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Green public procurement of certified wood: impact on international trade and global welfare

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Abstract

This paper investigates the impact of green public procurement (governments' purchases) of certified wood in the EU. A spatial partial price equilibrium model is developed to analyse whether this policy impacts interregional trade flows of wood and other regions' economic welfare. The model contains an innovative feature which allows the introduction of consumers' willingness to pay for certified wood, and producers' willingness to accept certified wood production in order to determine the share of certified wood in consumption and demand. The outcome of the analysis demonstrates that green public procurement of certified wood in one region can create a trade barrier for other regions and decrease other regions' economic welfare. In the worst case scenario, other regions' production of non-certified wood even increases. This endangers forest conservation. Cost reductions and adequate financial compensation for certified wood producers can tackle these problems.

Keywords: international trade, forestry, certification, spatial equilibrium modelling, policy

Introduction, scope and main objectives

This paper considers the conjoint effect of two instruments which aim to sustain the production and consumption of wood. The two instruments' impact is analysed at global level by making use of a Spatial Partial Equilibrium Model. This model links different regions' wood markets through trade. The characteristics of the two policy instruments require the introduction of an innovative feature to the traditional models.

The first instrument is forest certification. Forest certification is a transnational, non-governmental approach to environmental regulation and development. In the past, traditional conservation interventions such as international forest conservation agreements, national forest policy reform, and the creation of additional protected areas were not able to significantly reduce unsustainable logging in tropical forests (Auld, et al. 2008). This was partly because the governments responsible for the tropical forests lack the capacity to adequately manage natural resources and enforce pertinent forestry and land-use regulations (Ebeling & Yasué 2009, Kramer, et al. 1997) and to provide secure land tenure (Smith, et al. 2003). Market-based instruments involving non state actors, such as certification, depend less on public resources and governance capacity. Consequently, certification is promoted as economically attractive alternative and potentially more effective in tropical developing countries during the two last decades (Auld, Gulbrandsen & McDermott 2008, Gullison 2003). But certification does not yet positively affects forest management in countries with weak governance capacities. Nearly 90 percent of the FSC and PEFC (the two main certification schemes) certified forests are situated in the northern hemisphere. In contrast, only 2 percent of under-regulated southern tropical forest is certified.

The second instrument is Green Public Procurement (GPP). GPP refers to public procurement processes which take environmental aspects into account. At the supply side of the market, GPP encourages industries to develop green technologies and practices (Erdmenger 2003, European Commission 2011). At the demand side, GPP became a promising tool to foster the demand for greener products (Parikka-Alhola 2008).

Problem statement and research question

This paper assumes that if governments opt for GPP, they will buy certified wood (products) only. But 'forest industries in different countries are increasingly linked through international trade and global environmental policies' (Buongiorno 2003). Gan and McCarl (2007) for example demonstrated how production decisions in one continent induce output reactions in other continents. Also Sedjo and Sohngen (2013) (1999) (1995) described the global consequences of regional forest policies. Hence, the implementation of GPP of certified wood in one region can impact other regions' wood markets. Spatial Partial Equilibrium Models (SEMs) take this international aspect into account. Takayama and Judge (1971) first developed the SEM approach. SEMs distinguish supply and demand functions per region and determine prices, demand, and supply per region as well as bilateral trade flows. This allows to investigate the impact of policies on the welfare of consumers and producers separately.

The characteristics of the proposed policy require the introduction of an innovative feature to traditional SEMs. Governments will only buy certified products. Consequently, certified supply and demand must be distinguished from conventional supply and demand. This is done by introducing the Willingness to Pay for and Willingness to Accept certified products.

The SEM takes 5 regions into account: Europe & Russia, Northern America, Latin America, Asia & Oceania, and Africa. Only 'industrial roundwood' is considered in the SEM. The other wood products are taken into account indirectly. This research makes use of the data by Buongiorno (2003) in order to determine the demand for industrial roundwood in the baseline situation. In the work of Buongiorno (2003) this demand is partially determined by the demand for industrial roundwood as input for the production of other wood products (e.g. sawnwood, plywood, particleboards, fiberwood).

Model description

In traditional SEMs, no distinction is made between certified and conventional products. Therefore, a new SEM is developed. The specification of the supply and demand functions per region *i* is the first step in the development of the SEM. This allows the calculation of the traditional economic welfare per region. The regional economic welfare consists of the sum of the consumer surplus and producer surplus. These surpluses depend on the supply price and demand price and accompanying supplied and demanded quantities. Figure 1 visualises the economic welfare for an open market.

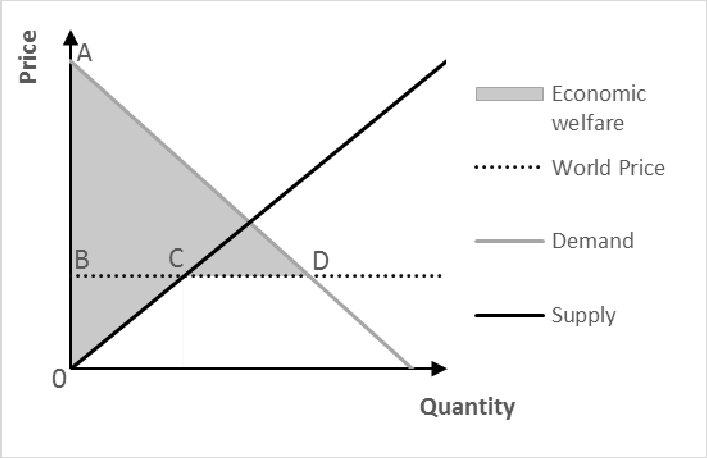

Figure 1: Economic welfare calculation

Economic Welfare: Consumer Surplus + Producer Surplus. Consumer Surplus = area ABD. Producer Surplus = area 0BC

In this paper, the regional demanded and supplied quantities ($Q_{d,i}$ and $Q_{s,i}$) are determined by allowing the baseline demand and supply ($Q^*_{d,i}$ and $Q^*_{s,i}$) to respond to price changes. The baseline prices ($P^*_{d,i}$ and $P^*_{s,i}$) attain new price levels ($P_{d,i}$ and $P_{s,i}$) due to the introduction of certification. The price elasticity of demand and supply ($\zeta_{d,i}$ and $\zeta_{s,i}$) determine the responsiveness of the supplied and demanded quantities to the price changes:

$$Q_{d,i} = Q^*_{d,i} + Q^*_{d,i} * \zeta_{d,i} * \left(\frac{P_{d,i} - P^*_{d,i}}{P^*_{d,i}}\right) \quad (1)$$

$$Q_{s,i} = Q^*_{s,i} + Q^*_{s,i} * \zeta_{s,i} * \left(\frac{P_{s,i} - P^*_{s,i}}{P^*_{s,i}}\right) \quad (2)$$

The demand and supply functions described above encompass the demand and supply of both certified and conventional wood. The second step of the SEM's development aims to distinguish conventional and certified wood. The share of certified wood in the aggregate demand and supply is determined by making use of the WTP and WTA.

Willingness To Pay – Willingness To Accept

The WTP expresses the maximum price premium consumers are willing to pay for certified wood. Cai and Aguilar (2013) conducted a meta-analysis on the consumers' WTP for certified wood products. They found a mean WTP for wood products of 12.8% on top of the conventional wood price (St. Dev. 0.08). This research assumes regional differences in WTP. Jacobsen and Hanley (2009) developed a logistic regression model which demonstrated that the WTP for eco-labels and ecosystem services is positively related to GDP per capita. Hence, 'Willingness to Pay' is probably a wrong choice of words. Instead it reflects the 'Capacity to Pay'. The model by Jacobsen and Hanley (2009) is used in order to determine the mean WTP per continent based upon the overall average WTP found by Cai and Aguilar (2013).

The WTA is the WTP's equivalent at the supply side of the market. The WTA represents the minimum price premium requested by wood producers before they switch from conventional to certified production. This price premium must compensate the additional direct and indirect costs related to certification. The certification bodies declare that wood producers

receive price premiums between 15 to 25 % on top of the conventional wood price. This allows to determine the WTA per region by combining the standardised distribution with the share of certified forests in the total forest area per continent derived from UNECE/FAO (2014).

The WTA is higher in developing countries than in developed countries for two reasons. First, 'the magnitude of the indirect costs depend upon the current quality of the management of conventional forests and the context in which forestry is taking place' (Gullison 2003, ITTC 2004). Because current management techniques in developing countries are less appropriate for certification, their producers demonstrate higher WTA. Second, only a small part of certification costs are variable costs. Consequently, certification costs are easier to bear for bigger producers. Large scale producers are generally more present in developed countries.

Both the WTP and WTA are introduced in the model as parameters and will be used in order to determine the share of certified wood in demand and wood ($sharecertified_{d,i}$ and $sharecertified_{s,i}$). Because it is assumed that the WTP and WTA follow a standardised distribution with known mean and standard deviation, the share of certified demand and supply can be determined for each price premium. Figure 2 and Figure 3 display this reasoning for a given price premium.

From these figures it becomes apparent that traditional welfare calculation is not sufficient for a market which is characterised by the presence of certified products. At the demand side of the market, some of the consumers buying certified goods at a given market price premium might be willing to pay higher price premiums. The shaded area in Figure 2 represents the additional consumer surplus related to the introduction of price premiums in the model. Accordingly, the shaded area in Figure 3 represents the additional producer surplus.

Since the WTP is assumed to be standardly distributed, the WTP function can be described by the following equation:

$$sharecertified_{d,i} = 1 - (1 - e^{-\frac{pricepremium_{d,i} - \mu_{WTP,i}}{v_{WTP,i}}})^{-1} \quad (3)$$

The integral of this function from the equilibrium WTP to infinity equals the consumer surplus related to the distribution of the WTP:

$$CS_i = v * \ln(1 + e^{\frac{-priceremium_{d,i} + \mu_{WTP,i}}{\sigma_{WTP,i}}}) \quad (4)$$

Accordingly, the producer surplus (PS_i) related to the distribution of the WTA is calculated:

$$sharecertified_{s,i} = (1 - e^{-\frac{priceremium_{s,i} - \mu_{WTA,i}}{v_{WTA,i}}})^{-1} \quad (5)$$

$$PS_i = priceremium_{s,i} + v * \ln(1 + e^{\frac{-priceremium_{s,i} + \mu_{WTA,i}}{\sigma_{WTA,i}}}) \quad (6)$$

The CS_i and PS_i related to the price premium are multiplied with the equilibrium price and equilibrium quantity for the aggregate demand and supply before being added to the traditional welfare calculation.

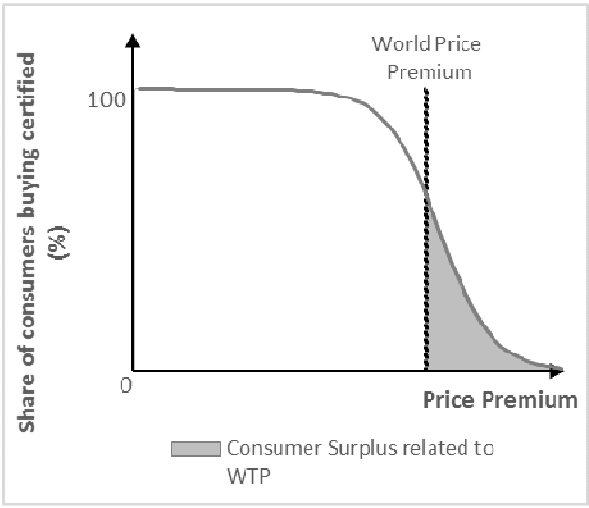

Figure 2: Distribution of the WTP, accompanying share of certified wood in total consumption per price premium

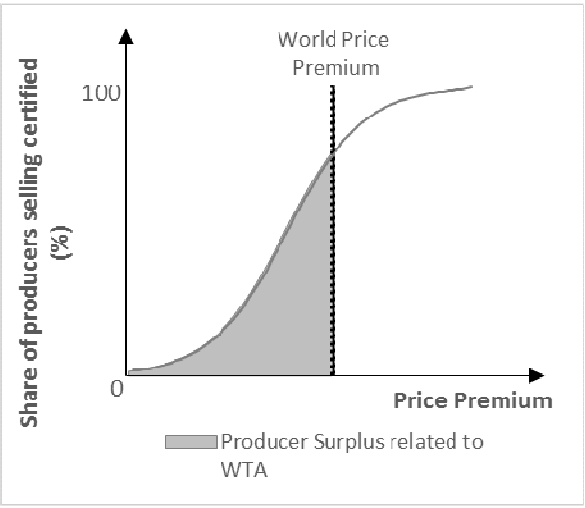

Figure 3: Distribution of the WTA, accompanying share of certified wood in total production per price premium

Welfare calculation

The new SEM maximises global welfare defined as:

$$\sum_i \left[\frac{P^*_{d,i} * Q^2_{d,i}}{2 * Q^*_{d,i} * \zeta_{d,i}} - P^*_{d,i} * Q_{d,i} * \left(\frac{1}{\zeta_{d,i}} + 1\right) - Q_{d,i} * P_{d,i}\right] - \sum_i \left[\frac{P^*_{s,i} * Q^2_{s,i}}{2 * Q^*_{s,i} * \zeta_{s,i}} - P^*_{s,i} * Q_{s,i} * \left(\frac{1}{\zeta_{s,i}} + 1\right) - Q_{s,i} * P_{s,i}\right] - \sum_{i,j} shipmentcon_{ij} * \left(P_{s,i} + TC_{ij}\right) * AVT_{i,j} - \sum_{i,j} shipmentcer_{i,j} * \left(P_{s,i} * \left(1 + pricepremium_{s,i}\right) + TC_{i,j}\right) * AVT_{i,j} - \sum_{i,j} shipmentcon_{ij} * TC_{ij} - \sum_{i,j} shipmentcer_{i,j} * TC_{i,j} + \sum_i \sigma_{WTP,i} * \left(\frac{\sqrt{3}}{\pi}\right) * \log(1 + e^{\left(\frac{-pricepremium_{d,i} + \mu_{WTP,i}}{\sigma_{WTP,i}}\right) * \sqrt{3}/\pi)} * Q_{d,i} * P_{d,i} + \sum_i pricepremium_i + \frac{\sigma_{WTA,i} * \sqrt{3}}{\pi} * \log(1 + e^{\left(\frac{-pricepremium_{s,i} + \mu_{WTA,i}}{\sigma_{WTA,i}}\right) * \frac{\sqrt{3}}{\pi}} * Q_{s,i} * P_{s,i}$$

This equation contains the traditional consumer and producers surplus in the first two summations. The integral of the supply and demand functions are calculated to come to the consumer and producer surplus for each region. The 3rd to the 5th summation are the costs related to the interregional transport of wood. Those costs decrease the global economic surplus. Value added taxes and transport costs from region *i* to region *j* are taken into account as costs related to trade. The final summations represent the extension to traditional welfare calculation. They add the consumer and producer surplus related to the distribution of the WTP and WTA to the welfare calculations.

Global consequences of GPP of certified wood in the EU

In the EU, the aggregated share of all governments in final consumption is 26.8% (EUROSTAT 2014). The SEM introduces the GPP of certified wood by modifying equation 3 into:

$$sharecertified_{d,i} = GPP_i + (1 - GPP_i) * (1 - (1 - e^{-\frac{pricepremium_{d,i} - \mu_{WTP,i}}{\sigma_{WTP,i}}})^{-1}) \quad 8$$

In this equation, GPP_i stands for the share of the government in final consumption and thus the potential share of demand reserved for certified wood due to GPP. In the SEM, parameter GPP_{EU} is set at 0.268.

Welfare implication

The global welfare increased by 1.31 % due to GPP of certified wood in the Europe & Russia. This should not come as a surprise. If governments opt for the cheapest type of wood – conventional wood – they prevent their economy from benefitting from its full economic welfare potential. Since the share of certified wood in consumption cannot encompass the share of the government in final consumption, producers cannot benefit from the producer surplus related to this demand. This does not imply that the economic welfare will increase under all circumstances if governments opt for GPP. It implies that this is possible.

Figure 4 presents the percentage change of the regional welfare per region. Two regions are confronted with a decreasing economic welfare: Latin America and Asia &Oceania. The economic welfare of the other regions increased.

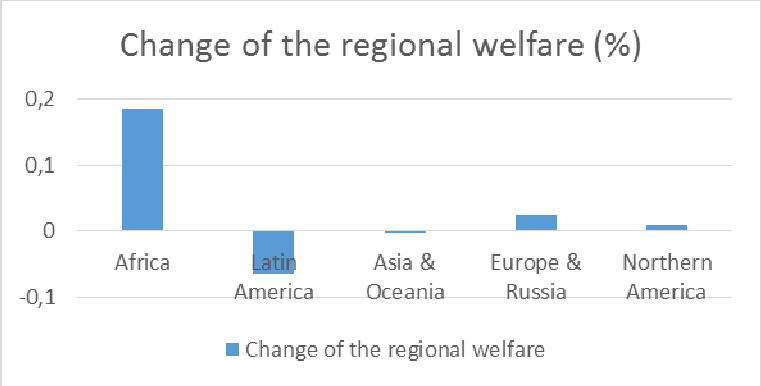

Figure 4: Change of the regional welfare due to GPP in Europe & Russia

All regions' producers – except in Africa – are worse off. This is a result of the global decreased demand for wood. In most regions – except in Africa – the price for wood also decreased, leading to an even smaller producer surplus. The increased producer surplus in Africa is a bit exceptional. Unfortunately, this increase relates to an increased production of conventional wood which are sold at higher prices.

Consumers surpluses generally increased due to lower prices of conventional wood. The certified wood price increased moderately. This is positive for consumers, but can be negative for producers. Hence, for the share of certified wood producers this decreasing conventional wood price is compensated by an increasing price premium. This price premium is received on top of the decreasing conventional wood price. But only part of the producers benefit from this increasing price premium. Consequently, the overall producer surplus still decreased in all regions – except for the African producers.

Trade implications

On a global level, trade of wood increased by 9.25 % after the GPP in the Europe & Russia. Surprisingly, this is due to increasing international trade flows of conventional wood. The quantity of traded certified wood decreased considerably. Most regions fulfil their own

demand for certified wood. Only Europe & Russia imports certified wood. But imports of certified wood in this region only accounts for 1.1 % of certified consumption. Only Africa and Northern America are exporting certified wood. Before GPP, all regions where exporting certified wood. Exports of conventional wood increased on global level. It are Africa, Latin America, and Northern America which are exporting conventional wood. Asia & Oceania is receiving most of this wood. This region imports 17.8 % of its conventional wood needs.

This analysis demonstrates that GPP of certified wood excluded some producers from the international wood market. Hence, the policy created a trade barrier in favour of domestically produced certified wood. In addition, the growing demand for certified products in Europe & Russia resulted in an increasing production of conventional wood in Africa. Also the global consumption of conventional products increased as these products now became cheaper. A contradictory outcome of the initial policy's goal.

The trends described by the SEM are also observed in reality by Auld, Gulbrandsen and McDermott (2008). Simula, et al. (2004) even warn for the problematic implications of this development: if 'producers are forced to drop out from traditional markets as has already happened in some cases, product prices are driven down. Simula, Astana, Ishmael, Santana and Schmidt (2004) share this opinion and claim that without 'tangible benefits deriving from certification in terms of profitability or competitiveness, enterprises will have little incentive to improve forest management with higher costs. The problem is particularly serious in the case of tropical timber producing countries'. The results of our SEM seem to confirm this statement.

Conclusion and policy recommendation

The GPP of certified wood in the EU has global consequences. Surprisingly, some of the results of GPP are contradictory to the initial goal of the policy. In Africa, the production of certified wood declined and global trade of certified wood decreased. GPP created a trade barrier for certified wood. Obviously, the developed SEM has its limitations and must not be used for precise forecasting. Nevertheless it describes the mechanisms leading to a potentially negative outcome of GPP of certified wood.

The SEM finds small shares of certified wood in the supply of wood in the continents below the equator. This is also observed in reality: only 2 percent of the tropical forests is certified at present (Dauvergne & Lister 2013). This suggests that certification costs are higher than the received price premium for most producers in the tropical region. Government policies could aim to reduce certification costs. The certification cost depends upon several factors: the legislative framework in support of certification (Putz, et al. 2000), the level of vertical integration of the forest industry along the production chain (Atyi & Simula 2002), the distance certifiers have to travel (Gullison 2003), the available financial means (ITTC 2004), and the size of the forest (Ebeling & Yasué 2009). The costs are relatively low for large-scale producers and relatively high for small-scale producers (Gullison 2003). In addition, large-scale wood producers are also favoured over small-scale wood producers by the buyers of certified wood. Demand for certified wood is mainly driven by retail which demands large volumes, uniform physical quality, and low prices. Large-scale wood producers are better able to meet these requirements (Klooster 2005, Molnar & Trends 2003, Rametsteiner & Simula 2003, Taylor 2005). Because large-scale producers and operators are more present in the Northern hemisphere, the average certification cost in this hemisphere also has the tendency to be lower. Producers in the Southern hemisphere could be assisted in their certification process. If this assistance decreases the costs of certification, it is more likely that the share of certified wood producers in these areas increases. According to Simula,

Astana, Ishmael, Santana and Schmidt (2004), a phased approach is required. In addition, a comprehensive strategy must be developed in which certification plays a complementary role in sustainable forest management.

Besides working on the costs of non-certified producers, it is also worthwhile to look at the price premium received for certified wood. In reality, producers hardly receive a price premium. Retailers are the most powerful actors in wood commodity chains, and they have little interest in either increasing the cost of the products to consumers or in passing any increased revenue back to their certified suppliers (Bass 2001, Klooster 2005, Madrid & Chapela 2003, Morris & Dunne 2004, Taylor 2005). Nevertheless, price premiums and an increased or protected market share are the main motivation for certification (Simula, Astana, Ishmael, Santana & Schmidt 2004)[1].

[1] Although also indirect costs can be significant.

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