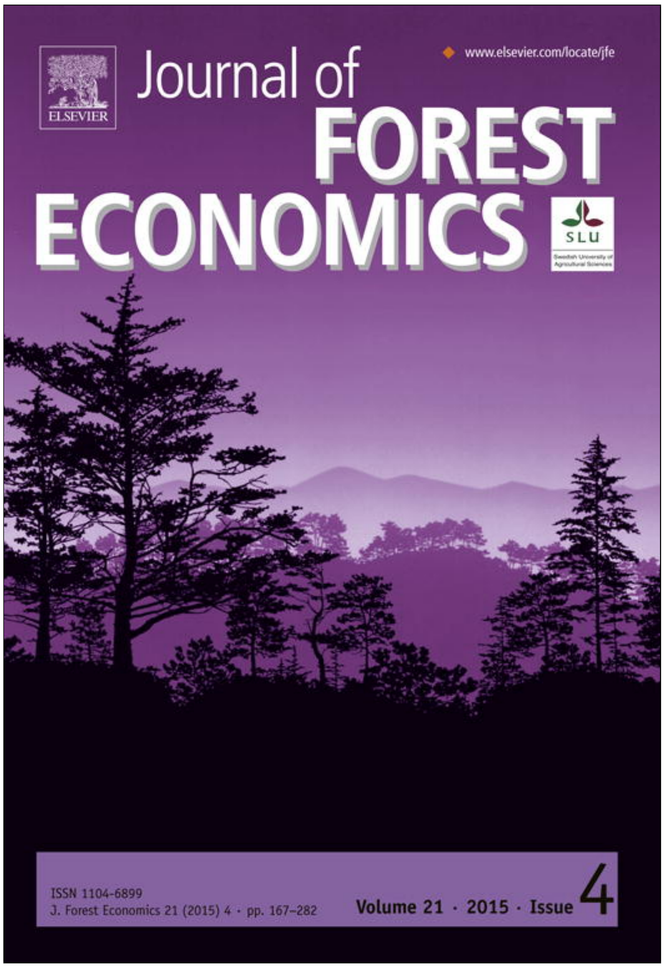
ELSEVIER
www.elsevier.com/locate/jfe
Journal of
FOREST
ECONOMICS
SLU
ISSN 1104-6899
J. Forest Economics 21 (2015) 4 · pp. 167–282
Volume 21 · 2015 · Issue 4

Journal of Forest Economics 21 (2015) 238–249

Contents lists available at ScienceDirect

Journal of Forest Economics

journal homepage: www.elsevier.com/locate/jfe

Monetary union and forest products trade – The case of the euro

Joseph Buongiorno*

Department of Forest and Wildlife Ecology, University of Wisconsin-Madison, 1630 Lindem Drive, Madison, WI 53706, United States

ARTICLE INFO

Article history:
Received 16 February 2015
Received in revised form 28 September 2015
Accepted 29 September 2015

JEL classification:
F14
F15
Q02
Q23

Keywords:
Europe
International trade
Forest products
Euro
Gravity

ABSTRACT

The objective of this study was to determine if the establishment of a monetary union in European countries had affected the international trade of forest products between the euro-using countries. A differential gravity model of bilateral trade flows was developed and estimated with panel data for the bilateral trade between 12 euro countries from 1988 to 2013, for commodity groups HS44 (wood and articles of wood), HS47 (pulp of wood, fibrous cellulosic material, waste, etc.), HS48 (paper and paperboard), and their sum. The parameters were estimated by ordinary least squares and fixed-effects methods. The results showed a positive or neutral effect of the euro on trade, for all products and countries, with both estimation methods. According to the most general result, the introduction of the euro had increased the average annual rate of growth of the bilateral trade of forest products by 6.5 ± 1.3% from 2002 to 2013.

Introduction

According to the theory proposed by Nobel laureate Robert Mundell (1961), the benefits of establishing a common currency such as the euro within the European Union arise from decreases in the cost

* Tel.: +1 608 262 0091; fax: +1 608 262 9922.
E-mail address: jbuongio@wisc.edu

http://dx.doi.org/10.1016/j.jfe.2015.09.005

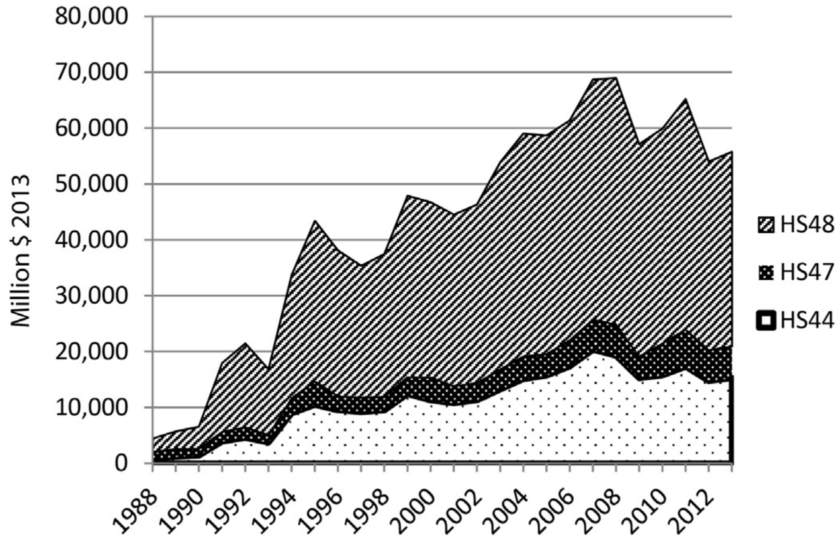

Fig. 1. Value of exports from 1988 to 2013 originating from 12 euro countries (Austria, Belgium, Finland, France, Germany, Italy, Luxembourg, Netherlands, Portugal, Ireland, Spain, Greece), in constant US$ of 2013, by commodity group: HS44 = Wood and articles of wood, wood charcoal. HS47 = Pulp of wood, fibrous cellulosic material, waste, etc., HS48 = Paper & paperboard, articles of pulp, paper and board.

of trade, stemming for example from the elimination of the cost of dealing with currency conversion, and greater predictability of prices due to the absence of exchange rate variations. Possible disadvantages may arise from the loss of independence in setting economic policies within the countries of the monetary union.

Among studies of the economic effects monetary unions on international trade Rose's (2000) pioneering work suggests that monetary unions have large effects on the trade between small countries, as much as 200%. But, the effects of the euro on the trade between European countries tends to be much smaller (10–15% according to Frankel, 2008), and Berger and Nitsch (2008) even find that after controlling for a general positive trend in trade, "the euro's impact on trade disappears".

Concerning the forest sector, there are few studies of the effect of monetary unions on the trade of wood and wood products. An exception is Baldwin et al. (2005), which report results for the effect of the introduction of the euro on the bilateral trade of commodities in the standard international trade classification (SITC) groups 20 and 21–22. For SITC 20 (wood and products of wood and cork) they estimate that the 95% confidence interval of the euro effect on bilateral trade is 9–230% and 3–148% for SITC 21–22, with large differences depending on model specification. One purpose of the present study was to try to reduce this range of uncertainty.

Fig. 1 shows that the total exports of the forest products considered here originating from the Euro-12 countries increased more than 15 times, from US$ 4468×10^6 to US$ $68{,}732 \times 10^6$ between 1988 and 2008. But they then declined by nearly 20% to reach US$ $55{,}752 \times 10^6$ in 2013, due to the post 2008 general economic recession. The paper and paperboard commodities (HS48) held the largest share of exports throughout the period, and the share increased from 55% in 1998 to 62% in 2013. Contemporaneously, the share of wood and articles of wood (HS 44) increased only slightly, from 20% to 27%, while the share of pulp (HS 47) decreased by 5 percentage points.

The objective of this paper was to determine how much of these changes, if any, could be attributed to the introduction of the euro. The paper is organized as follows. The following section presents the theoretical model (a differential gravity equation), the estimation methods (OLS, and fixed effects), and the panel data used in the analysis (12 countries, three product categories, and 26 years). This is followed by the results in terms of the effects of the euro on the bilateral trade between countries of each commodity group, as well as the effects on individual country exports. The conclusion argues that the evidence did support the hypothesis of a positive effect of the euro on the trade of forest products.

Materials and methods

Gravity equation

The gravity equation is one of the main models used to investigate the effect of currency unions on trade (Rose, 2000; Frankel and Rose, 2002; Berger and Nitsch, 2008; Glick and Rose, 2002). Several different theories of trade lead to an equation for trade flows analogous to Newton's gravitational law (Anderson, 1979; Feenstra et al., 2001; Anderson and van Wincoop, 2003). The gravitation equation states that the trade flow between countries depends on the size of the economy of the two countries, and on a host of other factors that may influence the trade. The equation has been applied to macroeconomic issues dealing with aggregate trade flows, as well as to sub sectors such as agricultural commodities (Peterson et al., 2013). The general form of the gravity equation used here was:

$$X_{ijt} = f(Y_{it}, Y_{jt}, T_{ij}, E_{ijt}, t, u_{ijt}) \tag{1}$$

where X_{ijt} referred to exports of a particular forest product from country i to country j in year t. Y_{it} was the GDP of the exporter and Y_{jt} was the GDP of the importer. T_{ij} were time-invariant characteristics of countries i and j that affected trade, such as distance between countries, length of common borders, common language, etc. E_{ijt} referred to the use of the euro in country i and j in year t; all the countries used in the analysis started using the euro as a physical currency simultaneously in 2002. The year t itself was included to account for time-related changes in trade independent of Y_{it}, Y_{jt}, and E_{ijt}. The idiosyncratic error, u_{ijt}, was the unexplained remaining variation over trade flows, ij, and time, t.

Rather than following most previous studies and seeking necessarily imperfect and incomplete proxies of the time-invariant variables, T_{ij}, here the model (1) was formulated in differential form, thus eliminating the unobserved effects, T_{ij}, the differences between countries that remain constant over time (Wooldridge, 2002, p. 279). In addition, differencing is essential to avoid spurious correlation in trended data. The trade series have a strong positive trend (Fig. 1), and the GDP of importers and exporters have also a positive trend. Consequently, regressions with such trended non-stationary data would lead to spurious results (Verbeek, 2008, p. 327). Thus, the empirical model was:

$$\ln X_{ijt} - \ln X_{ijt-1} = \beta(\ln Y_{it} - \ln Y_{it-1}) + \gamma(\ln Y_{jt} - \ln Y_{jt-1}) + \lambda E_{ijt} + \mu + u_{ijt} \tag{2}$$

Or, identically:

$$\Delta \ln X_{ijt} = \beta \Delta \ln Y_{it} + \gamma \Delta \ln \quad Y_{jt} + \lambda E_{ijt} + \mu + u_{ijt} \tag{3}$$

where ln was the natural logarithm of a variable, and β to μ were parameters to be estimated from the data. With all variables expressed in logarithms, and t in years, the dependent variable was the annual rate of growth of exports from i to j, β was the elasticity of the bilateral trade with respect to the GDP of the exporting country, and γ the elasticity of bilateral trade with respect to the importing country. Both β and γ were expected to be positive and near unity (Anderson and van Wincoop, 2003). E_{ijt} was a dummy variable with value 0 before the introduction of the euro, and 1 afterwards. Thus, λ was the change in annual growth rate of the exports from country i to j due to the introduction of the euro.

Although time-varying fixed effects (one dummy variable for each year of data) are also added in some gravity models (e.g. Baltagi et al., 2003; Baier and Bergstrand, 2007), this was not done here as it precluded the possibility of measuring the effect of the introduction of the euro, due to the near perfect correlation of the intervention variable, E_{ijt}, with the yearly dummies (R^2 = 1.0000), which even rendered the GDP variables insignificant and of wrong theoretical sign. Frankel (2006) warns about the overuse of dummy variables as they reduce the ability to measure the effect of the variables of interest. Here instead, given the differential form of the model, the constant parameter μ represented the remaining rate of growth of exports from i to j explained by variables other than Y_{it}, Y_{jt}, and E_{ijt}.

A more disaggregated version of model (3) was then used to investigate to what extent the effect of the euro varied across exporting countries. For example, by how much were exports originating specifically from France, or Germany affected by the introduction of the euro? The new equation was:

$$\Delta \ln X_{ijt} = \beta \Delta \ln Y_{it} + \gamma \Delta \ln Y_{jt} + \sum_{i}^{12} \lambda_i C_i E_{ijt} + \mu + u_{ijt} \quad (4)$$

where C_i was a dummy variable taking the value 1 for exporting country i and 0 otherwise. Thus the product $C_i E_{ijt}$ took the value 1 for exporting country i in a euro year, and 0 otherwise. There were 12 countries in the data set. Each parameter λ_i measured the change in growth rate of exports from country i due to the utilization of the euro in all countries considered.

Estimation methods

Eqs. (3) and (4) were estimated with panel data from multiple countries and years. Each observation was the export of a particular forest product between a country pair (ij) in a given year, t. To assess the robustness of the results, two estimation methods were used: ordinary least squares (OLS), and fixed effects (FE). Each one made different assumptions regarding the form of the residuals, u_{ijt}.

Ordinary least squares assumed that u_{ijt} was identically distributed, independently of the explanatory variables, with 0 mean and constant variance across trade flows, ij, and years, t. The fixed-effects approach assumed $u_{ijt} = a_{ij} + \varepsilon_{ijt}$ where a_{ij} was a constant for each trade flow, ij. Thus, each a_{ij} measured the difference in growth rate of exports for a particular country pair due to other variables than those explicitly in the model. The residual ε_{ijt} was identically distributed, independently of the explanatory variables with 0 mean and constant variance across trade flows, ij, and years, t. In the present context the countries being observed were not a random sample from a larger population, thus the OLS or fixed effects approach seemed "more convincing than the random effects model for policy analysis with aggregate data" (Wooldridge, 2006, p. 498), indeed random effects models are seldom used in gravity studies (Baier and Bergstrand, 2007).

The OLS, and FE methods were applied with robust estimation of the standard errors to account for possible heteroscedasticity or within-group correlation (Stata, 2011, p. 459). For each method, this has no effect on the coefficients and it changed their standard errors only slightly in the present context.

Comparing the two methods is helpful in assessing the robustness of the results, as they can be substantially different (e.g. Simangunsong and Buongiorno, 2001). To test the validity of the assumptions, the parameters of models (3) and (4) estimated by FE were compared to those estimated by OLS with a Hausman (1978) test, under the null hypothesis that they were the same. Rejection of the null suggested that the OLS model was incomplete, and the FE was superior (Wooldridge, 2006, p. 498).

Data

The data were collected for 12 countries: Austria, Belgium, Finland, France, Germany, Italy, Luxembourg, Netherlands, Portugal, Ireland, and Greece. These countries had all adopted the euro by January 1, 2002, when it was first introduced as a physical circulating currency (Berger and Nitsch, 2008). Annual export data from each reporting country to each partner country were obtained for the years 1988 to 2013 from the UN comtrade data base (United Nations, 2014), for three commodity groups with the following harmonized system (HS) codes:

HS44: Wood and articles of wood, wood charcoal,
HS47: Pulp of wood, fibrous cellulosic material, waste, etc.,
HS48: Paper & paperboard, articles of pulp, paper and board,
HS44 + 47 + 48: Sum of the above.

Each group contents are further detailed in United Nations (2014). The data were in current United States dollars. They were converted in constant US dollars of 2013 with the United States implicit GDP price deflator (United States Bureau of Economic Analysis, 2014).

Table 1
Summary statistics used in the panel data analysis.

Variable	Mean	Std. dev.	Min	Max	Observations
Exports HS44 (million 2013 US$)					
Overall	109.0	226.0	0.0	2210.0	$N = 2645$
Between		218.0			$n = 132$
Within		67.9			$\overline{T} = 20.0$
Exports HS47 (million 2013 US$)					
Overall	43.3	77.3	0.0	669.0	$N = 2084$
Between		63.8			$n = 125$
Within		34.6			$\overline{T} = 16.7$
Exports HS48 (million 2013 US$)					
Overall	273.0	481.0	0.0	3470.0	$N = 2673$
Between		465.0			$n = 132$
Within		106.0			$\overline{T} = 20.3$
Exports HS44 + 47 + 48 (million 2013 US$)					
Overall	530.0	768.0	0.1	4720.0	$N = 2082$
Between		705.0			$n = 123$
Within		193.0			$\overline{T} = 16.9$
GDP (million 2005 US$)					
Overall	759,013	833,107	16,711	3,087,139	$N = 3432$
Between		824,935			$n = 132$
Within		136,044			$T = 26$
Euro					
Overall	0.46	0.499	0	1	$N = 3432$
Between		0.000			$n = 132$
Within		0.499			$T = 26$

Notes: HS44 = wood and articles of wood; HS47 = pulp of wood, fibrous cellulosic material, waste etc.; HS48 = paper and paperboard, articles of pulp.
N = total number of observations.
n = number of exporter-importer groups.
T or $\overline{T}$ = number of yearly observations within group, or average number over all groups when some data are missing.

The annual data on the gross domestic product of each country, in constant US dollars, from 1988 to 2013 were obtained from the World Bank development indicators data base (World Bank, 2014). Last, the annual dummy variable marking the onset of the European Monetary Union for the concerned countries was set to 0 prior to 2002 and 1 thereafter (Berger and Nitsch, 2008).

The data summary statistics are in Table 1. In the absence of missing data there were 3492 potential observations (N) for 12 exporting countries and 11 partner countries leading to a maximum of 132 exporter–importer pairs (n), and 26 years (T) ranging from 1988 to 2013. However, commodity group HS47, pulp of wood and fibrous material, had only 2084 observations, for annual average exports that were half to a fifth of those for HS44 and HS48. As indicated by the standard deviations, there was much more variability in the export and GDP data between country pairs than within country pairs and over time. The trade data obtained from United Nations (2014) were time series of continuously positive trade data. There was no case of zero trade within the data set. Thus, the measured impact of the euro reported below was for countries that traded continuously during the period of observation.

Results

Overall effects of the euro

Table 2 shows the results of estimation of model (3) by ordinary least squares and fixed effects, with a euro effect assumed to vary by commodity group, but to be the same across countries. The Hausman χ^2 tests showed no statistically significant difference (at up to 10% level) between the OLS

Table 2
Estimates of gravity model of forest product trade between euro countries, assuming the same euro effect across country pairs, with different methods.

Product	Variables	OLS			FE		
		Coef.	Std. err.		Coef.	Std. err.	
HS44 + 47 + 48							
	$\Delta\ln(Y_i)$	1.282	0.344	***	1.397	0.426	***
	$\Delta\ln(Y_j)$	1.944	0.288	***	2.043	0.339	***
	Euro	0.065	0.013	***	0.068	0.013	***
	Constant	−0.084	0.014	***	−0.089	0.014	***
	Hausman	$\chi^2(3) = 6.21$					
HS44							
	$\Delta\ln(Y_i)$	1.710	0.795	**	1.772	0.774	**
	$\Delta\ln(Y_j)$	2.406	0.699	***	2.435	0.747	***
	Euro	0.138	0.031	***	0.148	0.033	***
	Constant	−0.142	0.029	***	−0.150	0.026	***
	Hausman	$\chi^2(3) = 0.88$					
HS47							
	$\Delta\ln(Y_i)$	3.183	1.764		4.019	1.423	***
	$\Delta\ln(Y_j)$	2.385	2.092		1.989	1.595	
	Euro	0.175	0.066	***	0.149	0.047	***
	Constant	−0.176	0.064	***	−0.168	0.047	***
	Hausman	$\chi^2(3) = 3.24$					
HS48							
	$\Delta\ln(Y_i)$	1.439	0.574	**	1.239	0.520	**
	$\Delta\ln(Y_j)$	0.807	0.557		1.099	0.399	***
	Euro	0.017	0.026		0.022	0.020	
	Constant	−0.022	0.026		−0.027	0.018	
	Hausman	$\chi^2(3) = 1.65$					

Notes: HS44 = wood and articles of wood; HS47 = pulp of wood, fibrous cellulosic material, waste etc.; HS48 = paper and paperboard, articles of pulp.
OLS, FE = ordinary least squares, and fixed effects estimates.
Y_i, Y_j = GDP of exporting and importing country, respectively.
Euro = dummy variable, 0 before 2002, 1 thereafter.
Hausman = test of equality of coefficients in OLS and FE estimation.
***, **, * indicate coefficients statistically different from 0 at the 1%, 5% and 10% level, respectively.

and FE coefficients. More attention is given to the FE results in what follows as they may control for omitted variables. However, the OLS and FE parameters and standard errors were not greatly different, which suggested that the results were robust to specification errors.

Given the objective of this study, the main data in Table 2 were the effects of the euro, assumed to be the same across exporter–importer country pairs in model (3), for a given commodity group. For the total of forest products (HS44 + 47 + 48), the euro increased the average annual growth rate of bilateral trade by 6.8 ± 1.3% according to the FE results. The effect was highly significant statistically (at least at the 1% level), and also significant from an economic point of view. The effect was practically identical with the OLS and FE methods.

For product subgroups, the effect of the euro was significant for HS44 (wood and articles of wood) averaging a 14.8 ± 3.3% increase in growth rate according to the FE method. OLS gave very similar results. There was also a statistically and economically significant effect of the euro on the trade of HS47 (pulp of wood and fibrous cellulosic material), 14.9 ± 4.7% according to the FE results, which was very similar to the effect on HS44. The results differed only slightly with OLS estimation. For HS48 (paper and paperboard), there was no statistically significant effect of the euro on trade at up to the 10% level. Nevertheless, the effect was not economically negligible, at near 2% per year according to both estimation methods.

The other statistics in Table 2 supported the gravity model of forest products trade as the coefficients of the importers and exporters GDP had the expected positive sign. For total trade (HS44 + 47 + 48), the elasticity with respect to the GDP of both importers and exporters was highly significant statistically, above unity, and almost twice as large for the GDP of importers as for that of exporters. There were only minor differences in the GDP elasticities derived with OLS or FE. For HS44 the GDP elasticities were similar to those of the aggregate HS44 + 47 + 48, largely independent of the estimation method, and statistically significant at least at the 5% level. For HS47 trade was very elastic with respect to exporters GDP (4.02 ± 1.4 with FE estimation), and half as much with respect to importers' GDP. For HS48, the GDP elasticities were similar for importers and exporters and not significantly different from unity.

The negative constant terms in all the results in Table 2 indicate that, conditional on the changes of GDP in the importing and exporting countries and on the euro introduction, the bilateral trade of forest products between the countries considered had declined over the period of observation, by 8.9 ± 1.4% per year for the aggregate HS44 + 47 + 48, and by as much as 16.8 ± 4.7% per year for HS47 alone according to the FE results. The decline was only slightly less for HS44, and much less and not statistically significant for HS48 (2.7 ± 1.8%). Thus, the general positive effect of the euro observed in Table 2 was to lessen the effect of these negative trends.

Effects by exporting country

The estimates of model (4), which allowed different effects of the euro by exporting country are in Table 3 for total forest products trade and in Tables 4–6 for its components.

Total forest products (HS44 + 47 + 48)

As shown in Table 3 the euro had a positive effect on exports of total forest products in most countries, regardless of estimation method. The only exception was that with FE the effect on Luxembourg was negative, but not statistically significant. The hypothesis that the euro effect was

Table 3
Estimates of gravity model of total forest products trade (HS44 + 47 + 48) between euro countries, allowing for different euro effects by exporting country, with different methods.

	OLS			FE		
Variable	Coef.	Std. err.		Coef.	Std. err.	
$\Delta\ln(Y_i)$	1.409	0.344	***	1.566	0.450	***
$\Delta\ln(Y_j)$	1.883	0.287	***	1.965	0.342	***
euro.Austria	0.059	0.019	***	0.062	0.015	***
euro.Belgium	0.066	0.022	***	0.178	0.075	**
euro.Finland	0.021	0.020		0.028	0.013	**
euro.France	0.045	0.015	***	0.077	0.021	***
euro.Germany	0.076	0.016	***	0.052	0.013	***
euro.Italy	0.167	0.061	***	0.351	0.116	***
euro.Luxembourg	0.072	0.052		-0.048	0.093	
euro.Netherlands	0.071	0.016	***	0.036	0.016	**
euro.Portugal	0.083	0.023	***	0.241	0.048	***
euro.Ireland	0.076	0.022	***	0.058	0.022	***
euro.Spain	0.070	0.048		0.129	0.039	***
euro.Greece	0.072	0.026	***	0.018	0.031	
Constant	−0.086	0.014	***	−0.101	0.015	***
Hausman	$\chi^2(14) = 33.46$***					
Equality	$F(112,486) = 1.60$*			$F(11,131) = 3.98$***		

Notes: HS44 = wood and articles of wood; HS47 = pulp of wood, fibrous cellulosic material, waste etc.; HS48 = paper and paperboard, articles of pulp.
OLS, FE =ordinary least squares, and fixed-effects estimates.
Y_i, Y_j = GDP of exporting and importing country, respectively.
Euro = dummy variable, 0 before 2002, 1 thereafter.
Hausman = test of equality of coefficients in OLS and FE estimation.
Equality = test of equality of the euro effect across exporting countries.
***, **, * indicate coefficients statistically different from 0 at the 1%, 5% and 10% level, respectively.

Table 4
Estimates of gravity model of the trade of wood and articles of wood (HS44) between euro countries, allowing for different euro effects by exporting country, with different methods.

	OLS			FE		
Variable	Coef.	Std. err.		Coef.	Std. err.	
$\Delta\ln(Y_i)$	2.213	0.863	***	2.361	0.792	***
$\Delta\ln(Y_j)$	2.127	0.729	***	2.033	0.740	***
euro.Austria	0.133	0.034	***	−0.026	0.067	
euro.Belgium	0.120	0.030	***	0.138	0.034	***
euro.Finland	0.076	0.041	*	0.011	0.025	
euro.France	0.074	0.036	**	0.059	0.053	
euro.Germany	0.133	0.030	***	0.070	0.025	***
euro.Italy	0.461	0.134	***	0.897	0.132	***
euro.Luxembourg	0.101	0.086		0.219	0.133	
euro.Netherlands	0.097	0.034	***	0.029	0.036	
euro.Portugal	0.088	0.099		0.222	0.135	
euro.Ireland	0.176	0.040	***	0.127	0.033	***
euro.Spain	0.138	0.062	**	0.099	0.075	
euro.Greece	0.126	0.039	***	0.049	0.034	
Constant	−0.149	0.030	***	−0.158	0.022	***
Hausman	$\chi^2(14) = 42.61^{***}$					
Equality	$F(11,2486) = 1.67^{*}$			$F(11,131) = 5.69^{***}$		

Notes: HS44 = wood and articles of wood; HS47 = pulp of wood, fibrous cellulosic material, waste etc.; HS48 = paper and paperboard, articles of pulp.
OLS, FE =ordinary least squares, and fixed effects.
Y_i, Y_j = GDP of exporting and importing country, respectively.
Euro = dummy variable, 0 before 2002, 1 thereafter.
Hausman= test of equality of coefficients in OLS and FE estimation.
Equality = test of equality of the euro effect across exporting countries.
***, **,* indicate coefficients statistically different from 0 at the 1%, 5% and 10% level, respectively.

Table 5
Estimates of gravity model of the trade of pulp of wood and fibrous cellulosic material (HS47) between euro countries, allowing for different euro effects by exporting country, with different methods.

	OLS			FE		
Variable	Coef.	Std. err.		Coef.	Std. err.	
$\Delta\ln(Y_i)$	3.468	1.987	*	4.284	1.511	***
$\Delta\ln(Y_j)$	2.231	2.170		1.782	1.644	
euro.Austria	0.166	0.180		−0.088	0.113	
euro.Belgium	0.135	0.169		0.075	0.108	
euro.Finland	0.181	0.090	**	0.249	0.064	***
euro.France	0.157	0.091	*	0.365	0.111	***
euro.Germany	0.204	0.076	***	0.107	0.046	**
euro.Italy	0.257	0.547		−0.362	0.248	
euro.Luxembourg	0.445	0.185	**	0.634	0.596	
euro.Netherlands	0.296	0.103	***	0.090	0.168	
euro.Portugal	0.172	0.086	**	−0.040	0.186	
euro.Ireland	0.149	0.141		0.062	0.115	
euro.Spain	0.157	0.172		0.299	0.133	**
euro.Greece	0.013	0.196		0.093	0.116	
Constant	−0.180	0.065	***	−0.160	0.050	***
Hausman	χ^2 (14) = 12.01					
Equality	$F(11,2486) = 0.47$			$F(11,131) = 2.00^{**}$		

Notes: HS44 = wood and articles of wood; HS47 = pulp of wood, fibrous cellulosic material, waste etc.; HS48 = paper and paperboard, articles of pulp.
OLS, FE =ordinary least squares, and fixed-effects estimates.
Y_i, Y_j = GDP of exporting and importing country, respectively.
Euro = dummy variable, 0 before 2002, 1 thereafter.
Hausman = test of equality of coefficients in OLS and FE estimation.
Equality = test of equality of the euro effect across exporting countries.
***, **, * indicate coefficients statistically different from 0 at the 1%, 5% and 10% level, respectively.

Table 6
Estimates of gravity model of the trade of paper and paperboard (HS48) between euro countries, allowing for different euro effects by exporting country, with different methods.

Variable	OLS Coef.	OLS Std. err.		FE Coef.	FE Std. err.	
$\Delta\ln(Y_i)$	1.492	0.643	**	1.211	0.576	**
$\Delta\ln(Y_j)$	0.779	0.569		1.121	0.426	***
euro.Austria	0.003	0.027		0.003	0.021	
euro.Belgium	−0.006	0.028		0.145	0.053	***
euro.Finland	−0.070	0.034	**	−0.037	0.027	
euro.France	−0.012	0.024		0.040	0.022	*
euro.Germany	0.017	0.025		0.022	0.013	
euro.Italy	0.100	0.094		0.002	0.124	
euro.Luxembourg	0.011	0.094		0.082	0.062	
euro.Netherlands	0.032	0.027		0.010	0.017	
euro.Portugal	0.024	0.033		−0.018	0.107	
euro.Ireland	0.020	0.032		0.041	0.014	***
euro.Spain	0.061	0.053		0.020	0.064	
euro.Greece	0.037	0.032		0.014	0.023	
Constant	−0.023	0.026		−0.030	0.019	
Hausman	$\chi^2(14) = 9.6$					
Equality	$F(11,2516) = 2.1^{**}$			$F(11,131) = 1.7^{*}$		

Notes: HS44 = wood and articles of wood; HS47 = pulp of wood, fibrous cellulosic material, waste etc.; HS48 = paper and paperboard, articles of pulp.
OLS, FE = ordinary least squares, and fixed-effects estimates.
Y_i, Y_j = GDP of exporting and importing country, respectively.
Euro = dummy variable, 0 before 2002, 1 thereafter.
Hausman = test of equality of coefficients in OLS and FE estimation.
Equality = test of equality of the euro effect across exporting countries.
***, **, * indicate coefficients statistically different from 0 at the 1%, 5% and 10% level, respectively.

the same for all exporting countries was rejected, at least at the 10% level, with both methods (Table 3, last line).

The Hausman test rejected the hypothesis that the coefficients were the same with OLS and FE, suggesting that the OLS estimates were inconsistent due to the omission of the exporter–importer constant effect, a_{ij}, assumed with FE (Wooldridge, 2006, p. 498). This result tended to favor the FE estimates. With FE the euro had a positive and statistically significant effect for all countries except Luxembourg and Greece, although for the Greece the effect was also positive. Of the statistically significant effects, at the 5% level at least, the largest was for Italy (35 ± 12%) and the smallest for Finland (2.8 ± 1.3%).

The elasticities of bilateral trade with respect to GDP were similar with the two estimation methods, and highly significant. Trade flows were elastic with respect to the GDPs of both importers and exporters, and more so with respect to the importers' GDP.

Wood and articles of wood (HS44)

For the subgroup HS44 the euro had a positive effect on exports of all 12 countries with both estimation methods (Table 4). For both methods the F test indicated that the effect of the euro was statistically different across exporting countries. The Hausman tests implied a statistically significant difference between parameters estimated by FE and those estimates by OLS, thus favoring the FE estimates for the reasons indicated above. With the FE method the largest and statistically significant effect was for Italy (89.7 ± 13.2%) and the smallest was for Finland (1.1%, not statistically significant).

The trade elasticities with GDP obtained with both methods were similar, near 2.0 for both importers and exporters, and statistically highly significant (at 1% level at least). The constant terms were also very similar with both methods, suggesting a decrease in bilateral trade of near 16 ± 2% with FE, other things being held constant.

Pulp of wood and fibrous cellulosic material (HS47)

In the case of HS47 (Table 5), according to the Hausman test there was no statistically significant difference (up to 10% level) between the coefficients obtained with FE and those with OLS. There was therefore no strong reason to prefer one set of estimates, except that the OLS results were in principle more efficient due to the increase in degrees of freedom brought about by the omission of the a_{ij} constants used in FE.

With OLS, all the euro effects were positive in all countries. The largest effect was for Luxembourg (44.5 ± 18.5%, significant at the 5% level) and the smallest for Greece (1.3%, not statistically significant). However, the hypothesis that the euro effect was the same across countries could not be rejected with OLS, suggesting that the cross country averages in Table 2 were the most efficient for this commodity group.

The GDP elasticities were positive for both exporters and importers, but not significantly so, statistically, for the importers. On the other hand, the trade of HS47 with respect to the exporters' GDP was very elastic (4.3 ± 1.5 with FE). In parallel with commodity group HS44, there was a strong decrease in the annual growth rate of exports of HS47 reflected by the constants in Table 5, estimated at −16% to −18% and highly significant, statistically.

Paper and paperboard (HS48)

For paper and paperboard (Table 6) as for pulp, there was no statistically significant difference between the parameters estimated with FE and those estimated with OLS, based on the Hausman test. There was therefore no strong reason to prefer one set of estimates, except for some possible efficiency gains with OLS compared to FE. The two methods resulted in statistically significant differences in the euro effect across countries. The OLS gave positive effects of the euro on exports from 9 of the 12 countries, and a statistically significant negative effect for Finland, but this effect, still negative, was not statistically significant with the FE method. The elasticities of bilateral trade with respect to GDP were smaller than those obtained for HS44 and HS47, and not statistically different from unity for both importers and exporters.

Summary and conclusion

The objective of this study was to determine if the establishment of a monetary union within European countries had affected the international trade of forest products between them. The theory used a gravity model of bilateral trade whereby the trade was determined by the GDP of the exporter and importer, other characteristics of the countries, and the introduction of the euro. The model was formulated in differential form to avoid time-invariant country specific effects. Estimation was carried with panel data from 12 countries observed from 1988 to 2013, for annual bilateral trade of commodity groups HS44 (wood and articles of wood), HS47 (pulp of wood, fibrous cellulosic material, waste, etc.), HS48 (paper and paperboard), and their aggregate HS44 + 47 + 48. The statistical analysis was done with OLS and fixed-effects estimation methods, first with all the countries pooled and then by differentiating the euro effect across countries.

Most of the results suggested a positive or neutral effect of the euro on trade, for all products and countries, regardless of estimation method. The results with the pooled country data suggested that the introduction of the euro had increased the average annual rate of growth of bilateral trade of total forest products by 6.5 ± 1.3%. The effect of the euro was largest and similar for wood products (HS44) and pulp products (HS47), a near 15 ± 0.05% increase in annual growth rate. The smallest effect was on the trade of paper and paperboard (HS48), a 2% increase not statistically significant.

The implications of these effects for the period when the euro circulated as a physical currency are shown in Fig. 2. The figure shows the evolution of actual exports of HS44, HS47, and HS48 from the 12 countries considered, between 2002 and 2013, together with the predictions of what would have happened without the euro. The predictions were obtained by reducing the observed annual rates of growth of each commodity by the annual impacts of the euro reported in Table 2.

The results in Fig. 2 suggested that by 2013, twelve years after the physical introduction of the euro, the exports of forest commodities (HS44 + 47 + 48) from the 12 countries were 76% higher than they would have been without the euro. Although this number seemed large, it was within the 95%

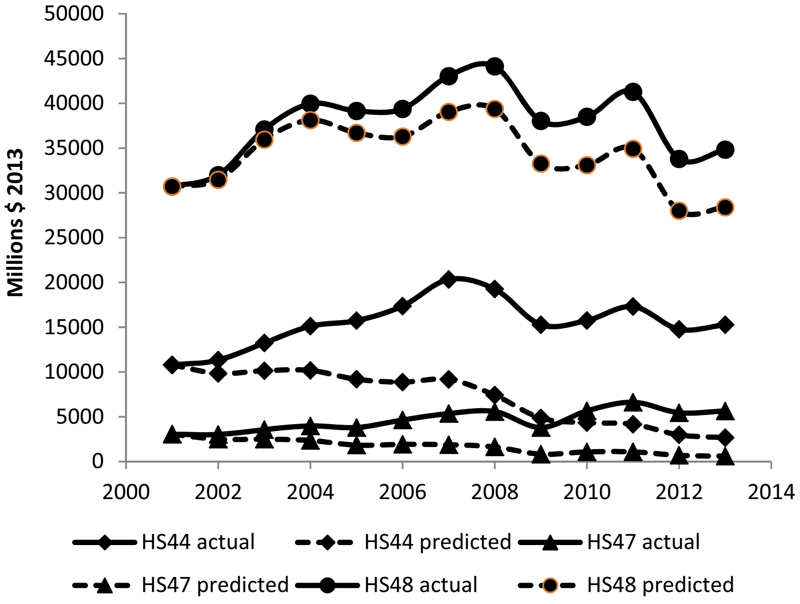

Fig. 2. Actual value of exports and predicted value without the euro from 2001 to 2013 originating from 12 euro countries (Austria, Belgium, Finland, France, Germany, Italy, Luxembourg, Netherlands, Portugal, Ireland, Spain, Greece), in constant US$ of 2013, by commodity group: HS44 = Wood and articles of wood, wood charcoal. HS47 = Pulp of wood, fibrous cellulosic material, waste, etc., HS48 = Paper & paperboard, articles of pulp, paper and board.

confidence interval of the estimated effects of the euro obtained by Baldwin et al. (2005), which ranged from 9% to 230% for SITC 20 (wood and products of wood), and from 3% to 148% for SITC 20–22 (pulp, paper & products, printing & publishing).

Given the intermediate nature of the commodities investigated, it would be worthwhile to further develop the gravity model to describe more precisely how the trade derives from the demand for end products. Meanwhile, the present findings confirmed a statistically and economically significant impact of the euro on the trade of forest products between euro countries. This result should be of interest to students and decision makers in the forest sector, both for historical and political relevance as monetary unions may expand or contract within the current euro zone and in other countries.

Acknowledgments

The research leading to this paper was supported in part by a joint venture agreement with the USDA Forest Service Southern Station in cooperation with project leader Jeff Prestemon.

References

Anderson, J., 1979. A theoretical foundation for the gravity equation. Am. Econ. Rev. 69, 106–116.
Anderson, J., van Wincoop, E., 2003. Gravity with gravitas: a solution to the border puzzle. Am. Econ. Rev. 93, 170–192.
Baldwin, R., Skudelny, F., Taglioni, D., 2005. Trade effects of the euro evidence from sectoral data. European Central Bank working paper series # 446, 53 p. Available from: http://ssrn.com/abstract_id=668246 (accessed January 2015).
Baier, S.L., Bergstrand, J.H., 2007. Do free trade agreements actually increase members' international trade? J. Int. Econ. 71, 72–95.
Baltagi, B.H., Egger, P., Pfaffermayr, M., 2003. A generalized design for bilateral trade flow models. Econ. Lett. 80, 391–397.
Berger, H., Nitsch, V., 2008. Zooming out: the trade effect of the euro in historical perspective. J. Int. Money Finance 27, 1244–1260.
Feenstra, R., Markusen, J., Rose, A., 2001. Using the gravity equation to differentiate among alternative theories of trade. Can. J. Econ. 34, 430–447.
Frankel, J.A.,2006. Comments on Richard Baldwin's, The Euro's trade effects. In: Proceedings of June 2005 workshop on what effects is EMU having on the euro area and its member countries? Working paper series No 594. European Central Bank, Frankfurt.
Frankel, J.A., 2008. The estimated effects of the euro on trade: why are they below historical effects of monetary unions among smaller countries? NBER working paper 14542, Available at: http://www.nber.org/papers/w14542 (accessed February 2015).
Frankel, J.A., Rose, A., 2002. An estimate of the effects of common currencies on trade and income. Quart. J. Econ. 117, 409–466.

Glick, R., Rose, A.K., 2002. Does a currency union affect trade? The time-series evidence. Eur. Econ. Rev. 46, 1125–1151.
Hausman, J.A., 1978. Specification tests in econometrics. Econometrica 46, 1251–1271.
Mundell, R., 1961. A theory of optimum currency areas. Am. Econ. Rev. 51, 657–665.
Peterson, E., Grant, J., Roberts, D., Karov, V., 2013. Evaluating the trade restrictiveness of phytosanitary measures on U.S. fresh fruit and vegetable imports. Am. J. Agric. Econ. 95 (4), 842–858.
Rose, A., 2000. Estimating the effect of common currency on trade. Econ. Policy 15, 7–46.
Simangunsong, B.C.H., Buongiorno, J., 2001. International demand equations for forest products: a comparison of methods. Scand. J. Forest Res. 16, 155–172.
Stata, 2011. Stata Longitudinal-Data/Panel-Data Reference Manual, release 12. StatCorp LP, College Station, pp. 570.
United Nations, 2014. UN comtrade data base. United Nations, Department of Economic and Social Affairs, Statistics Division, Trade Statistics, Available from: http://comtrade.un.org/data/ (accessed November 2014).
United States Bureau of Economic Analysis, 2014. United States Bureau of Economic Analysis. Gross domestic product (implicit price deflator), Available from: http://research.stlouisfed.org/fred2/series/A191RD3A086NBEA/downloaddata (accessed November 2014).
Verbeek, M., 2008. A Guide to Modern Econometrics, 3rd ed. Wiley, San Francisco, CA, pp. 472p.
Wooldridge, J.M., 2002. Econometric Analysis of Cross Section and Panel Data. The MIT Press, Cambridge, pp. 752.
Wooldridge, J.M., 2006. Introduction to Econometrics: A Modern Approach. Thomson, OH, pp. 890.
World Bank, 2014. World Bank development indicators data base. http://databank.worldbank.org/data/views/variableSelection/selectvariables.aspx?source=world-development-indicators (accessed November 2014).