

# Pollution in the Río Santiago: A Qualitative Analysis

by

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A THESIS

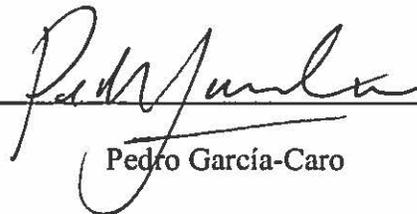
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The Río Grande de Santiago—colloquially known as the Río Santiago—has become one of the most polluted rivers in North America. The river, which spans more than 430 kilometers, directly borders numerous towns whose citizens have been afflicted with several pollution related health issues. Much of the pollution stems from the industrial center of Guadalajara where over a hundred corporations, many of which are international, set up plants and factories in the wake of NAFTA. Although the extent of the pollution and its repercussions for public health have been known for some time, the Mexican government has been slow make meaningful action towards preventing the pollution. This study performs a qualitative analysis on the economics of pollution in the Río Santiago, employing a systematic review of relevant literature in order to explore the culpability of NAFTA in promoting pollution, the mechanisms which encourage environmentally unsustainable behavior, as well as the sources and long-run economic effects of the pollution.

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The Santiago River rages.

Clouds of foam reach a height of 20 meters.

Those who walk across the bridge which joins the two towns, do so running.

Those who cross by car close their windows.

There are mountains of bubbles. The foam lifts off the river.

They are the size of pillows and they fly in the air.

The chemical clouds of foam are potent.

The surfaces of cars are stained. Skin burns, it stings, rashes form and fingernails fall off.

Bubbles fall in the streets and children play with them.

- El Peligro Que no Se Ve (IMDEC)

## **Introduction:**

The falls of Juanacatlán, located on the Río Grande de Santiago in the province of Jalisco, was once one of Mexico's natural wonders. A journalist for the Chicago Tribune in 1898 depicted the falls in their March 10<sup>th</sup> column, calling it “an artist's dream of rural delights,” and describing the cascade as “plunging over a wall of gray granite in a steady unbroken cataract 260 feet in width for a sheer distance of 60 feet into a seething, eddying vortex below.” Surrounding the waterfall, they write, was an abundance of flora and fauna, highlighted by “the constant presence of myriads of gorgeous butterflies, which flit in and out the rifts of the great cascade and to and fro through the clouds of drifting vapor, seemingly attracted and fascinated by the dazzling buffeting avalanche of foam.” Over time the falls became a major ecotourism attraction within the region, eventually obtaining the byname of “The Niagara of Mexico,” due to its reputation as the grandest waterfall in Mexico (Tetreault and McCulligh 2012, 100). More than a century later, however, the reputation of the falls of Juanacatlán, as well as its constituent river could not be more different.

The Río Grande de Santiago—colloquially known as the Río Santiago—has become one of the most polluted rivers in North America. The river, which spans more than 430 kilometers, directly borders numerous pueblos whose citizens have been afflicted with several pollution related health issues. The most afflicted of these pueblos are El Salto and Juanacatlán, which both lie directly on the riverbank and are bisected by the falls of Juanacatlán. According to Un Salto de Vida, an activist group promoting the sanitation of the river, over the last 15 years in the pueblo of El Salto alone (population of 19,794) there have been 524 cases of renal failure and 236 cases of

cancer as a result of the contamination (*La Jornada*, December 31, 2015). The health effects, however, range far beyond terminal illnesses. In a report published by the Instituto Mexicano para el Desarrollo Comunitario (IMDEC), the authors describe the health effect on students of two elementary schools located near the river, writing that “In a survey of 100 homes in the study area, where 166 children between the ages of 6 and 14 reside, it was found that 39% of the children regularly suffered from some illness. The most common illnesses presented among these children were: 49.23% respiratory illnesses, 44.61% throat infections, 4.61% skin problems, and 1.5% other types of illness. Symptoms were also reported, including headaches, nausea, throat irritation, heat rashes and conjunctivitis,” (5). Although the causal link between the pollution and the illnesses has not been solidly proved, the symptoms are consistent with those which occur as a result of exposure to many of the chemicals found within the river.

The vast majority of the pollution stems from the industrial center of Guadalajara, where more than three hundred corporations, many of which are international, set up plants and factories over the last thirty years. Industrialization intensified after the adoption of neoliberal economic reforms, including most notably the passage of the North Atlantic Free Trade Agreement (NAFTA) in 1994, leading many to posit a direct causal relationship between the reforms and the intensification of pollution. A significant portion of current studies of the Río Santiago, both academic and journalistic suggest this relationship, arguing that “[NAFTA] dramatically reduced export tariffs for foreign companies, and that opened the floodgates for U.S. companies seeking to take advantage of Mexico’s relatively cheap labor and lax environmental

regulation,” (*Fusion*, 2015). Proponents of economic reforms, however, argue the opposite, claiming that economic liberalization will actually improve environmental conditions as incomes rise and greener technology is introduced.

Although the extent of the pollution and its repercussions for public health have been known for some time, the Mexican government has been slow to make meaningful action towards preventing the pollution, although there is evidence that this is beginning to change. In general, environmental protection was cast aside in favor of industrial and economic development, as the two were seen as incompatible policy directions. In light of the severity of pollution, as well as the perceived relationship between economic development and the contamination of the Río Santiago, this paper seeks to explore the economic cause and effect of pollution on the Río Santiago. It employs a systematic review of relevant literature, and then contextualizes the findings within the framework of the specific case of pollution on the Río Santiago, and the broader context of Mexican economic development. Overall there seems to be little evidence to support the notion that economic liberalization represents one of the primary causes of the pollution—though at the very least, liberalization has failed to bring the benefits which its proponents had promised. Thus the effect of economic liberalization on pollution is ostensibly neutral.

Furthermore, the notion that the major polluters are the consigned to a particular demographic, namely multinational corporations, seems to have little basis. Instead it seems that nearly all of the firms in the area are engaging in illegal polluting in one form or another, and that their refusal to comply with environmental regulation is due primarily to the lack of regulatory enforcement from both national and international

organizations, in addition to a general lack of credit. Finally, this paper shows that in addition to the effects of pollution on human and ecosystem health, there are a number of hidden externalities which threaten to undermine the economic growth and general welfare of the region in the long-run.

### **Methodology:**

This paper employs a systematic review in order to perform this case study for two reasons. The first, and perhaps most limiting factor is that much of the data which could be used to perform a quantitative study of pollution on the Río Santiago either does not exist, is inaccessible, or is unreliable. In many cases it can be difficult, if not impossible, to discern the specific sources of each unit of pollution which enters a river due to the variety of ways in which it can reach the river. In addition to direct discharge, pollution can seep into the ground and be washed into the river, be deposited by atmospheric deposition, or carried by any number of informal or unintentional mechanisms (Tietenberg and Lewis, 2009, 463). This problem becomes compounded in the absence of stringent monitoring, as is the case with the Río Santiago.

Moreover, what data does exist on the sources of pollution in the Río Santiago is rendered practically unusable due to its unreliability. Although the publically available studies do include some data taken at individual plant sites, by and large these are too few and far between to draw any meaningful industry wide conclusions regarding propensity to contaminate. Similarly, the governmentally aggregated data on the sources of plant pollution, collected by the RETC (Registro de Emisiones y Transferencia de Contaminantes), relies on self-reporting. This is also too unreliable to

use in a quantitative study as those firms who do self-report have an incentive to obfuscate their true levels of pollution. This perverse incentive is only magnified by the fact that for many years self-reporting for the RETC was voluntary, and because there has been little to no indication that the Mexican government will check the validity of reported numbers. Moreover, as we would assume that there would be a fairly significant correlation between which firms are willing to report their effluents and those who pollute, we would expect selection bias to skew any results achieved from the data.

Finally, Mexico's economy is defined by an abnormally large informal sector, even among industrial sectors. It is extremely unlikely that these firms would appear in any of the self-reported data, even if they are polluters. By implementing a systematic review of relevant literature, this study is able to avoid the data issues while still making observations regarding the pollution of the Río Santiago. However, there are costs as well as benefits to employing a systematic review in order to perform a case study, as the lack of data removes a level of empirical rigor. Moreover, with systematic reviews it can be easy to draw false conclusions by applying the results of studies which are an inappropriate fit to the conditions found within the case study in question. To avoid this, this study primarily draws on literature which focuses on post-NAFTA Mexico.

### **Contributions to the Field:**

The literature covering pollution in the Río Santiago, due to its highly specific nature, is relatively sparse. This paper will represent the first general examination of the economic causes and effects of the situation. More specifically, what this paper does is

test the validity of pervasive claims regarding the effects of economic liberalization, and more specifically trade liberalization on the levels of pollution in R o Santiago. No such economic studies have previously been attempted in the area. In addition, there have been few to no studies examining the long-run effects of pollution on the urban and regional economic health in the Guadalajara area. This paper contributes to the literature by outlining some of the economic mechanisms at work, paving the way for future research in the area. Furthermore, this paper contributes to our understanding of many of the forces which influence and ultimately define our understanding of the relationship between trade liberalization and the environment specifically.

Perhaps useful when defining the contributions of this paper to our understanding of pollution on the R o Santiago and its relation to trade liberalization, is also explicitly defining what this paper is not. To start, this paper in no way seeks to make a substantive value judgement on NAFTA or economic liberalization as a whole. The economic reforms of the late 20<sup>th</sup> century—highlighted by NAFTA and the adoption of the series of reforms commonly referred to as the Washington Consensus—have a complex and varied set of consequences in Mexico. While in certain areas of the economy the reforms have made substantial and meaningful progress, such as the Mexican government’s progress on controlling inflation and promoting macroeconomic stability, in many other areas there have been clear and tragic failures. Similarly, this paper does not seek to perform statistical or quantitative analyses of the economic effects of the pollution. Rather it illustrates some of the perhaps non-traditional costs which have thus far remained untouched in the literature. Among which are the damages to future economic and demographic growth, as well as the exacerbation of

economic and regional inequality. In essence, this paper challenges the validity of a number of widely held beliefs regarding the interaction between economic development, the environment, trade liberalization, and the long-term effects of pollution in order that we may better evaluate these relationships when similar development programs are being considered.

## **Background information:**

### **History of Trade Liberalization in Mexico:**

Any discussion of economic liberalization and its effects in Mexico must first place itself within the larger context of modern Mexican economic development. The basic framework for the modern Mexican economy was established in the late 19<sup>th</sup> and early 20<sup>th</sup> century during the dictatorship of Porfirio Díaz, a time also known as the *Porfiriato*. Throughout his reign, Díaz established an economic system which revolved, above all, around foreign investment in extractive industries. The Díaz administration, and to a lesser extent the regimes which immediately followed the Mexican Revolution, sought to entice foreign investors to build the basic infrastructure which would allow them to export their natural resources (Kingstone 2011, 21-22). In addition, by expanding foreign involvement and export in the commodities market, early governments were able to collect significant revenues from export duties and land rents. This allowed them to fund the government largely through foreign revenue, and thus lessened the need to collect taxes and establish a tax base.

While the expansion of commodity exportation allowed Mexico to begin its march to modernization, it also left them perilously exposed and reliant on the global economy, and more specifically that of the United States. Thus when the stock market crashed and the Great Depression took hold in the United States and Europe, it wasn't long before the Mexican economy followed suit. Commodity prices fell in the face of global economic stagnation, and the Mexican government soon found themselves unable to import much of the capital which their modernization plan relied on.

Simultaneously, there were no domestic industries who could fill the capital void. The economic turmoil which resulted from the Great Depression made it abundantly clear to Mexico's ruling party that there needed to be major shifts in economic policy. This led to the era of import-substitution industrialization (ISI), which defined the economies of most Latin American countries in the post-war period until it was replaced by economic liberalization (Weintraub 2010, 26-27).

Designed by the Argentine economist Raúl Prebisch, ISI became a simple yet effective solution to Latin America's economic woes. Prebisch recognized that an economy that relied on commodity exports was in the long run unsustainable due to the tendency of commodity prices to decrease relative to those of manufacturing products over time (26). The solution, he proposed, was to insulate Latin American economies from those of the more developed nations, while simultaneously subsidizing investment in those industries whose goods were previously imported. This would allow those industries which didn't have the capital to be internationally competitive, such as manufacturing, to establish themselves gradually, and free from international pressure. Following Prebisch's advice, the Mexican government enacted a number of protectionist policies, including raising high tariffs, expropriating the oil and gas industries, fixing the exchange rate, and in 1972 even going so far as to place quotas on the amount of foreign technology that could be purchased in an attempt to incentivize technological innovation in domestic industries (45).

The ISI reforms were by and large successful from an economic growth standpoint. Throughout 1940-1965, Mexican real GDP grew by an average of 6.3

percent, resulting in a 117.2 percent increase in per capita GDP<sup>1</sup> over the same period. In addition, the manufacturing sector grew significantly, accounting for 25.3 percent of Mexico's GDP by 1965 (Middlebrook and Zepeda 2003, 6). Furthermore, ISI complemented nicely attempts by the Mexican government to distance themselves politically from the United States. According to Weintraub, "Mexico wanted to assert its nationalism that the United States had repeatedly dismissed for more than a century before," citing in particular "U.S. interference during the Mexican Revolution, its later military forays into Mexico, and its adamancy in the 1920s and 1930s that led Lázaro Cárdenas to expropriate the holdings of foreign oil companies," (27). Despite their disdain towards the U.S. tendency to interfere in domestic matters, prior to the adoption of ISI the Mexican economy was forced to retain a relationship with the United States in order to keep their market open for Mexican exports, and to maintain access to U.S. consumer goods.

Despite achieving its initial goal of stimulating economic and industrial development, ISI contained within it several fatal flaws which ultimately made the policies unsustainable. In order to spur industrial production of consumer goods it was necessary to import various forms of capital which were unable to be produced locally, either due to a physical lack of facility or technological sluggishness. Having shunned the export-centric model of obtaining revenue and being wary of foreign investment, the Mexican government instead turned to foreign debt financing in order to fund ISI (Weintraub 2010, 29). This consisted of borrowing money both from international organizations such as the IMF, as well as from private and public foreign investors.

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<sup>1</sup> Per Capita GDP is perhaps the most commonly used indicator by economists for general economic growth, as it accounts for the effect of population increases on gross production.

Foreign debt financing is, however, an inherently dangerous way of raising capital due to its unpredictability. Loan payments can be heavily affected by changes in interest and exchange rates, neither of which a government has full control over. In particular, Mexico's loans were heavily connected to the interest and inflation rates of the United States, a connection which although was initially beneficial, ultimately exacerbated repayment issues (29). By the early 1970's it became clear to many that Mexico was struggling to pay their international creditors, however any reform to economic policy was pushed back into the 1980's due to the increased oil revenue which accompanied the OPEC crisis (Middlebrook and Zepeda 2003, 7). It wasn't until 1982 and the fall in oil prices that Mexico's government realized it would have to liberalize the economy in order to maintain access to foreign capital and thus meet its financial obligations.

ISI's other major flaw is that it inherently shields domestic producers from any competition, and in doing so simultaneously creates opportunities for systemic abuse, while also putting a cap on potential economic growth. When acting in a protected economy firms have little incentive to increase efficiency. According to Kingston (2011) "Protected firms enjoy guaranteed markets and as a result do not feel the need to invest in new technology or to become more efficient or more productive. Instead, they can be content to earn their profits on high prices for the low volume of goods they sell," (41). Increases in efficiency and productivity are essential to an economy's wellbeing as they are the main engine of economic growth and accordingly are integral for raising standards of living. Even though productivity increases did occur throughout the ISI era, the inefficient actions of firms almost certainly slowed the rate of growth towards the end.

Furthermore, industrial development tends to follow a fixed path. Newly industrializing economies will begin by specializing in industries which are low-cost and require lower levels of human capital. The most obvious example of these types of industries are those which produce consumer goods, such as the textile industry. There are limits, however, as to how much economic growth can be generated by such industries, and developing economies eventually need to transition to producing more complex and viable goods, such as capital goods. To enter these markets a firm needs access to a number of things which can be hard to come by within an ISI scheme, such as higher levels of technical knowledge and larger capital investments (42). The isolation which ISI imposed on the Mexican economy ultimately proved to be a drag on the economy by holding prices high, capping economic growth, and preventing access to improved technology and industrial knowledge. Thus when the debt crisis of 1982 struck, the Mexican government had little choice but to begin the process of economic liberalization.

Economic liberalization was enacted gradually throughout the 1980s, pushed forward largely by international debt obligations and the requirements set by multilateral and commercial bank creditors (Middlebrook and Zepeda 2003, 8). That's not to say, however, that the economic liberalization of Mexico was conceived and implemented completely from abroad. Economic liberalization had long been advocated for by Mexican economists (Weintraub 2010, 28), and was ultimately implemented by a score of "political technocrats," who were "committed to opening the economy, redefining the established pattern of state/private-sector interactions, and promoting export-oriented growth," (Middlebrook and Zepeda 2003, 11). The reforms consisted of

a series of economic policy shifts designed towards opening and integrating the Mexican economy into the global economy, a development plan which ultimately became known as the Washington Consensus. Among the policies prescribed by the Washington Consensus, and implemented by the administrations of presidents Miguel de la Madrid (1982-1988) and Carlos Salinas de Gortari (1988-1994) were “market reforms that included trade, exchange-rate, and industrial policy liberalization; deregulation of foreign investment flows and domestic commercial and financial activities; and the large-scale privatization of state-owned enterprises,” (8). Trade liberalization specifically began in earnest in 1986 with Mexico’s entrance into the GATT (General Agreement on Tariffs and Trade), which significantly reduced many of the tariffs that had previously insulated the Mexican market from international goods.

Despite the extensive economic reforms adopted by the Mexican governments throughout the 1980s, economic recovery from the 1982 debt crisis proved elusive. While nations such as the United States were enjoying immense economic prosperity, Mexico’s economy contracted by an average of half a percentage point per year throughout the decade. Mexico’s economic troubles were accentuated by a decline in its industrial sector, which took a full nine years to reach its pre-1982 level of production (Weintraub, 2010, 29). Much of the problem lay with an inability to attract sufficient amounts of foreign direct investment (FDI). Part of the logic behind economic and trade liberalization was that Mexico would be able to grow through exporting, namely that companies would invest in building factories in Mexico to take advantage of cheap labor costs. These factories would primarily create goods to export to other developed nations, such as the United States. This would, at least in theory, result in the creation of

relatively better paying jobs working in factories, the accumulation of human and physical capital<sup>2</sup>, and the expansion of the available market that Mexican firms could sell to and buy from. The Mexican government's inability to attract sufficient FDI was compounded by events occurring abroad such as the fall of the Berlin Wall, which siphoned away much of the FDI that Western Europe was able to provide (30-31).

It was under these financial pressures that President Salinas went to then U.S. President George H.W. Bush in order to explore the possibility of a bilateral trade agreement—what would ultimately become NAFTA. Canada later joined the discussions in order to, in the words of Weintraub, “avoid having what it called a hub-and-spoke arrangement under which the United States would have free trade with both Mexico and Canada (the United States would be the hub), and each of them would have free trade only with the United States,” (31). Negotiations for the now tri-lateral trade agreement occurred from 1990-1992, with an agreement being signed on December 17, 1992 subject to ratification by each nation's respective legislative body. President Salinas had little trouble getting the bill passed, partially due to a widely successful promotional campaign and partially due to the naturally authoritarian nature of Mexico's political system (32). In the United States, however, ratification of the agreement was pushed into the Clinton presidency due to skepticism on both sides of the congressional aisle. The bill was ultimately ratified in November of 1993, but only after two side agreements were created: the North American Agreement on

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<sup>2</sup> Human Capital can be defined as the “stock of technical knowledge and skill embodied by a nation's workforce, resulting from investments in formal education and on-the-job training,” (Samuelson and Nordhaus 2005, 740). Physical Capital is defined as “those durable produced items that are in turn used as productive inputs for further production,” (267). An example of this would be a machine used in a factory to create automotive parts.

Environmental Cooperation (NAAEC) and the North American Agreement on Labor Cooperation.

The Mexican economy in the years following NAFTA was turbulent, although ultimately promising. Although the fanfare which initially accompanied NAFTA's ratification was dampened by the peso crisis of 1995, a side consequence of the political disorder which followed the Zapatista Rebellion, the first few years of free trade largely accomplished its goals. The Mexican economy was able to recover relatively quickly from the peso crisis as exports to the United States more than doubled during the first five years after NAFTA's initiation, and quadrupled within the first fifteen (33). United States investment in Mexico also increased dramatically. According to economist Sidney Weintraub, foreign direct investment "rose sharply, from about \$2.7 billion a year in the ten years before NAFTA came into effect to more than \$15 billion a year during the ten years after NAFTA," (33). That's not to say, however, that all of NAFTA's promises were fulfilled. Although manufacturing jobs did increase dramatically, the growth rate was unable to keep up with the amount of jobs being lost in the agricultural sector. One study found that while 500,000 manufacturing jobs were added as a result of NAFTA between 1994 and 2002, more than 1.3 million agricultural jobs were lost due to increased competition with the United States. Moreover, real wages in Mexico have not begun converging with those in the U.S as gains in productivity have not yet translated to gains in real wages for Mexican workers (Audley 2004, 6). Economic liberalization was, for the most part, completed when NAFTA was ratified. The notable exception to this is the petroleum industry, which only opened itself up to foreign investment in 2014 after significant internal debate.

The lessons to take from the overview of modern Mexican economic history, as well as its relevance to this analysis lies in the context it offers for the course of Mexican industrial development. Industrialization broadly has been a central pillar of Mexican economic policy throughout the 20<sup>th</sup> century, independent although not unrelated to economic ties to the United States. Thus as we begin to examine the causes of pervasive industrial pollution, and more specifically how NAFTA may have contributed to its prevalence, it becomes important to try and disentangle the effect of NAFTA from the effects of the industrialization which would have inevitably occurred in its absence. Second, the relationship between industry and the environment is heavily affected by developments in macroeconomic policy. In particular, fiscal, monetary, and trade policy all play integral roles in the allocation and availability of credit which helps determine access to new, greener capital. The allocation of funds to regulatory agencies, and particularly environmental regulatory agencies can vary significantly with changes in macroeconomic stability and vitality. Furthermore, foreign direct investment, as well as governmental investment can play a significant role in the industrial makeup of the economy, shifting emphasis towards cleaner or dirtier industries. Finally, it's important to observe that many of the drastic shifts in Mexican economic policy occurred out of necessity, brought on by economic or political crises. This limited the amount of potential development paths which the Mexican government was able to pursue, something which ultimately plays a large role in determining environmental policy.

### **Overview of the Leading Economic Theories in Trade and the Environment:**

Examining the effects of economic and trade liberalization on the environment will, of course, largely depend on the particular circumstances within a country. That

being said, economists have a number of theories and hypotheses regarding general trends which we would expect to see upon trade liberalization. Discussions of the potential interactions between economic liberalization and the environment often gravitate towards one of two mainstream ideas: the pollution haven hypothesis and the EKC curve hypothesis. Part of analyzing NAFTA's effect on pollution in the Río Santiago thus will necessarily entail testing the validity of these trends for our particular case study.

The first, and arguably more prominent theory regarding trade and the environment is the pollution haven hypothesis. More commonly known as "The Race to the Bottom" the pollution haven hypothesis argues that pollution acceptance can, in effect, serve as a comparative advantage for an underdeveloped economy. Recognizing this, underdeveloped or developing countries may have an incentive to weaken environmental regulations. Moreover, it assumes that producers will do whatever they can to avoid enacting costly but environmentally friendly actions, choosing instead to minimize their direct costs by adhering only to the minimum environmental standards required by the law. Thus, because underdeveloped nations such as Mexico often have more lax environmental standards (or enforcement), they may use this comparative advantage to attract foreign, would-be-polluting firms to their country, creating a haven for pollution.

The increases in pollution which occur under the pollution haven hypothesis are generally thought to result from one of three effects: the *composition effect*, the *scale effect*, or the *technique effect*. The composition effect simply describes pollution increases which result from an increased ratio of dirty industries to clean ones within a

nation's economy (Tietenberg and Lewis 2009, 585). To give an example, suppose a country produces 100 units of output, with 50 units occurring in clean and dirty sectors respectively. According to the composition effect, when trade liberalization occurs the undeveloped nation will specialize in the dirty industries, shifting the ratio of dirty to clean industries from 50-50 to 70-30. In this situation, although output remains constant, we see that emissions would increase due to the relative growth in the dirty sector. Under this scenario trade liberalization would have a wholly negative effect, as the increase in emission would not be offset by a subsequent increase in output.

The scale effect accounts for increases in pollution which occur due to growth in aggregate output. Namely, the ratio of dirty industries to clean industries could remain constant within an economy, but aggregate emission levels could increase simply due to increased levels of aggregate output which result from economic growth. Returning to our hypothetical country with 100 units of output, the scale effect would see that country's sectoral output increase from 50-50 to 60-60. Thus, although the aggregate level of pollution will increase, the country's economy hasn't gotten any "dirtier," and they still receive the benefits from the increased output. The scale effect is the most difficult to prevent, as it would require that firms not only prevent any relaxing of their environmental standards, but also that they tether their growth to their ability to improve their environmental performance.

With the technique effect we examine pollution as it occurs within a particular firm, as opposed to the economy at large. According to the technique effect, "emissions could increase in pollution havens if each firm in the pollution haven became dirtier as a result of openness to trade," (585). An example of the technique effect in action would

be a firm, now facing foreign competition, deciding to decrease the amount of their effluents which they treat. While in reality we would expect that pollution increases would be the result of some combination of the three effects, rather than due to a single effect, it can still be useful from a policy perspective to demarcate the individual effects. This is because the mechanism for mitigating pollution depends heavily on which of the three effects is responsible in a given situation. For example, if the composition effect is occurring we might see a number of dirty firms siphon investment from cleaner firms. In this scenario the government could subsidize investment in the cleaner firms, mitigating some of the damage. This solution, however, would do nothing to stop the pollution occurring due to the technique effect.

The pollution haven hypothesis is highly controversial among economists, largely because of the lack of conclusive empirical evidence supporting the notion. Studies such as Dean (1992), Jaffe et al. (1995), and Gallagher (2004) all find little evidence that the pollution haven hypothesis is valid. Even those studies which do find some evidence of a pollution haven forming, such as Copeland and Taylor (2004), find that the effects are fairly small. One reason that pollution havens may not be as common as our intuition might suggest is that, according to Tietenberg and Lewis (2009), “pollution control costs comprise a relatively small part of the costs of production,” thus “it would be surprising if lowering environmental standards could become a major determinant of either firm location decisions for the direction of trade unless the costs of meeting those standards became a significant component of production cost,” (586).

Despite the lack of empirical evidence supporting it, the pollution haven hypothesis continues to be one of the most commonly referenced theories in discussions

surrounding trade and the environment. One reason for this is that it corresponds well with what we seem to be witnessing on the ground in developing countries. One needn't dig very deep to find stories of large multinational corporations moving to poor and undeveloped countries and causing environmental catastrophe through extensive pollution. Another reason is that it is inherently difficult to know what exactly motivates a firm to move to another country. Without knowing the specific production function of a given firm, one cannot know with any certainty how influential environmental regulation is on incentivizing a firm's relocation. This only gets more complicated when other push and pull factors for a site are taken into account. For example, in many firms labor costs are a major factor in determining location decisions. Thus for a site like Mexico, where a firm might encounter labor pull factors and environmental pull factors, it can be difficult to parse out the relative weights of each.

### **EKC Relationship:**

The Environmental Kuznets Curve (EKC) theory, named after famed Harvard economist Simon Kuznets, is the other, more widely accepted theory regarding the effects trade liberalization on the environment. The EKC relationship, in its simplest form, argues that environmental quality decreases as incomes increase up to a certain point, after which rising incomes will increase environmental quality as people have a high enough base standard of living that they can begin focusing on environmental issues. To see an example of the EKC relationship in action one need only look at the industrial history of the United States. The EKC relationship is often cited by proponents of free trade, as it seems to imply that the environmental problems which

might arise under free trade will ultimately be self-correcting. Pollution might increase in the short-run, but as long as free trade lives up to its promise of raising household incomes, in the long run it will not be an issue. Moreover, the pollution increases very well could be offset by the standard of living increases wrought from increased trade.

What the EKC relationship fails to determine is what exactly causes the decrease in environmental degradation. Increased public environmental concern may be the motivation behind decreasing environmental contamination, but what is the mechanism which enacts the change? This ends up being an incredibly important question when determining the viability of the EKC relationship as a model of environmental progress. Tietenberg and Lewis (2009) describe the problem nicely, writing “The notion that increasing income from trade involves a self-correcting mechanism would have quite a different meaning if part of that correction involved exporting the pollution intensive industries to other countries,” (587). If this were the case, then what the EKC relationship would show is not environmental improvement, but merely a reallocation of pollution. While this may be beneficial for a given country, it could end up being globally inefficient, especially if the pollution intensive industries relocate to a country less adept at mitigating environmental degradation. What’s more, this would be an inherently unsustainable solution. Tietenberg and Lewis write that “this conjecture is especially important in a finite world because it implies that developing countries would never experience the Kuznets turning point. Since they would have nowhere to go, the pollution intensive industries could not be transferred again,” (587). The majority of the studies which have supported the EKC relationship were conducted looking at now developed nations, such as the United States, and thus would not account for pollution

displacement nor its potential inapplicability for developing countries (Gallagher 2004, 15).

Another issue with the EKC hypothesis is that there is no consensus as to what level of income (or GDP per capita) is necessary to reach the hypothetical Kuznets turning point, or whether or not specific institutions might prevent a country from reaching it. Traditionally the turning point was placed at around \$5000 GDP per capita, with estimates for certain pollutants being even lower (13-14). However, more recent studies argue that if the Kuznets turning point does in fact exist, that it might be at a much higher income level. Some studies have even found that the gains which might result from higher income levels are not permanent, and that there might be a second wave of environmental degradation at higher income levels (15). Interestingly, Mexico's per capita GDP was around \$5,000 at the beginning of their liberalization experiment, making the trajectory of Mexican industrial pollution over the last 30 years an interesting test of the EKC hypothesis.

### **FDI (Linkages):**

The last of the major economic concepts regarding trade and the environment, at least of relevance to this case study, is the effect of foreign direct investment on environmental performance. During the debate over NAFTA many economists made the argument that opening Mexican industry up to foreign investment will, in the long run, actually improve environmental performance. Kevin Gallagher, Daniel Chudnovsky, and Roberto Porzecanski, in their paper *FDI and Sustainable Development in the Americas*, examine this theory, arguing that there are three ways in

which FDI might be expected to promote sustainable development. The first is that FDI tends to be much less volatile than portfolio investment, which had financed Latin American growth in the previous decades. By providing consistent capital, FDI would both provide an investment lifeline for Mexican industries, as well as bring in foreign firms which would provide both employment and tax revenue for the Mexican government (10). The increased revenue, both for Mexican firms and the Mexican government, would provide the two with the financial flexibility to pursue more environmentally conscious development strategies.

The second, and by far most important reason that FDI might promote sustainable development is that it offers the potential for “spillovers” to occur between foreign and domestic firms. Gallagher et al. describes this process, writing “Multinational corporations (MNCs) are considered to possess a ‘bundle of assets’—technology, technical and management expertise, links to global markets—that makes FDI more productive and more environmentally sustainable than domestic investment...Because many of these special assets are a source of rents, MNCs work to keep them tightly in-house. Nonetheless, some knowledge “spills over” outside the firm,” (11). The concept of spillovers, or more specifically knowledge spillovers has a long tradition in economics, being first proposed by Alfred Marshall in his now famous work *Principles of Economics*. Marshall (1920) writes:

So great are the advantages when people following the same skilled trade get from near neighborhood to one another. The mysteries of the trade become no mysteries; but are as it were in the air, and children learn many of them unconsciously. Good work is appreciated; inventions and improvements in machinery, in processes and the general organization of the business have their merits promptly discussed; if one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus it becomes the source of new ideas (352).

Since Marshall first proposed knowledge spillovers in 1920 there have been countless studies which have validated the theory<sup>3</sup>, and it has become one of the cornerstones of urban economics.

In a development setting, when the gap of knowledge between entering firms and existing firms is larger than usual, there is thus a huge potential for host-country firms to benefit from the introduction of multinational corporations. In particular, knowledge spillovers are expected to benefit four distinct groups: multinational corporation subsidiaries, firms which inhabit the same industries as the relocating firm, and then those firms “downstream” and “upstream” from the firm, meaning that they either supply or are supplied by it (Gallagher et al. 2009, 11). The benefits could, and often do take several forms, all highly dependent on the nature of the firms involved. For example, if a MNC from an industry that requires high levels of human capital moves to an area, then they will likely increase the human capital in the region by hiring and training workers. These workers can and often do go on to work in other firms in the area, taking with them their accumulated knowledge and expertise (11). The introduction of MNCs to an area also forces local firms to become more competitive. In doing so they might adopt new, greener technologies, or find ways to improve the productivity of their energy use.

The final way which FDI might be expected to positively impact sustainable development is through the creation of beneficial linkages. Linkages, in their most general sense, can be thought of as connections between industries, generally through the consumption of inputs. There are two types of linkages—forward and backward—

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<sup>3</sup> See *Urban Economics* by Arthur O’Sullivan for more information.

with the direction of the linkage representing whether the recipient firm is “upstream” or “downstream” from the initial firm. Forward linkages affect “the ease of *supply* of another product,” whereas backward linkages affect the demand of another product (Ray 1998, 138-139). Debraj Ray, author of one of the most widely used textbooks on development economics, uses the example of the steel industry to illustrate forward and backward linkages. A firm in the steel industry would, for example, create forward linkages with the railroad industry. Because steel is an input for railroads, any increase in the supply of steel will of course make it easier to increase the supply of railroads. That same firm would create backward linkages with the coal industry, as an increase in steel production would necessarily result in increased demand for its inputs, such as coal (ibid). A central part of the development strategy envisioned by NAFTA’s architects lay in the creation of forward and backward linkages with Mexican firms, something which would boost the domestic economy.

### **Mexico’s Environmental Regime:**

Throughout the 1980’s, as Mexico’s economy increasingly industrialized and liberalized, the Mexican public began to become concerned about the environmental impacts of such changes. Hoping to get ahead of the issue, the Mexican government passed a number of environmental laws and regulations in 1988, spearheaded by the “General Law on Ecological Balance and Environmental Protection” which provided the general framework for governmental environmental protection and put into place regulations on most forms of pollution (Behre 2002, 332). These efforts were only intensified when NAFTA appeared on the horizon, as the Mexican government sought

to convince both the Mexican and American people that they were serious on environmental protection in order to alleviate fears regarding the environmental impact of free trade. Ultimately the NAFTA member states signed the trilateral environmental agreement, the North American Agreement on Environmental Cooperation (NAAEC), in order to create an international set of environmental protections which may prevent some of the possible abuses which were feared to accompany the opening of trade. NAAEC was widely regarded as a significant environmental achievement. Legal scholar Julie A. Soloway (2002) called the agreement “one of the world’s most far-reaching environmental cooperation agreements linked to an international trade agreement,” (172). While the agreement contains a number of environmental provisions, the most significant is its establishment of a trilateral governmental agency which handles environmental disputes between the nations, the Commission for Environmental Cooperation (CEC). In addition, NAAEC obliges member countries to “provide for just and fair access to private remedies on the part of individuals where an environmental law has been allegedly violated,” as well as “effectively enforce their environmental laws,” (173). The global community at large was impressed with Mexico’s efforts. Shortly after NAFTA was put into effect, Anne Rowly, an international attorney with the EPA summarized the achievements proclaiming “in only six years Mexico has established the foundation of a credible legal framework to control environmental contamination” (332). In general, economists and politicians alike were convinced that the environmental impacts of NAFTA would be negligible, if not positive.

Notwithstanding its advancements in environmental framework, throughout the post-NAFTA years Mexico has consistently been unable to control its levels of pollution. Despite significant increases in the scale of industry in Mexico, an obvious precursor to increased pollution, the rate of plant-level environmental inspections has steadily decreased (Gallagher 2004, 73). These issues stem, in large part, from the Mexican governments unwillingness to properly fund its environmental agencies. Kevin Gallagher, an economist whose area of research surrounds Mexico's environmental economics, writes that despite the fact that Mexico's environmental regulatory framework has improved drastically throughout the years, real spending on the application of said framework has decreased by more than 45 percent (73). It is worth noting that the initial cuts in environmental spending were due to the drastic decrease in revenue which accompanied the peso crisis in 1995. As the economy recovered, however, funding for environmental agencies continued to decrease.

Although we can only speculate as to the reason, there is some evidence that the underfunding of environmental programs in Mexico was part of a greater policy agenda that sought to make Mexico appear more business friendly. Victor Lichtinger Waisman, Minister of the Environment under Vicente Fox described this aspect of the Fox administration, writing "Fox became upset when I spoke about the environment at cabinet meetings. He argued that economic growth and environmental protection were not compatible. At first I thought that I could educate him, well 'de-educate' him, but it soon became apparent that it was not the case. He had a personal prejudice against the environment," (Díez 2008, 92). Another reason for the underfunding is that the Mexican people as a political body became preoccupied with other issues which they deemed

more pressing. One of Lichtinger's fellow cabinet members claimed "because environmental issues were not among the five most important issues with the Mexican population, [Fox] simply dropped the environmental portfolio to the bottom of the agenda," (92). The general disregard for the environment as a major issue continued, for the most part, with the subsequent presidential administrations, although there have been signs of improvement under the current Peña Nieto administration.

Similarly, the NAEEC has proven to be wildly unsuccessful at promoting the enforcement of environmental regulations in member countries. Again, efforts to combat Mexico's environmental degradation are thwarted by a lack of funding. Gallagher (2004) writes that "[the CEC] lacks resources to counter these problems. By its nature, an institution with an annual budget of \$9 million can hardly make a dent in a series of problems that cost the Mexican economy over \$40 billion annually," (74). Moreover, the CEC naturally serves all three of the member nations. Thus the resources which actually go towards mitigating pollution issues in Mexico are even fewer than the already insufficient amount allotted to the organization.

There are also structural problems which prevent NAEEC from being an effective solution to Mexico's pollution woes. Legal Scholar Tseming Yang describes how although there are citizens provisions which allow for private citizens of member countries to submit claims, this ultimately is "a weak device to coerce a party's compliance with the obligation 'to effectively enforce its environmental laws and regulations through appropriate government actions,'" (Yang 2006, 477). This is due to the fact that citizen's submissions, in effect, have no enforcement power with which to achieve a substantive remedy. As such, the process has been called "a complaint-based

monitoring system...likened to a fire alarm triggering an investigation into a party's compliance with treaty obligations," (478). Although submissions can serve as a vehicle through which to establish legal facts and raise international awareness, the burden of seeking reparations or enforcing host country environmental regulations falls on that country's judicial body.

## **Pollution on the Río Santiago:**

### **History of Industrial Pollution on the Río Santiago:**

Although the first industrial pollution in the Río Santiago would have appeared simultaneously with the early industries and factories at the beginning of the 20<sup>th</sup> century, no significant environmental impacts were recorded until the early 1970's. Up until then, the river and the ecosystem services it provided played a central role both socially and economically for the pueblos that grew on its banks. *Martires del Río Santiago*, a report written in part by sociologist Cindy McCulligh, describes the economic role of the river for the towns of Juanacatlán and El Salto, the two pueblos which are bisected by the falls of Juanacatlán, writing:

Several years ago, a little more than thirty, Juanacatlán was in essence a town of tourism and agriculture. Some inhabitants were dedicated to fishing, as there was a wide variety of fish in the river, white fish and carp most of all. Those who were involved in agriculture grew corn, beans, wheat, sorghum, chick peas, and other vegetables; tomato, onion, zucchini, cabbage, lettuce, carrots, etc. Downhill, on the right bank of the waterfall, there were ravines filled with fruit trees of mangos, guavas, peaches, plums, apples, and pears; in addition they planted white melon, cantaloupe, watermelon, etc (5).

The vast amount of agriculture which was cultivated on or around the river is illustrative of the significant connection between the inhabitants of El Salto and Juanacatlán, and the river. For them the river quite literally brought with it “precious life,” (5). However the river represented much more than just a physical resource which provided materially for the towns’ inhabitants. It was also the foundation around which the towns’ communities and identities were built, and a facilitator of social interaction. The report writes:

The Children, the youth, and adults spent much of their life in [the river]; the women used to wash in the waters, bringing with them their little ones, who learned to swim at a very young age. There were many events, such as competitions of swimming, boating, waterskiing, etc. On nights with a full moon there were evenings of music, with the youth, accompanied by young adults, and on the weekends dances were had in four locations with various music according to taste, it was de rigueur to spend Sundays on the river (5).

As industrialization occurred, each of these benefits, known by economists as ecosystem services, began to fade, reducing the rivers value not only economically, but socially and culturally. When a chemical plant was built along the river in 1965 residents noticed that the water began to change color, however the first signs of severe pollution appeared in 1973, when the fish who had populated the river began dying in large numbers. A longtime resident of the region described the scene:

One night, a little more than thirty years ago, a horrible smell invaded the entire pueblo. The following day, the river carried a load of death: thousands of fishing floating without life in its waters. Since then, this smell has invaded with great frequency. There are nights, when the pestilence is so strong that we have to get up and close the crevices of our doors and windows with wet towers so that it cannot penetrate (quoted in McCulligh, Tetreault, and González 2012, 133).

The first study of pollution in the river, done in 1989, wrote that the river had become “a channel of industrial waste that has finished with the fauna and with the possibility of using its water [for whatever other purpose], (quoted in McCulligh 2014, 24). Thus, even before the post-NAFTA industrialization boom there was a clear and present danger that arose from the pollution.

Even though industrialization and pollution predated its introduction, NAFTA still represented a watershed moment in the growth of industry in and around Guadalajara. Although firms from a diverse set of industries moved into the Guadalajara industrial zones, particular attention will be given in this paper to the IT

sector and its related industries. This is because, in the words of Kevin Gallagher and Lyuba Zarsky (2007), “More than any other industry, Mexico pinned its post-NAFTA hopes for economic development on the local growth of a vibrant, export-oriented information technology industry,” (71). Moreover, the vast majority of the investments into the IT industry occurred in the Guadalajara area, with the hope being that Guadalajara could become the “silicon valley,” of Mexico (153). While there had already been a latent IT sector in Guadalajara, the result of efforts by the Mexican government to improve Mexican technological autonomy during the ISI period, it exploded after NAFTA removed all restrictions on foreign investment. According to Gallagher and Zarsky, “IT exports quadrupled between 1995 and 2002 and by 2002, accounted for more than 61 percent of all exports from Jalisco,” (132). While Guadalajara’s IT sector has suffered in recent years due to competition with China, it still remains an important industry in the area, and also represents one of the largest sources of pollution in the Río Santiago. Other industries which have seen growth in the post-NAFTA years are in chemicals, cosmetics, pharmaceuticals, construction, textiles, and alcoholic beverages (IMTA 2011, 74).

While we might not know the exact chemical makeup of the contamination when it first occurred, and thus which health defects have arisen because of it, we do know the general makeup and effects of the present contamination. Water pollutants are often broken up between organic and inorganic pollutants. Among the organic pollutants in the river are chloroform, phenol, and fecal coliforms (13-14). The inorganic contaminants found in the river include arsenic, cadmium, chrome, mercury, nickel, zinc, and lead (12). Many of these pollutants are found in concentrations that far

exceed the maximum permissible for human health, including lead, arsenic, chloroform, and mercury (12-13).

Many of the health problems that we are currently seeing are connected to exposure to these specific chemicals. Among the health problems which are commonly reported by inhabitants of El Salto and Juanacatlán are cancer, renal failure, spontaneous abortions, congenital abnormalities, increased instances of respiratory infection, skin disease, headaches, and fatigue, among others (McCulligh et al. 2007). Chronic exposure to lead, as well as chloroform has been known to lead to renal failure, and nearly all of these chemicals act as a carcinogen of some form. Asthma, respiratory infections, and skin diseases are all known to be associated with exposure to sulfuric and hydrochloric acid, two chemicals which appear in the water as well as in the air surrounding the falls of Juanacatlán.

### **Local Efforts to Mitigate Pollution:**

Responding to governmental apathy towards the increasingly dire situation on the river, inhabitants of the towns of Juanacatlán and El Salto began community organizations with the goal of drawing attention to the dangers of the pollution. Numerous NGOs became interested in the situation, one of the first being the Instituto Vida, who quickly began publishing reports and articles demonstrating the effects of the contamination. In recent years Greenpeace has become more prominently involved in sanitizing the river, even suing the Mexican government in 2011 in order to secure the release of documents detailing the level of pollution at various checkpoints along the river. Citizen activist groups were formed as well, with the most important groups being

Valores Integrales y Desarrollo Ambiental, Un Salto de Vida, and el Comité Ciudadano de Defensa Ambiental (Tetreault and McCulligh 2012, 101). These groups organized marches and protests, wrote letters, and even started petitions in order to pressure the government into acting (102). Legal action was also attempted by the citizens against the Mexican government in order to get them to enforce environmental regulations. In 2003 the Instituto de Derecho Ambiental (IDEA) filed a citizen's petition to the Commission for Environmental Cooperation, the environmental enforcement agency established by NAFTA and NAAEC. The plaintiffs claimed that the Mexican authorities were breaking the international environmental agreement by failing to enforce their own environmental regulations, and ultimately won their case. Although the CEC issued a mandate to the Mexican authorities demanding that they comply with the regulations, the Mexican government was able to largely ignore the plea due to the lack of a significant enforcement mechanism (102).

In general, efforts to attract significant attention to the problem of pollution on the Río Santiago were largely ignored until 2008 when public opinion was galvanized around the death of Miguel Ángel Lopez Rocha, an eight year old child who died of arsenic poisoning a mere eighteen days after he fell into the river (*Fusion* 2015). In response to increasing public outrage, the Mexican government announced in 2008 that they would build a treatment plant for the river. However, the plant (completed in 2012) does not treat the water for heavy metals nor certain chemicals, leaving a major source of pollution and illness unchecked (*Fusion* 2015). The area received slightly more public attention in recent years due to several documentaries which highlight the contamination, as well as through continued citizen activism. Among the more notable

instances of civil agitation, members of Un Salto de Vida began offering “horror tours,” in which members of the organization take journalists and spectators around several particularly polluted areas in order to draw attention to the problem (Tetreault and McCulligh 2012, 103).

In spite of the significant civilian efforts to enact environmental change, and the overwhelming evidence that existed proving the danger of the pollution, Mexican authorities in the region actively fought against change. In 2010, two years after the death of Miguel Ángel Lopez Rocha, the Secretary of Health for the state of Jalisco announced that “We have not found any association between the inhalation of vapors from the river [Santiago] and risks to the health of people who live around the river,” (104-105). In fact, journalists for the news agency *Fusion* found that “over the past 10 years in the El Salto region, the National Water Commission couldn’t identify one instance in which any company was fined for dumping or discharging toxic waste into the Santiago River,” despite the fact that they had data which proved that companies were dumping in excess of the environmental laws (2015).

Although we cannot say anything with certainty about what compels the municipal authorities towards inaction, there is evidence for both political and economic reasoning behind it. First of all, it would not be unreasonable to assume that corruption and bribery play a role in the government’s inaction. According to an OECD report, Jalisco is one of the most corrupt states in Mexico, ranking 5<sup>th</sup> out of 32 with a corruption index nearly 46% higher than average (Crosta 2003, 105). Moreover, there is evidence that bribing is used in Mexico to avoid following environmental regulations (Oliva 2015). However, corruption could affect the process in multiple ways. In

addition to bribing, corruption can take the form of political repression. According to Darcy Tetreault and Cindy McCulligh, sociologists who study the Río Santiago, there have been numerous instances of governmental repression that have befallen the activists. They describe how in July of 2008 the leader of the CDDA was arrested under “false charges of possession of marijuana.” What’s more, “he and other members of the CCDA have suffered constant harassment from local police,” (105). In addition, various members of Un Salto de Vida were harassed and threatened by unidentified assailants so frequently that they were forced to move away from their house in El Salto and seek refuge elsewhere (*Silent River* 2014).

Municipal and federal authorities have also made several statements explicitly prioritizing economic health and industrial development over environmental concerns. In 2009 a petition was submitted to the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT), the federal agency in charge of “ensuring optimal protection, conservation and use of natural resources of the country, thus forming a comprehensive and inclusive environmental policy that will make possible sustainable development,” (SEMARNAT 2016). The petition requested that the industrial zone around the Río Santiago be declared an environmental emergency, something which would require extensive action limiting the pollution. Juan Rafael Elvira Quezada, head of SEMARNAT at the time, denied the petition, arguing that “the declaration of an environmental emergency would lead to the paralysis of a number of very important investments in the region,” (Tetreault and McCulligh 2012, 106).

It was not until these past few years that the Mexican government began the process of making meaningful action towards enforcing its environmental regulations.

Responding to a series of recommendations submitted by the Comisión Estatal de Derechos Humanos Jalisco (CEDHJ), Mexican regulators under the new presidential administration have vastly increased their presence on the Río Santiago. Since the Peña-Nieto administration took power, there have been 640 regulatory inspections conducted nationwide, 319 of which occurred in the region surrounding Guadalajara. Authorities found that 178 of the factories and plants which they surveyed were in possession of hazardous materials, leading to the imposition of 8 million pesos worth of fines and the complete closure of 9 factories (*El Informador*, April 23, 2016; *El Informador*, April 05, 2015). Although promising, these new actions still fall far short of what activists and environmental economists have called for. At this point authorities have enacted or pledged to enact only 50% of the reforms suggested by the CEDHJ in their initial report (*El Informador*, July 27, 2015). In addition, the federal government has been incredibly lenient with the fines and punishments which it actually levies. The commuting of sentences is relatively common, often replacing fines with a mandate to enact mitigation efforts in the future (*El Informador*, April 23, 2016). Although this may appear to be an acceptable substitute, it remains to be seen if there will be stringent enforcement of these mandates.

### **Is NAFTA Culpable for the Río Santiago's Pollution?**

Assessing the extent to which NAFTA is culpable for the current level of pollution on the river is difficult, and requires a somewhat nuanced analytical mechanism. Economists often claim that the true cost of a given action is not what it costs to do it, but rather the value of its alternatives, a term known as opportunity cost.

This can be a useful mechanism for analyzing specific policies. Applying this mechanism to analyzing NAFTA's culpability means that we must examine not the pure aggregate effect of NAFTA on the pollution, but rather the aggregate effect in relation to the other alternate routes which could have been taken. Now, considering that at any given point of time there are perhaps infinite alternative paths one can take, we must first simplify the scenario by implementing a few assumptions. The first of these assumptions is that economic growth is a desirable goal. A common critique of NAFTA is that it subverts a significant number of important things—such as cultural values, local sovereignty, or traditional ways of life—in favor of a modernist or “capitalist” view of progress. While this is a valid and important critique of NAFTA and neoliberalism as a whole, it nonetheless represents an attempt to apply an alternate set of values than those which the Mexican government exogenously decided to promote.

Second, we must assume that neoliberal reforms were by and large inevitable. I've shown that the ISI policies which predated neoliberal reforms were unsustainable in the long-run, and arguably undesirable in the short-run. Moreover, as mentioned previously the Mexican government had little choice but to liberalize in order to prevent economic catastrophe. Applying these assumptions dictates that the set of alternatives which we compare NAFTA to consists of alternate versions of liberalization and alternate economic growth policies, as opposed to avoiding growth altogether.

So how does this effect our analysis of NAFTA's culpability? The main effect is that it discounts the relative importance of the scale effect in our analysis. Under our assumptions industrialization was an inevitable, if not desirable path for the Mexican government to take. Thus, increases in pollution which result from a simple increase of

the size of industry would likely appear within our set of alternatives as well. That NAFTA affected pollution through the scale effect is undeniable. The explosion of industrial investment and growth which occurred after NAFTA's passage undoubtedly led to increases in the aggregate levels of pollution. While tragic, this effect is not an inherent characteristic of NAFTA and neoliberalism, but rather a characteristic of industrial growth generally, which would have occurred eventually regardless of NAFTA's passage.

To examine NAFTA's role in increasing pollution in the Río Santiago I will thus focus on answering four questions. First, has it resulted in the creation of a pollution haven around the river? Second, has it brought the environmental benefits which its proponents promised? This will be evaluated by whether or not there is evidence of the EKC relationship and FDI spillovers and linkages. Third, I will explore whether or not NAFTA and neoliberalism at large promotes lax environmental regulation as an ideological tenant. That environmental degradation is an inherent part of neoliberal ideology is a critique which appears frequently in the current literature on the Río Santiago. For example, McCulligh, Tetreault, and González (2012) refers to the social movement protesting the pollution as a "manifestation of a multidimensional crisis that has kept the neoliberal model in check," while in Tetreault and McCulligh (2012) the authors call environmental movements "a new front of resistance towards the neoliberal, capitalist development (165; 93). Finally, I will examine the possible effects of NAFTA's infamous Chapter 11—which permits corporations to sue member countries for damages caused by excessive regulatory harm—on discouraging the enforcement of environmental standards.

Considering the lack of empirical evidence supporting the pollution haven hypothesis, it is perhaps not surprising that nearly every study done examining the possibility of a pollution haven in Mexico has found no evidence for its existence. The most comprehensive of these, Gallagher (2004), examined how NAFTA affected the makeup of Mexico's economic sectors, checking to see if there were relative increases in pollution intensive industries. The analysis shows that "there was no widespread race to the bottom of dirty industries fleeing the United States to Mexico," and that "High pollution abatement costs in the United States are not significantly correlated to the levels of economic activity in Mexico during the period of economic integration," (32; 31). Similar results are found by Eskeland and Harrison (1997) and Kahn (2001). In fact, between 1988 and 1998, "dirty manufacturing's" relative share of the manufacturing industry fell by 3.6% (Gallagher and Zarsky 2007, 65).

Although nation-wide trends suggest that the pollution haven hypothesis does not apply to Mexico, there is some evidence that for Jalisco specifically there may have been an increase in the share of polluting industries. There are two reasons for this. First, while the IT sector in general may be considered a relatively "green industry", its rapid growth in Guadalajara and the documented lack of compliance by IT firms located there seems to suggest that a mini pollution haven might have formed. Although they may not have moved to Guadalajara specifically in order to pollute, that did not stop them from polluting once they got there. Similar conclusions may be drawn about other relatively green industries in the area, such as the beverage production industry. This finding has significant implications for future research on pollution havens. By focusing on those industries which are traditional polluters, such as steel or mining, previous

studies of NAFTA and the pollution haven hypothesis may have suffered from selection bias. Due to the prevalent role which environmental concerns played in the discussions surrounding NAFTA, it is highly likely that those industries which are traditionally dirty would have been more heavily regulated than those firms which are considered green. Thus mini pollution havens which form from relatively green industries may be overlooked. Future tests of the pollution haven hypothesis should focus not on the relative “greenness” of an industry, but rather examine that industry’s specific environmental performance after relocation.

Despite what NAFTA’s proponents promised, there does not seem to be evidence for either the EKC relationship or FDI spillovers and linkages in post-NAFTA Mexico. Gallagher (2004) writes that “despite the fact that Mexico reached levels of income beyond the range of a predicted EKC turning point, many environmental problems continue to worsen in Mexico,” (17). Aggregate levels of pollution have steadily increased in the post-NAFTA era, and there is no indication that the trend will be changing anytime soon. This is in spite of the fact that environmental degradation has proven to be a significant problem nationwide, both socially and economically. Between 1985 and 1999 environmental degradation cost the Mexican government an estimated 10% of their annual GDP (24). The case study of pollution on the Río Santiago further outlines the failure of the EKC curve hypothesis. The environmental degradation of the river has, as outlined earlier, resulted in a significant amount of social unrest. According to the EKC curve hypothesis, public pressure was one of the main mechanisms for enacting environmental change, thus we should expect to see environmental improvement. While there have been promising signs of change over the

last year, it remains to be seen if they will amount to significant environmental improvement.

There are a few possible explanations as to why a Kuznets turning point has not been reached in the area around the Río Santiago. First of all, that public pressure will lead to policy changes is entirely dependent on the government actually heeding the pressure. The Mexican government, historically, has displayed certain authoritarian tendencies. Policy objectives are often pursued in spite of public opinion, a result of the lack of a stable taxation base and mechanism for accountability. As such, it is not surprising that the Mexican government has not been particularly responsive towards the social discord surrounding the Río Santiago. Second, the oft-used indicator for individual income, GDP per capita, might be particularly ill-suited for Mexico's socioeconomic situation. Mexico is, and long has been a country of severe economic inequality. Esquivel and Cruces (2011) writes that "looking at the long-run trends in income inequality in Mexico leaves little room to be optimistic... the country has experienced very little progress in income distribution since the 1980s," (155). Because GDP per capita is calculated by simply dividing GDP by the population, it is unable to account for economic inequality. If gains by the upper classes are pushing the GDP up, then GDP per capita will increase despite no increases in living standards for the lower classes. As such, the EKC relationship may not apply simply because there hasn't been enough real movement along the EKC curve.

Likewise, there have been no signs that FDI has fulfilled its promise of improving environmental performance in the Guadalajara region. Again we will return to the IT sector to examine the effectiveness of FDI, both because of its economic

importance and because it is the only industry which has been studied in depth. Zarsky and Gallagher (2009) find that “based on extensive interviews with company managers and government officials, as well as NGOs...spillovers were meager to nonexistent,” (218). For spillovers to occur there must be significant interaction between the multinational corporations and the domestic firms. As discussed before, this interaction generally takes the form of forward and backward linkages. These linkages, however, did not form in Guadalajara. According to Zarsky and Gallagher, “rather than build local linkages, MNCs relied on foreign firms for manufacturing, which in turn sourced inputs from their global supply chains. Rather than upgrading, Mexican SME’s went out of business,” (218). Local Mexican firms were unable to access the credit needed to upgrade their physical capital, and accordingly could not compete with foreign firms. Therefore, based on the lack of evidence supporting either the EKC relationship or the existence of FDI spillovers, we can reasonably determine that NAFTA has by and large failed to deliver on its promise for increased environmental performance.

Is the Mexican government’s refusal to enforce environmental regulations simply a feature of the neoliberal ideology which was installed during the 1980’s? The answer seems to be probably not. While it is true that one of the planks of the Washington Consensus is deregulation, John Williamson, its architect, wrote that deregulation should be “focused specifically on easing barriers to entry and exit, not on abolishing regulations designed for safety or environmental reasons,” (Williamson 2002). In fact, neoclassical economics has long advocated for market intervention when faced with negative externalities. Arthur Pigou (1932), in his seminal work on the economics of welfare, writes that when a firm’s private actions lower the national

dividend of welfare, “certain specific acts of interference with normal economic processes may be expected, not to diminish, but to increase the dividend,” (371). Rather than being inherent to the economic development plan which they sought to achieve, it seems that the Mexican government simply made a choice not to value the enforcement of environmental standards. Perhaps they, as Lichtinger suggested, believed that the enforcement of environmental regulations would damage their prospects for attracting foreign firms, but if that was the case then they did so without any evidence supporting that belief. As Tietenberg and Lewis (2009) write:

Environmental regulations are not a major determinant of either firm location decisions or the direction trade. This implies that reasonable environmental regulations should not be held hostage to threats that polluters will leave the area and take their jobs with them; with few exceptions, firms that are going to move will move anyway, while firms that are not going to move will tend to stay whatever the regulatory environment (587).

Thus rather than being a symptom of ideology, it seems governmental inaction is a symptom of deep structural problems within the Mexican government, and a misunderstanding of the nuances of firm location decisions.

Finally, there is little reason to believe that Chapter 11 has been a significant deterring mechanism on the enforcement of environmental regulation. Since the implementation of NAFTA and its side agreements there have been relatively few Chapter 11 claims filed, with only 14 being filed against the Mexican government over the last 22 years. The only case involving the environment and pollution involved what is tantamount to the expropriation of the land owned by Metalclad, not the enforcement of pollution standards. Moreover, the case of *Methanex vs. U.S* provides a precedent for the enforcement of host country environmental standards, citing a state’s ability to

invoke traditional police powers (Mann 2005, 6). The existence of this precedent only decreases the likelihood that a firm would try to file a Chapter 11 claim due to the enforcement of pollution standards, and serves as proof that it is not Chapter 11 which is dampening Mexican enforcement of their environmental standards. Furthermore, none of the Chapter 11 suits which have occurred were filed by firms operating in the Guadalajara Industrial District. Thus, as Tietenberg and Lewis (2009) so deftly explain, “the concerns [about Chapter 11] are based more on potential harms than actual settled cases,” (590). That is not to say that the potential for abuse does not exist, nor that it is not significant. Indeed there is little evidence supporting the notion that the use of “secret arbitration tribunals,” to resolve Chapter 11 disputes is a good idea due to the inherent lack of accountability present in such rulings (589). There is, however, equally no evidence that Chapter 11 in practice has played any significant role in determining host country environmental policy.

### **Propensity to Pollute:**

As mentioned previously, it can be a difficult thing to accurately trace water pollution to its source, especially when monitoring efforts are sparse and the available data are incomplete. That being said, by combining general environmental performance trends in Mexico with what information is available, we can gain insight into the major sources of pollution. We know that of the more than 300 firms which lie on or near the Río Santiago, nearly all of them pollute in some form or another. Mexican regulators discovered that between 87-94% of the firms which were discharging into the river were in violation of at least one regulatory law. Individual studies have singled out

some of the larger polluters, among which are prominent multinational corporations such as Nestle, Huntsman, IBM, Celanese, and Quimikao, although they represent only a portion of the total pollution (McCulligh 2014, 27). Also, these studies give no information regarding what percent of their effluents are successfully abated. It is entirely possible that these firms are simultaneously some of the largest polluters, as well as some of the largest abaters.

Although there isn't any credible data regarding propensity to pollute in the Guadalajara area, we are able to draw some conclusions based on trends noticed elsewhere in Mexico. The most comprehensive study examining propensity to pollute in Mexico, Domínguez-Villalobos and Brown-Grossman (2007) explored the determinants of environmental decision making for 2,438 firms in Mexico from 1994-2002. The authors found that "environmental investment is associated with company size, foreign shareholder pressure, technological capabilities, business performance, government regulation, and the need to comply with standards demanded by customers in the international market," (246).

What does this tell us about which firms are more likely to be polluting? First, it tells us that large, export oriented firms are the most likely to invest in environmental technologies. Not only are they accountable to foreign shareholders and customers, but they uniquely have access to the improved technology and capital necessary to invest in environmental performance. What's more, larger firms in general tend to be more productive and have higher performance as they can reap the benefits of economies of scale. On the surface, this finding seems to be contradictory with what we know about

pollution on the Río Santiago. After all, many of the biggest polluters are large, export oriented firms with access to foreign investment.

Domínguez-Villalobos and Brown-Grossman's finding is important however not because of what it tells us about those large, exporting firms who produce the most aggregate pollution, but because of what it tell us about the small and medium firms who primarily serve the domestic market. As they explain:

Our evidence suggests that businesses make environmental investments as they become larger and as they become exporters. This means that although a large part of manufacturing industry pollution (caused by larger companies) is being abated by their investments, most pollution coming from small and medium-size enterprises persists and is uncontrolled (257).

Not only are there a significant amount of these firms in the Guadalajara area, but they also belong to many of the same industries as the other, more notorious polluters. There are a number of reasons that these firms are likely to be a significant part of the pollution problem. First, these firms are more susceptible to foreign competition as well as competition with the larger Mexican firms, as they do not have the benefits of economies of scale nor as great of access to the credit necessary to make environmental or productive investments. They then have an incentive to cut costs anywhere possible, and thus have an incentive to pollute. Furthermore, because the aggregate size of the effluents is less than that of the larger firms, these firms are under less pressure to adopt more environmentally beneficial practices. Dominguez-Villalobos and Brown-Grossman argue that "because environmental authorities only go after the big polluters, small business believe that they can operate with impunity," (257-258). Although it is true that small firms are pollute less than large firms in volume, because they are likely less environmentally efficient per unit of output, their marginal damage to society may

be greater than that of the large firms. While the pollution contribution of each individual small or medium size firm might just be drops in the larger river of pollution, together they represent a serious challenge to the sanitation of the Río Santiago.

The pollution in the Río Santiago does not just come, however, from firms that we know about, or that are monitored. There is good reason to believe that some of the pollution originates in the informal sector, and thus would not be subject to any monitoring or regulatory efforts. A recent report studying the informal economy in Mexico writes that “Informal businesses fail to comply with all regulatory requirements. They may not be registered with the authorities; they may under-report income to avoid paying all or part of their tax obligations; and they may pay bribes to avoid land use, sanitary, or other regulations.” (Bolio et al. 2014, 5). In addition, the informal sector represents a significant portion of modern Mexico’s economy. According to the McKinsey report, an estimated 54% of non-agricultural workers are employed in the informal sector, partially due to the high cost of starting a formal business (12-13). These firms are often smaller, less productive, and less likely to produce for export, all of which would incentivize pollution. What’s more, there is evidence that this is occurring specifically on the Río Santiago. Authorities in Jalisco recently detained five people who were caught illegally dumping hazardous waste into the river (*El Informador*, May 05, 2016).

While it can be difficult to pinpoint which industries pollute the most, evidence also seems to suggest that the IT sector may be responsible for a large portion of the pollution. According to Gallagher and Zarsky “the electronics industry in general and the IT industry in particular operate with little oversight and a great deal of opaqueness

as to their compliance with environmental laws, including in the all-important matter of the management of electronic waste generated in production,” (161). Only 30% of the industries which, by law, are required to report hazardous waste use to the government actually do so, and there is evidence that only one of the IT firms in Guadalajara filed forms indicating that they disposed of their waste properly (161). What’s more, many of the pollutants which are found in the Río Santiago are those which are used in large quantities within the IT industry. Gallagher and Zarsky write, “Foreign circuit board assembly operations based in Guadalajara use a considerable amount of lead in attaching components to copper plates. Moreover, the copper plating process emits formaldehyde and brominated flame retardants,” (162). In addition, several IT firms which located in Guadalajara have been identified as repeat pollution offenders around the world, including IBM who has already been pegged as one of the main polluters of the Río Santiago.

There are a multiple reasons as to why the IT sector in particular might be among the larger polluters. First of all, the IT sector is considered by many to be a relatively green industry. As such, it is generally less scrutinized than industries that are known polluters, such as the mining or chemical industries. This has allowed them to escape any significant regulatory pressures. Gallagher and Zarsky write that “the Mexican government did not develop an adequate environmental regulatory framework for the IT sector, which was considered a low priority compared to other industries. As a result, there was little incentive, apart from pressure by NGOs or by corporate headquarters, to improve environmental management, “(7-8). This was only magnified by the important role which the IT sector played in Mexico’s development strategy. As

mentioned before, the IT sector played a role similar to Atlas for Guadalajara's future economic regime, providing the foundation upon which economic growth could be built. Accordingly, the governmental officials in Jalisco may have been particularly hesitant to enforce any environmental standards on those firms in the IT sector. That being said, there is no evidence that any of the IT firms moved to Guadalajara in order to avoid following environmental standards. Gallagher and Zarsky (2007) interviewed a number of the flagship IT corporations who relocated there, finding that "IT companies came to Guadalajara because of the low labor costs and the proximity to the booming US market... Environmental standards simply were not on the radar screen," (165).

### **Policy Problems and Solutions:**

It is an unfortunate reality that much of the pollution on the Río Santiago is the direct result of policy actions or inactions by the Mexican state. The most significant mistake that the Mexican government has made is, without a doubt, their unwillingness to enforce environmental regulations. Numerous studies have found that the most significant factor in determining compliance with environmental norms in Mexico is regulatory enforcement. Dasgupta et al. (2000), using plant level data, find that regardless of whether a firm is of foreign or domestic origin, that "Regulatory pressure works: Plants which have experienced regulatory inspections are significantly cleaner than their counterparts," (61). Similarly, Wisner and Epstein (2005) find that not only does regulatory pressure work, but that the relative magnitude of the regulatory threat matters. Bearing these in mind, it is thus not surprising that environmental degradation in Mexico increased just as the rate of plant-level inspections fell. Speaking more

specifically of Jalisco and the Río Santiago, the relative leniency with respect to levying fines that has defined regional environmental policy over the past few decades has certainly served to embolden polluters, as their perceived risk is decreased. In addition, the dearth in funding and staffing for Mexican environmental agencies forces regulators to focus all of their efforts on the more visible polluters, namely the large multinational corporations. This has allowed small and medium firms, as well as the informal sector to pollute free of oversight. The first step in mitigating environmental degradation on the Río Santiago unequivocally needs to be increased regulatory aggressiveness, combined with more consistent punitive measures.

The second major policy failure which has led to the current contamination lies in the Mexican government's lack of support for domestic industries. In general, Mexican economic policy since economic liberalization has valued macroeconomic stability above all else. Mexican policymakers saw macroeconomic stability as "the sole basis for competitiveness," and in doing so have ignored regional, sectoral, and industrial policies which were badly needed to support domestic industry (Peters 2009, 74). In particular, there is a dire need for improved credit lines for domestic firms in Mexico so that they may purchase new, greener technology and capital which would allow them to remain competitive in a global market.

Insufficient lines of credit has been a defining feature of the Mexican economy from the onset of trade liberalization. Mexican officials overestimated the ability and willingness of foreign investors to invest in domestic industry. According to Vega and María de la Mora (2003), "by reducing barriers to trade, the Mexican government told companies, in effect, that in order to become competitive they had to invest in

technology, equipment, and training. However, most firms were left without access to the necessary resources to accomplish such modernization,” (169). A credit squeeze occurred, in which those firms that did not have access to the credit necessary for investment either went out of business, or found other ways to reduce costs. A number of macroeconomic decisions made by the Mexican government exacerbated the problem. In their zeal for promoting foreign investment, Mexican macroeconomic policy makers promoted high interest rates and an overvalued exchange rate, something which “created a climate conducive to foreign but problematic for domestic investment (Gallagher and Zarsky 2007, 43). Gallagher and Zarsky outline the extent of the problem, writing “In a survey of Mexican firms, the Bank of Mexico learned that an astonishing 82 percent were not able to access credit between 1998 and 2003. The majority were squeezed out by high interest rates, while the rest were simply rejected,” (231). By not providing investment opportunities for domestic firms, the Mexican government placed them in a position where they had little choice but to cut costs, essentially incentivizing environmentally harmful cost-saving mechanisms.

### **The Costs of Pollution:**

One area which has thus far remained almost entirely unexplored in the research on the Río Santiago is the long-run economic and social cost of the pollution. Although there have been studies valuing the annual drag which pollution represents on the Mexican economy, these analyses generally focus on the short-run, valuing the damage which the pollution currently does. There are, however, certain costs which appear in

the long-run which have important consequences for the future of Mexico's economic and social development.

In the long run, pollution in the Río Santiago will likely be a significant contributor to income and social inequality in the region. That the pollution disproportionately harms the poor is obvious, but some of the mechanisms through which it acts can be unexpected. For example, the existence of concentrated pollution often will result in increased gentrification for a given region. This is due to the fact that housing values are incredibly sensitive to changes in perceived risk caused by pollution and hazardous waste. Kohlhase (1991), McCluskey and Rausser (2001), Davis (2004), Jenkins-Smith et al. (2002), Reichert (1997), and Zabel and Guignet (2012) all find that property values depreciate when located near sources of pollution and health risks. As property values decrease there are two effects which tend to increase gentrification. First, by decreasing the value of their property, the pollution in effect increases the poverty of the homeowners. This reduces their mobility, as well as their ability to sell their property. Second, the now low-income housing will attract impoverished buyers who cannot afford not to be near the pollution, while those who can afford it will move away from the pollution.

Furthermore, the obscene levels of pollution in the Río Santiago and around Guadalajara generally jeopardize the future economic growth of the region. Over the last two decades Guadalajara has sought to enact major transformations in its economy, striving to emulate the industrial makeup of cities such as San Francisco or New York City. Their focus is thus on attracting high human capital, knowledge intensive industries, such as in IT and software. Many of these industries are being dominated by

start-ups; since 2014 around 300 start-ups appeared in Guadalajara, netting an impressive \$120 million from investors in the United States (Popescu 2016). Guadalajara's new mayor Enrique Alfaro has aggressively pushed towards bolstering these sectors. In a recent interview with the Washington Post he claimed that the tech center in Guadalajara already accounts for 30 percent of the cities total economy, and discussed his programs to "encourage STEM training, [build] a tech zone and municipal infrastructure to ensure future jobs." One of the main factors pulling firms to Guadalajara, according to the article, is its "well-educated workforce with salaries a third of their northern cousins," however this comparative advantage naturally depends on those workers remaining in Guadalajara, something which may be affected by the pollution (ibid).

There is a growing body of evidence that suggests that workers, especially college-educated workers, are sensitive to environmental risks when deciding where to locate. Banzhaf and Walsh (2008) finds "clear evidence of migration correlated with TRI facility emissions," while Kahn (2000) found evidence that improving air quality stimulated migration (844). Similarly, in a nationwide study of migration factors, Whisler (2008) finds that nearly all age and educational categories are sensitive to quality of life indicators when deciding if and where to migrate to, while Cameron and McConnaha (2006) finds that "households relocate in response to changes in perceived environmental quality," (273). As the effects of the pollution on the Río Santiago become more evident and widely known, it will begin to act a severe deterrent for the in-migration of college-educated workers, in addition to incentivizing out-migration.

This will harm Guadalajara's ability to attract productive, innovative, firms in human capital intensive industries, and thus jeopardize their economic growth.

Finally, recent scholarship has shown that the existence of pollution during formative years has a significant effect on the life-outcomes of those exposed. A forthcoming paper by Isen, Rossin-Slater, and Walker (2015) examines the effect of air pollution in the United States on overall life-earnings and labor market outcomes. They find that "a higher pollution level in the year of birth is associated with lower labor force participation and low earnings at age 30," (1). Similarly, Currie (2009) finds that "child health is important not only for its own sake but because it affects children's future prospects more broadly, as well as the prospects of their future children," (116). What's more, the pollution and health effects in both of these studies were less severe than that which is found in and around the Río Santiago. It would thus not be unreasonable to assume that any effects would be of an equal, if not more severe magnitude for the exposed inhabitants.

## **Conclusion:**

The pollution on the Río Santiago is the result of decades of interactions between economic and political forces, and state and non-state actors. Ultimately certain aspects of Mexico's economic and political institutions proved to be insufficient for correcting the externalities which accompanied rapid industrialization. Funding for environmental agencies was a constant problem, regulatory enforcement was lax at worst and inconsistent at best, and regional economic strategies focused too much on attracting FDI and not enough on supporting struggling domestic industries. These findings suggest that although NAFTA failed to deliver on its promise of improved environmental performance, it simultaneously was not the source of many of the problems for which it is often blamed. Clearly member-country institutions play a significant role in defining how the relationship between free trade and the environment ultimately develops, a fact which should be accounted for in future trade agreements. Moreover, the results of this analysis highlight the important role of rhetoric in defining policy outcomes. By focusing only on the large multinational corporations, both politicians and journalists alike have allowed a significant source of pollution to continue unabated and unnoticed. While it is certainly necessary and important to cast a light on infractions by the largest firms, that cannot be a substitute for a more measured analysis of all of the sources of pollution.

In spite of all of the aforementioned failings which contributed to the tragic contamination of the Río Santiago, there is reason to be optimistic looking forward. The recent steps taken by the Peña Nieto administration at enforcing environmental compliance along the river show promise, while international awareness of the damage

is steadily increasing due to dedicated efforts by documentary filmmakers, NGOs, and citizen activists. For the changes to last, however, the Mexican government must further increase both the scope, and the consistency of its regulatory efforts. Furthermore, additional studies should be conducted to better pin down the exact sources of pollution on the river, and to gain further insight into the mechanisms which promote environmental unsustainability.

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