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Deforestation, foreign demand and export dynamics in Indonesia

Joel Rodrigue *[,1], Omolola Soumonni [1]

Department of Economics, Vanderbilt University, VU Station B #351819, 2301 Vanderbilt Place, Nashville, TN 37235-1819, United States

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ABSTRACT

This paper presents a dynamic, heterogeneous firm model of investment in environmental abatement and exporting. The model highlights the interaction between firms' environmental investment and export decisions on the evolution of productivity and export demand in timber manufacturing industries. The model is structurally estimated using Indonesian timber manufacturing data that captures firm-level variation in environmental investment and export behavior. The results suggest that environmental abatement has little impact on productivity dynamics, but does encourage growth in export demand. Counterfactual experiments quantify the impact of policy change on trade and abatement decisions.

"I want to appeal to the citizens of the whole world: look for the stamp of approval on legal wood products."-Rashmat Witoelar, 2007
State Minister of Environment, Republic of Indonesia[2]

1. Introduction

This paper develops a dynamic model of environmental abatement and exports with heterogeneous firms. We study the impact of firm-level actions taken to reduce deforestation in Indonesia on domestic and export performance. The model emphasizes the role of firm-level environmental investment and export decisions on the evolution of the distribution of abatement and exports in Indonesian timber industries. The model is estimated using firm-level data from Indonesian timber manufacturers. Counterfactual policy experiments are used to assess the policy implications of trade and environmental regulation.

Today, consumers are often encouraged to "think globally and act locally" when purchasing a wide range of goods. What is less clear is whether such actions have discernable impacts on global environmental choices or outcomes. That is, can increasing demand for more environmentally conscious goods change the nature of production and products on a global level? This issue is particularly difficult since many goods of environmental concern are produced in developing countries which are often characterized by weak environmental regulation. Moreover, given the scarcity of data linking environmental actions in one country with outcomes in others it is nearly impossible to evaluate the potential role of evolving environmental preferences or regulation on production, abatement and export decisions across countries. We study one of the few cases where there exists producer-specific information regarding both the actions taken by producers in a developing country and outcomes of these actions in export markets. We exploit the unique structure of trade and international timber product certification during the early 1990s along with unique data on environmental decisions from the same period to document and quantify the impact of actions taken to reduce deforestation on export market demand in the Indonesian wood furniture and saw mill industries.

This is not to suggest that there is little existing literature linking trade and environmental outcomes. Rather the opposite is true, particularly in developing countries. For example, Copeland and Taylor (1994, 1995) argue that international trade may be particularly likely to increase pollution in countries that have a comparative advantage in pollution-intensive industries. Similarly, Ederington et al. (2005) and Levinson and Taylor (2008) argue that when we examine trade between developed and developing countries we often observe substantial reallocation of environmentally harmful production. In contrast, numerous authors cast doubt on the hypothesis that free

* Corresponding author.
E-mail address: joel.b.rodrigue@vanderbilt.edu (J. Rodrigue).
[1] Tel.: +1 615 322 2871; fax: +1 615 343 8495.
[2] EIA Environmental Investigation Agency (2007).

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trade will create pollution havens or reduce environmental quality.[3] We contribute to this literature by examining *firm-level* abatement and exporting activities in a developing country. We characterize firm-level behavior in the saw mill and wood furniture industries which are critical, resource-intensive industries in Indonesia.

Recent research on export dynamics has emphasized the complementarity between investment and exporting activities. Costantini and Melitz (2008), Ederington and McCalman (2008), Atkeson and Burstein (2009), Lileeva and Trefler (2010) and Aw et al. (2011) highlight this link across firm-level decisions and emphasize the impact it may have on the evolution of firm-level outcomes over time. We follow this literature by examining the relationship between exporting and the investment in mitigating negative outcomes on the natural environment.

While the preceding literature has stressed the link between investment and exporting through the impact of investment on the evolution of firm-level productivity, our paper, in contrast, emphasizes the impact of environmental investment on the evolution of *export demand* at the firm-level. In this sense, our paper is also related to the literature on firm-level decisions, productivity and demand as in Foster et al. (2008) or Eaton et al. (2009). We examine a situation where firms may choose to make environmental investments which have differential future returns in both export and domestic markets. While exporting firms are able to directly capture the return from such actions in export markets, we also consider the possibility that non-exporting firms internalize the benefit that current environmental investments have on potential export sales in the future.

A large number of papers have studied whether environmental investment improves firm-level performance, with mixed results. Gollop and Roberts (1983), Smith and Sims (1985) and Brannlund et al. (1995) all report large productivity declines, while Berman and Bui (2001) find significant improvements and Gray (1987) finds no significant change at all.[4] Porter and van der Linde (1995) argue that any measured productivity gain from environmental investment may actually reflect an increase in the demand for goods from "environmentally clean" sources. This interpretation is consistent with the evidence in Teisl et al. (2002) and Bjorner et al. (2004) which document that environmental labeling can have large impacts on consumer demand in the US and European markets, respectively.

Although some of the above papers examine the impact of environmental investment on firm performance, none of them capture the impact of trade decisions on firm behavior. Kaiser and Schulze (2003) and Girma et al. (2008) explicitly examine the interaction of firm-level abatement with the decision to export abroad. While they confirm that exporting firms from Indonesia and the UK are more likely to abate, they do not study the impact of environmental expenditures or exporting on the evolution of productivity, export demand and export/abatement decisions over time. Similarly, Holladay (2010) demonstrates that exporting US firms tend to emit 5.3% less pollution than non-exporting firms on average. He is not able, however, to directly observe whether exporting firms have actively pursued environmental abatement. Pargal and Wheeler (1996) report that larger, more efficient firms tend to produce less local pollution on average in Indonesia. Our paper, in contrast, emphasizes the internal incentive firms may have to reduce local environmental degradation: an increase in profits. Moreover, conditional on the domestic market response to abatement behavior we are able to separately distinguish whether there are further gains in export markets. In fact, our results indicate that exporting and environmental investment are closely linked within firms.

We build a dynamic structural model of exporting and abatement where these decisions endogenously influence the evolution of future productivity and export demand. The model links exporting and abatement through four mechanisms. First, the return to either activity is increasing in the firm's productivity, so that high-productivity firms self-select into both activities. Second, each activity potentially influences future productivity reinforcing the first effect. Third, we allow future export demand to depend directly on investment in abatement, encouraging future entry into export markets. Lastly, entry into either activity influences the return from undertaking the other activity. The decision to export directly influences the probability of abatement and vice-versa.

The data employed in this paper contains unique information detailing firm-level expenditures on environmental abatement, export decisions, and domestic and export revenues for all firms with more than 20 employees in the Indonesian manufacturing sector. While several papers have examined firm-level emissions we are not aware of any other data set that captures variation in *abatement behavior* across trade-oriented manufacturing firms. Fowlie (2010) examines firm-level abatement in the US electricity industry, but does not investigate the interaction of abatement with firm-level trade decisions given the domestic-orientation of this industry.

Our approach has a number of advantages. First, we are able to be specific regarding the environmental concern in the wood furniture and saw mill industries and tailor our model to suit these particular manufacturing industries. Second, deforestation is a leading environmental concern in Indonesia and has generated substantial interest both within Indonesia and abroad. Deforestation is a key environmental issue in Latin America, Eastern Europe, West and Central Africa and South East Asia. In almost every case deforestation and illegal timber practices are closely tied to international trade (WWF, 2008). Despite its importance, deforestation has received minimal attention in the economics literature.[5] Third, the nature of the sustainable resource issue studied here is typical of the type of trade-off between resource depletion and development common in many developing countries. Sachs and Warner (1995) document that the economic development in Latin America has relied heavily on natural resources and the degree to which resource booms influence trade has important implications for economic growth.

The model is estimated in two steps. First, the parameters governing the evolution of productivity are estimated using control function techniques as in Olley and Pakes (1996) and Doraszelski and Jaumandreu (2013). We find that abatement has little effect on firm productivity or on the evolution of domestic sales in the timber industry. The remaining dynamic parameters are estimated by Bayesian Markov Chain Monte Carlo (MCMC) methods. Our results suggest that deciding to abate has a significant positive effect on the evolution of export demand. We observe that firms which choose to start using wood in a sustainable, environmentally conscious manner observe that export demand grows 1 to 14% faster than non-abating firms. Consistent with evidence from the US, we further find that industries whose main product is closer to a finished product tend to enjoy larger increases in demand from such activity (Arora and Cason, 1996). Further, although we find weak evidence that past export experience improves productivity (often referred to as "learning-by-exporting"), our empirical exercise demonstrates that past export experience leads to stronger export demand growth.

We perform a number of counterfactual experiments in order to quantitatively assess the impact of policy on firms' decisions in a developing country. The experiments highlight that small changes in the

[3] See Grossman and Krueger (1995), Antweiler et al. (2001), or Frankel and Rose (2005) for examples.

[4] These papers study regulation in the US fossil-fueled electric power generator, Canadian brewing, Swedish pulp and paper, the US oil refinery and the US manufacturing industries, respectively. Further studies of environmental management on firm performance include Jaffe and Palmer (1997), Konar and Cohen (2001) and Brunnermeier and Cohen (2003). Theoretical arguments for the impact of regulation on firm-level efficiency and environmental performance can be found in Xepapadeas and de Zeeuw (1999), Ambec and Barla (2002), Campbell (2003), Bajona et al. (2010) and the references therein.

[5] Country-level studies include Ferreira (2004) and López and Galinato (2005). Likewise, firm-level studies from developing countries include Moeltner and van Kooten (2003).