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Economic globalization, trade and forest transition-the case of nine Asian countries☆

Lingchao Li [a,b], Jinlong Liu [a,*], Hexing Long [a], Wil de Jong [c], Yeo-Chang Youn [d]

[a] Centre of Forestry, Environmental and Resources Policy, Renmin University of China, Beijing 100872, China
[b] School of Economics and Management, Beijing Forestry University, Beijing 100083, China
[c] Center for Integrated Area Studies, Kyoto University, Kyoto 606-8501, Japan
[d] Department of Forest Sciences, Seoul National University, 151-921 Seoul, Republic of Korea

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ABSTRACT

Previous studies have mostly focused on the links between the variability of trade of primary sector products and forest transition. This study more widely discusses the effects of economic globalization on forest transition, and explores the links between trade, adjustment of trade structure, FDI and forest transition in nine Asian countries. The study also expands the scope of forest transition study and integrates the analysis of both forest quantity and quality change in forest transition research. The result suggests that the proportion of forestry products in total exports has significantly negative effects on forest area, forest volume and forest density, while the total export value has positive effects on forest area and forest density. It indicates that one country or region may improve forest resources condition through upgrading the export structure by absorbing FDI in manufacturing and service sectors to develop export-oriented manufacturing and service industries. This study demonstrates the need to introduce forest quality analysis in forest transition study. It also indicates that when exploring the relationship between economic globalization and forest transition, one should consider the overall situations how one country participates in economic globalization and the development and adjustment of its industries in the process of economic integration.

1. Introduction

Deforestation is directly caused by agricultural expansion, destructive logging, infrastructure development, and forest fires. These direct causes have been in turn influenced by population growth, economic development and policies. The global deforestation debate of the 1980s and the 1990s was complemented with a forest transition debate. Forest transition was, a concept first presented by Mather in 1992 (Mather, 1992) and it signals the beginning of documentation of drivers that could reverse the deforestation trend.

Forest transition refers to a process of forest area decline followed by forest are increase over time. Initially analysts suggested two main drivers: economic development and creation of non-agricultural jobs and forest product scarcity (e.g. Rudel et al., 2005). A focus on non-European and US cases of forest transition suggested the need to broaden the possible drivers that cause forest transition (Lambin and Meyfroidt, 2010; Mather, 2007; Perz and Skole, 2003). Drivers of forest transition equally may vary across different countries and regions, and may also vary in different stages of a country's or region economic development. Factors that possibly could explain forest transition include: agricultural intensification, rural–urban migration, changes of perceptions of resource values, timber and other wood product prices, policy interventions and institutional development (Foster and Rosenzweig, 2003; Mather, 2007; Mather et al., 1999). The relative importance of factors to explain forest transition has varied over time.

As a result, the forest transition academic debate has seen two phases of theoretical development: the deforestation Environmental Kuznets Curve phase (Barbier et al., 2010; Kauppi et al., 2006; Koop and Tole, 1999; Rudel, 1998; Shafik, 1994) and the forest transition pathway phase (Lambin and Meyfroidt, 2010; Rudel et al., 2005). The deforestation Environmental Kuznets Curve studies focus on the relationship between economic growth and forest transition, while forest transition pathway studies explore the common mechanisms across countries or regions from socio-ecological perspective and formulate five forest transition pathways, which are forest scarcity, state forest policy, economic development, globalization and smallholder tree-based land intensification.

Since the last few decades, international trade has expanded rapidly, importantly because of the liberalization of foreign investments. This economic globalization had a huge impact on politics, economies, society, and culture, and it also had a profound influence on the utilization and conservation of natural resources including forests (Jorgenson, 2008; Klooster, 2003; Mills Busa, 2013). Economic globalization can also be linked to factors that cause deforestation directly or indirectly,

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* Corresponding author.
E-mail address: liujinlong@ruc.edu.cn (J. Liu).

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but also to factors that cause forest transition (Meyfroidt et al., 2010; Yiridoe and Nanang, 2001; Zoomers, 2010). The increased complexity of international trade and investment, however, made it harder to understand the entanglement of forces that are responsible for the dynamics of forest cover change.

Some attention has been given to how globalization impacts reforestation and forest rehabilitation patterns. Studies zoomed in on the effects on forest cover on trade in agricultural and forestry products (Meyfroidt et al., 2010), remittances (Hecht et al., 2006), emigration (Klooster, 2003), and tourism (Kull et al., 2007). An important related effect is the replacement or leakage of deforestation, when the reduction of deforestation in one country or region increases the pressure on forests in other places, for instance when forest commodities or agricultural crops produced domestically are sourced from forest or produced on forest land elsewhere (Gan and McCarl, 2007; Lambin and Meyfroidt, 2011; Wittemyer et al., 2008). For example, an analysis of 176 countries suggested that rich countries meet their demand through appropriating resources from countries with lower GDP per capita, while themselves actively promoting forest conservation (Mills Busa, 2013). Another study on seven developing countries that recently experienced forest transition suggests that relocation of forest extraction abroad accompanied local reforestation (Meyfroidt et al., 2010). About 39% of the regrowth of Vietnam's forests from 1987 to 2006 was achieved by the de facto displacement of land use to other countries (Meyfroidt and Lambin, 2009). A country like Ghana is an example of the negative outcome of deforestation leakage, as it exports forest products to countries that manage to reduce pressure on their own forests (Yiridoe and Nanang, 2001). Table 1 shows that the value of trade of forest products increased rapidly especially after the 1980s across Asia and worldwide.

The impact of FDI on forest transition has yet received relatively little academic attention. FDI research has focused on how it contributes directly to economic growth (Borensztein et al., 1998; Markusen and Venables, 1999; Xu, 2000), but also on how it affects endogenous factors that themselves contribute to economic growth (Gao, 2005; Li and Liu, 2005). A study from several years back on 40 less developed countries found that levels of primary sector foreign investment were positively associated with rates of deforestation (Jorgenson, 2008). Recent research also has documented the land grabbing affect of FDI targeting export oriented food and biofuel production (Zoomers, 2010). For example, in Africa over 50 million ha of farmland was affected by such FDIs (Friis and Reenberg, 2011). However, agricultural and forestry products trade and related primary sector FDI only account for a small fraction of total global trade and related investments. FDI in manufacturing and service sectors helps host countries to prompt the development of export-oriented manufacturing and service industries (Hobday,1995; Markusen and Venables, 1999). The structural adjustment and relocation of manufacturing and service industries worldwide should also be considered when exploring the effects of economic globalization on forest resources.

Asia was among the fastest economic growth regions during the last three decades. But Asian countries show huge differences in economic growth patterns and trends in forest resource conditions. For example, Japan and South Korea achieved industrialization of their economies before 1980s and their forest areas remained at high percentages of total land areas throughout this period. China benefitted from globalization at a later stage and absorbed large amounts of FDI, as a result of which it was possible to introduce advanced technology to transform and upgrade domestic manufacturing and services industries. Export-oriented economic development was a great success and lead to broad economic growth in China. Almost simultaneously, the trend of deforestation in China reversed and the country's total forest area increased rapidly. Similar accounts can be given for India and Vietnam, although the scale of FDI and exports were smaller compared to China. Other developing countries in the region such as Indonesia and Malaysia also progressively joined global markets, but with a fluctuating inflow of FDI. Their exports of primary products remained high or declined slowly. Related to that, forest areas have continued to decline in Indonesia and Malaysia in the last three decades.

Table 1
Trend in the value of trade of forest products [billion US$].

Year	The world	Asia	
	Export/import value	Export value	Import value
1961	5.16	0.39	0.62
1980	56.65	7.19	16.55
2000	144.85	17.79	43.32
2012	231.25	38.98	92.39

Data source: FAOSTAT.

While most studies on forest transition mainly focus on forest cover dynamics (Mather, 2007; Rudel et al., 2005), we introduce forest quality analysis in this study as supplementary to traditional forest transition research, which only focuses on forest cover change. We try to expand on forest transition dimensions and integrate forest quantity and quality analysis in one study. We assume that the drivers to forest quantity and quality transitions could be quite different and that a forest quality analysis can be meaningful to understand forest transition in addition to forest quantity.

In this paper we undertake a comparative study in nine Asian countries to explore the links between economic integration, trade and forest transition. We especially try to identify how international trade and adjustment of trade structure which is associated with the expansion of FDI affect forest transition. We hope hereby to provide a new theoretical explanation of the forest transition globalization pathway from the perspective of international trade, and consider other drivers than the deforestation leakage dimension as the last one focuses only on the trade of primary products. This paper will thus expand the scope of forest transition studies by integrating the analysis of forest quantity and quality changes to better understand the drivers and implications of forest transition.

2. Data and model specification

In this paper we compare nine countries, including China, India, Japan, South Korea, and Vietnam that have already realized forest transition, and Indonesia, Laos, and Malaysia that were at the moment of comparison still reported to experience net forest cover loss. The last country, the Philippines is in an early stage of forest transition. The variety of forest change dynamics in the nine Asian countries and of factors like economic development phases, of trade volumes and structures, of FDI inflows, offer the opportunity to gain insights into the influence of these factors on the forest transition globalization pathway. The other reason we choose these countries is that the authors participated in a collaborative research funded by APFNet on forest transition with scholars from the nine countries. We explore how in these countries in the process of economic globalization, international trade and adjustment of trade structure affect forest area (FA), forest volume (FV), and forest density (FD, the latter of which is calculated as forest volume per area, i.e. FV/FA). We hope this will lead to insights of the relationship between economic globalization and forest transition.

We constructed a relevant dataset of all the nine countries using FAOSTAT and UNCTADSTAT as the main sources. FAO conducts forest inventories at ten-year intervals since 1970s and verifies data provided by countries with field level information gathered from FAO field offices as well as governmental agencies (Bhattarai and Hammig, 2001). Most of the previous cross-national analyses rely on these official database (Kastner et al., 2011; Kauppi et al., 2006; Mills Busa, 2013). Although there are some limits and problems with these statistics, there is no other reliable source of comparable cross-national forest land statistics for developing countries except FAO (Bhattarai and Hammig, 2001). Details about the advantages and disadvantages of these databases can be found in Mills Busa (2013) and Bhattarai and Hammig (2001). Data for descriptive analysis covers the years from 1980 to 2010. Because of the limited access to forest resources data, the longitudinal dataset for the

regression analysis covers four time points, namely 1990, 2000, 2005 and 2010. The sample size in the regression is thus 36.

Forest area (FA), forest volume (FV) and forest density (FD) are chosen as dependent variables in the regression analysis, to explore the drivers of both quantity (forest area and forest volume) and quality change of forest resources. Forest quality has diverse and multiple meanings, but can be understood to include biomass, forest health, stand structure, canopy density, and so on. In this paper we try to assess forest quality from the perspective of ecological benefits. However, subject to data acquisition, we use forest density (FD) as an indicator of forest quality (Kauppi et al., 2006). Forest density is to some extent related to the carbon sequestration and ecological functions of forests. Based mainly on the forest transition pathway studies, independent variables are chosen as follows:

1) Macroeconomic income factor. Economic growth may increase the demand for agricultural and forest products at the early stage of economic development, leading to the aggravation of deforestation. But as GDP per capita further increases, consumption preferences and the consumption pattern will change and environmental services demand will increase, leading to an increase of forest area. Economic growth may reduce deforestation through creating more non-farm employment opportunities (Xu et al., 2007), while urbanization changes energy sources from biofuel (i.e. firewood) to hydrocarbons (DeFries and Pandey, 2010). Exploring the relationship between forest area and GDP per capita constitutes the main content of research on the forest transition economic pathway and the Environmental Kuznets Curve for deforestation (Culas, 2012; Koop and Tole, 1999). As in most previous studies, we use GDP per capita (GDPPC) as a control variable in the regression.
2) Population factor. In developing countries, population pressure will result in the conversion of forest land to agricultural land to meet food demand, and also results in the over-use of forests when labor opportunities are scarce and incomes low (Geist and Lambin, 2002; Lambin et al., 2003; Moretti et al., 2014). Both processes contribute to deforestation. Some other researchers have argued that population pressure may reduce deforestation because it triggers innovation and technical progress (Templeton and Scherr, 1999). The population factor is also related to the economic development pathway. We use population density (POPDEN) as another control variable.
3) Afforestation factor. Afforestation activities are directly related to the process of forest transition. The afforestation factor is associated with the forest transition scarcity pathway and state forest policy pathway. In the last three decades afforestation activities in Asian countries have played an important role in forest resource changes (Mather, 2007). We use planted forest area (PFA) as control variable to account for the effects of the afforestation factor.
4) Trade and adjustment of trade structure. Data from the nine studied countries suggests that FDI inflows are significantly and positively associated with total export value (Spearman's rho 0.6777, p-value 0.0000). FDI inflows into the manufacturing and services sectors can prompt the development of export-oriented manufacturing and service industries (Hobday,1995; Markusen and Venables, 1999). This in turn helps host countries to upgrade their export structure and reduce the proportion of primary products in the total of exports. We use the percentage of forest products in total exports (PFEXP) to explore the effects of export structure change on forest resource changes. According to the definition of FAOSTAT, forest products include roundwood, sawnwood, wood panels, pulp and paper and so on. The import value of forest products (FIMP) is used to capture and reflect deforestation leakage. PFEXP is used together with total exports value (EXP) to help better understand how trade and adjustment of trade structure influence forest transition.

In contrast to most previous studies, which mainly focus on primary products trade as the major linkage to understand the relationship between international economic integration and forest transition, the econometric model presented here incorporates major trade structure adjustment factors. In addition, compared to country specific studies, the comparative analysis applied here includes a large variation of socioeconomic structures across countries. This facilitates the identification of the net impact of trade and trade structure adjustment on forest transition.

Given the large variation of size across the countries in the sample, it is suggested that the model is estimated by weighted least square (GLS) to give less weight to the outliers and obtain reliable parameter estimates (Bhattarai and Hammig, 2001). Therefore, we estimate the panel-data linear model by using a feasible generalized least squares (FGLS) method, and correct the empirical model for heteroscedasticity and autocorrelation (AR1). Details of the rational and advantages of using FGLS methods can be found in Bhattarai and Hammig (2001). The description of the variables is shown in Table 2.

3. Results

China, India and Vietnam have experienced forest transition in the 1980s and 1990s respectively. Forestry development and forest resource conservation policies are considered to have positive effects in this process (Mather, 2007). Especially, the afforestation activities implemented widely as part of broader forest and natural resource policies are closely related with forest cover increase (Fig. 1). By contrast, since the 1980s the scale of afforestation declined or remained stable in deforestation countries, such as Indonesia, Malaysia and Laos (Fig. 1). Japan and South Korea experienced forest transition before the 1980s and the percentage of forest areas in these countries remained high and afforestation areas remained stable (Fig. 1). Forests in Philippines were heavily destructed before the 1990s, but forest area began to increase slowly after 1990 (Fig. 1). In the last three decades, afforestation activities remained at a low level in Philippines (Fig. 1).

A significant variable that appears closely related to forest resource change is the international trade of agricultural and forest products. Of the nine countries that we studied, China, India and Vietnam experienced a dramatic increase in the value of import of forest products, while the total export value of forest products increased rapidly in Indonesia, Malaysia and Laos during the same time (Fig. 1). Japan and South Korea had a relatively stable net import value of forest products (Fig. 1). Philippines changed from a net exporter to a net importer of forest products since the 1990s (Fig. 1).

The expansion of FDI is one of the most important representations of the globalization wave since 1980s. The global FDI inward flow amounted to $13.35 billion in 1970, and this number increased rapidly to $54.07 billion, 207.36 billion, and 1413.17 billion in 1980, 1990, and 2000 respectively (UNCTAD, 2013). It was during 1980 and 2000 that the global FDI flow increased most rapidly, and the FDI inward flow has maintained high levels since 2000 (UNCTAD, 2013).

Table 2
Details of variables.

Variables	Explanation	Unit	Expected sign
Dependent variables			
FA	Forest area	Million hectare	
FV	Forest volume	Million m^3	
FD	Forest density, FV/FA	m^3 per hectare	
Independent variables			
GDPPC	GDP per capita	US$	Not clear
POPDEN	Population density	People per hectare	Negative
PFA	Planted forest area	Million hectare	Positive
FIMP	Import value of forest products	Million US$	Positive
EXP	Total export value	Million US$	Positive
PFEXP	Percentage of forest products in total exports	%	Negative

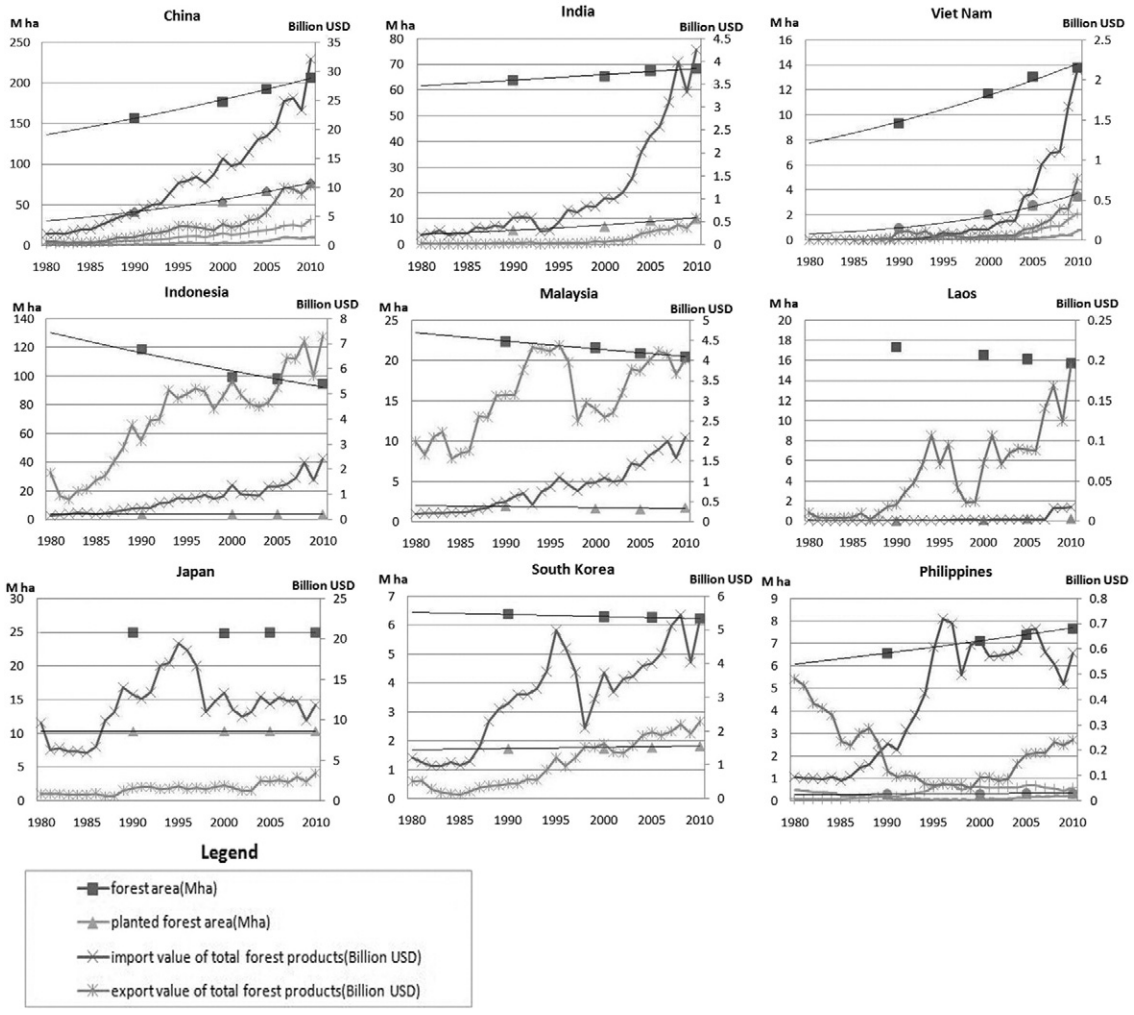

Fig. 1. Historical change in forest and planted forest area and in import and export value of total forest products for the nine countries studied. Data source: FAOSTAT and UNCTADSTAT.

We hypothesize that the FDI inflows in the manufacturing and service sectors could help host countries to develop export-oriented manufacturing and service industries (Hobday,1995; Markusen and Venables, 1999), and thus it may contribute to the upgrading of the export structure and to reduce the proportion of primary products in total exports. For instance, the FDI stock in primary sectors in China was reduced from 40.88% in 1984 to 3.1% in 1993 (Broadman and Sun, 1997), while the proportion of FDI in the manufacturing sector amounted to 59.6% in 1998 (OECD, 2000). The export structure changed correspondingly during this period, with the proportion of primary goods in total exports decreasing from 50.3% in 1980 to 10.2% in 2000, and the proportion of manufacturing goods in total exports increasing from 49.7% to 89.8% in the same period (NBS, 2013).

The proportion of FDI flows in primary sectors also decreased worldwide since the 1970s, and the proportion had declined to 14% in 2011 (UNCTAD, 2013). After the 1980s, especially after 1990, FDI inflows and export-oriented manufacturing and service sectors developed rapidly in China, India and Vietnam, causing a decline of the proportion of primary products in total exports (Fig. 2). However, in Indonesia, Malaysia and Laos, FDI inflows fluctuated and have been relative low since 1980s (Fig. 2). Although the proportion of forest products in total exports is in a declining trend, the absolute value is still high in these three countries (Fig. 2). FDI inflows also fluctuated in Japan and South Korea where industrialization was realized a long time ago. The proportion of forest products in total exports is relatively low in these two countries since the 1980s (Fig. 2). FDI inflows increased in Philippines after 1990, but they also fluctuated (Fig. 2). The proportion of forest products in total exports declined in Philippines after the 1980s (Fig. 2).

Fig. 3 shows the statistically significant regression results. The geometry point denotes regression the coefficient, and the error bar depicts 95% confidence interval for standard error. If the error bar is away from the zero line, the variable coefficient is statistically significant at the 95% significant level. The results suggest that the variable GDP per capita (GDPP) has a negative effect on forest area (FA) and forest volume (FV), while it has a positive effect on forest density (FD). The variable population density (POPDEN) has a negative effect on forest area, forest volume and forest density. The planted forest area (PFA) variable has a positive effect on forest area and forest volume, while it has a negative effect on forest density. The variable import value of forest products (FIMP) has a positive effect on forest area and forest volume, while it has no significant effect on forest density. The effects of variable proportion of forestry products in total exports (PFEXP) on forest area, forest volume and forest density are all negative. The variable total exports value (EXP) has a positive effect on forest area and forest density, while it has no significant effect on forest volume.

4. Discussion and conclusion

The results of this study should be interpreted cautiously as on the one hand, the empirical models do not represent any specific country. On the other hand, the relatively small dataset from the nine countries

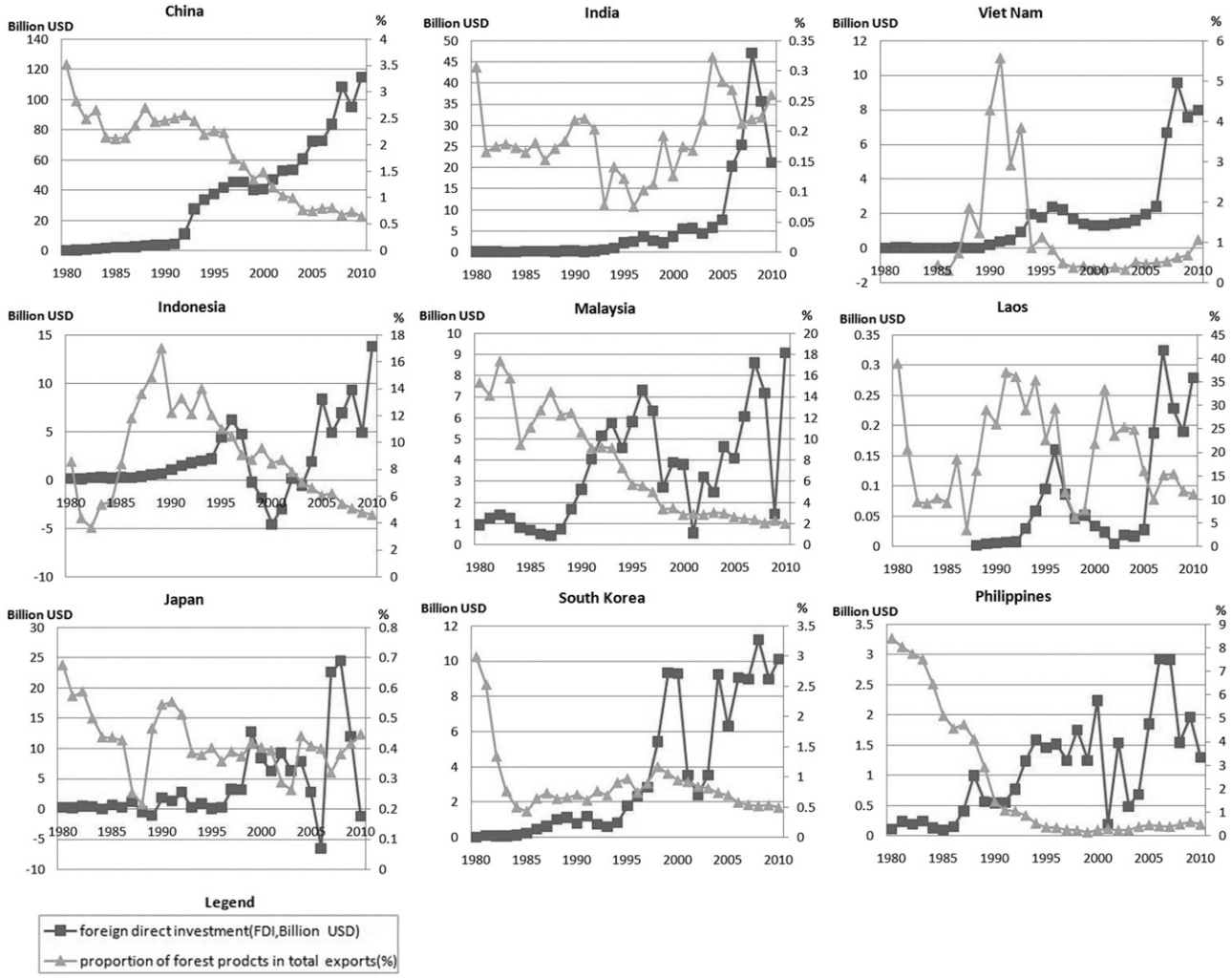

Fig. 2. Historical change in total foreign direct investment (FDI) inflows and in proportion of forest products in total exports for the nine countries studied. Data source: FAOSTAT and UNCTADSTAT.

may affect the validity of the results. Future research could incorporate more countries and develop internally consistent estimating methods. However, results from cross-country analyses like this one are useful to help understand forest transition mechanisms beyond the countries against an economic globalization background and provide implications for further theoretical explorations on forest transition.

The results from this study suggest that the population pressure has negative effects on forest resources in the countries studied. The positive effects of the variable planted forest area on forest area and forest volume may imply that afforestation initiatives are important driving forces to realize local forest transition (Fig. 3). But afforestation activities have negative effects on local forest densities (FD), which is probably due to the low stocking volumes of saplings and plantations in general. This may indicate that realizing forest transition by means of afforestation has important and complex effects on forest ecosystems that are ill reflected in forest cover data.

Our study also provides evidence of the deforestation leakage hypothesis. Results indicate that the imports of forest products have positive effects on local forest areas and forest volumes, while the proportion of forest products in total exports (PFEXP) has negative effects on local forest areas, forest volume and forest density (Fig. 3). Thus from this study it appears that if exports of forest products are replaced by imports of forest products, deforestation could be effectively exported as well. The results imply that economic integration may put pressures from both domestic and international demands of primary products on primary products exporters. The deforestation leakage caused by international agricultural and forest products trade may cause the illusion of resources conservation (Berlik et al., 2002; Lambin and Meyfroidt, 2011).

Rapid increase of forest products imports in China, India and Vietnam began in the 1980s, 1990s and 2000s respectively, and the large net imports of forest products may relieve pressures on domestic forest resources. On the contrary, large net exports of forest products from Indonesia, Malaysia and Laos could increase pressures from both domestic and international demands on domestic forest resources. The deforestation leakage can also be found in Japan and South Korea where imports exceed exports of forest products and imports of forest products in these two countries tend to stabilize. Before 1990 the Philippines was a net exporter of forest products and concurringly forest coverage continued to decline to 22%. The study hints at that once Philippines became an importer of forest products after 1990 the forest area began to increase slowly (Fig. 1). In summary, among the nine Asia-Pacific countries that we studied, those countries that experience forest transition have all imported more forest products than they exported and they may hereby manage to relieve domestic pressures on forest resources. In countries where deforestation continues, large net exports of forest products may play an important role.

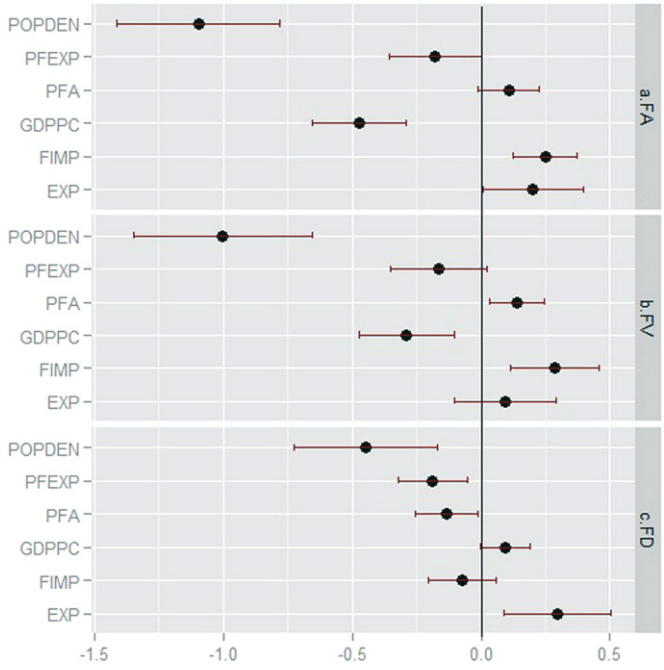

Fig. 3. Results of feasible generalized least squares regression for forest area (FA), forest volume (FV) and forest density (FD) across the nine countries studied.

The trade of agricultural and forest products only accounted for a small fraction of global trade over the last three decades. The structural adjustment and relocation of manufacturing and service industries worldwide should be considered when exploring the effects of economic globalization on forest resources. Krugman and Venables (1995) explained how global economic integration caused the manufacturing sector first to concentrate in developed, and then in developing countries. A decline of transportation costs and wage rate played a vital role in this process (Krugman and Venables, 1995; Krugman, 1990). Under the condition of global decline of transportation costs, it appears that the low labor cost in some labor-rich developing countries could provide fertile grounds to absorb foreign investment and technology transfer, adopt export-oriented economic strategies and develop labor intensive processing industries. Since the 1960s, the pursue of cheap labor by global capital and the improvement of terms of trade, may induce a worldwide boom in FDI, which in turn is hypothesized to have significantly influence in global forest transition trends.

FDI inflows in manufacturing and service sectors could prompt the development of export-oriented manufacturing and service industries in developing countries (Hobday,1995; Markusen and Venables, 1999), and thus are expected to upgrade the export structure and reduce the proportion of primary products in total exports. The effects of the investment flows on forest resources are revealed by our empirical results. The variable proportion of forestry products in total exports (PFEXP) has negative effects on forest area, forest density and forest volume (Fig. 3). This may imply that, other things being equal, the higher the proportion of forest products in total exports, the bigger the pressures on forest resources conservation. The variable total export value (EXP) has positive effects on forest area and forest density. Thus for the countries we studied, empirical results imply that when total exports increase in one country, forest resources condition tends to be improved. These two results together indicate the effects of export structure change on forest resources, as one country changes from primary products exporter to manufacturing and service products exporter. Against the background of global economic integration, the model presented here hypothesizes that one country or region could promote local forest resources preservation when the trade development of the country or region relies more on manufacturing and service industries and thus reduce economic and livelihoods dependence on land and land-based resources. For example, China, India, and Vietnam, which have experienced forest transition in the last three decades in Asia, may promote sustainable forest use and forest conservation as they develop export-oriented manufacturing and service industries through absorbing FDI.

Therefore, unlike the cases of deforestation leakage and negative effects of primary sector FDI inflows on local forest resources, this study implies that FDI inflows in manufacturing and service sector may have positive effects on forest conservation. In addition, we hypothesize that developing manufacturing and service products export and upgrading the export structure through absorbing FDI, may influence forest transition by two means. On the one hand, this may create massive work opportunities, prompt rural–urban migrations and thus reduce livelihoods pressures on forest resources. On the other hand, this could reduce economic dependence on land based resources and thus help realize local forest conservation and sustainable development. These mechanisms need to be better scrutinized in future research.

While previous researches mostly focus on the variable of trade of primary sector products, our study more widely discusses the effects of economic globalization on forest transition, and explores the link between trade, adjustment of trade structure, FDI and forest transition. This study presents a new research perspective on the globalization pathway theory of forest transition (Meyfroidt and Lambin, 2009). Our results indicate that when exploring the relationship between economic globalization and forest transition, one should consider the overall situations how one country participates in economic globalization and the development and structural adjustment of its industries in the process of economic integration. In addition, this study could help to better understand the dynamics of forest resources, and further expand the scope of forest transition studies and integrate the analysis of both forest quantity and quality change in forest transition study. This may constitute an important expansion of forest transition theory.

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