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Foreign Direct Investment, Environmental INGO Presence and Carbon Dioxide Emissions in Less-Developed Countries, 1980–2000

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Abstract
The authors engage foreign investment dependence and world society theories to examine environmental harms in less-developed countries. Results of cross-national random effects panel regression models indicate that foreign investment in manufacturing contributes to total carbon dioxide emissions and emissions per unit of production. World society integration in the context of environmental international non-governmental organization presence does not directly suppress emissions. However, a stronger presence of such organizations in some less-developed nations appears to mitigate the impacts of foreign investment on anthropogenic emissions. These results hold, net of population, level of development, and other structural factors.

Keywords: *Globalization, global warming, foreign direct investment, political-economy, world society, environmental sociology.*

Resumen
Los autores abordan la dependencia de inversión extranjera y las teorías de la sociedad mundial para examinar los daños medioambientales en los países menos desarrollados. Los resultados de los modelos de regresión de panel con efectos aleatorios nacionales indican que la inversión extranjera en el sector manufacturero contribuye al total de emisiones de dióxido de carbono y las emisiones por unidad de producción. La integración de la sociedad mundial en el contexto presencia de organizaciones medioambientales internacionales no gubernamentales no reprime directamente las emisiones. Sin embargo, una mayor presencia de esas organizaciones en algunos países naciones menos desarrolladas parece mitigar los impactos de la inversión extranjera en las emisiones antropogénicas. Los resultados son en forma de datos netos de la población, nivel de desarrollo y otros factores estructurales.

Palabras clave: *Globalización, calentamiento global, inversión directa extranjera, economía política, sociedad global, sociología del medio ambiente.*

1. Introduction

Different forms of environmental degradation and their human consequences are among the most pressing issues facing the world today, and this is even more pronounced for most less-developed countries. For example, while the total anthropogenic carbon dioxide emissions of all developed countries combined increased by approximately twenty-one percent and their emissions per unit of production decreased by close to thirty percent during the final two decades of the last century, within all less-developed countries combined, total emissions more than doubled from 1980 to 2000, and their emissions per unit of production also increased, albeit at a lower rate (World Resources Institute, 2005). There is overwhelming scientific consensus that the emission of carbon dioxide and other greenhouse gases contributes to global warming and climate change (Intergovernmental Panel on Climate Change, 2007), and the consequences of climate change have already been felt by the populations of many less-developed countries.

Much contemporary sociological theory and research focuses on the consequences for how and the extent to which less-developed countries have become more structurally integrated into the world economy (e.g. Dixon and Boswell, 1996; Jorgenson, Dick, and Mahutga, 2007; Kentor, 1998) or world society (e.g. Frank, Hironaka and Schofer, 2000; Meyer *et alii* 1997). While the world economy has experienced a globalization upswing in recent decades (e.g. Chase-Dunn, Kawano and Brewer, 2000), like many environmental degradation patterns, the increase in structural economic integration in the context of the relative presence of transnational firms and foreign capital is much more pronounced for less-developed countries than the world economy as a whole. For example, total foreign investment stocks within less-developed countries grew from roughly four percent of their overall GDP in 1980 to approximately twenty-eight percent in 2000 (United Nations 1992, 1994, 1996, 2000, 2003). As illustrated by Jorgenson (2009), the upward trajectories of the accumulated stocks of foreign investment as a percent of overall GDP and total carbon dioxide emissions in less-developed countries from 1980 to 2000 are highly correlated. Further, the temporal trajectories of foreign investment presence (% overall GDP) and emissions per unit of production from 1980 to 2000 in less-developed countries are moderately correlated as well.

Turning to world society conditions and transformations, the total number of active international non-governmental organizations [INGOs] grew from less than one thousand in the 1950s to almost twenty thousand by the year 1999 (Smith and Wiest, 2005), and the presence in less-developed countries of INGOs that focus explicitly on environmental issues [EINGOs] increased more than tenfold from 1980 to 2000. This has allowed not only an increase in the amount of resources focused on environ-

mental issues, but also an increase in the range of environmental issues covered. Not surprisingly, given the focus on global climate change in global discourse, the attention paid to anthropogenic carbon dioxide emissions by EINGOs and other civil society configurations has increased dramatically in recent years (Roberts and Parks, 2007).

In this study we draw from foreign investment dependence theory and world society theory to assess the extent to which the transnational control of production and the relative presence of transnationally-organized citizen groups contribute to environmental harms in less-developed countries. In particular, we assess the effects of (1) foreign direct investment in manufacturing and (2) the presence of EINGOs on total carbon dioxide emissions as well as emissions per unit of production. We also (3) investigate the extent to which the presence of transnationally-organized citizen groups mitigates the potential environmental impacts of foreign capital and transnational firms operating in host economies.

2. Foreign Investment and the Environment

Here we draw from the growing body of scholars who attempt to advance an «ecostructural» orientation of foreign investment dependence theory (e.g. Jorgenson *et alii*, 2007; Jorgenson and Kuykendall, 2008). The longstanding theory of foreign investment dependence (e.g. Chase-Dunn, 1975) asserts that the accumulated stocks of foreign investment generally make a less-developed country more vulnerable to different transnational and global political-economic conditions, which often leads to a variety of negative consequences for domestic populations, including increased domestic income inequality (e.g. Alderson and Nielsen, 1999) and suppressed economic development (e.g. Dixon and Boswell, 1996; Kentor, 1998).

During recent decades, many less-developed countries experienced a deepening of foreign debt, which resulted in austerity measures developed by global governance and finance institutions (McMichael, 2004). These austerity measures, such as structural adjustment programs, often encourage the governments of indebted countries to create more favorable domestic conditions for foreign investors and transnational corporations (Stiglitz, 2002). Attracting foreign capital is often considered a means of stimulating economic development to assist in debt repayment while increasing the overall well-being for domestic populations (OECD, 1999). Partly in an effort to attract foreign investment and transnational enterprises, many less-developed countries have attempted to facilitate and maintain more appealing business conditions, including relaxed labor laws and tax reductions as well as exemptions to environmental regulations designed to protect the natural environment (e.g. Clapp and Dauvergne,

2005; Jorgenson, 2007)[15]. In many cases, the real or perceived threat of capital flight could be viewed as an additional incentive for less-developed countries to offer regulatory concessions to foreign-headquartered firms and foreign capital (Wallerstein, 2005). Further, prior research shows that many less-developed countries are also less likely to ratify international environmental treaties, many of which deal explicitly with extractive and productive activities that are of direct relevance for transnational corporations (Roberts and Parks, 2007). While some point out the injustice in asking less-developed countries to cut emissions when more-developed countries are the ones who created the problem (e.g., Chang 2002; Roberts and Parks, 2007), it is also true that less-developed countries are likely to disproportionately feel the effects of global climate change. Overall, these conditions allow more-developed countries to outsource the pollution for many of their domestic consumption activities.

With the above structural conditions in mind, we posit that a large proportion of secondary [i.e. manufacturing] sector foreign direct investment in less-developed countries finances highly polluting and ecologically inefficient manufacturing processes and facilities, much of which are outsourced from developed countries. Transnational manufacturing firms often experience economic benefits from this form of environmental cost shifting since different ecologically inefficient and highly polluting manufacturing processes tend to include relatively outdated and inexpensive mechanization processes and equipment. This cost shifting also allows transnational firms to further distance themselves from the environmental impacts and related human well-being costs of their activities, particularly from the watchful eye of the public in articulated consumer markets (Clapp and Dauvergne, 2005). Moreover, partly due to a lack of tax revenue and cuts in public spending, with the latter often resulting at least partly from the austerity measures of global finance and governance institutions, the power generation techniques within many less-developed countries tend to be fossil fuel dependent and considerably less eco-efficient than in more-developed countries. Many of these types of facilities generate at least some of the electricity used by transnationally-owned manufacturing enterprises (Kentor and Grimes, 2006). Besides the privately-owned production equipment and publicly-owned power generation facilities, the transportation vehicles owned and operated by foreign-owned manufacturing centers in less-developed countries for the movement of inputs, outputs, and labor are more likely to be outdated, energy-inefficient, and thus more polluting (Jorgenson, 2007). What is more, the «on-the-ground» transportation infrastructure of many less-developed countries tends to be more poorly maintained than in developed countries. For example, roadways are less likely to be paved on a regular basis, and rail

15 This argument follows the logic of an environmental «race to the bottom» or «pollution haven» (e.g., Clapp and Dauvergne, 2005; Frey, 2006), which posits that Transnational Corporations will try to control their costs by locating in countries with the lowest environmental regulations.

systems are more likely to be spread out and inefficient. These conditions can lead to the increased use of fossil fuels for the transportation of raw materials, manufactured goods, and labor (Grimes and Kentor, 2003). These activities, all of which are to some extent tied to the manufacturing sector, contribute to the emission of noxious gases (e.g. Jorgenson, 2006; Shandra *et alii*, 2004).

In the subsequent analyses we assess the above theoretical articulations by investigating the effects of secondary sector foreign direct investment on carbon dioxide emissions in less-developed countries. We now turn to a discussion of how world society integration in the context of the presence of EINGOs might be beneficial for environmental conditions, and how in some less-developed nations EINGOs might successfully mitigate the environmental harms of foreign direct investment.

3. EINGOs and the Environment

Scholars working in the world society theoretical tradition hold that international organizations play an important role in constituting and reinforcing world cultural norms (e.g. Frank *et alii*, 2000; Meyer *et alii*, 1998). From this perspective, international non-governmental organizations are characterized as carriers of world culture who diffuse progressive global models that are adopted by local actors (Boli and Thomas, 1999; Clark, 2008). For example, Meyer and his colleagues (1997) describe the existence of the «world environmental regime», composed of environmental international non-governmental organizations [EINGOs] and other sorts of civil society groups who diffuse such models. Of particular interest here is the role EINGOs play in dealing with various forms of environmental degradation in less-developed countries.

We posit that a relatively stronger presence of EINGOs will often lead to a greater collective persistence and thus beneficial outcomes for environmental conditions. However, as Schofer and Hironaka (2005) suggest, one of the challenges of neo-institutional analysis, in the context of world society theory and the environment, is the sheer volume of different mechanisms involved. It is also likely that various procedures and organizational processes interact and reinforce each other, leading to greater influences on the practices of individual actors, groups, and facilities that degrade the environment. In other words, through an assortment of mechanisms and strategies, transnationally-organized civil society groups [i.e. EINGOs] —especially in nations where they have a stronger collective presence— are able to somewhat suppress the environmental harms of human activities. In the following paragraphs we describe some of the known practices used by EINGOs in efforts to curb environmental harms of economic activities in less-developed countries.

EINGOs can intervene in global political processes by helping shape the language of international treaties and organizations dealing with the environment.[16] In doing so, they influence the normative content of global institutions (Risse *et alii*, 1999). In the absence of resources and formal mechanisms of enforcement, EINGOs monitor compliance by nations with environmental treaties (Frank, 1999). Consequently, they are in a position of pointing out failures and duplicities of nations, which pressures governments to adapt their behaviors to international norms (Hafner-Burton and Tsutsui, 2005). Transnationally-organized citizen groups are also known to help mobilize support for problem-solving initiatives when national-level avenues are either inadequate or blocked, and it has become increasingly popular for EINGOs to provide support for conservation and environmental protection efforts at sub-national levels (Schofer and Hironaka, 2005). Additionally, EINGOs can serve as intermediaries, bridging disparate community groups under the rubric of «grassroots» development (Bradshaw and Schafer, 2000). This involves facilitating conservation efforts or technology transfer by integrating financial and organizational resources from abroad with local knowledge and community participation.

Social movement activities are often supported by EINGOs (Keck and Sikkink, 1998), and Frank *et alii* (2000) find that nations strongly linked to world society [e.g. more EINGOs] experience growth in domestic environmental movements. EINGOs are known to employ frames and discourses that encourage domestic social movement activity and, in turn, environmentalism within a nation (Frank, 1999). In such instances, governments and firms operating within a nation are «squeezed» from above and below to attend to environmental problems (Schofer and Hironaka, 2005).

In the following panel analyses, we evaluate the preceding world society theorization by assessing the extent to which the presence of EINGOs directly impacts anthropogenic carbon dioxide emissions in less-developed countries. Considering the increased levels of foreign direct investment as well as the growing attention paid towards the practices of transnational firms and foreign capital by transnationally-organized citizen groups, we also investigate if the effects of foreign investment in manufacturing on emissions are suppressed in less-developed countries with a greater presence of EINGOs.

16 A particular EINGO, the Center for Clean Air Policy, even worked with those negotiating the Kyoto Protocol to have the Clean Development Mechanism implemented in 2005 in Montreal. The nexus of this program is to increase sustainable development through foreign investment in energy efficient (i.e., low CO_2 per unit of GDP) technologies (CCAP 2005). This program is yet to be fully implemented, but the possibility is for the attenuation of some of the emissions that are often seen with foreign investment.

4. Methods and Sample

For methodological and substantive reasons, we estimate generalized least squares [GLS] random effects [RE] models with robust standard errors for all reported analyses. RE and fixed effects [FE] models are two approaches designed to correct for the problem of heterogeneity bias, which refers to the confounding effect of unmeasured time-invariant variables that are omitted from regression models (Greene, 2000). Both models «simulate» unmeasured time-invariant factors as case-specific intercepts (Nielsen and Alderson, 1995). The RE model treats case-specific intercepts as a random component of the error term, and the FE model treats the case-specific intercepts as fixed effects to be estimated, equivalent to including dummy variables for N–1 cases (Hsiao 2003). In studies where the number of observations per case is relatively small, a RE modeling approach is often preferable to FE models because fewer degrees of freedom are necessary to account for the subject-specific parameters (Frees, 2004:78). When one or more independent variables have relatively low variation across time per case, FE models can suffer from extreme multicollinearity since variables under these conditions will likely be highly collinear with the case-specific fixed effects. The estimation algorithm for the FE model could also be interpreted substantively as «throwing away» theoretically relevant between-subject variation present in the data. Using relevant diagnostics, we also conclude that the overall samples in the current study do not contain any overly influential cases, and none of the reported models are unstable due to high multicollinearity.

The dataset for the carbon dioxide emissions analyses include two to five observations on 36 less-developed countries from 1980 to 2000, with an overall sample size of 143. Observations are for any of the following five years: 1980, 1985, 1990, 1995, and 2000. The 36 countries include Argentina, Bangladesh, Brazil, Cameroon, China, Columbia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Ghana, Haiti, Honduras, India, Indonesia, Kenya, Malaysia, Mexico, Morocco, Nepal, Nicaragua, Nigeria, Pakistan, Panama, Paraguay, Peru, Philippines, Portugal, Rwanda, Senegal, Sri Lanka, Thailand, Turkey, Venezuela, Viet Nam, and Zimbabwe.

5. Data Dependent Variables

We analyze two measures of carbon dioxide emissions: total emissions and emissions per unit of GDP. Anthropogenic carbon dioxide emissions represent the mass of carbon dioxide produced during the combustion of solid, liquid, and gaseous fuels, as well as from gas flaring and the manufacture of cement. The CO_2 data are obtained from

the World Resources Institute (2005). The total emissions estimates are measured in thousand metric tons and logged [ln] to correct for excessive skewness. CO_2 emissions per unit of GDP measures the quantity of anthropogenic CO_2 released into the atmosphere for each million dollars of Gross Domestic Product (GDP) in a country. Consistent with other studies, we use emissions per GDP as a measure of relative eco-efficiency (e.g. Jorgenson, 2009; Roberts and Parks, 2007). The estimates for this second indicator of CO_2 are also obtained from the World Resources Institute (2005) and measured as metric tons of emissions per million constant 2000 United States dollars. Like the total emissions estimates, measures of emissions per unit GDP are logged [ln] to correct for excessive skewness.

Independent Variables of Interest

We use the following predictor to assess the effects of foreign direct investment: accumulated stocks of secondary sector foreign direct investment as percentage of total gross domestic product [GDP]. These data are logged [ln] to minimize skewness. Foreign direct investment stocks data are obtained from United Nations' *World Investment Directories* (1992, 1994, 1996, 2000, 2003) and the Organization for Economic Co-Operation and Development's *International Direct Investment Statistics Yearbook* (2001). Total GDP data are measured in 2000 US dollars (World Bank, 2007). The measures of secondary sector foreign direct investment stocks consist of investment in the following manufacturing activities: food and beverages, tobacco, textiles and clothing, leather, wood and wood products, publishing and printing, coke, petroleum products, nuclear fuel, chemicals and chemical products, rubber and plastic products, non-metallic mineral products, metal and metal products, machinery and equipment, electrical and electronic equipment, precision instruments, motor vehicles and other transport equipment, other manufacturing, and recycling.

We use a measure of environmental international non-governmental organization [EINGO] presence in all reported analyses. This predictor quantifies the number of EINGOs that report having members in a given country. We obtain these data from Smith and Wiest (2005), who gathered INGO information from the *Yearbook of International Organizations* and coded those INGOs explicitly focusing on the environment.

To assess if the presence of EINGOs mitigates the environmental impacts of sector-level foreign direct investment, we calculate and employ interactions between the foreign direct investment and EINGO measures. Specifically, we create slope-dummy interactions between secondary sector foreign direct investment as percentage of to-

tal GDP and a dummy-coded measure for «high EINGO presence». High EINGO presence refers to the cases in the panel dataset in question whose EINGO presence measure is in the upper quartile of all observations. These cases are coded with a value of one, and all other cases are coded with a value of zero. This dummy variable is then multiplied by the continuous variable of relevance, secondary sector foreign direct investment as percent GDP.

Additional Independent Variables Included in the Reported Analyses

In the CO_2 models we control for the time [i.e. year] of the observations. This allows us to control for temporal changes in the outcomes, and to guard against spurious associations among variables with common trends.

Total population is included in all reported models. These data, which we obtain from the World Bank (2007), are measured in thousands and logged (ln) to correct for excessive skewness. Sociologists working in the structural human ecology tradition argue that population is a key driver of scale-level environmental outcomes, such as total carbon dioxide emissions (Dietz and Rosa, 1994). For consistency, we also include total population as a statistical control in the analyses of CO_2 emissions per unit of production (Roberts and Parks, 2007).

Gross domestic product [GDP] per capita is included in all reported analyses. These data, which are logged [ln] to minimize skewness, are taken from the World Bank (2007) and are measured in 2000 US dollars. GDP per capita is the most common statistical control in cross-national investigations of environmental outcomes.

Urban population as percentage of total population controls for a country's level of urbanization. These measures are obtained from the World Bank (2007). Prior analyses reveal positive associations between urbanization and a variety of environmental outcomes, including the emission of carbon dioxide (Jorgenson, 2007).

Exports as percentage of total GDP controls for the extent to which a country is integrated into the international trading system. These data, which we log [ln] to correct for excessive skewness, are gathered from the World Bank (2007).

Gross domestic investment as percentage of total GDP is included in most reported models, and represents the level of domestic investment in fixed assets plus net changes in inventory levels. We obtain these data from the World Bank (2007). Controlling for domestic investment allows for a more rigorous assessment of the effects of foreign investment on the environmental outcomes. We would certainly prefer sector-

level measures of domestic investment. However, those types of data were unavailable at the time of this study.

Table 1 provides descriptive and bivariate correlations for the variables included in the analyses.

Table 1. Descriptive Statistics and Bivariate Correlations

	Mean	Std Dev		1.	2.	3.	4.	5.	6.	7.	8.	9.
Total Carbon Dioxide Emissions (ln)	10.128	1.831	1.									
Carbon Dioxide Emissions per GDP (ln)	6.680	.613	2.	.622								
Total Population (ln)	10.163	1.426	3.	.818	.578							
GDP per capita (ln)	6.947	1.039	4.	.281	-.234	-.238						
Urban Population as % Total Population	43.292	20.010	5.	.300	-.069	-.146	.793					
Exports as % GDP (ln)	3.011	.614	6.	-.162	.097	-.415	.177	.060				
Domestic Investment as % GDP	22.098	6.378	7.	.358	.147	.171	.276	-.011	.291			
Secondary Sector FDI stocks as % GDP (ln)	1.388	.624	8.	-.053	.021	-.208	.177	.141	.361	.101		
EINGO Presence (ln)	2.605	.749	9.	.355	.269	.314	.113	.142	.048	.070	.112	
FDI Stocks as % GDP (ln) X High EINGO Presence	.463	.806	10.	.312	.156	.218	.209	.159	.115	.174	.434	.582

Note: N=143

6. Results and Discussion

Table 2 presents the results of the carbon dioxide emissions models [total emissions and emissions per GDP]. We report unstandardized and standardized coefficients as well as robust standard errors. We also present values for r-square within, r-square between, and r-square overall for each tested model. Unstandardized regression coefficients are flagged for statistical significance. We present the results of the same three tested models for both outcomes. The first model is treated as a baseline, and includes the temporal control, total population, per capita GDP, urban population, and exports as percent GDP. The baseline allows us to first identify the extent to which the included domestic factors and another form of world economy integration [exports] contribute to carbon dioxide emissions.

Table 2. Unstandardized Coefficients for the Regression of Carbon Dioxide Emissions on Secondary Sector Foreign Investment, EINGO Presence, and other Selected Independent Variables: Random Effects Estimates for 2 to 5 Observations on 36 Less-Developed Countries [N=143], 1980–2000

	Total Emissions			Emissions per GDP		
	Baseline	Model A	Model B	Baseline	Model A	Model B
Year	.004	.003	.007	.009*	.003	.007
	[.013]	[.012]	[.025]	[.098]	[.028]	[.080]
	(.004)	(.007)	(.007)	(.005)	(.008)	(.009)
Total Population (ln)	1.230**	1.218**	1.231**	.273**	.260**	.279**
	[.957]	[.948]	[.958]	[.633]	[.604]	[.650]
	(.057)	(.058)	(.058)	(.038)	(.046)	(.049)
GDP per capita (ln)	.730**	.616**	.654**	-.133*	-.164*	-.117
	[.414]	[.349]	[.371]	[-.225]	[-.277]	[-.197]
	(.077)	(.092)	(.092)	(.066)	(.074)	(.079)
Urban Population as %	.007*	.011**	.010*	.007*	.008*	.006
Total Population	[.079]	[.125]	[.111]	[.222]	[.250]	[.205]
	(.004)	(.005)	(.005)	(.004)	(.004)	(.004)
Exports as % GDP (ln)	.072	.014	.021	.122*	.085	.092
	[.024]	[.005]	[.007]	[.122]	[.084]	[.092]
	(.071)	(.073)	(.073)	(.070)	(.066)	(.067)
Domestic Investment		.008*	.008*		.001	.001
as % GDP		[.029]	[.028]		[.015]	[.009]
		(.005)	(.005)		(.006)	(.006)
Secondary Sector		.101*	.130**		.092*	.137*
FDI stocks as % GDP (ln)		[.035]	[.044]		[.094]	[.139]
		(.045)	(.043)		(.054)	(.061)
EINGO Presence (ln)		-.013	-.010		.062	.070
		[-.005]	[-.004]		[.076]	[.086]
		(.061)	(.061)		(.074)	(.076)
FDI Stocks as % GDP (ln)			-.066*			-.098*
X High EINGO Presence			[-.029]			[-.129]
			(.032)			(.046)
Constant	-15.138	-13.991	-21.710	-14.243	-1.059	-11.171
R^2 Within	.777	.793	.801	.238	.256	.292
R^2 Between	.929	.930	.931	.521	.522	.519
R^2 Overall	.918	.919	.920	.443	.444	.449

Notes: *p<.05 **p<.01 (one-tailed tests); standardized coefficients are in brackets; robust standard errors are in parentheses; mean observations per country = 4.0 for all reported models; Model B also includes unreported High EINGO Presence dummy variable

The second model, labeled «Model A», consists of the baseline controls as well as domestic investment, secondary sector foreign direct investment stocks as percent GDP, and EINGO presence. The third model, labeled «Model B», also includes the slope-dummy interaction between secondary sector foreign direct investment and high EINGO presence. Model B also includes the «high EINGO presence» dummy variable used for calculating the slope-dummy interaction variable of interest. The effect of the dummy variable is unreported, but non-significant for both outcomes.

Prior to discussing the findings of interest for the analyses reported in Table 2, we briefly summarize the statistically significant relationships between the two outcomes and the controls. The effect of total population on both total emissions and emissions per GDP is positive. The former is consistent with prior research on scale outcomes as well as structural human ecology theorization while the latter is consistent with other recent cross-national investigations (e.g. Roberts and Parks, 2007). Total emissions is positively associated with level of economic development, and this association is well illuminated by treadmill of production theory (Schnaiberg and Gould, 1994). Higher income countries generally contain larger articulated markets that consume greater levels of energy and other natural resources, and environmental degradation is largely driven by the growth and intensification of market economies. To maintain profits, producers must constantly expand production, which requires additional ecological material inputs and overall increases in waste, including greenhouse gas emissions. On the other hand, in the first two models of emissions per GDP, the outcome is negatively associated with level of development, and the relationship is non-significant in Model B. The negative effect of per capita GDP in the first two models suggests that, all else being equal, «middle-developed» countries tend to be more eco-efficient than «lesser-developed» countries —at least in the context of carbon dioxide emissions.

Urban population has a positive effect on total emissions in all three models, and a positive effect on emissions per unit of production in the baseline model and Model A. Generally speaking, these results are consistent with the urban political-economy assertion that larger urban built environments require a great deal of energy and other resources for their construction and maintenance. Furthermore, resource-intensive as well as waste-intensive production processes often take place in more urban regions (Dickens, 2004). Exports as percent GDP has a positive effect on emissions per unit of production in the baseline model, but its effect is non-significant in the other two models for this outcome as well as all reported models for total emissions. We also note that the effect of domestic investment is positive for total emissions but non-significant for emissions per GDP. As discussed above, due to data availability limitations, the measures of domestic investment are for all sectors combined, while one of our primary interests is in the sector-level environmental impacts of foreign

investment. With this caveat in mind, however, the relative magnitude of the effect of domestic investment on total emissions is lower than the effect of secondary sector foreign direct investment, which we describe below.

Turning to the results of interest, the effect of secondary sector foreign investment as percent GDP on total CO_2 emissions and emissions per unit of production is positive. These findings lend support to ecostructural theorization concerning the potential environmental consequences of foreign investment dependence. It appears that foreign controlled manufacturing —all else being equal— is indeed more energy consumptive, which leads to higher emissions, and also relatively less eco-efficiency. Combined with the non-significant effect of exports on both outcomes [with the above noted exception], the results indicate that the environmental impacts of different forms of world economic integration are far from monolithic. While the relative magnitude of the effect of secondary sector foreign direct investment on total emissions is small, it warrants noting that in studies of environmental outcomes measured by scale [e.g. total emissions], population size usually has standardized coefficients close to a value of one, and by itself explains a high level of variation in the outcome (e.g. Jorgenson, 2007).

The direct effect of EINGO presence is non-significant for both outcomes. While this could be perceived as discrediting the relevance of world society theory —or more generally the impacts of social movements organizations to impact environmental outcomes— we postulate that EINGOs might benefit the environment through their collective abilities to suppress the environmental harms of transnational firms operating in host economies. We examine this hypothesis through the analyses of the slope-dummy interaction between foreign direct investment and high EINGO presence. The test of statistical significance for the slope-dummy coefficients determines whether the slope for the particular interaction and the reference category —in this case «low» EINGO presence— differ significantly. For both total CO_2 emissions and emissions per GDP, it appears as if the effect of secondary sector foreign direct investment is indeed mitigated by the higher presence of EINGOs. More specifically, the slope-dummy interaction is negative and statistically significant for both outcomes. Thus, the effect of foreign direct investment in manufacturing on total carbon dioxide emissions and emissions per unit of production is lower in nations with a higher presence of EINGOs than in less-developed countries with a lower presence of transnationally-organized citizen groups focusing on the environment. Put differently, it appears that EINGOs are able to help reduce anthropogenic carbon dioxide emissions in less-developed countries when their presence is high and they collectively target the environmentally harmful practices of transnational manufacturing firms.

7. Conclusion

This research contributes to our collective understanding of society-nature relationships in comparative perspective. Foremost, we engaged investment dependence and world society theories to investigate carbon dioxide emissions in less-developed countries. The findings of our cross-national panel analyses indicate that foreign direct investment in manufacturing contributes to total carbon dioxide emissions as well as emissions per unit of production, net of other factors. Thus, transnationally-controlled production facilities operating in less-developed countries are generally more energy consumptive, waste emitting, and less eco-efficient. These results provide substantial support for our ecostructural framing of foreign investment dependence theory. World society integration in the context of EINGO presence appears to have little if any direct benefits for environmental conditions —at least when considering anthropogenic greenhouse gas emissions. However, results of the analyses consistently show that nations with a stronger presence of world environmental regime agents [EINGOs] are able to mitigate the effects of foreign investment on carbon dioxide emissions. A greater presence of EINGOs facilitates a stronger collective persistence. Through their volume of different tactics and mechanisms, world environmental regime agents and other sorts of civil society groups can influence the practices of economically-motivated transnational organizations, many of which are distanced from the environmental impacts of their productive activities. In other words, through their collective influence and pressures on transnational corporations and foreign capital, it appears that world society forces can lead to environmentally beneficial changes in less-developed countries. While this holds true for attenuating the effects of foreign investment in manufacturing on carbon dioxide emissions in some less-developed countries, future research on other unique forms of environmental harms would do well to consider the extent to which EINGOs are able to suppress the effects of foreign investment in different economic sectors.

References

Alderson, A. S. and Nielsen, F. (1999). «Income Inequality, Development, and Dependence: A Reconsideration». *American Sociological Review,* 64: 606–631.

Boli, J. and Thomas, G. M. (1999). *Constructing World Culture: International Nongovernmental Organizations Since 1875*. Stanford: Stanford University Press.

Bradshaw, Y. and Schafer, M. J. (2000). «Urbanization and Development: The Emergence of International Non-Governmental Organizations among Declining States». *Sociological Perspectives*, 43: 97–116.

Center for Clean Air Policy [CCAP] (2005). «New Agreement on Emissions Reducing. Projects in Developing Nations Tops Policy News at Climate Conference». *Press Release*. Online Resource: http://www.ccap.org/international/Press%20Release-CDM%20ConclusionsREVISED%2 0FINAL%20_2_.pdf. Retrieved 3/10/2008.

Chang, Ha-Joon (2002). *Kicking Away the Ladder: Development Strategy in Historical Perspective*. London: Anthem.

Chase-Dunn, C. (1975). «The Effects of International Economic Dependence on Development and Inequality: A Cross-National Study». *American Sociological Review*, 40: 720–738.

Chase-Dunn, C.; Kawano, Y. and Brewer, B. (2000). «Trade Globalization since 1795: Waves of Integration in the World-System». *American Sociological Review*, 65: 77–95.

Clapp, J. and Dauvergne, P. (2005). *Paths to a Green World: The Political Economy of the Global Environment*. Cambridge, MA: MIT Press.

Clark, R. (2008). «Dependency, Network Integration, and Development». *Sociological Perspectives* (in press).

Dickens, P. (2004). *Society and Nature*. Cambridge: Polity Press.

Dietz, T. and Rosa, E. (1994). «Rethinking the Environmental Impacts of Population, Affluence, and Technology». *Human Ecology Review*, 1: 277–300.

Dixon, W. and Boswell, T. (1996). «Dependency, Disarticulation, and Denominator Effects: Another Look at Foreign Capital Penetration». *American Journal of Sociology*, 102: 543–562.

Frank, D. J. (1999). «The Social Bases of Environmental Treaty Ratification». *Sociological Inquiry*, 69: 523–550.

Frank, D. J.; Hironaka, A. and Schofer, E. (2000). «The Nation-State and the Natural Environment over the Twentieth Century». *American Sociological Review*, 65: 96–116.

Frees, E. (2004). *Longitudinal and Panel Data: Analysis and Applications in the Social Sciences*. New York, NY: Cambridge University Press.

Frey, R. S. (2006). «The Flow of Hazardous Exports in the World-System: The Case of the Maquiladora Centers in Northern Mexico», in Jorgenson, A. K. and Kick, E. (eds.). *Globalization and the Environment*, 133-150. Leiden: Brill Academic.

Greene, W. (2000). *Econometric Analysis* (4th edition). Upper Saddle, NJ: Prentice Hall.

Grimes, P. and Kentor, J. (2003). «Exporting the Greenhouse: Foreign Capital Penetration and CO2 Emissions 1980-1996». *Journal of World-Systems Research*, 9: 261–275.

Hafner-Burton, E. M. and Tsutsui, K. (2005). «Human Rights in a Globalizing World: The Paradox of Empty Promises». *American Journal of Sociology*, 110: 1373–1411.

Hsiao, C. (2003). *Analysis of Panel Data* (2nd edition). New York, NY: Cambridge University Press.

Intergovernmental Panel on Climate Change [IPCC] (2007). *Climate Change 2007: The Physical Science Basis*. Geneva: IPCC Secretariat.

Jorgenson, A. K. (2006). «Global Warming and the Neglected Greenhouse Gas: A Cross-National Study of the Social Causes of Methane Emissions Intensity, 1995». *Social Forces*, 84: 1777–1796.

Jorgenson, A. K. (2007). «Does Foreign Investment Harm the Air We Breathe and the Water We Drink? A Cross-National Study of Carbon Dioxide Emissions and Organic Water Pollution in Less-Developed Countries, 1975-2000». *Organization & Environment*, 20: 137–156.

Jorgenson, A. K. (2009). «The Transnational Organization of Production, the Scale of Degradation, and Ecoefficiency: A Study of Carbon Dioxide Emissions in Less-Developed Countries». *Human Ecology Review*, 16: 64–74.

Jorgenson, A.; Dick, C. and Mahutga, M. (2007). «Foreign Investment Dependence and the Environment: An Ecostructural Approach». *Social Problems*, 54: 371–394.

Jorgenson, A. K. and Kuykendall, K. (2008). «Globalization, Foreign Investment Dependence, and Agriculture Production: A Cross-National Study of Pesticide and Fertilizer Use Intensity in Less-Developed Countries, 1990-2000». *Social Forces*, 87: 529–560.

Keck, M. and Sikkink, K. (1998). *Activists Beyond Borders*. Ithaca: Cornell University Press.

Kentor, J. (1998). «The Long Term Effects of Foreign Investment Dependence on Economic Growth 1940-1990». *American Journal of Sociology*, 103: 1024–1046.

Kentor, J. and Grimes, P. (2006). «Foreign Investment Dependence and the Environment: A Global Perspective», in Jorgenson, A. K. and Kick, E.: *Globalization and the Environment*, 61-78. Netherlands: Brill Academic Press.

McMichael, P. (2004). *Development and Social Change: A Global Perspective*. Thousand Oaks, CA: Pine Forge Press.

Meyer, J.; Frank, D. J.; Hironaka, A.; Schofer, E. and Tuma, N. B. (1997). «The Structuring of a World Environmental Regime, 1870–1990». *International Organization,* 51: 623–51.

Meyer, J.; Boli, J.; Thomas, G. and Ramirez, F. (1998). «World Society and the Nation-State». *American Journal of Sociology*, 103: 144–181.

Muller-Carmen, M.; Almond, P.; Gunnigle, P.; Quintanilla, J. and Tempel, A. (2001). «Between Home and Host County: Multinationals and Employment Relations in Europe». *Industrial relations Journal*, 33 (5): 435–448.

Nielsen, F.; and Alderson, A. S. (1995). «Income Inequality, Development, and Dualism: Results from an Unbalanced Cross-National Panel». *American Sociological Review,* 60: 674–701.

Organisation for Economic Co-Operation and Development [OECD] (1999). *Foreign Direct Investment and the Environment.* Paris: OECD Publications.

Organisation for Economic Co-Operation and Development [OECD] (2001). *International Direct Investment Statistics Yearbook 1980-2000.* Paris: OECD Publications.

Risse, T.; Ropp, S. C. and Sikkink,K. ed(s) (1999). *The Power of Human Rights: International Norms and Domestic Change*. New York: Cambridge University Press.

Roberts, J. T. and Parks, B. (2007). *A Climate of Injustice: Global Inequality, North-South Politics, and Climate Policy.* Cambridge, MA: MIT Press.

Schnaiberg, A. and Gould, K. (1994). *Environment and Society: The Enduring Conflict*. New York, NY: St Martin's Press.

Schofer, E. and Hironaka, A. (2005). «The Effects of World Society on Environmental Outcomes». *Social Forces*, 84: 25–47.

Shandra, J.; London, B.; Whooley, O. and Williamson, J. (2004). «International Nongovernmental Organizations and Carbon Dioxide Emissions in the Developing World: A Quantitative, Cross-National Analysis». *Sociological Inquiry*, 74: 520–545.

Smith, J. and Wiest, D. (2005). «The Uneven Geography of Global Civil Society: National and Global Influences on Transnational Association». *Social Forces*, 84: 632–652.

Stiglitz, J. (2002). *Globalization and Its Discontents*. New York, NY: WW Norton & Company.

Union of International Associations (1980/1981, 2000/2001). *Yearbook of International Organizations.* Brussels: Union of International Associations.

United Nations (1992, 1994, 1996, 2000, 2003). *World Investment Directory* (Volumes 1-8). New York, NY: United Nations.

Wallerstein, I. (2005). «After Developmentalism and Globalization, What?». *Social Forces*, 83: 1263–1278.

World Bank (2007). *World Development Indicators* (CD-ROM). Washington, D.C.: World Bank.

World Resources Institute (2005). *Earth Trends Data CD-ROM: The Wealth of the Poor*. Washington, DC: World Resources Institute.