The impact of Green Public Procurement decisions on international trade and prices of certified and conventional wood

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Abstract

This poster presents the macro-economic analysis of the impact of Green Public Procurement of certified wood products in one continent on the wood markets of other continents. A Spatial Equilibrium Model is used to measure the global economic impact of both instruments. At present, certification is promoted as a useful tool for the sustainable management of (tropical) forests in countries with weak governments. This poster however demonstrates that the green public procurement of certification wood does not always result in the hoped-for positive welfare effects. In specific situations, the increased demand for certified wood can even entail a negative effect.

Keywords: forest certification, green public procurement, international trade

1. Introduction

This poster considers the conjoint effect of two instruments that aim to sustain the production and consumption of wood. More in particular it is investigated whether the implementation of the instruments in one region impact other regions' wood markets.

The first instrument is forest certification. Forest certification is a transnational, non-governmental approach to environmental regulation and development. Because certification is non-governmental, it is promoted as a useful tool for countries where the governance capacities are insufficient to adequately manage forests and enforce pertinent regulations. Many of the tropical forests are located in these kind of countries (Ebeling et al., 2009). Only few tropical forests are currently certified however. Nearly 90 percent of the FSC and PEFC[1] certified forests are situated in the northern hemisphere. In contrast, only 2 percent of southern tropical forests is certified.

Green Public Procurement (GPP) is the second instrument. GPP is a public procurement process which takes environmental aspects into account. This poster assumes that if governments opt for GPP of wood, they will buy certified wood only. This assumption is valid since certification is increasingly recognised by governments. Recently, FSC was even recognised in the EU's Due Diligence System (DDS) within the EU's Timber Regulation. The DDS obliges traders to demonstrate that imported wood is harvested legally. The EU's DDS recognises FSC certified wood as low-risk wood.

The implementation of certification and GPP of wood in one region can impact other regions' wood markets. This stems from the strong linkage between the different continent's wood markets through international trade. Sohngen et al. (1999) for example demonstrated that forest conservation decisions (e.g. certification) in one region can entail deforestation in other regions. Macro-economic analysis measures the magnitude of this impact. Certified and conventional wood are considered to be substitutes to this respect.

2. Method

A Spatial Equilibrium Model (SEM) measures the impact of GPP of certified wood in one continent on the other continents' wood markets. The SEM approach is developed by Takayama and Judge (1971). SEMs are nonlinear models which distinguish supply and demand functions per region. This allows the SEM to calculate bilateral trade flows, prices, demanded and supplied quantities endogenously. Five regions are taken into account: Europe & Russia, Northern America, Latin America, Asia & Oceania, and Africa. By taking averages for entire continents and not distinguishing between the different types of wood produced across the world, this poster is merely indicative of mechanisms that are activated through the taken policy measures.

Wagner et al.'s (2012) description of the supply and demand functions for wood is used to define a supply and demand function per region *i*:

$$P_{d,i} = \zeta_i + n_i * Q_{d,i} \tag{1}$$

$$P_{s,i} = \theta_i + \lambda_i * Q_{s,i} \tag{2}$$

$P_{d,i}$and $P_{s,i}$ are the demand and supply prices in region i, and $Q_{d,i}$ and $Q_{s,i}$ being the demanded and supplied quantities of conventional wood in region i. $Q_{d,i}$ depends on the price

[1] The two main certification schemes

of wood ($P_{d,i}$), the price of substitutes, the income level and the related price and income elasticity. The income and price elasticities are captured in n_i, the value of this parameter is derived from earlier research in different regions by FAO. The income level is captured in intercept ζ_i and is based upon the GDP per capita per continent in 2012.

$Q_{s,i}$ depends on the price of wood ($P_{s,i}$), the price of substitutes, the price of inputs (including labour), the technical efficiency of the production system, and the price elasticity. Intercept θ_i is derived from the added value of wood production of the year prior to analysis (2011). The responsiveness of supply to the price of wood is captured in λ_i. This parameter is derived from a study by CTFC. The price of substitutes is taken into account differently, this is explained below.

Takayama and Judge used the 'quasi welfare function' in order to optimise their model. Hence, the objective function optimises the net economic surplus (= net consumer surplus + net producer surplus):

$$W_i\left(Q_{s,i}^*, Q_{d,i}^*\right) = \int_0^{Q_{d,i}^*} P_{d,i} dQ_{d,i} - \int_0^{Q_{s,i}^*} P_{s,i} dQ_{s,i} \tag{3}$$

This poster only considers certified wood as substitute for conventional wood. This paper does not directly take the price of the substitutes into account by making use of cross price elasticities. Instead, estimated Willingness to Pay (WTP) and Willingness to Accept (WTA) functions from literature are used. The WTP_i is the price premium consumers are willing to pay for certified wood, on top of the price of conventional wood. The WTP has been listed for numerous countries by Aguilar et al. (2013). These findings will be used to derive WTPs per continent. Following Aguilar et al., it is assumed that the WTP in a continent is normal distributed, with known mean and standard deviation. The standard deviation is assumed to be constant for all regions at 0.08. This allows to define the standardized normal distribution and the z-scores for each price premium in region i ($PPrem_{d,i}$). Once the z-scores are known, the percent of total demand which is certified ($\%cer_{d,i}$) can be determined. The share of conventional wood in the total demand for wood than is $(1 - \%cer_{d,i})$.

Accordingly, the WTA expresses the minimum price premium suppliers want to receive in order to offer certified wood instead of conventional wood. The price premium received ($PPrem_{s,i}$) must compensate for the additional costs of certification. According to the ITTC (2004), certification costs are equal for all producers. Consequently, the ability to bear the additional certification costs depends upon the technical efficiency of wood producers. The added value per square km per continent is used as indicator for this technical efficiency and hence the WTA. With the known mean WTA and standard deviation, the share of certified wood and conventional wood in the total wood supply ($Q_{s,i}$) can again be determined for each price premium suppliers receive. The share of certified wood in total wood supply is $\%cer_{s,i}$, the share of conventional wood in the total wood supply equals $(1 - \%cer_{s,i})$.

The introduction of certification in the model has some implications for the objective function. If part of the consumers is willing to pay a price premium for certified wood, this will increase the net consumer surplus for the certified part of total wood consumption by:

$$(\%cer_{d,i} * Q_{d,i}) * (P_{d,i} * (1 + PPrem_{d,i})) \tag{4}$$

Similarly, part of the supply function is shifted upwards due to certification. The producer surplus will decrease by:

$$\left(\%cer_{s,i} * Q_{s,i}\right) * (P_{d,i} * (1 + PPrem_{s,i})) \quad (5)$$

Hence, the optimisation of the regional welfare also requires the determination of the optimal price premium for demand and supply and the accompanying shares of certified and conventional wood in total wood consumption and production.

Finally, also trade is introduced in the model. $T_{ij,cer}$ and $T_{ij,con}$ are the traded quantity of respectively certified and conventional wood from region i to region j. Trade is subject to constraints however. The first constraint concerns the supply balance. The supply balance stipulates that export out of a particular region (including interregional trade) cannot exceed regional supply. The constraint is valid for both certified and conventional wood:

$$\left(1 - \%cer_{s,i}\right) * Q_{si} \geq \sum_j T_{ij,con} \; for\ all\ i \quad (6)$$

$$\%cer_{s,i} * Q_{si} \geq \sum_j T_{ij,cer} \; for\ all\ i \quad (7)$$

Similarly, imported shipments (including interregional trade) in region i must be equal or exceed demand in region i for both conventional and certified wood:

$$\left(1 - \%cer_{d,i}\right) * Q_{di} \leq \sum_j T_{ij,con} \; for\ all\ i \quad (8)$$

$$\%cer_{d,i} * Q_{di} \leq \sum_j T_{ij,cer} \; for\ all\ i \quad (9)$$

This model has a unique optimal solution only if it is convex. Therefore demand curves must be downward sloping, while supply curves must be upward sloping (Rockafellar et al., 1975). Wagner et al.'s (2012) demand and supply functions meet this requirement.

Trade entails transport costs however. Variable c_{ij} representes the transport costs of shipping one unit of wood from region i to region j. This cost is the same for conventional and certified wood and is derived from the distance between the two closest seaports of two continents. The total transport costs (aggregated over region and type of wood) thus is:

$$Total\ Transport\ Cost = \left[\sum_i \sum_j c_{ij} * T_{ij,con}\right] + \left[\sum_i \sum_j c_{ij} * T_{ij,cer}\right] \quad (10)$$

Also these costs must be taken into account while maximising the aggregate economic welfare. Combining the original objective function (3) with the additional adaptions to the model (4), (5) and (10) results in the final objective function:

$$W_i\left(Q^*_{s,i}, Q^*_{d,i}\right) = \left[\int_0^{Q^*_{d,i}} P_{d,i} * dQ_{d,i}\right] + \left(\%cer_{d,i} * Q_{d,i}\right) * (P_{d,i} * \left(1 + PPrem_{d,i}\right)) - \left[\int_0^{Q^*_{s,i}} P_{s,i} * dQ_{s,i}\right] - \left(\%cer_{s,i} * Q_{s,i}\right) * (P_{s,i} * \left(1 + PPrem_{s,i}\right)) - \left[\sum_i \sum_j c_{ij} * T_{ij,con}\right] - \left[\sum_i \sum_j c_{ij} * T_{ij,cer}\right] \quad (11)$$

This objective function allows the maximisation of the net aggregate (global) welfare while allowing for trade. Whether bilateral trade occurs depends upon the cost of trade c_{ij} between two regions. For a producer from region i, trade to region j will only be beneficiary if the producer is able to recover his costs and the transport costs. This is the case for both conventional wood (12) and certified wood (13):

$$P_{s,i} + c_{ij} \geq P_{d,j} \quad (12)$$

$$P_{s,i} * \left(1 + PPrem_{s,i}\right) + c_{ij} \geq P_{d,j} * (1 + PPrem_{d,j}) \quad (13)$$

Three possible outcomes can occur: region i fulfils its demand ($P_{d,i} = P_{s,i}$), region i exports to region j $\left(P_{d,j} = P_{s,i} + c_{ij}\right)$, or region i does not export to region j ($P_{d,j} < P_{s,i} + c_{ij}$).

3. Results

The model described above determines the optimal regional supply and demand, regional prices, bilateral trade flows of conventional and certified wood, the share of certified wood in regional supply and demand, and the price premium paid for certified wood endogenously. This allows the calculation of the regional economic surpluses.

First, the model is run without the introduction of GPP. This allows to analyse the trade flows of conventional and certified wood within the model and the regional economic surpluses. Table 1 presents the trade flows in the model prior to GPP.

Table 1. Bilateral trade flows of conventional (Con) wood and certified (Cer) wood in baseline situation

Exporting continents	**Importing continents**									
	Africa		*Latin America*		*Asia & Oceania*		*Europe & Russia*		*Northern America*	
	Con	*Cer*	*Con*	*Cer*	*Con*	*Cer*	*Con*	*Cer*	*Con*	*Cer*
Africa	0,24						4,26	0,17		0,21
Latin America			0,74	0,01					5,55	0,88
Asia & Oceania					7,53	0,08			1,35	3,44
Europe & Russia							14,25	5,65		
Northern America									12,16	6,60

The regional economic surpluses in the baseline situation are presented in Table 2.

Table 2. Regional economic surplusses in baseline situation

	Africa	*Latin America*	*Asia & Oceania*	*Europe & Russia*	*Northern America*
Economic surplus	21,68	46,02	209,76	954,40	1262,30

It is now assumed that the EU will implement GPP of certified wood. Within Europe, the government's share in final consumption is estimated at 27 % (Eurostat, 2014). The remaining European consumers maintain their original preferences (WTP) for certified and conventional wood. **Error! Reference source not found.** presents the bilateral trade flows after GPP in Europe. This demand shock entails two major consequences. First of all, the certified area increases in all continents except Asia. This is necessary to satisfy the increased demand for certified wood in Europe. This increased certified area can entail a positive effect on the continents' economic surplus. Second, Africa, Latin America and Asia & Oceania face a decreased demand for their original production of conventional wood. Consequently they also face a lower demand price for their conventional wood. This will negatively impact their economic surplus. Table 3 allows to analyse whether the positive effect outweighs the negative effect per region. For Africa, Latin America, Asia & Oceania, and Northern America the net welfare effect is negative. The African net welfare even decreased by 9,6 %.

Table 3. Regional economic surpusses after GPP in Europe

	Africa	*Latin America*	*Asia & Oceania*	*Europe & Russia*	*Northern America*
Economic surplus	19,58 (-)	45,17 (-)	208,27 (-)	985,46 (+)	1256,46 (-)

4. Discussion

As stated in literature, the costs of certification is harder to bear for some continents compared to other continents. Consequently these continents do not get certified and cannot respond to the increasing demand for certified wood. Instead they face a declining demand for conventional wood. As such, certification and GPP entails the same effects as a trade barrier for the least developed continents. This is also observed at present (Auld et al., 2008).

Obviously, this model is a simplification of the actual situation and subject to numerous limitations. First of all, it is difficult to consider continents as a homogenous region and apply continent-wide averages and benchmarks. Second, this research does not distinguish between the different types of wood produced on the different continents. Nevertheless this model explicitly demonstrates how producers who face high certification costs cannot participate in certification schemes and subsequently face trade barriers. This can negatively impact their economic welfare.

5. References

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