SUSTAINABILITY AT MULTIPLE SCALES: INTERACTIONS BETWEEN ENVIRONMENT, ECONOMIC AND SOCIAL INDICATORS AT THE COUNTRY, CITY AND MANUFACTURING FACILITY SCALE

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To the pursuit of connections between seemingly unconnected (or *disconnected*) things.

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Many initiatives we pursue in life begin with a crazy idea. While I had thought about the 'crazy idea' of getting a Ph.D. before I left grad school after my Master's, I decided then that only a boss down the road suggesting I do it for career advancement would motivate me to ever do it.

Rick Frazier, Vice-President at The Coca-Cola Company, was my 'boss' during the 2006-2007 time frame and the one who resurfaced that idea, over ten years later. It sounded a bit crazy as he suggested it, but I saw it as the sign I never thought would come and bit. Rick has been a trusted mentor since, and this pursuit has become much more than "checking the box" on a professional development plan.

Within Coke, I have described the conversation Rick and I had in the summer of 2006 as "the mid-year review gone awry." But in all seriousness, it was a conversation that has changed the course of my career, not just academically, but professionally. And, it's changed the way I think about myself and the world. I owe Rick a tremendous amount of gratitude for setting me down this path.

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ways throughout every step of my academic and professional journey, for as long as I can remember.

Unfortunately, the person who has perhaps inspired me most along this journey is not here to see me complete it. My mother, who passed away early in this process, inspired me not just during the time she was alive, but every day since. Her ability to look on the bright side of things, to never focus too much on the negative, and to keep a smile on regardless of what the circumstances were before her, is an ability I can only try to emulate.

During this process, I learned a fair bit about environmental policy and environmental economics. I learned a lot more about myself, and about how important it is to step outside your "world" every now and then. When you do that, you understand it a lot more, your ability to impact it is strengthened, and it is much more meaningful to you.

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SUMMARY

The simplicity of the Environmental Kuznets (EKC) curve concept motivated this study of the relationships between environmental, economic and social indicators at the country, city/regional and manufacturing facility scale. The study builds on almost 20 years of research on the EKC, which has shown conflicting results for confirmation of the EKC hypothesis that the environment first degrades, then improves, with increasing economic wealth.

Most EKC studies have been performed at the country scale, though over the last several years studies have cropped up at other scales: country-group, state-province, city-county, lake-watershed, firm, household and individual scale. Across the board, results have been mixed. Approximately one-third of EKC studies have confirmed the hypothesis; one-third of the studies have rejected it; and, one-third have shown mixed results.

This research effort includes analysis at three scales: country, city/regional and manufacturing facility. Most EKC studies use country-scale income or GDP as the primary economic indicator of interest; this study uses country-scale GDP (Purchasing Price Parity-adjusted) for country scale analysis and experiments with using city/regional GDP at the local scale. For the purposes of manufacturing facility analysis, a country-scale “market maturity” indicator commonly used by The Coca-Cola Company (the corporation studied here) is employed.

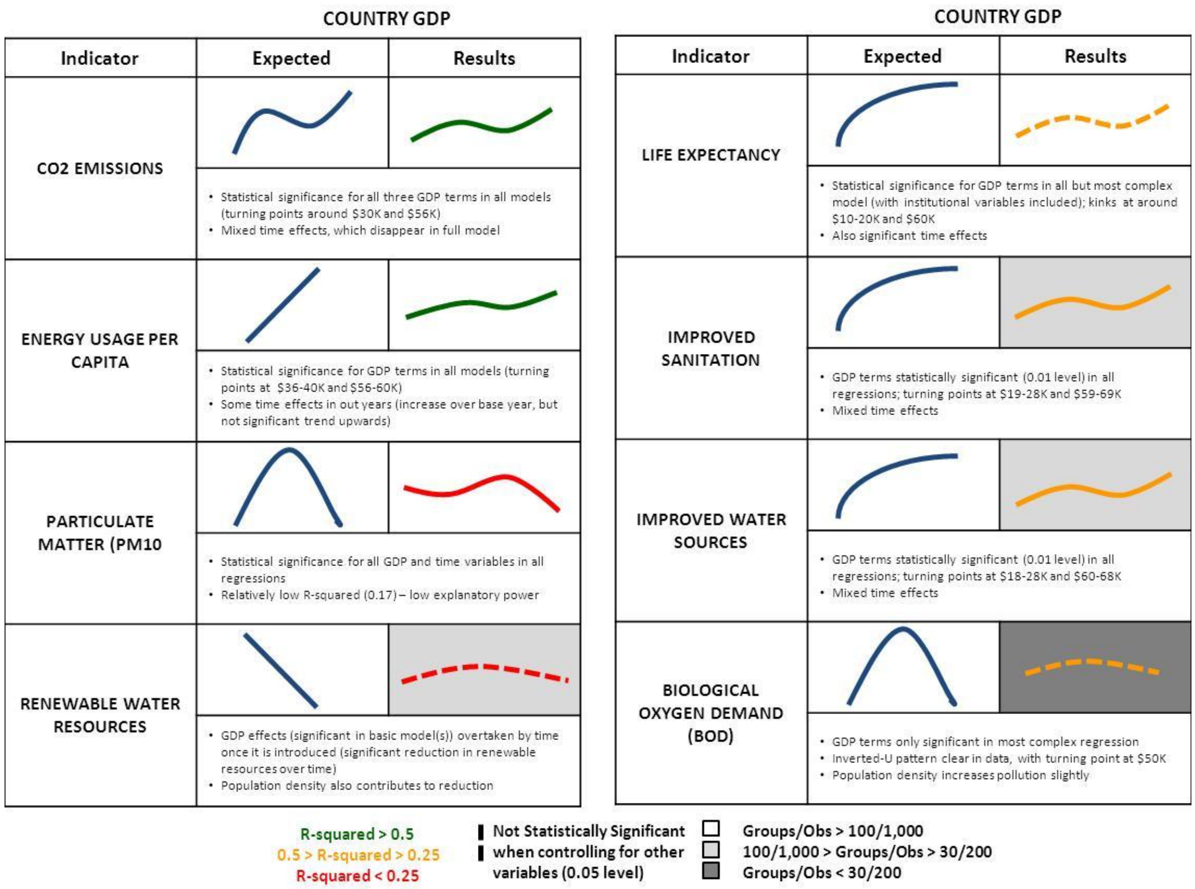
The manufacturing facility scale analysis is new territory in the EKC literature. Firm-scale studies in the past have been just that, evaluating firm environmental performance across a specific industry. This effort evaluates manufacturing facility performance within the same firm across a set of 21 countries of particular interest to the corporation.

This study is unique in a few other ways. Including multiple scales in the same study is not common in the EKC literature. Typically, a study would focus on one or a few indicators at one specific scale. The actual environmental and social outcome variables used here are also somewhat unique. In additional to traditional pollution indicators, life expectancy at the country-scale is used, as well as energy usage at the country scale and water usage at the city/regional scale. A biological oxygen demand concentration for the country scale is constructed; this is evaluated alongside renewable water resources per capita.

Considering the three scales together, a mix of traditional pollution (i.e., concentration) measures is used with consumption and/or efficiency-based indicators to determine how patterns might be similar or different among the different types of indicators.

Generally speaking, the results reported here will fall into the "mixed" bucket relative to the 20 years of existing EKC literature; however, there are a few key learnings. Figures 1 through 3 show the expected results (stylized shapes for expected; actual shapes of calculated log values for results). First of all, pollution indicators (particulate matter and biological oxygen demand) at the country-scale appear to be improving at the highest levels of income over the time period evaluated here. Life expectancy and access to water and sanitation systems are also improving at higher levels of wealth. However, CO_2 emissions and energy usage per capita are increasing, and renewable water resources per capita are declining. Of 8 total indicators, only one (BOD) follows an inverted-U pattern (the EKC hypothesis would hope that half or more might). Surprising results are shown for life expectancy and access to improved water and sanitation systems. While all generally increase with increasing GDP, the relationships are not monotonic – meaning there is unexpected curvature in the patterns. There are "dips" in all three variables between around $10K and $70K GDP per capita.

Figure 1. Summary of Country-Scale Results



At the city/regional scale, more traditional air and water quality (pollution concentration) indicators are the focus. Using city/regional GDP as the primary economic variable, all but two (chemical oxygen demand and dissolved oxygen) of these indicators are improving at the highest levels of local wealth. The story is not as clear when using country-scale instead of city/regional GDP. Air quality indicators improve in the wealthiest countries, though water quality indicators show mixed results (DO and COD improve, but BOD does not).

Water usage at the city/regional scale shows a similar pattern to energy use at the national scale – an N-shaped pattern increasing at the highest levels of income. This pattern holds when using either the country-scale or city/regional-scale GDP.

Figure 2. Summary of City/Regional-Scale Results (Air Quality and Water Use)

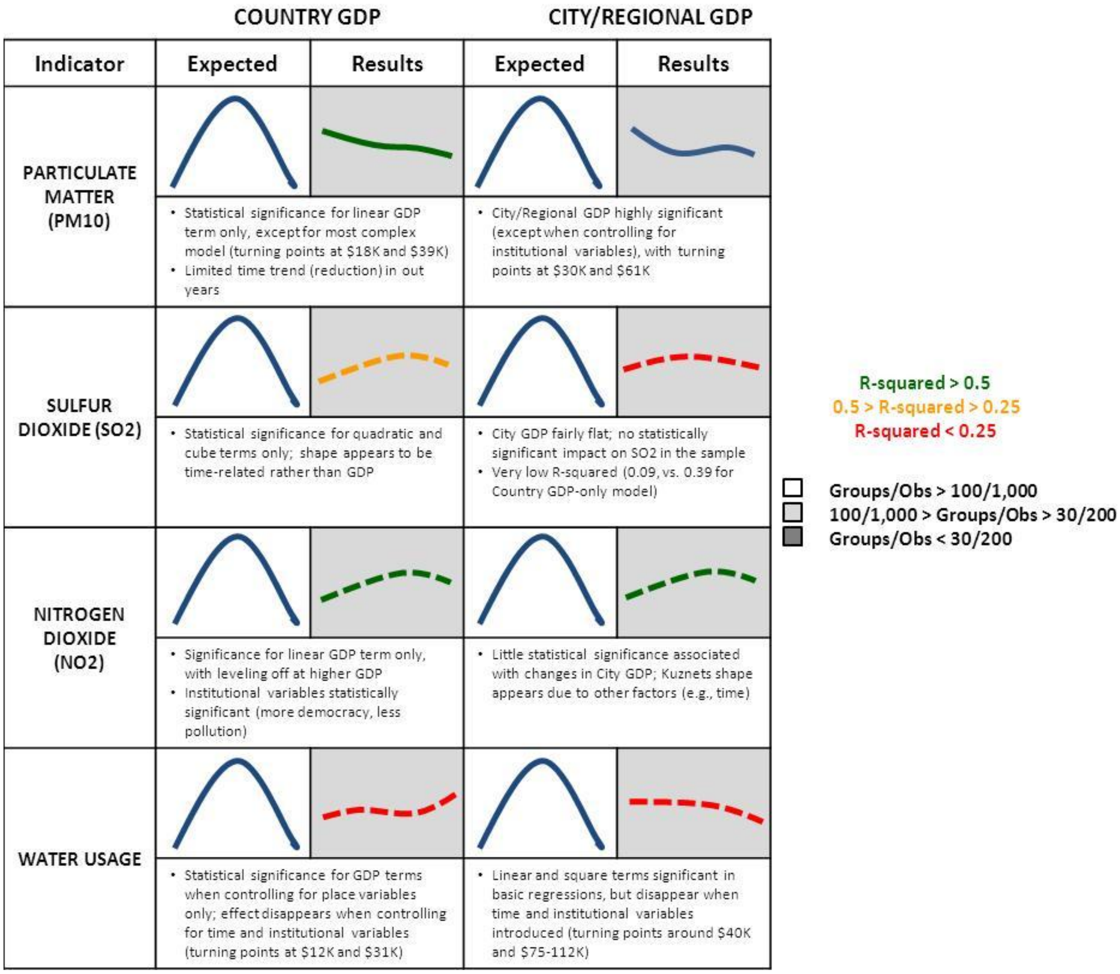
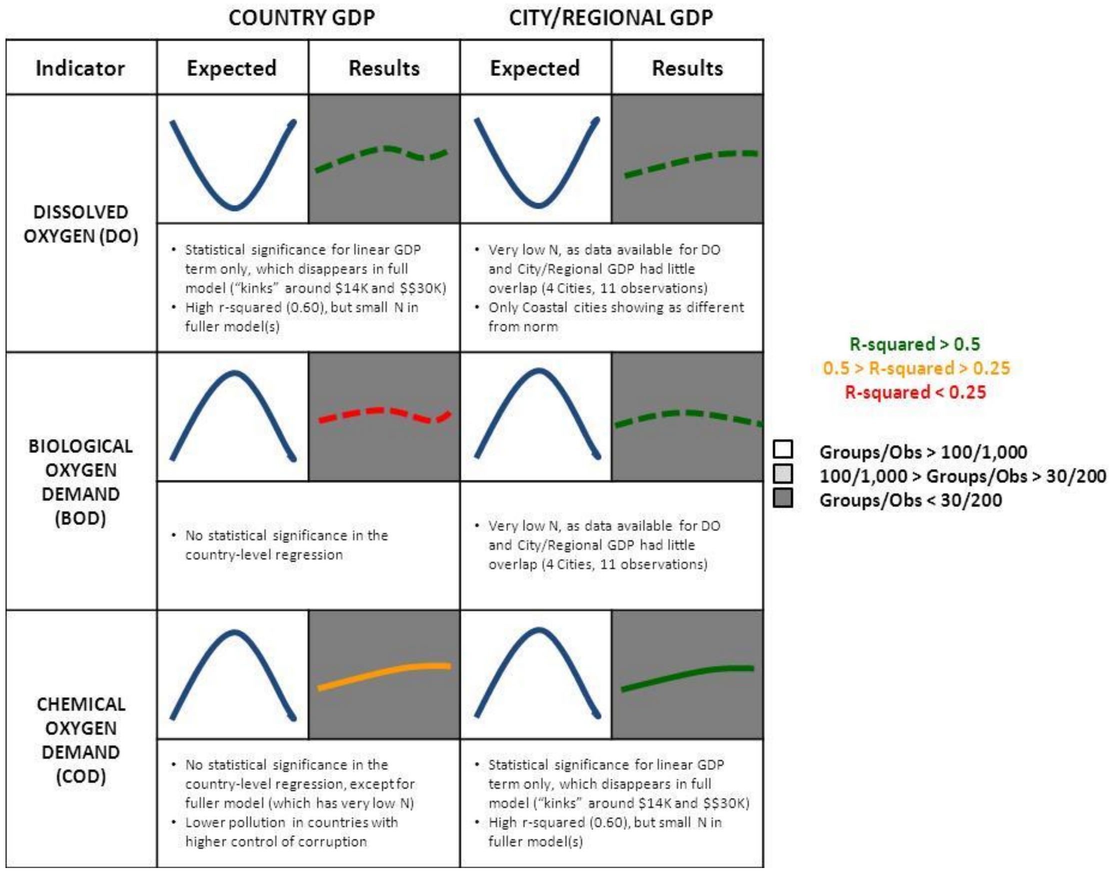
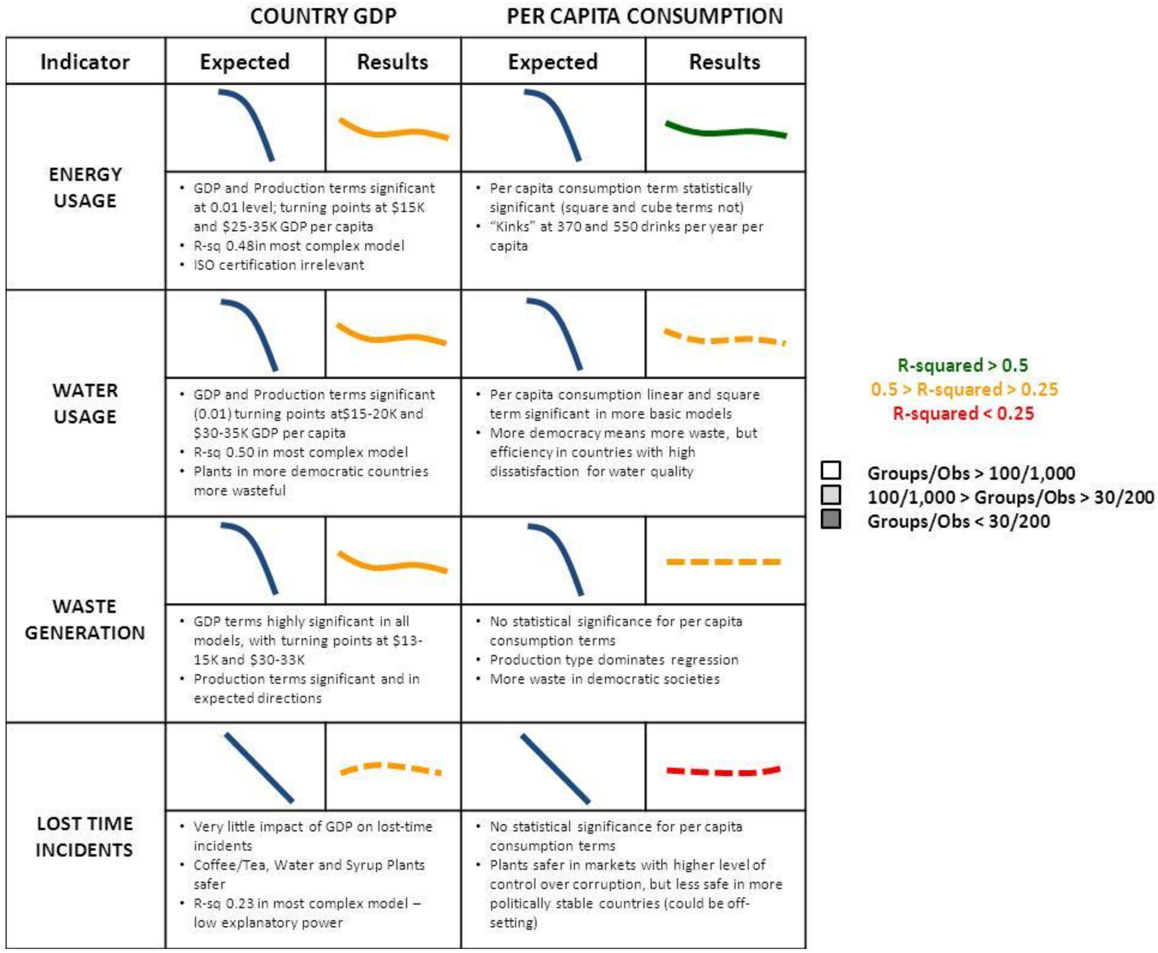


Figure 3. Summary of City/Regional-Scale Results (Water Quality)



At the manufacturing facility scale, environmental, occupational safety and health performance is clearly connected to country-scale GDP, though patterns are more complex than a hypothesized inverted-U. The Coca-Cola Company's market maturity indicator has less explanatory power than country-scale GDP, though plants in the most mature markets perform better for energy and water usage. There is no statistically significant trend for waste generation and market maturity, or for safety incidents for either market maturity or country-scale GDP.

Figure 4. Summary of Manufacturing Facility-Scale Results



Control variables present additional information to the analysis. Typical place and time variables are used for country and city-scale regressions, though World Governance Indicators are used for institutional strength variables (this is not commonly done in EKC research). Control of Corruption, Political Stability and Voice and Accountability (which can be interpreted as an indicator for level of democracy) show mixed and often surprising results at all three scales.

At the manufacturing facility, the main control variables relate to types of production. This is an effort to delve into "composition" of manufacturing and the influence it might play on performance. In most cases, production types known to be more resource intensive are shown statistically to be; while there are some surprising results for the impact production type has on waste generation and occupational safety and health. Plant “institutional controls” such as ISO 14001 (in the case of environmental performance) and OHSAS 18001 (for safety) are used and show no impact on plant-scale performance.

This research project includes limited qualitative analysis to complement the quantitative analysis. “Policy profiles” are generated for 21 select countries, and country-specific EKC curves are generated for those countries. Within country variation across the countries is mostly monotonic, with very little curvature for individual countries, except in the cases of CO_2 emissions per capita and energy usage. For CO_2 emissions and energy usage, many of the most advanced economies (as defined by GDP) demonstrate within-country curves consistent with the EKC hypothesis.

This research effort advances the EKC literature in a few ways. As the first study of its kind to detail manufacturing facility scale impacts, a possible research platform is established. More traditional EKC research is also advanced in the form of the use of city/regional GDP and the combination of city/regional and country-scale GDP in the same analysis. This study also provides a comparison across scales and environmental and social outcomes that is not typically covered in one study. Based on the results of the study, economic development works in different ways for different outcomes within the same scale, and differently across scales. “Riding the wave” of development may be part of the solution, but policymakers should understand more about the reasons for these changes and develop policies targeted to specific outcomes at particular scales.

In particular, the differences between traditional pollution-type indicators and consumption indicators should be more fully explored. The ‘most regulated’ outcomes show the most improvement at higher levels of wealth.

CHAPTER 1

INTRODUCTION

The Brundtland Commission over 30 years ago defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs," bringing the historical tension between the concepts of "sustainability" and "development" into a more formalized and public debate towards resolution. Before Brundtland, environmental history often included discussion of the industrial revolution as a turning point in the relationship between human needs and the environment.

Today, the academic literature is split on the impact of economic development on environmental quality. Some blame development for all environmental ills, while others believe economic growth is critical to environmental improvement. Proponents of the Environmental Kuznets Curve (EKC) concept portend that development, while first degrading the environment, eventually brings environmental improvement, after a "peak" or turning point beyond a certain level of development (as expressed by GDP, income or a number of economic indicators).

In truth, even EKC studies are mixed on the influence economic growth has on environmental quality. Approximately one-third of past empirical studies confirm the "EKC hypothesis," one-third reject it, and one-third find mixed results. This all points to a need to get beyond mere evaluation of the interplay between economic development and environmental quality to understand more about what causes turning points – or what causes environmental improvement rather than degradation.

The basic research questions motivating this research have been the following: *How do economic, environmental and social indicators relate differently at the country, city/urban and manufacturing facility scales? And, what can we learn from a quantitative analysis about the* *"trickle down" of environmental, economic and social performance from the country to the city/urban to the plant scale?*

This research effort includes multiple levels of analysis at three scales of analysis: the country, city/regional and manufacturing facility scales. Using data from The Coca-Cola Company, a large multinational corporation which operates in over 200 countries, the research targets 21 countries of interest to the corporation to test how EKC-type approaches might apply at the manufacturing facility scale.

The analysis at each scale begins with a baseline assessment against the basic EKC model (simply evaluating environmental and social outcomes relative to GDP). Next, models used in "state of the art" EKC-type studies are duplicated at the country, city/regional and manufacturing facility scale within the 21 identified countries. Additional variables beyond those used in even state-of-the-art analyses are then integrated into the analysis.

A limited qualitative analysis was conducted to supplement the "story" that can be told by the data, particularly for the 21 identified countries evaluated in the manufacturing-scale analysis. "Policy profiles" for each country are included, with some discussion of the relevant implications for cities and businesses operating within them. The supplemental qualitative analysis also includes a look at country-specific "EKC curves" for each country-scale indicator in the 21 identified countries.

CHAPTER 2

LITERATURE REVIEW

In 1987, the Brundtland Commission's famous report, "Our Common Future," defined sustainable development as "development that meets the needs of the present without compromising future generations' ability to meet their own needs" (Brundtland Commission, 1987). That publication can be seen to have formalized a debate that had taken place for many years before – that environment and economic growth were at odds with each other, and that while minimizing the impact of development was a worthwhile goal, it is a difficult challenge.

Accounts of environmental history or the evolution of environmental policy include a major focus on discussion of the industrial revolution as a turning point in the relationship between man and the environment. Pollution from industry has changed the way we think about our environment.

Prior to the mid-1990s, most believed that more economic growth and development meant a more significant impact on the environment. Grossman and Krueger (1991, 1995) sought to challenge this contention in their early work on the environmental "Kuznets curve" (EKC) concept, which suggests that environmental degradation (pollution) increases with income, then decreases after a peak, or turning point. This was part of a broader effort by Grossman and Krueger to illustrate three things:

> "First, increases in income were not automatically associated with increased pollution. Second, freer trade would not necessarily make pollution worse. Third, a free-trade agreement with Mexico would make the pollution situation in Mexico and the United States better, not worse." (Carson, 2010).

Over the last 15 years, the EKC literature has grown, with some studies confirming the EKC hypothesis and others challenging or rejecting it. More complex analyses and reviews suggest moving beyond the simplicity of the EKC model to study underlying causes for change and the conditions under which environmental quality improves – or degrades – with economic development (Dasgupta, et.al., 2002; Copeland and Taylor, 2004; Carson, 2010).

Grossman and Krueger's original work (prior to, and including, 1995) had focused on the North American Free Trade Agreement (NAFTA). However, the EKC literature since then has grown to be much more broad, and Grossman and Krueger's original focus is sometimes forgotten. But economic trade has been a key topic in the tension between economic growth and the environment – along with discussions of a "race to the bottom" that may occur when industry "exports pollution" by relocating manufacturing facilities to places that are not only less expensive, but also have fewer environmental regulations (Esty, 2001; Alpay, 2000).

The EKC literature since 1995 has highlighted a number of challenges with the simple form of the EKC hypothesis. In its basic form, the EKC hypothesis simply relates changes in income or GDP with changes in pollution levels, environmental quality, or environmental degradation. There are many theories for why income changes would impact environmental quality. Grossman and Krueger discussed scale, composition and technique effects. Scale in production increases environmental degradation, while composition and technique effects can bring about a leveling off, or ultimately a reduction in pollution. Technique effects would include efficiency gains manufacturers might make in production. Composition effects include changes in the types of production over a defined geographic area. For example, transition to more manufacturing-related industry would increase emissions, but changes to more service-related industry could mean reductions.

Turning points, or peaks, in pollution could arise from increasing demands for environmental quality as a society matures. These demands could come about directly from government or from citizens through government (i.e., advocating for government action). Grossman and Krueger (1995) limited their discussion of various theories, which is where much of the debate has focused in studies since (Carson, 2010).

Dasgupta, et.al. (2002) list the following as ways EKC curves can become "lower and flatter" (e.g., for countries to reach their peaks sooner or at lower levels of income or GDP): environmental regulation, economic liberalization, pervasive informal regulation, pressure from market agents, better methods of environmental regulation, and better information. These are what they propose as direct effects on pollution (reduction) that are brought on by increasing income levels. Though many of these have been explored in the EKC literature, most empirical studies have focused solely on the relationship between income and environmental quality (Dasgupta, et.al., 2002; Copeland and Taylor, 2004; Carson, 2010). Carson (2010) points to additional issues in past empirical studies: representativeness of samples and comparability of pollution measures, data quality issues and difficulty in showing causality (what came first: rises in income or rises/decline in pollution?).

Prior to Grossman and Krueger's contention that increased development did not necessarily mean reduced environmental quality, the previously held view followed the famous "IPAT" equation, which suggested that

Impact = *Population* x *Affluence* x *Technology*.

This meant that environmental impacts (negative) increased monotonically with income (affluence). While environmentalists posited that technology improvements could reduce negative impacts from population and economic growth, most who followed the IPAT formulation assumed that economic development worsened the environment (Carson, 2010).

A preliminary meta-analysis of EKC studies was conducted by the author to characterize the present state of EKC-related research. The aim of the review was to determine the degree of confirmation of the EKC hypothesis in the empirical literature. Limited quantitative analysis was conducted to determine whether specific aspects of past empirical analysis impacted confirmation of the EKC hypothesis. Generally speaking, in the literature, EKC studies have between a 36% and 39% probability of leading to confirmation of the EKC hypothesis. Studies on pollution-economy dynamics at the local level (e.g., state-province or city-county) are shown to increase likelihood of confirmation by 22%. However, over time, confirmation is shown to be less likely (as each additional year goes by, the probability of confirmation is reduced by 1-2%)

Most EKC studies have been conducted at the country scale, though there are also studies at the State-Province, City-County, Lake, Watershed, Firm, Household and Individual scale. With growing urbanization, the limited number of City-County scale studies points to possible research paths.

Air, Climate and Energy measures are most frequently covered in EKC analyses, though Water, Land, Biodiversity, Waste and other topics have been evaluated as well.

Though the EKC literature (reviews) point to the frequency of use of SO_2 as an environmental indicator (as well as the frequency by which it leads to confirmation), the author found that SO_2 studies were no more likely than those using other indicators to lead to confirmation of the EKC hypothesis. Scale of analysis (country, state-province, etc.) also did not affect outcomes.

HISTORY AND EVOLUTION OF EKC ANALYSIS

In order to provide more granularity and context on EKC studies published to date, this section gives a detailed review of selected EKC studies. Studies were selected based largely on a recent review of the EKC literature by Richard T. Carson in the *Review of Environmental Economics and Policy* (Carson, 2010). Consideration was also given to an interest by the author in assessing differences in study method and technique at various scales of analysis. For example, what differences are there in how studies focusing on the country scale are conducted, versus those focusing at the city-county or other jurisdictional or environmental boundary scale? How do the various dependent and independent variables differ from study to study? And, is the EKC hypothesis more likely to be confirmed when focusing on a particular scale?

Similarly, consideration was given to spread of studies over the more than fifteen years of publication since the EKC hypothesis was solidified in Grossman and Krueger (1995). And, there was an attempt to include studies focusing on a variety of environmental media.

Holtz-Eakin and Selden (1995) use a reduced-form equation similar to Grossman and Krueger (1995), estimating the relationship between Carbon Dioxide (CO_2) emissions per capita and per capita GDP. They use CO_2 emissions data from the Oak Ridge National Laboratory (ORNL), combined with previously published income and population data for 130 countries between 1951 and 1986.

Holtz-Eakin and Selden (1995) find that CO_2 emissions follow an inverted-U shape consistent with the EKC hypothesis. The turning point for CO_2 emissions in their model is $35,428. (Grossman and Krueger (1995) had found most turning points for air and water pollutants they assessed were at below $8,000). However, within their data set, Holtz-Eakin and Selden only demonstrate stabilization of emissions, not an accompanying reduction.

Even assuming CO_2 emissions follow an inverted-U shape, and growth eventually leads to reductions, Holtz-Eakin and Selden (1995) predict CO_2 emissions will continue to rise globally due to high growth in lower-income countries within the data set. They call for balance in policies to promote growth, the distribution of income, and the curtailing of greenhouse gas emissions.

While previous studies had focused on energy-related pollutants, Suri and Chapman (1998) analyze the relationship between income and energy consumption (specifically, the consumption of commercial energy per capita). Similar to Holtz-Eakin and Selden (1995), Suri and Chapman (1998) use the reduced form model popularized by Grossman and Krueger (1995).

Suri and Chapman (1998) analyze a data set covering 33 countries over the period of 1971-1991 (data for some countries only went through 1990). Their results indicate a turning point for energy consumption in the range of $55,000, a level far outside their data set (and far above estimates for other pollutants, as in, e.g., Grossman and Krueger (1995)). They run a second model incorporating considerations for trade (i.e., of manufactured goods) which indicates a turning point much higher - $224,000. This suggests that countries may improve their own environmental quality through importing goods whose manufacture places a burden on the exporting country instead.

Torras and Boyce (1998) build on reduced form formulations to incorporate literacy, political rights, civil liberties and other "distribution of power" variables to determine how these might impact environmental quality and/or the pollution-income relationship. They pay homage to Simon Kuznets' original work, which focused on income inequality, to assess the impacts of power inequality (Kuznets' "curve" was only borrowed later for application to environmental quality). Torras and Boyce use much of the same data as Grossman and Krueger, with incorporation of the additional explanatory variables being a key difference.

Torras and Boyce (1998) confirm the existence of an inverted-U relationship between pollution and income, validating Grossman and Krueger's analysis but also note the important role that the distribution of power can play (literacy, political rights and civil liberties are all shown to have significant effects). However, key findings from Torras and Boyce (1998) also include reiteration of "troughs" and subsequent upturns in pollution after declines (something

Grossman and Krueger also found but did not highlight). They suggest a need for determining the best policy approaches to eliminate these up-turns.

Lopez and Mitra (2000) put more weight on behavioral and policy approaches than do other researchers in explaining why pollution follows an inverted-U pattern (they suggest a stronger influence of increasing demands for environmental quality with income, leading citizens to advocate for policy, while other authors point first to changes in technology/technique or industry composition effect.

Lopez and Mitra (2000) incorporate corruption as an explanatory variable for changes in the pollution-income relationship, suggesting that while corruption does not necessarily influence the shape of the pollution-income curve, it may impact turning points. With corruption, turning points are always higher than the socially optimal level. The Lopez and Mitra (2000) study is not an empirical study, but a theory/review article that incorporates discussion of Nash equilibria between firms and government entities when negotiating over pollution regulation.

Harbaugh and Wilson (2002) highlight the questions typically asked in EKC-related research: 1) how or whether an inverted U-shaped curve relating environmental quality and economic growth is consistent with Pareto optimality, and 2) whether environmental quality does, in fact, eventually improve with economic growth. They challenge research indicating that environmental quality necessarily increases with development, or at least the robustness at which the empirical evidence demonstrates this.

Harbaugh and Wilson use an updated version of the GEMS dataset similar to the one originally put to use by Grossman and Krueger (1995). They subject the EKC model to changes in explanatory variables, as well as additional variables altogether, concluding that the empirical evidence for the EKC hypothesis is not as robust as previous research would indicate.

Harbaugh and Wilson (2002) are not aiming to directly refute the EKC hypothesis. However, their focus is on highlighting sensitivities in the model and also demonstrating the need for specificity in future research and models. They argue that one size rarely fits all with respect to the relationship between environmental quality and economic growth. Pointing to Grossman and Krueger's original work, they insist that environmental quality can improve with economic growth, though it does not always improve. Under the right conditions, growth can be good for the environment. There are geographies, and pollutants, for which this rule applies, whereas in others, this may not be the case.

Aldy (2005) constructs his own data set to assess for the first time whether CO_2 emissions in the United States follow an EKC-type inverted U-shaped curve. Focusing on state-scale emissions, Aldy tests whether environmental quality does, in fact, improve at higher levels of income. He also incorporates trade and other variables, specifically energy endowments and variations in climate patterns from state to state.

Aldy runs two sets of models, one focused on production-based, and the other consumption-based CO_2 emissions. Production-based emissions "peak" sooner than consumption-based emissions based on (e.g., composition, technique) changes that are possible to control in manufacturing. Aldy's turning point for production-based emissions ranges from $14,708 to $16,840, while the consumption-based emissions turning point is at incomes ranging from $20,389 to $23,870. Production-based emissions follow an inverted U pattern while consumption-based emissions follow a "peak and plateau" shape over the ranges of income studied. Aldy runs separate regressions for each of 48 U.S. states, finding inverted-U patterns in 32. Turning points vary from state to state, highlighting the need for specificity in research efforts (versus a "one size fits all" approach relied on in earlier studies).

While many theories exist for why emissions follow an EKC-type curve, Aldy posits that the only feasible explanation for CO_2 emissions is the shift in production that states (countries, etc.) can make as their economic development matures. Aldy questions whether inverted-U curves for environmental quality are permanent or only reflect the current state of economic development in the world.

Smith and Ezzati (2005) conduct the first empirical test of the World Health Organization's (WHO) "environmental risk transition framework," challenging common assumptions about how disease/risk exposures change with economic development.

WHO's environmental risk transition framework is one of three frameworks that have been used over the years to describe how a society changes along its continuum of development. The "demographic transition" first came about in the 1940s to describe various demographic trends in development (changes in fertility rates, mortality rates, ethnicities). The "epidemiologic transition" was introduced around 1970 to describe health characteristics of societies in transition. And around 1990, the "risk transition" was developed to describe changes in environmental risks causing illness and disease.

According to the environmental risk transition framework, communities would drive illness and disease from the household, to community, to global scale over the course of their development. For example, limited access to sanitation in the household may make way for urban water pollution, which causes global issues later.

Smith and Ezzati's findings indicate that development improves disease and risk factors more than commonly believed. Rather than trading off household risks for community-scale, then global exposure, most environmental health risks have a tendency to lessen as a society develops.

York, Rosa and Dietz (2005) utilize the "ecological footprint" indicator to compare three approaches for describing how environmental quality changes with development: industrial ecology (IE), ecological modernization theory (EMT), and the environmental Kuznets curve (EKC). Their findings indicate that, although ecological footprint *intensity* per capita improves as nations develop, the significant production capacity in developed nations (and resulting emissions) means that development itself does not improve the environment.

York, Rosa and Dietz run correlations of the ecological footprint against other typical environmental indicators used in similar analyses to determine its reasonableness for use in EKC-related studies. Their empirical analysis includes 139 countries.

Deacon and Norman (2006) test for "qualitative" agreement with EKC shapes for three common air pollutants (SO_2, smoke, particulates), comparing the EKC model to "chance." Their focus is on within-country changes in income and pollution patterns, rather than a global analysis. In other words, they chart a given country's pollution profile versus income over time to see whether an EKC inverted-U pattern can be drawn through it. This idea is motivated by research questioning whether the EKC applies to individual countries over time, as they are all on one portion of the curve only at a given time.

Deacon and Norman's findings indicate the EKC only applies in limited conditions and is no better than chance in most. They also highlight the fact that high-income countries are over-represented in the GEMS dataset used by Grossman and Krueger (1995) and commonly used in many other EKC analyses, which would mean a higher likelihood of accepting the EKC hypothesis.

Auffhammer and Carson (2008) forecasted China's CO_2 emissions through 2010, using data through 2004. They project emissions much higher than other models using a dynamic model that accounts for spatial variations (where other models use time-series data for cross-country analyses), rejecting the EKC hypothesis/models in favor of these more dynamic models. They use province-scale data covering the time period from 1985 to 2004, describing three previous approaches to forecasting emissions levels: IPAT (impact = population x affluence x technology), EKC and input-output models. Rather than forcing data to fit one of these existing models, they allow the data to drive which model fits best.

Auffhammer and Carson (2008) predicted that China would overtake the U.S. in CO_2 emissions by 2006, rather than in 2020 as indicated in other models. Their approach allows for the use of much shorter time-series (because of the utility and richness of province-scale information).

Barua and Hubacek (2008) conduct a unique study of water pollution at the state and watershed scale in India. In doing so, they highlight the spatial mismatch between areas of interest/analysis and areas for which environmental quality data actually exists. They find statistically significant relationships between income and pollution for 12 of the 16 Indian states assessed; 4 followed the EKC inverted-U pattern, while the other 12 indicated a second rise in pollution after an initial peak (and trough). This N-shaped curve is consistent with the challenge by Aldy (2005) regarding the possible temporary nature of EKC-shaped curves.

Liu (2008) uses a combination of quantitative analysis and field research to study the linkages between economic development and local community sustainability leadership in China. The Chinese government's "Eco-Communities" program is an effort to encourage local cities and provinces to improve environmental quality and overall community sustainability. Municipalities designated as "Eco-Communities" must score a certain level on a points-based system, the scoring of which is based on various policies and programs put in place at the local scale.

Liu's analysis indicates that it is not always the wealthiest communities that demonstrate leadership. Though the wealthier provinces in China have led in eco-community designation, at the local scale, it is not always the wealthiest communities within a province that step up to lead. Therefore, Liu (2008) points to opportunities in solving environmental problems early in a community's development (versus after a "peak" in environmental degradation has been reached).

Figueroa and Pasten (2009) incorporate random coefficient modeling to allow for heterogeneity between countries (versus forcing the same model/structure for all, as many previous studies do). They conduct individual EKC analyses for 73 high and low income countries, using SO_2 emissions data. Findings indicate a high variation in shapes and turning points, even with confirmation of the EKC hypothesis.

The analysis of curve shapes and turning points for each individual country allows for additional checking in the robustness of the model(s) and the pollution-income relationship. Figueroa and Pasten (2009) confirm the high statistical significance of income as an explanatory variable for changes in pollutant emissions.

EXPLORATORY META-ANALYSIS OF PUBLISHED STUDIES

In an effort to better understand the landscape of the EKC literature, a basic meta-analysis of the literature was conducted. The aim was to identify gaps in the literature, or possible paths for future research. Of primary interest to the author is the increasing focus on urban sustainability in the academic literature, which has accompanied increasing urbanization globally. A partial motivation for the meta-analysis was to determine the extent to which the EKC model has been applied to the city, or local, scale.

A Web of Science literature search was conducted on November 2, 2010, to select EKC articles for review as part of the meta-analysis. For the first search, all Web of Science articles with "environment" and ("EKC" OR "Kuznets") in the topic were retrieved. This yielded a total of 645 results, with one duplicate. Upon first glance at this total (644), it was determined that there were additional acronyms for "EKC" in various environmental journals. For example, Epidemic Keratoconjunctivitis in medicine (environmental health) and East Krkonose Complex in geology. After leveraging Web of Science to refine the search and eliminate these and other irrelevant terms, a total of 279 articles remained.

To this total, all (445, net of duplicates) articles citing Grossman and Krueger (1995) were added, for a total of 724. After eliminating duplicates from the two searches (154), a total of 570 net articles were left to analyze. Upon initial review of the 570 abstracts, another 18 articles were eliminated due to irrelevance, leaving a total of 552. The original Grossman and Krueger (1995) was added back in for a final tally of 553.

Grossman and Krueger (1995) was used, although there were earlier publications by them (1991, 1993, 1994). The 1995 article is the only one that appears in Web of Science. Further, no studies earlier than 1995 were found in the "'EKC' OR 'Kuznets'" search. Therefore, 1995 appeared to be a good starting year for publications in this analysis. (Upon further review - i.e., through snowballing - a small handful of articles published prior to 1995 were found; however, only articles published since 1995 were included in the analysis).

Due to the exploratory nature of this aspect of the research project, and time constraints, only the abstracts of the 553 articles were reviewed. The aim of the abstract review was to determine the degree of confirmation of the EKC hypothesis in the empirical literature. However, not all the articles flagged were empirical studies. Upon review of the article abstracts, each article was coded as either an Empirical study (255), Theory/Review (226), or Other (72). The Other category included empirical studies that were not specifically EKC studies – to the extent possible, the Empirical category was left for EKC studies in particular. However, for some studies, it was impossible to determine what method or model was used in the empirical analysis. Articles were coded as Empirical if it was reasonable to suspect that the analysis could have yielded findings relevant to the confirmation or rejection of the EKC hypothesis.

For the 255 articles ultimately coded as Empirical (that is, the EKC-specific ones) and analyzed, a single observation was entered into a Stata dataset for each dependent variable modeled in the article. The dependent variable used in this meta-analysis is confirmation of the EKC-hypothesis, with possible values of confirm, reject or mixed. An initial analysis using each article as one observation yielded a large number of “mixed” findings, often due to the modeling of multiple dependent variables within an article (the EKC hypothesis being confirmed once and rejected once by two different variables in the same article would result in the article being coded as “mixed”). Therefore, an attempt was made to separate out each dependent variable modeled and to treat these as the single observations for the meta-analysis.

After entering multiple observations for each article, the 255 articles were expanded to a total of 373 observations. Table 1 provides a listing of the other variables captured in the analysis, with limited descriptive statistics; Table 2 lists the most frequently modeled dependent variables.

Table 1. Variables Captured in Meta-Analysis of EKC Literature

Category	**Possible Values (Frequency)**	**Comment(s)**
Study Start and End Dates	Year	A total of 133 observations included a Start and End Date
Scale of Analysis	Country-Group (1) Country (201) State-Province (47) City-County (20) Firm (1) Household (6) Individual (4) Lake (6) Watershed (4)	It was not clear in every article exactly what scale of analysis was used.
Geography Covered	China (38) U.S. (20) Italy (14) Spain (11)	Only the most frequent examples are listed here.
Continent of Study	Asia-Pacific (54) EU (50) North America (40) Latin America (10)	Some multi-continent studies were conducted (6); many focused on either developed or developing countries/geographies but did not specify exact coverage.
Media	Air, Climate and Energy (214) Water (35) Land (16) Biodiversity (13) Waste (7) Other (88)	Media was a category used to group dependent variables.

Table 2. Frequency of Common Dependent Variables in EKC Studies

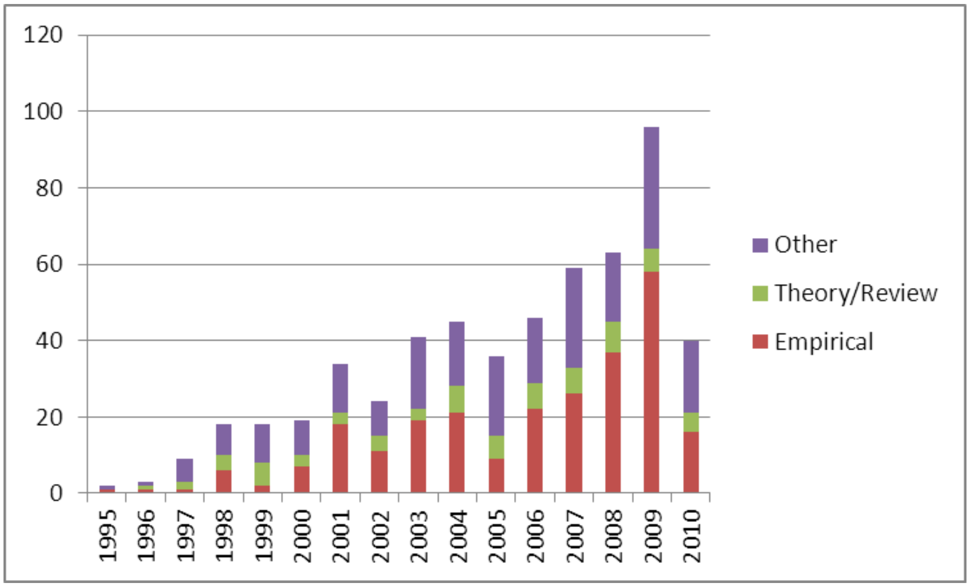
Variable	Frequency
Carbon Dioxide (CO_2)	66
Sulfur Dioxide (SO_2)	34
Energy Consumption	17
NOx Emissions	11
Ecological Footprint	9
Particulate Matter (PM_{10})	9
Deforestation	8
Water Quality	7
Species Imperilment	6

Because the EKC literature has spanned over 15 years, the frequency of publication was charted in order to determine if there has been recent fall-off in interest. Clearly, there has not, as level of publication of both Empirical and overall studies climbed steadily through 2009 (partial year 2010 is also shown in the graph).

While the overall number of empirical studies published each year has risen, there has been a particular focus on specific geographies (where earlier studies focused almost exclusively on country-scale studies that were global in nature). Specifically, there have been over 25 empirical studies published in the last three years focusing on China.

There has also been a growth of studies focusing on a scale other than the country scale. While in the first five years, only four studies were published focusing on a scale other than country scale, since that time, studies have been published with country-groups, state-province, city-county, household, firm and individual scales of analysis. The predominance of studies continues to be at the country scale.

Figure 5. Frequency of EKC-Related Publications, 1995-2010



Results from Exploratory Meta-Analysis

Beyond detailing the descriptive statistics of the 255 Empirical EKC studies (and 373 resulting observations), a limited quantitative analysis was conducted to determine whether specific aspects of the empirical analysis impacted confirmation of the EKC hypothesis. Figures 6-9 show the level of confirmation for studies by year, scale of analysis, environmental media of focus and for the most frequently used dependent variables (environmental quality indicators), respectively.

Figure 6. Confirmation of the EKC Hypothesis by Year

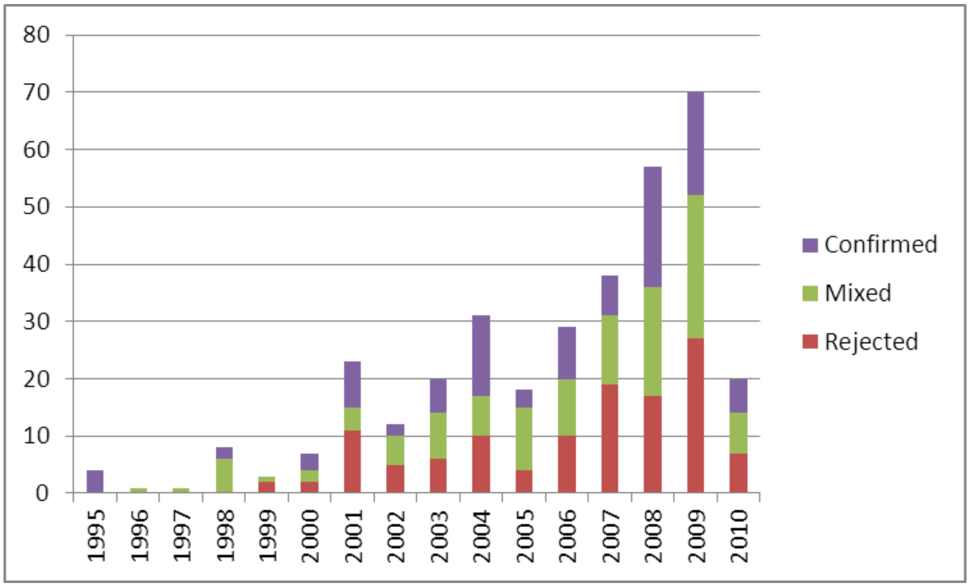


Figure 7. Confirmation of the EKC Hypothesis According to Scale of Analysis

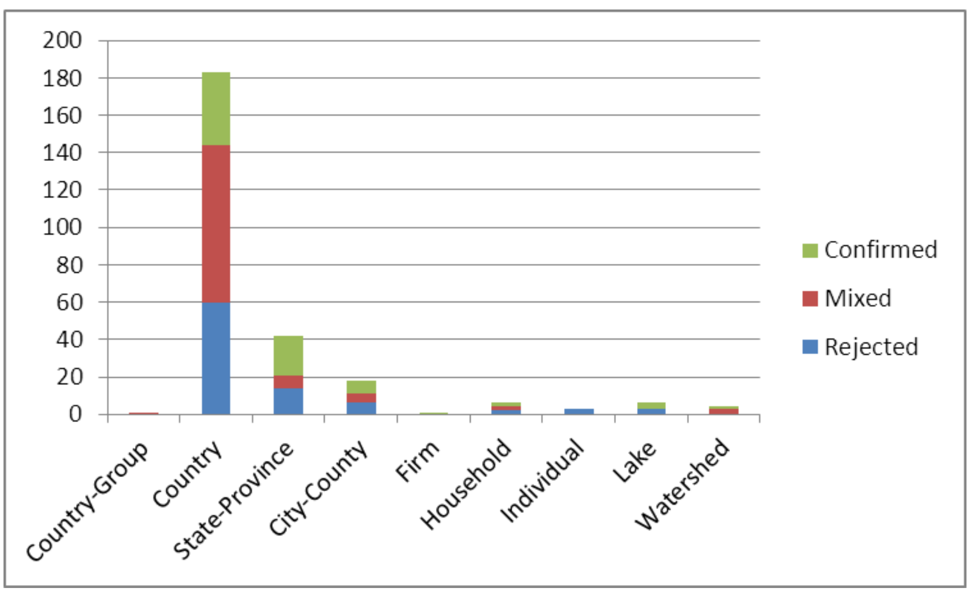


Figure 8. Confirmation of the EKC Hypothesis by Environmental Media of Focus

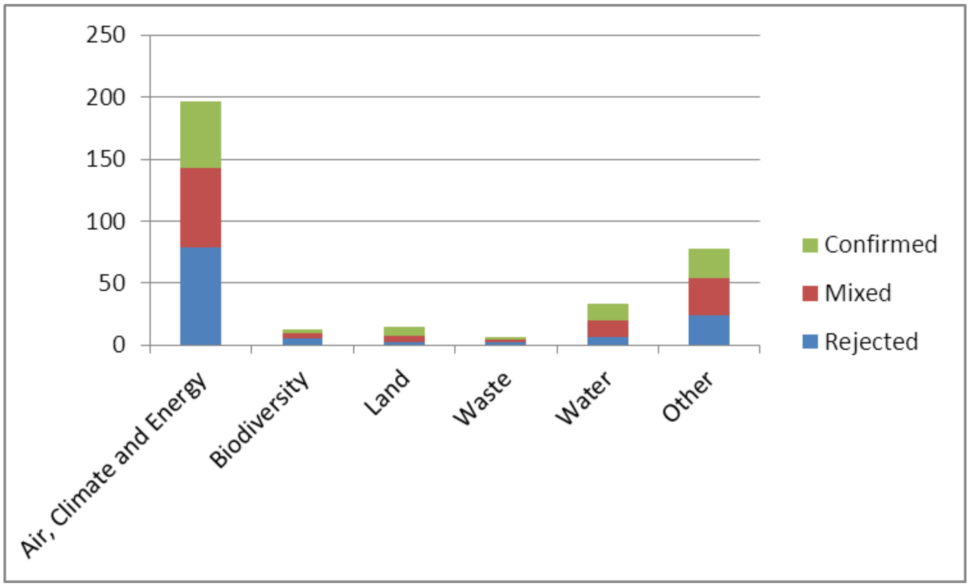
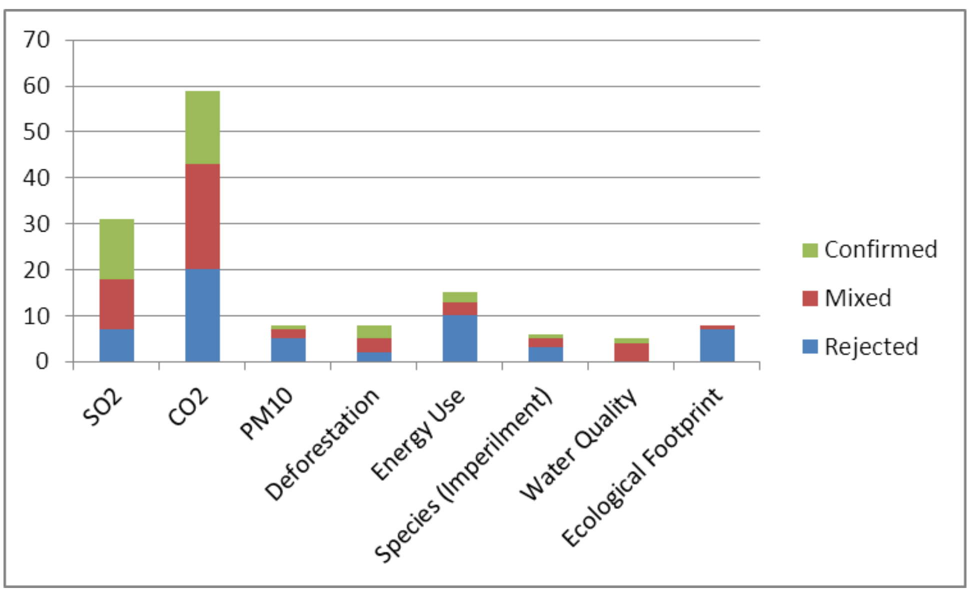


Figure 9. Confirmation of the EKC Hypothesis by Most Frequently Tested Environmental Quality Indicators



A limited statistical analysis (simple OLS regression) was run to determine if in the literature the probability of confirming the EKC hypothesis depends on the year of publication, scale of analysis or geography of focus, or whether studies focusing on specific environmental media or environmental quality indicators are more or less likely to lead to confirmation. Table 3 lists the results from three different OLS regressions – one controlling for year of publication, scale of analysis and environmental media; the second adding geography; and the third controlling for specific environmental quality indicator, instead of media (which are more general categories).

Table 3. Results of Statistical Analysis of Confirmation Probabilities

	Model 1	**Model 2**	**Model 3**
Constant	.3661271***	.3911416***	.3948335***
Year	-.012105*	-.0161556**	-.0166468**
Country-Group	(dropped)	(dropped)	(dropped)
State-Province	.223166**	.1020852	.1120074
City-County	.0493434	-.0857017	-.0646799
Firm	.7912382*	.8188807*	.8215744*
Hazardous Waste Sites	-.329812	-.3422606	-.3298397
Household	.0247449	-.061034	-.0124327
Individual	(dropped)	(dropped)	(dropped)
Lake	.1783969	.2178767	.2700408
Watershed	-.047393	.0001878	.1019778
Air, Climate and Energy	-.0133125	-.0311395	-
Biodiversity	.0042445	.0214781	-
Land	.166188	.1667791	-
Waste	.1230596	.1139403	-
Water	.0644212	.036796	-
Africa	-	.3661757	.2928733
Europe/EU	-	.1050673	.0886739
Latin America	-	.1049495	.1107585
North America	-	-.0004143	-.0150535
Asia-Pacific	-	.2349783**	.2323218**
CO_2	-	-	-.0062346
SO_2	-	-	.0969303
PM_{10}	-	-	-.1868287
Deforestation	-	-	.1311498
Species (Imperilment)	-	-	-.0120245
Ecological Footprint	-	-	-.224083
Water Quality	-	-	-.1945739
Number of observations	373	373	373
F(13, 359)	1.60	1.69	1.73
Prob > F	0.0839	0.0385	0.0278
R-squared	0.0546	0.0793	0.0893
Adj R-squared	0.0204	0.0325	0.0376

** statistically significant at the .1 level*
*** statistically significant at the .05 level*
**** statistically significant at the .01 level*

Observations in the reference group for this analysis are country-scale studies (keep in mind, one article can contain more than one observation) focusing on environmental media other than Air, Climate and Energy, Biodiversity, Land, Waste or Water that covered more than one continent or an unspecified geography. For model 3 (which focused on specific dependent variables rather than the more general categories of environmental media), the reference group were similar studies that utilized dependent variables other than the most frequent ones (CO_2, SO_2, PM_{10}, Deforestation, Species (Imperilment), Ecological Footprint and Water Quality).

Based on the analysis, the reference group studies have between a 36% and 39% probability of leading to confirmation of the EKC hypothesis. Only the Year and State-Province variables show statistically significant departures from the reference group in all three models. As each additional year goes by, confirmation is 1-2% less likely, depending on the model. There is only one firm-scale study in the analysis, so that variable should not be treated as particularly important.

Regarding the time trend reducing likelihood of confirmation, this could be explained by the increasing desire by some to “refute” the EKC hypothesis, the proliferation of articles by specific authors in that “camp,” or an increasing complexity in the types of analysis used (e.g., leading to more “mixed” results once additional indicators are evaluated). These variables were not included in the meta-analysis per se; however, an attempt was made to ensure that the same research published in multiple sources was

For Model 1, the State-Province variable is statistically significant at the 0.05 level; State-Province scale studies are 22% more likely to lead to confirmation, controlling for other factors. However, the State-Province variable is not statistically significant in either Model 2 or Model 3. This could be explained by the Asia-Pacific variable, which is statistically significant at the 0.05 level in both models. Almost all State-Province scale studies included in the analysis are from the Asia-Pacific region (most notably, China).

Model 3, which controls for specific dependent variables, does not yield any statistically significant departures from the reference group for the most frequently utilized environmental quality indicators (reference group being all other indicators). It is interesting to note that neither the SO_2 nor the ecological footprint indicators are statistically significant. Reviews of EKC literature often note the frequency by which SO_2 is used as an indicator (as well as the frequency by which it leads to confirmation). Seven of the eight studies (observations) utilizing the ecological footprint indicator rejected the EKC hypothesis.

RECENT INNOVATIONS IN THE LITERATURE

In a recent innovation in the EKC literature (since this research effort first commenced), Burnett and Bergstrom (2010) developed a spatial-temporal model for incorporating neighbor state impacts in a study of U.S. state-scale CO_2 emissions. They found that regional impacts are significant and point to the need for regional policies for targeting CO_2 emission reductions. Though not explored here, the complexity and robustness of their model may prove fruitful in future EKC-related research, particularly internationally (geographically, many countries are similar in size to U.S. states, and a study similar to theirs could be done over a country-group, like the EU, or continent scale).

Jayanthakumaran, et.al. (2012) recently published a study that was both a methodological innovation and an interesting comparative analysis of changes in CO_2 emissions and energy use in China and India, two of the world's largest emerging economies. The methodological innovation consisted of determining structural breaks in data, coinciding, for example, with within-country policy changes or changes in energy infrastructure. Their analysis may provide the foundation for future research that explores the "why" behind changes in environmental and social outcomes (a long-described need in the EKC literature, for which little research has attempted to truly assess).

RAMIFICATIONS FOR RESEARCH EFFORT

The preliminary meta-analysis and detailed review of select EKC studies has impressed a number of things on the author. First and foremost, the literature studying the environmental Kuznets curve is as complex as the relationship between economic growth and environmental quality. Carson (2010), Dasgupta, et.al. (2002), and Copeland and Taylor (2004) would suggest opportunities to strengthen it.

From the author's perspective, the opportunities proposed by past reviews are only the beginning. On the one hand, there is a myriad of opportunity to delve into reasons why inverted-U, U- or other-shaped curves describe, or do not describe, the relationship between economic development and environmental quality. Carson (2010) suggests the first decade or more of EKC-related literature was "lost" in a struggle to determine shapes of curves rather than underlying reasons for changes in environmental quality resulting from income growth – that is, why these changes occur.

On the other hand, focusing specifically on the use of EKC-type models to describe how environmental quality relates to economic growth, one simple question arises from this preliminary analysis. An underlying premise of the EKC hypothesis is that environmental impacts must be local in nature (that is, *felt*), and that externalities from those impacts must be internalized for a turning point to be reached (Carson, 2010). If the first is true, then why have over two-thirds of the empirical studies to date focused on the country as the scale of analysis? *Do we "feel" country-scale impacts?*

If the second is true, then indeed our focus should be on understanding what specific factors truly lead to a turning point – or tipping point, with respect to environmental quality. As

Carson (2010) notes, “what is needed now and in the future is work identifying factors that can translate some of the increased income from growth into improved environmental quality.”

With increasing urbanization (over half of the world’s population living in cities, with a projected 80-20 urban-rural split by 2050, according to some estimates), perhaps the local scale is where environmental impacts will not only be felt, but where policy makers will take it upon themselves to do something about them. The answer to the rhetorical question above is that historically, the country/national and international scale have been the scales at which the most significant policy change has taken place. Increased urbanization may tilt the balance in that regard. Therefore, the city-county and state-province scales of analysis are ripe for study.

While continued urbanization has focused academic research at the local scale, there is also opportunity for research into the role of the private sector in economic development and its resulting impact on the environment (positive or negative). This research project attempts to build on a 20-year stream of academic policy research on the EKC and other models to describe how environmental performance changes with economic development. A quantitative analysis of the interplay between social/health, environmental and economic indicators at the country, city and manufacturing facility scale is complemented by a limited qualitative analysis of the policy context within 21 identified countries.

CHAPTER 3

STUDY DESIGN AND INITIAL RESEARCH QUESTIONS

This three-scale analysis starts at the country scale, with a series of models assessing various environmental and social outcomes against traditional EKC-type models. Second, the same (type) models were tested at the city/regional scale, using a dataset that was constructed for this purpose, which includes cities/regions in the United States, China, India and the European Union. Finally, the analysis of manufacturing facilities within a group of countries (scale 3) adds granularity to how environmental and social outcomes play out in the private sector.

The analysis will determine the "shape of curves" from country-scale to city/regional and manufacturing facility scale, supplemented with limited qualitative analysis to tell "the story behind the story" found in the data. Country-specific EKC curves are also generated for each of the 21 identified countries, for each indicator of interest.

The country-scale “policy profiles” characterize the state of evolution and the current situation in each country with respect to political environment, size of country, evolution of environmental policy, and other variables unique to the country that may explain trends apparent or hidden in the data. These might also help to explain “turning points” or tipping points with respect to changes in environmental quality that are not explained by variables in the quantitative analysis.

The Coca-Cola Company, a major multinational corporation, has operations in over 200 countries. This analysis targets 21 of the Company’s important markets (listed below). These were selected based on size of current business and growth potential looking at indicators such as projected population growth between now and 2020 (the target year for the Company's long-term vision, goals and strategy for the Company and its core business partners), and projected growth in personal expenditure per capita.

Table 4. List of Countries for Analysis

1. Argentina
2. Australia
3. Brazil
4. Canada
5. Chile
6. China
7. France
8. Germany
9. India
10. Italy
11. Japan
12. Mexico
13. Nigeria
14. Philippines
15. Russia
16. South Africa
17. Spain
18. Thailand
19. Turkey
20. United Kingdom
21. United States

Within these countries, there is diversity in terms of size (though they are all in the top 60 countries by population in the world), continent, cultural make-up, public policy approaches and other variables. Approximately 2/3 of the world's top 100 cities (in population) are within these countries. The company and its core business partners have nearly 500 manufacturing facilities in identified countries, with as few as 7 in the U.K. and Thailand to as many as 87 in the United States.

In effect, within the company/business partner system there are many possible scales of analysis. The manufacturing company has its own operating structure (that only roughly follows geographic boundaries), as do its business partners.

PRELIMINARY RESEARCH QUESTIONS

There are several possible benefits of a three-scale analysis. First, each scale of analysis will present its own research questions and hypotheses for testing. Second, ultimately it will be possible to analyze data from all three scales (e.g., over time) in each geography to determine if there are over-riding trends that are affecting indicators at all three scales. Hypotheses for each indicator at each scale are included along with reporting of the analysis and results in following sections.

The basic research questions motivating this research have been the following:

How do economic, environmental and social indicators relate differently at the country, city/urban and manufacturing facility scales?

What can we learn from a quantitative analysis about the "trickle down" of environmental, economic and social performance from the country to the city/urban to the plant scale?

CHAPTER 4

DATA COMPILATION AT THE COUNTRY, CITY/REGIONAL AND MANUFACTURING FACILITY SCALES

Compiling data for environmental and social indicators is in itself a research project. While there has been a proliferation of sustainability-related indicators in the past several years, some datasets are so new that there are not adequate time-series for rich analysis. This is particularly the case for data at the city/urban scale.

World Bank maintains a database of approximately 1,200 World Development Indicators (WDI) for over 200 economies. Data exists at the country scale beginning in 1960, currently through 2010. The core dataset includes 420 indicators on Agriculture and Rural Development, Aid Effectiveness, Economic Policy and External Debt, Education, Energy and Mining, Environment, Financial Sector, Health, Infrastructure, Labor and Social Protection, Poverty, Private Sector, Public Sector, Science and Technology, Social Development and Urban Development.

The Organization for Economic Cooperation and Development (OECD) has also established a set of key environmental indicators at the country scale, the progress against which was most recently published for OECD countries in 2008. Of the 21 countries targeted for this research effort, 11 are OECD member companies; 10 are not. While more data is available for the OECD member companies through the OECD Key environmental indicators publication, in order to perform analysis against indicators for which there is data for a larger group of countries, the World Bank dataset has been used for this research, supplemented in the specific treatment of the environmental context in the 21 countries later.

Data at the City/Regional scale do not exist in centralized databases as they do at the country scale. This is the case for a number of reasons. First and foremost, environmental and social indicators have not historically been tracked by local governments as systematically as they have been tracked at the country scale. As noted above, environmental and social policy has been more prevalent at the country scale, especially in developing countries.

Historically, databases such as the GEMS dataset used by Grossman and Krueger were managed centrally by programs within the UN Environment program. However, in recent years many of these programs have gone by the wayside. The GEMS Water program still exists under the auspices of UNEP, but the quality of data is dependent upon regional and local governments providing it, and is highly variable.

The UN Habitat program has published "State of the World's Cities" reports every other year since 2000-2001. These reports contain data on social, environmental and economic development in urban environments around the world, and most of the data behind these reports is open to the public on the UN Habitat program web site. Limited exploration of this data found that the longest-tracked indicators are on urban environments/populations within countries, versus indicators specific to a particular city (for example, poverty data characterizes the state of urban populations across a country rather than within specific cities).

There are other possible data sources for city/urban scale indicators. As one example, a recent effort spearheaded by Siemens Corporation, in conjunction with *Economist* magazine, has established a "Green Cities Index" (for example, *Economist* Intelligence Unit, 2011). Several reports (e.g., Brookings, 2008) have been published on assessing the carbon footprint of metropolitan areas in the United States. An online community called "Sustain Lane" (www.sustainlane.com), published three "green" City Rankings for U.S. cities from 2005-2008, based on a variety of indicators. And, groups such as ICLEI-Local Governments for

Sustainability and its Urban Sustainability Directors Network are developing research and indicators to compare city sustainability efforts globally. However, these datasets (more often, they are lists and rankings rather than databases) at most cover just a few years; therefore, a dataset was constructed specifically for this research effort.

In order to build a dataset in a reasonable time frame that would allow for sufficient city/regional-scale analysis, emphasis was placed on the United States, China, India and the European Union. Focusing on these 4 entities provided the strongest return on research investment. Many of the world's largest cities are located in China, India and the United States. The European Union's Eurostat program offered the opportunity to obtain data from cities within multiple countries with one approach. Five of the 21 countries most interesting to the author (for reasons outlined above) are part of the European Union.

Eurostat maintains a central database of regional statistics in the EU for population, economics, environmental and social matters (one can think of Eurostat as a census bureau for the entire EU). Between China, India, the United States and EU, data on environmental or economic performance was compiled for 138 cities/regions: 50 cities in the United States, 74 cities and provinces in china, 7 cities in India and the rest in the EU. Once a cross-check was made for cities/regions with both environmental and economic data, a total of 113 cities/regions survived in the dataset.

Data for Chinese cities and provinces was obtained from publicly available datasets provided by the China Bureau of Statistics, which publishes an annual Statistical Yearbook of indicators on population, demographics, development and environmental performance, as well as a host of other areas (National Bureau of Statistics of China, 1995-2010). Bloomberg's electronic portal actually maintains China City GDP data, so for ease, this was used rather than the Statistical Yearbook (since getting data from the Yearbook is a laborious process involving year-by-year collection (Bloomberg LP, 2011). Data for Indian cities was obtained from publicly available data from the Indian Bureau of Statistics. Air quality data were available for seven Indian cities through this publication (Government of India, 2008-2009, 2010).

For the European Union, statistical data is also managed centrally, Eurostat databases were accessed for regional economic, environmental and population data (Eurostat, 2011). In the case of the United States, there is no central repository of data covering all topics. A combination of data from the U.S. Census Bureau (population density), the Bureau of Economic Analysis (City/Regional GDP) and the U.S. EPA (air quality) was used (U.S. EPA, 2012).

The only global database utilized for city/regional scale indicators was the GEMS water program. Data for BOD, DO and COD was obtained through GEMS. This data covered a smaller time period than the air quality data obtained directly from each country/regional entity. Further, this data was at the station scale, where the desired approach for this analysis was the city/regional scale (ideally, the equivalent of a metropolitan statistical area in U.S. terms). Stations were identified using the interactive GIS-based system on the GEMS web page and a list of all stations in the 21 identified countries that was provided by GEMS program staff. Stations near major cities in the 21 countries were identified, and data was provided by GEMS for those stations. In the case of multiple stations for the same city, or multiple measurements for the same year, simple averaging across stations was employed to obtain an annual average reading for the city. The unit of analysis in this research is a city-year (for country-scale and manufacturing-scale, the country-year and facility-year, respectively).

VARIABLES OF INTEREST: COUNTRY AND CITY/REGIONAL SCALES

As environmental and social quality indicators for this analysis at the country and city/urban scales, this effort has focused on the following *dependent* variables:

- Water – access to water, access to improved sanitation, water quality, water consumption

- Energy/Climate – CO_2 emissions, energy consumption, air quality
- Social indicators – life expectancy

The following *independent* variables were utilized for analysis:

- GDP (per capita, purchasing power parity, constant international $)
- World Governance Indicators
- Population density
- Trade openness

Data for these indicators within these areas is available through Worldbank for the country scale. The *CIA World Factbook* was utilized for country-scale data for the supplementary "policy profiles" developed for identified countries. The Edelman Trust Barometer (Edelman, 2011), which has been conducted for 11 years to gauge opinion leaders' trust in business and government was explored as a possible data source for public trust and demand for environmental quality, as was the Gallup annual survey of public attitudes on the environment, which has surveyed the public in 153 countries since 2006 (English, 2010). Ultimately data from these two sources was not utilized for the analysis but may be part of a future research effort.

For the city/regional scale, information resources described above were supplemented with coastal/port data from World Port Source (www.worldportsource.com), which lists port cities in all countries (World Port Source, 2011). Population density data not found in country-specific data sources was taken from the Demographia World Urban Areas (World Urban Agglomerations) 7th Annual Edition, April 2011 (Demographia, 2011).

TIME PERIOD FOR ANALYSIS

The motivators for this study were the city/regional and manufacturing facility scale data, as well as use of the World Governance Indicators (WGI) variables as institutional variables.

Therefore, the time period of the study was limited to the period over which those data were available. The data range was limited to the years 1990-2010 for the basic regressions; models involving the institutional variables were limited to 1996-2010. City data for some indicators covered the full time period, while other indicators only covered a sub-set of those years.

WGI variables have only been tracked since the mid-1990s. Therefore, the institutional variables limit time coverage as well.

In the case of manufacturing facility data, the years covered were 2004-2010. This is the time period over which the most complete and reliable dataset exists for bottling facilities. While the Company reported environmental performance publicly before that time, it was 2004 before data coverage and reliability reached a comfortable point for the company.

With respect to the City/Regional dataset, economic and population data was as much a limiting factor as was data for environmental and social outcomes. Ultimately, city/region scale GDP was not available for Indian cities for the full time period; therefore, no Indian cities were included in the analysis.

As in the United States, population data for many countries is updated once every ten years. This was the case for the United States and China. In the EU, there were more frequent data available, but not for all years. In any case where there was not a reported or estimated population or population density, population density figures were imputed on a city-by-city basis. Microsoft Excel was used to chart available data, and the line-fitting function was utilized to determine whether a linear or polynomial equation fit best. Population densities were calculated for gap years based on the better formula.

The tables below show the summary statistics for country-scale and city/regional-scale regressions. A final table summarizes the data evaluated for each environmental/social topic area and scale.

For particulate matter (the environmental output metric for which there was the most data where City/Regional-scale GDP was also available, there were cities from Belgium, China, France, Germany, Spain, the United Kingdom and United States. Data covered the range of 2002-2010. Data covered this same range for nitrogen dioxide, with cities/regions in the same countries (though there was a slightly smaller data set overall).

Table 5. Summary Statistics for Country-Scale Regressions

Variable	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Carbon Dioxide (CO_2) Emissions (metric tons per capita)	6.61	5.76	.013	44.84
Energy Use per Capita (kg oil equivalent per capita)	2,790	2,438	9	21,013
Access to Improved Sanitation Facilities (% of total population with access)	100	.	100	100
Access to Improved Water Sources (% of total population with access)	77	.	77	77
Life Expectancy (total, years)	71.00	7.83	44.89	81.56
Literacy Rate, adult (%)	83.75	20.21	39.27	99.50
Country-scale Population Density (people per square km)	242.05	863.62	1.69	6,650
Renewable Water Resources per Capita (cubic meters per capita)	11,200	21,300	28	99,900
Trade (% of GDP)	94.35	57.77	20.63	405.50
Organic Water Pollution (Biological Oxygen Demand, BOD, total kg discharged)	224,900	764,094	236.26	9428,874
Energy Imports (%, net of use)	.40	146.51	-845.24	100
Agricultural Land (% of total land area)	41.68	22.48	1.15942	82.05
Electricity Production (kwh)	1.61e+11	5.05e+11	2.14e+08	4.03e+12
Electricity Production from Coal Sources ()	23.23	29.20	0	99.17
Energy Use per Capita	2,790	2439	9.02	21,013
Total Country Land Area (square km)	798,000	2,335,000	320	1.64e+07
PM-10, country-scale (mg per m3)	44.04	28.81	11.34	153.19
Urban Population Growth (%, total)	242.04	863.62	1.69	6,650
Control of Corruption Estimate (World Governance Indicator)	1.43	1.57	-1.86	5.9
Political Stability and Absence of Terrorism Estimate (World Governance Indicators)	.26	1.07	-1.43	2.46
Voice and Accountability estimate (World Governance Indicator)	.16	.93	-2.32	1.66
CO_2 Emissions, total (1,000 metric tons)	.14	1.00	-2.09	1.57

Table 5 (continued).

Country GDP (PPP-adjusted, constant 2005$, thousands)	14,844	12,811	531	67,945
CO2 Emissions, total (1,000 metric tons)	226,039	779,936	359	6,533,019
Country GDP (PPP-adjusted, constant 2005$, thousands)	14.84	12.81	.53	67.95
Robust z statistics in parentheses * significant at 5%; ** significant at 1%				

Table 6. Dependent Variables at the Country- and City/Regional-Scales

Scale	**Climate Change and CO_2 Emissions**	**Energy Consumption**	**Water and Wastewater**	**Solid Waste**	**Social, Occupational Safety and Health**
Country	CO2 emissions per capita)	Energy consumption per capita	Availability of Water resources Access to improved Water and sanitation systems Water quality Renewable Water Resources per Capita		Life expectancy
City/Urban	Air quality		Water quality Water Use		

Table 7. Sample Statistics for Particulate Matter (PM_{10})* at the City/Regional Scale

Variable	Mean	Standard Deviation	Minimum	Maximum
Population Density (people per square km)	432.39	517.6984	40.51	2978
Particulate Matter (PM_{10}, mg per m3)	.057	.0251361	.0192	.162
Sulfur Dioxide (SO2, mg per m3)	.119	.0961903	.00262	.46374
Nitrogen Dioxide (NO_2, mg per m3)	.251	.102141	.0223	.423752
Coastal	.624	.485089	0	1
Country-Scale Political Stability measure	.133	.3075652	-.6142502	.9581274
Country-Scale Voice and Accountability measure	1.022	.718453	-1.704122	1.600154
Country-Scale Control of Corruption measure	1.367	.5839037	-.6425853	2.048113
City/Regional GDP (PPP-adjusted, constant 2005 $, thousands)	45.634	14.12291	2.340391	82.62237
Country GDP (PPP-adjusted, constant 2005$, thousands)	39.065	9.725509	3.397629	43.65973

**Regressions for other dependent variables were more limited and showed small variations in economic and place variables.*

Table 8. Year and Country Coverage for City/Regional-Scale Regressions

Dependent Variable	Year Coverage	Country Coverage
Particulate Matter (PM_{10})	2002-2010	Belgium, China, France, Germany, Spain, United Kingdom, United States
Sulfur Dioxide (SO_2)	2002-2010	China, United States
Nitrogen Dioxide (NO_2)	2002-2010	Belgium, China, France, Germany, Spain, United Kingdom, United States
Dissolved Oxygen (DO)	1995-1997, 2001, 2004	China, United States
Biological Oxygen Demand (BOD)	1990-2004	China, Germany, India, Spain, United Kingdom
Chemical Oxygen Demand (COD)	1995-1997, 2001, 2004	China, United Kingdom
Residential Water Use	1996, 1998, 2000, 2003-2008	China, France, Germany, Spain

VARIABLES OF INTEREST: MANUFACTURING FACILITY SCALE

The Coca-Cola Company key environmental impact (and management focus) areas are Global Water Stewardship, Sustainable Packaging, Energy and Climate Protection, and increasingly, Sustainable Agriculture. Environmental initiatives sit within a broader Sustainability framework in place at the Company, which includes objectives for Workplace, Marketplace and Community initiatives as well.

The Sustainability framework is sometimes referred to as "Live Positively," a program in place within the Company and its broader business system. This framework is embedded as the "Planet" objective within the Company's overarching "2020 Vision," a document put in place in 2008 in partnership with the Company's key bottlers. Vision 2020 outlines key objectives for the company to meet between now and the year 2020 in the areas of product Portfolio, Partners, Planet, Profit, Productivity and People.

The Coca-Cola Company has reported its environmental performance through public reporting since the 2002/2003 time frame. The Coca-Cola Company has tracked environmental, occupational safety and health (EOSH) indicators for some facilities for approximately 15 years. Environmental reports are published on the Company's web site as well as being distributed to employees, shareholders and outside stakeholders. Currently, environmental reports dating back to 2008 are available for download on the web site. The 2008/2009 report contains global summary data for environmental performance dating back to 2005. Data from 2004-2010 was felt by Company personnel to be the most accurate and covers the largest number of indicators (though typically additional indicators are added every year). Therefore, this research will focus on the data covering 2004-2010.

The Coca-Cola Company made detailed environmental, occupational safety and health performance data available for the years 2004-2010 for the production facilities that the company and its business partners own in the 21 countries of interest. Data is collected centrally (at global headquarters) by the corporation on an annual basis for environmental, occupational health and safety indicators. Various production indicators are also tracked for the purposes of normalization (for example, water or energy usage per product output). Therefore, data exists for conducting an EKC-type analysis at the manufacturing facility scale for the corporation. For the purposes of this research, this effort has focused on four core environmental, occupational safety and health indicators:

- Energy usage per product output
- Water usage per product output
- Solid Waste generated per product output; and,
- Lost-time incident ratio per product output.

The Company has not historically released plant-scale data publicly. They have done so for the purposes of this project in a hope to gain learnings about patterns in the data, specifically within these markets. *Data were made available under the condition that they only be used for aggregation purposes at the country scale and individual facilities were not publicly identified.*

Typically, plant-scale data are aggregated at the business unit scale (a business unit typically covers a country or a few countries), which is then aggregated across what Coca-Cola calls "geographic operating groups" (roughly the same as the major continents of the world). The operating groups compile all data and deliver it to the global headquarters through an online system. (In practice, facility personnel input their data into the system directly; however, through security filters and system controls, their counterparts at the business unit and group scale must approve the data before it is submitted to the corporate office in Atlanta.

The core environmental measures that the Company has historically reported link to the Company's environmental platform (priority) areas. Of the production facility-based metrics, the most engrained within reporting and internal management systems are the water usage ratio and the energy usage ratio (sometimes referred to internally as "WUR" and "EUR", as they will be abbreviated here). Both are ratios normalized to production (energy use ratio is megajoules (MJ) of energy used per liter of (beverage) product output; water use ratio is liters of water used per liter of product output).

The Company established specific goals for Global Water Stewardship in 2008 that marked a change from simply reporting data to more aggressive goal-setting. Prior to 2008, commitments related mostly to production plant efficiencies, while the 2008 goals and programs since have expanded to include water programs outside the plant (for example, regarding watershed protection efforts near plants as well as community water partnership programs in areas where the Company and its bottling partners operate (The Coca-Cola Company, 2009).

Also in 2008, the Company set a "grow the business, not the carbon" target for energy and climate protection, which applies to Company and bottling production facilities globally. This goal was established as part of The Coca-Cola Company's global partnership with the World Wildlife Fund (WWF), through which it has established a number of water, energy and climate protection programs since 2005 (The Coca-Cola Company, 2008).

The Coca-Cola Company, generally speaking, has historically produced beverage syrups and concentrates, and sold those products to its franchise Bottling partners, who convert these syrups and concentrates into finished beverages. These are separate companies that contract with The Coca-Cola Company to produce and distribute beverages over a certain geographic territory. Over the last several years, the Company has purchased Bottling operations in several countries around the world, as well as in North America. Currently, the Company owns approximately 1/3 of its Bottling operations.

Unlike water and energy metrics, waste generation and lost-time incidents, the two additional environmental, occupational safety and health areas included in this study, have not been reported externally for as long as water and energy usage have. Waste generation ratio is the total waste generated per liter of (beverage) product output and is the historical measure for waste generation within production plants.

Lost-time incidents are typically measured on an absolute basis (number of incidents) as well as an industry accepted lost-time incident rate (LTIR), which is the number of incidents per 1,000 hours worked. For the purposes of this study, rather than using the LTIR measure, an LTI "ratio" was constructed, which is lost-time incidents per liter of product output. This will allow for more direct comparison between the four measures.

A global director of occupational safety and health put in place in 2010, which elevated workplace safety to the same priority level organizationally as environmental sustainability. In recent years (since 2005), occupational safety and health measures have been reported externally for company-owned operations (not for franchise bottlers, except for those bottlers producing their own environmental/sustainability reports).

As previously mentioned, the construction of an EKC-type analysis for the production facility scale is branching into new territory. An attempt was made to find place- and institutional-related control variables to build into the regression analysis.

PLACE-BASED CONTROL VARIABLES

Within the beverage business, there are several different types of beverages. Major types include carbonated soft drinks, bottled water, juice and juice drinks, syrup, and, coffee and tea. These are considered the primary "place"-related variables in the regressions for this analysis.

These variables demonstrate some of the key differences between types of production. Grossman and Krueger's original EKC research discussed "composition" effects for changes in pollution. Beverage production would constitute variation in composition from one production facility to another.

Total hours worked in the production facility was also included as a control variable in some of the regressions. For institutional variables, external environmental, occupational safety and health certifications were used – ISO 14001 in the case of the environment variables (water, energy and waste) and OHSAS 18001 in the case of lost-time incidents. External management system certifications should demonstrate some level of operational control within the production facilities – control over not the specific measures per se but overall management systems for the production operation(s). These could be thought of as an indicator of the level of governance/strength of governance within the production environment, analogous to the WGI indicators used at the country and city/regional scale.

The country-scale WGI variables themselves were also used in the more complex regressions, as they were in the country- and city/regional-scale analyses.

The question of economic development at the country scale and its relation to performance of an individual production facility led to the search for a Company-related "economic development indicator" that might serve as a proxy for GDP within the Company and bottling system.

Historically, a primary measure of business growth and development within the Coca-Cola system has been per capita consumption of Company beverage products. This is measured as the number of 8-ounce servings of beverages produced by the Company and its bottlers that are consumed by each member of the country's population over the course of a year. Over the identified countries included here, per capita consumption ranges from a low of 6 (drinks per year) to a high of 675 (drinks per year). A per capita consumption of 6 beverages per year, as is the case in India, can be interpreted as every Indian citizen consuming 6 Coca-Cola beverage products per year, or about one every 8 weeks. On the other end of the spectrum, a per capita consumption figure of 675 for Mexico means that, on average, every Mexican citizen is consuming two servings of Coca-Cola products every day. To illustrate the variation across the countries evaluated here, the table below shows the per capita consumption figures for identified countries in 2010.

Table 9. Per Capita Consumption in Identified Markets

Country	Per Capita Consumption
Argentina	318
Australia	319
Brazil	229
Canada	236
Chile	445
China	34
France	143
Germany	179
India	11
Italy	139
Japan	178
Mexico	675
Nigeria	28
Philippines	144
Russia	69
South Africa	254
Spain	284
Thailand	94
Turkey	159
United Kingdom	204
United States	394

Three sets of regressions were run at the manufacturing facility scale. The first utilized country-scale GDP as the primary economic indicator. The second series utilized The Coca-Cola Company's per capita consumption measure. Lastly, a series of regressions was run utilizing both indicators to determine which had the strongest explanatory power.

The tables below show mean values for key environmental, occupational safety and health performance indicators across identified countries. Color coding highlights leading and lagging countries for each indicator. Simple averaging was used across facilities (vs. production-weighted averaging).

Table 10. Mean Values for Key Environmental, Occupational Safety and Health Performance Indicators across Identified Countries

Country	Number of Facilities		Production Volume (1000 liters)	Energy Use Ratio (MJ/l)	Water Use Ratio (l/l)	Waste Generation Ratio (kg/l)	Lost-Time Incident Ratio (incidents per million liters)
Argentina	11	Mean	241,630	0.337	2.763	11.603	0.00028
		Minimum	29,420	0.192	1.928	3.645	0.00001
		Maximum	961,719	0.871	4.232	28.062	0.00146
Australia	15	Mean	123,008	**0.272**	1.571	16.308	0.00004
		Minimum	984	0.057	1.078	0.094	**0**
		Maximum	465,636	1.646	3.017	**523.749**	0.00036
Brazil	38	Mean	211,039	0.441	2.784	10.949	0.00047
		Minimum	6,016	0.045	1.053	1.182	**0**
		Maximum	1,610,221	2.134	7.376	140.806	0.00479
Canada	9	Mean	197,049	0.766	3.020	25.472	0.00008
		Minimum	5,089	0.093	1.227	1.572	**0**
		Maximum	428,868	**7.784**	12.083	65.601	0.00046
Chile	13	Mean	114,240	0.394	3.055	7.431	0.00023
		Minimum	18,621	0.090	1.409	0.701	**0**
		Maximum	682,302	2.813	5.584	35.632	0.00082
China	34	Mean	179,045	0.628	2.677	6.765	0.00006
		Minimum	4,467	0.204	1.196	0.178	**0**
		Maximum	680,452	3.404	11.747	34.090	0.00090
France	6	Mean	326,279	0.300	1.656	5.505	
		Minimum	2,480	0.153	1.149	1.062	
		Maximum	741,629	0.782	4.340	19.758	
Germany	26	Mean	126,978	0.473	2.409	13.471	0.00006
		Minimum	19,375	0.190	1.164	0.587	**0**
		Maximum	258,129	1.474	4.783	43.028	0.00034
India	49	Mean	37,072	0.935	3.959	25.030	0.00005
		Minimum	86	0.031	1.531	**0.002**	**0**
		Maximum	294,290	7.518	**38.768**	263.178	0.00117
Italy	10	Mean	168,090	0.348	2.367	8.436	0.00011
		Minimum	7,302	0.152	1.409	1.267	**0**
		Maximum	530,134	0.645	5.038	20.374	0.00022

Table 10 (continued).

Japan	30	Mean	141,430	1.332	**6.880**	28.250	**0.00001**
		Minimum	3,037	0.470	2.761	0.718	**0**
		Maximum	381,744	3.733	33.776	87.066	0.00049
Mexico	55	Mean	278,701	0.274	2.144	7.800	0.00022
		Minimum	27,285	0.008	0.985	0.823	**0**
		Maximum	1,361,923	0.879	4.845	36.008	0.00355
Nigeria	15	Mean	63,398	**1.369**	4.771	**34.221**	-
		Minimum	8,685		1.711	0.125	-
		Maximum	221,271	4.879	13.288	108.495	-
Philippines	26	Mean	79,229	0.453	4.082	28.724	0.00003
		Minimum	730	**0.002**	**0.006**	0.361	**0**
		Maximum	405,254	6.385	20.421	185.031	0.00022
Russia	13	Mean	144,266	0.870	2.647	6.313	0.00002
		Minimum	37,328	0.424	1.589	1.951	0.00002
		Maximum	539,090	2.565	6.288	22.231	0.00002
South Africa	18	Mean	155,542	0.432	2.542	12.286	**0.00167**
		Minimum	3,178	0.127	1.198	1.294	**0**
		Maximum	559,901	1.607	4.291	55.670	**0.10440**
Spain	16	Mean	185,237	0.574	2.817	16.149	0.00008
		Minimum	8,181	0.153	1.152	0.546	**0**
		Maximum	638,064	4.113	9.896	138.005	0.00032
Thailand	7	Mean	166,819	0.469	2.939	15.669	0.00017
		Minimum	15,678	0.237	1.692	3.011	**0**
		Maximum	381,691	0.812	4.475	77.691	0.00135
Turkey	7	Mean	298,932	0.302	1.722	**3.056**	0.00005
		Minimum	12,522	0.127	1.182	0.513	**0**
		Maximum	518,838	0.744	3.595	6.822	0.00139
United Kingdom	7	Mean	374,800	0.452	1.614	3.850	
		Minimum	1,166	0.145	1.237	1.649	
		Maximum	1,270,911	3.185	2.379	7.723	
United States	79	Mean	239,552	0.432	1.936	7.308	0.00004
		Minimum	18,795	0.013	0.923	0.739	**0**
		Maximum	782,844	6.186	4.943	353.155	0.00030

**17 markets with at least one observation with no incidents in a particular year*

Green: leading market for that indicator
Red: lagging market

Table 11. Summary Statistics for Manufacturing Facility-Scale Regressions

Variable	Mean	Standard Deviation	Minimum	Maximum
Production Volume (kL)	192,000	190,000	730	1,600,000
Per Capita Beverage Consumption (country-scale)	242	195	6	675
Carbonated Soft Drink Production (%)	84.75	31.41	0	100
Bottled Water Production (%)	6.07	20.4	0	100
Juice Production (%)	1.89	10.71	0	100
Syrup Production %)	0.21	1.47	0	25
Coffee/Tea Production (%)	4.25	15.7	0	100
Other Bottling (%)	1.55	6.05	0	57
Total Hours Worked	1,200,000	3,000,000	0	82,400,000
Average Hours Worked	2,400	5,900	0	244,000
Net Energy Use (MJ)	85,300,000	87,800,000	237,000	671,000,000
Energy Use Ratio (MJ/L)	0.57	0.46	0.05	6.38
Scope 1 CO2 Emissions	3,003,00	4,157,000	0	35,100,000
Scope 2 CO2 Emissions	12,400,000	12,200,000	60,080	107,000,000
CO_2 Emissions Ratio (MJ/L)	54.03	43.05	1	457
Total Water Use (kL)	461,000	408,000	3,400	2,700,000
Water Use Ratio (L/L)	2.94	1.66	0.92	11.99
Total Waste Generated (kg)	1,706,000	2,150,000	75	23,800,000
Waste Generation Ratio (g of waste per liter of product)	14.50	20.19	0.002	467.34
Lost-time Incidents	18.60	50.32	0	1100
Lost-time Incident Ratio (LTI per L of Production)	2.14E-07	2.51E-06	0	0.0001

Table 12. Dependent Variables at the Manufacturing Facility Scale

Scale	**Climate Change and CO_2 Emissions**	**Energy Consumption**	**Water and Wastewater**	**Solid Waste**	**Social, Occupational Safety and Health**
Manufacturing Facility		Energy consumption (per product output)	Water usage (per product output)	Solid Waste generated (per product output)	Lost-time incidents (per product output)

CHAPTER 5

SPECIFICATION OF MODEL(S)

As noted earlier, basic specifications of the EKC model simply related environmental quality (dependent) variables to income, GDP or other economic (independent) variables. That is, early models took the form:

$$\textit{Environmental Quality} = f_1(\text{GDP}) - f_2(\text{GDP}^2) - \mu \ (\textit{some error term}).$$

As EKC research evolved over time, additional variables were included in the analysis. For example, more time-series studies were conducted, as well as studies controlling for fixed effects associated with certain geographies or locations. Recently, more advanced studies have controlled for additional factors, such as corruption, trade openness and strength of institutions within a place of study. As one example, Torras and Boyce (1998) use the following:

$$\text{POL} = \alpha + \beta_1 Y + \beta_2 Y^2 + \beta_3 Y^3 + \delta_1 \text{GINI} + \delta_2 \text{LIT} + \delta_3 \text{RIGHTS} + \Upsilon_i Z_i + \mu_i,$$

where POL is a pollution variable, Y is income per capita, GINI is the GINI coefficient for income inequality, LIT is the literacy rate, RIGHTS signifies political rights and civil liberties, and Z is a vector of "non-economic determinants of pollution levels."

An attempt was made to replicate EKC-type analyses that have appeared in the literature, controlling for place, time and institutional variables. For this study, the World Governance Indicators were used as institutional controls.

For each scale of analysis, this research specifies basic, place, time-series and advanced models for a set of dependent variables, mimicking the multiple "generations" of EKC-related research, going beyond the state-of-the-art with the inclusion of additional variables.

Table 13. Specification of Model for Analysis

Level of analysis	**Preliminary Model**
Base Model	$EQ = f\,(\mathrm{GDP}) - f\,(\mathrm{GDP}^2) - \mu$ (*some error term*) EQ = environmental quality indicator of interest GDP = gross domestic product
"State of the Art" Model Chosen to Emulate	$\mathrm{POL} = \alpha + \beta_1 Y + \beta_2 Y^2 + \beta_3 Y^3 + \delta_1 \mathrm{GINI} + \delta_2 \mathrm{LIT} + \delta_3 \mathrm{RIGHTS} + \Upsilon_i Z_i + \mu_i$ POL = pollution variable of interest Y = income per capita GINI = GINI coefficient for income inequality LIT = literacy rate RIGHTS signifies political rights and civil liberties Z = vector of non-economic determinants
More complex analysis	Example: $CO_2 = \alpha 1 + \beta_1$**GDP* + β_2**GDP*^{2} + β_3**GDP*^{3} + β_4**population density* + β_5-β_{20}*[*year dummy variables*] + β_{21} *trade intensity* + β_{22}**political stability* + β_{23}**voice and accountability* + β_{24}**energy imports* + μ (error term)

The "state of the art" model used was based on Torras and Boyce (1998), who built on reduced form formulations of the influence of economic development on environmental outcomes to incorporate literacy, political rights, civil liberties and other "distribution of power" variables. Their aim, similar to the one here, was to determine how these might impact environmental quality and/or the pollution-income relationship. Log-values of the dependent variables were used in all regressions.

Torras and Boyce (1998) confirm the existence of an inverted-U relationship between pollution and income, validating Grossman and Krueger's analysis but also note the important role that the distribution of power can play (literacy, political rights and civil liberties are all shown to have significant effects). Key findings from Torras and Boyce (1998) also include reiteration of "troughs" and subsequent upturns in pollution after declines (something Grossman and Krueger also found but did not highlight). They suggest a need for determining the best policy approaches to eliminate these up-turns.

Since the publication of Torras and Boyce's article in 1998, the World Governance Indicators (WGI) of the World Bank have come along as a measure for institutional capacity within a country (they existed beginning in 1995 but had yet to be used for detailed analysis). There are 6 WGI measures tracked by World Bank:

- Voice and Accountability
- Political Stability and Absence of Violence/Terrorism
- Government Effectiveness
- Regulatory Quality
- Rule of Law
- Control of Corruption

This analysis utilizes 3 of these indicators: Voice and Accountability, Political Stability and Control of Corruption. These most closely resemble the original indicators used by Torras and Boyce (1998). Voice and Accountability measures the power of individual citizens to affect change within the country. Political Stability gauges the likelihood that the country's government may be overthrown. And, Control of Corruption measures the extent to which the government eliminates the use of public resources for private gain (World Bank, 2011).

Voice and Accountability in particular is potentially an interesting measure for Coca-Cola because it may be a leading indicator for consumer pressure on firms to improve environmental/social performance.

As EKC-type studies have evolved, the quantitative analysis used has also evolved. Early days research focused on basic panel data analysis; increasingly time-series analysis has been used to tease out time trends. However, most analysis employ fixed effects regression. For our purposes here, random effects regression in Stata was utilized. Random effects offers advantages over fixed effects models. With random effects, we are able to look more deeply at variation across groups (of countries, cities/regions and manufacturing facilities in this case). Our models show us more granularity on the variation within groups and between groups. Random-effects models provide more explanatory power – as one example, in the case of CO_2 emissions per capita, the overall R-squared of 0.66 was considerably higher than the 0.52 for a corresponding fixed-effects model. Though often a random-effects model can result in higher standard errors, this was not the case with respect to this example (this was also checked across other regressions).

Random effects are preferred over fixed effects when there are time invariant variables in the model(s). At the city/regional and manufacturing facility scales, time-invariant "place" variables were used. In the case of city/regional scale, the coastal-port variable is time-invariant; for manufacturing facility scales, ISO 14001 and OHSAS 18001 certification is generally time-invariant over the time period of study.

CHAPTER 6

GENERAL HYPOTHESES AND EXPECTATIONS

There are a few angles from which to think about hypotheses and expected results in this project. One approach is to base hypotheses on past literature on the interactions between development and the environment. From that perspective, the results historically have been quite mixed. The simplicity of the EKC hypothesis being part of the motivation of this study, we would consider hypothesizing an inverted-U relationship for all pollution indicators.

COUNTRY AND CITY/REGIONAL SCALE

However, the dependent variables of interest here are not solely pollution indicators, nor have they all been studied widely in the research. Consumption-based indicators (e.g., CO_2, energy or water usage per capita) are included, as well as variables like life expectancy and access to improved water and sanitation sources.

With respect to life expectancy, we would expect a monotonically increasing relationship with wealth. The literature on the connection between wealth and health has generally shown an increase in health with wealth (Hunter, 2009). More advanced economies would have more universities and hospitals, which would be able to provide health care to keep people living longer.

Water and sanitation infrastructure are an interesting case unto themselves. We would generally expect an increase in access to water sources and sanitation systems with wealth and time. Water and sanitation systems represent an important milestone in the development of a city or country.

With virtually all the indicators explored here, we would expect a more stark relationship between wealth and environmental or social outcomes at the local scale than at the country scale. For example, in the case of water and sanitation systems, development of urban infrastructure would be covering large portions of the population in one fell swoop – whereas at the country scale there will always be rural populations that are hard to reach, and the development of systems in rural areas will follow a longer time and lagged path relative to wealth.

Air quality and water quality indicators should demonstrate stronger relationships with local wealth than at the country-scale. The 'statistical' reasoning as applied above for water and sanitation systems also applies here. However, in the case of the water and air quality indicators, there is a different reason as well. Air and water quality is 'felt' at the local scale, and in effect, if that is the case, local action should/would be taken to improve air and water quality. Especially in more advanced economies, air and water quality is monitored, tracked and regulated locally. (Additionally, the basic meta-analysis of EKC studies showed that state-province and city-county scale studies were over 20% more likely to result in EKC confirmation).

Some of the indicators evaluated here are not traditional 'pollution' indicators. For example, energy and water usage are consumption-based indicators that follow more of a "private market" evolution than a public good or pollution indicator might. In other words, in the case of water or energy, assuming adequate access, a private individual or corporation can always pay more to use more.

CO_2 emissions are similar in some regard. Until CO_2 caps recently in some countries due to the Kyoto Protocol, CO_2 emissions, unregulated, would have simply grown with the growth of industry. For each of these three measures, then, we would hypothesize a monotonically increasing relationship with wealth. As wealth goes up, usage (consumption) would go up.

Measuring these three indicators in a "per capita" sense also provides complexity, or at least additional considerations. Most pollution indicators are measured in terms of pollutant concentrations (either in the air or water). In the case of per capita indicators of consumption, pollution growth may have a statistical impact on the denominator for these indicators. For example, in the case of access to water and sanitation systems, if population is growing faster than urban infrastructure can be developed, the percentage of the population with access will go down even though the country is developing infrastructure.

As general hypotheses, then, we would expect inverted-U patterns with pollution (concentration) indicators at both the country and city/regional scale. We would expect monotonically increasing patterns for water and energy consumption indicators. We would expect life expectancy and access to water sources and sanitation systems to improve monotonically with wealth.

The renewable water resources per capita indicator is a bit of an outlier. This indicator is more about resources available to the country than a pollution indicator. Trends associated with this indicator may look a lot more like a consumption-based indicator than a pollution output. Based on the measure being *renewable* resources per capita rather than non-renewable resources, we might be tempted to hypothesize something other than a monotonically decreasing level of resources over time. However, for two reasons, we do hypothesize a monotonically decreasing relationship. First, we expect consumption to over-ride any ability of a country (this is a country-scale indicator only) to react and respond to declining resources. Second, the pollution growth wild card adds enough uncertainty to lead us towards a pessimistic expectation regarding management of renewable water resources.

Table 14. General Hypotheses for Indicators at the Country and City/Regional Scales

Scale	Climate Change and CO2 Emissions		Energy Consumption		Water and Wastewater		Social, Occupational Safety and Health	
Country	CO2 emissions per capita)		Energy consumption per capita		Availability of Water resources		Life expectancy	
					Access to improved Water and sanitation systems			
					Water quality			
City/ Regional	Air quality				Water quality			
					Water Use per capita			

MANUFACTURING FACILITY SCALE

The introduction of manufacturing facility scale data into this analysis, and in effect, creating a production facility scale EKC is something new to the EKC literature. There have been a handful of firm-scale EKC studies in the past, but nothing to this level of detail and specificity. However, if there is anything generalizable about the relationships between wealth and environmental outcomes, we should be able to learn from the past EKC literature to develop hypotheses.

The manufacturing-facility scale indicators in use here are somewhat of a hybrid between the pollutant concentration measures at the country and city/regional-scales and the consumption-based indicators used there. Water and Energy Usage are clearly consumption based indicators. Waste generation is also consumption-related. However, all three of these are normalized against production volume (liter of beverages produced). Because they are normalized this way, they are an “efficiency” indicator which in some ways can be viewed similar to a pollutant concentration. Certainly, because this is how they are measured and reported within Coca-Cola (and publicly after being rolled up to the global scale), this is how they are monitored and tracked – and managed.

The safety accidents (lost-time incidents per liter of beverage produced) measure used here was constructed for this analysis but is similar to what is managed and tracked in production facilities. It is normally tracked as an absolute measure or incidents per number of hours worked. In any case, it, as well as the water, energy and waste indicators, can be treated similarly to pollutant concentration measures as described above.

As general hypotheses for the manufacturing-facility scale indicators of water usage, energy usage and waste generation, we hypothesize the "back half" of an inverted-U pattern relative to both country-scale GDP and the Coca-Cola market maturity indicator of per capita consumption of beverages. In other words, we expect efficiency only to improve with wealth over the range of time covered in this analysis. We expect more of a linear decrease in safety accidents with wealth and/or market maturity.

Table 15. General Hypotheses for Indicators at the Manufacturing Facility Scale

Scale	**Energy Consumption**		**Water and Wastewater**		**Waste Generation**		**Occupational Safety and Health**	
Manufacturing Facility Scale	Energy Use per Product Output		Water Use per Product Output		Waste Generated per Product Output		Lost-time Incident Ratio	

CHAPTER 7

ANALYSIS AND RESULTS

For each scale of analysis, a mix of traditional "pollution" type indicators was included alongside efficiency indicators and those we might expect to display a different shape relationship to GDP, place, time or institutional variables.

COUNTRY SCALE ANALYSIS AND RESULTS

For the country-scale analysis, a series of (5) models of increasing complexity were run, starting first with a basic relationship between country GDP and the following environmental and social indicators:

- CO_2 Emissions per capita;
- Energy Usage per capita;
- Particulate matter (PM_{10}) concentration, country scale;
- Renewable water resources per capita;
- Life Expectancy;
- Biological Oxygen Demand (constructed concentration measure);
- Access to Improved Sanitation Systems; and,
- Access to improved water sources.

An initial (basic) model was run establishing the basis relationship between GDP and the environmental outcome measure. Next, a model controlling for country-scale population density was run, followed by one controlling for time, then trade intensity (trade as a percentage of GDP) and a final model incorporating institutional indicators. For institutional indicators, the World

Governance Indicators (WGI) for Control of Corruption, Political Stability (and the absence of Violence/Terrorism) were used. These indicators have begun to show up in the academic research since first launching in the mid-1990s. However, quantitative research utilizing these indicators has been somewhat limited.

In the case of CO_2 emissions per capita, energy usage per capita, and particulate matter (PM_{10}) concentration, a sixth model was run controlling for energy imports (% of net use) to evaluate whether countries importing more of their energy were seeing increased environmental pollution.

As an example, for the case of CO_2, the most complex regression followed this model:

$CO_2 = \alpha 1 + \beta_1 * GDP + \beta_2 * GDP^2 + \beta_3 * GDP^3 + \beta_4 * \textit{population density} + \beta_5 - \beta_{20} * [\textit{year dummy variables}] + \beta_{21}\, \textit{trade intensity} + \beta_{22} * \textit{political stability} + \beta_{23} * \textit{voice and accountability} + \beta_{24} * \textit{energy imports} + \mu$ (error term).

The table below includes the full output for the regression models on CO_2. Figure 11 demonstrates the curve calculated from the regression for various levels of GDP. In large part, the GDP terms are the only consistently significant independent variables across the regressions. There are some years that show a statistically significant departure (increase) in models 3 and 4, but these years are lost in models 5 and 6 (due to data availability for institutional variables included in those models). Controlling for indicators besides GDP does little to improve the explanatory power of the model(s) for CO_2 emissions per capita.

Table 16. Sample Regression Results: CO_2 per capita at the Country Scale

	(1) Controlling for Country GDP Only	(2) Controlling for City GDP and Population Density	(3) Controlling for Time and Place Indicators	(4) Controlling for Trade Intensity	(5) Controlling for Time, Place and Institutional Variables	(6) Controlling for Energy Indicators
Country GDP – PPP Adjusted (1,000 2005 International $)	0.23301	0.23387	0.23884	0.24177	0.21220	0.12322
	(7.57)**	(7.62)**	(7.80)**	(8.00)**	(5.72)**	(6.51)**
Country GDP-squared	-0.00590	-0.00595	-0.00609	-0.00617	-0.00503	-0.00306
	(7.18)**	(7.23)**	(7.62)**	(7.73)**	(5.73)**	(5.91)**
Country GDP-cubed	0.00005	0.00005	0.00005	0.00005	0.00004	0.00002
	(6.65)**	(6.69)**	(6.95)**	(6.89)**	(5.56)**	(5.52)**
Population density (people per sq. km of land area)		0.00003	0.00002	0.00001	-0.00002	0.00006
		(1.08)	(0.69)	(0.60)	(0.67)	(1.08)
Year-1991			-0.00177	0.00193		
			(0.13)	(0.14)		
Year-1992			0.07268	0.07650		
			(2.94)**	(3.06)**		
Year-1993			0.05887	0.06193		
			(2.24)*	(2.33)*		
Year-1994			0.03666	0.03957		
			(1.21)	(1.28)		
Year-1995			0.07805	0.07800		
			(1.74)	(1.67)		
Year-1996			0.08689	0.08927	0.06151	0.00666
			(1.86)	(1.83)	(1.68)	(0.20)
Year-1997			0.09116	0.09243		
			(1.91)	(1.85)		
Year-1998			0.05838	0.05986	0.03400	-0.01111
			(1.14)	(1.12)	(1.10)	(0.37)
Year-1999			0.05834	0.06263		
			(1.14)	(1.19)		
Year-2000			0.05539	0.05550	0.03120	-0.02507
			(1.04)	(0.98)	(1.11)	(1.00)
Year-2001			0.07170	0.07196		
			(1.33)	(1.26)		
Year-2002			0.05867	0.05802	0.02874	-0.02636
			(1.07)	(1.01)	(1.08)	(1.42)
Year-2003			0.07969	0.07856	0.04857	-0.00015
			(1.42)	(1.32)	(2.02)*	(0.01)
Year-2004			0.07931	0.07691	0.04928	0.01170
			(1.35)	(1.22)	(2.75)**	(0.79)
Year-2005			0.07079	0.06809	0.04087	0.01235
			(1.16)	(1.03)	(2.81)**	(0.99)
Year-2006			0.04247	0.03914	0.01342	-0.00255
			(0.67)	(0.57)	(1.42)	(0.31)
Year-2007			0.03054	0.02493		
			(0.46)	(0.35)		

Table 16 (continued).

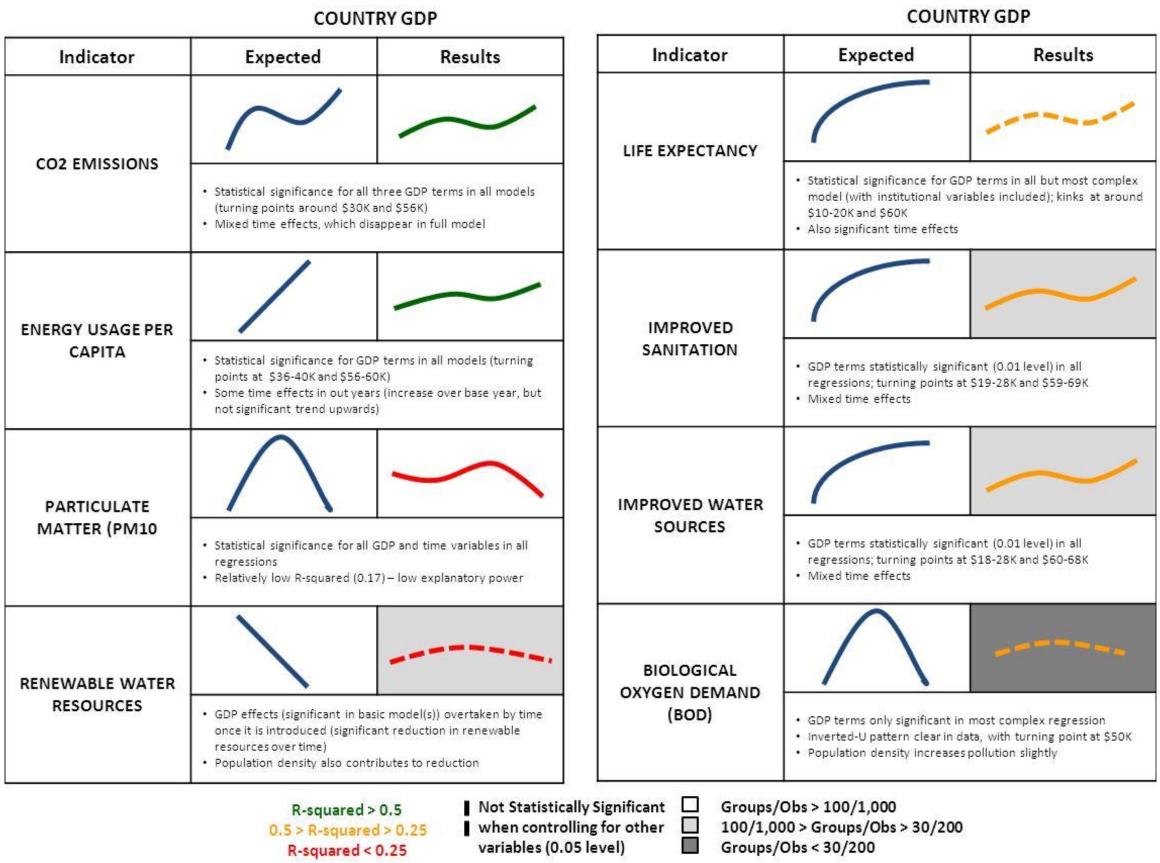
Trade (% of GDP)				0.00031	-0.00025	0.00037
				(0.32)	(0.25)	(0.56)
Political Stability					0.00563	0.03381
					(0.21)	(1.12)
Voice and Accountability					0.03192	0.07804
					(0.72)	(1.61)
Energy imports, net (% of energy use)						0.00015
						(0.53)
Constant	-0.81611	-0.82378	-0.90502	-0.94634	-0.75088	0.12824
	(4.00)**	(4.05)**	(4.61)**	(4.91)**	(3.22)**	(0.67)
Turning Point 1	57.1034	57.19629	56.83206	56.96495	56.01012	55.87354
Turning Point 2	30.20408	29.95194	29.91095	29.84153	33.82252	31.50314
Observations	3095	3095	3095	3019	1529	1136
Number of Countries	180	180	180	176	176	128
R-sq within	0.1897	0.1902	0.1970	0.1983	0.1897	0.1897
R-sq between	0.7139	0.7084	0.7128	0.7173	0.7139	0.7139
R-sq overall	0.6995	0.6943	0.6984	0.7021	0.6995	0.6995

Considering the country-scale analysis more broadly, we would hypothesize that PM_{10} and BOD, as traditional pollution indicators, might display a Kuznets-type, or inverted-U, relationship. Life Expectancy and Access to Improved Water Sources and Sanitation Systems should increase monotonically over time.

Recent studies have shown an n-shaped relationship for CO_2 emissions (an inverted-U pattern with a subsequent upturn), so that is what we hypothesize here. We assume a monotonically increasing relationship for energy usage per capita.

Results are surprising for a number of these indicators. CO_2 emissions per capita does follow an n-shaped pattern, as does energy usage per capita. But Life Expectancy and Access to Improved Water and Sanitation Systems do as well.

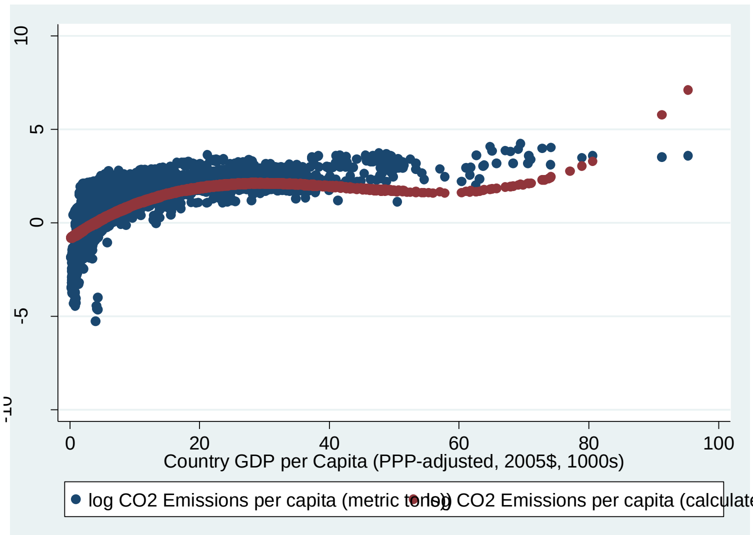
Figure 10. Summary of Results at the Country Scale



BOD follows an inverted-U pattern, as expected, but PM_{10} is mostly decreasing over the study range.

With the exception of Biological Oxygen Demand (BOD), all three GDP terms were statistically significant (at the 0.01 level) in every basic regression (controlling for GDP only). Of the remaining regressions, for all but Renewable Water Resources, the three terms were statistically significant for all regressions (the entire series of regressions). In the case of renewable water resources, after controlling for time, the effect of GDP was dampened (changes in renewable water resources per capita appeared to be a time trend rather than wealth-related).

Figure 11. Representative Calculated Curve for Country Scale (CO_2 Emissions)



Biological Oxygen Demand and Renewable Water Resources are the only two indicators at the country scale that display a Kuznets-type inverted-U pattern. The BOD result is expected; this is a traditional pollutant concentration measure. However, the result is not expected for renewable water resources. Renewable water resources follow an inverted-U pattern, while we had hypothesized a monotonically decreasing result. This means that, over the study period, renewable water resources per capita first increase, then decrease as GDP increases. In hindsight, the hypothesized relationship for renewable water resources might be a better guess for nonrenewable water resources. But the result points to renewable water resources behaving like a traditional pollution indicator – though the EKC hypothesis would have it behave in the flip – the situation gets better, then worse (rather than the EKC hypothesis of things getting better after a certain turning point). Wealthier countries, up to a point, have more renewable water resources per capita than their less wealthy peer countries. However, the richest countries have fewer renewable water resources per capita than those in the middle. Water may, in fact, be the limit to growth that many have feared it may become.

CO_2 emissions follows the patterns we would expect. Based on literature an N-shaped pattern was expected, which was found for both CO_2 emissions and energy usage per capita. For energy usage, we had hypothesized a monotonically increasing (linear) trend for energy usage per capita (following the 'consumption' story, though a more enlightened hypothesis might have made use of the same thinking as for CO_2 – though energy usage per capita has not been covered as broadly in the EKC literature).

For particulate matter (PM_{10}) concentrations at the country scale, concentrations appear to decrease with wealth, with a bit of a kink in the curve as it falls. This appears to be almost the "back half" of an inverted-U curve, with a bit more curvature to it.

As far as "shapes," go, the most surprising results are for the life expectancy and access to water and sanitation variables. We would expect monotonically increasing relationship between these variables and wealth. It stands to reason that as countries develop and as access to health care improves, these variables would also improve. However, results indicate some "kinks" in the curves for each of these variables. The linear (or at least monotonically increasing) trend is not as straightforward as one would think. In the case of life expectancy, we see kinks in the curve at between \$10,000 and \$20,000 per capita GDP, and then again at \$60,000; for access to water and sanitation systems (two separate variables), we see kinks between \$18,000 and \$28,000 and then again between \$59,000 and \$68,000 per capita GDP.

While there is some shape to these curves, the pattern is somewhat flatter than the generic symbol used in the summary chart (meaning the dips between turning points are less drastic than they appear in the summary chart).

CITY/REGIONAL SCALE RESULTS

As mentioned above, due to the lack of availability of comprehensive data on city/regional scale, the analysis was somewhat limited. A series of regressions was run focusing on the following environmental performance indicators:

- Particulate matter (PM_{10}) concentration
- Sulfur Dioxide (SO_2)
- Nitrogen Dioxide (NO_2)
- Residential water usage per capita
- Dissolved Oxygen (DO)
- Biological Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)

For each of these environmental outcomes, 3 series of models were run: a first model utilizing country-scale GDP as the primary economic indicator; a second series utilizing city/regional GDP as the primary economic indicator; and, a final series using both. The final model was run less for interpretation than to test the relative strength of the country-scale and city/regional-scale GDP as determinants of environmental outcomes. The country-scale GDP was shown to be a stronger predictor (as evidenced by joint significance tests carried out in the combined models).

Within each series, 4 models of increasing complexity were evaluated: a first establishing the basic relationship between the economic indicator and environmental output; a second controlling for place indicators (namely, population density and whether the city is a coastal/port city); a third controlling for time; and, a final model controlling for time, place and institutional indicators (also using country-scale WGI).

As an example, for the case of PM_{10}, the most complex regression (including both country and city/regional GDP) followed this model:

$$PM_{10} = \beta 1 + \beta_2 * GDP + \beta_3 * GDP^2 + \beta_4 * GDP^3 + \beta_5 * \textit{population density} + \beta_6 * \text{coastal} + \beta_7 - \beta_{15} * [\textit{year dummy variables}] + \beta_{16} * \textit{control of corruption} + \beta_{17} * \textit{political stability} + \beta_{18} * \textit{voice and accountability} + \mu \text{ (error term)}$$

Regression outputs for PM_{10} (log PM_{10}) are included below. As you see in the results, the effect of city/regional-scale GDP is dampened completely after the inclusion of country-scale GDP, raising a question about whether city/regional-GDP is a worthwhile indicator. Figure 14 shows the calculated curve based on the model results.

Table 17. Sample Regression Results: Particulate Matter (PM_{10}) at the City/Regional Scale

	(1)	(2)	(3)	(4)	(5)
	Controlling for City GDP Only	Controlling for City and Country GDP	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
City GDP – PPP Adjusted (1,000 2005 International $)	-0.06395	0.01839	0.02007	-0.00814	-0.00356
	(2.98)**	(0.93)	(1.03)	(0.37)	(0.20)
City GDP- squared	0.00156	-0.00002	-0.00006	0.00016	0.00031
	(3.28)**	(0.03)	(0.12)	(0.34)	(0.66)
City GDP-cubed	-0.00001	-0.00000	-0.00000	-0.00000	-0.00000
	(3.52)**	(0.53)	(0.45)	(0.48)	(0.92)
Country GDP – PPP Adjusted (1,000 2005 International $)		-0.30569	-0.28875	-0.07099	-0.03002
		(5.77)**	(5.54)**	(1.05)	(0.50)
Country GDP-squared		0.01076	0.00981	-0.00032	0.00096
		(4.85)**	(4.44)**	(0.10)	(0.38)
Country GDP-cubed		-0.00012	-0.00010	0.00003	-0.00000
		(4.44)**	(3.97)**	(0.83)	(0.01)
Population Density (people per sq km)			-0.00008	-0.00001	-0.00004
			(1.19)	(0.17)	(1.66)
Coastal			-0.06833	-0.06990	-0.04642
			(0.73)	(0.80)	(0.55)

Table 17 (continued).

Year-2001				0.30988	0.33140
				(3.45)**	(2.36)*
Year-2002				0.28521	0.29516
				(3.71)**	(2.92)**
Year-2003				0.12390	0.15942
				(2.55)*	(1.64)
Year-2004				0.14542	0.17119
				(3.59)**	(2.32)*
Year-2005				0.02036	0.00967
				(0.41)	(0.19)
Year-2006				0.05548	0.04436
				(1.00)	(0.89)
Year-2007				-0.03610	-0.04573
				(0.89)	(0.76)
Year-2008				-0.03743	-0.06695
				(0.67)	(1.24)
Year-2009				0.37549	0.00000
				(3.87)**	(.)
Control of Corruption					-0.00071
					(0.00)
Political Stability					-0.11014
					(1.53)
Voice and Accountability					-0.53548
					(2.93)**
Constant	-2.31607	-1.26925	-1.15171	-1.89465	-2.98041
	(7.35)**	(5.83)**	(4.54)**	(6.52)**	(6.26)**
Turning Point 1-City	30.69656	-62.32726	-81.38955	-	6.281748
Turning Point 2-City	61.4513	56.53108	56.1562	-	59.17611
Turning Point 1-Country		21.91683	23.20014	29.48417	15.6915
Turning Point 2-Country		40.4211	40.22528	-23.2795	1828.71
Observations	397	397	396	396	351
Number of Cities/Regions	48	48	48	48	48
R-sq within	0.0134	0.0180	0.0252	0.2403	0.2795
R-sq between	0.2420	0.6363	0.6513	0.7285	0.7732
R-sq overall	0.1610	0.3997	0.4111	0.5234	0.5190

Generally speaking, at the City scale, we might expect many more inverted-U patterns (though the research, frankly, has been split). One of the long-standing aspects of the EKC hypothesis has been that environmental degradation must be “felt” in order for governments, citizens and industry to act on it (or be forced to act). Nowhere else are environmental impacts felt like they are at the local scale, within cities and provinces.

As another reason, for the most part, only traditional air and water quality indicators are evaluated here: particulate emissions, SO_2 and NO_2, BOD, COD and Dissolved Oxygen (DO).

Residential water usage per capita is also included, which is a different type indicator, but one for which we would also expect an inverted-U pattern.

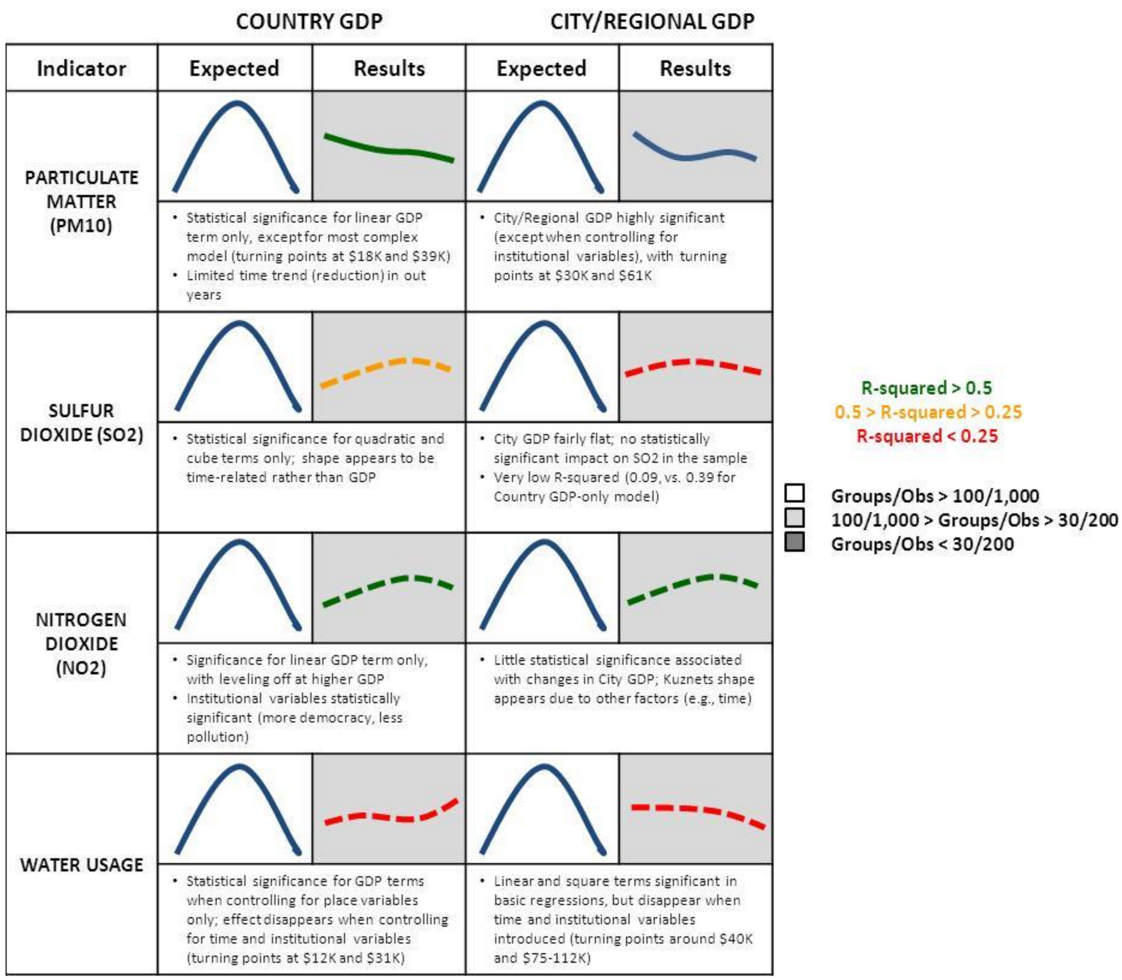
With the exception of water usage, all other indicators are pollutant concentration levels. Water usage per capita as more of a consumption indicator should tell a similar story: as wealth increases, residents consume more, but then as governments and civil society understand more about constraints on resources, per capita consumption decreases. (Water is a very local issue, which is why we hypothesize this result and not the “consumption story” hypothesis as we did for energy consumption per capita at the country scale).

Only NO_2 and SO_2 display somewhat of an inverted-U pattern: NO_2 relative to City GDP in both the City-only and full model (controlling for Country-scale GDP). SO_2 demonstrates an inverted-U pattern relative to Country GDP, with less of a relationship with City GDP (flat in the City only model). Particulate matter (PM_{10}) appears to monotonically decrease with GDP in the country-only model, with a more complicated pattern when evaluated with city/regional GDP as the primary economic indicator.

Sulfur dioxide has been called by some (e.g., Carson) the “poster child” for the Environmental Kuznets Curve hypothesis. It has been studied more often than any other indicator. Although research has been split on the existence of an inverted-U shaped curve for SO_2, this is what we hypothesize here. We find the existence of an inverted-U pattern relative to country-scale GDP; however, we see more of an inverted-N type curve with respect to city/regional GDP.

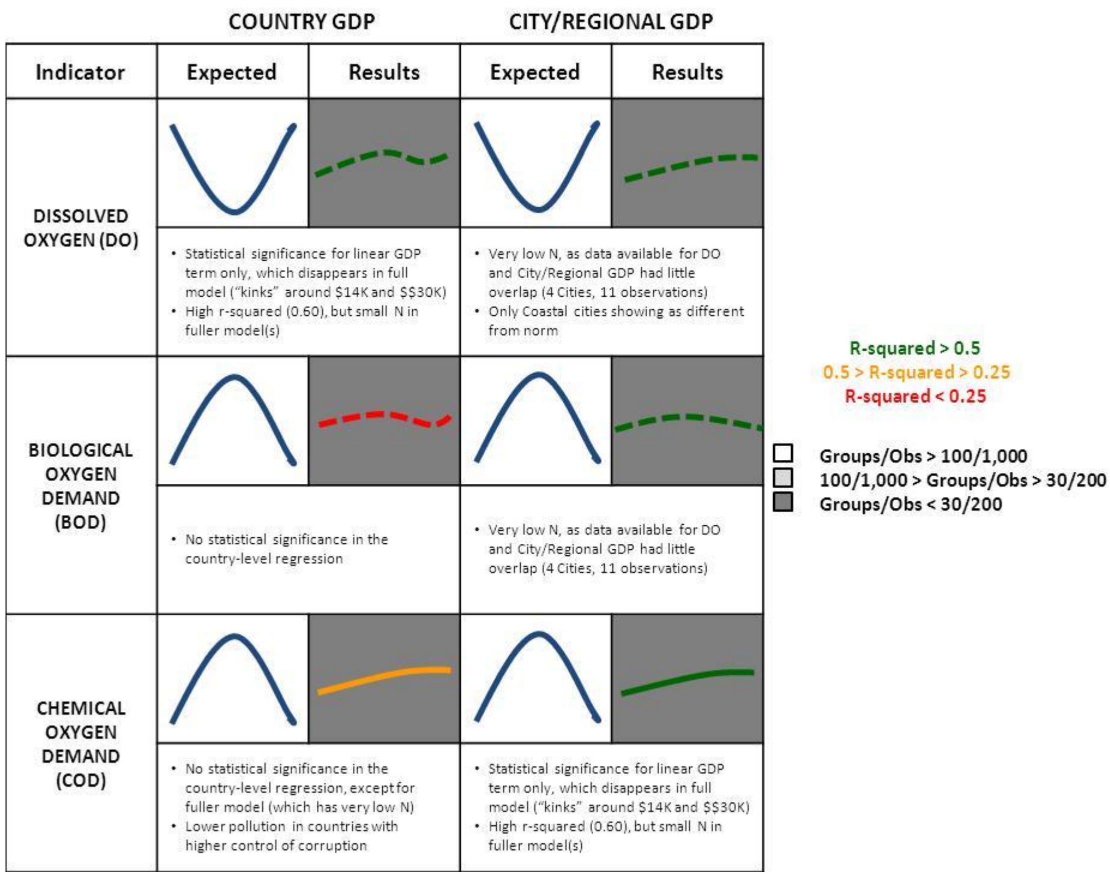
With respect to nitrogen dioxide, while we hypothesize a Kuznets-type curve, only the linear GDP term is statistically significant in the regression. When evaluating concentration levels relative to country-scale GDP, we see an increase in NO_2 concentration with wealth, with a leveling off at higher levels of GDP. When using City-scale GDP, we do see an inverted-U pattern.

Figure 12. Summary Results at the City/Regional Scale: Air Quality/Water Usage



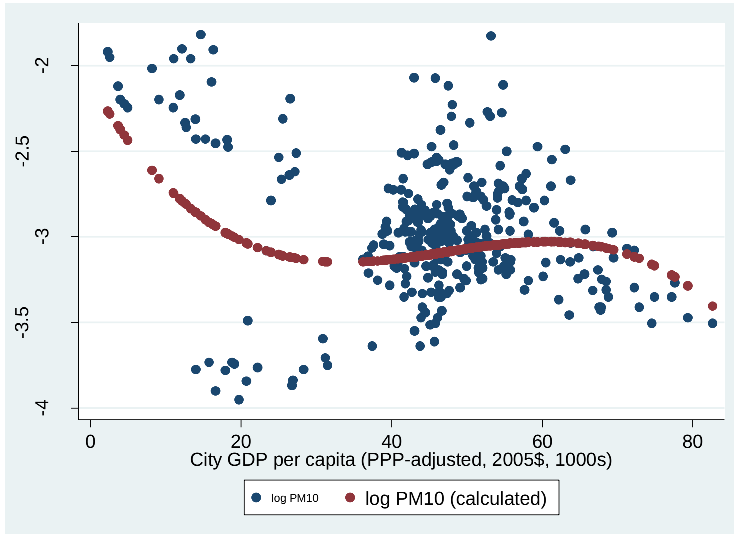
Water usage per capita follows more of a “consumption story” at the city scale than we would expect, or hope, for. While we hypothesize an inverted-U pattern, we see the N-shaped increase that many of the other environmental outcomes display. The N-shaped pattern holds relative to country-scale GDP in the country-GDP-only regression, with turning points at $12,000 and $31,000; in the city/regional GDP regression, water use declines at higher levels of per capita wealth.

Figure 13. Summary of Results at the City/Regional Scale: Water Quality Indicators



Dissolved oxygen (DO) and Biological Oxygen Demand (BOD) display N-shaped patterns in the country GDP-only regression. For DO, there is statistical significance for the linear GDP term only, and for BOD and COD, there is very little statistical significance at all. City/regional and country-city combination regressions have very low N for these parameters, so the interpretation of these results is limited.

Figure 14. Representative Calculated Curve for City/Regional Scale (PM_{10})



MANUFACTURING FACILITY SCALE RESULTS

For the manufacturing facility scale, as with the city-scale analyses, three series of models were run. In the first, country GDP was utilized as the primary economic indicator. In the second, per capita consumption of beverages, The Coca-Cola Company's internal "market maturity" indicator was used. And, in the third, both GDP and per capita consumption were employed. As with the city/regional scale, interpretation of this third series of models is limited – they were run merely to show the relative strength of the different 'economic development' indicators.

Table 18 shows the 6 resulting models for manufacturing facility scale energy consumption (log of the energy use ratio, mega-joules of energy consumption per liter of product output); Figure 16 shows the calculated curve for energy use ratio. GDP was statistically significant in all regressions. Per capita consumption was also statistically significant, though the effect was much smaller than changes in GDP. Much of the variation in energy use ratio can be attributed to changes in the types of beverages produced at a specific facility. In this case, Juice, Coffee/Tea and "Other" beverages decrease energy efficiency in a plant, while bottled water and syrup production improve efficiency, relative to the production of carbonated beverages (approximately 85% of overall production is carbonated soft drinks). While the effect of changes in type of beverages produced makes sense intellectually, it has not been studied statistically within the Coca-Cola business. So, therefore, this is a meaningful outcome purely from that standpoint.

Table 18. Sample Regressions: Energy Consumption at the Manufacturing Facility Scale

	(1)	(2)	(3)	(4)	(5)	(6)
	Controlling for Country GDP Only	Controlling for Country GDP and Per Capita Consumption	Controlling for Production Type	Controlling for Time	Controlling for ISO Certification and Hours Worked	Controlling for Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	-0.24583	-0.18084	-0.19547	-0.19651	-0.19980	-0.18071
	(9.67)**	(4.57)**	(5.67)**	(5.84)**	(5.91)**	(4.63)**
Country GDP-squared	0.01194	0.00940	0.00934	0.00944	0.00960	0.00789
	(9.65)**	(5.23)**	(5.99)**	(6.15)**	(6.23)**	(4.57)**
Country GDP-cubed	-0.00016	-0.00013	-0.00012	-0.00013	-0.00013	-0.00010
	(9.24)**	(5.39)**	(5.97)**	(6.12)**	(6.19)**	(4.38)**
Per Capita Consumption		-0.00315	-0.00301	-0.00303	-0.00301	-0.00465
		(2.50)*	(2.56)*	(2.54)*	(2.52)*	(3.94)**
Per Capita Consumption-squared		0.00001	0.00001	0.00001	0.00001	0.00001
		(1.98)*	(2.44)*	(2.41)*	(2.40)*	(3.44)**
Per Capita Consumption-cubed		-0.00000	-0.00000	-0.00000	-0.00000	-0.00000
		(1.70)	(2.23)*	(2.20)*	(2.20)*	(2.85)**
Bottled Water Production			-0.00659	-0.00660	-0.00659	-0.00602
			(3.27)**	(3.28)**	(3.26)**	(2.89)**
Juice Production			0.00923	0.00927	0.00940	0.00966
			(6.16)**	(6.14)**	(6.36)**	(6.78)**
Coffee/Tea Production			0.01457	0.01444	0.01440	0.01439
			(9.16)**	(8.98)**	(8.89)**	(8.96)**
Syrup Production			-0.02244	-0.02254	-0.02154	-0.01681
			(4.34)**	(4.31)**	(4.29)**	(2.53)*

Table 18 (continued).

Other Bottling Production			0.01841	0.01842	0.01820	0.01789
			(5.58)**	(5.59)**	(5.48)**	(5.50)**
Year-2005				0.00521	0.00762	-0.03529
				(0.14)	(0.20)	(0.88)
Year-2006				-0.01305	-0.01216	-0.03190
				(0.40)	(0.37)	(0.92)
Year-2007				-0.01083	-0.00993	-0.02318
				(0.41)	(0.38)	(0.86)
Year-2008				-0.01046	-0.01227	-0.02183
				(0.44)	(0.51)	(0.88)
Year-2009				-0.03237	-0.03253	-0.03931
				(1.97)*	(1.98)*	(2.36)*
Year-2010				0.00000		
				(.)		
ISO 14000 Certification					-0.03956	-0.03778
					(0.76)	(0.77)
Total Hours Worked					0.00000	0.00000
					(5.64)**	(5.55)**
Control of Corruption						-0.05297
						(0.74)
Political Stability						0.16571
						(2.44)*
Voice and Accountability						0.14450
						(2.63)**
Constant	0.24634	0.18084	0.25582	0.26944	0.28365	0.48429
	(1.86)	(1.22)	(2.08)*	(2.28)*	(2.34)*	(2.74)**
Turning Point 1 (GDP)	14.5279	13.24658	14.91626	14.82502	14.80547	16.9189
Turning Point 2 (GDP)	35.34168	35.07266	35.07796	34.95197	34.99986	35.39073
Observations	1390	1390	1390	1390	1390	1390
Number of Facilities	305	305	305	305	305	305
R-sq within	0.0430	0.0342	0.0428	0.0446	0.0465	0.0467
R-sq between	0.2350	0.2881	0.5266	0.5274	0.5284	0.5521
R-sq overall	0.2463	0.2916	0.4827	0.4836	0.4842	0.5101

In the case of the manufacturing plant environment more broadly, we see several "inverted-N" relationships, where efficiency is improving over time, with some "kinks" in the reduction of, for example, water usage and energy usage. A summary chart is included below; results from all remaining regressions are included in the Appendix.

Water and Energy efficiency seem to improve with maturity of a market, both in terms of country GDP and per capita consumption of Company products. However, waste generation is flat to per capita consumption, and lost-time incidents are flat to both country GDP and per capita consumption.

Of the four manufacturing facility indicators studied, Water and Energy usage show more statistically significant connection to both country-scale GDP and the per capita consumption indicator; these are the areas where the Company and its bottlers have placed the most focus. Arguably, little focus has been placed on either waste generation in the plants (in deference to more focus on the Company's packaging – bottles and cans that make it to the marketplace) or occupational safety and health (only recently has a corporate safety director been named).

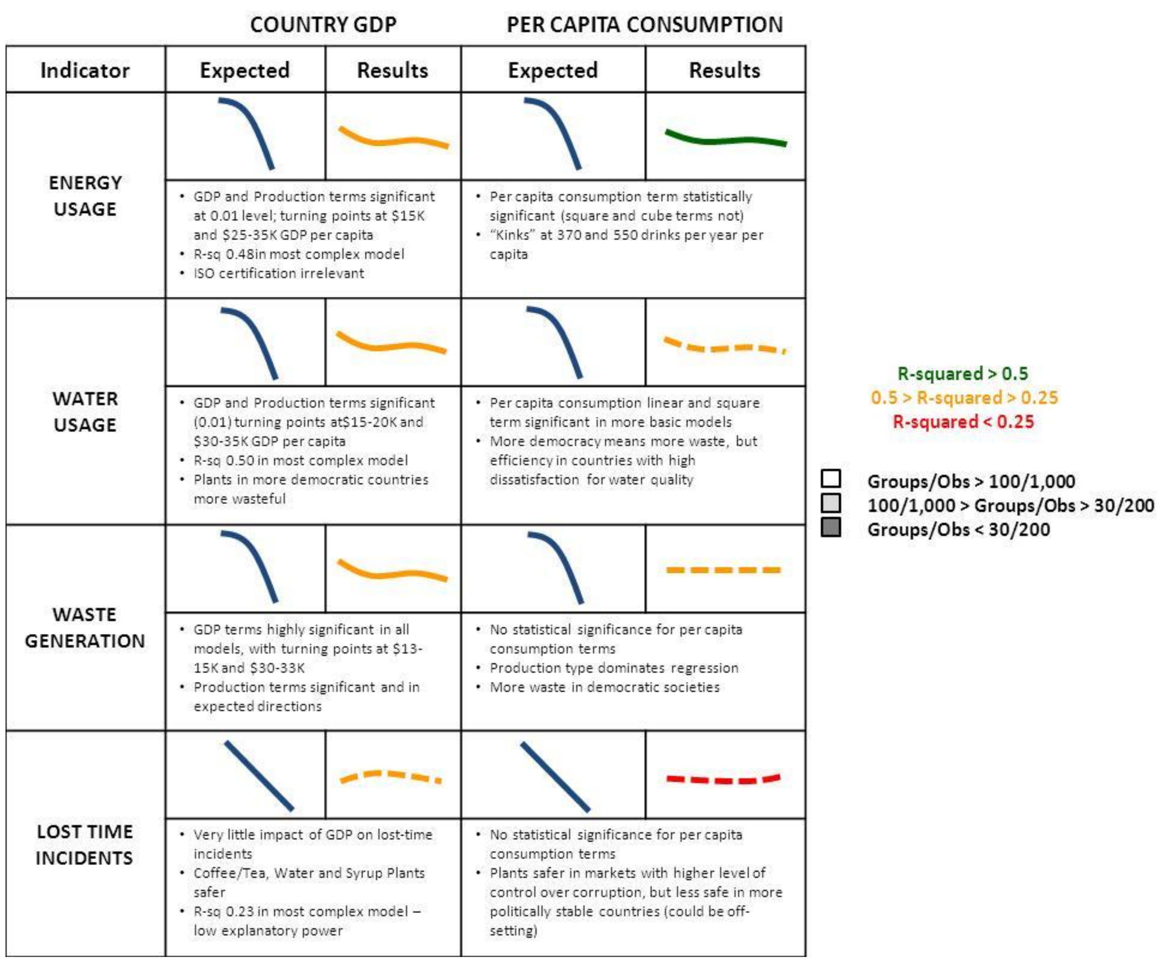
For all manufacturing facility environmental, occupational safety and health indicators studied, the type of production taking place within facilities has statistically significant impact on performance. Generally speaking, plants with more bottled water production are more efficient than carbonated soft drink plants, and coffee/tea and juice production reduces the efficiency of plants. An interesting relationship must be pointed out with regard to occupational safety and health. Plants producing more coffee and tea are safer than a typical soft drink manufacturing plant. On first glance, this is a curious relationship; there are two possible explanations. First of all, because coffee/tea production is a bit more specialized within the Coca-Cola business system (there is much less of it, say, than carbonated soft drink production), perhaps it is a bit more controlled, which would result in the form of improved performance on, for example, occupational safety and health indicators.

Another possible explanation relates to the location of coffee and tea production facilities within the global system. Most coffee and tea production is in Japan, which is known for its management systems and controls (both in general and anecdotally within Coca-Cola).

Why would this relationship not carry over to water and energy efficiency? The answer there is simple. Water and energy usage are more closely tied to production inputs than management controls. Coffee and tea production are more energy, water and material input-intensive than other types of beverage production – this has less to do with management controls than occupational safety and health measures.

In order to evaluate the impact of known management controls, with each of the environment, occupational safety and health measures, ISO 14000 and OSHAS 18000 certification were included in respective versions of the models. In no case did environmental or occupational safety management systems certification demonstrate a statistically significant relationship driving efficiency (or inefficiency).

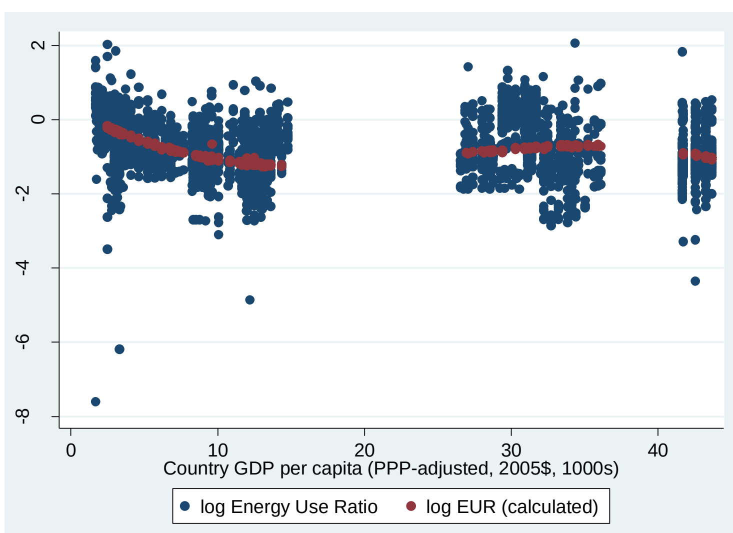
Figure 15. Summary Results: Manufacturing Facility Scale



In the case of occupational, safety and health measures, some argue that performance is more related to the "people intensity" of a manufacturing operation than the technical complexity of production. In order to test for this, I controlled for total hours worked in the facility in a regression for each indicator. Total hours worked can be viewed as both a people-intensity measure and a scale measure (there are no other facility-scale indicators in the regressions). In the case of water, plants with more total hours worked are slightly (though statistically significant) more efficient; for energy, plants with more total hours worked are less efficient. Plants with more total hours worked appear to be slightly safer, though this finding is not statistically significant.

In future research, this measure should be scaled or normalized. Currently, total hours worked is being used, where "thousand hours worked" may be a better indicator. Alternatively, the measure could be normalized for total production volume, which would accomplish the same goal – possibly being a better people intensity measure.

Figure 16. Representative Calculated Curve for Manufacturing Facility Scale (Energy Use Ratio)



Future research should look beyond a targeted set of markets. While the countries reported here were somewhat representative of the global picture within Coca-Cola (in terms of ranges for market development and core environmental, occupational safety and health indicators), they did not stretch across the full spectrum for country GDP. There was a significant gap right in the middle, which may have had an impact on the results.

IMPACT OF CONTROL VARIABLES AT THE THREE SCALES

In the commencement of this research effort, the author had a specific interest in the role that other factors, beyond wealth, play in environmental and social outcomes. This effort focused on place, time and institutional strength variables.

In the case of the country-scale analysis, population density and trade intensity were the primary place-related variables, though in the case of CO_2 emissions, energy usage and particulate matter, energy imports were also evaluated. At the city/regional scale, population density and whether a city was a coastal (or port) city was evaluated. At the manufacturing facility scale, the primary place-related variables related to type of beverage production (carbonated soft drinks, bottled water, juice, syrup, coffee/tea and other), though total hours worked was also included (as a “scale” variable).

For time, year was included, as all data was annual (with some gaps). The unit of analysis here was a country, city or manufacturing facility in a particular year. For country regressions, years were limited to 1990-2010; city regressions covered the same time period; and, manufacturing facility analysis was over the period of 2004-2010. In all cases, some variables further limited the data coverage (as indicated).

Time trends were spotty across the range of dependent variables. For the country scale, statistically significant time trends were apparent with particulate matter (PM_{10}), water resources, life expectancy and biological oxygen demand (BOD). “Improvements” over time were clear in all cases, except water resources per capita, which declined over time.

At the city/regional scale, only nitrogen dioxide (NO_2) showed a statistically significant time trend. And, in the case of the manufacturing facility scale, there was no clear time trend separate from increasing wealth and other controls.

Institutional control variables included the country-scale World Governance Indicator (WGI) scores for Political Stability, Control of Corruption and Voice and Accountability. In the case of the manufacturing facility analysis, an additional set of indicators was used. For environmental outcomes (water, energy and waste indicators), certification to the ISO 14001 environmental management systems standard was used, and in the case of occupational safety and health, certification to OHSAS 18001 was used.

Generally speaking, the role of the control variables for institutional strength was less than anticipated. The management systems certifications were not statistically significant in the manufacturing facility-scale analysis for any indicator. At the country scale, Political Stability was only statistically significant for Renewable Water Resources per Capita (a surprising result of more stable economies resulting in less renewable resources per capita); countries with higher levels of Voice and Accountability (which can be interpreted as a a higher level of democracy) demonstrated higher life expectancy. Control of Corruption was not used at the country scale.

Table 19. Impact of Place, Time and Institutional Control Variables at the Country Scale

Dependent Variable	Population Density	Time	Trade Intensity	Political Stability	Voice and Accountability	Energy Imports
CO_2 Emissions	—	—	—	—	—	—
Energy Use	↓	—	—	—	—	↑
Particulate Matter	↓	↓	↑	—	—	↑
Water Resources	↓	↓	—	↓	—	
Life Expectancy	—	↑	—	—	↑	
Improved Sanitation	↑	—	—	—	—	
Improved Water Sources	↑	—	—	—	—	
Biological Oxygen Demand (BOD)	↑	↓	↑	—	—	

Statistical significance at the 0.05 level or greater.

At the City scale, increasing Political Stability at the country scale corresponds to increasing pollution at the local scale in the case of Sulfur Dioxide (SO_2) and Nitrogen Dioxide (NO_2), though there is no statistically significant correlation for the other indicators. Cities in countries with higher levels of Control of Corruption have higher levels of air pollution and lower levels of water usage per capita (with no statistically significant effect on water quality indicators). Voice and Accountability only had a statistically significant impact on particulate matter and NO_2, reducing both.

Table 20. Impact of Place, Time and Institutional Control Variables at the City/Regional Scale

Dependent Variable	Population Density	Coastal/ Port	Time	Political Stability	Control of Corruption	Voice and Accountability
Particulate Matter	↓	—	—	—	↑	↓
Sulfur Dioxide/ SO_2	—	—	—	↑	↑	—
Nitrogen Dioxide/NO_2	↓	—	↓	↑	↑	↓
Water Usage	—	—	—	—	↓	—
Dissolved Oxygen	—	↓	—	—	—	—
Biological Oxygen Demand	↑	—	—	—	—	—
Chemical Oxygen Demand	—	—	—	—	—	—

At the manufacturing facility scale, there was also limited impact of the WGI variables. However, plants in countries with higher Voice and Accountability showed higher levels of water usage, energy usage, waste generation and incidents. Plants in countries with higher Political Stability showed increased energy usage and incidents. Control of Corruption did not have any statistically significant relation to plant performance on key indicators.

Table 21. Impact of Production Type Variables at the Manufacturing Facility Scale

Dependent Variable	**Bottled Water Production**	**Juice Production**	**Coffee/Tea Production**	**Syrup Production**	**Other Bottling Production**
Energy	↓	↑	↑	↓	↑
Water	↓	↑	↑	↓	↑
Waste	↓	—	↑	↓	—
Accidents	↓	↑	↓	↓	↓

Table 22. Impact of Time and Institutional Control Variables at the Manufacturing Facility Scale

Dependent Variable	**Time**	**Management Systems Certification**	**Total Hours Worked**	**Political Stability**	**Control of Corruption**	**Voice and Accountability**
Energy	—	—	↑	↑	—	↑
Water	—	—	—	—	—	↑
Waste	—	—	—	—	—	↑
Accidents	—	—	—	↑	—	↑

Total hours worked, only showed a statistically significant relationship with energy usage. This variable was included partly due to a possible relationship between "people intensity" for the purposes of occupational safety and health (i.e., incidents involving people) but showed no impact on that particular measure (the Future Study section discusses possible avenues for further explanation on the role of "people intensity").

CHAPTER 8

DISCUSSION OF IDENTIFIED COUNTRIES FOR MANUFACTURING FACILITY SCALE ANALYSIS

This section aims to provide context on the environmental policies and performance within the 21 countries identified for this study. The hope is that this context will help guide The Coca-Cola Company's corporate policy and management of sustainability within those markets. The comparison of environmental policies in developed and emerging markets will be a great reference for decision makers at Coca-Cola who are looking to launch sustainability initiatives in emerging markets as the Company and its bottling system aim to double worldwide business between now and 2020 – in a sustainable manner (The Coca-Cola Company, 2010). Table 23 lists the identified countries, along with their expected incremental population growth between 2008 to 2020, teen population and personal expenditure per capita in the year 2020, trends that The Coca-Cola Company monitors in projecting potential business growth.

Table 23. Population and Personal Expenditure in Identified Markets (IHS Global Insights, 2010)

2008-2020 Incremental Population (millions)		2020 Teen Population (millions)		2020 Personal Expenditure Per Capita ($000's)	
India	176	India	173	United States	$ 32
China	77	China	118	Great Britain	$ 23
Nigeria	38	United States	31	Canada	$ 22
United States	31	Nigeria	31	Australia	$ 21
Brazil	23	Brazil	25	Japan	$ 19
Philippines	17	Philippines	15	France	$ 19
Mexico	11	Mexico	14	Germany	$ 19
Turkey	9	Russia	10	Italy	$ 18
Argentina	4	Turkey	9	Russia	$ 16
Thailand	3	Japan	8	Spain	$ 15
Canada	3	South Africa	7	Argentina	$ 14
Great Britain	3	Thailand	6	Chile	$ 13
France	3	France	6	South Africa	$ 13
Australia	2	Germany	5	Turkey	$ 12
South Africa	2	Great Britain	5	Mexico	$ 10
Chile	2	Argentina	5	Brazil	$ 8
Spain	2	Italy	4	Thailand	$ 8
Italy	-	Spain	3	China	$ 7
Germany	(1)	Canada	3	Philippines	$ 5
Japan	(3)	Australia	2	India	$ 4
Russia	(9)	Chile	2	Nigeria	$ 1

GOVERNMENT AND POLICY DYNAMIC IN IDENTIFIED MARKETS

Markets vary in their type of government and participation in international organizations. Table 24 lists the countries by government type and international organization participation. Twelve of the twenty-one countries are members of the Organization for Economic Cooperation and Development (OECD), and sixteen are members of the G-20. All countries are members or observers of the International Labor Organization (ILO), International Monetary Fund (IMF) and World Trade Organization (WTO), demonstrating some level of interest in participating and conforming to international norms and standards of conduct in business, labor and finance.

Table 24. Government Types and International Organization Participation (U.S. CIA, 2011)

Country	Government type	International Organization Participation				
		G-20	*ILO*	*IMF*	*WTO*	*OECD*
Argentina	Republic	x	x	x	X	
Australia	Federal parliamentary democracy and a Commonwealth realm	x	x	x	X	x
Brazil	Federal republic	x	x	x	X	
Canada	Parliamentary democracy, a federation, and a constitutional monarchy	x	x	x	X	
Chile	Republic		x	x	X	x
China	Communist state	x	x	x	X	
France	Republic	x	x	x	X	x
Germany	Federal republic	x	x	x	X	x
India	Federal republic	x	x	x	X	
Italy	Republic	x	x	x	X	x
Japan	Parliamentary government with a constitutional monarchy	x	x	x	X	x
Mexico	Federal republic	x	x	x	X	x
Nigeria	Federal republic		x	x	X	
Philippines	Republic		x	x	X	
Russia	Federation	x	x	x	x (observer)	x
South Africa	Republic	x	x	x	X	
Spain	Parliamentary monarchy		x	x	X	x
Thailand	Constitutional monarchy		x	x	X	
Turkey	Republican parliamentary democracy	x	x	x	X	
United Kingdom	Constitutional monarchy and Commonwealth realm	x	x	x	X	x
United States	Constitution-based federal republic; strong democratic tradition	x	x	x	X	x

INSTITUTIONALIZATION OF ENVIRONMENTAL POLICY

Weidner and Janicke (2001), in a study of capacity building in national environmental policy, studied 15 of the 21 countries of interest. Table 2, largely reprinted from Weidner and Janicke, shows the institutionalization of environmental policy across those markets over time. The United Kingdom and United States were the first countries to create a Ministry of the Environment or National Environmental Agency (both in 1970), though Australia, Canada and Japan soon followed. Japan (1967), U.S. (1969) and Mexico (1972) were first on the scene with an Environmental Framework Law. But, it was the 1980s before countries began to create national environmental plans.

Table 25. Institutionalization of Environmental Policy/Management within Countries

Country	Ministry of the Environment[a]	National Environmental Agency[a]	National Environmental Report[a]	Environmental Framework Law[a]	Article in the Constitution[a]	Council of Environmental Experts[a]	National Environ-mental Plan[a]	Kyoto Protocol (Signed/Ratified/ Into Effect)[b]
Argentina[1]	1994[2]	1973[2], 1991[3]	N/A	N/A	N/A	N/A	N/A	1998/2001/2005
Australia	1971/ 1975	1988	1980/1996	1974			1992	1998/2007/2008
Brazil	1985/ 1992	1989		-1981	1988	1971	1995	1998/2002/2005
Canada	1971		1986	1988		1971	1990	1998/2002/2005
Chile		1990/1994	1992	1994	1980	1996	1998	1998/2002/2005
China		1984	1989	1979/1989		1991	1994	1998/2002/2005
France	1971/ 1984	1991	1973	2001		1975	1990	1998/2002/2005
Germany	1986	1974	1976		1994	1971		1998/2002/2005
India	1980/ 1985	1974	1982	1986	1976/1994	1993	1993	/2002/2005
Italy	1971/ 1986	1994	1989	1986	-1948	-1986	-1997	1998/2002/2005
Japan	2001	1971	1969	1967/1993		1967	1995	1998/2002/2005
Mexico	1982/ 1994	1992	1986	1972/1988	1988	1995	1989	1998/2000/2005
Nigeria		1988	1992	1988	(1979/1989)	1990	1988/1990	/2004/2005
Philippines[1]	[redacted]							1998/2003/2005
Russia	1988		1988	1991	1977/1993		1993	1999/200/2005
South Africa[1]	[redacted]							/2002/2005
Spain[1]	[redacted]							1998/2002/2005
Thailand[1]	[redacted]							1999/2002/2005
Turkey[1]	[redacted]							/2009/2009
United Kingdom	1970	1972/1995	1978	1974/1990		1970	1990	1998/2002/2005
United States		1970	1970	1969		1971		1998//

[a] Source Table from Weidner and Janicke, 2001. [1] These countries not included in Weidner and Janicke, 2001.
[b] Sourced from UNFCC, 2011.
[2] Sourced from Galezian, 2009
[3] Sourced from Vazquez-Brust et.al.

Building on Weidner and Janicke, this table also includes countries' status with respect to the Kyoto Protocol. All countries except the United States have ratified the Kyoto Protocol, with most signing in 1998 (a year after the Kyoto Protocol was first established) and having ratified it by 2002 (with a few countries ratifying as late as 2002-2003, Australia waiting until 2007, and Turkey until 2009). The effective date for most countries was 2005, with the exception of those countries ratifying after that date.

The Kyoto Protocol is included here since it is the most high-profile international environmental agreement to be on the radar screen over the last several years. Climate change is a hot topic not only with the environmental community at large but also within The Coca-Cola Company.

OTHER KEY ENVIRONMENTAL ISSUES

Besides Climate Change, the most relevant environmental issues to The Coca-Cola Company are water (the largest ingredient in beverages) and waste (from packaging – bottles, cans, etc.). An emerging area of interest for the Company is sustainable agriculture, due to the fact that over half of the purchased inputs for beverage ingredients and products are agriculture-related (e.g., sweetener, juice, coffee, tea, natural colors and flavors).

The U.S. Central Intelligence Agency publishes the *World Factbook* annually as basic intelligence on the countries of the world. The *World Factbook* includes information on Geography; People and Society; Government; Economy; Communications; Transportation; Military; and, Transnational Issues. Within these categories, the *Factbook* lists the natural resources existing within a country and current environmental issues. Appendix D lists natural resources and relevant environmental issues within the context of a specific environmental policy/performance profile for each of the identified markets. Water and air pollution are common in most countries of interest. Waste as an identified issue is less apparent. Agricultural impacts are unique to those countries with specific focus on agriculture. However, many of these countries are those with growing populations and demands on limited resources.

ENVIRONMENTAL PERFORMANCE INDEX FOR IDENTIFIED COUNTRIES

The Yale Center for Environmental Law and Policy at Yale University has for several years published an “Environmental Performance Index” of countries, which includes sub-rankings in areas like Environmental Health and Ecosystem Vitality. The index is both a measure of the actual environmental situation in countries as well as the policy dynamic in place to approach solutions to specific problems. Table 26 shows the rankings of the selected countries for 2010.

Countries range from 40.2 (Nigeria) to 78.2 (France) for the overall index, with similar ranges on the sub-rankings. Environmental Health and Ecosystem Vitality sub-rankings are divided into component measures. Air, Water and Climate elements are included here. A similar diversity appears in the sub-components.

In the annual Environmental Performance Index (EPI) publication, countries are divided into five groupings based on overall rankings: 85-100; 70-85; 55-70; 40-55; and, 25-40. A country with a ranking below 25 does not appear on the EPI.

Four countries are listed in the highest EPI grouping (85-100): Iceland, Switzerland, Costa Rica and Sweden (note: none of these are selected countries here). Six of the countries appear in the next grouping (70-85), nine in the next, and the remainder in the fourth of five groupings. While no country scores below a 40% (putting it in the lowest grouping), Nigeria is the lowest scoring country in the fourth grouping of countries (just above the cut-off, at 40.25).

Table 26. 2010 Environmental Performance Index Scores for Identified Countries

Country	EPI	Environmental Health	Ecosystem Vitality	Air Impacts to Environmental Health	Water Impacts to Environmental Health	Air Impacts to Ecosystems	Water Impacts to Ecosystems	Climate
Argentina	61.0	74.5	47.6	63.2	91.5	48.2	72.9	49.6
Australia	65.7	91.7	39.6	97.4	100.0	29.5	58.0	27.6
Brazil	63.4	71.6	55.2	90.2	79.3	39.3	85.6	46.4
Canada	66.4	92.8	40.1	97.4	100.0	25.3	90.7	37.3
Chile	73.3	81.3	65.4	74.4	92.3	42.2	59.2	60.7
China	49.0	58.7	39.3	40.1	70.0	30.2	66.0	40.2
France	78.2	90.7	65.7	97.4	100.0	42.0	79.9	56.4
Germany	73.2	90.7	55.7	97.4	100.0	40.0	72.4	49.6
India	48.3	41.6	55.1	37.6	50.1	37.1	68.3	60.2
Italy	73.1	90.9	55.2	89.7	100.0	38.9	73.6	48.0
Japan	72.5	90.2	54.9	87.0	100.0	34.7	82.6	48.3
Mexico	67.3	76.6	58.1	75.5	85.0	40.2	60.0	56.4
Nigeria	40.2	17.6	62.7	37.2	15.0	40.6	62.1	75.8
Philippines	65.7	65.9	65.5	71.7	81.6	51.8	86.4	64.5
Russia	61.2	68.6	53.8	95.9	90.1	54.6	84.5	45.3
South Africa	50.8	59.0	42.6	90.2	71.0	30.4	68.1	39.5
Spain	70.6	88.7	52.5	85.3	100.0	38.0	69.8	46.1
Thailand	62.2	65.6	58.7	54.5	96.0	36.6	77.7	53.0
Turkey	60.4	74.5	46.3	76.1	90.7	46.2	62.8	53.6
United Kingdom	74.2	89.8	58.7	97.4	100.0	37.1	77.4	51.8
United States	63.5	88.3	38.6	95.7	99.1	31.6	70.2	29.4

ECONOMIC AND DEVELOPMENT INDICATORS

Table 27 adds some context around the economic indicators from the 21 countries: GDP, household consumption expenditure, trade (as a percentage of GDP), urban population and energy use. Urban population is of interest since urban areas are where issues of air pollution and other resource constraints are at their most extreme. Data from 2008 is used, as this provided the most data coverage across countries for the indicators listed. *More detailed profiles in the Appendix use data from 2007 and prior years in order to maximize coverage over a broader set of indicators.*

Interestingly, for Coca-Cola, urbanization presents opportunity in terms of providing a concentrated consumer population. However, beyond the obvious environmental constraints in cities, constrained urban infrastructure often delays/hampers delivery. So, this is both a blessing and a curse for the Company. Continued growth in areas with constrained infrastructure will require effective management of this dilemma.

Table 27. Key Relevant Indicators from World Development Indicators Database (WorldBank, 2011)

Country	GDP per capita (constant 2000 US$)	Household final consumption expenditure (% of GDP)	Trade (% of GDP)	Urban population (% of total)	Energy use (kg of oil equivalent per capita)
Argentina	$9,935.80	59.4	45.1	92.0	1,922.7
Australia	$25,170.10	57.3	41.4	88.7	6,052.2
Brazil	$4,478.50	58.9	27.1	85.6	1,297.5
Canada	$26,063.60	55.7	69.0	80.4	8,008.4
Chile	$6,240.10	59.1	85.7	88.4	1,872.3
China	$2,032.60	34.9	62.2	43.1	1,597.7
France	$23,432.70	56.7	56.0	77.4	4,151.8
Germany	$25,546.80	57.0	88.5	73.6	4,083.3
India	$711.90	59.9	52.4	29.5	544.7
Italy	$19,585.20	59.3	58.3	68.1	2,942.1
Japan	$40,253.70	57.7	34.9	66.5	3,882.7
Mexico	$6,346.40	64.8	58.2	77.2	1,632.6
Nigeria	$492.30		71.2	48.4	737.8
Philippines	$1,314.20	74.3	76.3	64.9	455.4
Russian Federation	$3,043.70	47.8	53.4	72.8	4,838.0
South Africa	$3,795.10	61.7	74.2	60.7	2,756.3
Spain	$16,264.60	57.2	58.7	77.1	3,046.7
Thailand	$2,608.20	56.0	150.3	33.3	1,570.3
Turkey	$5,288.40	69.8	52.2	68.7	1,388.8
United Kingdom	$28,718.50	64.2	61.1	89.9	3,395.3
United States	$38,335.80	70.7	30.8	81.7	7,503.0

GDP per capita ranges across the countries from under $500 (Nigeria) to over $40,000 (Japan). Household consumption as a percentage of GDP ranges from around 35% (China) to over 70% (U.S.), with no reported number for Nigeria. Trade ranges from a low of 27.1% (of GDP, for Brazil) to over 150% (Thailand). Urban population ranges from around 30% (India and Thailand) to over 90% (Argentina). Energy usage ranges from around 450 kg of oil equivalent per capita (Philippines) to over 8,000 (Canada). Net-net, there is broad diversity in the list of identified countries in their levels of development.

ENVIRONMENTAL OUTCOMES IN IDENTIFIED MARKETS

On economic, social and environmental indicators included above, there is real diversity among the countries of interest for this study. There appears to be more similarity between the issues facing each country (population growth, urbanization, environmental impacts) than their current environmental performance/outcomes. Additional analysis is required to further illuminate the differences from country to country in terms of their policy approaches to mitigate impacts and realize opportunity.

Country-by-country profiles based on available data, comparative analyses and academic literature are in the Appendix. As an example, further research could evaluate the differences in CO_2 reduction policies from country to country and whether these have resulted in significant differences in environmental outcomes. As an example, Table 28, adapted from Brown and Sovacool (2011), characterizes the uptake of renewable energy policies within identified countries. Most countries of interest have adopted some form of renewable energy promotion policies (as of 2010). Countries with state and provincial governments show uptake at the local and regional scale where gaps exist at the national scale.

Table 28. Uptake of Renewable Energy Policies in Identified Markets (Adapted from Brown and Sovacool, 2011)

Country	Feed-In Tariff	Renewable Standard Portfolio/ Quota	Capital Subsidies, Grants, Rebates	Investment or Other Tax Credits	Sales tax, energy tax, excise tax, or VAT reduction	Tradable RE Certificates	Energy production payments or tax credits	Net metering	Public investing, loans or financing	Public competitive bidding
Argentina	X		X	Regional[c]	X		X		x	X
Australia	Regional	X	X			X		X	x	
Brazil				X					x	X
Canada	Regional	Regional	X	X	X			X	x	X
Chile		X	X	X	X				x	X
China	X	X	X	X	X		X		x	X
France	X		X	X	X	x			x	X
Germany	X		X	X	X			X	x	
India	Regional	Regional	X	X	X	x	X		x	
Italy	X	X	X	X	X	x		X	x	
Japan	X	X	X	X		x		X	x	
Mexico				X				X	x	X
Nigeria										
Philippines	X	X	X	X	X		X	X	x	X
Russia			X							
South Africa	X		X		X				x	X
Spain	X		X	X	X	x			x	
Thailand	X				X				x	
Turkey	X		X							
United Kingdom	X	X	X		X	x			x	
United States	Regional	Regional	X	X	Regional	Regional	X	Regional	Regional	Regional

[c] "Regional" notes that states or provincial governments within countries have adopted policies, though none is in place at the country scale
[2] Nigeria was not included in the Brown and Sovacool (2011) assessment of RE policies.

Understanding the uptake of CO_2 emissions reduction policies within selected countries could also help the Company determine possible levers for future reductions (e.g., the identification of incentives for using renewable energy, which could make investments more economically attractive).

"ENVIRONMENTAL KUZNETS CURVES" FOR THE 21 COUNTRIES

The country-scale analysis reported here included all world economies. Care must be taken in interpretation of such results. A critique of the EKC literature to date has been inference about within-country variation based on analysis largely capturing between-country variation. The time-series regression used here reports both; as an indication, for CO_2 emissions per capita, the r-squared within was 0.1897, while the r-squared between countries was 0.7139. R-squareds for within and between-country variation for all analyses are reported in the full regression results in the Appendices.

In an attempt to get a sense of the 'shape' of environmental and social outcomes within the 21 countries targeted for the manufacturing-scale analysis, "basic" EKC curves (scatter plots of the indicator relative to GDP, really), were generated for each indicator Four graphs are included in this section to give the reader an idea for the situation in the specific countries relative to the global situation. All other curves are included in Appendix F.

Countries were grouped geographically along continent lines that roughly correspond to The Coca-Cola Company's geographic operating groups:

- North America and Latin America (two different operating units for Coca-Cola) – including the U.S., Canada, Mexico, Brazil, Argentina and Chile
- Europe – including the United Kingdom, France, Germany, Italy and Spain
- Eurasia and Africa – including Russia, India, Turkey, Nigeria and South Africa
- Asia-Pacific – including China, Japan, Philippines, Thailand and Australia

Each country's 'shape' relative to GDP is apparent based on color-coding of the graphs. It is clear that CO_2 emissions in emerging economies are still growing in the emerging economies. There is what appears to be a monotonic increase in many of those countries. A few of the more mature/developed countries demonstrate a U-shaped curve, or something other than a monotonic increase in CO_2 emissions per capita.

The European countries in particular show reductions in per capita emissions, with the exception of Italy and Spain, which are growing. Emissions per capita in Europe range from between 5 and 12.5 metric tons per capita in these countries, while in the U.S., Canada and Australia, emissions per capita are over 15 metric tons. While these are the largest emitters, emissions per capita seem to either have leveled off or are declining at the highest levels of GDP.

India and China, two countries whose growth is the subject of many EKC analyses, but also important growth regions for Coca-Cola, show emissions per capita on a steep increase, though both are below 5 metric tons per capita. Japan, as another large economy of strategic importance for Coca-Cola, shows emissions per capita leveling off or declining at the highest levels of GDP.

Energy usage per capita tells a similar story. However, the leveling off for CO_2 emissions that has largely occurred in the most developed markets does not hold for Australia and Japan in the case of energy usage. Spain and Italy also show increases with GDP, where the rest of Europe, the United States and Canada all show leveling off or decline. Asia-Pacific and Eurasia-Africa display increasing energy usage with GDP, which is under $20K per capita in all countries except Australia and Japan over the span of time covered here (1960-present, or respective data ranges for various indicators).

All countries indicate improvement with increasing GDP for life expectancy, access to improved sanitation systems, and access to improved water sources, with the exception of South Africa for life expectancy and Nigeria for access to improved sanitation systems.

For only one country in the target group, Russia, did renewable water resources per capita show an increase with GDP. In all cases besides Russia, renewable resources per capita declined with GDP over the range of data. The biological oxygen demand (BOD) data was quite sparse; therefore, trends are difficult to assess.

Perhaps the “best” story across all of the country specific EKC curves is that for particulate matter, which is declining with GDP for all countries.

Assessing the country-specific curves qualitatively, there are two overarching observations. First, for any given country, in virtually all cases, the ‘shape’ of the curve relative to any particular indicator has less curvature than the all-countries regressions. In most cases, environmental outcomes are either monotonically increasing or decreasing with GDP. CO_2 emissions and energy usage show the most curvature at the country-level. There are, in fact, several countries that display an inverted-U pattern for CO_2 and/or energy usage.

Figure 17. CO_2 Emissions per Capita relative to GDP in North and Latin America

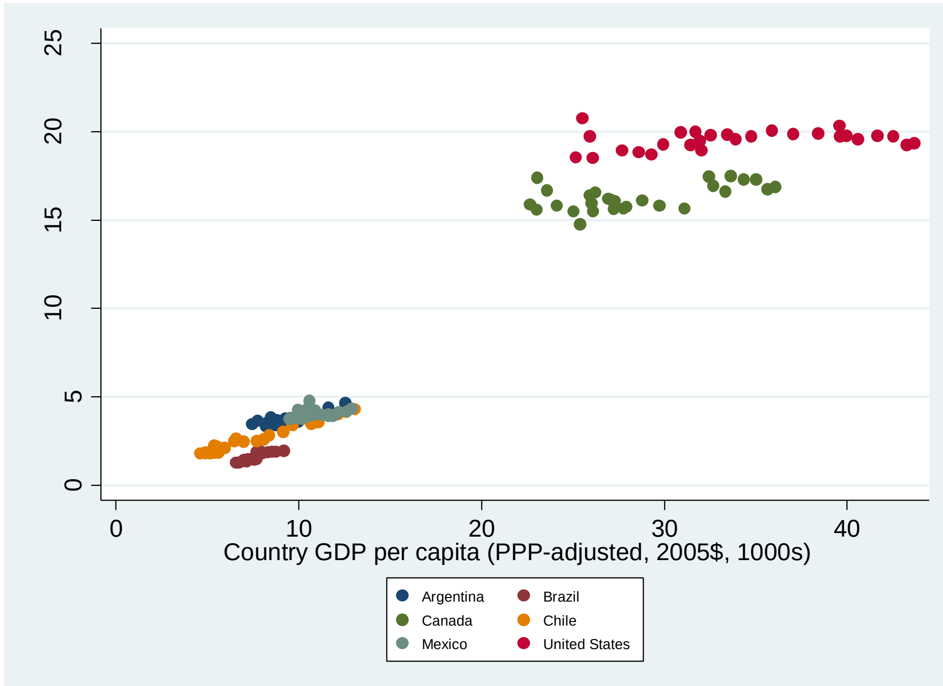


Figure 18. CO_2 Emissions per Capita relative to GDP in Eurasia and Africa

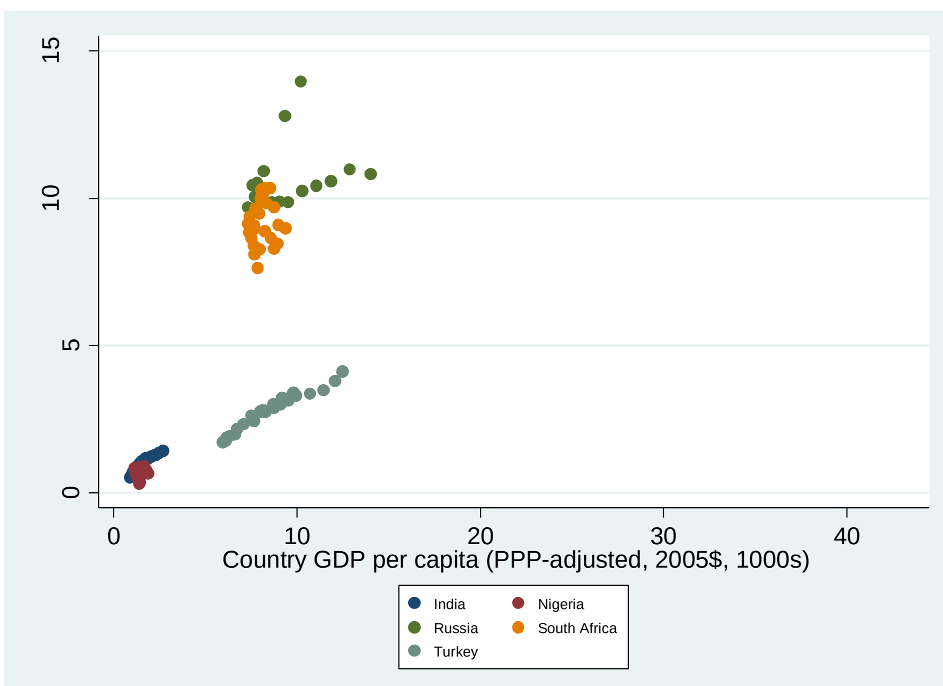


Figure 19. CO_2 Emissions per Capita relative to GDP in Europe

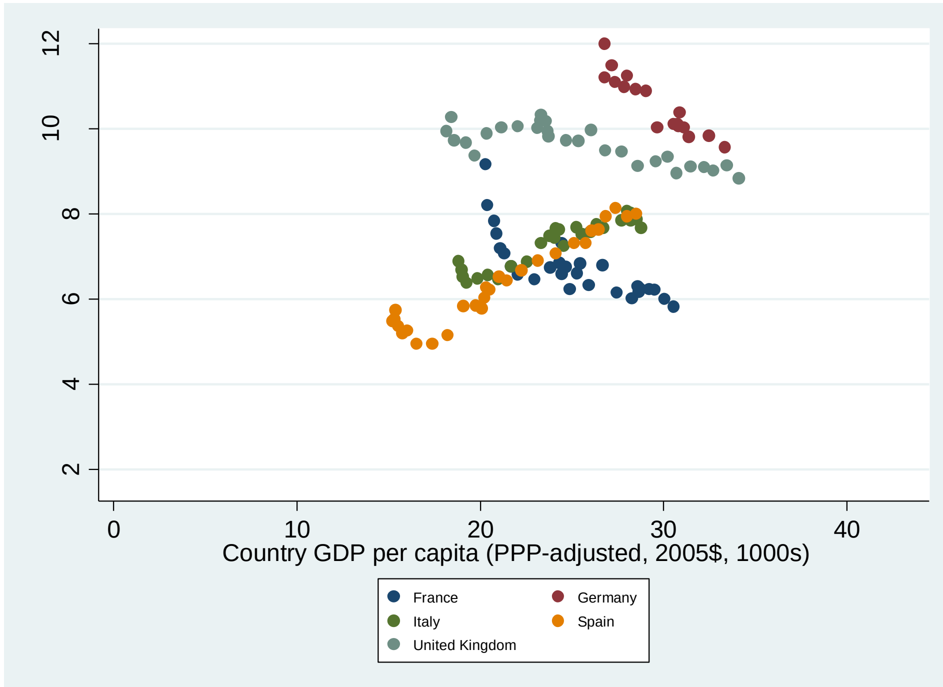


Figure 20. CO_2 Emissions per Capita relative to GDP in Asia-Pacific

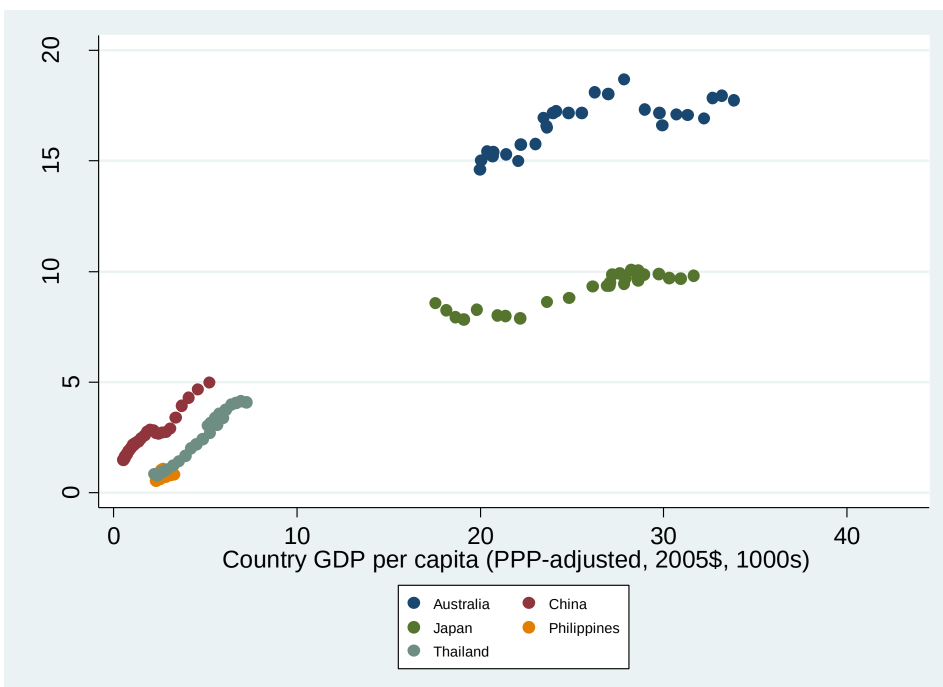
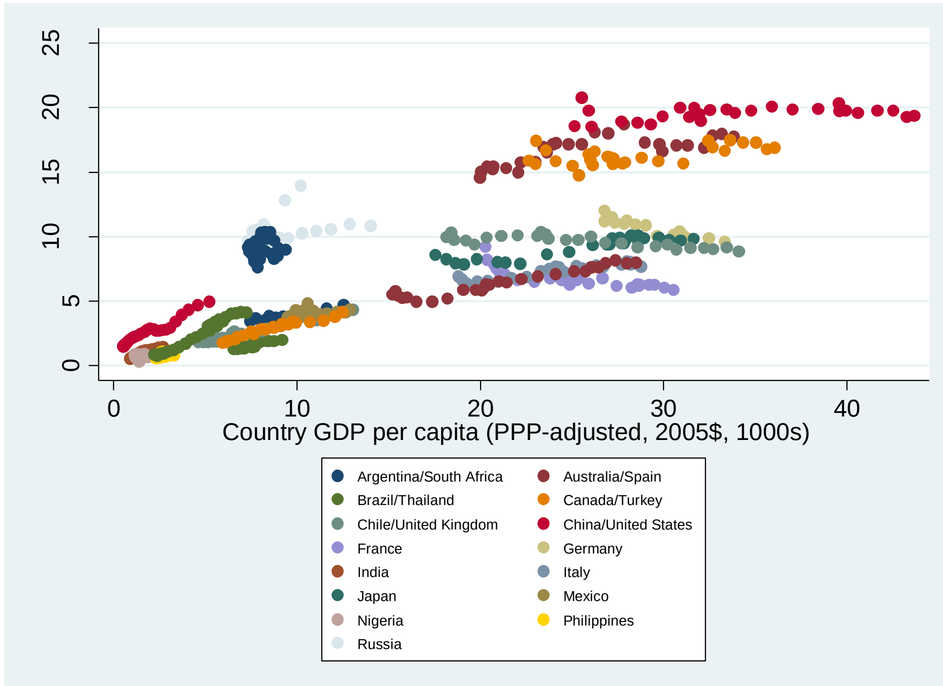


Figure 21. CO_2 Emissions per capita in 21 countries



CHAPTER 9

CONCLUSIONS AND IMPLICATIONS

The attractiveness of the EKC hypothesis is the simplicity in the illustration of how various environmental outcomes relate to GDP or other measures of economic development. The complexities with EKC have related to asking "why" such relationships exist. It has long been known that GDP or wealth itself has not been the main driver for things getting worse, then better. However, policy changes, technology improvements, "attention" to the problem – these are the things that must be driving improvement (if, in fact, there has been improvement – in reality, even that is a question, or at best, a mixed result, here as in other studies).

This study tells us less about the 'why' than simply validating that wealth plays a different role for different outcomes – at different scales.

Conclusions fall into five basic categories, included in sub-sections that follow: 1) overall results against the EKC hypothesis; 2) differences from scale-to-scale; 3) direction of the impact of wealth from scale to scale; 4) test of The Coca-Cola Company's market maturity indicator vs. country-scale GDP; and, 5) the role that institutional strength and other place indicators play in describing environmental outcomes.

OVERALL RESULTS AGAINST THE EKC HYPOTHESIS

Of the 46 model configurations tested as part of this analysis, only four resulted in a true Kuznets "inverted-U": Biological Oxygen Demand (BOD) and Renewable Water Resources at the country scale, and Sulfur Dioxide (SO_2) and Nitrogen Dioxide (NO_2) at the City scale. Only BOD, NO_2 and SO_2 are true "pollution" indicators, where we would seek such a shape.

Renewable Water Resources per capita, if we believe in the consumption story that wealth drives increased consumption, would call for monotonic reduction.

Recent innovations in the EKC literature have used a cubic term to test for upturns in pollution indicators after improvements with prosperity. For all regressions in this study, a cubic term was included for relevant economic indicators (country or city-scale GDP and the per capita consumption "market maturity" indicator of Coca-Cola). *In virtually all cases, this cubic term was significant, meaning the "shape" of the evolution of environmental outcomes is more complex than a simply monotonic or u-shaped (up or down!) relationship.* S-shapes and n-shapes dominate the summary sheets from this research.

While this is the case, it is difficult to ascertain whether these shapes hold true across the data range or are just artifacts of the model we have chosen (cubic fit vs. a higher order equation). Carson (2010) in his influential review of the EKC literature calls cubic equations an improvement over simpler quadratic models but cautions against reading too much into them. What is seen as an up-turn or down-turn, he says, is more likely a leveling off of pollution that not described well by a quadratic equation.

The two indicators where the stakes are highest with respect to this question are CO_2 emissions and energy usage per capita at the country-scale. Both of these indicators show an upturn at the highest levels of wealth (around $50,000 per capita). While there are countries in the data set with GDP per capita greater than $50,000, these are very small economies relatively speaking. Following below is a list of the countries with GDP per capita over $50,000. Is it fair to base the global trajectory for CO_2 emissions on these few relatively small countries?

Table 29. Countries with GDP per capita greater than $50,000

Country	Mean GDP per capita (PPP-Adjusted, 2005$, 1000s)	Mean GDP (PPP-adjusted, 2005$, total)	Mean CO_2 Emissions per capita (tons)	Mean Total CO_2 emissions (ktons)
Brunei Darussalam	52.84	5.6 billion	17.94	5,040
Luxembourg	50.07	16.3 billion	23.08	9,350
Macao SAR, China	26.78	7 billion	3.13	1,250
Qatar	70.10	30 billion	53.23	41,340
Singapore	31.70	75 billion	13.63	46,820
United Arab Emirates	53.15	63 billion	30.92	72,270

These countries, based on their size and absolute CO_2 emissions, pale in comparison to the largest world economies. Therefore, a set of regressions was run without these countries for CO_2 emissions and energy usage per capita, the two indicators where perhaps the policy ramifications may be greatest (due to ongoing international dialogues on climate policy). Resulting curves are show in Figures 22 and 23.

Figure 22. CO_2 Emissions Curve without Countries with GPD greater than $50,000 per capita

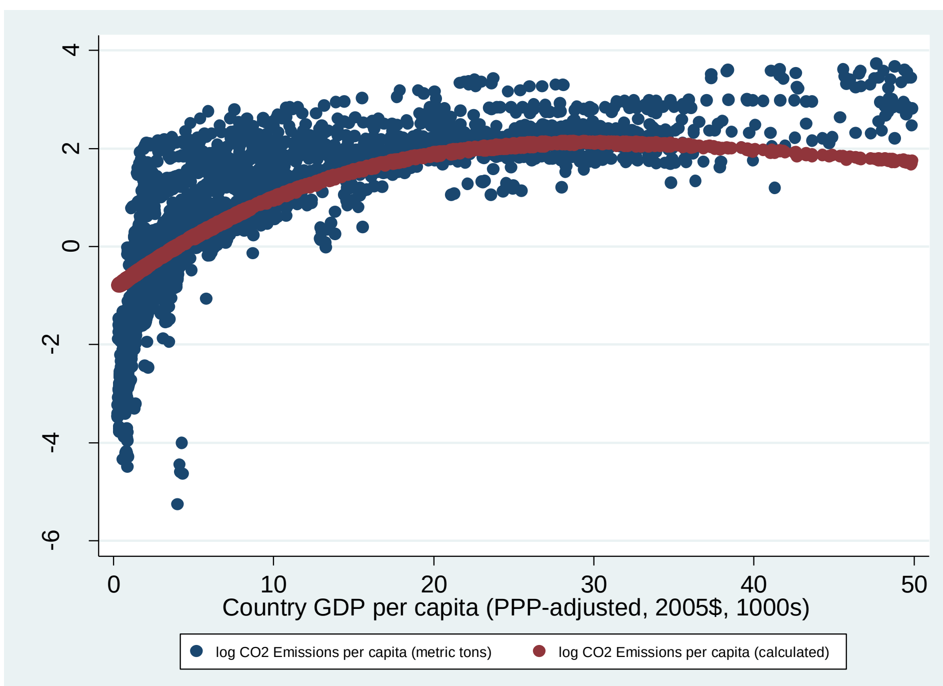
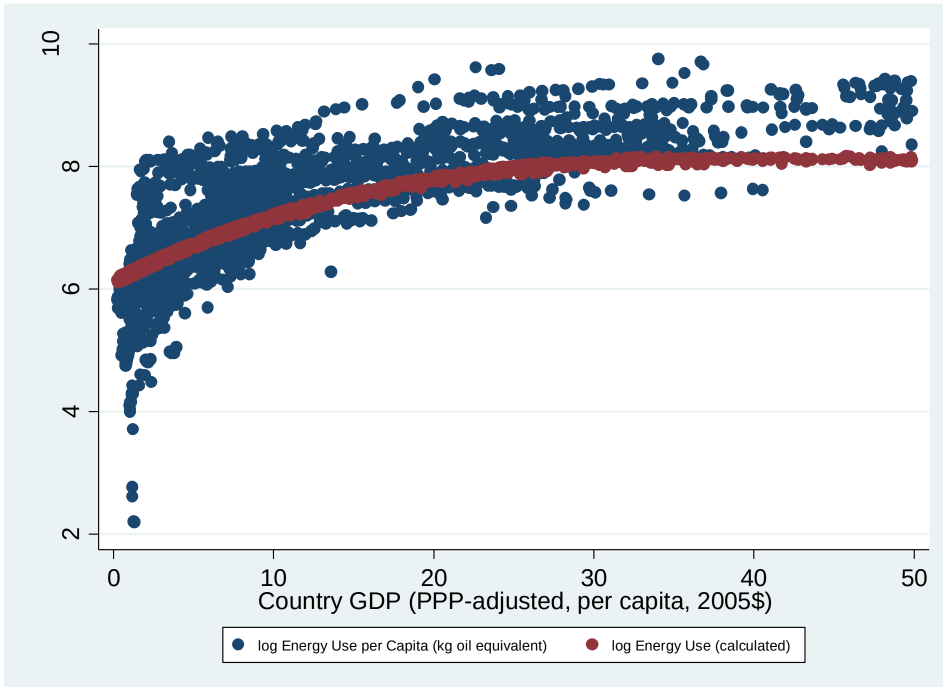


Figure 23. Energy Use Curve without Countries with GPD greater than $50,000 per capita



In the updated regressions for both CO_2 emissions and energy usage per capita, the cubic term for GDP was significant. In the case of CO_2 emissions, the turning point calculated was well outside the range of data (over $100K per capita); however, in the case of energy usage per capita, the turning point appears at around $35,000 per capita. The trajectory of the upturn is much less than in the previous graphs including the high per capita wealth countries.

In the final analysis, as we are taking care not to infer too much about individual countries from the "global curves," whether or not we include the highest wealth countries here may be a moot point. The fact of the matter is, the highest wealth countries have the highest per capita emissions and energy usage, which should be noted regardless of whether we allow their small contributions on an absolute basis to skew the global analysis. The policy ramifications are the same: attention should be paid to regions of the world with high (or increasing) emissions per capita to reverse trends.

DIFFERENCES FROM SCALE TO SCALE

At the country scale, all indicators, except for CO_2 emissions per capita and energy consumption per capita, show improvements at the highest levels of GDP. While the shape of the curve may be more complex than an inverted-U, this is at least hope that wealth drives environmental outcomes in a positive direction (at least over this range of time).

Table 30. Key Findings at Each Scale

Country Scale	Traditional pollution indicators improving at the highest levels of wealth Consumption type indicators (CO_2 emissions per capita and energy usage) increasing at higher levels of wealth; renewable water resources being depleted
City Scale	Generally, wealth influences the same indicators in the same directions at the country and city scales (for air quality, less so for water) Country-scale GDP is a better predictor of performance than city GDP
Manufacturing Facility Scale	Environmental performance closely tied to country-scale GDP for water and energy usage; these indicators reverse of country-scale trends Country-scale GDP a better predictor of plant-scale performance than Coca-Cola's per capita consumption indicator

At the city scale, the situation is a little less clear. Air pollution indicators show improvements at the highest levels of GDP (for both country-scale and city/regional-scale GDP). However, water quality indicators are mixed. Dissolved oxygen (DO) and Chemical Oxygen Demand (COD) show improvements at the highest levels of GDP. However, Biological Oxygen Demand (BOD) is increasing at the highest levels of country-scale GDP. Both COD and DO are moving in similar directions when using City-scale GDP; however, BOD is not (but remember, these results are virtually meaningless due to the small N in these regressions).

DIRECTIONAL IMPACTS OF WEALTH FROM SCALE TO SCALE

It is surprising that we would see different directions relative to country-scale and city-scale wealth in their respective stand-alone models for city/regional environmental outcomes. However, it must be noted that, in the city/regional-scale regressions, for water quality indicators, only chemical oxygen demand (COD) is statistically significant across the regressions. This is partially due to sample size and points to the need for better data in future analysis.

At the manufacturing facility scale, there is general alignment between the directional impacts of country-scale GDP and The Coca-Cola Company's market maturity indicator of per capita beverage consumption. However, while both indicators are statistically significant for energy usage, the significance of the TCCC market maturity indicator breaks down for water usage, waste generation and lost-time incidents, particularly when both country-scale GDP and per capita consumption of beverages are included in the analysis.

At the manufacturing plant scale, the explanatory power of the models improves greatly with the addition of the types of beverage production of the facility (facilities). For example, for energy consumption, the overall r-squared goes from around 0.24 to 0.46 when adding in production type. So, although GDP has a major impact on environmental outcomes, the type of production has a similar impact.

TEST OF THE COCA-COLA COMPANY'S MARKET MATURITY INDICATOR

As an overall test, then, of The Coca-Cola Company's market maturity indicator, per capita consumption of beverages, provides limited value over country-level GDP. However, as the Company grows its business in line with its Vision 2020 business targets, it may become an increasingly important indicator for driving progress on all types of initiatives within the company and its bottling system. Therefore, further analysis may be needed to determine if this indicator could be used to guage or drive progress on sustainability. (For example, if this is the primary market development/maturity indicator for Coca-Cola, should the business drive awareness around this indicator as a possible impetus for driving other types of improvements – e.g., environmental outcomes)?

Another question we might ask related to the manufacturing-scale analysis, and the use of country GDP and/or per capita beverage consumption as a predictor for environmental efficiencies is whether greater efficiency with increasing wealth may off-set increasing growth in production. A basic analysis was conducted based on regression results for manufacturing facility water usage to see how this might play out within the range of data evaluated here. Two relatively high GDP (and, as it would turn out, relatively high per capita consumption) countries, Spain and Japan, were used for this basic analysis. Table 30 shows the predicted change in water usage, and production growth, based on the model(s).

Table 31. Model Predictions for the Balance between Production Efficiency and Growth (2005 to 2010)

Country	**Change in GDP (2005-2010)**	**Change in Production**	**Predicted Change in Water Usage (based on GDP model)**
Spain	6.2%	9.9%	17.5%
Japan	5.2%	1.7%	7 %

It appears that in these cases, reductions in water usage would off-set increasing production demands. However, note that these are relatively stable markets with moderate growth (in both production and GDP). Higher growth markets would undoubtedly have greater challenges (i.e., these are the countries that will contribute much of the growth for Coca-Cola's 2020 *Vision*).

THE ROLE OF INSTITUTIONAL STRENGTH AND OTHER PLACE AND TIME VARIABLES

The impact of place, time and institutional variables is less than anticipated across all regressions, other than at the manufacturing facility scale, where production type (“composition” as Grossman and Krueger would term it) adds notable explanatory power to models for water and energy usage, waste generation and lost-time incidents. There are very few time trends; the only meaningful time trend at the city/regional scale is for nitrogen dioxide (NO_2), and there are no statistically significant time trends across the manufacturing facility scale indicators (apart from wealth trends associated with time). At the country scale, particulate matter, water resources, life expectancy and biological oxygen demand (BOD) demonstrate changes over time (all but water resources show improvement over time).

Population density has statistically significant impacts at the country scale for all indicators except CO_2 emissions (country scale) and life expectancy. Impact is in the expected direction, except for particulate matter, which is improving with greater population density. This could be explained by advanced policies in countries that are more urbanized (there may be more advanced policies – or other attention to environmental problems – within urban areas in those countries).

Table 31. Impacts of Place, Time and Institutional Variables

Country Scale	• Time trends for PM_{10}, water resources*, life expectancy and BOD • Stable countries have less water resources per capita • Higher democracy countries have higher life expectancy • Population density associated with lower energy use, particulate matter and water resources; higher access to water/sanitation systems and BOD
City Scale	• Time trend for NO_2 only • Higher political stability at the country scale is associated with higher NO_2 and SO_2 pollution • Higher control of corruption is associated with worse air quality and lower levels of water usage per capita • More "democratic" societies have lower particulate matter and NO_2 pollution (population density has the same effect)
Manufacturing Facility Scale	• No statistically significant time trends • Production type has significant impact • Management systems do not improve performance • More democracy is associated with more water usage, energy usage, waste and incidents • Political stability is associated with increased energy usage and incidents

The World Governance Indicator (WGI) variables used at the country scale (Political Stability and Voice and Accountability) demonstrate little statistical significance in the country-scale regressions. Political Stability is associated with less renewable resources per capita (possibly explained by increased consumption in wealthier, more stable countries) and life expectancy is higher in more democratic societies (which makes sense, for similar reasons).

At the city/regional and manufacturing facility scales, the WGI variables for Control of Corruption, Political Stability and Voice and Accountability were used. More stable regions had higher SO_2 and NO_2 pollution, as did less corrupt ones (less corrupt regions also had higher levels of particulate matter, though this was not statistically significant for political stability). Higher Voice and Accountability resulted in lower particulate matter (PM_{10}) and nitrogen dioxide (NO_2) concentrations.

At the manufacturing facility scale, Control of Corruption had no statistically significant impact in the regressions. However, Political Stability was associated with higher levels of energy usage and lost-time incidents, while plants in more democratic societies (higher Voice and Accountability) used more energy and water, generated more waste, and had more lost-time incidents. This last point brings into question whether reporting anomalies exist in the data (for example, is there more accurate reporting, all else being equal, in more politically stable and/or democratic societies?).

BUT WHAT DOES ALL THIS REALLY SAY ABOUT THE EKC HYPOTHESIS?

As we knew before this project commenced, the picture is less clear than it was nearly 20 years ago, when Grossman and Krueger first published their famous (notorious?) study. To the author, now that this study is nearing completion, the picture is in some ways even less clear than it was then. On the one hand, there is a contribution in continuing to muddy the waters (by showing that sometimes the EKC pattern holds, but mostly it does not).

As Carson (2010) reminds us, Grossman and Krueger were not out to prove that economic development improved the environment, only that it does not necessarily have to degrade it. The conclusions here are certainly in line with that contention but validate, as many others since Grossman and Krueger have, that the relationship between wealth and environmental outcomes is more complicated than even they acknowledged.

There are some points around which there is now additional clarity. For example, the simple point that the relationship between wealth and various environmental and social outcomes is different across indicators shows that those who hope to “ride the wave” of economic development can’t. Different environmental and social outcomes require (or at least are being given) differing levels of focus.

The distinction between “traditional” pollution indicators and consumption-based indicators is also an important one to make – and explore further. Increased consumption per capita will increase pollution if not otherwise controlled. Regulatory instruments have not traditionally targeted per capita reductions. If we continue to base analyses on per capita indicators, and we believe improvement on a per capita basis is a meaningful target, we ought to consider more focus there from a policy perspective. In some cases, per capita indicators simply serve as a convenient way to normalize. In other cases, these measures are much more meaningful. For example, CO_2 emissions per capita at the country level does not have the same meaning as residential water use, energy use or waste generation per capita (energy use as used in this analysis is at the country scale, while water consumption is at the residential level; data on waste generation was not widely available, and it is not included here).

The manufacturing-scale indicators are not per capita based but do target consumption rather than an environmental quality outcome. This is where targets have been set globally for the Coca-Cola business, particularly in the areas of water and energy usage. These are the two areas that showed the tightest connection to increasing wealth, as well as the Company's market maturity indicator. This may demonstrate the enabling role that wealth plays in improving environmental and social performance for firms when policies are in place. Further research is required to explore this connection.

Also from the manufacturing plant analysis, clarity is provided here on the impacts from various production types – previously, this had not been analyzed quantitatively from an internal company perspective, let alone the external perspective. There is a vast possibility for combining EKC-type analysis at the production facility scale with traditional production management and/or efficiency analyses to delve deeper.

For The Coca-Cola Company, its 2020 Vision outlines business and sustainability objectives globally and for high-growth markets. Growth must occur in traditional carbonated soft drinks and the other types of beverages the Company and its business system make and sell. Understanding more about the water, energy, waste and occupational safety impacts associated with the production of those different types of beverages will help Coca-Cola tailor its policies in growing (and mature) markets over the next several years as it works to live out the goals and objectives laid out in its 2020 Vision.

The major takeaway points from this study are as follows:

- Not all indicators follow the same path (relative to each other).
- Generally, development at the country scale and city/regional scale influence the same types of indicators in the same direction. *However, this pattern does not hold for water: water consumption increases in wealthier countries but declines in wealthier cities and manufacturing facilities, perhaps because local water constraints have led to action.*
- Consumption per capita is moving in the wrong direction at the country scale, if we consider the upswings at high levels of wealth as being more than the result of a few outlying high-wealth economies. *However, the only countries currently demonstrating this pattern are relatively small economies.*
- Indicators that have had focus (i.e., traditional pollution indicators, and manufacturing-scale indicators that have more stringent goals/targets) show most improvement at the highest levels of wealth. This is true for all scales (though it breaks down for city/regional water quality, partially due to small N). *This may help make the case for more measuring, tracking and regulating indicators that often find their way into the public debate (and academic analysis) but have yet to get considerable policy focus.*
- Environmental, occupational safety and health performance at the manufacturing plant scale is improving in the wealthiest markets, but does not improve consistently over all ranges of wealth; thus, focus should be placed on emerging markets to keep trends moving in the right direction.

Regarding the difference between consumption-based and environmental pollutant (e.g., concentration) measures, on the one hand, we should be looking at a 'place's' ability to handle pollution, not necessarily how much is created (or what is consumed). On the other, if consumption is much of what drives that, we have to figure out a way to 'regulate' it. Should future policies be driven towards consumption-based indicators?

Table 32 includes a set of considerations for policy makers at each of the three scales, based on the analysis from the three scales (those that can be drawn directly from this analysis are in bold). As previously mentioned, we cannot infer within-country (city, manufacturing facility, etc.) variation based on analysis that largely captures between-country variation. It is easy to fall into the trap of thinking of a global curve as a possible trajectory for an individual country. This has been a significant critique of EKC literature to date. The main point should really be to focus on countries (or individual entities at any respective scale) that are on the pollution "upswing" to determine ways to cause a tipping point the forces trends in the opposite direction. Countries on a steep growth and/or pollution trajectory can learn from those who have put policies or other actions in place to cause reductions.

The country-specific EKC graphs in the section above demonstrate that there is within-country curvature for some indicators (i.e., directions of pollution and/or environmental outcomes is not purely monotonic for an individual country, most notably for CO_2 and energy usage at the country-scale). Other EKC studies have explored variation within-scales more fully. While conducting full regressions for each country would get unwieldy, a possible future path of research may include targeted analysis at the identified countries of interest to The Coca-Cola Company (or another selection of a few countries).

While a “leap” cannot be taken to infer that any individual country may follow what appears to be a global trajectory, the simple perspective of an individual policy maker or influencer faced with an increase in pollution should be to accelerate tipping points and downward trajectories; those on the down slope should ensure increasing development (complacency, etc.) does not cause future upswings that degrade environmental quality.

Table 32. Considerations for Policy Makers Based on Analysis at the 3 Scales

	Country-Scale Analysis	City/Regional-Scale Analysis	Manufacturing Facility-Scale Analysis
National Governments	**Countries at the highest levels of income, where traditional indicators are improving, should apply focus to other indicators (e.g., consumption), where trends are not moving in the same direction (with wealth)** **Countries on the pollution "upswing" should look to more those where improvements are happening**	**Trajectories are similar for similar indicators at the city/regional level** **Cities at the leading edge of improvement can offer learning to those on the upswing; national governments should work to facilitate this cross-regional learning**	National governments should track the impact of manufacturing on environmental quality (not just economic development) **Corporations may be a source of environmental improvement (or at least, efficiency) as the economy develops**
City/Regional Governments	**Cities should look for opportunities to influence/leverage country-scale economic development as a way to drive local improvements in infrastructure and environmental quality but be prepared to regulate locally if trends are going in the wrong direction and/or policy frameworks at the country-scale are not effective**	Leading cities should drive the national/global dialogue on the development and tracking of meaningful measures. This will allow for better comparison across cities, which will be important for driving improvement	**Local governments should attract industry that will work to improve local environmental quality (either through "composition" of production, technology offerings or management philosophy)** Corporations have a stake in a steady and reliable local infrastructure and may be able to help where constraints currently exist (e.g., roads for delivery of products, water infrastructure for production)
Corporations	There may be opportunities to "get ahead of the curve" by adopting environmentally sustainable practices in countries on the environmental pollution "upswing" (which may otherwise be ripe for future regulation) **Corporations should understand their role in driving per capita consumption in ways that increase pollution and/or degrade environmental quality**	Locating new facilities in cities or regions facing environmental constraints may be more difficult than in those with improving infrastructure and environmental quality Corporations may consider taking an active role in helping local municipalities build infrastructure that enables economic development and improved environmental/health conditions (e.g., water and sanitation systems)	**Goals and targets provide a framework that allows wealth (economic development) to play a role in improving efficiency** **Production type or "composition" of manufacturing will drive much of the environmental, occupational safety and health performance** **Management systems (e.g., OHSAS, ISO) alone do not drive improvement in performance**

CHAPTER 10

LIMITATIONS

As for the limitations of this study, I must first start with data compilation. One of the key research motivations for this study was to evaluate the situation specifically at the city/regional scale. An effort was made to construct a dataset that would bring together various environmental, economic and social indicators at cities across a select group of countries. However, based on lack of centralized global databases, four individual data sources were targeted, resulting in data across the U.S., China, India and EU only. Economic data has been as much a limiting factor for this analysis as environmental data has been, and for that reason, data from India was not included in the final regressions. While this study provided an interesting diversity of cities, both in terms of demographics and the indicators of interest, future study should look at a broader group of cities. As data availability on cities is increasing dramatically based on the ever-growing focus on urbanization, this type of study should be much more reasonable in the future.

In the city-scale analysis, observations were disproportionate for U.S. cities in air quality analysis and by China in water consumption. Cluster analysis might be a good approach if data continues to come out of a handful of economies. While some past research has focused on a detailed look within a country, perhaps detailed studies across a set of countries could provide comparison not fully explored to date.

Quality of data, particularly from the Chinese government, has been questioned. Other researchers have attempted to address inconsistencies in data from China by calibrating economic data through the use of satellite sensing (e.g., measuring economic activity through detailing light coverage at night). However, country-scale and city/regional-scale data from the National Bureau of Statistics of China, like that used for this analysis, has been used in many EKC studies.

Jayanthakumaran, et.al., (2012) use the same World Bank dataset used here for a country-scale analysis comparing India and China. De Groot, et.al. (2004) utilize China Statistical Yearbook data for a comparison of various indicators across Chinese cities and provinces. He (2008) also uses this same dataset, as do Auffhammer and Carson (2008), the only authors to address and test for data quality. *All of the above studies were conducted by researchers outside of China and were published in journals outside China.* Auffhammer and Carson (2008) find that the data is valid through performing statistical tests that even the U.S. EPA's Toxics Release Inventory (TRI) does not pass (the Chinese government data performs better than that from the U.S. EPA).

However, because data quality has been expressed as a concern, shapes for all indicators at all three scales were re-created without data from China in the samples. *Note: full regressions were not re-run, only graphs using the previously generated models to calculate values for each (logged) environmental outcome; therefore, this is not a full solution to check for bias. More complete testing will be done in future iterations of this analysis.*

In the case of the country scale, all shapes remained exactly the same, as they did at the manufacturing facility scale. In both the country-scale and manufacturing facility scales, data from China does not make up a significant percentage of the overall dataset (although in the case of the 21-country manufacturing facility analysis China does have a larger number of facilities than most every other country, with the exception of the U.S.). The regional-scale analysis does contain a high proportion of data from China, and there were some changes to the shapes of curves for those outcomes. Air quality largely remained the same, with the exception of particulate matter (PM_{10}), which demonstrated less of a peak in pollution at lower levels of wealth. Water usage and water quality indicators changed dramatically, as data from China dominated the water analysis, particularly when using city GDP as the primary economic indicator. Only the regressions using country GDP allow for meaningful interpretation with or without China in the dataset.

Also regarding data is the issue of time coverage. As mentioned in previous sections, analysis was limited to a relatively short time period due to the availability of data. In some ways, using a more recent dataset can be seen as a strength. The opportunity in a more recent dataset is to evaluate how things that have been studied for some years are playing out today. Many past studies cover more historical time periods. Environmental policy grew dramatically over the course of the time period evaluated here. And while in many countries it was quite mature by 1990, a more recent dataset provides the opportunity to see how those policies are working to improve environmental outcomes.

The time coverage concern may be more valid for country-scale analysis than for city/regional or manufacturing facility scale. In the case of country scale, data exists covering years 1960-2010, so why not use it? In fact, while the World Bank Data Catalog covers years 1960-2010, some of the millennium development goal indicators used for this analysis roughly cover the years 1990-present only (2009 was the last year covered by any individual indicator). Of the indicators included in this analysis, only data for CO_2 emissions, energy use per capita and life expectancy covers a longer time period (all beginning in 1960; CO_2 emissions are covered through 2007, energy use through 2008, and life expectancy through 2009). Other indicators covered the following time periods:

- Access to Improved Sanitation Systems: 1992-2007 (with gaps)
- Access to Improved Water Sources: 1992-2007 (with gaps)
- Renewable water sources: 1992-2007 (with gaps)
- Particulate matter (PM_{10}): 1990-2008
- Biological Oxygen Demand (BOD), constructed measure: 1992-2007 (with gaps)

The regressions for CO_2 emissions, energy use and life expectancy were re-run using data for all years and are included in Appendix E. In all cases, the shapes of curves relative to country-scale GDP did not change. However, for life expectancy, the statistical significance of the squared and cubic terms for GDP increased in the time-limited model, suggesting the relationship between country-scale wealth and life expectancy has only gotten more complex in the last 20 years. In the cases of both CO_2 emissions and energy use per capita, the effect of the linear term of GDP has strengthened in the limited regression, relative to the square and cubic terms; however, the general shape stayed the same.

Another limitation of this study is that there is no test for causality. This is simply an analysis of the relationship between wealth and environmental and social outcomes. While time trend was evaluated for all outcomes at each scale, further research could assess the time-lagged effects of GDP as well as other tests for causality. For the purposes of this analysis, tests for causality were not the goal. The author fully appreciates the role that many other indicators play in environmental and social outcomes and hopes to conduct further research to illuminate those at various scales.

CHAPTER 11

OPPORTUNITIES FOR FUTURE RESEARCH

An intermediate milestone in this research effort having been reached, there is perhaps a fork in the road related to the pursuit of longer-term prospects. There is clearly more to uncover in the relationship between economic, social and environmental indicators at the country and regional-scale, perhaps more interesting from a public policy standpoint; however, there is also opportunity to pursue regarding the manufacturing facility analysis and determinants of performance there. This latter direction may be something to pursue in the context of management research rather than public policy; however, there are directions within the manufacturing facility research that clearly connect to corporate policy, if not public policy.

In the plant-scale analysis, a primary objective was to test the per capita consumption measure as an alternative measure for country GDP or the economic development of a market (country). Per capita consumption has long been a “development” measure within The Coca-Cola Company. However, there are other possible measures that could be explored. One idea is related to scale or efficiency of production operations. For example, the “people intensity” measure described above, if flipped, could be an interesting “economic development” indicator for a local operation: “production volume per hours worked.” This would also take the economic development indicator down to the plant scale, which is not currently possible with per capita consumption or country-scale GDP. Both of these measures are country-scale in nature.

There is also the possibility of creating an additional measure based on data we do have. The production volume of an individual facility and the country-scale per capita consumption could be used to develop an indicator of the percentage of a country population served by a particular production plant. This would be an interesting economic development indicator; however, it would be theoretical and not very practical (i.e., the entire population of a country is not reached by Coca-Cola, nor does everyone in the population that is reached choose their products!).

There are additional possibilities for institutional variables as well. For several years, the Company's Supplier Guiding Principles (SGP) program has assessed workplace practices in Bottler and Supplier facilities. This process results in an "SGP Index Score" for each facility, which is developed based on approximately 50 different possible findings in workplace audits. The SGP Index was explored on a preliminary basis for this project but was not included in the final analysis due to the variability of audit coverage across facilities in a given year. Facilities receive audits more or less frequently based on risk, with high risk facilities being audited as many as three times per year, and some very low risk facilities being audited every three years. Therefore, more work is needed to rationalize the SGP index for use in year-on-year time series regression, where most are annual measures.

Moving forward, there is also the opportunity to integrate measures across the various functional and organizational entities within the global business. For this project, environmental, occupational safety and health, economic development and Supplier Guiding Principles data was collected from three different internal sources. In the case of the SGP and environmental, occupational safety and health data, production facilities are not coded such that data can be compared across multiple databases. As part of this project, facilities were catalogued and cross-tabulated so that they can be compared in the future (work is underway to feed this back into existing internal systems).

In some ways, every production facility is its own little economy – a microcosm of what is going on more broadly across the global Coca-Cola system, the beverage industry and the global marketplace. Detailed data on production environments exist that could take the analysis reported here to a much deeper level. Research could be strengthened with the addition of a second Company, where not only would there be learnings for both companies, but findings may be more generalizable.

Interesting research for a company or group of countries may include looking at environmental/safety measures across plants along two dimensions (as examples) - one would be looking at various plant profiles (scale, composition, technique) and resulting environmental/safety performance. The other would be "trickle down" from global to geographic operating group (continent) to business unit and plant. Approximately 2/3 of Coca-Cola's bottling facilities globally are owned by business partners contracted to produce on behalf of the Company. These are large companies in their own right, with their own policies and management approach to environment/sustainability. Some by their nature, location, etc., are more/less progressive on environmental policy, so there is sometimes leading, sometimes lagging that happens within the Company and its global system. The Company has in the past not performed detailed statistical analysis on this dynamic – performance measures are simply consolidated at the country scale, continent scale and global scale. Most public reporting is at the global and continent scale only, though some business partners produce their own public reports for specific geographies.

Perhaps the most interesting future path from a true public policy standpoint would be the further exploration at the city/regional scale. As indicated earlier, there are very few centralized data sources for environmental, social and economic data at the city/regional scale. However, the amount of data available is increasing annually, if not more frequently. Development of city/regional indices such as Siemens' Green City Index will over time provide useful data for rich analysis. Currently, there is limited time coverage of data in this and other similar sources (as described above).

The Green City Index is only partially based on quantitative measures. Siemens and the Economist Intelligence Unit research cities in-depth as part of the analysis for the geography-specific reports for Asia, Africa, Latin America, Europe and the U.S. and Canada. The rating and ranking of cities through the index is a result of this research and the compilation of quantitative indicators like the ones evaluated here. Yale University's Environmental Performance Index for countries is a good example of what could be done at the country scale to compare cities and their environmental and social performance. The EPI work mostly relies on third-party data sources but does include separate research to convert individual indicators into an index. (Indicators such as the ones here feed into sub-components of the EPI).

Ultimately, what policy makers care about (or should care about) is learning which countries and cities are performing better along economic, environmental and social/health dimensions, and emulating the practices that leading countries or cities are using. While the aim of this study was not to get to the level of detail of comparing countries or cities, there are some learnings for future consideration.

Ironically, perhaps one of the key learnings for public policy can come from the manufacturing facility analysis. The water and energy use indicators, key environmental priority areas for the Coca-Cola business, around which the Company has set global system targets along with its bottling partners, demonstrated stronger relationship to both country-scale GDP and the Company's per capita consumption indicator for market maturity than the waste generation and occupational safety and health indicators, for which there are less established targets in place. Perhaps a key learning here is that goals and targets – and focus – lead to improvement. This is not a major earth-shattering revelation. However, this research effort demonstrates quantitatively the importance of focus in affecting the trend. Perhaps this is validation that wealth alone does not improve performance – but there is something else required. Again, this is in itself not a novel result, but quantitative proof of the level to which this is important.

The impacts of the recent economic recession will provide great opportunities for future research. Over the course of most of this study period (and most other studies), country (and city/regional) GDPs have been growing. However, for the first time in a long time, over the last few years substantial parts of the world economy have been shrinking. Depending on how long the current situation exists, study of environmental performance outcomes with declining GDP over time will be a new and different test of all these various relationships. *Will environmental quality improve or degrade with shrinking GDP?*

Based on the robust data available from the World Bank and other sources, there is an unlimited amount of possibilities for exploring relationships between country-scale variables and others, or between country-scale variables and, for example, production facility or company scale variables as data is available. From a Coca-Cola perspective specifically, care should be taken to understand the pace of change within each of the Company's important markets to determine if there are areas where Coca-Cola should invest in environmental, social or business improvements "ahead of the curve."

While the universe of data available at the City/Regional scale is growing, it does not seem to be keeping pace with the level of interest that academic researchers and practitioners alike are putting on the urban environment. Hopefully, new global databases of city/regional indicators will come on-line to enable greater research possibilities – and importantly, peer-to-peer exchange between practitioners trying to manage impacts and realize opportunities.

Siemens and IBM ("Smarter Planet") both have a major focus on building more sustainable urban systems. Applying new technology in the built environment, within transportation systems and across our urban infrastructure will allow for real-time tracking of indicators. Companies and governments will have to balance "information for information's sake" vs. tracking important indicators that really communicate meaningful progress towards sustainability.

Investment from global companies like IBM, Siemens and Coca-Cola may help growing cities manage through existing and future constraints. While the focus for now may be on making today's leading cities "smarter," urban environments on the lower end of the development curve may be in need of more immediate assistance. Hopefully these cities will not need to consume/degrade/etc at levels that the developing country consumed/polluted before turning points were reached.

Carson (2010) challenges academics and the policy community to tackle the problem of “identifying factors that can translate some of the increased income from growth into improved environmental quality.” It would appear based on this analysis that manufacturing scale efficiencies, at least in the Coca-Cola case, are improving in the wealthiest countries, when this is not the case at the country-scale (notably, for water resources, often described as a limit to growth, but frankly, an area that does not have the same international policy focus as climate change). This would indicate that investment is translating into local efficiencies; however, in the case of renewable water resources, they are being depleted in the wealthiest countries. The challenge moving forward will not just be driving improvements, but driving improvements that stay ahead of growth trajectories at all scales.

APPENDIX A:

FULL RESULTS OF COUNTRY-LEVEL REGRESSION MODELS

Table 34. (log) CO_2 Emissions per capita – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)	(6)
	Controlling for Country GDP Only	Controlling for City GDP and Population Density	Controlling for Time and Place Indicators	Controlling for Trade Intensity	Controlling for Time, Place and Institutional Variables	Controlling for Energy Indicators
Country GDP – PPP Adjusted (1,000 2005 International $)	0.23301	0.23387	0.23884	0.24177	0.21220	0.12322
	(7.57)**	(7.62)**	(7.80)**	(8.00)**	(5.72)**	(6.51)**
Country GDP- squared	-0.00590	-0.00595	-0.00609	-0.00617	-0.00503	-0.00306
	(7.18)**	(7.23)**	(7.62)**	(7.73)**	(5.73)**	(5.91)**
Country GDP-cubed	0.00005	0.00005	0.00005	0.00005	0.00004	0.00002
	(6.65)**	(6.69)**	(6.95)**	(6.89)**	(5.56)**	(5.52)**
Population density (people per sq. km of land area)		0.00003	0.00002	0.00001	-0.00002	0.00006
		(1.08)	(0.69)	(0.60)	(0.67)	(1.08)
Year-1991			-0.00177	0.00193		
			(0.13)	(0.14)		
Year-1992			0.07268	0.07650		
			(2.94)**	(3.06)**		
Year-1993			0.05887	0.06193		
			(2.24)*	(2.33)*		
Year-1994			0.03666	0.03957		
			(1.21)	(1.28)		
Year-1995			0.07805	0.07800		
			(1.74)	(1.67)		
Year-1996			0.08689	0.08927	0.06151	0.00666
			(1.86)	(1.83)	(1.68)	(0.20)
Year-1997			0.09116	0.09243		
			(1.91)	(1.85)		
Year-1998			0.05838	0.05986	0.03400	-0.01111
			(1.14)	(1.12)	(1.10)	(0.37)
Year-1999			0.05834	0.06263		
			(1.14)	(1.19)		
Year-2000			0.05539	0.05550	0.03120	-0.02507
			(1.04)	(0.98)	(1.11)	(1.00)
Year-2001			0.07170	0.07196		
			(1.33)	(1.26)		
Year-2002			0.05867	0.05802	0.02874	-0.02636
			(1.07)	(1.01)	(1.08)	(1.42)
Year-2003			0.07969	0.07856	0.04857	-0.00015
			(1.42)	(1.32)	(2.02)*	(0.01)
Year-2004			0.07931	0.07691	0.04928	0.01170
			(1.35)	(1.22)	(2.75)**	(0.79)
Year-2005			0.07079	0.06809	0.04087	0.01235
			(1.16)	(1.03)	(2.81)**	(0.99)
Year-2006			0.04247	0.03914	0.01342	-0.00255
			(0.67)	(0.57)	(1.42)	(0.31)
Year-2007			0.03054	0.02493		
			(0.46)	(0.35)		

Table 34 (continued).

Trade (% of GDP)				0.00031	-0.00025	0.00037
				(0.32)	(0.25)	(0.56)
Political Stability					0.00563	0.03381
					(0.21)	(1.12)
Voice and Accountability					0.03192	0.07804
					(0.72)	(1.61)
Energy imports, net (% of energy use)						0.00015
						(0.53)
Constant	-0.81611	-0.82378	-0.90502	-0.94634	-0.75088	0.12824
	(4.00)**	(4.05)**	(4.61)**	(4.91)**	(3.22)**	(0.67)
Turning Point 1	57.1034	57.19629	56.83206	56.96495	56.01012	55.87354
Turning Point 2	30.20408	29.95194	29.91095	29.84153	33.82252	31.50314
Observations	3095	3095	3095	3019	1529	1136
Number of Countries	180	180	180	176	176	128
R-sq within	0.1897	0.1902	0.1970	0.1983	0.1897	0.1897
R-sq between	0.7139	0.7084	0.7128	0.7173	0.7139	0.7139
R-sq overall	0.6995	0.6943	0.6984	0.7021	0.6995	0.6995
Robust z statistics in parentheses						
* significant at 5%; ** significant at 1%						

Table 35. (log) Energy Usage Per Capita – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)	(6)
	Controlling for Country GDP Only	Controlling for City GDP and Population Density	Controlling for Time and Place Indicators	Controlling for Trade Intensity	Controlling for Time, Place and Institutional Variables	Controlling for Energy Indicators
Country GDP – PPP Adjusted (1,000 2005 International $)	0.11659	0.11709	0.12941	0.13240	0.09311	0.09904
	(8.15)**	(8.17)**	(8.20)**	(8.25)**	(6.30)**	(6.90)**
Country GDP-squared	-0.00256	-0.00259	-0.00277	-0.00283	-0.00180	-0.00194
	(6.72)**	(6.66)**	(6.80)**	(6.80)**	(4.73)**	(5.25)**
Country GDP-cubed	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001
	(5.89)**	(5.80)**	(5.92)**	(5.95)**	(3.94)**	(4.41)**
Population density (people per sq. km of land area)		0.00004	0.00003	0.00003	-0.00007	-0.00011
		(0.67)	(0.61)	(0.55)	(1.72)	(2.92)**
Year-1991			0.04432	0.04922		
			(2.82)**	(2.95)**		
Year-1992			0.03546	0.04640		
			(2.05)*	(2.56)*		
Year-1993			0.02245	0.03297		
			(1.15)	(1.66)		
Year-1994			0.00263	0.01377		
			(0.12)	(0.59)		
Year-1995			0.00233	0.01186		
			(0.10)	(0.50)		
Year-1996			0.01208	0.02069	0.08583	0.09767
			(0.52)	(0.85)	(3.30)**	(3.76)**
Year-1997			0.00383	0.01314		
			(0.16)	(0.52)		
Year-1998			0.00051	0.00969	0.08116	0.09151
			(0.02)	(0.37)	(3.61)**	(4.09)**
Year-1999			-0.00704	0.00286		
			(0.27)	(0.10)		
Year-2000			-0.01413	-0.00492	0.06698	0.07419
			(0.52)	(0.17)	(3.21)**	(3.51)**
Year-2001			-0.01283	-0.00492		
			(0.46)	(0.17)		
Year-2002			-0.01712	-0.00971	0.06876	0.07429
			(0.60)	(0.32)	(3.44)**	(3.69)**
Year-2003			-0.00698	-0.00174	0.07900	0.08163
			(0.24)	(0.06)	(4.09)**	(4.17)**
Year-2004			-0.00299	0.00157	0.07820	0.08324
			(0.09)	(0.05)	(4.06)**	(4.28)**
Year-2005			-0.00665	-0.00159	0.07781	0.07833
			(0.20)	(0.05)	(4.08)**	(4.02)**
Year-2006			-0.01512	-0.01368	0.07078	0.06915
			(0.44)	(0.37)	(3.80)**	(3.67)**
Year-2007			-0.02357	-0.02417	0.06663	0.06285
			(0.66)	(0.63)	(3.63)**	(3.43)**
Year-2008			-0.04660	-0.04860	0.05674	0.05155
			(1.24)	(1.19)	(3.15)**	(2.84)**
Year-2009			-0.09693	-0.09284		
			(2.64)**	(2.37)*		

Table 35 (continued).

Trade (% of GDP)				-0.00005	0.00046	0.00072
				(0.10)	(0.98)	(1.55)
Political Stability					-0.00253	-0.00039
					(0.14)	(0.02)
Voice and Accountability					-0.00136	-0.00039
					(0.05)	(0.01)
Energy imports, net (% of energy use)						0.00049
						(4.56)**
Constant	6.22117	6.21368	6.11992	6.11101	6.26778	6.40298
	(51.52)**	(50.95)**	(47.68)**	(44.21)**	(43.39)**	(46.84)**
Turning Point 1	58.90843	59.12221	57.25748	56.84296	-	-
Turning Point 2	37.16375	36.66272	39.49065	39.80857	-	-
Observations	2608	2608	2608	2541	1402	1295
Number of Countries	162	162	162	159	158	129
R-sq within	0.2590	0.2596	0.2647	0.2714	0.264	0.3173
R-sq between	0.6941	0.6866	0.6919	0.6956	0.7243	0.7830
R-sq overall	0.7254	0.7167	0.7223	0.7305	0.7588	0.7770
Robust z statistics in parentheses						
* significant at 5%; ** significant at 1%						

Table 36. (log) Particulate Matter (PM_{10}) – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)	(6)
	Controlling for Country GDP Only	Controlling for City GDP and Population Density	Controlling for Time and Place Indicators	Controlling for Trade Intensity	Controlling for Time, Place and Institutional Variables	Controlling for Energy Indicators
Country GDP – PPP Adjusted (1,000 2005 International $)	-0.13011	-0.13369	-0.04246	-0.04253	-0.05054	-0.04543
	(10.40)**	(11.12)**	(3.00)**	(2.96)**	(4.74)**	(3.99)**
Country GDP-squared	0.00273	0.00294	0.00143	0.00143	0.00145	0.00132
	(7.15)**	(8.11)**	(4.05)**	(3.97)**	(4.71)**	(4.30)**
Country GDP-cubed	-0.00002	-0.00002	-0.00001	-0.00001	-0.00001	-0.00001
	(6.43)**	(7.41)**	(4.48)**	(4.44)**	(4.79)**	(4.52)**
Population density (people per sq. km of land area)		-0.00037	-0.00017	-0.00019	-0.00004	-0.00007
		(1.87)	(2.67)**	(2.82)**	(0.61)	(0.97)
Year-1991			-0.04049	-0.04101		
			(6.36)**	(6.25)**		
Year-1992			-0.04444	-0.04079		
			(3.07)**	(2.77)**		
Year-1993			-0.07433	-0.07088		
			(5.79)**	(5.35)**		
Year-1994			-0.12311	-0.12028		
			(8.85)**	(8.56)**		
Year-1995			-0.18270	-0.18110		
			(11.11)**	(10.96)**		
Year-1996			-0.22026	-0.21798	0.40162	0.40719
			(11.87)**	(11.62)**	(17.46)**	(14.12)**
Year-1997			-0.26224	-0.26061		
			(13.44)**	(13.16)**		
Year-1998			-0.28153	-0.27957	0.34242	0.35759
			(13.09)**	(12.70)**	(17.58)**	(14.89)**
Year-1999			-0.29554	-0.29195		
			(13.50)**	(13.00)**		
Year-2000			-0.32037	-0.31930	0.30348	0.30181
			(13.89)**	(13.49)**	(16.65)**	(14.19)**
Year-2001			-0.33796	-0.33760		
			(14.08)**	(13.66)**		
Year-2002			-0.37096	-0.36963	0.25578	0.26011
			(15.16)**	(14.64)**	(14.79)**	(13.28)**
Year-2003			-0.40897	-0.40772	0.21805	0.21777
			(16.11)**	(15.51)**	(14.41)**	(12.80)**
Year-2004			-0.47537	-0.47609	0.14987	0.15705
			(17.35)**	(16.64)**	(11.93)**	(11.20)**
Year-2005			-0.51744	-0.51875	0.10762	0.11112
			(18.16)**	(17.34)**	(10.71)**	(10.48)**
Year-2006			-0.55889	-0.56008	0.06731	0.06299
			(18.37)**	(17.28)**	(8.38)**	(7.74)**
Year-2007			-0.60367	-0.60332	0.02507	0.01718
			(18.41)**	(17.24)**	(4.09)**	(2.51)*
Year-2008			-0.63076	-0.62862		
			(18.78)**	(17.61)**		

Table 36 (continued).

Trade (% of GDP)				0.00051	0.00102	0.00151
				(1.41)	(2.74)**	(3.16)**
Political Stability					0.00967	0.02501
					(0.66)	(1.35)
Voice and Accountability					-0.02254	-0.00935
					(0.93)	(0.29)
Energy imports, net (% of energy use)						0.00032
						(2.66)**
Constant	4.66085	4.71410	4.35608	4.30854	3.69143	3.68710
	(56.87)**	(57.34)**	(51.56)**	(49.80)**	(42.56)**	(34.34)**
Turning Point 1	-	-	19.89618	20.13339	24.9701	24.98093
Turning Point 2	-	-	57.70391	56.59853	57.12149	55.95321
Observations	3121	3121	3121	3047	1617	1237
Number of Countries	169	169	169	167	167	126
R-sq within	0.2889	0.3055	0.7061	0.7014	0.2889	0.3055
R-sq between	0.1764	0.1573	0.1162	0.1198	0.1764	0.1573
R-sq overall	0.1904	0.1690	0.1793	0.1762	0.1904	0.1690
Robust z statistics in parentheses						
* significant at 5%; ** significant at 1%						

Table 37. (log) Renewable Water Resources per capita – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)
	Controlling for Country GDP Only	Controlling for City GDP and Population Density	Controlling for Time and Place Indicators	Controlling for Trade Intensity	Controlling for Time, Place and Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	-0.03856	-0.04481	0.01612	0.01542	0.01513
	(4.52)**	(5.12)**	(1.00)	(0.94)	(2.20)*
Country GDP- squared	0.00086	0.00120	0.00009	0.00011	0.00019
	(3.08)**	(4.11)**	(0.25)	(0.29)	(0.61)
Country GDP-cubed	-0.00001	-0.00001	-0.00000	-0.00000	-0.00000
	(2.67)**	(3.78)**	(0.81)	(0.84)	(1.00)
Population density (people per sq. km of land area)		-0.00053	-0.00029	-0.00029	-0.00066
		(2.05)*	(3.00)**	(3.01)**	(3.45)**
Year-1997			-0.08799	-0.08716	
			(13.13)**	(12.53)**	
Year-2002			-0.17566	-0.17487	0.10370
			(13.80)**	(13.54)**	(12.13)**
Year-2007			-0.27994	-0.27787	
			(11.96)**	(11.20)**	
Trade (% of GDP)				0.00005	0.00033
				(0.21)	(1.04)
Political Stability					-0.02945
					(2.51)*
Voice and Accountability					0.01988
					(0.83)
Constant	8.43955	8.52380	8.21831	8.20658	7.95529
	(54.84)**	(56.69)**	(44.48)**	(42.70)**	(47.62)**
Turning Point 1	-	28.76794	-36.35839	-33.39013	-23.72269
Turning Point 2	-	53.81169	63.4608	63.0266	57.46083
Observations	648	648	648	631	317
Number of Countries	167	167	167	164	163
R-sq within	0.0983	0.1567	0.6961	0.6906	0.6562
R-sq between	0.0087	0.0632	0.0127	0.0148	0.0552
R-sq overall	0.0061	0.0609	0.0182	0.0200	0.0554
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 38. (log) Life Expectancy – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)
	Controlling for Country GDP Only	Controlling for City GDP and Population Density	Controlling for Time and Place Indicators	Controlling for Trade Intensity	Controlling for Time, Place and Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	0.01566	0.01614	0.00530	0.00585	0.00135
	(5.31)**	(5.54)**	(2.76)**	(2.93)**	(0.91)
Country GDP-squared	-0.00033	-0.00036	-0.00017	-0.00018	-0.00007
	(4.62)**	(4.97)**	(3.49)**	(3.60)**	(2.00)*
Country GDP-cubed	0.00000	0.00000	0.00000	0.00000	0.00000
	(4.47)**	(4.82)**	(3.54)**	(3.63)**	(2.19)*
Population density (people per sq. km of land area)		0.00001	0.00001	0.00001	0.00001
		(1.48)	(1.88)	(1.90)	(1.95)
Year-1991			0.00215	0.00222	
			(2.51)*	(2.48)*	
Year-1992			0.00378	0.00437	
			(2.38)*	(2.68)**	
Year-1993			0.00526	0.00586	
			(2.65)**	(2.90)**	
Year-1994			0.00753	0.00797	
			(3.44)**	(3.58)**	
Year-1995			0.01021	0.01085	
			(4.22)**	(4.25)**	
Year-1996			0.01384	0.01411	-0.05677
			(4.99)**	(4.81)**	(8.92)**
Year-1997			0.01825	0.01726	
			(5.27)**	(4.62)**	
Year-1998			0.02093	0.02002	-0.05023
			(5.12)**	(4.57)**	(10.24)**
Year-1999			0.02417	0.02356	
			(5.07)**	(4.66)**	
Year-2000			0.02835	0.02779	-0.04176
			(5.24)**	(4.80)**	(11.64)**
Year-2001			0.03261	0.03202	
			(5.54)**	(5.14)**	
Year-2002			0.03628	0.03568	-0.03327
			(5.81)**	(5.44)**	(11.88)**
Year-2003			0.03984	0.03907	-0.02925
			(5.96)**	(5.55)**	(12.15)**
Year-2004			0.04448	0.04344	-0.02412
			(6.28)**	(5.79)**	(12.57)**
Year-2005			0.04815	0.04707	-0.01950
			(6.53)**	(6.03)**	(12.59)**
Year-2006			0.05304	0.05118	-0.01457
			(6.88)**	(6.29)**	(11.94)**
Year-2007			0.05734	0.05500	-0.00974
			(7.18)**	(6.48)**	(10.60)**
Year-2008			0.06174	0.05897	-0.00499
			(7.64)**	(6.76)**	(6.64)**
Year-2009			0.06676	0.06408	
			(8.50)**	(7.59)**	

Table 38 (continued).

Trade (% of GDP)				0.00002	0.00002
				(0.27)	(0.27)
Political Stability					0.01062
					(1.73)
Voice and Accountability					0.01524
					(2.49)*
Constant	4.08702	4.08330	4.12920	4.12464	4.22155
	(221.15)**	(222.10)**	(280.10)**	(254.24)**	(245.87)**
Turning Point 1	-	47.94142	59.13939	59.55051	66.87136
Turning Point 2	-	41.61654	20.76899	21.98871	11.4093
Observations	3463	3463	3463	3325	1826
Number of Countries	183	183	183	179	177
R-sq within	0.0902	0.0932	0.3057	0.2898	0.444
R-sq between	0.5150	0.5031	0.3258	0.3736	0.2893
R-sq overall	0.4944	0.4815	0.2461	0.2931	0.2483
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 39. (log) Biological Oxygen Demand per Renewable Water Resources – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)
	Controlling for Country GDP Only	Controlling for City GDP and Population Density	Controlling for Time and Place Indicators	Controlling for Trade Intensity	Controlling for Time, Place and Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	-0.01023	0.00283	0.03288	0.03423	0.15293
	(0.49)	(0.12)	(1.11)	(1.16)	(2.84)**
Country GDP- squared	0.00082	0.00026	-0.00002	-0.00006	-0.00596
	(1.32)	(0.33)	(0.03)	(0.07)	(2.61)**
Country GDP-cubed	-0.00001	-0.00000	-0.00000	-0.00000	0.00006
	(1.72)	(0.71)	(0.53)	(0.50)	(2.36)*
Population density (people per sq. km of land area)		0.00022	0.00022	0.00021	0.00051
		(2.89)**	(2.54)*	(2.33)*	(2.20)*
Year-1997			-0.12915	-0.13457	
			(1.52)	(1.53)	
Year-2002			-0.19312	-0.20006	0.12458
			(1.86)	(1.89)	(1.59)
Year-2007			-0.29135	-0.30152	
			(2.02)*	(2.05)*	
Trade (% of GDP)				0.00038	0.00529
				(0.33)	(2.23)*
Political Stability					0.09539
					(0.55)
Voice and Accountability					-0.03946
					(0.21)
Constant	-7.50428	-7.58903	-7.74489	-7.77880	-8.94088
	(26.76)**	(26.31)**	(25.38)**	(25.37)**	(20.67)**
Turning Point 1	7.208112	-4.860989	-54.8014	-60.83903	46.12984
Turning Point 2	47.8037	39.99426	50.95889	50.25036	17.77603
Observations	182	182	182	182	103
Number of Countries	85	85	85	85	75
R-sq within	0.0175	0.0091	0.0491	0.0475	0.1467
R-sq between	0.0297	0.1037	0.1462	0.1503	0.2935
R-sq overall	0.0070	0.1206	0.0968	0.1013	0.2693
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 40. (log) Access to Improved Sanitation Systems – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)
	Controlling for Country GDP Only	Controlling for City GDP and Population Density	Controlling for Time and Place Indicators	Controlling for Trade Intensity	Controlling for Time, Place and Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	0.06828	0.06949	0.03938	0.03928	0.04002
	(7.82)**	(7.94)**	(5.61)**	(5.68)**	(5.38)**
Country GDP-squared	-0.00181	-0.00190	-0.00139	-0.00141	-0.00115
	(7.05)**	(7.19)**	(6.16)**	(6.61)**	(5.16)**
Country GDP-cubed	0.00001	0.00001	0.00001	0.00001	0.00001
	(6.26)**	(6.42)**	(5.70)**	(6.18)**	(4.70)**
Population density (people per sq. km of land area)		0.00017	0.00013	0.00012	0.00011
		(1.80)	(2.61)**	(2.16)*	(1.85)
Year-1990			-0.18414	-0.17417	
			(6.27)**	(5.77)**	
Year-1995			-0.11808	-0.10657	
			(5.57)**	(4.83)**	
Year-2000			-0.06240	-0.05335	-0.04648
			(4.80)**	(3.80)**	(3.66)**
Year-2002			-0.11580	-0.10747	-0.07064
			(2.12)*	(1.76)	(0.99)
Year-2004			-0.12041	-0.11448	-0.07253
			(2.21)*	(1.91)	(1.10)
Year-2005			-0.01908	-0.01601	-0.01202
			(3.38)**	(2.29)*	(2.05)*
Trade (% of GDP)				0.00066	0.00049
				(1.89)	(1.79)
Political Stability					0.01021
					(0.58)
Voice and Accountability					0.03561
					(1.51)
Constant	3.68125	3.66034	3.93766	3.88915	3.85996
	(47.93)**	(46.80)**	(57.34)**	(48.21)**	(47.75)**
Turning Point 1	59.05399	59.83696	62.65445	64.42753	68.46595
Turning Point 2	27.80401	26.24372	18.33348	17.84716	23.2385
Observations	803	803	803	767	486
Number of Countries	173	173	173	169	168
R-sq within	0.0395	0.0483	0.2835	0.2929	0.1598
R-sq between	0.4918	0.4704	0.3643	0.3410	0.4382
R-sq overall	0.4746	0.4530	0.3168	0.3084	0.4243
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 41. (log) Access to Improved Water Sources – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)
	Controlling for Country GDP Only	Controlling for City GDP and Population Density	Controlling for Time and Place Indicators	Controlling for Trade Intensity	Controlling for Time, Place and Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	0.03661	0.03709	0.02329	0.02351	0.01988
	(8.78)**	(8.91)**	(6.27)**	(6.37)**	(4.80)**
Country GDP-squared	-0.00099	-0.00102	-0.00079	-0.00081	-0.00057
	(7.57)**	(7.71)**	(6.21)**	(6.62)**	(4.87)**
Country GDP-cubed	0.00001	0.00001	0.00001	0.00001	0.00000
	(6.60)**	(6.74)**	(5.61)**	(6.04)**	(4.47)**
Population density (people per sq. km of land area)		0.00006	0.00005	0.00004	0.00005
		(1.73)	(3.06)**	(2.45)*	(2.24)*
Year-1990			-0.11316	-0.10765	
			(7.01)**	(6.77)**	
Year-1995			-0.07291	-0.06487	
			(6.65)**	(5.94)**	
Year-2000			-0.04042	-0.03350	-0.03512
			(5.90)**	(4.78)**	(4.77)**
Year-2002			-0.05943	-0.05288	-0.04416
			(3.18)**	(2.54)*	(2.07)*
Year-2004			-0.04568	-0.03858	-0.02743
			(4.49)**	(3.64)**	(2.25)*
Year-2005			-0.01263	-0.00692	-0.00868
			(4.02)**	(1.77)	(2.61)**
Trade (% of GDP)				0.00021	0.00000
				(0.98)	(0.01)
Political Stability					0.00235
					(0.26)
Voice and Accountability					0.01327
					(1.06)
Constant	4.18889	4.18103	4.32381	4.30040	4.31843
	(136.51)**	(134.11)**	(153.79)**	(121.14)**	(109.24)**
Turning Point 1	58.87899	59.31217	62.15207	63.32284	69.01608
Turning Point 2	27.10845	26.08288	19.18246	18.96622	23.5812
Observations	811	811	811	775	486
Number of Countries	175	175	175	171	170
R-sq within	0.0524	0.0573	0.3207	0.3269	0.2503
R-sq between	0.4499	0.4494	0.3855	0.3734	0.4243
R-sq overall	0.4466	0.4446	0.3745	0.3708	0.4253
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

APPENDIX B

FULL RESULTS OF CITY/REGIONAL-LEVEL REGRESSION MODELS

Table 42. (log) Particulate Matter (PM_{10}) – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)
	Controlling for Country GDP Only	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	-0.07063	-0.06869	-0.05504	-0.11460
	(4.20)**	(3.83)**	(2.47)*	(4.95)**
Country GDP- squared	0.00146	0.00130	0.00088	0.00457
	(1.85)	(1.51)	(0.82)	(4.14)**
Country GDP-cubed	-0.00001	-0.00001	-0.00001	-0.00005
	(1.46)	(1.10)	(0.47)	(3.46)**
Population Density (people per sq km)		-0.00002	-0.00000	0.00002
		(2.27)*	(0.45)	(2.35)*
Coastal		-0.12376	-0.13031	-0.14733
		(1.27)	(1.40)	(1.94)
Year-2001			-0.02542	
			(1.14)	
Year-2002			-0.05904	-0.11752
			(2.73)**	(3.12)**
Year-2003			-0.01876	-0.04812
			(0.65)	(1.09)
Year-2004			-0.08926	-0.09008
			(3.83)**	(2.43)*
Year-2005			-0.02780	-0.01116
			(1.02)	(0.25)
Year-2006			-0.05236	-0.10087
			(1.70)	(2.58)**
Year-2007			-0.00764	-0.05039
			(0.22)	(1.17)
Year-2008			-0.12763	-0.20499
			(4.44)**	(5.91)**
Year-2009			-0.17285	-0.19257
			(5.55)**	(4.73)**
Control of Corruption				0.19442
				(3.22)**
Political Stability				0.03666
				(0.79)
Voice and Accountability				-0.35621
				(4.93)**
Constant	-2.00361	-1.85429	-1.99280	-2.24319
	(25.24)**	(17.29)**	(17.60)**	(11.88)**
Turning Point 1	-	-	-	18.46467
Turning Point 2	-	-	-	39.04479
Observations	1117	1097	1097	734
Number of Cities/Regions	113	109	109	109
R-sq within	0.2967	0.2988	0.3279	0.1998
R-sq between	0.3974	0.3769	0.4286	0.6354
R-sq overall	0.2806	0.2765	0.3101	0.5201
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

Table 43. (log) Particulate Matter (PM_{10}) – City/Regional GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)
	Controlling for City GDP Only	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
City GDP – PPP Adjusted (1,000 2005 International $)	-0.06395	-0.06272	-0.07681	-0.00460
	(2.98)**	(2.91)**	(4.68)**	(0.25)
City GDP- squared	0.00156	0.00153	0.00177	0.00063
	(3.28)**	(3.20)**	(4.52)**	(1.34)
City GDP-cubed	-0.00001	-0.00001	-0.00001	-0.00001
	(3.52)**	(3.42)**	(4.40)**	(1.87)
Population Density (people per sq km)		-0.00004	-0.00001	-0.00010
		(1.29)	(0.28)	(2.48)*
Coastal		-0.04991	-0.06631	-0.02098
		(0.37)	(0.51)	(0.23)
Year-2001			0.15988	
			(3.68)**	
Year-2002			0.10658	0.30185
			(2.56)*	(2.01)*
Year-2003			0.13976	0.24644
			(2.80)**	(3.10)**
Year-2004			0.03882	0.13084
			(1.00)	(1.81)
Year-2005			0.13260	0.14090
			(3.40)**	(2.15)*
Year-2006			0.06422	0.04496
			(1.42)	(0.77)
Year-2007			0.13202	0.09289
			(3.00)**	(1.79)
Year-2008			-0.02005	0.02171
			(0.54)	(0.24)
Year-2009			-0.11137	-0.11559
			(2.44)*	(2.52)*
Control of Corruption				-0.15692
				(0.69)
Political Stability				-0.16529
				(1.28)
Voice and Accountability				-0.37817
				(1.75)
Constant	-2.31607	-2.27558	-2.08037	-2.86590
	(7.35)**	(6.97)**	(7.74)**	(12.50)**
Observations	397	396	396	351
Number of group(cityregion)	48	48	48	48
Turn 1	30,697	30,727	33,736	3,882
Turn 2	61,454	61,454	60,634	63,490
Quadratic turn	N/A	N/A	N/A	N/A
R-sq within	0.0134	0.0178	0.2717	0.2810
R-sq between	0.2420	0.2413	0.2277	0.7025
R-sq overall	0.1610	0.1418	0.2306	0.4414
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

Table 44. (log) Particulate Matter (PM_{10}) – Country and City/Regional GDP Used as Economic Indicators

	(1)	(2)	(3)	(4)	(5)
	Controlling for City GDP Only	Controlling for City and Country GDP	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
City GDP – PPP Adjusted (1,000 2005 International $)	-0.06395	0.01839	0.02007	-0.00814	-0.00356
	(2.98)**	(0.93)	(1.03)	(0.37)	(0.20)
City GDP- squared	0.00156	-0.00002	-0.00006	0.00016	0.00031
	(3.28)**	(0.03)	(0.12)	(0.34)	(0.66)
City GDP-cubed	-0.00001	-0.00000	-0.00000	-0.00000	-0.00000
	(3.52)**	(0.53)	(0.45)	(0.48)	(0.92)
Country GDP – PPP Adjusted (1,000 2005 International $)		-0.30569	-0.28875	-0.07099	-0.03002
		(5.77)**	(5.54)**	(1.05)	(0.50)
Country GDP- squared		0.01076	0.00981	-0.00032	0.00096
		(4.85)**	(4.44)**	(0.10)	(0.38)
Country GDP-cubed		-0.00012	-0.00010	0.00003	-0.00000
		(4.44)**	(3.97)**	(0.83)	(0.01)
Population Density (people per sq km)			-0.00008	-0.00001	-0.00004
			(1.19)	(0.17)	(1.66)
Coastal			-0.06833	-0.06990	-0.04642
			(0.73)	(0.80)	(0.55)
Year-2001				0.30988	0.33140
				(3.45)**	(2.36)*
Year-2002				0.28521	0.29516
				(3.71)**	(2.92)**
Year-2003				0.12390	0.15942
				(2.55)*	(1.64)
Year-2004				0.14542	0.17119
				(3.59)**	(2.32)*
Year-2005				0.02036	0.00967
				(0.41)	(0.19)
Year-2006				0.05548	0.04436
				(1.00)	(0.89)
Year-2007				-0.03610	-0.04573
				(0.89)	(0.76)
Year-2008				-0.03743	-0.06695
				(0.67)	(1.24)
Year-2009				0.37549	0.00000
				(3.87)**	(.)

Table 44 (continued).

Control of Corruption					-0.00071
					(0.00)
Political Stability					-0.11014
					(1.53)
Voice and Accountability					-0.53548
					(2.93)**
Constant	-2.31607	-1.26925	-1.15171	-1.89465	-2.98041
	(7.35)**	(5.83)**	(4.54)**	(6.52)**	(6.26)**
Turning Point 1-City	30.69656	-62.32726	-81.38955	-	6.281748
Turning Point 2-City	61.4513	56.53108	56.1562	-	59.17611
Turning Point 1-Country		21.91683	23.20014	29.48417	15.6915
Turning Point 2-Country		40.4211	40.22528	-23.2795	1828.71
Observations	397	397	396	396	351
Number of Cities/Regions	48	48	48	48	48
R-sq within	0.0134	0.0180	0.0252	0.2403	0.2795
R-sq between	0.2420	0.6363	0.6513	0.7285	0.7732
R-sq overall	0.1610	0.3997	0.4111	0.5234	0.5190
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 45. (log) Sulfur Dioxide (SO_2) – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)
	Controlling for Country GDP Only	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	-0.01994	0.01620	0.03265	0.02709
	(0.47)	(0.36)	(0.64)	(0.40)
Country GDP- squared	0.00525	0.00253	0.00270	-0.00147
	(2.72)**	(1.21)	(1.11)	(0.38)
Country GDP-cubed	-0.00010	-0.00006	-0.00007	0.00001
	(4.04)**	(2.26)*	(2.22)*	(0.19)
Population Density (people per sq km)		-0.00008	-0.00007	-0.00004
		(5.06)**	(3.64)**	(1.43)
Coastal		0.09655	0.07060	0.04797
		(0.56)	(0.41)	(0.26)
Year-2001			0.12362	
			(2.12)*	
Year-2002			-0.00987	-0.17892
			(0.19)	(2.05)*
Year-2003			0.05662	0.09585
			(0.95)	(1.10)
Year-2004			0.10395	0.13823
			(1.67)	(1.69)
Year-2005			0.22430	0.38994
			(4.26)**	(5.09)**
Year-2006			0.20477	0.27674
			(3.54)**	(4.37)**
Year-2007			0.20185	0.29654
			(3.06)**	(4.35)**
Year-2008			0.05329	0.01249
			(0.96)	(0.23)
Year-2009			-0.15772	0.05085
			(3.16)**	(0.80)
Control of Corruption				0.81838
				(5.66)**
Political Stability				0.31491
				(3.67)**
Voice and Accountability				-0.10268
				(0.64)
Constant	-3.26404	-2.88345	-3.19320	-2.90328
	(15.44)**	(10.71)**	(10.47)**	(8.27)**
Turning Point 1	2.01998	-2.887599	-5.03506	90.74037
Turning Point 2	32.16844	29.64606	29.8977	10.26476
Observations	956	942	942	628
Number of Cities/Regions	71	69	69	69
R-sq within	0.3013	0.3164	0.3580	0.3313
R-sq between	0.4381	0.5288	0.5379	0.4606
R-sq overall	0.3829	0.4509	0.4588	0.3864
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

Table 46. (log) Sulfur Dioxide (SO_2) – City/Regional GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)
	Controlling for City GDP Only	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
City GDP – PPP Adjusted (1,000 2005 International $)	0.01852	0.02945	0.03587	0.00163
	(0.38)	(0.54)	(0.85)	(0.04)
City GDP- squared	-0.00038	-0.00075	-0.00084	0.00031
	(0.23)	(0.43)	(0.65)	(0.24)
City GDP-cubed	-0.00000	0.00000	0.00001	-0.00000
	(0.07)	(0.14)	(0.53)	(0.33)
Population Density (people per sq km)		-0.00015	-0.00002	0.00003
		(1.85)	(0.44)	(0.86)
Coastal		0.36702	0.33708	0.31796
		(1.01)	(1.02)	(0.96)
Year-2001			0.70792	
			(4.57)**	
Year-2002			0.57796	0.71916
			(5.18)**	(2.79)**
Year-2003			0.57069	0.62328
			(5.49)**	(4.37)**
Year-2004			0.53384	0.55589
			(6.37)**	(4.70)**
Year-2005			0.52404	0.48553
			(7.75)**	(4.53)**
Year-2006			0.41033	0.43486
			(5.93)**	(5.50)**
Year-2007			0.35548	0.37118
			(5.09)**	(5.06)**
Year-2008			0.22178	0.30425
			(3.64)**	(2.23)*
Year-2009			0.08588	0.08810
			(1.26)	(1.21)
Control of Corruption				-0.22572
				(0.59)
Political Stability				-0.10222
				(0.52)
Voice and Accountability				0.27645
				(0.73)
Constant	-2.28782	-2.52493	-3.42256	-3.34228
	(6.42)**	(4.38)**	(6.30)**	(4.00)**
Observations	339	339	339	307
Number of group(cityregion)	36	36	36	36
Turn 1	-278,836	217,945	66,116	-2,509
Turn 2	22,217	21,718	31,330	59,148
Quadratic turn	N/A	N/A	N/A	N/A
R-sq within	0.0508	0.0526	0.4133	0.4558
R-sq between	0.0000	0.0213	0.0445	0.0476
R-sq overall	0.0024	0.0319	0.0994	0.0889
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

Table 47. (log) Sulfur Dioxide (SO_2) – Country and City/Regional GDP Used as Economic Indicators

	(1)	(2)	(3)	(4)	(5)
	Controlling for City GDP Only	Controlling for City and Country GDP	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
City GDP – PPP Adjusted (1,000 2005 International $)	0.01852	-0.06665	-0.05418	-0.04159	-0.00540
	(0.38)	(0.63)	(0.53)	(0.55)	(0.07)
City GDP- squared	-0.00038	0.00174	0.00147	0.00044	0.00046
	(0.23)	(0.80)	(0.69)	(0.28)	(0.27)
City GDP-cubed	-0.00000	-0.00001	-0.00001	-0.00000	-0.00000
	(0.07)	(0.85)	(0.75)	(0.12)	(0.35)
Country GDP – PPP Adjusted (1,000 2005 International $)		-0.04224	-0.02964	0.10034	-0.14434
		(0.19)	(0.12)	(0.83)	(0.37)
Country GDP- squared		0.00508	0.00423	-0.00224	0.00790
		(0.64)	(0.48)	(0.41)	(0.33)
Country GDP-cubed		-0.00009	-0.00008	0.00002	-0.00011
		(1.09)	(0.84)	(0.24)	(0.35)
Population Density (people per sq km)			-0.00007	0.00002	0.00002
			(0.79)	(0.87)	(0.69)
Coastal			0.32500	0.33045	0.31783
			(1.03)	(0.96)	(0.95)
Year-2001				0.73006	
				(3.11)**	
Year-2002				0.60166	0.72895
				(3.02)**	(1.64)
Year-2003				0.58735	0.54120
				(3.65)**	(3.65)**
Year-2004				0.54586	0.50741
				(5.23)**	(3.17)**
Year-2005				0.53644	0.41085
				(7.98)**	(3.27)**
Year-2006				0.41511	0.53888
				(4.60)**	(3.71)**
Year-2007				0.35586	0.50325
				(2.91)**	(3.19)**
Year-2008				0.22107	0.49954
				(2.45)*	(1.44)
Year-2009				0.09388	-0.00323
				(1.11)	(0.01)

Table 47 (continued).

Control of Corruption					-0.59105
					(0.66)
Political Stability					-0.29505
					(0.54)
Voice and Accountability					0.64453
					(1.06)
Constant	-2.28782	-2.01746	-2.28332	-3.52421	-2.51536
	(6.42)**	(5.53)**	(4.39)**	(5.41)**	(2.33)*
Turning Point 1 – City	-278.8362	28.73371	26.94759	71.4337	6.528957
Turning Point 2 – City	22.21682	57.91113	57.70164	143.445	59.64169
Turning Point 1 – Country		4.78146	3.951995		12.55508
Turning Point 2 – Country		32.02715	30.9614		33.59182
Observations	339	339	339	339	307
Number of Cities/Regions	36	36	36	36	36
R-sq within	0.0508	0.1438	0.1438	0.4171	0.4561
R-sq between	0.0000	0.0296	0.0673	0.0431	0.0480
R-sq overall	0.0024	0.0318	0.0740	0.0889	0.0891
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 48. (log) Nitrogen Dioxide (NO_2) – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)
	Controlling for Country GDP Only	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	0.04301	0.07507	0.07382	0.04603
	(2.05)*	(2.96)**	(3.28)**	(1.26)
Country GDP- squared	-0.00081	-0.00208	-0.00155	0.00223
	(0.79)	(1.68)	(1.40)	(1.64)
Country GDP-cubed	0.00000	0.00002	0.00001	-0.00004
	(0.09)	(0.99)	(0.73)	(2.65)**
Population Density (people per sq km)		-0.00007	-0.00002	-0.00004
		(3.70)**	(1.14)	(1.57)
Coastal		0.02693	-0.01415	-0.05411
		(0.13)	(0.08)	(0.35)
Year-2001			-0.13721	
			(6.03)**	
Year-2002			-0.02043	-0.06644
			(1.00)	(1.70)
Year-2003			-0.08057	-0.07107
			(3.32)**	(3.12)**
Year-2004			-0.16665	-0.09172
			(5.91)**	(3.44)**
Year-2005			-0.13724	-0.04279
			(4.61)**	(1.07)
Year-2006			-0.12441	-0.18151
			(3.91)**	(5.36)**
Year-2007			-0.13334	-0.18440
			(4.18)**	(4.37)**
Year-2008			-0.25109	-0.35335
			(8.64)**	(10.08)**
Year-2009			-0.23355	-0.26175
			(8.62)**	(6.22)**
Control of Corruption				0.24450
				(3.15)**
Political Stability				0.13138
				(3.55)**
Voice and Accountability				-0.71170
				(5.42)**
Constant	-3.18007	-3.21663	-3.38063	-4.07540
	(21.91)**	(18.33)**	(19.35)**	(16.58)**
Turning Point 1	431.4781	59.80279		-8.28966
Turning Point 2	28.18814	25.89052		42.33324
Observations	888	864	864	589
Number of Cities/Regions	94	90	90	90
R-sq within	0.1191	0.1214	0.1647	0.0502
R-sq between	0.0704	0.1328	0.2845	0.5489
R-sq overall	0.2736	0.3902	0.5555	0.7618
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

Table 49. (log) Nitrogen Dioxide (NO_2) – City/Regional GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)
	Controlling for City GDP Only	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
City GDP – PPP Adjusted (1,000 2005 International $)	-0.03336	-0.02762	0.00840	0.03370
	(2.14)*	(1.39)	(0.29)	(0.69)
City GDP- squared	0.00098	0.00083	0.00068	0.00108
	(2.40)*	(1.67)	(0.89)	(0.82)
City GDP-cubed	-0.00001	-0.00001	-0.00001	-0.00002
	(2.51)*	(1.84)	(1.51)	(1.45)
Population Density (people per sq km)		-0.00006	-0.00029	-0.00020
		(1.35)	(2.23)*	(1.48)
Coastal		-0.11129	-0.05074	-0.13207
		(0.34)	(0.19)	(0.87)
Year-2001			0.02544	
			(0.56)	
Year-2002			0.20007	0.51442
			(5.31)**	(1.62)
Year-2003			0.12555	0.22836
			(3.56)**	(1.41)
Year-2004			0.05918	0.04152
			(1.25)	(0.25)
Year-2005			0.09194	-0.04569
			(3.00)**	(0.41)
Year-2006			0.10530	0.08265
			(3.35)**	(1.22)
Year-2007			0.08447	0.01970
			(2.69)**	(0.33)
Year-2008			0.03709	0.10390
			(0.91)	(0.64)
Year-2009			-0.00870	-0.04919
			(0.27)	(1.79)
Control of Corruption				-0.43723
				(0.88)
Political Stability				-0.37159
				(1.65)
Voice and Accountability				0.13577
				(0.29)
Constant	-1.65023	-1.59383	-2.53266	-3.17651
	(9.38)**	(6.46)**	(6.98)**	(6.36)**
Observations	297	296	296	261
Number of group(cityregion)	38	38	38	38
Turn 1	24,550	23,863	-5,533	-12,370
Turn 2	55,315	54,686	56,525	60,415
Quadratic Turn	N/A	N/A	N/A	N/A
R-sq within	0.0370	0.0347	0.1042	0.2026
R-sq between	0.1760	0.2859	0.5867	0.8320
R-sq overall	0.0582	0.2137	0.5919	0.7554
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

Table 50. (log) Nitrogen Dioxide (NO_2)– Country and City/Regional GDP Used as Economic Indicators

	(1)	(2)	(3)	(4)	(5)
	Controlling for City GDP Only	Controlling for City and Country GDP	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
City GDP – PPP Adjusted (1,000 2005 International $)	-0.03336	0.09161	0.09130	0.02426	0.01495
	(2.14)*	(3.18)**	(2.81)**	(0.67)	(0.96)
City GDP- squared	0.00098	-0.00145	-0.00139	-0.00068	-0.00006
	(2.40)*	(2.08)*	(1.78)	(0.93)	(0.18)
City GDP-cubed	-0.00001	0.00001	0.00001	0.00000	-0.00000
	(2.51)*	(1.40)	(1.13)	(0.93)	(0.47)
Country GDP – PPP Adjusted (1,000 2005 International $)		-0.64957	-0.70372	-0.18938	0.09281
		(6.97)**	(7.01)**	(2.46)*	(1.36)
Country GDP- squared		0.02822	0.03034	0.00577	0.00409
		(7.17)**	(7.11)**	(1.56)	(1.16)
Country GDP-cubed		-0.00033	-0.00035	-0.00001	-0.00006
		(7.12)**	(6.99)**	(0.26)	(1.15)
Population Density (people per sq km)			0.00001	0.00012	0.00002
			(0.13)	(0.86)	(1.12)
Coastal			-0.21766	-0.16960	-0.16100
			(1.65)	(1.86)	(3.48)**
Year-2001				0.70837	
				(5.28)**	
Year-2002				0.73520	1.05089
				(6.02)**	(7.31)**
Year-2003				0.48259	0.69477
				(4.75)**	(7.92)**
Year-2004				0.25891	0.57237
				(4.93)**	(5.44)**
Year-2005				0.13392	0.36564
				(6.59)**	(5.13)**
Year-2006				-0.00444	-0.04637
				(0.11)	(1.45)
Year-2007				-0.10075	-0.13382
				(1.56)	(3.47)**
Year-2008				-0.07582	-0.09384
				(1.96)	(1.74)
Year-2009				0.16629	-0.00661
				(3.66)**	(0.15)

Table 50 (continued).

Control of Corruption					-0.37637
					(1.96)
Political Stability					-0.12081
					(1.94)
Voice and Accountability					-1.44629
					(6.08)**
Constant	-1.65023	-1.56964	-1.21237	-2.78162	-6.27446
	(9.38)**	(4.74)**	(2.91)**	(8.81)**	(13.16)**
Turning Point 1 – City	24.54975	82.82587	90.10728	76.9481	-86.88122
Turning Point 2 – City	55.31518	51.32901	51.50005	23.20131	52.35044
Turning Point 1 – Country		15.87844	16.02187	17.48322	-9.417051
Turning Point 2 – Country		41.83596	41.97147	263.967	55.46547
Observations	297	297	296	296	261
Number of Cities/Regions	38	38	38	38	38
R-sq within	0.0370	0.0589	0.0536	0.2727	0.3836
R-sq between	0.1760	0.8394	0.8717	0.9413	0.9821
R-sq overall	0.0582	0.8276	0.8465	0.9195	0.9659
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 51. (log) Water Usage – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)
	Controlling for Country GDP Only	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	-0.06418	-0.07086	0.03900	0.01478
	(4.21)**	(3.48)**	(1.09)	(0.33)
Country GDP- squared	0.00364	0.00411	-0.00206	0.00139
	(3.02)**	(2.70)**	(0.91)	(0.61)
Country GDP-cubed	-0.00006	-0.00006	0.00003	-0.00003
	(2.30)*	(2.22)*	(0.92)	(0.63)
Population Density (people per sq km)		0.00000	0.00002	0.00001
		(0.14)	(1.24)	(1.18)
Coastal		0.09488	0.05779	-0.05070
		(1.11)	(0.72)	(0.45)
Year-2001			-0.05697	
			(1.71)	
Year-2002			-0.02861	-0.08199
			(1.28)	(1.18)
Year-2003			-0.02739	-0.07126
			(0.75)	(1.25)
Year-2004			-0.08363	-0.16318
			(1.74)	(2.23)*
Year-2005			-0.08107	-0.20384
			(1.48)	(2.19)*
Year-2006			-0.15992	-0.22464
			(2.28)*	(2.02)*
Year-2007			-0.27483	-0.37859
			(4.10)**	(2.87)**
Year-2008			-0.25081	-0.33401
			(3.53)**	(2.55)*
Year-2009			-0.32182	-0.40179
			(4.12)**	(2.78)**
Control of Corruption				-0.36271
				(3.16)**
Political Stability				0.00132
				(0.02)
Voice and Accountability				0.01918
				(0.17)
Constant	4.57104	4.52368	4.26557	4.19488
	(81.79)**	(73.20)**	(54.01)**	(19.65)**
Turning Point 1	12.20874	11.98283	24.27413	-4.720207
Turning Point 2	31.83769	30.76943	15.48646	41.6364
Observations	525	494	494	332
Number of Cities/Regions	102	98	98	55
R-sq within	0.1274	0.1482	0.2272	0.3146
R-sq between	0.0312	0.0019	0.1267	0.1788
R-sq overall	0.0014	0.0064	0.0870	0.1128
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

Table 52. (log) Water Usage – City/Regional GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)
	Controlling for City GDP Only	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
City GDP – PPP Adjusted (1,000 2005 International $)	-0.03470	-0.03228	0.00048	-0.00801
	(3.71)**	(2.89)**	(0.03)	(0.20)
City GDP- squared	0.00068	0.00053	-0.00059	-0.00049
	(2.15)*	(1.51)	(1.10)	(0.20)
City GDP-cubed	-0.00000	-0.00000	0.00001	0.00001
	(1.30)	(0.71)	(1.63)	(0.18)
Population Density (people per sq km)		-0.00001	0.00001	0.00001
		(0.67)	(0.94)	(0.77)
Coastal		0.09533	0.00417	-0.08063
		(0.64)	(0.03)	(0.55)
Year-2001			0.03653	
			(1.57)	
Year-2002			0.02323	0.04501
			(0.78)	(1.05)
Year-2003			0.01760	0.05006
			(0.50)	(0.62)
Year-2004			-0.00567	0.03426
			(0.12)	(0.34)
Year-2005			-0.06452	-0.00615
			(1.13)	(0.07)
Year-2006			-0.16262	-0.08643
			(3.07)**	(0.82)
Year-2007			-0.16380	-0.09642
			(3.25)**	(1.03)
Control of Corruption				0.02214
				(0.09)
Political Stability				-0.10564
				(1.10)
Voice and Accountability				0.13440
				(0.73)
Constant	4.47613	4.43985	4.33199	4.47121
	(67.56)**	(65.10)**	(64.08)**	(24.29)**
Observations	370	365	365	268
Number of group(cityregion)	40	37	37	37
Turn 1	38,684	41,838	50,888	48,113
Turn 2	76,426	111,503	408	-6,988
Quadratic Turn	N/A	N/A	N/A	N/A
R-sq within	0.1791	0.1830	0.2835	0.3101
R-sq between	0.0002	0.0025	0.0023	0.0068
R-sq overall	0.0023	0.0008	0.0359	0.0330
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

Table 53. (log) Water Usage – Country and City/Regional GDP Used as Economic Indicators

	(1)	(2)	(3)	(4)	(5)
	Controlling for City GDP Only	Controlling for City and Country GDP	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
City GDP – PPP Adjusted (1,000 2005 International $)	-0.03470	-0.02361	-0.01941	-0.02098	-0.02486
	(3.71)**	(1.03)	(0.82)	(0.94)	(0.61)
City GDP- squared	0.00068	0.00013	-0.00006	-0.00016	0.00025
	(2.15)*	(0.19)	(0.10)	(0.25)	(0.10)
City GDP-cubed	-0.00000	0.00000	0.00000	0.00000	-0.00001
	(1.30)	(0.28)	(0.63)	(0.89)	(0.22)
Country GDP – PPP Adjusted (1,000 2005 International $)		-0.04821	-0.05170	0.09229	0.06081
		(1.72)	(1.68)	(1.68)	(1.32)
Country GDP- squared		0.00539	0.00541	-0.00348	0.00506
		(3.27)**	(2.98)**	(0.92)	(1.85)
Country GDP-cubed		-0.00012	-0.00011	0.00004	-0.00013
		(3.34)**	(3.09)**	(0.60)	(2.62)**
Population Density (people per sq km)			-0.00000	0.00001	0.00001
			(0.19)	(0.53)	(0.47)
Coastal			-0.01037	-0.07905	0.02820
			(0.07)	(0.54)	(0.16)
Year-2001				0.01053	
				(0.37)	
Year-2003				-0.02821	-0.19462
				(0.66)	(2.08)*
Year-2004				-0.05610	-0.32888
				(1.10)	(2.37)*
Year-2005				-0.08733	-0.43634
				(1.28)	(2.43)*
Year-2006				-0.16204	-0.42167
				(1.88)	(2.36)*
Year-2007				-0.28919	-0.65238
				(2.75)**	(2.87)**
Year-2008				-0.30764	-0.57875
				(2.76)**	(2.88)**
Control of Corruption					-0.77720
					(2.85)**
Political Stability					-0.00138
					(0.02)
Voice and Accountability					-0.06955
					(0.36)
Constant	4.47613	4.50018	4.48117	4.15935	3.90012
	(67.56)**	(62.35)**	(59.73)**	(33.50)**	(12.10)**
Turning Point 1 – City	38.68369	49.40928	49.38141	52.18881	-
Turning Point 2 – City	76.42587	-104.5995	-37.11094	-29.26951	-
Turning Point 1 – Country		5.440698	5.880384	31.91562	-5.010812
Turning Point 2 – Country		25.18888	25.5438	22.65849	30.1
Observations	370	370	365	365	268
Number of Cities/Regions	40	40	37	37	37
R-sq within	0.1791	0.1827	0.1889	0.3003	0.3304
R-sq between	0.0002	0.0024	0.0033	0.0013	0.0179
R-sq overall	0.0023	0.0065	0.0089	0.0184	0.0217
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 54. (log) Dissolved Oxygen (DO) – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)
	Controlling for Country GDP Only	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	0.00095	0.13389	0.13604	0.58598
	(0.03)	(1.97)*	(2.32)*	(1.31)
Country GDP- squared	0.00108	-0.00739	-0.00747	-0.02787
	(0.58)	(1.88)	(2.24)*	(1.82)
Country GDP-cubed	-0.00002	0.00012	0.00012	0.00040
	(0.70)	(1.91)	(2.30)*	(2.37)*
Population Density (people per sq km)		-0.00001	-0.00001	-0.00001
		(1.63)	(1.50)	(1.41)
Coastal		0.06758	0.06544	0.13259
		(0.62)	(0.60)	(0.88)
Year-2001			0.07827	
			(1.13)	
Year-2003			0.05874	-0.20550
			(1.22)	(0.67)
Year-2004			0.07170	-0.33238
			(0.83)	(0.88)
Year-2005			0.00139	-0.27879
			(0.03)	(0.94)
Control of Corruption				-0.51830
				(0.51)
Political Stability				-0.40888
				(0.85)
Voice and Accountability				-0.21477
				(0.91)
Constant	1.88372	1.72337	1.71790	0.47079
	(18.10)**	(6.75)**	(7.31)**	(0.30)
Turning Point 1	-.4333613	29.08299	29.38621	30.78894
Turning Point 2	33.64862	13.16338	13.19626	15.96183
Observations	298	82	82	34
Number of Cities/Regions	33	17	17	11
R-sq within	0.0006	0.0731	0.1405	0.4522
R-sq between	0.3612	0.6430	0.6428	0.6785
R-sq overall	0.3196	0.6241	0.6315	0.5953
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

Table 55. (log) Dissolved Oxygen (DO) – City/Regional GDP as Primary Economic Indicator

	(1)	(2)	(3)
	Controlling for City GDP Only	Controlling for Place Indicators	Controlling for Time and Place Indicators
City GDP – PPP Adjusted (1,000 2005 International $)	0.01824	-0.02814	0.87176
	(0.97)	(0.53)	(0.88)
City GDP- squared	-0.00021	0.00153	-0.19708
	(0.32)	(0.70)	(1.19)
City GDP-cubed	0.00000	-0.00002	0.01371
	(0.03)	(0.74)	(1.56)
Population Density (people per sq km)		0.00002	-0.00001
		(0.79)	(1.31)
Coastal		-0.14040	-0.21071
		(5.84)**	(5.00)**
Year-2001			-2,359.31099
			(1.69)
Year-2004			-250.73420
			(1.85)
Constant	1.96337	2.29826	1.13165
	(10.45)**	(15.95)**	(0.58)
Observations	23	11	11
Number of group(cityregion)	5	4	4
Turn 1			
Turn 2			
Quadratic Turn			
R-sq within	0.4170	0.1005	0.7907
R-sq between	0.1465	0.9963	1.0000
R-sq overall	0.3166	0.6502	0.9194
Robust z statistics in parentheses			
* significant at 5%; ** significant at 1%			

Table 56. (log) Dissolved Oxygen (DO) – Country and City/Regional GDP Used as Economic Indicators

	(1)	(2)	(3)	(4)
	Controlling for City GDP Only	Controlling for City and Country GDP	Controlling for Place Indicators	Controlling for Time and Place Indicators
City GDP – PPP Adjusted (1,000 2005 International $)	0.01824	0.03550	-0.63301	-0.48656
	(0.97)	(0.92)	(2.53)*	(0.24)
City GDP- squared	-0.00021	-0.00054	0.06410	0.03825
	(0.32)	(0.50)	(2.58)**	(0.11)
City GDP-cubed	0.00000	0.00000	-0.00082	0.00068
	(0.03)	(0.21)	(2.60)**	(0.04)
Country GDP – PPP Adjusted (1,000 2005 International $)		-0.13323	0.18853	1.40885
		(2.88)**	(0.73)	(0.09)
Country GDP- squared		0.00752	-0.02407	-0.33116
		(3.36)**	(5.75)**	(0.09)
Country GDP-cubed		-0.00012		
		(3.24)**		
Population Density (people per sq km)			-0.00003	-0.00003
			(2.38)*	(0.66)
Coastal			-0.25736	-0.25688
			(6.32)**	(4.88)**
Year-2004				256.20161
				(0.08)
Constant	1.96337	2.21360	3.68121	2.21078
	(10.45)**	(17.28)**	(3.21)**	(0.11)
Turning Point 1 – City	759.4949	123.8933	5.520897	5.543587
Turning Point 2 – City	46.47847	44.28949	46.71021	-43.18693
Turning Point 1 – Country	-	12.88749	-	-
Turning Point 2 – Country	-	28.27496	-	-
Observations	23	23	11	11
Number of group(cityregion)	5	5	4	4
R-sq within	0.4170	0.4868	0.7126	0.7151
R-sq between	0.1465	0.8002	1.0000	1.0000
R-sq overall	0.3166	0.8097	0.8893	0.8903
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

Table 57. (log) Biological Oxygen Demand (BOD) – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)
	Controlling for Country GDP Only	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	0.01338	-0.19170	0.03859	0.65729
	(0.13)	(0.73)	(0.08)	(0.23)
Country GDP- squared	-0.00222	0.01091	-0.00484	-0.04213
	(0.31)	(0.61)	(0.15)	(0.32)
Country GDP-cubed	0.00005	-0.00016	0.00012	0.00079
	(0.37)	(0.50)	(0.21)	(0.42)
Population Density (people per sq km)		0.00001	0.00002	0.00006
		(0.48)	(0.68)	(1.42)
Coastal		-0.65724	-0.60618	-0.60286
		(1.20)	(1.14)	(0.72)
Year-2001			0.06449	
			(0.27)	
Year-2002			-0.41068	-0.45121
			(1.74)	(0.28)
Year-2003			0.06872	0.20317
			(0.32)	(0.10)
Year-2004			-0.21813	-0.46921
			(1.22)	(0.27)
Control of Corruption				-0.94267
				(0.19)
Political Stability				0.73551
				(0.54)
Voice and Accountability				0.00000
				(.)
Constant	1.04865	1.92032	1.48007	0.39411
	(4.91)**	(3.95)**	(1.94)	(0.06)
Turning Point 1	28.63714	11.95353	21.41123	23.81482
Turning Point 2	3.371849	33.11936	4.893873	11.60048
Observations	265	73	73	32
Number of Cities/Regions	31	15	15	10
R-sq within	0.0043	0.0066	0.1114	0.2621
R-sq between	0.0152	0.1925	0.1951	0.0442
R-sq overall	0.0477	0.2093	0.2199	0.0907
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

Table 58. (log) Biological Oxygen Demand (BOD) – City/Regional GDP as Primary Economic Indicator

	(1)	(2)	(3)
	Controlling for City GDP Only	Controlling for Place Indicators	Controlling for Time and Place Indicators
City GDP – PPP Adjusted (1,000 2005 International $)	-0.08144	-0.56086	-3.60213
	(0.39)	(2.13)*	(1.19)
City GDP- squared	0.00265	0.02435	0.60037
	(0.33)	(2.21)*	(1.17)
City GDP-cubed	-0.00003	-0.00026	-0.03526
	(0.32)	(2.27)*	(1.25)
Population Density (people per sq km)		0.00007	0.00009
		(0.44)	(0.68)
Coastal		-0.09116	-0.08131
		(1.15)	(1.04)
Year-2001			5,806.11248
			(1.27)
Year-2004			593.12424
			(1.31)
Constant	1.53954	3.36170	8.48858
	(1.82)	(5.06)**	(1.41)
Observations	18	11	11
Number of group(cityregion)	4	4	4
Turn 1	23,156	15,247	N/A
Turn 2	45,730	47,080	N/A
R-sq within	0.0071	0.4507	0.5548
R-sq between	0.4602	0.9999	0.9992
R-sq overall	0.2065	0.7734	0.8102
Robust z statistics in parentheses			
* significant at 5%; ** significant at 1%			

Table 59. (log) Biological Oxygen Demand (BOD) – Country and City/Regional GDP Used as Economic Indicators

	(1)	(2)	(3)	(4)
	Controlling for City GDP Only	Controlling for City and Country GDP	Controlling for Place Indicators	Controlling for Time and Place Indicators
City GDP – PPP Adjusted (1,000 2005 International $)	-0.08144	-0.33364	0.10908	1.96015
	(0.39)	(11.25)**	(0.08)	(0.41)
City GDP- squared	0.00265	0.00472	-0.04745	-0.37422
	(0.33)	(5.24)**	(0.36)	(0.53)
City GDP-cubed	-0.00003	-0.00002	0.00066	0.01956
	(0.32)	(2.30)*	(0.39)	(0.59)
Country GDP – PPP Adjusted (1,000 2005 International $)		0.15088	0.27210	15.69607
		(0.15)	(0.18)	(0.57)
Country GDP- squared		0.00472	0.01397	-3.86743
		(0.07)	(0.65)	(0.60)
Country GDP-cubed		-0.00014		
		(0.13)		
Population Density (people per sq km)			0.00014	0.00010
			(2.10)*	(0.59)
Coastal			0.05885	0.06495
			(0.28)	(0.22)
Year-2004				3,238.20250
				(0.61)
Constant	1.53954	2.48769	0.93391	-17.65130
	(1.82)	(1.47)	(0.14)	(0.45)
Turning Point 1 – City	23.15619	47.66949	46.82663	9.070171
Turning Point 2 – City	45.72987	136.3891	1.178357	3.682258
Turning Point 1 – Country		-10.87925	-	-
Turning Point 2 – Country		34.02067	-	-
Observations	18	18	11	11
Number of Cities/Regions	4	4	4	4
R-sq within	0.0071	0.4235	0.5118	0.5391
R-sq between	0.4602	0.9902	1.0000	1.0000
R-sq overall	0.2065	0.7038	0.8006	0.8117
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

Table 60. (log) Chemical Oxygen Demand (COD) – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)
	Controlling for Country GDP Only	Controlling for Place Indicators	Controlling for Time and Place Indicators	Controlling for Time, Place and Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	0.01119	0.31834	-0.55209	2.19476
	(0.07)	(0.79)	(1.27)	(3.41)**
Country GDP- squared	-0.00033	-0.01620	0.04301	-0.09481
	(0.03)	(0.62)	(1.51)	(2.69)**
Country GDP-cubed	-0.00001	0.00026	-0.00081	0.00129
	(0.03)	(0.58)	(1.61)	(2.20)*
Population Density (people per sq km)		0.00012	0.00009	0.00008
		(2.91)**	(3.05)**	(1.72)
Coastal		-0.62250	-0.83123	-1.16125
		(1.07)	(1.73)	(1.50)
Year-2001			0.34139	
			(2.13)*	
Year-2002			0.02130	-1.15524
			(0.10)	(1.91)
Year-2003			0.44980	-0.95774
			(2.17)*	(1.55)
Year-2004			0.74254	-0.70441
			(2.15)*	(1.08)
Control of Corruption				-3.88792
				(2.15)*
Political Stability				-0.49534
				(0.88)
Voice and Accountability				0.00000
				(.)
Constant	2.59079	1.18480	2.94750	-2.69432
	(5.35)**	(1.62)	(4.12)**	(1.64)
Turning Point 1	-55.89478	25.39866	8.420139	30.43733
Turning Point 2	13.01344	16.02744	26.98589	18.67783
Observations	212	69	69	28
Number of Cities/Regions	24	16	16	10
R-sq within	0.0000	0.2973	0.3509	0.5523
R-sq between	0.0526	0.3930	0.5622	0.5201
R-sq overall	0.0411	0.2074	0.4285	0.4936
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

Table 61. (log) Chemical Oxygen Demand (COD) – City/Regional GDP as Primary Economic Indicator

	(1)	(2)	(3)
	Controlling for City GDP Only	Controlling for Place Indicators	Controlling for Time and Place Indicators
City GDP – PPP Adjusted (1,000 2005 International $)	-0.12587	-0.63063	-6.57954
	(0.52)	(2.14)*	(2.18)*
City GDP- squared	0.00687	0.02893	1.17325
	(0.74)	(2.34)*	(2.29)*
City GDP-cubed	-0.00008	-0.00031	-0.07088
	(0.82)	(2.42)*	(2.52)*
Population Density (people per sq km)		0.00006	0.00011
		(0.34)	(0.99)
Coastal		-0.18650	-0.12514
		(2.03)*	(1.52)
Year-2001			11,757.63467
			(2.60)**
Year-2004			1,207.17232
			(2.70)**
Constant	2.22874	4.26442	14.07406
	(2.30)*	(5.66)**	(2.37)*
Observations	18	11	11
Number of group(cityregion)	4	4	4
Turn 1	11,295	14,106	N/A
Turn 2	48,488	47,956	N/A
Quadratic Turn	N/A	N/A	N/A
R-sq within	0.0107	0.2642	0.6918
R-sq between	0.8312	1.0000	0.9992
R-sq overall	0.7656	0.8841	0.9492
Robust z statistics in parentheses			
* significant at 5%; ** significant at 1%			

Table 62. (log) Chemical Oxygen Demand (COD) – Country and City/Regional GDP Used as Economic Indicators

	(1)	(2)	(3)	(4)
	Controlling for City GDP Only	Controlling for City and Country GDP	Controlling for Place Indicators	Controlling for Time and Place Indicators
City GDP – PPP Adjusted (1,000 2005 International $)	-0.12587	-0.39936	0.94163	0.03187
	(0.52)	(7.18)**	(0.59)	(0.00)
City GDP- squared	0.00687	0.00861	-0.13495	0.02564
	(0.74)	(6.03)**	(0.85)	(0.02)
City GDP-cubed	-0.00008	-0.00006	0.00179	-0.00750
	(0.82)	(5.41)**	(0.90)	(0.14)
Country GDP – PPP Adjusted (1,000 2005 International $)		-0.12724	-0.25274	-7.83330
		(0.10)	(0.15)	(0.17)
Country GDP- squared		0.02725	0.05630	1.96392
		(0.35)	(1.93)	(0.18)
Country GDP-cubed		-0.00057		
		(0.44)		
Population Density (people per sq km)			0.00019	0.00021
			(1.95)	(1.13)
Coastal			0.12761	0.12462
			(0.50)	(0.41)
Year-2004				-1,591.50771
				(0.17)
Constant	2.22874	3.76871	0.22751	9.36175
	(2.30)*	(1.80)	(0.03)	(0.15)
Turning Point 1 – City	11.29499	40.85324	46.54445	-.5081474
Turning Point 2 – City	48.48837	53.60969	3.771422	2.786771
Turning Point 1 – Country		2.53445	-	-
Turning Point 2 – Country		29.61189	-	-
Observations	18	18	11	11
Number of Cities/Regions	4	4	4	4
R-sq within	0.0107	0.3274	0.5221	0.5281
R-sq between	0.8312	0.9890	1.0000	1.0000
R-sq overall	0.7656	0.9345	0.9247	0.9257
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

APPENDIX C

FULL RESULTS OF MANUFACTURING FACILITY-LEVEL REGRESSION MODELS

Table 63. (log) Plant Energy Use Ratio (EUR) – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)
	Controlling for Country GDP Only	Controlling for Production Type	Controlling for Time	Controlling for ISO Certification and Hours Worked	Controlling for Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	-0.24583	-0.23413	-0.23266	-0.23564	-0.24518
	(9.67)**	(11.08)**	(11.49)**	(11.58)**	(11.56)**
Country GDP- squared	0.01194	0.01069	0.01071	0.01086	0.01041
	(9.65)**	(10.22)**	(10.51)**	(10.60)**	(9.52)**
Country GDP-cubed	-0.00016	-0.00014	-0.00014	-0.00014	-0.00013
	(9.24)**	(9.40)**	(9.61)**	(9.69)**	(8.24)**
Bottled Water Production		-0.00691	-0.00692	-0.00692	-0.00653
		(3.53)**	(3.54)**	(3.52)**	(3.27)**
Juice Production		0.00937	0.00943	0.00958	0.00968
		(6.38)**	(6.28)**	(6.57)**	(6.53)**
Coffee/Tea Production		0.01479	0.01456	0.01452	0.01457
		(9.73)**	(9.47)**	(9.35)**	(9.24)**
Syrup Production		-0.01946	-0.01945	-0.01841	-0.01517
		(2.62)**	(2.58)**	(2.60)**	(1.97)*
Other Bottling Production		0.01843	0.01844	0.01818	0.01808
		(5.55)**	(5.58)**	(5.46)**	(5.48)**
Year-2005			0.01222	0.01469	-0.02660
			(0.32)	(0.38)	(0.67)
Year-2006			0.00208	0.00297	-0.01822
			(0.06)	(0.09)	(0.53)
Year-2007			0.00098	0.00186	-0.01064
			(0.04)	(0.07)	(0.41)
Year-2008			-0.00017	-0.00198	-0.01227
			(0.01)	(0.08)	(0.50)
Year-2009			-0.03015	-0.03030	-0.03737
			(1.86)	(1.87)	(2.29)*
Year-2010			0.00000		
			(.)		
ISO 14000 Certification				-0.04468	-0.04265
				(0.82)	(0.81)
Total Hours Worked				0.00000	0.00000
				(5.73)**	(5.39)**

Table 63 (continued).

Control of Corruption					-0.01096
					(0.16)
Political Stability					0.14283
					(2.15)*
Voice and Accountability					0.06437
					(1.34)
Turning Point 1	14.5279	15.79214	15.66148	15.62195	17.51929
Turning Point 2	35.34168	35.6883	35.46571	35.49999	35.90455
Constant	0.24634	0.26548	0.25897	0.27461	0.48241
	(1.86)	(2.48)*	(2.54)*	(2.61)**	(3.54)**
Observations	1390	1390	1390	1390	1390
Number of Facilities	305	305	305	305	305
R-sq within	0.0430	0.0468	0.0486	0.0504	0.0520
R-sq between	0.2350	0.5034	0.5048	0.5061	0.5193
R-sq overall	0.2463	0.4606	0.4624	0.4634	0.4775
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 64. (log) Plant Energy Use Ratio (EUR) – Per Capita Consumption as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)
	Controlling for Per Capita Consumption	Controlling for Production Type	Controlling for Time	Controlling for ISO Certification and Hours Worked	Controlling for Institutional Variables
Per Capita Consumption	-0.00359	-0.00535	-0.00518	-0.00517	-0.00831
	(3.13)**	(5.35)**	(5.15)**	(5.13)**	(7.54)**
Per Capita Consumption-squared	0.00001	0.00001	0.00001	0.00001	0.00002
	(1.65)	(3.47)**	(3.25)**	(3.24)**	(5.19)**
Per Capita Consumption-cubed	-0.00000	-0.00000	-0.00000	-0.00000	-0.00000
	(1.33)	(2.84)**	(2.61)**	(2.60)**	(3.99)**
Bottled Water Production		-0.00534	-0.00536	-0.00534	-0.00510
		(2.73)**	(2.74)**	(2.72)**	(2.51)*
Juice Production		0.00961	0.00964	0.00973	0.00988
		(5.57)**	(5.59)**	(5.62)**	(7.46)**
Coffee/Tea Production		0.01542	0.01532	0.01532	0.01405
		(10.57)**	(10.45)**	(10.37)**	(9.36)**
Syrup Production		-0.03188	-0.03205	-0.03167	-0.01652
		(4.92)**	(5.03)**	(4.80)**	(2.36)*
Other Bottling Production		0.01991	0.01987	0.01981	0.01739
		(5.97)**	(6.00)**	(5.91)**	(5.57)**
Year-2005			-0.28087	0.04780	0.00779
			(3.96)**	(1.15)	(0.19)
Year-2006			-0.31979	0.00792	-0.00594
			(4.73)**	(0.24)	(0.18)
Year-2007			-0.32892	-0.00128	-0.01181
			(4.96)**	(0.05)	(0.45)
Year-2008			-0.33041	-0.00428	-0.01078
			(4.88)**	(0.18)	(0.46)
Year-2009			-0.33991	-0.01289	-0.02216
			(5.06)**	(0.82)	(1.40)
Year-2010			-0.32701		
			(4.78)**		
ISO 14000 Certification				-0.02067	-0.03094
				(0.40)	(0.64)
Total Hours Worked				0.00000	0.00000
				(1.41)	(3.82)**

Table 64 (continued).

Control of Corruption					-0.09701
					(1.69)
Political Stability					0.12064
					(2.01)*
Voice and Accountability					0.26441
					(5.74)**
Constant	-0.35393	-0.31387	0.00000	-0.32528	-0.07267
	(4.48)**	(4.77)**	(.)	(4.57)**	(0.79)
Turning Point 1	-	-	-	-	370.1528
Turning Point 2	-	-	-	-	550.7593
Observations	1398	1398	1398	1398	1398
Number of Facilities	305	305	305	305	305
R-sq within	0.0027	0.0048	0.0093	0.0101	0.0169
R-sq between	0.2249	0.4999	0.4982	0.4975	0.5506
R-sq overall	0.1903	0.4546	0.4534	0.4525	0.5089
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 65. (log) Plant Energy Use Ratio (EUR) – Country GDP and Per Capita Consumption Included as Economic Indicators

	(1)	(2)	(3)	(4)	(5)	(6)
	Controlling for Country GDP Only	Controlling for Country GDP and Per Capita Consumption	Controlling for Production Type	Controlling for Time	Controlling for ISO Certification and Hours Worked	Controlling for Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	-0.24583	-0.18084	-0.19547	-0.19651	-0.19980	-0.18071
	(9.67)**	(4.57)**	(5.67)**	(5.84)**	(5.91)**	(4.63)**
Country GDP- squared	0.01194	0.00940	0.00934	0.00944	0.00960	0.00789
	(9.65)**	(5.23)**	(5.99)**	(6.15)**	(6.23)**	(4.57)**
Country GDP-cubed	-0.00016	-0.00013	-0.00012	-0.00013	-0.00013	-0.00010
	(9.24)**	(5.39)**	(5.97)**	(6.12)**	(6.19)**	(4.38)**
Per Capita Consumption		-0.00315	-0.00301	-0.00303	-0.00301	-0.00465
		(2.50)*	(2.56)*	(2.54)*	(2.52)*	(3.94)**
Per Capita Consumption-squared		0.00001	0.00001	0.00001	0.00001	0.00001
		(1.98)*	(2.44)*	(2.41)*	(2.40)*	(3.44)**
Per Capita Consumption-cubed		-0.00000	-0.00000	-0.00000	-0.00000	-0.00000
		(1.70)	(2.23)*	(2.20)*	(2.20)*	(2.85)**
Bottled Water Production			-0.00659	-0.00660	-0.00659	-0.00602
			(3.27)**	(3.28)**	(3.26)**	(2.89)**
Juice Production			0.00923	0.00927	0.00940	0.00966
			(6.16)**	(6.14)**	(6.36)**	(6.78)**
Coffee/Tea Production			0.01457	0.01444	0.01440	0.01439
			(9.16)**	(8.98)**	(8.89)**	(8.96)**
Syrup Production			-0.02244	-0.02254	-0.02154	-0.01681
			(4.34)**	(4.31)**	(4.29)**	(2.53)*
Other Bottling Production			0.01841	0.01842	0.01820	0.01789
			(5.58)**	(5.59)**	(5.48)**	(5.50)**
Year-2005				0.00521	0.00762	-0.03529
				(0.14)	(0.20)	(0.88)
Year-2006				-0.01305	-0.01216	-0.03190
				(0.40)	(0.37)	(0.92)
Year-2007				-0.01083	-0.00993	-0.02318
				(0.41)	(0.38)	(0.86)
Year-2008				-0.01046	-0.01227	-0.02183
				(0.44)	(0.51)	(0.88)
Year-2009				-0.03237	-0.03253	-0.03931
				(1.97)*	(1.98)*	(2.36)*
Year-2010				0.00000		
				(.)		
ISO 14000 Certification					-0.03956	-0.03778
					(0.76)	(0.77)
Total Hours Worked					0.00000	0.00000
					(5.64)**	(5.55)**

Table 65 (continued).

Control of Corruption						-0.05297
						(0.74)
Political Stability						0.16571
						(2.44)*
Voice and Accountability						0.14450
						(2.63)**
Constant	0.24634	0.18084	0.25582	0.26944	0.28365	0.48429
	(1.86)	(1.22)	(2.08)*	(2.28)*	(2.34)*	(2.74)**
Turning Point 1 (GDP)	14.5279	13.24658	14.91626	14.82502	14.80547	16.9189
Turning Point 2 (GDP)	35.34168	35.07266	35.07796	34.95197	34.99986	35.39073
Observations	1390	1390	1390	1390	1390	1390
Number of Facilities	305	305	305	305	305	305
R-sq within	0.0430	0.0342	0.0428	0.0446	0.0465	0.0467
R-sq between	0.2350	0.2881	0.5266	0.5274	0.5284	0.5521
R-sq overall	0.2463	0.2916	0.4827	0.4836	0.4842	0.5101
Robust z statistics in parentheses						
* significant at 5%; ** significant at 1%						

Table 66. (log) Plant Water Use Ratio (WUR) – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)
	Controlling for Country GDP Only	Controlling for Production Type	Controlling for Time	Controlling for ISO Certification and Hours Worked	Controlling for Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	-0.20957	-0.18821	-0.15288	-0.15227	-0.15121
	(12.19)**	(11.99)**	(11.14)**	(11.07)**	(10.84)**
Country GDP- squared	0.00949	0.00809	0.00704	0.00701	0.00616
	(10.65)**	(9.96)**	(9.74)**	(9.68)**	(8.62)**
Country GDP-cubed	-0.00012	-0.00010	-0.00010	-0.00009	-0.00008
	(9.56)**	(8.75)**	(9.00)**	(8.95)**	(7.63)**
Bottled Water Production		-0.00211	-0.00228	-0.00229	-0.00215
		(2.06)*	(2.28)*	(2.29)*	(1.99)*
Juice Production		0.00330	0.00360	0.00366	0.00397
		(1.44)	(1.70)	(1.74)	(2.04)*
Coffee/Tea Production		0.01272	0.01132	0.01129	0.01167
		(7.86)**	(7.54)**	(7.57)**	(7.76)**
Syrup Production		-0.00933	-0.01020	-0.00998	-0.00324
		(1.32)	(1.82)	(1.72)	(1.16)
Other Bottling Production		0.01254	0.01238	0.01229	0.01246
		(2.03)*	(2.26)*	(2.24)*	(2.27)*
Year-2005			0.14972	0.14940	0.12778
			(7.60)**	(7.59)**	(6.30)**
Year-2006			0.14182	0.14180	0.13253
			(8.82)**	(8.81)**	(8.16)**
Year-2007			0.14385	0.14378	0.13963
			(9.46)**	(9.45)**	(9.15)**
Year-2008			0.08695	0.08738	0.08035
			(7.57)**	(7.58)**	(6.84)**
Year-2009			0.03269	0.03274	0.02859
			(3.58)**	(3.58)**	(3.04)**
Year-2010			0.00000		
			(.)		
ISO 14000 Certification				-0.01678	-0.01729
				(0.44)	(0.46)
Total Hours Worked				-0.00000	-0.00000
				(1.18)	(1.12)
Control of Corruption					0.07637
					(1.89)
Political Stability					0.02862
					(0.86)
Voice and Accountability					0.10303
					(3.73)**
Constant	1.98329	1.90683	1.62649	1.62971	1.72106
	(25.20)**	(26.90)**	(25.15)**	(24.10)**	(21.24)**
Turning Point 1	16.04259	17.30059	16.14919	16.14886	20.22029
Turning Point 2	35.48024	35.50179	33.13446	33.10353	31.26282
Observations	1389	1389	1389	1389	1389
Number of Facilities	305	305	305	305	305
R-sq within	0.1971	0.2124	0.2700	0.2697	0.2814
R-sq between	0.1690	0.3956	0.4543	0.4556	0.4684
R-sq overall	0.1426	0.3780	0.4485	0.4497	0.4806
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 67. (log) Plant Water Use Ratio (WUR) – Per Capita Consumption as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)
	Controlling for Per Capita Consumption	Controlling for Production Type	Controlling for Time	Controlling for ISO Certification and Hours Worked	Controlling for Institutional Variables
Per Capita Consumption	-0.00425	-0.00472	-0.00196	-0.00193	-0.00299
	(5.72)**	(7.05)**	(3.13)**	(3.08)**	(3.89)**
Per Capita Consumption-squared	0.00001	0.00001	0.00000	0.00000	0.00000
	(3.46)**	(4.56)**	(0.65)	(0.61)	(1.58)
Per Capita Consumption-cubed	-0.00000	-0.00000	0.00000	0.00000	-0.00000
	(2.81)**	(3.75)**	(0.31)	(0.34)	(0.51)
Bottled Water Production		-0.00101	-0.00138	-0.00140	-0.00135
		(0.95)	(1.42)	(1.44)	(1.33)
Juice Production		0.00294	0.00292	0.00293	0.00333
		(1.17)	(1.33)	(1.33)	(1.73)
Coffee/Tea Production		0.01219	0.01120	0.01118	0.01118
		(8.13)**	(8.04)**	(8.04)**	(7.91)**
Syrup Production		-0.01666	-0.01384	-0.01374	-0.00357
		(1.39)	(1.65)	(1.64)	(1.19)
Other Bottling Production		0.01147	0.01063	0.01056	0.00973
		(1.89)	(1.90)	(1.89)	(1.77)
Year-2005			0.19260	0.19193	0.17318
			(8.47)**	(8.47)**	(7.74)**
Year-2006			0.16305	0.16294	0.16239
			(8.77)**	(8.77)**	(8.71)**
Year-2007			0.14975	0.14957	0.14800
			(9.39)**	(9.40)**	(9.12)**
Year-2008			0.09096	0.09160	0.09583
			(7.69)**	(7.71)**	(7.49)**
Year-2009			0.04993	0.05000	0.04722
			(5.71)**	(5.71)**	(5.07)**
Year-2010			0.00000		
			(.)		
ISO 14000 Certification				-0.00440	-0.01406
				(0.11)	(0.34)
Total Hours Worked				-0.00000	-0.00000
				(1.20)	(1.28)

Table 67 (continued).

Control of Corruption					-0.10152
					(3.00)**
Political Stability					0.02894
					(0.77)
Voice and Accountability					0.18283
					(6.47)**
Constant	1.42652	1.38162	1.11460	1.11583	1.18007
	(33.89)**	(35.59)**	(26.86)**	(25.56)**	(20.79)**
Turning Point 1	-	396.3684	508.0032	508.1409	479.7674
Turning Point 2	-	503.136	-2000.782	-1793.464	1852.945
Observations	1397	1397	1397	1397	1397
Number of Facilities	305	305	305	305	305
R-sq within	0.1555	0.1713	0.2112	0.2110	0.2187
R-sq between	0.1202	0.3164	0.3812	0.3831	0.4151
R-sq overall	0.0832	0.3078	0.3754	0.3774	0.4211
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 68. (log) Plant Water Use Ratio (WUR) – Country GDP and Per Capita Consumption Included as Economic Indicators

	(1)	(2)	(3)	(4)	(5)	(6)
	Controlling for Country GDP Only	Controlling for Country GDP and Per Capita Consumption	Controlling for Production Type	Controlling for Time	Controlling for ISO Certification and Hours Worked	Controlling for Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	-0.20957	-0.21153	-0.21815	-0.19002	-0.18975	-0.17804
	(12.19)**	(7.32)**	(8.13)**	(8.32)**	(8.30)**	(7.17)**
Country GDP- squared	0.00949	0.00959	0.00933	0.00848	0.00847	0.00728
	(10.65)**	(7.42)**	(7.84)**	(8.24)**	(8.22)**	(6.59)**
Country GDP-cubed	-0.00012	-0.00012	-0.00012	-0.00011	-0.00011	-0.00009
	(9.56)**	(7.24)**	(7.48)**	(8.10)**	(8.08)**	(6.37)**
Per Capita Consumption		-0.00058	0.00035	0.00191	0.00193	0.00100
		(0.59)	(0.37)	(2.42)*	(2.44)*	(1.19)
Per Capita Consumption-squared		0.00000	0.00000	-0.00000	-0.00000	-0.00000
		(1.04)	(0.64)	(1.91)	(1.92)	(0.96)
Per Capita Consumption-cubed		-0.00000	-0.00000	0.00000	0.00000	0.00000
		(1.34)	(1.22)	(1.64)	(1.65)	(0.95)
Bottled Water Production			-0.00234	-0.00262	-0.00263	-0.00243
			(2.16)*	(2.57)*	(2.58)**	(2.20)*
Juice Production			0.00336	0.00375	0.00382	0.00398
			(1.45)	(1.84)	(1.89)	(2.05)*
Coffee/Tea Production			0.01353	0.01180	0.01177	0.01186
			(7.75)**	(7.50)**	(7.54)**	(7.59)**
Syrup Production			-0.00939	-0.00888	-0.00857	-0.00480
			(1.71)	(2.65)**	(2.43)*	(1.70)
Other Bottling Production			0.01278	0.01253	0.01242	0.01263
			(1.95)	(2.22)*	(2.20)*	(2.26)*
Year-2005				1.80357	0.14937	0.13095
				(24.06)**	(7.63)**	(6.31)**
Year-2006				1.80118	0.14739	0.13615
				(23.21)**	(8.79)**	(8.00)**
Year-2007				1.80304	0.14922	0.14334
				(23.72)**	(9.57)**	(9.13)**
Year-2008				1.74561	0.09235	0.08202
				(23.41)**	(7.82)**	(6.74)**
Year-2009				1.68564	0.03193	0.02764
				(22.49)**	(3.43)**	(2.88)**
Year-2010				1.65376		
				(21.51)**		
ISO 14000 Certification					-0.02069	-0.01779
					(0.54)	(0.47)
Total Hours Worked					-0.00000	-0.00000
					(1.25)	(1.13)

Table 68 (continued).

Control of Corruption						0.09685
						(2.32)*
Political Stability						0.02988
						(0.88)
Voice and Accountability						0.07482
						(2.35)*
Constant	1.98329	2.01102	1.97116	0.00000	1.65863	1.76283
	(25.20)**	(22.00)**	(23.33)**	(.)	(21.06)**	(18.15)**
Turning Point 1 (GDP)	16.04259	16.05105	17.553	16.84479	16.85554	19.82544
Turning Point 2 (GDP)	35.48024	35.26011	35.02271	33.44484	33.42251	31.91674
Observations	1389	1389	1389	1389	1389	1389
Number of Facilities	305	305	305	305	305	305
R-sq within	0.1971	0.2055	0.2071	0.2724	0.2722	0.2837
R-sq between	0.1690	0.1599	0.3953	0.4646	0.4661	0.4708
R-sq overall	0.1426	0.1356	0.3839	0.4588	0.4601	0.4827
Robust z statistics in parentheses						
* significant at 5%; ** significant at 1%						

Table 69. (log) Plant Waste Generation Ratio – Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)
	Controlling for Country GDP Only	Controlling for Production Type	Controlling for Time	Controlling for ISO Certification and Hours Worked	Controlling for Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	-0.22247	-0.20731	-0.21351	-0.23536	-0.22452
	(8.48)**	(8.27)**	(8.34)**	(6.25)**	(5.65)**
Country GDP- squared	0.01182	0.01059	0.01087	0.01255	0.01105
	(8.65)**	(8.02)**	(8.16)**	(6.50)**	(5.67)**
Country GDP-cubed	-0.00018	-0.00016	-0.00016	-0.00019	-0.00016
	(8.76)**	(7.91)**	(8.07)**	(6.56)**	(5.64)**
Bottled Water Production		-0.01097	-0.01107	-0.01455	-0.01431
		(6.68)**	(6.69)**	(5.35)**	(4.81)**
Juice Production		0.00426	0.00422	0.00841	0.00994
		(1.07)	(1.06)	(1.34)	(1.86)
Coffee/Tea Production		0.01656	0.01649	0.01492	0.01661
		(8.70)**	(8.66)**	(4.57)**	(5.41)**
Syrup Production		-0.03098	-0.03130	-0.05504	-0.03099
		(1.12)	(1.12)	(3.06)**	(4.63)**
Other Bottling Production		-0.00214	-0.00198	-0.00849	-0.00896
		(0.44)	(0.41)	(0.88)	(0.96)
Year-2005			0.09290	-0.03177	-0.07364
			(2.69)**	(0.55)	(1.15)
Year-2006			0.08739	-0.02646	-0.02245
			(2.39)*	(0.54)	(0.42)
Year-2007			0.08009	-0.02405	-0.02359
			(1.95)	(0.50)	(0.47)
Year-2008			0.13042	0.01872	0.02885
			(2.58)*	(0.39)	(0.61)
Year-2009			0.07756	0.01975	0.01492
			(1.80)	(0.56)	(0.41)
Year-2010			0.05271		
			(1.20)		
ISO 14000 Certification				0.04877	0.02529
				(0.49)	(0.27)
Total Hours Worked				0.00000	0.00000
				(2.44)*	(2.13)*
Control of Corruption					-0.21031
					(1.67)
Political Stability					0.07509
					(0.60)
Voice and Accountability					0.44133
					(5.33)**
Constant	3.10381	3.12919	3.09063	3.22495	3.24789
	(22.83)**	(24.52)**	(23.61)**	(15.71)**	(12.09)**
Turning Point 1	13.47929	14.29173	14.34063	13.35091	15.20223
Turning Point 2	31.19154	31.07465	31.12274	31.52224	30.58562
Observations	2832	2832	2832	1234	1234
Number of facilities	541	541	541	296	296
R-sq within	0.0052	0.0052	0.0114	0.0252	0.0238
R-sq between	0.1626	0.2843	0.2815	0.3187	0.3783
R-sq overall	0.1445	0.2692	0.2696	0.2827	0.3512
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 70. (log) Plant Waste Generation Ratio – Per Capita Consumption as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)
	Controlling for Per Capita Consumption	Controlling for Production Type	Controlling for Time	Controlling for ISO Certification and Hours Worked	Controlling for Institutional Variables
Per Capita Consumption	0.00064	-0.00073	-0.00062	-0.00066	-0.00303
	(0.33)	(0.40)	(0.35)	(0.38)	(1.30)
Per Capita Consumption-squared	-0.00001	-0.00000	-0.00000	-0.00000	0.00000
	(1.12)	(0.31)	(0.38)	(0.36)	(0.51)
Per Capita Consumption-cubed	0.00000	0.00000	0.00000	0.00000	-0.00000
	(1.30)	(0.57)	(0.64)	(0.62)	(0.13)
Bottled Water Production		-0.01355	-0.01356	-0.01349	-0.01339
		(5.54)**	(5.52)**	(5.49)**	(4.67)**
Juice Production		0.00593	0.00592	0.00563	0.00722
		(0.94)	(0.94)	(0.88)	(1.33)
Coffee/Tea Production		0.01852	0.01845	0.01860	0.01943
		(6.05)**	(6.07)**	(6.00)**	(6.46)**
Syrup Production		-0.06091	-0.06093	-0.06232	-0.03243
		(2.81)**	(2.83)**	(2.99)**	(4.75)**
Other Bottling Production		-0.01322	-0.01331	-0.01276	-0.01405
		(1.38)	(1.39)	(1.33)	(1.50)
Year-2005			2.39036	0.02737	-0.01564
			(17.22)**	(0.45)	(0.24)
Year-2006			2.37950	0.01499	0.02052
			(18.17)**	(0.29)	(0.39)
Year-2007			2.36075	-0.00354	-0.00715
			(16.73)**	(0.07)	(0.14)
Year-2008			2.39229	0.02555	0.03618
			(16.39)**	(0.50)	(0.71)
Year-2009			2.39250	0.02749	0.02608
			(17.93)**	(0.84)	(0.76)
Year-2010			2.36453		
			(17.32)**		
ISO 14000 Certification				0.08575	0.05246
				(0.78)	(0.51)
Total Hours Worked				0.00000	0.00000
				(2.09)*	(2.14)*

Table 70 (continued).

Control of Corruption					-0.32615
					(2.45)*
Political Stability					0.03034
					(0.23)
Voice and Accountability					0.54327
					(5.57)**
Constant	2.29496	2.38545	0.00000	2.33910	2.45792
	(15.22)**	(17.49)**	(.)	(16.47)**	(11.85)**
Turning Point 1	586.8311	544.12	544.4881	545.9658	512.7567
Turning Point 2	48.70565	-141.0713	-111.0083	-122.3468	2548.729
Observations	1242	1242	1242	1242	1242
Number of Facilities	296	296	296	296	296
R-sq within	0.0000	0.0003	0.0008	0.0017	0.0056
R-sq between	0.0526	0.2336	0.2348	0.2353	0.3122
R-sq overall	0.0408	0.2008	0.2014	0.2000	0.2935
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 71. (log) Plant Waste Generation Ratio – Country GDP and Per Capita Consumption Included as Economic Indicators

	(1)	(2)	(3)	(4)	(5)	(6)
	Controlling for Country GDP Only	Controlling for Country GDP and Per Capita Consumption	Controlling for Production Type	Controlling for Time	Controlling for ISO Certification and Hours Worked	Controlling for Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	-0.22247	-0.26890	-0.28231	-0.29604	-0.41041	-0.33517
	(8.48)**	(7.06)**	(7.69)**	(8.22)**	(6.54)**	(4.90)**
Country GDP-squared	0.01182	0.01351	0.01355	0.01413	0.01992	0.01604
	(8.65)**	(7.47)**	(7.66)**	(8.14)**	(6.72)**	(4.90)**
Country GDP-cubed	-0.00018	-0.00020	-0.00019	-0.00020	-0.00028	-0.00023
	(8.76)**	(7.71)**	(7.65)**	(8.07)**	(6.78)**	(4.97)**
Per Capita Consumption		0.00364	0.00417	0.00458	0.00549	0.00251
		(2.34)*	(2.86)**	(3.12)**	(2.64)**	(1.04)
Per Capita Consumption-squared		-0.00001	-0.00001	-0.00001	-0.00001	-0.00000
		(2.06)*	(2.12)*	(2.25)*	(1.33)	(0.33)
Per Capita Consumption-cubed		0.00000	0.00000	0.00000	0.00000	-0.00000
		(1.67)	(1.52)	(1.57)	(0.66)	(0.02)
Bottled Water Production			-0.01127	-0.01138	-0.01585	-0.01515
			(6.50)**	(6.47)**	(5.71)**	(4.97)**
Juice Production			0.00406	0.00401	0.00911	0.00999
			(1.00)	(0.99)	(1.57)	(1.88)
Coffee/Tea Production			0.01714	0.01710	0.01684	0.01742
			(9.07)**	(9.04)**	(5.18)**	(5.59)**
Syrup Production			-0.02572	-0.02522	-0.04934	-0.03445
			(1.18)	(1.15)	(5.52)**	(4.58)**
Other Bottling Production			-0.00189	-0.00163	-0.00764	-0.00832
			(0.39)	(0.34)	(0.80)	(0.89)
Year-2005				0.09477	-0.06425	-0.08987
				(2.73)**	(1.08)	(1.39)
Year-2006				0.09601	-0.03842	-0.03593
				(2.61)**	(0.78)	(0.68)
Year-2007				0.09089	-0.02798	-0.03032
				(2.20)*	(0.58)	(0.61)
Year-2008				0.14532	0.02173	0.02515
				(2.80)**	(0.46)	(0.53)
Year-2009				0.08659	0.01313	0.01035
				(1.96)	(0.37)	(0.28)
Year-2010				0.06289		
				(1.37)		
ISO 14000 Certification					0.03247	0.02182
					(0.34)	(0.24)
Total Hours Worked					0.00000	0.00000
					(2.25)*	(2.08)*

Table 71 (continued).

Control of Corruption						-0.17671
						(1.41)
Political Stability						0.07873
						(0.58)
Voice and Accountability						0.34490
						(3.44)**
Constant	3.10381	3.10032	3.17839	3.14160	3.53945	3.48815
	(22.83)**	(21.77)**	(23.56)**	(22.67)**	(14.54)**	(10.90)**
Turning Point 1 (GDP)	13.47929	14.56445	15.59813	15.71238	15.17646	15.66189
Turning Point 2 (GDP)	31.19154	31.4127	31.38494	31.43821	32.06962	31.40556
Observations	2832	2832	2832	2832	1234	1234
Number of Facilities	541	541	541	541	296	296
R-sq within	0.0052	0.0041	0.0041	0.0094	0.0245	0.0253
R-sq between	0.1626	0.1830	0.3106	0.3087	0.3600	0.3878
R-sq overall	0.1445	0.1700	0.2996	0.3016	0.3367	0.3630
Robust z statistics in parentheses						
* significant at 5%; ** significant at 1%						

Table 72. (log) Lost-Time Incident Ratio– Country GDP as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)
	Controlling for Country GDP Only	Controlling for Production Type	Controlling for Time	Controlling for OSHAS Certification and Hours Worked	Controlling for Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	0.07981	0.07708	0.10919	0.10591	0.05087
	(1.35)	(1.31)	(1.86)	(1.80)	(0.86)
Country GDP- squared	-0.00548	-0.00395	-0.00499	-0.00480	-0.00596
	(1.89)	(1.38)	(1.74)	(1.68)	(2.13)*
Country GDP-cubed	0.00007	0.00004	0.00005	0.00005	0.00009
	(1.87)	(1.08)	(1.30)	(1.24)	(2.26)*
Bottled Water Production		-0.01071	-0.01105	-0.01094	-0.00872
		(2.91)**	(2.97)**	(2.93)**	(2.24)*
Juice Production		0.00596	0.00623	0.00631	0.00861
		(2.06)*	(2.08)*	(2.07)*	(3.36)**
Coffee/Tea Production		-0.02057	-0.02263	-0.02270	-0.02218
		(5.43)**	(5.77)**	(5.84)**	(5.60)**
Syrup Production		-0.06014	-0.06069	-0.06215	-0.04103
		(6.88)**	(6.67)**	(6.42)**	(2.61)**
Other Bottling Production		-0.02502	-0.02481	-0.02468	-0.02575
		(1.90)	(1.80)	(1.79)	(1.87)
Year-2005			0.20439	0.21185	0.04472
			(1.55)	(1.60)	(0.34)
Year-2006			0.15862	0.16101	0.09070
			(1.74)	(1.76)	(0.98)
Year-2007			0.15040	0.15219	0.11942
			(1.94)	(1.96)	(1.52)
Year-2008			-0.03215	-0.03609	-0.05619
			(0.47)	(0.52)	(0.78)
Year-2009			0.02199	0.02156	-0.01623
			(0.99)	(0.97)	(0.63)
Year-2010			0.00000	0.00000	0.00000
			0.00000	0.00000	0.00000
OSHAS 18000 Certification				0.08016	0.05075
				(0.51)	(0.32)
Total Hours Worked				0.00000	0.00000
				(1.20)	(1.07)
Control of Corruption					-0.21296
					(0.99)
Political Stability					0.62848
					(3.68)**
Voice and Accountability					0.43248
					(3.53)**
Constant	-16.69201	-16.67465	-16.93011	-16.94473	-16.01893
	(58.50)**	(58.97)**	(57.72)**	(57.46)**	(43.72)**
Turning Point 1	39.84173	49.81402	50.74841	51.53632	39.97308
Turning Point 2	8.91972	12.14405	13.96417	14.02615	4.776829
Observations	980	980	980	980	980
Number of facilities	252	252	252	252	252
R-sq within	0.0018	0.0059	0.0075	0.0089	0.0276
R-sq between	0.1399	0.2542	0.2681	0.2679	0.3108
R-sq overall	0.1180	0.1939	0.2068	0.2070	0.2572
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 73. (log) Lost-Time Incident Ratio– Per Capita Consumption as Primary Economic Indicator

	(1)	(2)	(3)	(4)	(5)
	Controlling for Per Capita Consumption	Controlling for Production Type	Controlling for Time	Controlling for OSHAS Certification and Hours Worked	Controlling for Institutional Variables
Per Capita Consumption	-0.00458	-0.00201	-0.00010	-0.00011	-0.00452
	(1.53)	(0.68)	(0.03)	(0.04)	(1.35)
Per Capita Consumption-squared	0.00001	0.00000	-0.00000	-0.00000	0.00001
	(1.07)	(0.29)	(0.34)	(0.33)	(0.85)
Per Capita Consumption-cubed	-0.00000	0.00000	0.00000	0.00000	-0.00000
	(0.69)	(0.01)	(0.65)	(0.63)	(0.37)
Bottled Water Production		-0.01140	-0.01189	-0.01174	-0.01053
		(2.73)**	(2.79)**	(2.76)**	(2.24)*
Juice Production		0.00261	0.00293	0.00298	0.00526
		(1.13)	(1.18)	(1.19)	(1.90)
Coffee/Tea Production		-0.02131	-0.02291	-0.02281	-0.02564
		(5.99)**	(6.32)**	(6.29)**	(6.44)**
Syrup Production		-0.04881	-0.04820	-0.04775	-0.04548
		(4.66)**	(4.07)**	(3.93)**	(2.77)**
Other Bottling Production		-0.03372	-0.03336	-0.03316	-0.03311
		(2.69)**	(2.59)**	(2.58)**	(2.28)*
Year-2005			0.18252	0.19365	0.07209
			(1.41)	(1.49)	(0.57)
Year-2006			0.17659	0.17918	0.14244
			(1.96)*	(1.99)*	(1.57)
Year-2007			0.14501	0.14778	0.14105
			(1.82)	(1.86)	(1.75)
Year-2008			-0.03463	-0.04026	-0.00129
			(0.49)	(0.57)	(0.02)
Year-2009			0.02517	0.02502	-0.01456
			(1.29)	(1.29)	(0.61)
OSHAS 18000 Certification				-0.00338	-0.00786
				(0.02)	(0.05)
Total Hours Worked				0.00000	0.00000
				(1.30)	(1.08)
Control of Corruption					-0.91249
					(4.81)**
Political Stability					0.77714
					(5.05)**
Voice and Accountability					0.43087
					(3.16)**
Constant	-16.43915	-16.40302	-16.59651	-16.61324	-15.94527
	(85.17)**	(84.52)**	(83.85)**	(81.39)**	(59.33)**
Turning Point 1	268.4681	324.4726	377.5501	378.9892	301.2992
Turning Point 2	818.541	-19060	-13.63377	-15.22872	1336.995
Observations	985	985	985	985	985
Number of facilities	252	252	252	252	252
R-sq within	0.0051	0.0023	0.0142	0.0159	0.0287
R-sq between	0.0168	0.1656	0.1810	0.1838	0.2497
R-sq overall	0.0016	0.0976	0.1118	0.1143	0.1983
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

Table 74. (log) Lost-Time Incident Ratio– Country GDP and Per Capita Consumption Included as Economic Indicators

	(1)	(2)	(3)	(4)	(5)	(6)
	Controlling for Country GDP Only	Controlling for Country GDP and Per Capita Consumption	Controlling for Production Type	Controlling for Time	Controlling for OSHAS Certification and Hours Worked	Controlling for Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	0.07981	-0.02959	-0.00124	0.02741	0.02516	0.03941
	(1.35)	(0.35)	(0.01)	(0.31)	(0.29)	(0.43)
Country GDP- squared	-0.00548	-0.00075	-0.00052	-0.00145	-0.00130	-0.00557
	(1.89)	(0.19)	(0.13)	(0.36)	(0.32)	(1.34)
Country GDP-cubed	0.00007	0.00001	-0.00000	0.00001	0.00000	0.00008
	(1.87)	(0.24)	(0.05)	(0.11)	(0.07)	(1.46)
Per Capita Consumption		0.00235	0.00107	0.00187	0.00178	-0.00568
		(0.65)	(0.30)	(0.52)	(0.50)	(1.59)
Per Capita Consumption-squared		-0.00000	0.00000	-0.00000	-0.00000	0.00002
		(0.07)	(0.09)	(0.24)	(0.22)	(1.31)
Per Capita Consumption-cubed		-0.00000	-0.00000	0.00000	0.00000	-0.00000
		(0.16)	(0.21)	(0.18)	(0.16)	(0.88)
Bottled Water Production			-0.01137	-0.01189	-0.01178	-0.00973
			(3.18)**	(3.24)**	(3.21)**	(2.49)*
Juice Production			0.00636	0.00676	0.00683	0.00869
			(2.43)*	(2.47)*	(2.44)*	(3.41)**
Coffee/Tea Production			-0.01930	-0.02168	-0.02175	-0.02214
			(5.09)**	(5.50)**	(5.55)**	(5.58)**
Syrup Production			-0.06075	-0.06100	-0.06256	-0.05164
			(5.34)**	(4.79)**	(4.67)**	(3.00)**
Other Bottling Production			-0.02473	-0.02453	-0.02439	-0.02499
			(1.96)*	(1.83)	(1.82)	(1.83)
Year-2005				0.20189	0.20916	0.01331
				(1.51)	(1.56)	(0.10)
Year-2006				0.17074	0.17270	0.08849
				(1.89)	(1.91)	(0.97)
Year-2007				0.16219	0.16363	0.11901
				(2.04)*	(2.06)*	(1.47)
Year-2008				-0.02326	-0.02738	-0.06750
				(0.33)	(0.38)	(0.92)
Year-2009				0.01588	0.01544	-0.02938
				(0.64)	(0.62)	(1.06)
OSHAS 18000 Certification					0.07849	0.07551
					(0.49)	(0.48)
Total Hours Worked					0.00000	0.00000
					(1.19)	(1.11)

Table 74 (continued).

Control of Corruption						-0.18223
						(0.83)
Political Stability						0.75915
						(4.48)**
Voice and Accountability						0.51378
						(3.44)**
Constant	-16.69201	-16.48145	-16.49435	-16.76737	-16.78125	-15.55927
	(58.50)**	(48.91)**	(49.14)**	(47.75)**	(47.66)**	(36.57)**
Turning Point 1 (GDP)	39.84173	52.67484	-138.0713	152.5063	217.7901	40.4787
Turning Point 2 (GDP)	8.91972	-14.31748	-1.196599	10.109	10.1259	3.877081
Observations	980	980	980	980	980	980
Number of facilities	252	252	252	252	252	252
R-sq within	0.0018	0.0002	0.0005	0.0114	0.0129	0.0359
R-sq between	0.1399	0.1467	0.2549	0.2640	0.2639	0.3200
R-sq overall	0.1180	0.1283	0.1973	0.2067	0.2070	0.2656
Robust z statistics in parentheses						
* significant at 5%; ** significant at 1%						

APPENDIX D

COUNTRY-SPECIFIC ENVIRONMENTAL

POLICY/PERFORMANCE PROFILES

Table 75. Country Profile: Argentina

Country	**ARGENTINA**	
Population[1]		39 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person), 2007	2,736,690 0.826
Form of Government[2]	Republic	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	-0.394 0.159 0.369
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$12,544.62
Natural Resources[2]	fertile plains of the pampas, lead, zinc, tin, copper, iron ore, manganese, petroleum, uranium	
Key Environmental Issues[2]	• environmental problems (urban and rural) typical of an industrializing economy • air pollution water pollution note: Argentina is a world leader in setting voluntary greenhouse gas targets	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	7,011
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	90% 96%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	4.66 183,577
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998 2001 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	*48.73%* *0.90*
2010 Environmental Performance Index[4]		61.0
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	*318* *11*

Table 75 (continued).

Environmental Policy Context	Gulezian (2009) conducts a comprehensive study of the evolution of environmental policy in Argentina within a study of the country's most comprehensive environmental law to date, the Ley de Bosques (Forest Law), which regulates the growing and trade of soy. She finds that recent regime change in Argentina (following the country's economic crisis in 2001) has opened the country up to more thoughtful consideration of environmental and social policies. The government in place prior to 2001 was notoriously corrupt and eliminated many policies and regulations before the economic crisis ultimately resulted in their departure. Environmental NGOs have become more influential within Argentina post-2001 – this includes local organizations as well as those with global connections – however, they have had more of an impact on environmental capacity building than implementation of specific policies. The three most influential environmental NGOs in Argentina are Greenpeace Argentina, Vida Silvestre and the Foundation for the Environment and Natural Resources (FARN). Argentina is a member of Mercosur (a coalition of South American countries), however, Gulezian finds that the country's participation has not influenced its environmental policy. According to Vazquez-Brust, et.al. (2010), the era of the 1990s was marked with command-and-control regulation after the country's Environmental Secretariat was created in 1991. Between then and the economic crisis in 2000-2001, issues like climate change, community involvement and sustainability dominated the policy agenda, mirroring the hot topics of the environmental community rather than the real problems facing the country. Although environmental policy has taken on new importance since the economic crisis, resource constraints and social issues facing much of Argentina's population have hindered progress. Vazquez-Brust, et.al., see the role of corporations as critical to ensuring Argentina's environment improves. As such, future environmental policies at the national level should encourage firms to step up to stakeholder pressures.
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 76. Country Profile: Australia

Country	**AUSTRALIA**	
Population[1]		21 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	7,682,300
Form of Government[2]	Federal parliamentary democracy and a Commonwealth realm	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	2.05 0.95 1.36
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$33,848.11
Natural Resources[2]	bauxite, coal, iron ore, copper, tin, gold, silver, uranium, nickel, tungsten, rare earth elements, mineral sands, lead, zinc, diamonds, natural gas, petroleum **note:** Australia is the world's largest net exporter of coal accounting for 29% of global coal exports	
Key Environmental Issues[2]	• industrial development, urbanization, and poor farming practices • soil salinity rising due to the use of poor quality water • clearing for agricultural purposes threatens the natural habitat of many unique animal and plant species limited natural freshwater resources	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	23,348
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	100% 100%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	17.74 373,739
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998 2007 2008
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	55.38% 3.3%
2010 Environmental Performance Index[4]		65.7
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	319 14

Table 76 (continued).

Environmental Policy Context	Bulkeley (2000) discusses the role of local governments in greenhouse policy in Australia, in light of reports suggesting local government actions control over half of greenhouse gas emissions in that country. The national government of Australia has recognized the role that local governments play and is supporting the development of best practices in areas like Newcastle. The Australian government has provided funding to ICLEI, the International Council of Local Environmental Initiatives, and their Cities for Climate Protection (CCP) program, which has been embraced by more Australian municipalities than in any other country. Connection between local, national and global initiatives is important to ensure local best practices do not thrive in isolation and do not result in meaningful contributions to overall environmental change.
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 77. Country Profile: Brazil

Country	**BRAZIL**	
Population[1]		190 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	8,459,420 0.32
Form of Government[2]	Federal republic	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	-0.11 -10.35 0.51
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$9,196.42
Natural Resources[2]	bauxite, gold, iron ore, manganese, nickel, phosphates, platinum, tin, rare earth elements, uranium, petroleum, hydropower, timber	
Key Environmental Issues[2]	• deforestation in Amazon Basin destroys the habitat and endangers a multitude of plant and animal species indigenous to the area • air and water pollution in Rio de Janeiro, Sao Paulo, and several other large cities • land degradation and water pollution caused by improper mining activities wetland degradation	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	28,546
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	78% 95%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	1.94 368,015
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998 2002 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	31.27 18.3
2010 Environmental Performance Index[4]		63.4
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	229 37
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.	

Table 78. Country Profile: Canada

Country	**CANADA**	
Population[1]		33 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	9,093,510 1.37
Form of Government[2]	Parliamentary democracy, a federation, and a constitutional monarchy	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	1.99 1.37 1.02
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$36,073.63
Natural Resources[2]	iron ore, nickel, zinc, copper, gold, lead, rare earth elements, molybdenum, potash, diamonds, silver, fish, timber, wildlife, coal, petroleum, natural gas, hydropower	
Key Environmental Issues[2]	• air pollution and resulting acid rain severely affecting lakes and damaging forests • metal smelting, coal-burning utilities, and vehicle emissions impacting on agricultural and forest productivity ocean waters becoming contaminated due to agricultural, industrial, mining, and forestry activities	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	86,426
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	100% 100%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	16.89 556,884
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998 2002 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	*7.43%* *2.5%*
2010 Environmental Performance Index[4]		66.4
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	*236* *8*

Table 78 (continued).

Environmental Policy Context	Paehlke (2000) describes Canada's reduction in focus on environmental policy over the 1990s, after being recognized as a leader early on in the global environmental movement. He cites three reasons for this slide: globalization, conflicting push from the public (between economic and environmental concerns), and decentralization of environmental authority from Canada's national government to the provincial level. Environmental spending in the national government was reduced by approximately one-third. Paehlke discusses the fact that environmental policy-making in Canada has been relatively closed, less inclusive than the United States. Canada's image as an environmental leader may be as much about its natural features as its focus or enforcement of environmental laws and regulations. While globalization hindered Canada in the 1990s, Paehlke hopes that environmental pressures from globalization (e.g., participation in global accords such as Kyoto) will override the economic forces. Granzeier (2000) acknowledges Canada's loss of leadership but points to bright spots as well. Canada remains a leader on forestry and fisheries policy. Forestry policy leadership is apparent at the provincial level (British Colombia), where Canada's national leadership on fisheries has driven international policy through the North Atlantic Fisheries Organization (NAFO). Environmental leaders across Canada were surprised at Canada's positioning in the Kyoto Protocol negotiations, which were seen as only slightly more progressive than those of the United States. Adamowicz (2007) responds to a 2004 OECD report that assessed Canada's environmental policy approaches, finding that it lagged other countries in the use of cost-benefit analysis and other economic and market-based approaches to solving environmental problems. Adamowicz discusses the reasons why this is the case and offers ideas for how the economics profession can contribute to making Canada more of a leader in this area. He agrees with the OECD assessment that Canada has favored softer policies, such as voluntary initiatives, and says the data on environmental indicators demonstrates a need for the country to be more aggressive with its policies. He suggests that expertise exists in the environmental economics field to help national and provincial governments design market-based policies and assess their success. He points to early progress made in some provincial governments to develop incentive-based programs for environmental improvement.
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 79. Country Profile: Chile

Country	**CHILE**	
Population[1]		16.6 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	743.530 0.08
Form of Government[2]		Republic
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	1.34 0.40 1.04
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$13.047
Natural Resources[2]	copper, timber, iron ore, nitrates, precious metals, molybdenum, hydropower	
Key Environmental Issues[2]	• widespread deforestation and mining threaten natural resources • air pollution from industrial and vehicle emissions water pollution from raw sewage	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	53,147
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	96% 96%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	4.31 71,645
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998 2002 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	
2010 Environmental Performance Index[4]		73.3
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	445 13

Table 79 (continued).

Environmental Policy Context	Silva (1997) details the environmental legacy of the military government that ruled the country from 1973-1989 and the initial period of democratic rule that followed, where the new government promised environmental reforms to attack some of the key issues in the country. The military government reduced regulations in an effort to improve the country's economy, which had some detrimental environmental effects. For example, the fisheries industry, though prospering economically, at the time of the transition from military to democratic rule, was averaging twice the maximum sustainable yield (MSY) of the nation's waters. As in many developing countries, forest resources also took a hit, as plantation farming cleared natural species of trees. The mining and agricultural sectors were also allowed to grow unimpeded, with significant impacts to water and air quality. Urban environments saw the brunt of the pollution. Biodiversity was threatened, with almost 70 species of Chilean flora and 6 species of birds and mammals in danger of extinction. The environmental movement, which started in the 1960s with the formation of NGOs, was quelled substantially during the military government's rule. However, one issue, climate change, took a priority for the government in the second half of the 1980s, after a national scientific conference sounded the alarm on a whole host of environmental issues. The military government latched onto climate change as a priority for four reasons: 1) action for developing countries was delayed, so there was minimal start-up cost, 2) Chile assumed that technology transfer from other countries would be possible, 3) Chile needed good publicity for its military government, which was seen in a negative light by the rest of the world, and 4) climate negotiations took place elsewhere (i.e., there was little risk that the negotiations themselves would instigate conflict within the country). As the democratic government took over in 1990, while there was a commitment to environmental change, the overall position of the government and population was to make gradual, rather than drastic, change. An Environmental Framework Law was instituted in 1994, with four major principles: prevention (of impacts), the polluter pays (for cleanup), gradualism, and participation. In general, the move from dictatorship to democracy increased Chile's level of focus and institutionalization of environmental policy, partially confirming the common hypothesis that democracy improves the environment. However, Silva believes this view should be tempered by several considerations: more influence by the movement can mean more influence on the movement; increased stakeholder influence on government action does not mean all stakeholders have influence; those who are most aligned with the agendas of political leaders are the ones who most readily gain access.
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 80. Country Profile: China

Country	**CHINA**	
Population[1]		1.3 billion
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	9,327,480 0.08
Form of Government[2]	Communist state	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	-0.59 -0.52 -1.70
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$5,238
Natural Resources[2]	coal, iron ore, petroleum, natural gas, mercury, tin, tungsten, antimony, manganese, molybdenum, vanadium, magnetite, aluminum, lead, zinc, rare earth elements, uranium, hydropower potential (world's largest)	
Key Environmental Issues[2]	• air pollution (greenhouse gases, sulfur dioxide particulates) from reliance on coal produces acid rain • water shortages, particularly in the north • water pollution from untreated wastes; deforestation estimated loss of one-fifth of agricultural land since 1949 to soil erosion and economic development	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	2,134
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	53% 86%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	4.98 6,533,019
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998 2002 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	56% 40.8%
2010 Environmental Performance Index[4]		49.0
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	34 37

Table 80 (continued).

Environmental Policy Context	Grumbine details 3 key drivers to China's rise in global importance: the size and scale of the country (land area, population and economic growth rate), the policies of the central government, and globalization. China opened up its economy in 1978, and since then has favored economic growth over environmental protection. National and provincial government targets, until recently, have been tied to economy, not environment. The government's goal from 2005 to 2020 is to quadruple GDP while doubling energy use. China continues to rely on coal as its primary energy source. Environmental degradation, political instability, coal and oil consumption, and rising CO_2 emissions are China's primary constraints to growth. The Chinese central government recognizes that opportunities exist to reduce energy consumption by transitioning away from coal and driving efficiency in the transportation and building sectors. National legislation has been passed to spur renewable energy development, with $180 billion in funding. The government has also passed vehicle taxes to drive inefficient vehicles (e.g., SUVs) out of the market, strict fuel standards and emissions controls, and transit system requirements. These laws are more strict than those in the U.S. However, economic growth in China continues to outpace spending on environmental improvements (per $ GDP). Grumbine believes international assistance in the form of technology transfer and financial assistance is critical to turn the tide. Chan (2004) describes the evolution of environmental policy in China and the embrace of international environmental treaties over the course of the 1980s and 1990s, soon after the government opened up the country. He assesses China's compliance with these environmental treaties. He notes that the first international meeting China participated in after joining the UN in 1971 was the UN Conference on the Human Environment in 1972. China's first National Environmental Protection Bureau was actually housed in the Ministry of Construction, pointing to the priority that growth has long played in the country. China's environmental protection bureau can be over-ruled by the Congress, and local protection bureaus can often get their own way in disagreements, depending on relative power of provincial governments. China's central government operates against five-year plans that are put together with different themes. The tenth five-year plan (2001-2005) included comprehensive environmental policies on "pollution control, biological/ecological protection, and the development of an environmental industry." However, competition between environment and economic development, low awareness/understanding, inconsistencies in how laws are applied, and corruption in government result in such laws rarely being followed. In general, China's state environmental protection agency adheres to five basic principles in international environmental policy discussions: 1) there should be a balance between economic growth and environmental protection, 2) developed countries should consider the needs of developing countries, 3) because developed countries are more advanced with solutions, even though they are still contributing to problems, they should provide technologies and other assistance to developing countries, 4) sovereignty should be respected, and countries should not interfere with each other's domestic affairs, and 5) peace and stability should be considered alongside environmental protection and development. Generally, China has attempted to keep to the spirit of the environmental agreements it has signed; however, the rapid pace of economic growth has not allowed it to fully meet all goals. Capacity building and assistance from other countries is needed, as well as an increase in understanding and action by China's citizenry (both in terms of taking individual action and demanding the government do more).

Table 80 (continued).

	Liu (2008) uses a combination of quantitative analysis and field research to study the linkages between economic development and local community sustainability leadership in China. The Chinese government's "Eco-Communities" program is an effort to encourage local cities and provinces to improve environmental quality and overall community sustainability. Municipalities designated as "Eco-Communities" must score a certain level on a points-based system, the scoring of which is based on various policies and programs put in place at the local level. Liu's analysis indicates that it is not always the wealthiest communities that demonstrate leadership. Though the wealthier provinces in China have led in eco-community designation, at the local level, it is not always the wealthiest communities within a province that step up to lead. Therefore, Liu (2008) points to opportunities in solving environmental problems early in a community's development (versus after a "peak" in environmental degradation has been reached). Auffhammer and Carson (2008) forecasted China's CO_2 emissions through 2010, using data through 2004. They project emissions much higher than other models using a dynamic model that accounts for spatial variations (where other models use time-series data for cross-country analyses), rejecting the EKC hypothesis/models in favor of these more dynamic models. Auffhammer and Carson use province-level data covering the time period from 1985 to 2004. They describe three previous approaches to forecasting emissions levels: IPAT (impact = population x affluence x technology), EKC and input-output models. Rather than forcing data to fit one of these existing models, they allow the data to drive which model fits best. Auffhammer and Carson (2008) predicted that China would overtake the U.S. in CO_2 emissions by 2006, rather than in 2020 as indicated in other models. Their approach allows for the use of much shorter time-series (because of the utility and richness of province-level information).
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 81. Country Profile: France

Country	**FRANCE**	
Population[1]		63.8 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	547,660 0.29
Form of Government[2]	Republic	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	1.44 0.52 1.25
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$30,554
Natural Resources[2]	metropolitan France: coal, iron ore, bauxite, zinc, uranium, antimony, arsenic, potash, feldspar, fluorspar, gypsum, timber, fish	
Key Environmental Issues[2]	• air pollution from industrial and vehicle emissions water pollution from urban wastes, agricultural runoff	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	3,133
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	100% 100%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	5.82 371,452
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998 2002 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	53.72% 3.5%
2010 Environmental Performance Index[4]		78.2
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	143 6

Table 81 (continued).

Environmental Policy Context	Szarka chronicles the history and state of environmental policy in France within the context of case studies on the use of “new” policy instruments (eco-taxation, voluntary approaches and eco-labeling programs). He describes the French style of policy as having both a top-down and bottom-up character – top-down from the standpoint of unilateral (and traditionally quite progressive) environmental legislation, but bottom-up in terms of implementation. As a result of this duality, a host of organizations and networks have developed. At the national level, the main government actors are the Environment Ministry and the Agency for Environment and Energy Efficiency (“the active arm of the Environment Ministry”). Major early environmental laws in France were the 1975 Waste Act, the 1976 Nature Conservation Act and the 1976 Licensed Sites Act. While in recent years the French government has delved into new policy approaches, driven by increased activism, increasing public concern, and increasing environmental threats. However, although market-based approaches, voluntary programs and eco-labeling schemes are all in place, (at least as of 2003) they have been less effective than traditional modes of policy.
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 82. Country Profile: Germany

Country	**GERMANY**	
Population[1]		82.3 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	348,670 0.14
Form of Government[2]	Federal republic	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	1.70 1.01 1.38
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$33,363
Natural Resources[2]	coal, lignite, natural gas, iron ore, copper, nickel, uranium, potash, salt, construction materials, timber, arable land	
Key Environmental Issues[2]	• emissions from coal-burning utilities and industries contribute to air pollution • acid rain, resulting from sulfur dioxide emissions, is damaging forests pollution in the Baltic Sea from raw sewage and industrial effluents from rivers in eastern Germany; hazardous waste disposal	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	1,300
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	100% 100%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	9.57 787,291
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998 2002 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	48.61% 2.2%
2010 Environmental Performance Index[4]		73.2
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	179 27

Table 82 (continued).

Environmental Policy Context	In the early days of environment policy in Germany, the federal system of government minimized the role of the central government. From its early days (late 19th century), environment policy took on “abstract principles,” such as the concept of Best Available Technology, which came about at the turn of the century. The role of the federal government became stronger by the 1950s, when The ‘Precautionary Principle,’ ‘Polluter Pays Principle,’ and ‘Cooperation Principle’ arose in German laws (and were later “uploaded” to the EU level). The first focus for national government laws was water and air pollution, with the Water Household Act of 1957 and the Air Maintenance Law of 1959. Germany’s Federal Agency for the Environment was established in 1974, though it was 1986, as a response to the Chernobyl nuclear disaster in Russia, that this agency was elevated to Ministry level (it was named the Federal Ministry for Environment, Nature Protection and Reactor Safety). Economic concerns in the 1970s took focus away from environment policy, and little new policy was created; however, in the late 1970s and early 1980s an increasing environmental consciousness took hold. This led to agreement across political parties to pursue an “activist agenda” to improve the environment. German unification led to economic concerns that again took focus away from environmental policy in the 1990s. The conflict between economic and environmental concerns meant political conflict which slowed down progress. However, Germany remains a leader in environmental policy. Voluntary agreements have a long history in Germany, though market-based instruments have not been embraced (Lees, 2007).
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 83. Country Profile: India

Country	**INDIA**	
Population[1]		1.12 billion
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	2,973,190 0.14
Form of Government[2]	Federal republic	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	-0.42 -1.17 0.43
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$2,686
Natural Resources[2]	coal (fourth-largest reserves in the world), iron ore, manganese, mica, bauxite, rare earth elements, titanium ore, chromite, natural gas, diamonds, petroleum, limestone, arable land	
Key Environmental Issues[2]	• deforestation and soil erosion • air pollution from industrial effluents and vehicle emissions • water pollution from raw sewage and runoff of agricultural pesticides • tap water is not potable throughout the country huge and growing population is overstraining natural resources	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	1,134
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	28% 85%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	1.43 1,611,043
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	 2002 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2005	60.44% 55.8%
2010 Environmental Performance Index[4]		48.3
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	11 49

Table 83 (continued).

Environmental Policy Context	India participated actively in both the 1972 UN Human Environment Conference and the Rio Earth Summit in 1992, taking actions in between to develop its environmental policies. In India there has been a great struggle to cope with the issues of economic development and population growth (of both humans and animals). The most significant side effects of industrial development in India have been the following: deforestation, polluting industries, water and air pollution, urbanization (unplanned), environmental refugees (displaced from mining and dam megaprojects), pesticides and agriculture. Prior to 1972, environmental concerns were all dealt with by different agencies. However, in 1972 there was an effort to integrate an approach through the creation of the National Committee on Environmental Planning and Coordination. Later, an Office of Environmental Planning and Coordination was established, which ultimately became the Ministry of Environment and Forests. Post-Stockholm, India was the first country to amend its constitution for environmental change. However, environmental progress was slow due to changes in leadership and difficulty coordinating among agencies. Some progress occurred over the next decade or so, and the Environmental Protection Act of 1986 improved the policy framework for action. Environment had also become a broader priority of the government over that time period. The major focus areas were water and air pollution, with discharge standards, monitoring and fines for non-compliance. As of 1995, five (of the more than 2 dozen) laws formed the backbone of India's approach to environmental protection: the Water Act of 1974, the Air Act of 1981, the Environmental Protection Act of 1986, the Forest (Conservation) Act of 1980 and National Forest Policy of 1988. The staff of the environment ministry grew from around 250 in 1982 to over 1,000 in 1991. Although the federal ministry grew in size and importance, much authority for implementation of policies rested with India's state governments. States varied in their uptake of policies and their implementation and performance. There were often turf battles between the various levels of government involved in policy development and implementation. Regulated industries often found "the cost of compliance [was] greater than the cost of defiance," and government regulators did not have the resources required to enforce laws and regulations. There was a lack of grassroots support (public pressure) for industries to improve or the government to act to ensure compliance (Dwivedi and Khator, 1995). Agrawal and Yokozuka (2001) offer optimism with acknowledgement of growing public awareness of environmental concerns. They point to examples from India's past, where mass political movements made change on other issue areas. They also mention the growing influence of NGOs in the country, which they believe offers hope. Environmental degradation has arisen as a major concern across India, "emerging as potentially one of the most pressing sources of conflict and crisis in India." By 2050, some project industry to generate over 40% of national output and agriculture, which has traditionally been very important, to only contribute 5%. Air emissions "will increase by 6 times unless new technologies are found and used to ensure cleaner fuels inside and outside the household." The political process is democratic and theoretically allows citizen participation to drive for change. However, in practice it is not so easy. Decentralization is still a relatively new phenomena, and some natural resources are still managed by the central government in top-down fashion.

Table 83 (continued).

	There is sometimes gridlock between the central government and state governments. Government has been unwilling to push industry to comply with government regulations, and historically there has not been awareness and action by the citizenry. A new set of environmental actors has emerged on the scene, however. These include international donor agencies, international and local NGOs and the news media. There is hope that these actors can engage the public to create change. There are opportunities in the judicial system for public and other interested parties to sue polluters and/or the government. There is also opportunity to leverage science and technical institutes/universities to educate the public and continue to raise awareness. GDP growth in India as of 2002 was in the 6% per year range, with energy consumption doubling over the past decade. In 2001, coal sources made up 71% of power generation. Population and economic growth, energy intensity, urbanization, appliance stock, energy pricing, energy availability, and environmental impacts of energy consumption are all trends that impact future energy use scenarios. Reddy and Balachandra project future energy consumption in India, along with corresponding CO_2 emissions. Economic reforms, regulatory instruments, social programs and technology development are needed to balance economic growth and environment. Changes to energy pricing policy, environmental and renewable energy policies are required. The Indian government should leverage the international focus on the issues to overcome the technical, financial, and institutional barriers to implementation of effective policies (Reddy and Balachandra, 2003).
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 84. Country Profile: Italy

Country	ITALY	
Population[1]		59.4 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	294,140 0.12
Form of Government[2]	Republic	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	0.22 0.46 1.09
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$28,765
Natural Resources[2]	coal, mercury, zinc, potash, marble, barite, asbestos, pumice, fluorspar, feldspar, pyrite (sulfur), natural gas and crude oil reserves, fish, arable land	
Key Environmental Issues[2]	• air pollution from industrial emissions such as sulfur dioxide • coastal and inland rivers polluted from industrial and agricultural effluents • acid rain damaging lakes inadequate industrial waste treatment and disposal facilities	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	3,074
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	- 100%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	7.68 456,054
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998 2002 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	47.22% 4%
2010 Environmental Performance Index[4]		73.1
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	139 11
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.	

Table 85. Country Profile: Japan

Country	**JAPAN**	
Population[1]		128 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	364,500 0.03
Form of Government[2]	Parliamentary government with a constitutional monarchy	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	1.21 0.98 0.97
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$31,659
Natural Resources[2]	negligible mineral resources, fish	
Key Environmental Issues[2]	• air pollution from power plant emissions results in acid rain acidification of lakes and reservoirs degrading water quality and threatening aquatic life	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	3,365
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	100% 100%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	9.8 1,253,517
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998 2002 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	12.76% 4.2%
2010 Environmental Performance Index[4]		72.5
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	178 29
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.	

Table 86. Country Profile: Mexico

Country	**MEXICO**	
Population[1]		109 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	1,943,950 0.23
Form of Government[2]	Federal republic	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	-0.25 -0.66 0.04
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$12,905
Natural Resources[2]	petroleum, silver, copper, gold, lead, zinc, natural gas, timber	
Key Environmental Issues[2]	• rural to urban migration • natural freshwater resources scarce and polluted in north, inaccessible and poor quality in center and extreme southeast • raw sewage and industrial effluents polluting rivers in urban areas • deforestation, widespread erosion; desertification and deteriorating agricultural lands • serious air and water pollution in the national capital and urban centers along US-Mexico border land subsidence in Valley of Mexico caused by groundwater depletion **note:** the government considers the lack of clean water and deforestation national security issues	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	3,745
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	82% 93%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	4.31 471,073
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998 2000 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	52.73% 13.5%
2010 Environmental Performance Index[4]		67.3
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	675 54

Table 86 (continued).

Environmental Policy Context	Environmental concerns were not considered in public policy in Mexico in the 1950s and 1960s but emerged in the 1970s and became more apparent in the 1980s. Mexico's first environmental law, the Federal Law to Prevent and Control Environmental Pollution, established in 1971, included provisions on air, water and land pollution. Mexico's National Policy on Ecology and the Environment (built on the General Law of Ecological Balance and Environmental Protection) is "based on the principle that ecosystems are the common property of all Mexicans" and "aims to achieve the general objective: the planning and execution of government actions and of all new projects shall require that natural resources are a strategic asset for national sovereignty and an essential reserve for future generations." The basic idea is to balance economic growth and environmental protection with long-term policies. Public concern for the environment became apparent with a survey in the late 1980s that ranked the environment as a bop issue. Mexico's president (Salinas) at the time of the Rio Summit in 1992 was outspoken relative to Mexico's support of sustainable development goals, but at the same time, like other developing country leaders, pushed for respect to individual country's sovereignty, vs. enforcement of international regulations on developing countries by developed economies (Janetti-Diaz, et.al., 1995). Since 1992, there have been reforms (deregulation) to Mexican energy policy that now allows for more private participation in energy generation. The law now allows: co-generation/self-generation below 30 mega-watts, the selling of electricity generated by independent power producers to the government-owned electric utility, export of electricity generated by private parties, importing of electricity for private use, and private generation of electricity specifically for emergencies (when the state-owned utilities are down). Likewise, for natural gas, it is possible for the private sector to "participate in the construction, operation and ownership of transport, storage and distribution systems, as well as in the regional commercialization and exports and imports." At the same time, environmental policies aimed at improving fuels have led to increased use of natural gas. While some fuel oil generation is switching to coal, coal power production was projected to drop from 11.2 to 7.7% from 1996 to 2006. Nuclear power generation was projected to remain constant over that time period, with small increases in hydro-electric and geothermal. Though Mexico has significant natural gas resources, the costs for exploration suggested that most demand would be realized through imports. Even with shifts to natural gas, based on lack of significant investment in the other environmentally-friendly technologies, CO_2 emissions were expected to increase overall (Bauer and Quintanilla, 2000).

Table 86 (continued).

	Tortajada (1998) calls for a more integrated and comprehensive approach to water management, in light of the fact that some people called gastrointestinal disease the most pressing environmental problem in Mexico in the 1997-1998 time frame. Mexico's Law of National Waters was updated in 1992 with regulations promulgated in 1994 to drive "(1) systematic monitoring and evaluation of water quality, (2) establishment of a set of water quality standards, (3) establishment of a discharge permit and effluent charge system and (4) construction of wastewater treatment plants and sewerage facilities." The government's subject Water Program (to play out over the course of 1995-2000, included specific projects in rural and urban areas, "macroprojects" in the largest cities, and projects on the northern border and specific river basins. Investment in the infrastructure projects was planned to be a split of federal government funds, state funds and third-party funds (loans and funding from development agencies). Other general and environmental laws governed the projects, namely the General Law for Ecological Equilibrium and Environmental Projection, first issued in 1998 and updated in 1997, and the Federal Tax Law. The complexity of regulations has allowed some industry to skirt compliance, and some politicians have worked to keep compliance fees low to ensure re-election. Though environmental impact statements for all big projects have been required since the 1980s, these assessments have often been mechanical in nature and have missed the bigger picture of environmental risk and opportunity. The public has been unable to adequately engage in policy processes or driving for improvement since most of the information on environmental impacts and improvement projects is controlled by the government. Mexico is considered an upper-middle class country based on GDP per capita, but has many of the problems of a rapidly-developing emerging economy. Mexico suffered serious environmental degradation since World War II, and the main environmental problems are water supply and quantity, air quality, biodiversity and waste/hazardous waste. The government's approach to environmental protection evolved in three stages, beginning with the country's first major environmental law in 1972. The second stage was marked by reforms to that original law in 1982. And, the third stage, beginning in 1988, included a "comprehensive overhaul" of that legislation and the establishment of two new government ministries, the Secretariat for Social Development and the Secretariat for Environment, Natural Resources and Fisheries. In 1996, the General Law on Ecological Equilibrium and Environmental Protection (the latest iteration in the national framework law) was updated to bring it current with movements within and external to the country, to establish sustainable development as more of a national priority, etc. This and other laws utilize a mix of regulatory instruments, from command-and-control to market-based and voluntary mechanisms. Recently, there has been a greater focus on partnerships with private sector organzations. Enforcement of regulations has been weak due to lack of government resources and regulated entities' desires (and ability) to pay fines instead of complying. The rapid growth of environmental regulations/focus since 1988 has given Mexico much needed capacity to protect the environment, but it still lags more industrialized nations. Moving forward, further integration of existing laws and regulations, as well as integration of environmental protection with broader country goals, is critical (Mumme and Lybecker, 2001).

Table 86 (continued).

	As focus on sustainable development and environmental planning has advanced beyond a focus purely on economic development (and relevant infrastructure enhancements) and clean-up of environmental degradation, innovative tools to map Mexico's watersheds and to develop enhanced ecosystem indicators have been critical in regional planning. There exists a lot of potential for using outputs from these types of tools to drive a more comprehensive approach to sustainable development (Bocco, et.al., 2010). According to Miller, et.al. (2010), though evidence is mixed, and it is hard to determine whether NAFTA itself had an impact on the environment in Mexico, it likely resulted in a "ratcheting down" of sustainability/environmental protections in the country. Other factors make it difficult to determine it's true effects. Increase in foreign investment in manufacturing has increased the scale of manufacturing, meaning increased emissions, though environmental standards per se have not been impacted.
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 87. Country Profile: Nigeria

Country	**NIGERIA**	
Population[1]		147 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	910,770 0.26
Form of Government[2]	Federal republic	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	-0.95 -1.97 -0.75
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$1,882
Natural Resources[2]	natural gas, petroleum, tin, iron ore, coal, limestone, niobium, lead, zinc, arable land	
Key Environmental Issues[2]	• soil degradation and rapid deforestation • urban air and water pollution • oil pollution - water, air, and soil • loss of arable land rapid urbanization	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	1,504
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	92% 57%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	0.65 95,194
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	 2004 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2004	86% 44.6%
2010 Environmental Performance Index[4]		40.2
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	28 13

Table 87 (continued).

Environmental Policy Context	Adeoti (2008) evaluates environmental policy in Nigeria and the response of industry. He notes that, though most of Africa lags behind the rest of the world in environmental policy, Nigeria, South Africa, Zimbabwe and Egypt are exceptions. Nigeria has actually had environmental policy in place longer than South Africa. A federal environmental agency was established in 1988, which became the Ministry of Environment in 2000. Largely, environmental policy is command-and-control, though the recent dialogue on climate change has led the country to consider market-based instruments. Policy enacted in the early 1990s established minimum standards for industrial pollution; Nigerian states may enact more stringent location than is in place at the national level. Adeoti's survey of industrial firms in Nigeria show that environmental performance is driven by the "intricate links between the prevailing regime of environmental policy under which firms are operating and the economic, social and environmental motives of firms." Adeoti suggests that future policies should incorporate environment with other business objectives (e.g, consider environmental policy alongside R&D or innovation policy), and the role of third parties (e.g., NGOs and other stakeholders) should also be considered, as they have an impact on the performance of firms. Akinwumi, et.al. (2001) highlight the "crisis state" that Nigeria's urban environment faced as of 2001, as well as natural resource constraints in rural areas. They discuss land clearing/deforestation, mining, soil erosion, industrial activities and consumption patterns as primary environmental impacts/issue areas. Although the Federal Environmental Protection Agency (FEPA) set up in 1988 created a "blueprint" for environmental policy, set up field offices in major cities, and created state environmental protection agencies (SEPAs). However, largely, Nigerian environmental policy has failed because of the lack of embrace by the Nigerian people. One success story has been Environmental Sanitation Day, which takes place once a month. This policy has worked because it engages everyone, in a bottoms-up manner. Akinwumi et.al., suggest policies like this should be considered moving forward. Shifting to an "environmentally-friendly culture" will require education, mass mobilization, adequate incentives and legislation (with penalties as needed).
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 88. Country Profile: Philippines

Country	**PHILIPPINES**	
Population[1]		88.7 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	298,170 0.06
Form of Government[2]	Republic	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	-0.695 -1.56 -0.14
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$3,303
Natural Resources[2]	timber, petroleum, nickel, cobalt, silver, gold, salt, copper	
Key Environmental Issues[2]	• uncontrolled deforestation especially in watershed areas • soil erosion • air and water pollution in major urban centers increasing pollution of coastal areas, including mangrove swamps and reefs	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	5,403
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	73% 90%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	0.799 70,858
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998 2003 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	38.6% 35.1%
2010 Environmental Performance Index[4]		65.7
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	144 23

Table 88 (continued).

Environmental Policy Context	The Philippine Council for Sustainable Development, created by government (executive) order in 1993, has responsibility for implementing the country's sustainable development plan. The council includes representatives from government agencies, civil society and business. The main government agencies involved are the National Economic and Development Authority (NEDA), the Department of Environment and Natural Resources (DENR) and the Department of Foreign Affairs. Similar to the U.K.'s plan, there is limited legal framework driving the national plan (it is not based in a national law, per se), but there is some integration with national planning and budgeting processes (Swanson and Pinter, 2006).
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 89. Country Profile: Russia

Country	**RUSSIA**	
Population[1]		142 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	16,400,000 0.86
Form of Government[2]	Federation	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	-0.95 -0.86 -0.99
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$14,016
Natural Resources[2]	wide natural resource base including major deposits of oil, natural gas, coal, and many strategic minerals, reserves of rare earth elements, timber **note:** formidable obstacles of climate, terrain, and distance hinder exploitation of natural resources	
Key Environmental Issues[2]	• air pollution from heavy industry, emissions of coal-fired electric plants, and transportation in major cities • industrial, municipal, and agricultural pollution of inland waterways and seacoasts • deforestation; soil erosion; soil contamination from improper application of agricultural chemicals urban solid waste management; abandoned stocks of obsolete pesticides	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	30,351
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	87% 96%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	10.81 1,536,099
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1999 200 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	13.16% 9%
2010 Environmental Performance Index[4]		61.2
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	69 14

Table 89 (continued).

Environmental Policy Context	Feldman and Blokov (2009) report on a survey of opinion leaders (environmental NGOs, news media, scientific community, corporations, and public agencies.) on the role and prospect for civil society to affect environmental outcomes in Russia. The paper chronicles the current role of civil society in Russia and its evolution over three previous time periods: Communist rule from 1917-1985, the "waning years" of Communist rule (1985-1991) and the post-1991 era. Historically, the role of civil society in the development and enforcement of environmental policy has been unimportant, for a variety of reasons: NGO participation by the public has been low; NGOs have been controlled by the government; government is not seen as having accountability to citizens; and, there has been little expectation that laws would be followed if enacted. The opening up of Russia through the Gorbachev years presented opportunity; however, disappointment arose when government leaders tried to do too much, too fast. Emphasis on economic growth continues to threaten environmental improvement. The government has not been strengthened to adequately govern and enforce policies when enacted. And, corruption exists in the private sector, much of which grew about through the privatization of state resources (leaving many of the same players, and corruption that existed, in place). The national environmental agency sits within the Ministry of Natural Resources, which represents business interests in the exploitation of natural resources to grow the country's economy. The most important environmental laws seen by the survey respondents include the 1991 Law on Nature Protection and law reforms regarding environmental enforcement. Public participation is viewed as most critical on laws/regulations regarding urban planning, water pollution and nuclear power.
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 90. Country Profile: South Africa

Country	**SOUTH AFRICA**	
Population[1]		48.3 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	1,214,470 0.30
Form of Government[2]	Republic	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	0.22 0.20 0.59
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$9,373
Natural Resources[2]	gold, chromium, antimony, coal, iron ore, manganese, nickel, phosphates, tin, rare earth elements, uranium, gem diamonds, platinum, copper, vanadium, salt, natural gas	
Key Environmental Issues[2]	• lack of important arterial rivers or lakes requires extensive water conservation and control measures • growth in water usage outpacing supply • pollution of rivers from agricultural runoff and urban discharge • air pollution resulting in acid rain soil erosion and desertification	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	928
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	75% 89%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	8.98 433,173
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	 2002 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	81.83% 8.8%
2010 Environmental Performance Index[4]		50.8
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	254 16

Table 90 (continued).

Environmental Policy Context	Russouw and Wiseman (2004) provide an assessment of South Africa's environmental regulations post-apartheid. During apartheid, the environment was more important than minorities – natural resources were protected for the benefit of white South Africans (e.g., through the creation of game parks). Only with the first democratic elections in 1994 were Blacks given a voice. Changes to the Constitution through the transition that marked the end of apartheid resulted in a rights-based approach to government at all levels (national, provincial and local). Each level of government has a role in environmental policy. In 1995, the South African government initiated a year-long process to develop updated environmental policy for the country. This resulted in the Environmental Management Policy for South Africa, which was established in 1998. This was not the first environmental policy the government had in place (an Environmental Conservation Act was put in place in 1982 and amended in 1989). While many were pleased with this important milestone, local government was not consulted in the policy-setting process, nor was consideration made for the role of local councils in environmental management. There was no engagement of civil society in implementation and monitoring, and there was little follow-up on commitments made in the law. Therefore, initial progress towards implementing the law and its spirit was slow. South Africa is heavily reliant on coal, which provides over 70% of the country's primary energy demand and 93% of electricity generation. This puts South Africa above all other countries on CO_2 emissions per capita and per unit of GDP. Critics say government policy has been weak in attempting to reverse emissions growth, which has been outpacing GDP growth. Energy consumption leads to more CO_2 emissions, which result in economic growth in the short-run and long-run. Therefore, in order to reduce CO_2 emissions, with the current energy portfolio (reliance on coal) South Africa must sacrifice economic growth, which it is unlikely to do. Therefore, policies to encourage more alternative energy sources are needed (Menyah and Wolde-Rufael, 2010).
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 91. Country Profile: Spain

Country	**SPAIN**	
Population[1]		44.9 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	499,110 0.28
Form of Government[2]	Parliamentary monarchy	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	1.00 -0.15 1.1
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$28,521
Natural Resources[2]	coal, lignite, iron ore, copper, lead, zinc, uranium, tungsten, mercury, pyrites, magnesite, fluorspar, gypsum, sepiolite, kaolin, potash, hydropower, arable land	
Key Environmental Issues[2]	• pollution of the Mediterranean Sea from raw sewage and effluents from the offshore production of oil and gas • water quality and quantity nationwide • air pollution deforestation and desertification	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	2,478
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	100% 100%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	8.0 358,965
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998 2002 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	56% 4.5%
2010 Environmental Performance Index[4]		70.6
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	284 15

Table 91 (continued).

Environmental Policy Context	EU policies (namely the EU Common Agricultural Plan, or CAP) put subsidies in place over the time period of 1986-1992. In the agricultural areas of Spain, significant shifts in crops took place, and increased water intensive crops put demands on the water resources in the region. Conflicts between the national-level Water Act (updated in 1985) and the needs of the local region put additional stress on water management. Local governments attempted to fix the problems but did not have the resources to manage the situation. Up to 20,000 unregistered wells exist in one region (over half of the total), exacerbating the situation. In this region, the Castilla-La Mancha Regional Government passed a plan that would included compensating farmers for water conservation measures. Many farmers participated in the program, and the plan was deemed a huge success. However, over much of the time period since the plan was put in place, Spain has received significant rainfall (the plan was put in place in 1992, in the midst of a significant drought from 1991-1995). Therefore, it has been difficult to determine the role of the plan in driving desired environmental incomes. However, the Plan has resulted in the creation of local associations and networks for water management; this and the engagement of farmers is projected to have long-term benefit. However, more strenuous policies may be needed in light of EU directives on water management, which call for recovering aquifers and ecosystems by 2015 (Martinez-Santos, et.al., 2008).
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 92. Country Profile: Thailand

Country	**THAILAND**	
Population[1]		67.8 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	510,890 0.22
Form of Government[2]	Constitutional monarchy	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	-0.38 -1.11 -0.60
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$7,249
Natural Resources[2]	tin, rubber, natural gas, tungsten, tantalum, timber, lead, fish, gypsum, lignite, fluorite, arable land	
Key Environmental Issues[2]	• air pollution from vehicle emissions • water pollution from organic and factory wastes deforestation and soil erosion	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	3,311
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	96% 98%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	4.09 277,284
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1999 2002 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	38.46 41.7
2010 Environmental Performance Index[4]		62.2
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	94 7

Table 92 (continued).

Environmental Policy Context	*Direct reprint from Daniere and Takahashi, 1999:* "In general, the Thai government is highly centralized. The national government, based in Bangkok, exerts great influence over both provincial agencies charged with delivering specific services as well as over local municipal governments. Bangkok is somewhat of an exception to this pattern in that the Bangkok Metropolitan Authority (BMA). the municipal agency responsible for managing many local level services, does have some power and quite a few financial resources to implement policies and projects relatively free from national intervention. The institutional structure of the National Environmental Board, for example, was reconfigured in 1994 presumably to enhance the effectiveness of environmental regulations. The restructuring of the Board was prompted by a growing awareness on the part of Thai policy makers of the economic consequences associated with deteriorating environmental conditions especially in terms of tourism and business investments." In recognition of the need for engagement by all citizens in environmental action, some work has been done at the municipal level (e.g., in Bangkok) to engage even slum-dwellers in water and waste management efforts. The Thai government has made good headway in education efforts (raising the education level of the average Thai citizen). Perhaps these efforts can be leveraged/tied to citizen engagement for the environment.
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 93. Country Profile: Turkey

Country	**TURKEY**	
Population[1]		70 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	769,630 0.31
Form of Government[2]	Republican parliamentary democracy	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	0.08 -0.84 -0.16
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$12,488
Natural Resources[2]	coal, iron ore, copper, chromium, antimony, mercury, gold, barite, borate, celestite (strontium), emery, feldspar, limestone, magnesite, marble, perlite, pumice, pyrites (sulfur), clay, arable land, hydropower	
Key Environmental Issues[2]	• water pollution from dumping of chemicals and detergents • air pollution, particularly in urban areas deforestation	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	3,243
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	89% 97%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	4.12 288,444
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	 2009 2009
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	*51.33%* *23.5%*
2010 Environmental Performance Index[4]		60.4
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	*159* *8*

Table 93(continued).

Environmental Policy Context	Over 2/3 of Turkey's energy demand, mostly oil is imported. Turkey's energy demand is expected to almost double between 2010 and 2020. Population is growing, and energy use per capita is also growing. Energy production in the country is growing, with increases in across all sectors (most significant in electricity, solar, geothermal and hydropower). Current energy policies in the country are designed to increase uninterrupted supply with growing demand. Renewables have declined as a proportion of the energy mix due to the decreased use of biomass for home heating – however, this is an environmental benefit due to concerns regarding deforestation and air quality impacts of burning. Renewables remained fairly steady as a percentage of energy generation over the period of 2002-2006. Turkey received a loan of over $200 million from World Bank to provide assistance to developers of renewable energy sources. There is good potential for solar, geothermal and wind. Turkey delayed ratification of the Kyoto Protocol until 2008 and is not subject to specific Kyoto targets. A new energy policy is under development which will focus on renewable sources of electricity generation. Recent prioritization in the energy sector will affect energy pricing. Agriculture is the leading employer in Turkey, and agricultural output has increased dramatically since 1990, though its share of employment and GDP declined over that time period. Subsistence farming is significant, and most farms (85%) are small (below 9 hectares). Government support to agriculture has declined over the last 10 years, with most support now being in direct payments and not subsidies that increase production intensity and environmental pressure. Though agricultural intensity in Turkey is lower than in other OECD countries, environmental impacts have increased since 1990. The growth of pesticide use has grown more rapidly in Turkey than almost any other OECD country. Agricultural reforms updated in 1995 included a focus on protecting environmentally sensitive areas. There have been lands dedicated as permanent pasture land, which protects them from certain environmental impacts. However, issues remain with degradation of agricultural soils, erosion and overgrazing. The growth of agriculture produces increasing amounts of biomass, which may be a potential source for renewable energy. There are as of yet no biomass-to-energy generation facilities, but this could be another option on the horizon (Kaygusuz, 2010).
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 94. Country Profile: United Kingdom

Country	**UNITED KINGDOM**	
Population[1]		61 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	241,930 0.10
Form of Government[2]	Constitutional monarchy and Commonwealth realm	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	1.72 0.52 1.33
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$34,115
Natural Resources[2]	coal, petroleum, natural gas, iron ore, lead, zinc, gold, tin, limestone, salt, clay, chalk, gypsum, potash, silica sand, slate, arable land	
Key Environmental Issues[2]	• continues to reduce greenhouse gas emissions (has met Kyoto Protocol target of a 12.5% reduction from 1990 levels and intends to meet the legally binding target and move toward a domestic goal of a 20% cut in emissions by 2010) by 2005 the government reduced the amount of industrial and commercial waste disposed of in landfill sites to 85% of 1998 levels and recycled or composted at least 25% of household waste, increasing to 33% by 2015	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	2,378
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	100% 100%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	8.84 539,176
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998 2002 2005
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	73% 1.4%
2010 Environmental Performance Index[4]		74.2
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	204 7

Table 94 (continued).

Environmental Policy Context	The United Kingdom was "the first industrial democracy in which an identifiable environmental policy domain was to develop," much prompted by environmental pollution concerns in cities after the industrial revolution. The first wave of policies specific to the environmental policy domain, dating back to the mid-19th century, were very specific in nature, targeted to specific environmental concerns and/or impacts (e.g., the 1863 Alkali Act). Even a century later, U.K. environment policy employed a specific problem-solving approach. However, environment was often integrated with other policy domains (for example, public health) which were much more holistic in their approach. Underlying environmental policies was an "institutional architecture" consisting of agencies and procedures for mitigating concerns. Prior to 1970, up to ten different government agencies were involved in environmental policy making. However, the creation of the Department in 1970 was an attempt to streamline policy making and authority. This department was later elevated to the now cabinet-level Ministry of Environment, Food and Rural Affairs. The U.K. has recently embraced "new" environmental policy instruments (Lees, 2007). Swanson and Pinter (2006), a report prepared for the OECD highlights the top-down approach to sustainable development planning in the U.K. in the analysis of several countries' progress against the development of national sustainability plans as called for in the "Earth Summits" at Rio de Janeiro in 1992 and Johannesburg (ten years later). The NSD in the U.K., though not based on a legal framework per se, is somewhat integrated with national Budgeting and Planning. The U.K. Sustainable Development Program, established in 2005 was a build on the original version from 1999. The updated version attempts to integrate more broadly across government, both horizontally (across various national government functions) and vertically (through the multiple levels of government). The report lists the U.K. plan as a best practice in the area of integration across government. The plan also sets up a non-governmental advisory panel to monitor progress against the plan. U.K. environment policy has traditionally focused on regulatory measures. Policy has been "informal, reactive, gradualist and accommodative," which has included consultation, rather than imposition, of mandates on regulated parties. However, voluntary agreements have not been part of U.K. policy until recently. The U.K. was a late-comer to "new" policy instruements. However, various pressures and drivers have increased use of new policy instruments over the last several years. Economic concerns in the 1990s led governments to look for more cost-effective ways to regulate. There has been more receptivity to ideas from elsewhere. The "Europeanization" of environmental policy has helped, though not necessarily in the top-down sense (from the EU). Rather, countries have learned from each other through more interaction across the EU. Specific EU directives, though not mandating the use of market-based and other new instruments, have forced member states to innovate with policies. However, the EU also serves as a constraint to innovation, with approval requirements for certain policies (that sometimes get mired in bureaucracy). The use of voluntary agreements is trending towards aspiration-type commitments and benchmarking rather than true negotiated (binding) commitments, somewhat in the spirit of Kyoto dialogue on climate change (Jordan, et.al., 2xxx).

Table 94 (continued).

Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

Table 95. Country Profile: United States

Country	UNITED STATES	
Population[1]		302 million
Land Area[1]	Total (sq.km.) Arable Land Per Capita (hectares per person)	9,161,920 0.57
Form of Government[2]	Constitution-based federal republic; strong democratic tradition	
Governance Indicators[1]	Control of Corruption Political Stability and Absence of Violence/Terrorism Voice and Accountability	1.29 0.23 1.09
Economic Development[1]	GDP per Capita[1] (PPP, Constant 2005 International $), 2007	$43,660
Natural Resources[2]	coal, copper, lead, molybdenum, phosphates, rare earth elements, uranium, bauxite, gold, iron, mercury, nickel, potash, silver, tungsten, zinc, petroleum, natural gas, timber **note:** the US has the world's largest coal reserves with 491 billion short tons accounting for 27% of the world's total	
Key Environmental Issues[2]	• air pollution resulting in acid rain in both the US and Canada • the US is the largest single emitter of carbon dioxide from the burning of fossil fuels • water pollution from runoff of pesticides and fertilizers limited natural freshwater resources in much of the western part of the country require careful management	
Freshwater Resources[1]	Renewable Internal Freshwater Resources per Capita (cubic meters), 2007	9,344
Access to Improved Sanitation and Water Sources[1]	Improved Sanitation (% access), 2005 Water Sources (% access), 2005	100% 99%
CO_2 Emissions[1]	CO_2 emissions per capita (metric tons), 2007 Total CO_2 emissions (kt), 2007	19.33 5,832,194
Kyoto Protocol[3]	Year Signed Year Ratified Year Protocol went tnto Effect	1998
Agricultural Economy[1]	Agricultural Land (% of Total), 2007 Employment in Agriculture (% of total), 2007	44.87% 1.4%
2010 Environmental Performance Index[4]		63.5
Coca-Cola Presence[5,6]	Per capita consumption of products, 2010 Number of Bottling Plants, 2010	394 87

Table 95 (continued).

Environmental Policy Context	The United States was a leader early on in environmental policy, creating the United States Environmental Protection Agency in 1970 and a host of environmental laws and regulations in the late 1960s and early 1970s (Clean Water Act, Clean Air Act, etc.), most of which have been updated since. Legislative frameworks for environmental policy have been copied by other countries; the U.S. has rarely copied others, except in the example of eco-labelling from Europe (Weidner and Janicke). Over the last several years, the United States' position on global environmental leadership has been questioned with the country's reluctance to ratify the Kyoto Protocol. A recent OECD document documenting best practices in national sustainable development plans (Swanson and Pinter, 2006) evaluated 16 [verify] countries but did not include the U.S. There were examples of leadership highlighted from American states, however. Brown and Sovacool (2010) also mention the role of states in renewable energy policy in the United States, which has somewhat filled the void left by the lack of leadership at the national level.
Sources for Profile	[1]WorldBank World Development Indicators Database (2011) [2]*CIA World Factbook*, country profile (2011) [3]U.N. Framework Convention on Climate Change (2006) [4]Yale Center for Environmental Law and Policy (2010) [5]The Coca-Cola Company (2011a) [6]The Coca-Cola Company (2011b) Sources for Environmental Policy Context listed in the References.

APPENDIX E

REGRESSION RESULTS FOR COUNTRY-SCALE INDICATORS COVERING TIME PERIOD LARGER THAN 1990-2010

Table 96. (log) CO_2 Emissions per Capita

	(1)	(2)	(3)	(4)	(5)	(6)
	Controlling for Country GDP Only	Controlling for City GDP and Population Density	Controlling for Time and Place Indicators	Controlling for Trade Intensity	Controlling for Time, Place and Institutional Variables	Controlling for Energy Indicators
Country GDP – PPP Adjusted (1,000 2005 International $)	0.22644	0.22653	0.22354	0.22315	0.21220	0.12322
	(9.91)**	(9.93)**	(9.28)**	(9.37)**	(5.72)**	(6.51)**
Country GDP- squared	-0.00525	-0.00525	-0.00523	-0.00523	-0.00503	-0.00306
	(7.57)**	(7.47)**	(7.40)**	(7.46)**	(5.73)**	(5.91)**
Country GDP-cubed	0.00004	0.00004	0.00004	0.00004	0.00004	0.00002
	(6.14)**	(6.03)**	(6.02)**	(6.05)**	(5.56)**	(5.52)**
Population density (people per sq. km of land area)		-0.00000	-0.00001	-0.00001	-0.00002	0.00006
		(0.11)	(0.37)	(0.22)	(0.67)	(1.08)
Year-1980			0.06470	0.07047		
			(1.00)	(1.05)		
Year-1981			-0.00526	0.00758		
			(0.08)	(0.11)		
Year-1982			-0.00808	0.00733		
			(0.13)	(0.11)		
Year-1983			-0.03069	-0.01304		
			(0.48)	(0.20)		
Year-1984			-0.03930	-0.02200		
			(0.65)	(0.35)		
Year-1985			-0.02170	-0.00575		
			(0.38)	(0.09)		
Year-1986			-0.05753	-0.04100		
			(1.04)	(0.70)		
Year-1987			-0.01247	-0.00035		
			(0.23)	(0.01)		
Year-1988			-0.01331	-0.00364		
			(0.25)	(0.06)		
Year-1989			-0.00328	0.00689		
			(0.06)	(0.12)		
Year-1990			-0.04063	-0.02884		
			(0.66)	(0.43)		
Year-1991			-0.04233	-0.02645		
			(0.74)	(0.43)		
Year-1992			0.03314	0.04884		
			(0.60)	(0.83)		
Year-1993			0.01870	0.03359		
			(0.35)	(0.58)		
Year-1994			-0.00421	0.00939		
			(0.09)	(0.18)		

Table 96 (continued).

Year-1995			0.03919	0.04914		
			(1.03)	(1.26)		
Year-1996			0.04824	0.06089	0.06151	0.00666
			(1.38)	(1.70)	(1.68)	(0.20)
Year-1997			0.05242	0.06223		
			(1.61)	(1.83)		
Year-1998			0.01989	0.02988	0.03400	-0.01111
			(0.72)	(1.02)	(1.10)	(0.37)
Year-1999			0.02016	0.03261		
			(0.77)	(1.15)		
Year-2000			0.01633	0.02243	0.03120	-0.02507
			(0.73)	(0.94)	(1.11)	(1.00)
Year-2001			0.03295	0.04017		
			(1.44)	(1.65)		
Year-2002			0.02125	0.02825	0.02874	-0.02636
			(0.97)	(1.18)	(1.08)	(1.42)
Year-2003			0.04243	0.04819	0.04857	-0.00015
			(2.17)*	(2.28)*	(2.02)*	(0.01)
Year-2004			0.04532	0.04829	0.04928	0.01170
			(3.04)**	(2.90)**	(2.75)**	(0.79)
Year-2005			0.03596	0.03815	0.04087	0.01235
			(2.85)**	(2.68)**	(2.81)**	(0.99)
Year-2006			0.00867	0.01060	0.01342	-0.00255
			(1.13)	(1.19)	(1.42)	(0.31)
Trade (% of GDP)				0.00084	-0.00025	0.00037
				(1.14)	(0.25)	(0.56)
Political Stability and Absence of Violence/Terrorism: Estimate					0.00563	0.03381
					(0.21)	(1.12)
Voice and Accountability: Estimate					0.03192	0.07804
					(0.72)	(1.61)
Energy imports, net (% of energy use)						0.00015
						(0.53)
Constant	-0.83054	-0.83071	-0.81834	-0.89572	-0.75088	0.12824
	(5.35)**	(5.35)**	(4.59)**	(4.61)**	(3.22)**	(0.67)
Observations	4443	4443	4443	4329	1529	1136
Number of group(countryname)	180	180	180	176	176	128
Robust z statistics in parentheses						
* significant at 5%; ** significant at 1%						

Table 97. (log) Energy Use per Capita

	(1)	(2)	(3)	(4)	(5)	(6)
	Controlling for Country GDP Only	Controlling for City GDP and Population Density	Controlling for Time and Place Indicators	Controlling for Trade Intensity	Controlling for Time, Place and Institutional Variables	Controlling for Energy Indicators
Country GDP – PPP Adjusted (1,000 2005 International $)	0.12983	0.12964	0.13294	0.13252	0.09311	0.09904
	(10.13)**	(9.92)**	(10.59)**	(10.46)**	(6.30)**	(6.90)**
Country GDP- squared	-0.00259	-0.00264	-0.00272	-0.00272	-0.00180	-0.00194
	(7.52)**	(7.36)**	(7.91)**	(7.90)**	(4.73)**	(5.25)**
Country GDP-cubed	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001
	(5.68)**	(5.60)**	(5.88)**	(5.91)**	(3.94)**	(4.41)**
Population density (people per sq. km of land area)		0.00012	0.00009	0.00009	-0.00007	-0.00011
		(2.54)*	(2.09)*	(1.90)	(1.72)	(2.92)**
Year-1980			0.04492	0.03590		
			(1.00)	(0.80)		
Year-1981			0.04211	0.03325		
			(1.02)	(0.81)		
Year-1982			0.05834	0.05042		
			(1.42)	(1.23)		
Year-1983			0.05010	0.04280		
			(1.24)	(1.06)		
Year-1984			0.06566	0.05461		
			(1.63)	(1.39)		
Year-1985			0.06522	0.05473		
			(1.64)	(1.40)		
Year-1986			0.07017	0.06146		
			(1.85)	(1.62)		
Year-1987			0.07837	0.07208		
			(2.09)*	(1.91)		
Year-1988			0.07422	0.07350		
			(2.03)*	(1.99)*		
Year-1989			0.08129	0.07952		
			(2.33)*	(2.24)*		
Year-1990			0.10749	0.09608		
			(2.78)**	(2.39)*		
Year-1991			0.15199	0.14610		
			(3.87)**	(3.63)**		
Year-1992			0.14346	0.14247		
			(3.91)**	(3.82)**		
Year-1993			0.13022	0.12841		
			(3.69)**	(3.60)**		
Year-1994			0.11024	0.10895		
			(3.29)**	(3.22)**		

Table 97 (continued).

Year-1995			0.10940	0.10676		
			(3.41)**	(3.30)**		
Year-1996			0.11840	0.11528	0.08583	0.09767
			(3.75)**	(3.62)**	(3.30)**	(3.76)**
Year-1997			0.10950	0.10741		
			(3.58)**	(3.47)**		
Year-1998			0.10567	0.10325	0.08116	0.09151
			(3.62)**	(3.51)**	(3.61)**	(4.09)**
Year-1999			0.09821	0.09674		
			(3.48)**	(3.41)**		
Year-2000			0.09022	0.08735	0.06698	0.07419
			(3.25)**	(3.10)**	(3.21)**	(3.51)**
Year-2001			0.09112	0.08760		
			(3.34)**	(3.17)**		
Year-2002			0.08727	0.08373	0.06876	0.07429
			(3.21)**	(3.03)**	(3.44)**	(3.69)**
Year-2003			0.09731	0.09181	0.07900	0.08163
			(3.57)**	(3.30)**	(4.09)**	(4.17)**
Year-2004			0.10160	0.09602	0.07820	0.08324
			(3.68)**	(3.39)**	(4.06)**	(4.28)**
Year-2005			0.09687	0.09216	0.07781	0.07833
			(3.51)**	(3.26)**	(4.08)**	(4.02)**
Year-2006			0.08791	0.07999	0.07078	0.06915
			(3.20)**	(2.83)**	(3.80)**	(3.67)**
Year-2007			0.07963	0.07045	0.06663	0.06285
			(2.95)**	(2.53)*	(3.63)**	(3.43)**
Year-2008			0.05704	0.04634	0.05674	0.05155
			(2.12)*	(1.64)	(3.15)**	(2.84)**
Trade (% of GDP)				0.00013	0.00046	0.00072
				(0.26)	(0.98)	(1.55)
Political Stability and Absence of Violence/Terrorism: Estimate					-0.00253	-0.00039
					(0.14)	(0.02)
Voice and Accountability: Estimate					-0.00136	-0.00039
					(0.05)	(0.01)
Energy imports, net (% of energy use)						0.00049
						(4.56)**
Constant	6.09523	6.08317	5.97561	5.98750	6.26778	6.40298
	(56.19)**	(55.58)**	(52.41)**	(47.93)**	(43.39)**	(46.84)**
Observations	3572	3572	3572	3481	1402	1295
Number of group(countryname)	162	162	162	159	158	129
Robust z statistics in parentheses						
* significant at 5%; ** significant at 1%						

Table 98. (log) Life Expectancy

	(1)	(2)	(3)	(4)	(5)
	Controlling for Country GDP Only	Controlling for City GDP and Population Density	Controlling for Time and Place Indicators	Controlling for Trade Intensity	Controlling for Time, Place and Institutional Variables
Country GDP – PPP Adjusted (1,000 2005 International $)	0.01624	0.01633	0.00584	0.00606	0.00135
	(5.78)**	(5.82)**	(2.61)**	(2.68)**	(0.91)
Country GDP- squared	-0.00030	-0.00031	-0.00017	-0.00018	-0.00007
	(4.16)**	(4.24)**	(2.86)**	(3.08)**	(2.00)*
Country GDP-cubed	0.00000	0.00000	0.00000	0.00000	0.00000
	(3.25)**	(3.37)**	(2.78)**	(3.03)**	(2.19)*
Population density (people per sq. km of land area)		0.00001	0.00001	0.00001	0.00001
		(1.22)	(1.73)	(2.63)**	(1.95)
Year-1980			-0.10889	-0.10719	
			(12.03)**	(11.10)**	
Year-1981			-0.10437	-0.10193	
			(11.57)**	(10.56)**	
Year-1982			-0.09758	-0.09396	
			(10.99)**	(9.85)**	
Year-1983			-0.09235	-0.08823	
			(10.45)**	(9.28)**	
Year-1984			-0.08850	-0.08398	
			(10.21)**	(8.96)**	
Year-1985			-0.08425	-0.07981	
			(9.98)**	(8.72)**	
Year-1986			-0.08021	-0.07633	
			(9.81)**	(8.54)**	
Year-1987			-0.07565	-0.07206	
			(9.65)**	(8.41)**	
Year-1988			-0.07222	-0.06872	
			(9.45)**	(8.16)**	
Year-1989			-0.06850	-0.06483	
			(9.13)**	(7.91)**	
Year-1990			-0.06598	-0.06163	
			(9.02)**	(7.87)**	
Year-1991			-0.06379	-0.05933	
			(8.63)**	(7.49)**	
Year-1992			-0.06204	-0.05744	
			(8.34)**	(7.28)**	
Year-1993			-0.06062	-0.05609	
			(8.26)**	(7.20)**	
Year-1994			-0.05836	-0.05438	
			(8.47)**	(7.43)**	

Table 98 (continued).

Year-1995			-0.05565	-0.05151	
			(8.95)**	(7.82)**	
Year-1996			-0.05219	-0.04845	-0.05677
			(9.39)**	(8.21)**	(8.92)**
Year-1997			-0.04780	-0.04521	
			(9.87)**	(8.73)**	
Year-1998			-0.04524	-0.04247	-0.05023
			(10.55)**	(9.24)**	(10.24)**
Year-1999			-0.04204	-0.03880	
			(11.14)**	(9.62)**	
Year-2000			-0.03787	-0.03540	-0.04176
			(11.51)**	(9.73)**	(11.64)**
Year-2001			-0.03376	-0.03110	
			(11.51)**	(9.61)**	
Year-2002			-0.03005	-0.02715	-0.03327
			(11.62)**	(9.52)**	(11.88)**
Year-2003			-0.02667	-0.02428	-0.02925
			(12.17)**	(9.59)**	(12.15)**
Year-2004			-0.02207	-0.02046	-0.02412
			(12.45)**	(9.00)**	(12.57)**
Year-2005			-0.01842	-0.01723	-0.01950
			(13.28)**	(8.35)**	(12.59)**
Year-2006			-0.01376	-0.01366	-0.01457
			(13.93)**	(8.32)**	(11.94)**
yr2007			-0.00950	-0.00978	-0.00974
			(13.67)**	(6.92)**	(10.60)**
Year-2008			-0.00510	-0.00682	-0.00499
			(11.30)**	(5.81)**	(6.64)**
Trade (% of GDP)				0.00018	0.00002
				(2.30)*	(0.27)
Political Stability and Absence of Violence/Terrorism: Estimate					0.01062
					(1.73)
Voice and Accountability: Estimate					0.01524
					(2.49)*
Constant	4.06917	4.06789	4.19191	4.17246	4.22155
	(242.33)**	(243.17)**	(230.26)**	(212.54)**	(245.87)**
Observations	4872	4872	4872	4636	1826
Number of group(countryname)	183	183	183	179	177
Robust z statistics in parentheses					
* significant at 5%; ** significant at 1%					

APPENDIX F

EKC PLOTS FOR 21 IDENTIFIED COUNTRIES

Figure 24. EKC Plot for 21 Identified Countries – CO_2 Emissions

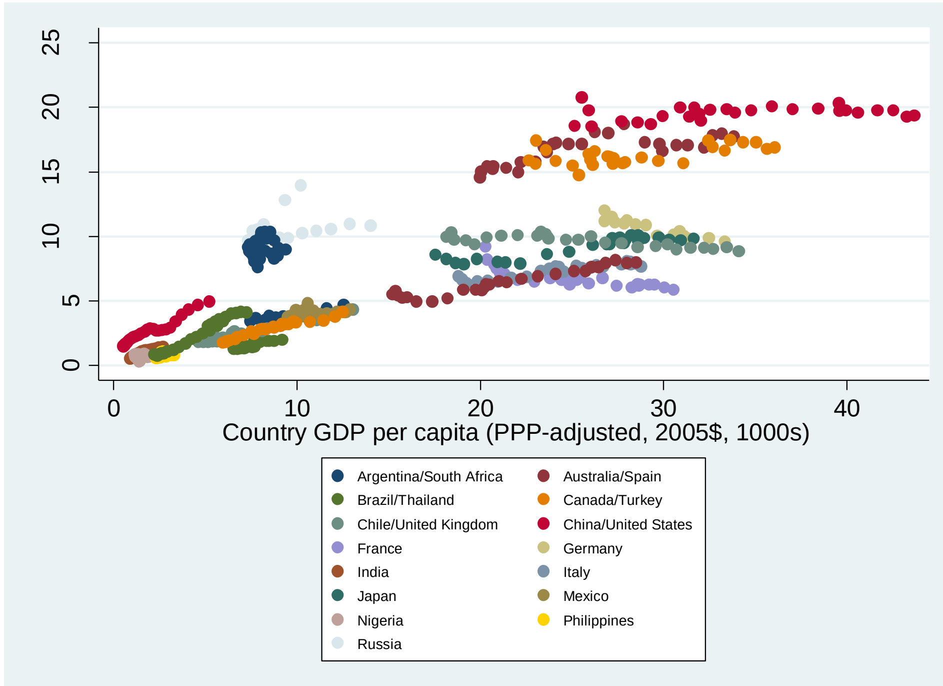


Figure 25. EKC Plot for 21 Identified Countries – Energy Use

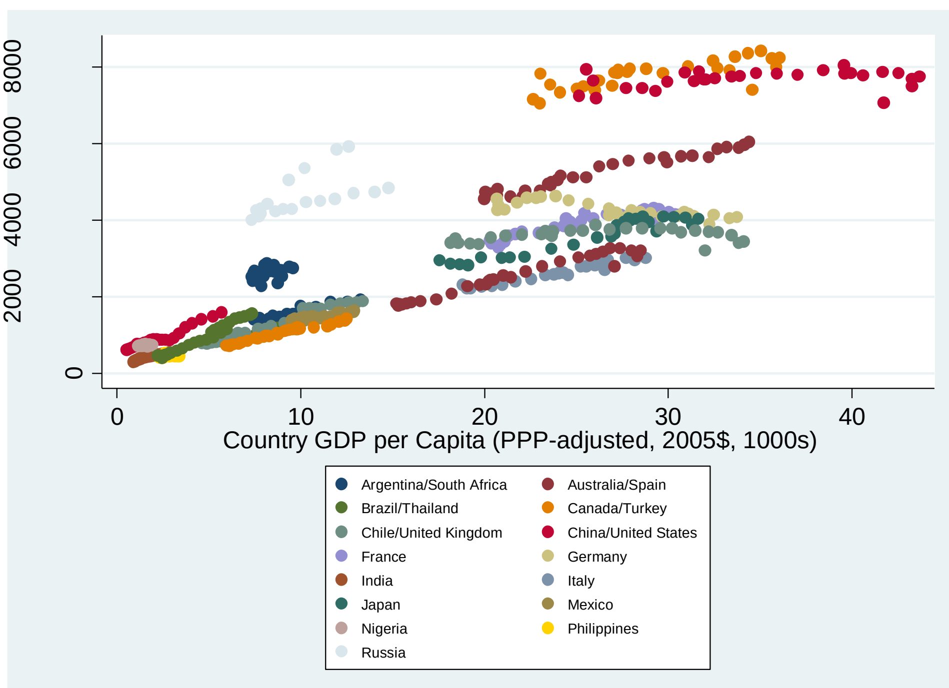


Figure 26. EKC Plot for 21 Identified Countries – Life Expectancy

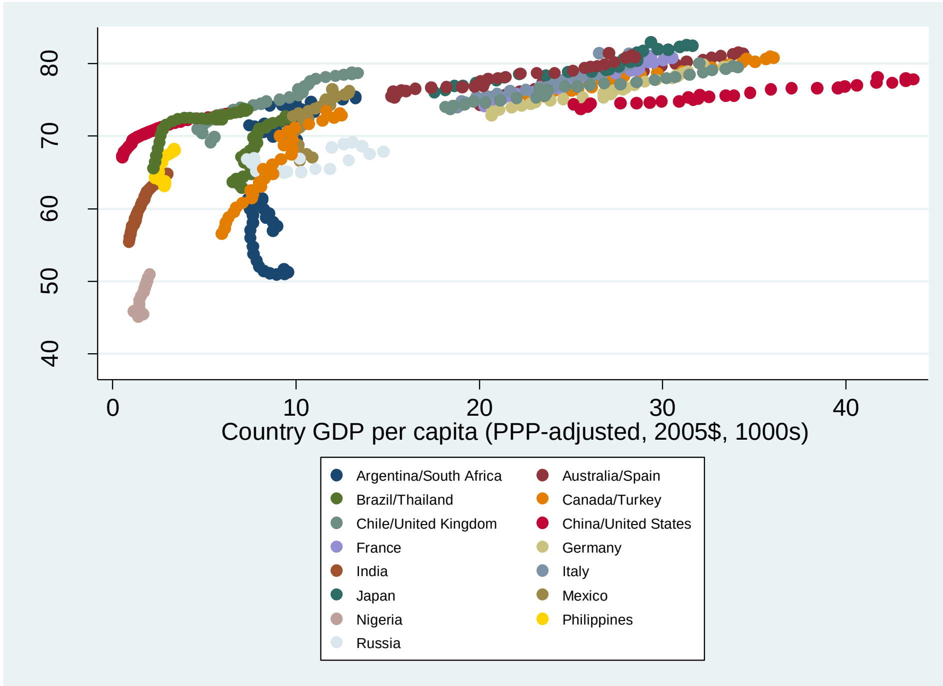


Figure 27. EKC Plot for 21 Identified Countries – Particulate Matter (PM_{10})

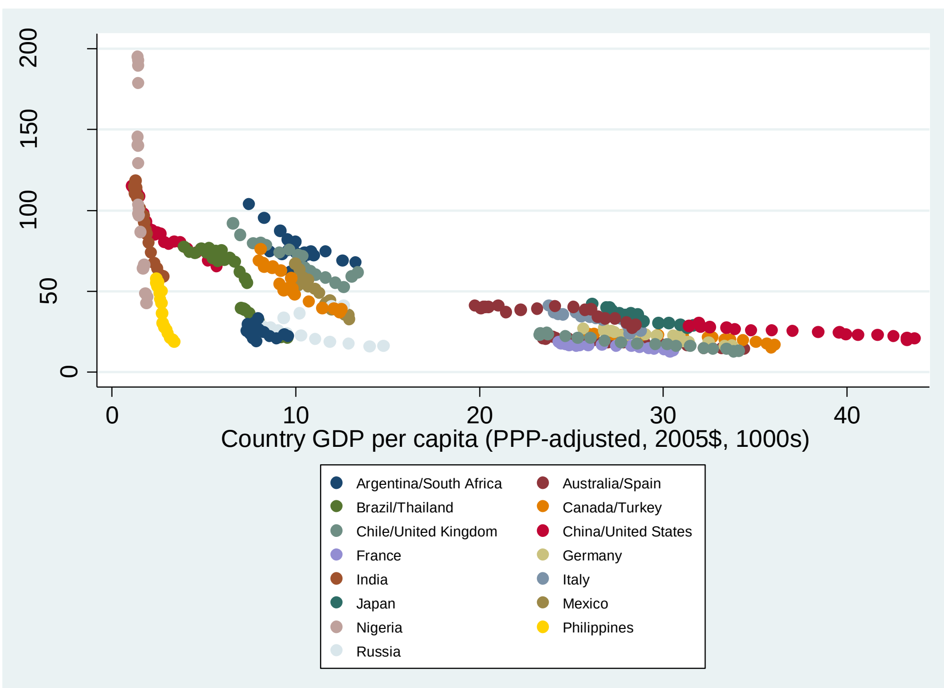


Figure 28. EKC Plot for 21 Identified Countries – Renewable Water Resources

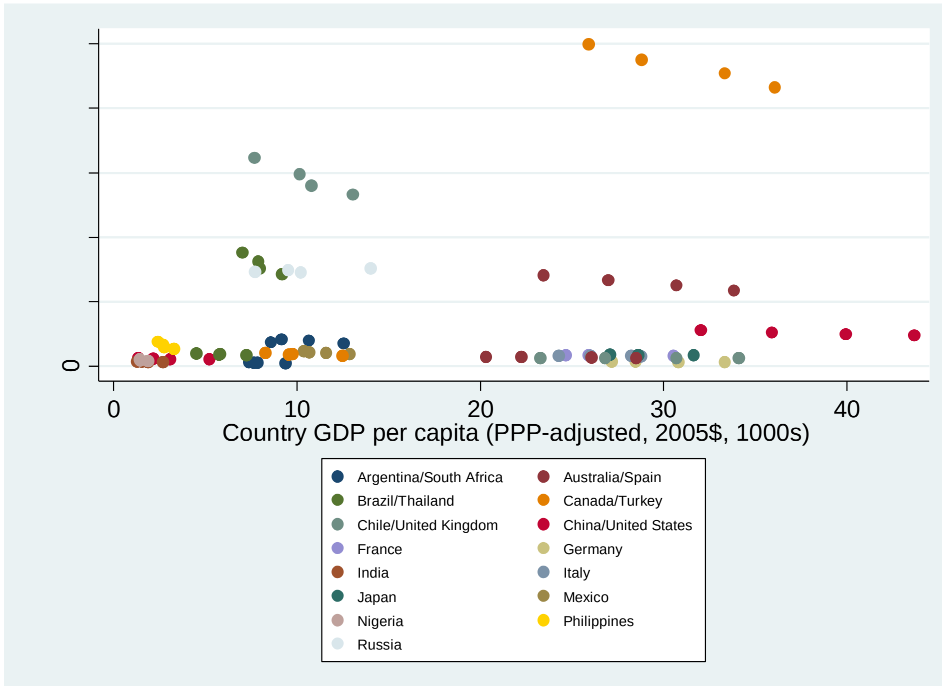


Figure 29. EKC Plot for 21 Identified Countries – Access to Improved Sanitation

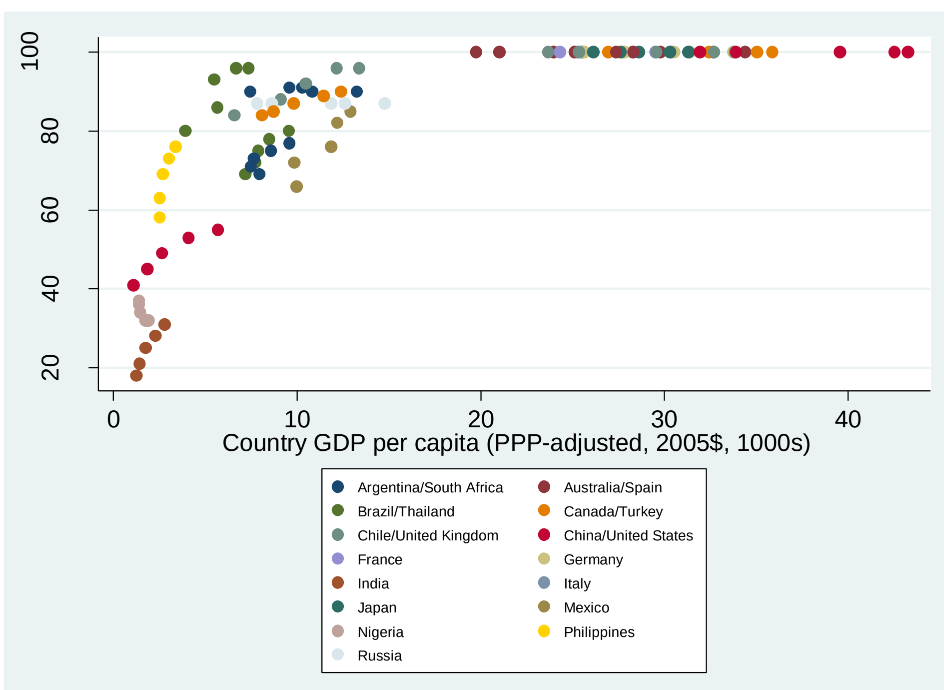


Figure 30. EKC Plot for 21 Identified Countries – Access to Improved Water Sources

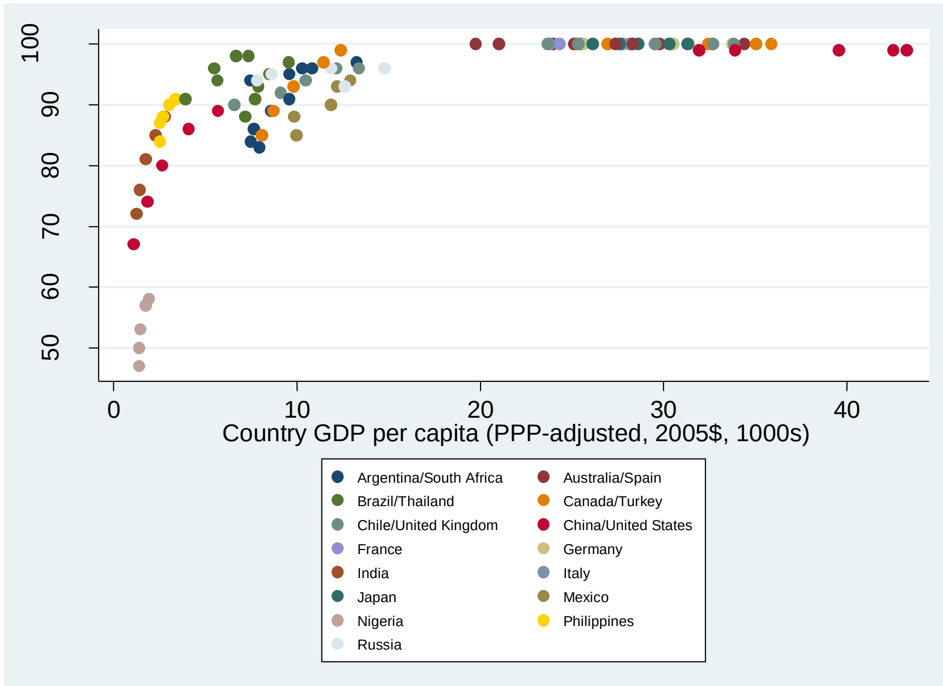
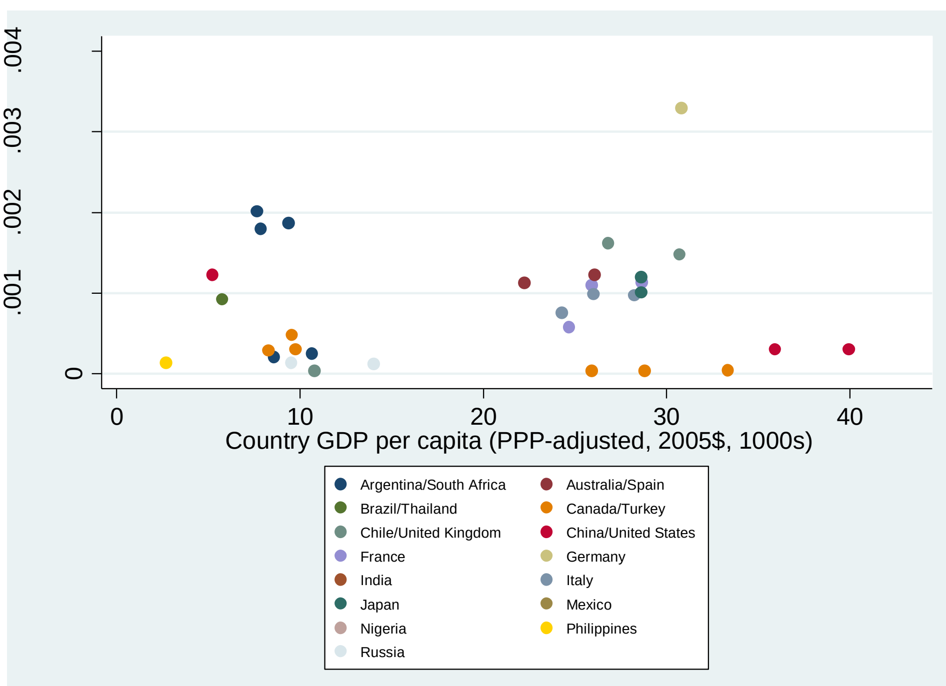


Figure 31. EKC Plot for 21 Identified Countries – BOD Concentration



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