in turn transformed in end products: Newsprint, printing and writing paper and other paper.

With the TTIP high-impact scenario, consumption of wood pulp, the sum of mechanical and chemical pulp, was 5% higher in the US and 1% higher in the EU (Table 7). Production in both regions increased less than consumption, thus worsening their trade balance. There was little change in wood pulp consumption in other regions, leading to a total global increase in annual consumption of 1.7 million $m^3$ by 2030. Production increased the most in the United States and South America where net exports increased substantially.

**Table 7**
Differences in wood pulp consumption, production, and net trade in 2030 due to the TTIP, predicted with the GFPM model under the high and low impact scenarios.

| | High impact (1000 t) | | | Low impact (1000 t) | | |
|---|---|---|---|---|---|---|
| | Consumption | Production | Net trade | Consumption | Production | Net trade |
| Africa | −69 | −51 | 18 | −13 | −6 | 7 |
| N/C America | 1599 | 1108 | −491 | 51 | −1 | −52 |
| United States | 1840 | 1114 | −726 | 72 | 8 | −64 |
| South America | −100 | 322 | 422 | 3 | −16 | −19 |
| ASIA | −146 | 91 | 237 | −102 | −61 | 41 |
| Oceania | −19 | 55 | 74 | −4 | −4 | 1 |
| Europe | 440 | 180 | −260 | −43 | −20 | 23 |
| EU-28 | 474 | 192 | −282 | 19 | −7 | −26 |
| Austria | 14 | 22 | 8 | 1 | −4 | −5 |
| Finland | 43 | 42 | −1 | 3 | 3 | 0 |
| France | 61 | 59 | −3 | 5 | −1 | −6 |
| Germany | 102 | 70 | −32 | 5 | −9 | −13 |
| Italy | 84 | 8 | −76 | 2 | 1 | −1 |
| Spain | 53 | 51 | −2 | 3 | 2 | −1 |
| Sweden | 47 | 46 | 0 | 2 | 3 | 1 |
| United Kingdom | 58 | 9 | −48 | 2 | 0 | −2 |
| World | 1704 | 1704 | 1[a] | −109 | −108 | 1[a] |

[a] World net trade may not add up to 0 due to round-off errors.

With the TTIP low-impact scenario there was practically no change in wood pulp consumption, production, and trade in the EU and the US, and only a small decrease of world production and consumption by 2030.

*Effects on paper and paperboard*

Under the high-impact scenario, the TTIP raised the world annual consumption of paper and paperboard by nearly 4 million metric tonnes in 2030. There were substantial increases of consumption in the US (6%) and in the EU (2%) by 2030, relative to the base scenario (Table 8). In both the EU and the US

**Table 8**
Differences in paper and paperboard consumption, production, and net trade in 2030 due to the TTIP, predicted with the GFPM model under the high and low impact scenarios.

| | High impact (1000 $m^3$) | | | Low impact (1000 $m^3$) | | |
|---|---|---|---|---|---|---|
| | Consumption | Production | Net trade | Consumption | Production | Net trade |
| Africa | −120 | −126 | −6 | −66 | −32 | 34 |
| N/C America | 3741 | 2744 | −997 | 164 | 72 | −92 |
| United States | 4349 | 3235 | −1115 | 240 | 129 | −112 |
| South America | −234 | −190 | 44 | −16 | 3 | 19 |
| ASIA | −1382 | −151 | 1231 | −498 | −425 | 74 |
| Oceania | −172 | −32 | 140 | −16 | −8 | 8 |
| Europe | 1968 | 1555 | −413 | 21 | −21 | −42 |
| EU-28 | 2099 | 1628 | −470 | 102 | 76 | −25 |
| Austria | 30 | 42 | 12 | 1 | 2 | 1 |
| Finland | 41 | 64 | 23 | 3 | 5 | 2 |
| France | 124 | 174 | 50 | 10 | 13 | 3 |
| Germany | 454 | 466 | 12 | 21 | 22 | 1 |
| Italy | 236 | 226 | −11 | 12 | 7 | −5 |
| Spain | 197 | 198 | 0 | 10 | 10 | 0 |
| Sweden | 72 | 63 | −9 | 3 | 3 | 0 |
| United Kingdom | 526 | 266 | −260 | 20 | 10 | −10 |
| World | 3801 | 3800[a] | 0 | −411 | −411 | 0 |

[a] World production may differ from consumption due to round-off errors.

**Table 9**
Differences in value added in 2030 due to the TFTA, predicted with the GFPM model under the high and low impact scenarios.

| | High impact[a] | | Low impact[a] | |
|---|---|---|---|---|
| | Million $ | | Million $ | |
| Africa | −133 | −2.7% | −31 | −0.6% |
| N/C America | 3058 | 2.5% | 72 | 0.1% |
| United States | 3460 | 3.7% | 123 | 0.1% |
| South America | −118 | −0.4% | −21 | −0.1% |
| ASIA | −635 | −0.2% | −563 | −0.2% |
| Oceania | −33 | −0.5% | −20 | −0.3% |
| Europe | 1505 | 0.9% | −51 | 0.0% |
| EU-28 | 1663 | 1.2% | 29 | 0.0% |
| Austria | 82 | 0.8% | 1 | 0.0% |
| Finland | 28 | 0.2% | 2 | 0.0% |
| France | 142 | 1.2% | −2 | 0.0% |
| Germany | 537 | 1.3% | 8 | 0.0% |
| Italy | 205 | 2.1% | 8 | 0.1% |
| Spain | 175 | 2.1% | 4 | 0.1% |
| Sweden | 30 | 0.3% | 1 | 0.0% |
| United Kingdom | 288 | 3.5% | 10 | 0.1% |
| World | 3643 | 0.5% | −614 | −0.1% |

[a] In constant $US of 2010.

this increased consumption was supplied by more production and less net exports. The consumption of paper and paperboard in Asia was 1.4 million tonnes lower, due mostly to decreases in Japan and China. However, China's production increased sufficiently to improve markedly Asia's net trade.

With the low-impact scenario of the TTIP, there was little change in the situation of the paper and paperboard sub sector in 2030. While consumption and production increased slightly in the US and the EU, there were larger declines in other countries, in Asia in particular.

### *Effects on value added*

For this study, the value added in the forest sector of a country was defined as the total value of the end products (sawnwood, wood-based panels, paper and paperboard) manufactured in the country, minus the cost of the wood and fibre consumed in making them.

According to the high-impact scenario, the TTIP increased the value added in the US forest sector by $3.5 billion a year in 2030, or 3.7%, and in the EU by $1.7 billion, or 1.2% (Table 9). Most third party countries experienced a decrease in value added, in particular in Asia, where Japan's value added was $800 million lower, and in South America. Nevertheless, in total, the world value added increased by $3.6 billion.

With the low-impact scenario, value added increased barely in the US and the EU. Overall, global value added was slightly lower than with the base scenario, mostly due to the deterioration in Asia, primarily in China and India.

### *Welfare effects*

The second column of Table 10 shows the difference in consumers' surplus or welfare, between the high-impact scenario and the base scenario. For all end products considered by the model (fuelwood, sawnwood, panels, paper and paperboard), the TTIP raised the consumers' welfare in 2030 by about $16 billion for the world. Most of this gain was in the US (nearly $14 billion) and in the EU ($6.8 billion). Meanwhile, Asia lost $1.7 billion in consumer surplus, due in large part to a decrease in Japan.

The gain of the world producers of wood and fibre was much smaller than that of consumers, less than $1 billion, spread through all countries but highest in the EU, Asia, and the US. The total welfare change, the sum of producers' and consumers' surplus was double for the US than for the EU. Within

**Table 10**
Differences in consumer surplus, producer surplus, and total welfare in 2030 due to the TFTA, predicted with the GFPM model under the high and low impact scenarios.

| | High TTIP impact (million $) | | | | LowTTIP impact (million $) | | | |
|---|---|---|---|---|---|---|---|---|
| | Consumers | Producers | Total | CV[a] | Consumers | Producers | Total | CV[a] |
| Africa | 454 | 82 | 536 | 18% | −309 | −8 | −317 | 7% |
| N/C America | 11,704 | 229 | 11,933 | 10% | 439 | −3 | 436 | 9% |
| United States | 13,645 | 127 | 13,772 | 11% | 700 | −1 | 699 | 10% |
| South America | −354 | 95 | −259 | 30% | −24 | −2 | −25 | 37% |
| Asia | −1721 | 209 | −1513 | 21% | −1482 | −19 | −1501 | 14% |
| Oceania | −460 | 12 | −447 | 14% | −56 | 0 | −56 | 14% |
| Europe | 6450 | 322 | 6772 | 9% | −115 | −7 | −122 | 27% |
| EU-28 | 6764 | 228 | 6993 | 9% | 271 | −1 | 270 | 9% |
| Austria | 156 | 7 | 162 | 8% | 4 | 0 | 4 | 33% |
| Finland | 224 | 23 | 247 | 8% | 12 | 0 | 11 | 4% |
| France | 486 | 23 | 510 | 8% | 27 | 0 | 27 | 5% |
| Germany | 1384 | 38 | 1422 | 9% | 48 | 0 | 48 | 9% |
| Italy | 684 | 3 | 687 | 9% | 30 | 0 | 30 | 10% |
| Spain | 520 | 9 | 529 | 9% | 22 | 0 | 22 | 9% |
| Sweden | 342 | 39 | 381 | 9% | 11 | 0 | 11 | 9% |
| United Kingdom | 1333 | 6 | 1339 | 11% | 45 | 0 | 45 | 10% |
| World | 16,073 | 949 | 17,021 | 9% | −1547 | −39 | −1585 | 15% |

[a] Coefficient of variation of the total welfare impact based on projections with the low, high and mean elasticity of demand with GDP in Table 11.

the EU Germany and the United Kingdom gained the most. Among third-party countries, those in Asia suffered the largest welfare losses.

With the low-impact scenario, there was practically no change in producers' surplus. All the welfare differences came from consumers' surplus (Table 10, last 4 columns). The world welfare was $1.6 billion lower. Although there were some welfare gains in the US and the EU, decreases in Asia were larger, stemming in part from large declines in consumers surplus in China and India.

### *Sensitivity analysis*

A sensitivity analysis was carried out to judge how much this measure of the total welfare impact of the TTIP varied with the choice of parameters. Focus was on the elasticity of demand with respect to GDP since the effect of the TTIP was traced through its impact on the GDP growth which in turn affected the demand for forest products. In addition to the projections discussed above, with an average elasticity of demand with GDP, the projections were repeated with "high" and "low" elasticity defined by the mean elasticity plus or minus one standard error, corresponding to a 70% confidence interval (Table 11).

The variability of the results was measured by the coefficient of variation, the standard deviation divided by the absolute value of the mean, over the projections with a high, low, or mean elasticity. The results, in the middle and last column of Table 10, show that the total welfare impact of the high TTIP impact scenario varied by approximately 11% for the United States and by 9% for the EU, depending on the elasticity of demand with GDP. For the world the variation was 9%, but it was two to three times larger for Asia and South America.

In the case of the low TTIP impact scenario, the coefficient of variation for the EU and the US was also near 10%. But it was larger for the world and for South America and for some individual countries, thus strengthening the inference that little or no change could be attributed to the low impact scenario.

## Summary and conclusion

The purpose of this paper was to simulate the impact of a Transatlantic Trade and Investment Partnership on the global consumption, production and trade of forest products. As tariffs on forest products in the US and the EU are already low, the main effects of an agreement would not be due to

**Table 11**
GFPM demand elasticity with GDP and price.

| | GDP elasticity | | | Price elasticity | Annual trend |
|---|---|---|---|---|---|
| | Mean | High[1] | Low[a] | | |
| Sawnwood | 0.22 | 0.25 | 0.19 | −0.1 | −0.003 |
| S.E. | 0.03 | | | 0.02 | 0.001 |
| Plywood and veneer | 0.41 | 0.45 | 0.37 | −0.29 | −0.009 |
| S.E. | 0.04 | | | 0.02 | 0.002 |
| Particleboard | 0.54 | 0.61 | 0.47 | −0.29 | −0.006 |
| S.E. | 0.07 | | | 0.02 | 0.002 |
| Fiberboard | 0.35 | 0.41 | 0.29 | −0.46 | −0.002 |
| S.E. | 0.06 | | | 0.02 | 0.002 |
| Newsprint | 0.58 | 0.62 | 0.54 | −0.25 | −0.008 |
| S.E. | 0.04 | | | 0.02 | 0.001 |
| Printing and writing | 0.45 | 0.48 | 0.42 | −0.37 | 0.003 |
| S.E. | 0.03 | | | 0.02 | 0.001 |
| Other paper and paperboard | 0.43 | 0.46 | 0.40 | −0.23 | −0.004 |
| S.E. | 0.03 | | | 0.02 | 0.001 |

[a] Mean value plus or minus one standard error (S.E.) used for the sensitivity analysis in Table 10.

the elimination of tariffs on forest products, but rather to its impact on the growth of GDP in the US, the EU, and the rest of the world, which would affect the demand for forest products. Two estimates of a TTIP impact on GDP growth were used, based on Felbermayr et al. (2013a): a "low impact" scenario, where only trade tariffs (in all sectors) were eliminated, simulating a direct reduction of trade costs; and a "high impact" scenario, where both tariff and non-tariff trade barriers were eliminated, with a deeper integration of the two market areas, liberating resources for more GDP growth. The Global Forest Products Model, recalibrated for the 2010 base-year, was then used to simulate the potential impact of these changes of GDP growth on the forest sector from 2010 to 2030.

According to the results, under the low-impact scenario the TTIP would have no, or only small consequences for the forest sector. With more comprehensive trade liberalization (the high-impact scenario including non-tariff barriers that need to be negotiated under the treaty), a TTIP would still have only a small positive effect on the world prices of most products, but it would change forest products consumption, production, and trade. For all forest products, consumption would increase about twice as much, in percent, in the US as in the EU. Production would increase less than consumption, leading to a deterioration of the trade balance in both the EU and the US, compensated by increased exports of some third countries. Global welfare (consumers and producers' surplus) would increase by approximately $17 billion, of which $14 billion in the US, and half as much in the EU, with some decrease in third countries, especially in Asia.

However, according to the sensitivity analysis, the measures of the welfare impact for the US and the EU may vary by ±10% depending on the elasticity of demand with GDP, and by as much as ±30% for Asia. This uncertainty points to the need for further research. In particular, for the issue examined here, more accurate estimates of the elasticities of demand by product and country are needed, with particular attention to how they may vary between countries and over time (Hetemaki and Obersteiner, 2001, Michinaka et al., 2010). Another area of potential improvement is in the modelling of trade, to achieve a compromise between purely competitive trade and the assumption that products from different countries are always different commodities (Armington, 1969). As an alternative, Felbermayr et al. (2013b) combine gravity trade models with a general equilibrium model (GTAP, Hertel, 1997). They project a small positive effect of the TTIP on exports of wood and paper products in the United States and Germany, and a negative effect on forestry exports from Germany, but a positive effect in the United States. Meanwhile, the present study projected negative impacts on the United States' net trade of all products, and little impact on Germany's.

From the point of view of policy, to reach the high impact results, non-tariff barriers for the forestry sector must be negotiated. The non-tariff barriers are defined in ECORYS, 2012 as "all non-price and non-quantity restrictions on trade in goods, services and investment, at federal and state level. This includes border measures (customs procedures, etc.) as well as behind-the border measures flowing

from domestic laws, regulations and practices". Regulations cannot be changed as easily as tariffs and are the results of differences in culture, geography or language. In the agriculture negotiations and it would be similar for forestry, the different political philosophies stem in part from a difference between the «science based information» guiding the US negotiators and the «precautionary principles» followed by the EU (Grueff, 2013).

For the forestry sector, the OECD product market regulation indexes, which measure non-tariff trade barriers, are a mere 0.10 for US exports, and 0.08 for EU exports on a scale from 0 to 1 (Berden et al., 2009). Nevertheless, negotiators will have to agree on how to consider forest biodiversity protection for instance and how to harmonize the Lacey act and the EU regulation governing illegal logging. Also, different, sometimes incompatible quality norms and forest products classifications exist in the two regions and may hinder trade. It is largely unknown how deep a TTIP would impact timber and forest products classifications, eco-certifications and labelling.

While these limitations and uncertainties must be kept in mind in evaluating the results, they remain useful as estimates of the magnitude of a potential TTIP on the forest sector, acknowledging the wide range of its macroeconomic consequences depending on the depth of the reforms. Furthermore, the results illustrate the importance of a global perspective in evaluating the TTIP and other potential regional trade agreements, and their consequences on specific sectors. In particular, while considering only the US and the EU would force zero-sum trade, the present results suggest instead that the trade balance of both the US and the EU would deteriorate and be compensated by exports from third countries. Such inferences can be made effectively with a partial equilibrium model of the forest sector with sufficient country and product detail such as the GFPM, conditional on macro-economic projections obtained from economy-wide general equilibrium models.

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