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THE IMPACT OF NATURAL DISASTERS ON ECONOMIC GROWTH: A STUDY OF MEXICO AND CENTRAL AMERICA

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ABSTRACT OF THESIS

THE IMPACT OF NATURAL DISASTERS ON ECONOMIC GROWTH: A STUDY OF MEXICO AND CENTRAL AMERICA

Natural disasters have potentially large economic impacts on developing nations. There is a small, but growing literature analyzing these impacts on variables such as gross domestic product. In this study Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, and Nicaragua are studied to measure the impact that disasters have had on economic growth over the past twenty-nine years (1970-1998). The development indicator, gross domestic product (GDP) growth rate, will be measured over the twenty-nine year study period and analyzed with respect to correlation with natural disasters. Regression analysis is used to investigate the relationship between natural disasters and economic growth.

It is hypothesized that the number of natural disasters that a country faces has a negative impact on economic growth rate as measured by GDP. As the quantity of disasters experienced in any given year increases the overall disruption of the economy is predicted to be greater, thus leading to lower levels of economic growth in the short term.

KEYWORDS: Natural Disasters, Economic Growth, Developing Countries

Sharon Louise Garcia

14 April 2002

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THE IMPACT OF NATURAL DISASTERS ON ECONOMIC GROWTH: A STUDY OF MEXICO AND CENTRAL AMERICA

By

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April 14, 2002

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THESIS

Sharon Louise Garcia

The Graduate School

University of Kentucky

2002

THE IMPACT OF NATURAL DISASTERS ON ECONOMIC GROWTH: A STUDY OF MEXICO AND CENTRAL AMERICA

THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Science in the
College of Agriculture
at the University of Kentucky

By

Sharon Louise Garcia

Lexington, Kentucky

Co-Directors: Dr. Eric Scorsone, Professor of Agricultural Economics
And Dr. Ron Fleming , Professor of Agricultural Economics

Lexington, Kentucky

2002

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DEDICATION

I would like to dedicate this work to four very special people in my life. To my father, Theodore J. Senninger, who taught me the great importance of education and to believe that I could accomplish anything that I set my mind and heart to do. To my mother, Marsha Rae Senninger, who always helped me to recognize and celebrate my small accomplishments along the way. She also helped me to develop the faith necessary to maintain a good perspective, press forward, smile always and endure to the end. To my beloved husband, Vicente Alejandro Garcia Nieto, who has always seen the potential within me. He has loved, supported and encouraged me in every moment. To our little baby, who will soon be born, who has been patient with me, her mother, and given me the strength and perspective I have needed. It is my wish that he or she will share my love of education.

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In addition, I received much motivation and support from friends and loved ones. Rita Parsons has been a daily dose of sunshine and encouragement to me. My four wonderful brothers, John, Ben, Mike and Daniel have also helped me to laugh and enjoy the experience along the way. My loving parents have constantly shown their confidence and support in me. Also my husband has cheered and directed me in the daily rigors of writing. Most of all I want to acknowledge the hand of my Heavenly Father in my thesis. He enlightened my understanding and helped me to accomplish my goal of completing my thesis, while blessing me with a family.

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In developing countries, where the brunt of natural disasters is felt, the increasing incidence of natural disasters is taking a larger and larger toll (World Bank 2000/2001). Not only do a greater percentage of the disasters hit developing countries, but they are also responsible for more deaths than in developed countries. For example,

> "between 1990 and 1998, 94 percent of the entire world's 568 major natural disaster and more than 97 percent of all natural disaster-related deaths were in developing countries" (World Bank 2000/2001, p.170).

Then, in 1999 alone, approximately $100 billion (US) in losses and over 105,000 deaths were caused by natural catastrophes and man-made disasters, with approximately two thirds of these losses and 95 percent of deaths borne by developing countries (Kunreuther, 2001). In addition, the World Bank Development Report (2000/2001) shows that damages from natural disasters across all countries averaged over $60 billion (US) a year with 50,000 lives lost, between 1988 and 1997. These direct losses, while staggering, still do not accurately depict the economic impact of such disasters, especially in developing countries.

The occurrence of natural disasters and countries' vulnerability to them is increasing (ProVention Consortium, 2001). For example, as reported by Munich Re, a large reinsurance company,

> "…after correction for increased population, wealth and inflation, economic losses due to natural disasters increased twofold from 1970 to 2000" (Best's Review, p.93).

Data compiled by the Office of U. S. Foreign Disaster Assistance (OFDA) and the Centre for Research on the Epidemiology of Disasters (CRED) for the International Disaster Database also show increases in the number of disasters reported and the number of people affected by these disasters over the last thirty years (see Figures 1.1-1.4). Interestingly, the number of people killed in disasters has not shown the same dramatic increase. Contributing to the increase and magnitude of natural disasters are such factors as urbanization, rapid population growth, and environmental degradation (Kunreuther, 2001). Each unforeseen natural disaster has the ability to wreak havoc and destruction on the environment, infrastructure, and the human family (UN-

DHA, 1992). Natural disasters cause severe economic and social damage in many nations, yet "their most deadly impact is on the lives and living environment of the poor" (Kunreuther, p.1). Also, in addition to the initial infrastructure and resource damages, natural disasters can temporarily halt or slow economic development by diverting funds from development projects to other, more immediate, concerns arising from the disaster, such as reconstruction assistance or financial relief (Kreimer, 1999). Furthermore, natural disasters affect many social conditions as many people are forced to leave their homes and lands. According to the Red Cross,

> "in 1998, for the first time, more people were forced to leave their homes because of environmental disaster than because of war"(McConahay, p. 66).

The existing levels of poverty and lagging development as seen in many developing countries can also amplify the effects of natural disasters, which also can cause greater increases in the level of poverty (World Bank 2000/2001).

Natural disaster related damages could also be magnified or compounded by the acts of human intervention in nature that decrease natural defenses to disaster (Nash, 2000). For example, deforestation can destabilize land making it more vulnerable to heavy rains and flooding, as experienced in Honduras during Hurricane Mitch:

> "Many of these floods…would have taken place in any case, for the amount of rainfall was extreme… But it is unlikely that so many people would have died (6,000) or become homeless (80,000) had Honduras not lost half its tree cover in recent decades" (Nash, p.3).

In addition to deforestation, mankind has also increased a nation's vulnerability to the elements through such practices as building and planting on steep slopes or unstable and sensitive soils, improper construction of roads and lack of proper drainage systems (Nash, 2000). This is easily seen in large megacities, such as Rio de Janeiro or Guatemala City, where the poor are "forced to build on steep, marginal land prone to landslides"(World Bank 2000/2001, p.170).

In addition to varying in the severity of their damages, natural disasters also vary in type. According to the OFDA/CRED International database, EM-DAT, natural disasters are defined as

> "a situation or event caused by nature, which overwhelms local capacity, necessitating a request to a national or international level for external assistance"

They are divided into nine main categories. For the purpose of this analysis, only four categories of disasters will be considered. The first category is earthquakes, defined as a

> "sudden break within the upper layers of the earth, [which] sometimes break[s] the surface, resulting in vibrations of the ground, which, where strong enough, will cause the collapse of buildings, and destruction of life and property" (UN-DHA, 1992).

The second category is floods, defined as a "significant rise of water level" (UN-DHA, 1992). The third category includes tropical cyclones, hurricanes, typhoons and storms. This category of disasters is defined as a

> "large-scale closed circulation system in the atmosphere with low barometric pressure and strong winds that rotate counter clockwise in the northern hemisphere and clockwise in the southern hemisphere. The system is referred to as a 'cyclone' in the Indian Ocean and South Pacific, 'hurricane' in the western Atlantic and eastern Pacific and 'typhoon' in the western Pacific (in EM-DAT, 'cyclone/hurricane/typhoon' are under 'wind storm')" (UN-DHA, 1992).

The final category is comprised of volcanoes and is defined as

> "a vent in the crust of the earth … from which usually molten or hot rock and steam issue" (Webster, p.1321).

Although there are other types of natural disasters such as avalanches/landslides, forest/scrub fires and tsunami and cold waves, these disasters have occurred rarely and minimally impacted the countries in the case study over the twenty-nine year period (EM-DAT, 2001).

The Office of United Nations Disaster Relief Coordinator (UNDRO) considers natural disasters as "major development problem [s]." Although considered to negatively affect developing countries, the impacts of natural disasters on the economic growth rates of developing countries are not yet well understood. Indicators, such as the number of deaths caused, the number of people affected, and the dollar cost of direct damages, are generally used to measure the effects of natural disasters. Although these data help to frame the immediate effects of the natural disasters, they are limited in their usefulness as they fail to include the indirect and long-term impacts of disasters (Kreimer, 1999). Additional indicators that could help measure this type of impact on developing countries include changes in poverty levels, education, and basic living and health conditions, in addition to macroeconomic variables.

The purpose of this paper is to gain a more complete understanding of the impact natural disasters have on the gross domestic product (GDP) growth rates of selected developing countries. In this study the developing countries of Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, and Nicaragua are studied to measure the impact that disasters have had on economic growth over the past twenty-nine years (1970-1998). This area of Latin America was chosen for the case study due to the researcher's familiarity with the area in addition to the area's vulnerability to natural disasters, similar structure of economies, and common weather patterns that generally affect the region in varying stages of severity. The development indicator, gross domestic product (GDP) growth rates, will be measured over the last twenty-nine years (1970-1998) and analyzed with respect to correlation with natural disasters. Regression analysis is used to investigate the relationship between natural disasters and economic growth.

It is hypothesized that the number of natural disasters that a country faces has a negative impact on economic growth rate as measured by GDP. As the quantity of disasters experienced in any given year increases the overall disruption of the economy is predicted to be greater, thus leading to lower levels of economic growth in the short term.

This analysis begins with a literature review of economic development indicators and theories, and economic studies showing relationships between natural disasters and development. The methodology chapter follows, which discusses the economic model used in the analysis, the data sources and the expected results based on the literature. Then the results of the econometric models are discussed in relation to predicted outcomes. The two models of the study are also compared and contrasted against each other, then evaluated on their ability to explain the data. Finally the analysis is summarized and the hypothesis of the paper is evaluated. In conclusion the impact of the results are discussed along with areas for future research. (Copyright 2002, Sharon L. Garcia)

Table 1.1A Belize: Chronological Table of Natural Disasters--Total; Droughts/famines; Earthquakes; Epidemics

Year	Total Events	Total Killed	Total Affected	Drought/famines			Earthquakes			Epidemics		
				Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected
1998	1	-	60,000	-	-	-	-	-	-	-	-	-
1995	1	-	2,600	-	-	-	-	-	-	-	-	-
1990	2	-	-	-	-	-	-	-	-	-	-	-
1979	1	-	17,000	-	-	-	-	-	-	-	-	-
1978	1	5	6,000	-	-	-	-	-	-	-	-	-

Source:"EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium"

**Years without occurrences of natural disaster were removed from this table.

Table 1.1B Belize: Chronological Table of Natural Disasters--Floods; Slides; Volcanoes; Wind storms

Year	Floods			Slides			Volcanoes			Wind Storms		
	Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected
1998	-	-	-	-	-	-	-	-	-	1	-	60,000
1995	1	-	2,600	-	-	-	-	-	-	-	-	-
1990	1	-	-	-	-	-	-	-	-	-	-	-
1979	1	-	17,000	-	-	-	-	-	-	-	-	-
1978	-	-	-	-	-	-	-	-	-	1	5	6,000

Source:"EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium"

*The two categories: Wildfires and Other: Extreme temperatures-Waves/Surges-Insect infestations, were dropped due to only relatively few disasters recorded in these categories across the case study countries

**Years without occurrences of natural disaster were removed from this table.

Table 1.2A Costa Rica: Chronological Table of Natural Disasters--Total; Droughts/famines; Earthquakes; Epidemics

Year	Total Events	Total Killed	Total Affected	Drought/famines			Earthquakes			Epidemics		
				Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected
1998	3	8	17,150	1	-	-	-	-	-	-	-	-
1996	3	60	736,000	-	-	-	-	-	-	-	-	-
1995	2	-	12,848	-	-	-	-	-	-	1	-	4,786
1994	1	2	2,556	-	-	-	-	-	-	-	-	-
1993	2	12	38,691	-	-	-	1	3	240	-	-	-
1992	1	-	1,200	-	-	-	-	-	-	-	-	-
1991	4	48	199,370	-	-	-	2	47	14,349	-	-	-
1990	2	1	14,609	-	-	-	2	1	14,609	-	-	-
1988	2	35	140,000	-	-	-	-	-	-	-	-	-
1983	2	2	5,675	-	-	-	2	2	5,675	-	-	-
1980	1	1	1,350	-	-	-	-	-	-	-	-	-
1976	2	-	70,000	-	-	-	-	-	-	-	-	-
1975	1	2	-	-	-	-	-	-	-	-	-	-

Source:"EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium"

**Years without occurrences of natural disaster were removed from this table.

Table 1.2B Costa Rica: Chronological Table of Natural Disasters--Floods; Slides; Volcanoes; Windstorms

Year	Floods			Slides			Volcanoes			Wind Storms		
	Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected
1998	-	-	-	-	-	-	1	-	450	1	8	16,700
1996	1	6	20,000	-	-	-	-	-	-	2	54	716,000
1995	1	-	8,062	-	-	-	-	-	-	-	-	-
1994	1	2	2,556	-	-	-	-	-	-	-	-	-
1993	1	9	38,451	-	-	-	-	-	-	-	-	-
1992	-	-	-	-	-	-	-	-	-	-	-	-
1991	1	1	185,021	-	-	-	1	-	-	-	-	-
1990	-	-	-	-	-	-	-	-	-	-	-	-
1988	1	7	12,500	-	-	-	-	-	-	1	28	127,500
1983	-	-	-	-	-	-	-	-	-	-	-	-
1980	1	1	1,350	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	1	-	70,000	-	-	-
1975	-	-	-	-	-	-	1	2	-	-	-	-

Source:"EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium"

*The two categories: Wildfires and Other: Extreme temperatures-Waves/Surges-Insect infestations, were dropped due to only relatively few disasters recorded in these categories across the case study countries

**Years without occurrences of natural disaster were removed from this table.

Table 1.3A El Salvador: Chronological Table of Natural Disasters--Total; Droughts/famines; Earthquakes; Epidemics

Year	Total Events	Total Killed	Total Affected	Drought/famines			Earthquakes			Epidemics		
				Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected
1998	2	475	85,670	-	-	-	-	-	-	1	-	1,670
1997	1	4	2,000	-	-	-	-	-	-	-	-	-
1996	1	12	-	-	-	-	-	-	-	-	-	-
1995	2	13	10,796	-	-	-	-	-	-	1	5	9,296
1993	1	22	-	-	-	-	-	-	-	-	-	-
1992	2	2	8,350	-	-	-	-	-	-	1	-	350
1991	1	155	5,625	-	-	-	-	-	-	1	155	5,625
1989	1	10	-	-	-	-	-	-	-	-	-	-
1988	2	55	39,060	-	-	-	-	-	-	-	-	-
1986	1	1,100	770,000	-	-	-	1	1,100	770,000	-	-	-
1982	3	520	101,194	1	-	-	1	20	33,194	-	-	-

Source:"EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium"

**Years without occurrences of natural disaster were removed from this table.

Table 1.3B El Salvador: Chronological Table of Natural Disasters--Floods; Slides; Volcanoes; Wind storms

	Floods			Slides			Volcanoes			Wind Storms		
Year	Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected
1998	-	-	-	-	-	-	-	-	-	1	475	84,000
1997	-	-	-	-	-	-	-	-	-	1	4	2,000
1996	-	-	-	-	-	-	-	-	-	1	12	-
1995	1	8	1,500	-	-	-	-	-	-	-	-	-
1993	-	-	-	1	22	-	-	-	-	-	-	-
1992	1	2	8,000	-	-	-	-	-	-	-	-	-
1991	-	-	-	-	-	-	-	-	-	-	-	-
1989	1	10	-	-	-	-	-	-	-	-	-	-
1988	1	33	39,060	1	22	-	-	-	-	-	-	-
1986	-	-	-	-	-	-	-	-	-	-	-	-
1982	1	500	68,000	-	-	-	-	-	-	-	-	-

Source:"EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium"

*The two categories: Wildfires and Other: Extreme temperatures-Waves/Surges-Insect infestations, were dropped due to only relatively few disasters recorded in these categories across the case study countries

**Years without occurrences of natural disaster were removed from this table.

Table 1.4A Guatemala: Chronological Table of Natural Disasters--Total; Droughts/famines; Earthquakes; Epidemics

Year	Total Events	Total Killed	Total Affected	Drought/famines			Earthquakes			Epidemics		
				Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected
1998	4	452	107,653	-	-	-	-	-	-	1	17	1,345
1996	1	-	743	-	-	-	-	-	-	-	-	-
1995	2	31	10,837	-	-	-	-	-	-	1	-	3,402
1994	1	10	600	-	-	-	-	-	-	-	-	-
1992	2	206	5,000	-	-	-	-	-	-	1	206	-
1991	3	217	50,690	-	-	-	1	14	23,890	1	180	26,800
1990	1	200	-	-	-	-	-	-	-	1	200	-
1989	1	10	-	-	-	-	-	-	-	-	-	-
1988	3	-	44,000	1	-	36,500	1	-	1,500	-	-	-
1987	4	84	46,050	1	-	36,500	-	-	-	-	-	-

Table 1.4A (Continued) Guatemala: Chronological Table of Natural Disasters--Total; Droughts/famines; Earthquakes; Epidemics

1985	1	-	12,000	-	-	-	1	-	12,000	-	-	-
1984	1	-	3,000	-	-	-	-	-	-	-	-	-
1983	1	-	3,500	-	-	-	-	-	-	-	-	-
1982	2	640	20,256	-	-	-	1	20	-	-	-	-
1979	1	-	2,040	-	-	-	1	-	2,040	-	-	-
1976	1	23,000	4,993,000	-	-	-	1	23,000	4,993,000	-	-	-

Source:"EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels,

**Years without occurrences of natural disaster were removed from this table.

Table 1.4B Guatemala: Chronological Table of Natural Disasters--Floods; Slides; Volcanoes; Wind storms

Year	Floods			Slides			Volcanoes			Wind Storms		
	Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected
1998	-	-	-	1	51	8	1	-	600	1	384	105,700
1996	-	-	-	-	-	-	1	-	743	-	-	-
1995	1	31	7,435	-	-	-	-	-	-	-	-	-
1994	1	10	600	-	-	-	-	-	-	-	-	-
1992	-	-	-	-	-	-	1	-	5,000	-	-	-
1991	-	-	-	1	23	-	-	-	-	-	-	-
1990	-	-	-	-	-	-	-	-	-	-	-	-
1989	1	10	-	-	-	-	-	-	-	-	-	-
1988	1	-	6,000	-	-	-	-	-	-	-	-	-
1987	1	84	6,515	-	-	-	1	-	3,035	-	-	-

Table 1.4B (Continued) Guatemala: Chronological Table of Natural Disasters--Floods; Slides; Volcanoes; Wind storms

1985	-	-	-	-	-	-	-	-	-	-	-	-
1984	-	-	-	-	-	-	1	-	3,000	-	-	-
1983	-	-	-	-	-	-	1	-	3,500	-	-	-
1982	1	620	20,256	-	-	-	-	-	-	-	-	-
1979	-	-	-	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	-	-	-	-	-	-

Source: "EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium"

*The two categories: Wildfires and Other: Extreme temperatures-Waves/Surges-Insect infestations, were dropped due to only relatively few disasters recorded in these categories across the case study countries

**Years without occurrences of natural disaster were removed from this table.

Table 1.5A Honduras: Chronological Table of Natural Disasters--Total; Droughts/famines; Earthquakes; Epidemics

Year	Total Events	Total Killed	Total Affected	Drought/famines			Earthquakes			Epidemics		
				Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected
1998	3	14,617	2,114,452	-	-	-	-	-	-	2	17	2,452
1996	1	7	75,000	-	-	-	-	-	-	-	-	-
1995	3	37	41,020	-	-	-	-	-	-	1	5	15,998
1994	2	151	15,500	-	-	-	-	-	-	-	-	-
1993	2	413	82,447	-	-	-	-	-	-	-	-	-
1990	1	5	48,000	-	-	-	-	-	-	-	-	-
1989	1	10	-	-	-	-	-	-	-	-	-	-
1988	3	19	16,137	-	-	-	-	-	-	-	-	-
1986	1	-	30,000	-	-	-	-	-	-	-	-	-
1984	1	-	-	-	-	-	-	-	-	-	-	-
1982	1	130	20,000	-	-	-	-	-	-	-	-	-
1981	1	-	-	-	-	-	-	-	-	-	-	-
1979	1	1	40,000	-	-	-	-	-	-	-	-	-
1978	1	-	7,500	-	-	-	-	-	-	-	-	-
1976	1	20	15,000	-	-	-	-	-	-	-	-	-

Source:"EM-DAT: The OFDA/CRED International Disaster Database,Université catholique de Louvain, Brussels, Belgium"

**Years without occurrences of natural disaster were removed from this table.

Table 1.5B Honduras: Chronological Table of Natural Disasters--Floods; Slides; Volcanoes; Wind storms

Year	Floods			Slides			Volcanoes			Wind Storms		
	Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected
1998	-	-	-	-	-	-	-	-	-	1	14,600	2,112,000
1996	1	7	75,000	-	-	-	-	-	-	-	-	-
1995	1	14	25,000	-	-	-	-	-	-	1	18	22
1994	2	151	15,500	-	-	-	-	-	-	-	-	-
1993	2	413	82,447	-	-	-	-	-	-	-	-	-
1990	1	5	48,000	-	-	-	-	-	-	-	-	-
1989	-	-	-	1	10	-	-	-	-	-	-	-
1988	2	19	16,125	-	-	-	-	-	-	1	-	12
1986	1	-	30,000	-	-	-	-	-	-	-	-	-
1984	1	-	-	-	-	-	-	-	-	-	-	-
1982	-	-	-	-	-	-	-	-	-	1	130	20,000
1981	1	-	-	-	-	-	-	-	-	-	-	-
1979	1	1	40,000	-	-	-	-	-	-	-	-	-
1978	-	-	-	-	-	-	-	-	-	1	-	7,500
1976	1	20	15,000	-	-	-	-	-	-	-	-	-

Source:"EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels,

few disasters recorded in these categories across the case study countries

**Years without occurrences of natural disaster were removed from this table.

Table 1.6A Mexico: Chronological Table of Natural Disasters--Total; Droughts/famines; Earthquakes; Epidemics

Year	Total Events	Total Killed	Total Affected	Drought/famines			Earthquakes			Epidemics		
				Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected
1998	10	1,822	518,082	-	-	-	-	-	-	-	-	-
1997	9	567	823,155	-	-	-	2	1	17,000	-	-	-
1996	4	14	19,830	1	-	-	-	-	-	-	-	-
1995	11	304	140,635	1	-	-	3	69	67,310	1	16	6,525
1994	2	-	75,700	-	-	-	-	-	-	-	-	-
1993	7	103	338,290	-	-	-	1	-	-	-	-	-
1992	3	83	24,000	-	-	-	-	-	-	-	-	-
1991	4	88	59,000	-	-	-	-	-	-	1	52	5,000
1990	3	463	17,900	-	-	-	-	-	-	-	-	-
1989	3	40	350	-	-	-	1	-	350	-	-	-
1988	5	311	125,000	1	-	-	-	-	-	-	-	-
1987	3	18	262	-	-	-	1	2	50	-	-	-
1986	1	20	-	-	-	-	-	-	-	-	-	-

Table 1.6A (Continued) Mexico: Chronological Table of Natural Disasters--Total; Droughts/famines; Earthquakes; Epidemics

1985	1	8,776	130,204	-	-	-	1	8,776	130,204	-	-	-
1984	2	4	30,000	-	-	-	-	-	-	-	-	-
1983	3	325	282,500	-	-	-	-	-	-	-	-	-
1982	5	352	95,717	-	-	-	1	2	17	-	-	-
1981	2	109	-	-	-	-	1	9	-	-	-	-
1980	5	171	106,360	-	-	-	2	67	6,360	-	-	-
1979	2	5	67,535	-	-	-	1	5	7,535	-	-	-
1978	3	15	10,850	1	-	-	1	9	3,850	-	-	-
1977	1	10	50,000	-	-	-	-	-	-	-	-	-
1976	3	720	576,400	-	-	-	-	-	-	-	-	-
1975	1	29	-	-	-	-	-	-	-	-	-	-

Source:"EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium"

**Years without occurrences of natural disaster were removed from this table.

Table 1.6B Mexico:Chronological Table of Natural Disasters--Floods; Slides; Volcanoes; Wind storms

Year	Floods			Slides			Volcanoes			Storms		
	Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected
1998	2	1,414	511,744	1	12	120	1	-	758	3	246	5,460
1997	-	-	-	1	12	-	1	20	-	3	242	804,755
1996	-	-	-	-	-	-	-	-	-	3	14	19,830
1995	-	-	-	-	-	-	-	-	-	5	170	66,800
1994	-	-	-	-	-	-	2	-	75,700	-	-	-
1993	2	65	261,290	-	-	-	-	-	-	4	38	77,000
1992	-	-	-	-	-	-	-	-	-	1	3	8,000
1991	2	23	44,000	-	-	-	-	-	-	1	13	10,000
1990	1	45	17,900	-	-	-	-	-	-	1	38	-
1989	1	40	-	-	-	-	-	-	-	-	-	-
1988	-	-	-	-	-	-	-	-	-	3	288	125,000
1987	2	16	212	-	-	-	-	-	-	-	-	-
1986	1	20	-	-	-	-	-	-	-	-	-	-

Table 1.6B (Continued) Mexico: Chronological Table of Natural Disasters--Floods; Slides; Volcanoes; Wind storms

1985	-	-	-	-	-	-	-	-	-	-	-	-
1984	1	-	20,000	-	-	-	-	-	-	1	4	10,000
1983	-	-	-	1	50	-	-	-	-	2	275	282,500
1982	2	25	5,200	-	-	-	1	100	40,500	1	225	50,000
1981	-	-	-	-	-	-	-	-	-	1	100	-
1980	2	104	100,000	-	-	-	-	-	-	1	-	-
1979	1	-	60,000	-	-	-	-	-	-	-	-	-
1978	1	6	7,000	-	-	-	-	-	-	-	-	-
1977	-	-	-	-	-	-	-	-	-	1	10	50,000
1976	-	-	-	-	-	-	-	-	-	3	720	576,400
1975	-	-	-	-	-	-	-	-	-	1	29	-

Source:"EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium"

*The two categories: Wildfires and Other: Extreme temperatures-Waves/Surges-Insect infestations, were dropped due to only relatively few disasters recorded in these categories across the case study countries
**Years without occurrences of natural disaster were removed from this table.

Table 1.7A Nicaragua: Chronological Table of Natural Disasters--Total; Droughts/famines; Earthquakes; Epidemics

Year	Total Events	Total Killed	Total Affected	Drought/famines			Earthquakes			Epidemics		
				Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected
1998	4	3,139	871,581	-	-	-	-	-	-	3	7	3,353
1997	1	-	290,000	1	-	290,000	-	-	-	-	-	-
1996	1	42	10,724	-	-	-	-	-	-	-	-	-
1995	4	56	40,491	-	-	-	-	-	-	2	18	13,406
1994	1	-	80,000	1	-	80,000	-	-	-	-	-	-
1993	1	37	123,000	-	-	-	-	-	-	-	-	-
1992	2	181	351,064	-	-	-	1	179	40,989	-	-	-
1991	2	2	381	-	-	-	-	-	-	1	2	381
1990	2	4	106,411	-	-	-	1	-	-	-	-	-
1988	1	130	360,278	-	-	-	-	-	-	-	-	-
1982	1	71	52,000	-	-	-	-	-	-	-	-	-
1980	1	-	40,000	-	-	-	-	-	-	-	-	-
1979	1	-	30,000	-	-	-	-	-	-	-	-	-
1976	1	16	8,000	-	-	-	-	-	-	-	-	-

Source:"EM-DAT: The OFDA/CRED International Disaster Database,Université catholique de Louvain, Brussels,

**Years without occurrences of natural disaster were removed from this table.

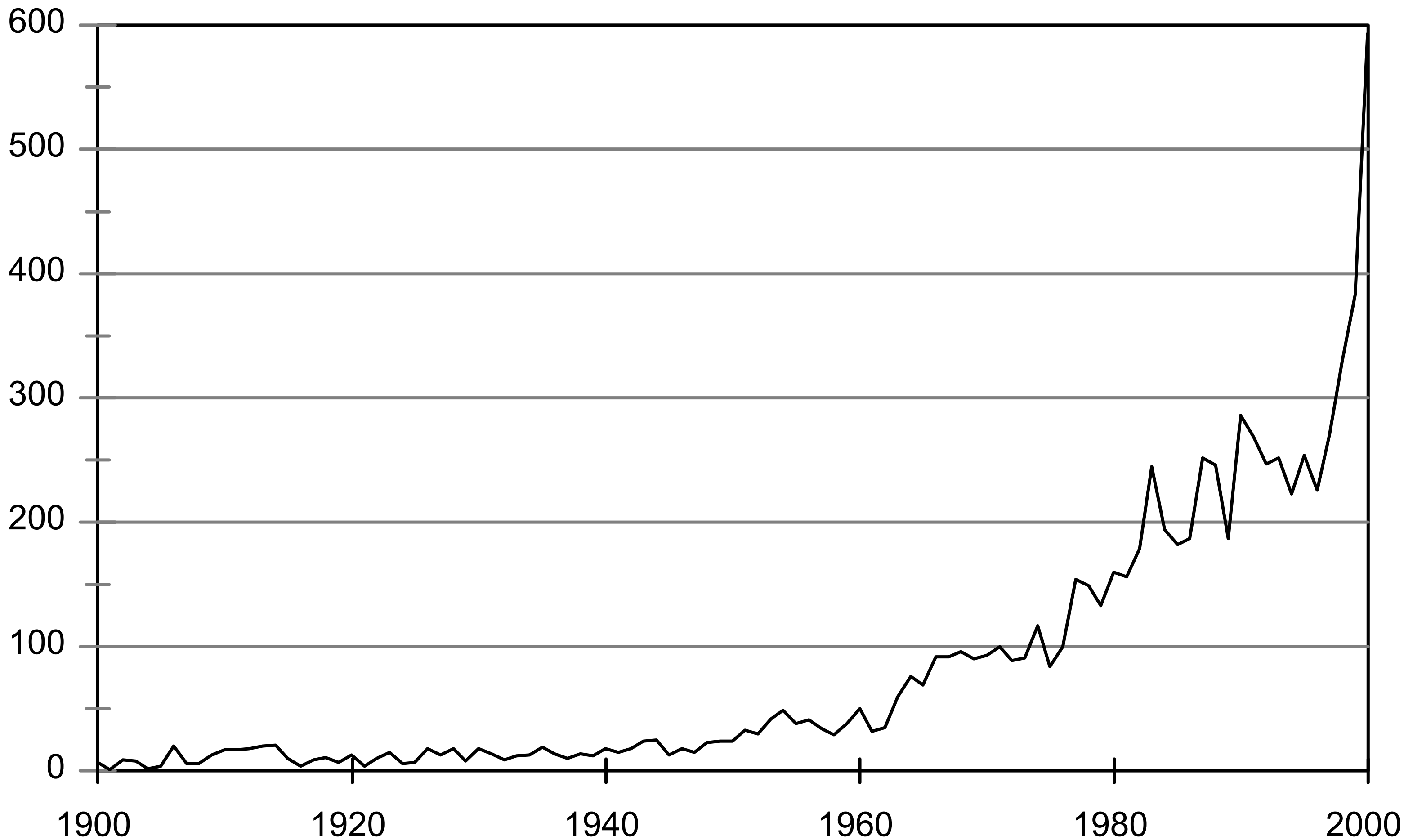
Table 1.7B Nicaragua: Chronological Table of Natural Disasters--Floods; Slides; Volcanoes; Wind storms

Year	Floods			Slides			Volcanoes			Wind Storms		
	Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected	Events	Killed	Affected
1998	-	-	-	-	-	-	-	-	-	1	3,132	868,228
1997	-	-	-	-	-	-	-	-	-	-	-	-
1996	-	-	-	-	-	-	-	-	-	1	42	10,724
1995	1	38	15,085	-	-	-	1	-	12,000	-	-	-
1994	-	-	-	-	-	-	-	-	-	-	-	-
1993	-	-	-	-	-	-	-	-	-	1	37	123,000
1992	-	-	-	-	-	-	1	2	310,075	-	-	-
1991	-	-	-	-	-	-	-	-	-	-	-	-
1990	1	4	106,411	-	-	-	-	-	-	-	-	-
1988	-	-	-	-	-	-	-	-	-	1	130	360,278
1982	-	-	-	-	-	-	-	-	-	1	71	52,000
1980	1	-	40,000	-	-	-	-	-	-	-	-	-
1979	1	-	30,000	-	-	-	-	-	-	-	-	-
1976	1	16	8,000	-	-	-	-	-	-	-	-	-

Source:"EM-DAT: The OFDA/CRED International Disaster Database,Université catholique de Louvain, Brussels,

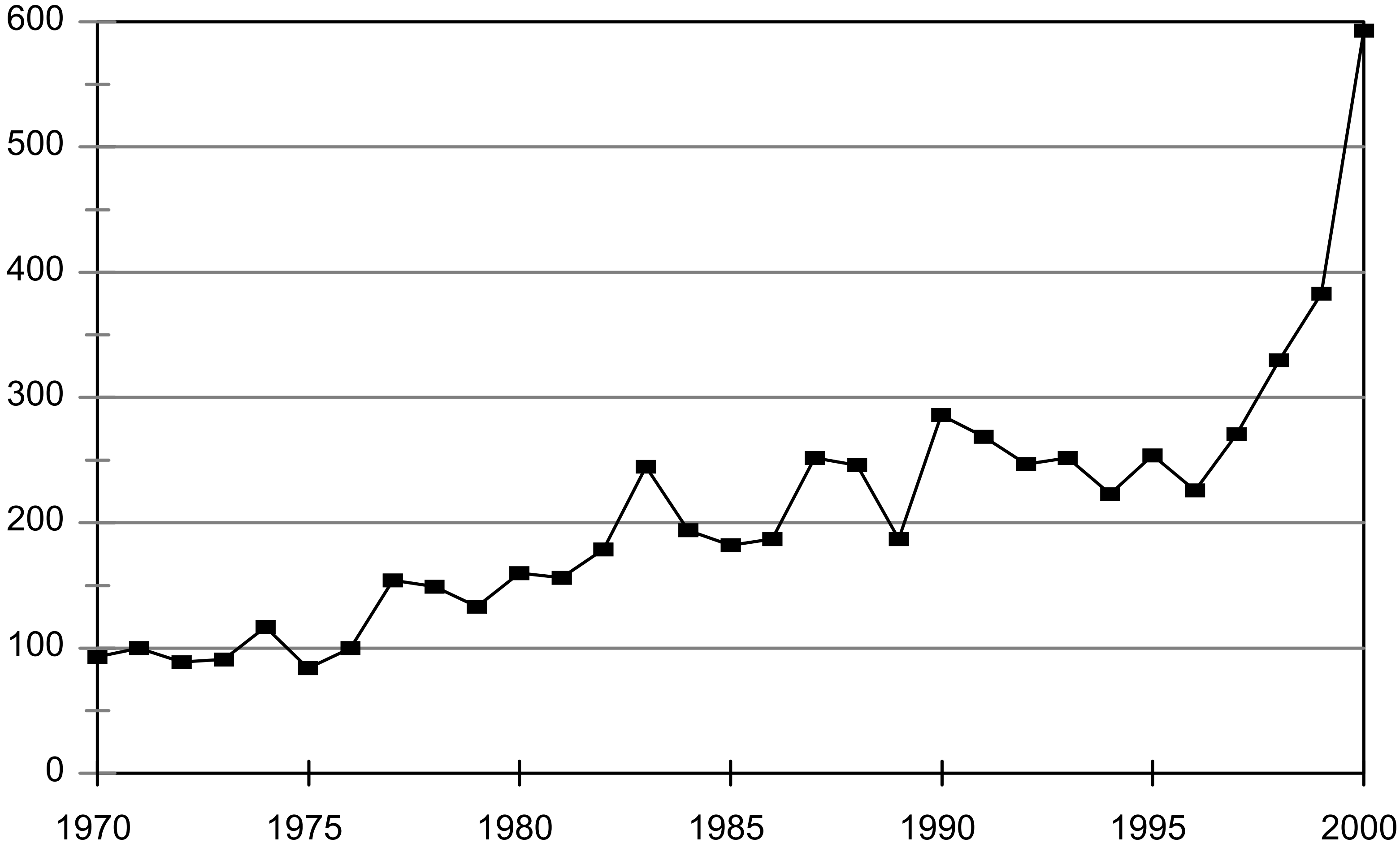
*The two categories: Wildfires and Other: Extreme temperatures-Waves/Surges-Insect infestations, were dropped due to only relatively

Figure 1.1 Natural Disasters (1900-2000): Number of Events



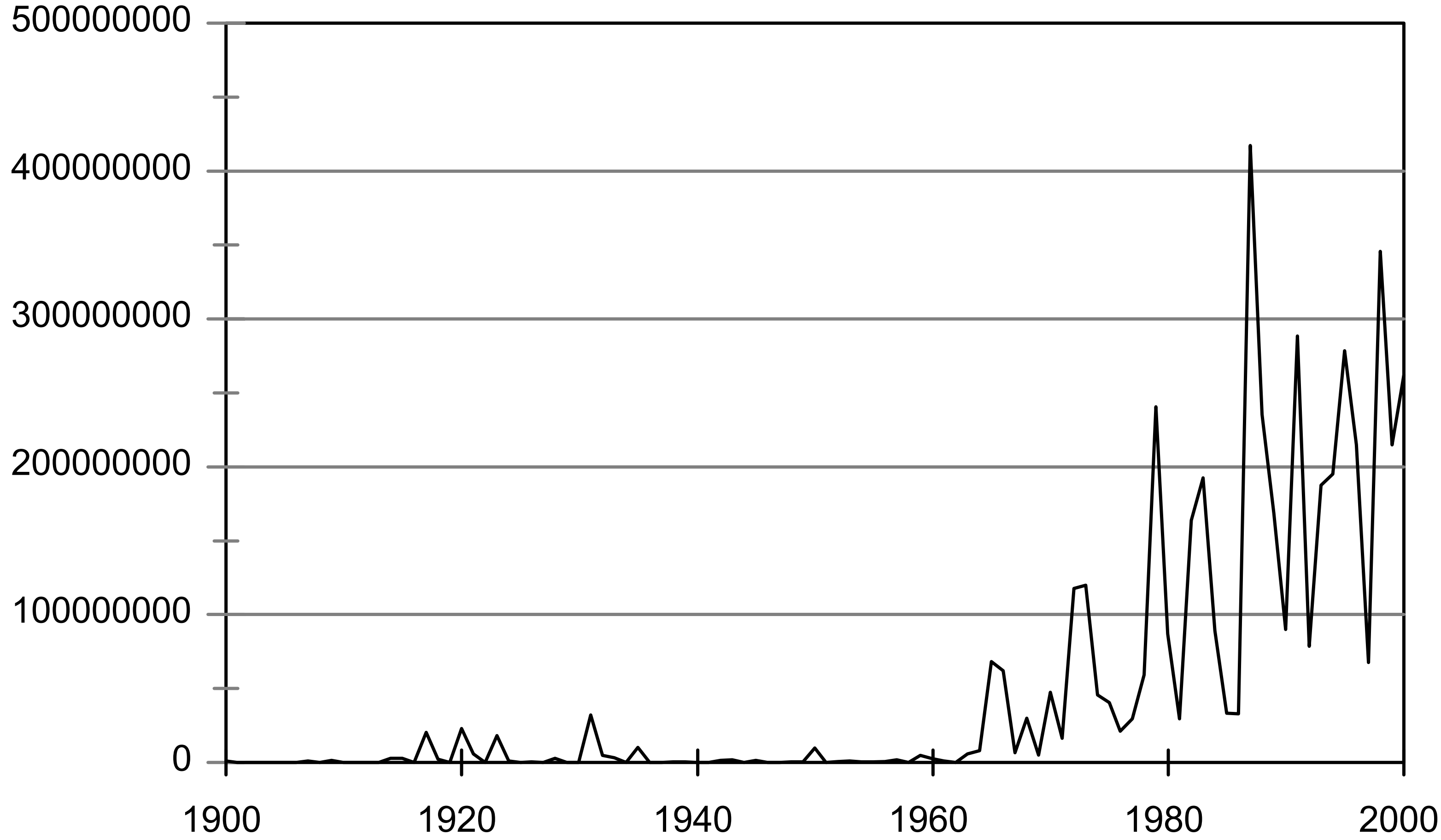
Source: EM-DAT: The OFDA/CRED International Disaster Database (http://www.cred.be)

Figure 1.2 Natural Disaster (1970-2000): Number of Events



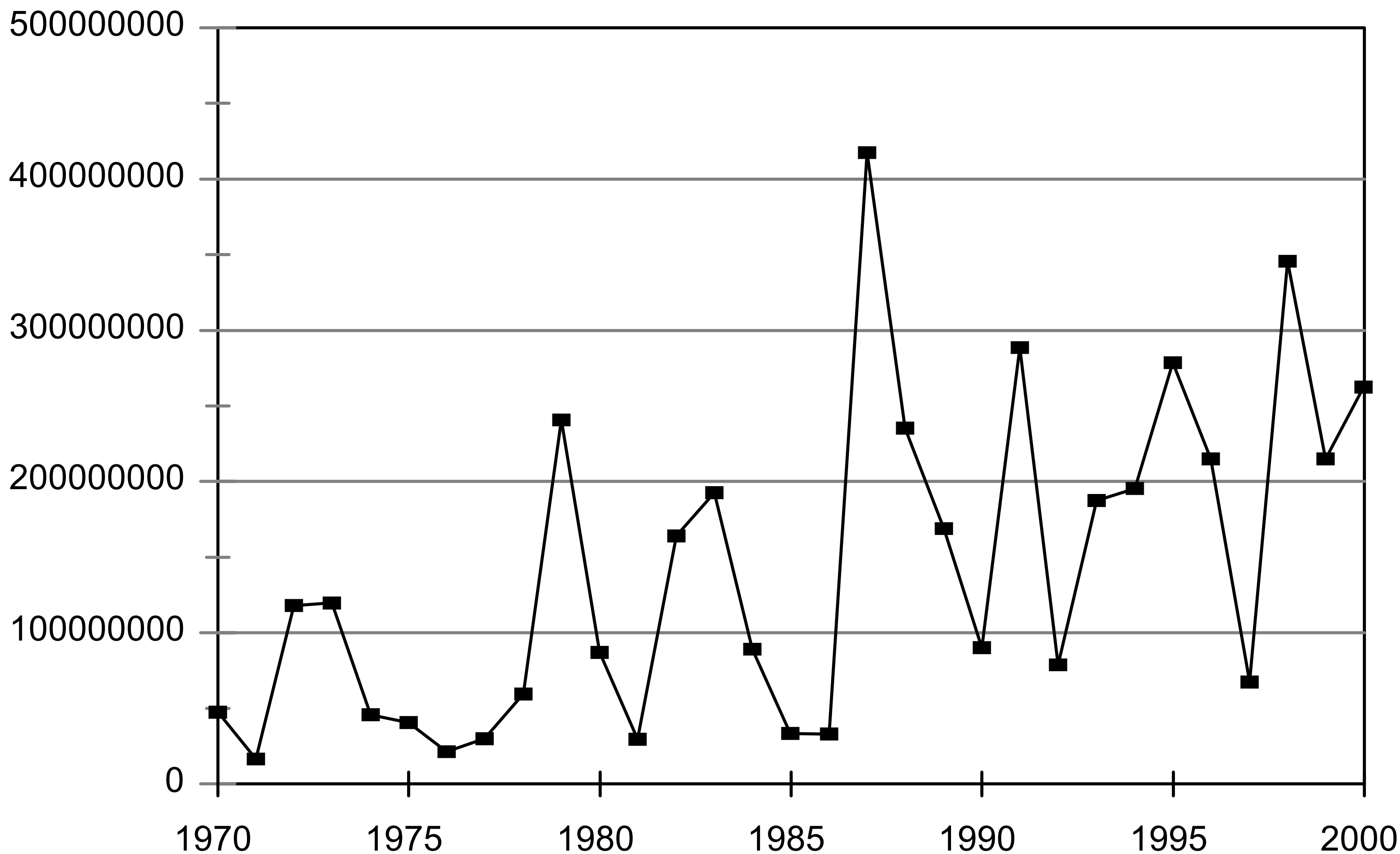
Source: EM-DAT: The OFDA/CRED International Disaster Database (http://www.cred.be)

Figure 1.3 Natural Disasters (1900-2000): Total Affected



Source: EM-DAT: The OFDA/CRED International Disaster Database (http://www.cred.be)

Figure 1.4 Natural Disasters (1970-2000): Total Affected



Source: EM-DAT: The OFDA/CRED International Disaster Database (http://www.cred.be)

Chapter Two
Literature Review

There is a growing body of literature that analyzes the variables affecting economic development including the impacts of natural disasters. For clarity, the literature review is subdivided into two sections: (1) economic development theories and indicators, and (2) studies that show the relationship between natural disasters and development.

1. Economic Development Indicators and Theories

There has been an evolution of leading theories concerning economic development. The first of these theories was the linear-stages theory, prevalent in the 1950's and 1960's (Todaro, 1997). Walt W. Rostrow and others proposed that there were a series of stages that all countries must pass through to reach or be considered economically developed (Todaro, 1997). These stages of growth include the traditional society, the preconditions for take-off, the take-off, the drive to maturity, and the age of high mass-consumption. This theory was criticized because there is no single sequence of growth stages that is in accordance with the actual recorded histories of all countries (Meier, 1995).

Another type of linear stages model is the Harrod-Domar growth model. This model describes how less developed countries can launch into the initial stages of development growth, based on an understanding of the relationship between investment and GNP. This theory proposes that as a country's savings increase, national income also increases. As the country's capital-output ratio increases, the national income decreases (Todaro, 1997).

Yet, more savings and investment were not sufficient for explaining accelerated economic growth, which lead to the structural-change theory. This theory, which prevailed from the1950's to the early 1970's, dealt with ways to change from traditional subsistence agriculture to a more diverse manufacturing and service economy (Todaro, 1997). This theory's main proponent was W. Arthur Lewis and was based on his two-sector surplus labor model. Work by Hollis B. Chenery on the patterns of development analysis was also integral (Todaro, 1997).

The 1970's saw the emergence of the international-dependence models, which, according to Todaro, holds the view that more developed countries exert their influence and power over developing countries resulting in dependence on the more developed countries. These influences were felt in political, economic and institutional realms (Todaro, 1997).

The neoclassical counter-revolution followed in the 1980's and focused on the removal of public policies that were price distorting and that caused non-market failures (Meier, 1995). Neoclassical theory argued that excess government intervention, which causes implementation of inappropriate public policies and poor allocation of resources, slows the pace of development growth (Todaro, 1997).

The late 1980's and 1990's saw the emergence of a new economic development theory, the endogenous or new growth theory. This theory was developed due to the failure of traditional theory to explain differences in economic growth across countries (Todaro, 1997). It explains the factors of development considered exogenous in the Solow neoclassical growth model and how they determine the growth rate of GDP (Todaro, 1997). This theory is marked by a broader interpretation of capital that includes human capital (knowledge). The result is that GDP, instead of showing normal returns to scale, actually shows increasing returns to scale (Mankiw, 2000). This is summarized in the Equation 2.1, Solow's growth rate of output.

$$\Delta Y/Y = \Delta K/K = sA - \delta \qquad \text{Equation 2.1}$$

In Equation 2.1, $\Delta Y/Y$ is the growth rate of per capita income, $\Delta K/K$ is the growth rate of human capital, s is the fraction of income saved and invested, A is a constant measuring the amount of income produced for each unit of human capital, and δ the depreciation rate of physical capital (Mankiw, 2000). According to Solow, as long as sA is greater than δ, the economy's income grows forever even without the assumption of exogenous technological progress (Mankiw, 2000). In Solow's model savings and investment in knowledge capital can lead to persistent and long run growth in per capita income (Meier, 1995). Furthermore, the savings rate, investment rate, growth rate of human capital, and rate of technological progress all are factors influencing the economic growth of a country (Mankiw, 2000). The analysis applied in this thesis uses the endogenous growth theory as a basis for explaining economic growth, but includes other explanatory variables to more fully explain the affects of natural disasters on overall economic growth.

Although economic development theory has evolved through the years, the basic definition of economic development has seen less change. Economic development is broadly defined as the "process whereby the real per capita income of a country increases over a long period of time" (Meier, p.7). It is commonly measured in terms of gross national product (GNP) or gross domestic product (GDP) and is further refined by putting the growth of GDP in per capita terms to account for the growth of the population (Todaro, 1997) and in real terms, to account for inflation. The main components of GDP include consumption spending, investment spending, government spending, and net exports (Buckles, 2001). These general economic indicators offer an overall broad measure of growth, but do not fully demonstrate the effects of a disaster on the informal sector. Consequently, social indicators such as the number of people below the poverty level and income inequality are also used to supplement traditional economic indicators and add a qualitative and quantitative element to measuring development (Meier, 1995).

Economists, such as Johnson, support the addition of supplemental indicators for measures of economic welfare. Johnson (2001) notes that traditional economic indicators, such as GNP and GDP, "were never intended even theoretically to be good measures of overall economic welfare" (Johnson, p.3). The shortcoming of using only macroeconomic indicators like the GNP or GDP is that they only take into account goods that are traded for money on the formal market, thus ignoring a very large category of economic activity in the informal market (Johnson, 2001). Thus, when looking at developing countries, supplemental indicators are helpful to account for a major part of overall economic activity, which is in the informal sector.

The informal sector,

> "in less developed countries, [is] characterized by small competitive individual or family firms, petty retail trade and services, labor-intensive methods, free entry, and market-determined factor and product prices [and]…often provides a major source of urban employment and economic activity" (Todaro, p.699).

This sector, which encompasses many of the very poor, is one of the sectors most dramatically affected by disasters. This is due

> "in part because they [the poor] are priced out of the more disaster-proof areas and live in crowded, makeshift houses" (World Development Report 2000/2001, p.172).

These houses often have unsound structures and are located in areas vulnerable to bad weather and seismic activity (WDR 2000/2001). Thus, when choosing indicators to demonstrate the effects of natural disasters, it is important to consider poverty and demographic data and data on education, health, and basic living conditions. By integrating additional indicators, the impacts of natural disasters on the informal sector can be more fully developed. This could result in a clearer and more complete picture of the effects of natural disasters on economic welfare. Yet, the data needed for such indicators that give a more complete view of the overall economy are only recently being gathered for developing countries. In the absence of the availability of data, as is the case with many developing countries including the case study countries of Central America and Mexico, alternative methods can be incorporated.

Commander, Davoodi, and Lee in their paper "The Causes and Consequences of Government for Growth and Well-Being" (1997) considered the effects of economic policies and institutional capabilities on economic development as measured by the growth of GDP per capita (World Bank, 1997). Their choice of variables was based on new growth theory with the inclusion of additional variables that focused on the impacts of economic policies and institutional capabilities on GDP per capita growth. The main variables included in their study resulted in expected signs for the t-values, in accordance with new growth theory. The human capital proxy (years of schooling) and the terms of trade variables were positive as expected, yet insignificant. The investment rate demonstrated both positive and significant t-values, as hypothesized by new growth theory. The population growth variable results were also in accordance with theory, showing a negative effect on growth rates, but the probability of t was not significant. The initial level of GDP and the ratio of government consumption to GDP variables had significantly negative results (World Bank, 1997). The impact of economic policies is measured with the policy distortion variable, which indicates that policy distortions negatively affect growth (World Bank, 1997). The variable used to measure the impact of institutional capabilities indicated a positive effect on growth (World Bank, 1997).

Barro and Sala-i-Martin did an empirical analysis of growth rates of a cross section of countries in their book, Economic Growth. In their regression analysis they examine real per capita growth rates across countries over long time periods. The variables included in their analysis are broken down into two categories: initial levels of state variables and control or environmental variables.

The state variables measure levels of human and capital stock and include educational attainment (broken down into secondary and higher education by gender), life expectancy, and an interaction between GDP and human capital. The educational attainment variables for males were positive and significant. The educational attainment variables for females were individually negative, but jointly significant and positive (Barro, 1995). This is in accordance with new growth theory that shows investment in human capital positively affects economic growth. The life expectancy variable was also positive.

The control or environmental variables are considered by endogenous growth theory to affect long-term growth rates. The results of the included control and environmental variables varied greatly. Public expenditures on education as a ratio of GDP and the variables representing terms of trade were positive and significant, as in the Commander paper and as predicted by new growth theory. The ratio of government consumption to GDP and the population growth rate both were negative as predicted, yet the population growth rate was not significant. Interestingly the ratio of real gross domestic investment to real GDP, which is predicted by new growth theory to be significant and positive, showed a positive coefficient but was not statistically significant. Barro reasons that this finding could be due to holding constant additional explanatory variables in the regression. The quality of political institutions is measured using a black-market premium on foreign exchange (proxy for government distortion of markets) and a measure of political instability. These variables were both negative and significant, and suggest that more political stability and less distortion of markets is conducive for growth, as hypothesized by Barro.

Then Barro added a category of additional explanatory variables, which were suggested by previous researchers. The added explanatory variables included data on primary schooling, contemporaneous changes in schooling and life expectancy, and school-enrollment ratios, all of, which were statistically insignificant. Other variables considered the effects of the type and quality of political institutions including the tariff rate, a democracy variable, a political rights and civil liberties variable, and a rule of law variable. These results also were statistically insignificant. Other variables included a war dummy, defense expenditures ratio, private versus public investment, log of the working-age population (scale effects), log $|GDP|$ of bordering countries (spillover effects from neighboring countries), and regional dummy variables. These additional explanatory variables were statistically insignificant except for the regional dummy variables, of which some regions such as Latin America were significantly negative (Barro, 1995).

2. Natural Disasters and Development

Albala-Bertrand in his book, The Political Economy of Large Natural Disasters, examines the social and economic effects of disasters. In his analysis of the effects of disasters on macroeconomic variables, short and medium term impacts are measured based on simple mathematical comparisons of countries whose macroeconomic variables increased or decreased from pre-disaster years, to impact year, to post-disaster years (Albala-Bertrand, 1993). The variables included in the analysis were growth rate of GDP, inflation rate, unemployment rate, growth rate of fixed capital formation, growth rate of agricultural output, growth rate of manufacturing, growth rate of construction, ratio of public deficit to GDP, trade deficit in relation to imports, change of reserves per capita, capital flows per capita, unrequited transfers per capita, and exchange rate. The analysis included twenty-six countries, each with one disaster apiece. The changes in the variables were compared for the two years previous to the disaster, the disaster year and the two years after the disaster. GDP, gross fixed capital formation, agricultural output, and manufacturing were shown to improve in disaster years. With the exception of construction, these results are in contrast with perceived views (Albala-Bertrand, 1993). Unemployment was unable to be measured due to lack of data, but was hypothesized by Albala-Bertrand to decrease in a disaster year due to reconstruction projects. Inflation resulted in insignificant changes from pre-disaster to post-disaster years, which is contrary to perceived views of inflation increasing more dramatically in post disaster years. Manufacturing and exchange rates displayed no significant or discernable changes, which is the opposite of the expectation that these variables should decrease from pre- to post-disaster years. Public deficit, which had almost negligible increases, was expected to show large increases due to the "need to deal promptly with disaster emergencies, when other fund sources are lacking" (Albala-Bertrand, p.77). Yet, the trade deficit showed sharp increases in post disaster years in accordance with expectations. Per capita reserves showed increases, an unexpected result that could be due to the inflow of aid in post disaster years (Albala-Bertrand, 1993). Both capital flows and unrequited transfers, which had no previous agreed upon view, showed sharp increases (Albala-Bertrand, 1993).

Albala-Bertrand's study takes into account only twenty-six individual disasters all occurring in different countries and at different times. As a result this study could be considered too small to make generalizations or conclusions about the effects of natural disasters. A regression analysis relating the individual variables used by Albala-Bertrand could give more insight as to how these variables relate in the overall effect of natural disasters on the economy. For example, an empirical analysis of growth rates of a cross section of countries, as done by Barro and Sala-i-Martin, could be used with the addition of dummy variables relating to natural disasters.

Freeman has analyzed the risks of natural disasters and has demonstrated the need for more work in determining the effects of natural disasters on the economy. His research quantifies natural disaster losses and looks at how the risks of catastrophes can be managed. When looking at the number and severity of natural catastrophes, his figures show that both have been increasing for the last ten years:

> "During the decade of the 1990's, the number of catastrophes has increased five-fold, and the damages have increased by a factor of nine, contrasted to the decade of the 1960's" (Freeman 2000, p.2).

The great increases in the numbers of disasters and the damages resulting from them cause an increasing economic burden on the world. Those that are being forced to face this increasing economic burden are the developing countries of the world, which bear half of the overall costs of natural disasters. For example, of the approximately 70 billion USD that was spent on average for direct costs of natural catastrophes from 1987-1997, half was borne by the developing world (Freeman, 2000). If considered in relation to the GDP of these regions, the per capita costs paid by developing countries are much higher than those paid by developed countries (Freeman, 2000). The inability of developing countries to absorb catastrophic losses was highlighted by a comparison of Mexico and the United States that showed the cost of a disaster in relation to the availability of internal resources to handle the loss (Freeman, 2001). In this comparison,

> "...assuming an earthquake with USD 5.5 billion in damage (equivalent to the Mexico earthquake in 1997 dollars), the cost of the earthquake as a percentage of GDP would be 20 times greater in Mexico than in the United States" (Freeman 2000, p.7).

Mexico, along with other developing countries, has great exposure to natural disasters and has felt their impacts on development for years.

Kreimer's research (1999) discusses how in coping with natural disaster losses there has been a constant reallocation of funds from development to disaster assistance. Kreimer notes that

> "disasters have destroyed human, social, and physical capital, and they have derailed economic development, as funds are reallocated from ongoing programs to finance relief and reconstruction assistance" (Kreimer 1999, p.2).

This reallocation of funds has slowed growth and sidetracked important development efforts. By measuring the impacts of natural disasters more accurately, Mexico and the Central American countries can prepare for and mitigate future risks. They can also make more informed decisions of how to plan development to reduce vulnerability to natural disasters and investigate risk financing measures that will deal with the real costs of disasters and avoid diverting funds from development projects.

Further research by Freeman (2000) notes the key relationship of natural disasters to infrastructure and poverty. Through its studies on infrastructure, the World Bank has found that investments in infrastructure projects related to agriculture reduce rural poverty and increase GDP. Thus infrastructure can be viewed as a "key component of economic growth" (Freeman 2000, p.3). When infrastructure is damaged or lost due to natural disasters, the effects of these losses can significantly impact the poor (Freeman, 2000). Consequently, access to infrastructure can be viewed as a measure of poverty. By noting this relationship, one can more clearly measure the effects of natural disasters on the low-income sector. One problem noted by Freeman is the unavailability of data concerning the indirect impacts of natural disasters, while direct economic costs are easily accessible. He states,

> "To date, little work has been done to measure the indirect impacts of natural catastrophes to developing countries. While measuring indirect impacts is much more difficult than measuring direct property loss, the implications of the indirect costs can be much more severe. Some studies measuring the impacts of the loss of flows from infrastructure indicate that damage may be 2.5 times the cost of the direct losses" (Freeman 2000, p.4).

After researching economic development theories, the endogenous or new growth theory was chosen as a basis for this thesis because it more fully explains economic growth across countries. In examining the study by Commander (1997), this thesis was tailored in a similar format with the exception of focusing the study on the effects of natural disasters on economic development instead of the effects of economic policies and institutional capabilities. The study by Barro (1995) also influenced this thesis in the choice and specification of variables. The results of the study by Albala-Bertrand (1993) were unexpected but insightful. In order to see how the variables used by Albala-Bertrand related to each other in the overall effect of natural disasters on the economy, a regression analysis was chosen. The work by Freeman provided insight into the relationship between natural disasters and infrastructure and poverty, which explained how disasters could greatly impact the poor.

Consequently an empirical analysis of the growth rates of a cross section of countries, similar to the Barro study, was chosen. The addition of dummy variables relating to natural disasters allowed the analysis to focus on the effects of natural disasters on growth rates. In view of the literature, the empirical analysis was designed to test the hypothesis that natural disasters negatively affect the economic growth of a country. (Copyright 2002, Sharon L. Garcia)

Chapter Three
Methodology

In this study the developing countries of Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, and Nicaragua were studied to measure the impact that disasters have had on economic growth over the past twenty-nine years (1970-1998). This area of Latin America was chosen for the case study due to the researcher's familiarity with the area in addition to the area's vulnerability to natural disasters, similar structure of economies, and common weather patterns that generally affect the region in varying stages of severity. The development indicator, gross domestic product (GDP) growth rates, was measured over the last twenty-nine years (1970-1998) and analyzed with respect to correlation with natural disasters. Regression analysis was used to investigate the relationship between natural disasters and economic growth. Table 3.1 reports the dependent and independent variables, their definitions and units. Table 3.2 reports the mean values of the variables by country.

The economic model used in this analysis is based on the new or endogenous growth theory. The new growth theory broadens the definition of capital to include human capital, which it considers endogenous. In this model, savings and investment in physical and knowledge (human) capital can show increasing returns for each additional unit added and lead to persistent and long run growth in per capita income (Meier, 1995). In this theory, the savings rate, the investment rate, the growth rate of human capital, the growth rate of physical capital, and the rate of technological progress all are factors influencing the economic growth of a country (Mankiw, 2000).

While based on endogenous growth theory, additional variables are included in the model to measure the effects of natural disasters on growth and to account for the potential growth differences based on varying initial growth levels. Theoretically the growth rate of GDP is a function of physical capital accumulation, human capital accumulation, initial level of GDP, population growth rate and technology adoption. To these theoretically important variables is added a variable that accounts for the total number of disasters in a year. Each of these factors can be empirically measured as follows: physical capital accumulation can be measured by investment as a percentage of GDP; human capital accumulation can be measured by educational expenditures as a percentage of GDP, levels of educational attainment, and life expectancy rates;

technology adoption can be measured as research and development expenditures as a percentage of GDP; and natural disasters can be measured by the number of events of natural disasters, total killed in natural disasters and total affected by natural disasters.

The impacts of natural disasters on the GDP growth rates for the case study countries of Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico and Nicaragua are quantified using regression analysis to minimize the sum of squared error of Equation 3.1. The independent variables in Equation 3.1 were chosen because they are theoretically correct, practical to collect, and readily available from reliable data sources. In addition, these variables help define the essential measures of growth and demonstrate more fully the effects of disasters on the development of the economy as a whole. The period of the study is from 1970 to 1998. These years were chosen because data on natural disasters and economic data were available for all of the case study countries.

Several of the key variables were not available in the case study countries including the human capital variables suggested by Barro (1995), such as educational attainment, life expectancy, and public expenditures on education. Also government expenditures as a percentage of GDP are substituted for expenditures on educational and expenditures on research and development expenditures, which were not available. Other explanatory variables that were found to be insignificant in Barro (1995) were also not included. Inflation, as measured in terms of consumer prices, was added to assess whether inflation negatively affects GDP growth. A variable capturing official development assistance and official aid was added to assess if external aid in the wake of a disaster would counteract the negative effects of the disaster, as hypothesized by Albala-Bertrand. A population growth rate variable was not included in the analysis as it was highly correlated to the country dummy variable (as indicated by large variance inflation). Finally, a country dummy variable was included to account for possible influences of the country.

The disaster variable included in this analysis was based on the number of natural disasters that occurred in each country by year. This variable was chosen over variables defined by the number of people affected and the number of people killed because it resulted in a higher adjusted R2 (i.e. a better model). GDP level was included to account for variations in growth caused by varying levels of GDP. Also variations in GDP growth due to the business cycle are accounted for by the inclusion of the lagged GDP growth variable. By taking out the variations caused by such differences, the influence of natural disasters is clearer. These variables were then combined to yield a base model of GDP growth rate that accounts for the theoretically accepted explanatory variables of GDP and takes into account additional variables that would also help explain the effects of natural disasters on GDP growth.

A fixed effects model is a way of analyzing observations from a cross-section of units, in this case countries, across time. With a fixed effects model, dummy variables are used to measure shifts in the regression line arising from differences in location (Kennedy, 1998). A fixed effects model can only make inferences or conclusions inside the model, or only about the panel itself. The fixed effects model is appropriate in this analysis because the countries used in this study, while unique in location and political structure, are close enough in proximity that a single weather event can cause disasters in a number of the case study countries. As a consequence, it is expected that spatial correlation or correlation between countries based on proximity to each other, is a concern. Equation 3.1 is a fixed-effects model that captures differences in the independent variable by country. Specifically, Equation 3.1 allows changes in the intercept and slope terms to vary by country.

The base model is specified as follows:

$$\begin{aligned} GDPG_n = {} & \beta_{1j} * CD_{nj} + \beta_{2j} LCDD_{nj} * CD_{nj} + \beta_{3j} DAA_{nj} * CD_{nj} + \\ & \beta_{4j} GDI_{nj} * CD_{nj} + \beta_{5j} CG_{nj} * CD_{nj} + \beta_{6j} GDPD_{nj} * CD_{nj} \\ & \beta_{7j} INF\_CP_{nj} * CD_{nj} + \beta_{8j} LGDPG_{nj} * CD_{nj} + \varepsilon_n \quad \because \quad j \end{aligned} \qquad \text{Equation 3.1}$$

Where:

N	=	$i * j$
i	=	1...29: A year in the period 1970-1998
j	=	1...7: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua
GDPG	=	Annual growth rate of gross domestic product
CDn_{nj}	=	Dummy variable representing individual country 1 if country j; 0 otherwise…for all j
LCDD	=	Lagged continuous disaster variable
DAA	=	Official development assistance and official aid

GDI	=	Ratio of gross domestic investment to GDP
CG	=	Ratio of general government consumption to GDP
GDPD	=	Gross domestic product
INF_CP	=	Inflation, consumer prices
LGDPG	=	Lagged gross domestic product growth rate
ε	=	Error term

The design of Equation 3.1 is a block diagonal matrix such that Y = Xb where

$$X = \begin{bmatrix} x_{(i,k),j=1} & 0 \ldots & 0 \\ 0 & x_{(i,k),j=2} & 0 \\ 0 & \ldots & x_{(i,k),j=J} \end{bmatrix} \qquad \begin{matrix} i = 1 \ldots I = 29^{*} \\ j = 1 \ldots J = 7 \end{matrix} \qquad \text{Equation 3.2}$$

The block diagonal matrix is (J∗I)∗(J∗K) where J is 7 (the number of countries), I can vary by country from 19 to 29, (the number of years), and K is 8 (the number of parameters plus the country dummy variable CD). Thus this model estimates J∗K parameter values (i.e., b is (J∗K)∗1) to explain the variation in the vector ϒ that is dimension (J∗K)∗1. Note that all J country dummy variables are included in this model; hence estimation does not include an intercept. The intercept, if included, would be perfectly correlated with the included country dummy variables and estimation of Equation 3.1 would fail due to X being

The dependent variable, GDP growth rate, used in this model (Equation 3.1), was calculated by the World Bank by first measuring GDP in local currency and then converting the local currency to current U.S. dollars. Next, GDP in U.S. dollars was changed to an annual percentage growth rate. Due to this process, the resulting GDP growth rate is closer to real terms than nominal terms because the exchange rate used to convert the local currency to U.S. currency is affected by the inflation rate in the individual countries.

The country dummy variable is used in this model (Equation 3.1) to capture differences in the GDP growth rates that are attributable to differences in the individual countries. Barro used similar dummy variables in his study to capture regional influences. Barro's study found that the coefficients of some regions, including Latin America, were significant. If a dummy variable for a specific country is significant, that country has some unique attribute that makes it different from the other case study countries, which is contributing greatly to the overall results and not being taken into account by other explanatory variables in the regression (Barro, 1995).

The disaster variable is used to capture the effects of the occurrence of natural disasters on the GDP growth rates. This variable is continuous in that it counts the number of total disaster events that occurred in any given country in any given year. The disaster variable in each country was lagged to better account for the time that it takes for disaster damages to impact GDP growth rates. The length of time to lag the disaster variable was determined by comparing the adjusted R2 values and the significance of resulting t-values of models with different lag lengths. The length of lag showing the highest R2 value and highest significance of t-values was chosen on a country-by-country basis.

Disaster data was collected from EM-DAT, the international disaster database compiled by the U.S. Office of Foreign Disaster Assistance (OFDA) and Centre for Research on the Epidemiology of Disasters (CRED). The EM-DAT database includes the number and type of disasters that occurred in any given country in any given year along with figures on the number of deaths and number of people affected by these disasters. In this regression the disaster variable has a value that ranges from zero to a maximum of ten. The disaster variable is used to test the hypothesis that the occurrences of natural disasters negatively affect GDP growth rates. The decision to choose the number of disasters as the disaster variable was based on a comparison of adjusted R2 from alternative models using disaster variables consisting of total number of deaths caused by disasters and the total number of people affected by disasters. The use of the actual number of natural disasters resulted in a much higher adjusted R2 and thus a much better fitting model.

The DAA variable captures the value in dollars (US) of official development assistance and aid given to a country for disaster relief or other purposes. This data was also collected from the World Bank Human Development Index CD-ROM. This variable was included to capture the effect that aid and development assistance has on the growth of GDP. Assistance and aid, which can greatly increase in periods following natural disasters, is hypothesized by Albala-Bertrand to counteract the negative effects of natural disasters resulting in positive GDP growth rates. Yet, the relationship of official development assistance and official aid to the overall real

GDP growth rate could be ambiguous as the aid could stifle innovation or it could spawn growth that would otherwise not have been possible.

The GDI variable, gross domestic investment as a ratio to GDP, is included to demonstrate how the relative rate of investments in physical and human capital to overall GDP affects the GDP growth rates. This data was also collected from the World Bank Human Development Index CD-ROM. A positive relationship is expected between overall increases in the ratio of investment to GDP and GDP growth rates because of the economic assumptions behind the new growth theory that has shown increasing returns to scale for investments in capital.

The gross government consumption of goods and services, CG, variable is reported as a ratio of GDP. It is included in the model (Equation 3.1) as a substitute for educational expenditures, which was unavailable for the case study countries. This variable includes expenditures on education that are assumed to have a positive affect on GDP growth rates, but it also contains other expenditures by government such as military expenditures, which could show a negative effect. Commander (1997) and Barro (1995) both report negative effects in their studies and thus suggest an overall negative effect. This data was also collected from the World Bank Human Development Index CD-ROM.

The variable GDPD represents the level of gross domestic product measured in dollar terms. It was included in the equation because the level of GDP affects how fast the economy can grow. If a country begins at a much higher level of GDP, there is less potential for growth. Yet a country with a lower GDP has a higher growth potential. Thus a negative relationship is expected between this variable and the GDP growth rate. This data was also found in the World Bank Human Development Index CD-ROM.

The inflation variable is used to show how inflation affects GDP growth. Inflation as measured by consumer prices is expected to positively affect the growth rate of GDP if the GDP figure is measured in nominal terms or negatively affect it if it is measured in real terms. The measure of GDP growth rate used in this model was calculated by the World Bank by first measuring GDP in local currency, then converting the local currency to current U.S. dollars, and then changing it to an annual percentage growth figure. Thus, in converting the GDP figures to U.S. dollars, the resulting GDP growth rate is closer to real terms because the exchange rate is affected by the inflation. Thus with years of high inflation, the currency would depreciate and when converted to dollars would show negative effects on GDP growth. Consequently, it is expected that higher levels of inflation would have a negative effect on GDP growth rates.

The final variable included in the regression analysis is LGDPG, which is the growth rate of the gross domestic product with a one-year lag. The data for this variable was also collected from the World Bank Human Development Index CD-ROM. The inclusion of the lagged GDP growth variable takes into account variations due to changes in the business cycle. If the natural disaster came during a time of increasing economic growth, the effect of the disaster could be masked by the growth in the current business cycle. Thus by including this variable in our regression analysis we are able to control for, or account for, business cycle effects and better isolate the effects that natural disasters have on the GDP growth rate.

The model was checked for problems associated with non-normality, autocorrelation, heteroskedasticity, and multicollinearity. The model did not suffer from non-normality or autocorrelation, but most countries were corrected within the cross-section for heteroskedasticity. The correction for heteroskedasticity exacerbated the multicollinearity already present in the full model. The problem of multicollinearity was not addressed due to the small sample size of the data and the desire to avoid other problems associated with dropping data. At worst multicollinearity increases the variance of the estimates resulting in t-values that are less significant. If the sample size were larger the significance level of the estimates would increase.

When the full model was run with corrections made for heteroskedasticity in all of the countries, the results were poor in that the results of country six (Mexico) masked the other interactions in the model. This was caused because the equation used to generate the weights to fix the heteroskedasticity in country six (Mexico) resulted in severe levels of multicollinearity that dominated the contributions of the remaining parameter estimates and drove the results of the regression of the main model (Equation 3.1). Specifically, the parameter estimates of the remaining six countries were not significant. To avoid the severe level of multicollinearity caused by the fixing of heteroskedasticity in Mexico, the model was then run without the corrections for heteroskedasticity in Mexico. The consequence of not correcting the heteroskedasticity present in the Mexico cross-section is that the parameter estimates for the Mexico data will be biased and statistical inferences will not be reliable.

The base or main model expressed as Equation 3.1 was then modified to remove the assumption of spatial correlation. Equation 3.3 is a model that is run country by country (i.e. one model for each j). In this model the country dummy variable acts as the intercept. Although the model (Equation 3.1) was run as a fixed effects model, the specification of the dependent variable as an annual percentage growth figure removes the linear spatial fixed effects from the model. Thus the fixed effects were removed from the model resulting in a first difference model. Theory suggests that if there are no fixed effects and the model is a true first difference model, then the results of the full model should be the same as results from the country-by-country model (Equation 3.3) when both are corrected for heteroskedasticity. As a consequence two estimations are included in this analysis. The first is the full fixed effects model as specified by Equation 3.1. The second estimation is country by country (i.e. one regression for each country or seven regressions total) according to Equation 3.3.

$$GDPG_{ij} = \beta_{0j}\, CD + \beta_{1j}\, LCDD_{ij} + \beta_{2ij}\, DAA_{ij} + \beta_{3j}\, GDI_{ij} + \beta_{4j}\, CG_{ij} + \beta_{5j}\, GDPD_{ij} + \beta_{6j}\, INF\_CP_{ij} + \beta_{7j}\, LGDPG_{ij} + \in_{ij} \qquad i = 1 \ldots 29,\ j = 1 \ldots 7 \qquad \text{Equation 3.3}$$

A benefit of the country-by-country analysis is that it is now possible to correct heteroskedasticity that is present in the Mexico cross-section. Because of the data problems in Mexico it is not possible to directly compare the results of the two estimation procedures. In theory the results of these two procedures should be identical, if they could both be corrected for heteroskedasticity.

F-tests were conducted on the fixed effects model (Equation 3.1) to test if the coefficients of the variables differ by country. Further F-tests were conducted to test if removing Mexico from the estimation changed the results of the fixed effects model. This was done to assure that leaving Mexico uncorrected for heteroskedasticity was not affecting the results of the F-tests. If the results of the F-tests were greater than 0.10 then one would reject the hypothesis that the coefficients are different across countries, thus suggesting that that spatial correlation is not as strong as suspected. If the coefficients were the same across countries, then a traditional fixed effects model could be run that makes this assumption and the independent variables would not be split out by country. Consequently, the F-tests test for the influence of spatial correlation on the case study countries will demonstrate the strength of the assumption of spatial correlation, thus illustrating whether the assumption of spatial correlation is warranted among the case study countries and which model is most appropriate. (Copyright 2002, Sharon L. Garcia)

Table 3.1: Descriptive Data on Dependent and Independent Variables

Variable	Definition of variable	Units
GDPG	Gross domestic product, growth rate	Annual % growth
CD	Country dummy variable	N=1 if specified country and 0 if not
LCDD	Lagged Disaster variable	A lagged continuous variable given in actual numbers of natural disasters in the year
DAA	Official development assistance and official aid	Current US$
GDI	Gross domestic investment as a ratio to GDP	%
CG	General government consumption as a ratio to GDP	%
GDPD	Gross domestic product	Current US$
INF_CP	Inflation, consumer prices	Annual % growth
LGDPG	Lagged gross domestic product growth rate	Annual % growth

Table 3.2: Mean Values for Variables According to Country

Variable	Belize	Costa Rica	El Salvador	Guatemala	Honduras	Mexico	Nicaragua
GDPG	0.4878	0.7277	0.3681	0.5966	0.6524	0.6579	0.1453
CD	0.1079	0.1617	0.1677	0.1677	0.1677	0.1257	0.1018
LCDD	0.0299	0.1796	0.0958	0.1856	0.1677	0.4491	0.0898
DAA	2229760	16268084	36508444	21731018	34407126	18696587	25322755
GDI	2.6434	4.1324	2.7703	2.5536	3.8332	2.9158	2.0566
CG	1.8462	2.5993	1.9816	1.1377	2.0089	1.2392	1.7021
GDPD	42578309	777381023	784690356	1433183753	479790658	28134534203	204422146
INF_CP	0.3589	2.5898	2.2870	2.0938	1.9349	2.4156	2.0277
LGDPG	0.5545	0.7055	0.3668	0.5999	0.6559	0.6230	0.1387

Chapter Four

Results

As discussed in Chapter one, the primary objective of this thesis is to gain a more complete understanding of the impact natural disasters have on the GDP growth rates of selected developing countries. This is assessed by testing the hypothesis that natural disasters negatively affect the economic growth path of a country as measured by the annual percentage change in GDP growth. There is empirical evidence that GDP growth is not negatively affected by natural disasters. The results from the estimations of Equations 3.1 and 3.3 are discussed in this chapter.

Both the fixed effects (Equation 3.1) and country-by-country (Equation 3.3) models were estimated using SAS. Results of the econometric analyses are compared based on conformance with theory (Tables 4.1 and 4.2) and significance of parameter estimates (Tables 4.3 and 4.4). Although the model was run as a fixed effects model, the specification of the dependent variable as an annual percentage growth figure removed the linear spatial fixed effects. Consequently, the only resulting variations are attributed to country specific time trends and do not include variation due to fixed effects such as country location.

The data, which is identical in both analyses, was tested for and corrected for infinite error variance and non-spherical errors by cross-sections where necessary. Problems associated with heteroskedasticity were identified in Belize, El Salvador, Honduras, Mexico and Nicaragua. Weighted least squares was used to correct for heteroskedasticity, except for the panel representing Mexico. The correction weights in country six (Mexico) dominated the estimation and determined the results of the regression for the fixed effects model (Equation 3.1). All other parameter estimates in the other countries were not significant. To avoid this problem the decision was made to not correct the data for Mexico in the fixed effects model.

Not correcting for heteroskedasticity in the Mexico data results in an increase in the variances of the β distributions. This causes OLS to underestimate the variances of the coefficients resulting in the inflation of t-statistics. Consequently the variance results in invalid t- and F-statistics for country six, while the parameter estimates remain valid. However, the t-values for Mexico do not change drastically between models even with the bias introduced by heteroskedasticity (see Tables 4.3 and 4.4).

Heteroskedasticity was corrected for in the Mexico data for the country-by-country model (Equation 3.3). The model was then tested for normality, autocorrelation, and multicollinearity. The Bera-Jarque test, used to test for infinite error variance (normally distributed errors), failed to reject the null hypothesis of normality. The Durbin-Watson d-test, used to test for autocorrelation, failed to reject the null hypothesis of no autocorrelation. The variance inflation factor test, an option in SAS, was used to check for multicollinearity. Variance inflation was high (VIF > 10) in the estimated data. One method of remedying multicollinearity is to drop one or more of the multicollinear variables (Studenmund, 1992). Yet in both models, theory suggests that the estimated variables belong in the equation and, therefore, should not be dropped. If they were to be dropped it could create bias in the equation due to exclusion of relevant independent variables (Studenmund, 1992). Another solution is to increase the sample size. Unfortunately this option is not possible in this case. Consequently, it was deemed best to leave the model unadjusted for the high level of multicollinearity. The impact of not adjusting for the multicollinearity is lower calculated t-values. Yet in the models, even in the face of severe multicollinearity, many of the variables remain significant.

F-tests were conducted on the fixed effects model (Equation 3.1) to test if the coefficients of the variables differ by country. The F-tests indicated that only two of the variables, the disaster variable and the government consumption variable, were the same across countries. Further F-tests were conducted to test if removing Mexico from the estimation changed the results of the fixed effects model. This was done to assure that leaving Mexico uncorrected for heteroskedasticity was not affecting the results of the F-tests. The remaining six variables failed to reject the hypothesis that the coefficients were different across the countries. This suggests that the fixed effects model is better than a "traditional" fixed effects model with the assumption that the coefficients are the same across countries. The country-by-country model, which was corrected for heteroskedasticity, theoretically gives the same results as the fixed effects model would give if it had been able to be corrected for heteroskedasticity without introducing the severe levels of multicollinearity. Consequently the country-by-country model (Equation 3.3) gives the most appropriate and accurate results.

Inter-Country Comparisons

Analyzing the mean values of the variables by country gives some insight into the countries in the case study. The average annual GDP growth rate across countries is 0.5194 percent. Costa Rica has the highest rates at 0.7277 percent and Nicaragua lags far behind at 0.1453 percent. The mean values for the country dummy variable are nearly identical across countries. The disaster variable mean is the highest in Mexico, which actually experiences a disaster every year in the period of the case study, and the lowest in Belize. Official aid means range from $2,229,760 in Belize to $36,508,444 in El Salvador. The mean values for gross domestic investment as a ratio of GDP average at 3 percent of GDP with the highest investment found in Costa Rica with 4.1324 percent of GDP. Government consumption mean values are on average 1.78 percent of GDP across the countries, with Costa Rica at the highest mean of 2.60 percent of GDP. The average mean value for level of GDP has the greatest variance. Mexico has the largest economy by far with a mean of $28,134,534,203, while Nicaragua with $204,422,146 and Belize with $42,578,309 have the two smallest. Inflation average mean across countries is 1.96 percent with all the countries at about 2 percent except for Belize whose mean is .36 percent. The averages for the mean values of the lagged GDP growth variable are almost identical to the GDP growth rate, with the average mean of 0.5206 percent.

Results of the Fixed Effects Model

The fixed effects (Equation 3.1) has an adjusted R2 value of 0.9473 indicating that the model explains 94 percent of the variation in GDPG. F-test results indicate that the variables are contributing to an understanding of GDPG. The results of the regressions for each of these variables follow with a discussion of how they relate to expected outcomes.

The country dummy variable is a variable that explains variation in GDPG that is not accounted for by the other independent variables. This variation is attributed to the differences in country specific time trends and does not include variation due to fixed effects such as country location. The significance of these country dummy variables cannot be determined a priori. A significant positive country dummy variable suggests that a time trend within the country is positively affecting GDP growth over time. The parameter estimates for the country dummy variable are significant and positive for Belize and Costa Rica (Table 4.3), indicating that time trends in those countries positively affect the mean GDP growth rate. Costa Rica's increasingly stable government for this region of the world may account for its higher mean growth rate. The stability of Belize's government may also contribute to its greater growth potential. This would be in accordance with Barro's hypothesis that more stability and less distortion of markets are conducive to growth. The parameter estimates on the country dummy variables for Mexico and Nicaragua (Table 4.3), on the other hand, are negative and statistically different from zero (α = 0.10). This result indicates that mean growth rate in these two countries is lower on average and grows slower relative to the other case study countries. Political instability and corruption could be the cause of Nicaragua's slower growth.

The parameter estimate for the lagged disaster variable is hypothesized to be negative, suggesting that the occurrence of natural disasters slows or retards the growth rate of a country. Regression results indicate both positive and negative signs for this variable with only Belize having a significant positive result (Table 4.1). This suggests that a positive relationship could exist between natural disasters and GDP growth rate. In Belize, the parameter estimate for the disaster variable was 1.84 (Table 4.3), which implies that each additional natural disaster results in an increase in the GDP growth rate by 1.84 percent. Although theorized to have a negative impact on GDP growth, the results of this study are plausible. Natural disasters could stimulate growth by providing new jobs in such areas as construction, by increasing aid dollars coming into the country, and by increasing government investment in productive areas. Also the anticipated negative effect of natural disasters assumes that disasters negatively affect all sectors of society. Yet those most affected by natural disasters are the poor, who are generally part of the informal sector, and this sector is not accounted for in the GDP. Consequently, the negative effects of disasters felt by this sector would not be picked up in the dependent variable, GDP growth.

The sign of the parameter coefficient for the variable representing official development assistance and aid cannot be determined from theory. As suggested by Albala-Bertrand (1993), this variable could be positive indicating that aid can counteract any negative effects of natural disasters. Yet, aid from other countries could also stifle innovation and thus negatively impact GDP growth. Results indicate that the aid variable was positive in six of the seven case study countries and statistically greater than zero (significant) in two countries, Belize and Guatemala (Table 4.1). These results seem to suggest that aid triggers growth and economic recovery after a disaster. The cause of the positive influence of aid could perhaps be due to indirect benefits of aid including better-constructed buildings, increased employment opportunities and restructuring of public policies that could trigger growth. Yet, the parameter estimate for aid in Belize is small ($2.64*10^{-7}$) suggesting that, while significant, the actual impact on GDP growth is small (Table 4.3). This supports Albala-Bertrand's hypothesis that aid has a positive affect on the GDP growth, but may not be the only factor in counteracting the negative effects of natural disasters.

Economic theory suggests that increases in investment should positively affect growth. Regression results (Table 4.3) are in accordance with theory, with the exception of Belize, where the parameter coefficient is negative, but not statistically different from zero ($\alpha = 0.10$). The parameter estimates for Mexico and Nicaragua are statistically different from zero (significant). Mexico shows the highest coefficient at 1.716, suggesting that a one percent increase in the relative levels of gross domestic investment as compared to overall GDP increases the GDP growth rate by 1.716 percent.

The anticipated effect of government consumption as a ratio of GDP on GDP growth rates is negative. Theory suggests that the portion of government expenditures that is spent on education has a positive impact on GDP growth, yet when all government expenditures are aggregated together the overall effect is negative. Regression results indicate that a negative relationship exists between government consumption and GDP growth across all the countries studied (Table 4.3). In Belize, Costa Rica, Guatemala and Honduras, the negative results were also significant ($\alpha = 0.15$ in Costa Rica and Honduras, $\alpha = 0.10$ in Belize and Guatemala). A negative relationship could result from military expenditures (for example expenditures on imported weapons and ammunition) that do little to help the overall growth of the country.

The level of GDP is expected to affect the rate at which GDP can grow. If a country has a very high level of GDP, there is less growth potential and the country is expected to have slower rates of economic growth. Alternatively, if a country has a low GDP level it has greater potential for growth and can grow at a much faster rate. Regression results indicate that the level of GDP has a significant ($\alpha = 0.10$) negative impact on the GDP growth rate in Belize, Guatemala, Honduras and Mexico (Table 4.3). This result was anticipated for Guatemala, Honduras and Mexico that have the highest mean GDP levels of the case study countries. The significant, negative result in Belize is interesting as it has one of the lowest GDP levels of all the case study countries. Although the GDP level in Belize is low in comparison to other countries, the GDP level is large in comparison to the Belize's small geographic size, which could retard the growth rate potential and result in the negative outcome.

Inflation as measured by consumer prices is expected to have a negative impact on GDP growth rates. The sign of the parameter estimates for the inflation variable were in accordance with expectations in six of the seven case study countries (Table 4.1). Nicaragua, the only exception, had a coefficient that was positive and insignificant. Of the countries with negative coefficients, four had parameter estimates that were significantly different from zero (Table 4.3).

The sign of the parameter estimate for the lagged gross domestic product growth rate variable cannot be determined a priori. If a country experiences falling annual growth rates, it is expected that growth rates will continue to fall. For example, if a country experiences an economic recession in one year, it is expected that the following year will also be a recession year, thus a negative effect. The influence of the growth rate in previous years would be true of an expanding economy also. In this case the further expansion of the economy would be expected, resulting in a positive effect. Specifically, the lagged GDPG variable accounts for the affect of the business cycle on the overall economic growth rate. Regression results suggest that the lagged growth rate variable is only significant in Nicaragua where it is negative (Table 4.3). This demonstrates that while the business cycle does affect the GDP growth rate it is not as good at explaining variation in GDPG as are the other variables in the model.

<u>Results of the Country-by-Country Model</u>

Estimations run country by country resulted in a higher adjusted R2 in two of the countries, relative to the fixed effects model. The adjusted R2 for the case study countries are respectively: 0.9871, 0.8293, 0.9075, 0.8531, 0.8646, 0.9851, and 0.9234 for Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico and Nicaragua (see Table 4.2). The results of the country-by-country model will only be noted below when they differ from the results of the fixed effects model.

In the country-by-country analysis the CD variable acts as an intercept. Regression results indicated that El Salvador and Guatemala, which were statistically equal to zero in the fixed effects model, are positive and significant ($\alpha = 0.10$) in the country-by-country analysis (Table 4.4). With the exception of Honduras, all the countries in the case study show a significant positive relationship between the CD intercept variable and GDP growth. This result could partially be attributable to population growth, which is being picked up by the intercept. As noted in chapter three the population variable was omitted from the estimation due to its high correlation with the CD variable.

The parameter estimates on the lagged disaster variable are more significant in this country-by-country analysis (Table 4.4). The sign of the parameter estimate on the disaster variable in Mexico remains positive, but is now significantly different from zero ($\alpha = 0.10$). Other differences from the fixed effects model include the change of the signs of the parameter estimates for El Salvador and Honduras. The parameter estimates for these countries, which were negative in the fixed effects model, are now positive. Overall, the disaster variable that was hypothesized to be negative is positive for all countries except Guatemala where the result is insignificant. The occurrence of natural disasters, while they often destroy infrastructure and cause a decline in wealth, positively affect the GDP growth rate of these developing countries. Although generally theorized to have a negative impact on an economy, natural disasters appear to stimulate growth, perhaps by providing new jobs in construction, by an increase in aid dollars, and (or) increasing government investment in productive areas. Furthermore, those most impacted by the natural disasters, the poor, are part of the informal sector that is not accounted for in the calculations of GDP. Consequently, the negative impact on this sector will not be seen in the GDP growth rate changes. These findings support some of the hypotheses of Albala-Bertrand (1993), that the overall effects of natural disasters are positive.

The official development assistance and aid variable is positive in three of the countries in the country-by-country model (Table 4.4). El Salvador, which had a positive coefficient, is now also significant ($\alpha = 0.10$). While the variable coefficient for Nicaragua is still negative, it is insignificant in this model. These results, which are more positive than the fixed effects analysis, lend more support to the idea that official development and aid positively influence the growth rate of GDP.

The gross domestic investment variable increases in the level of significance for the country-by-country model (Table 4.4). The parameter coefficients for Belize and El Salvador are now positive and significant ($\alpha = 0.10$). Yet the parameter coefficient for Honduras is now insignificant. These results confirm the positive relationship expected between increasing investment relative to GDP and the rate of GDP growth. The coefficient for Mexico, although still the largest among case study countries, dropped in value from 1.716 to 1.365. This signifies that a one-unit increase in the ratio of investment to GDP increases the overall GDP growth rate by 1.365 percent.

The government consumption variable remained negative in all the seven case study countries, with the exception of Mexico (Table 4.4). Some changes in the significance of the variables in three countries were noted. The negative results for Costa Rica, which was significant at a fifteen percent significance level ($\alpha = 0.15$), and El Salvador are now significant ($\alpha = 0.10$). Yet Honduras, which was significant ($\alpha = 0.15$) in the fixed effects model, is now insignificant. The coefficient for Mexico changed from negative to positive, yet remained insignificant. Overall, the results are negative as suggested by previous studies.

Results of the fixed effects model indicated a significant ($\alpha = 0.10$) negative impact of the level of GDP on GDP growth in Belize, Guatemala, Honduras, and Mexico. The changes from the fixed effects model to the country-by-country model are the loss of significance in Honduras and the gaining of significance for El Salvador (Table 4.4). Although El Salvador with its low GDP level should have more potential for growth, perhaps the small earnings base makes it difficult to invest in the economy and increase growth rates. Costa Rica also changed from a positive to a negative parameter coefficient, but remained insignificant.

The signs of the parameter estimates for the inflation variable all remained negative in the country-by-country model (Table 4.4). The only change in the results is the improved level of significance over the main model, which is due to the significant ($\alpha= 0.10$) negative results now in Guatemala. These results reaffirm that inflation has a negative relationship to GDP growth for the developing countries used in the case study.

The lagged gross domestic product growth variable also increased in significance over the results of the fixed effects model (Table 4.4). Guatemala is now significant and positive in the country-by-country analysis. This result indicates that the growth rate of GDP from the previous year has a significantly positive effect on the following year's growth rate in Guatemala (Copyright 2002, Sharon L. Garcia).

Table 4.1: Expected versus Actual Results (Fixed Effects Model)

Variable	Expected Results	Actual **Belize**	Actual **Costa Rica**	Actual **El Salvador**	Actual **Guatemala**	Actual **Honduras**	Actual **Mexico**	Actual **Nicaragua**
CD	**unknown**	+ **significant**	+ **significant**	+	+	+	– **significant**	+ **significant**
LCDD	–	+ **significant**	+	–	–	–	+	+
DAA	**unknown**	+ **significant**	+	+	+ **significant**	+	+	– **significant**
GDI	+	– **significant**	+	+	+	+ **significant**	+ **significant**	+ **significant**
CG	–	– **significant**	–	–	– **significant**	– **significant**	–	–
GDPD	–	– **significant**	+	–	– **significant**	– **significant**	– **significant**	+
INF_CP	+	– **significant**	– **significant**	–	–	– **significant**	– **significant**	+
LGDPG	**unknown**	+	+	–	+	+	–	– **significant**

Note: items are considered significant at the 10 percent level

Table 4.2: Expected versus Actual Results (Country by Country Model)

Variable	Expected Results	Actual **Belize**	Actual **Costa Rica**	Actual **El Salvador**	Actual **Guatemala**	Actual **Honduras**	Actual **Mexico**	Actual **Nicaragua**
Adj. R2		**.9871**	**.8293**	**.9075**	**.8531**	**.8646**	**.9851**	**.9234**
CD	**unknown**	+ **significant**	+ **significant**	+ **significant**	+ **significant**	+	– **significant**	– **significant**
LCDD	–	+ **significant**	+ **significant**	+	–	+	+ **significant**	+
DAA	**unknown**	+ **significant**	+	+ **significant**	+ **significant**	+	+	–
GDI	+	– **significant**	+	+ **significant**	+	+ **significant**	+ **significant**	+ **significant**
CG	–	– **significant**	– **significant**	– **significant**	– **significant**	–	+	–
GDPD	–	– **significant**	–	– **significant**	– **significant**	–	– **significant**	+
INF_CP	+	– **significant**	– **significant**	– **significant**	– **significant**	– **significant**	– **significant**	+
LGDPG	**unknown**	+	+	–	+ **significant**	+	–	– **significant**

Note: items are considered significant at the 10 percent level

Table 4.3: Parameter Estimates and Probability of T (Fixed Effects Model)

Variable	**Belize** Par.Est	**Costa Rica** Par.Est	**El Salvador** Par.Est	**Guatemala** Par.Est	**Honduras** Par.Est	**Mexico** Par.Est	**Nicaragua** Par.Est
CD	50.13* (0.0015)	17.2* (0.0768)	15.74 (0.9076	12.67 (0.1215)	9.83 (0.1944)	−23.78* (0.0062)	−18.22* (<.0001)
LCDD	1.84* (0.0441)	0.50 (0.2625)	−0.54 (0.8455)	−0.44 (0.2864)	−0.07 (0.8606)	0.19 (0.6002)	0.39 (0.4843)
DAA	0.00* (0.0103)	0.00 (0.3625)	0.00 (0.9335)	0.00* (0.0237)	0.00 (0.3444)	0.00 (0.5571)	−0.00* (0.0083)
GDI	−0.42 (0.1157)	0.06 (0.8326)	0.37 (0.9211)	0.18 (0.3530)	0.31* (0.0451)	1.72* (0.0002)	1.04* (<.0001)
CG	−1.68* (0.0021)	−0.76 (0.1369)	−1.51 (0.8788)	−1.51* (0.0681)	−0.64 (0.1180)	−0.30 (0.6147)	−0.22 (0.1972)
GDPD	−0.00* (0.0008)	0.00 (0.9730)	−0.00 (0.8953)	−0.00* (0.0312)	−0.00* (0.0630)	−0.00* (0.0629)	0.00 (0.5135)
INF_CP	−0.55* (0.0832)	−0.02* (0.0019)	−0.08 (0.9694)	−0.07 (0.2342)	−0.32* (<.0001)	−0.22* (0.0027)	0.002 (0.9558)
LGDPG	0.05 (0.8124)	0.03 (0.8557)	−0.11 (0.9824)	0.36 (0.1358)	0.09 (0.4216)	−0.23 (0.3031)	−0.31* (<.0001)

Note: Parameter estimates denoted with an * are significant at the 10 percent level

Table 4.4: Parameter Estimates and Probability of T (Country by Country Model)

Variable	**Belize** Par.Est	**Costa Rica** Par.Est	**El Salvador** Par.Est	**Guatemala Par.Est**	**Honduras Par.Est**	**Mexico Par.Est**	**Nicaragua Par.Est**
CD	50.17* (0.0153)	18.37* (0.0498)	10.658* (0.0916)	12.24* (0.0378)	8.31 (0.4176)	–23.35* (0.0008)	–18.22* (0.0190)
LCDD	2.44* (0.0439)	0.56 (0.1782)	0.45 (0.3860)	–0.35 (0.3884)	0.03 (0.9674)	0.32* (0.0462)	0.39 (0.6998)
DAA	0.00* (0.0303)	0.00 (0.3580)	0.00* (0.0341)	0.00* (0.0078)	0.00 (0.5399)	0.00 (0.4809)	–0.00 (0.1619)
GDI	–0.55* (0.1006)	0.08 (0.7663)	0.40* (0.0134)	0.19 (0.1750)	0.32 (0.1263)	1.29* (0.0005)	1.04* (<.0001)
CG	–1.55* (0.0264)	–0.84* (0.0839)	–1.08* (0.0259)	–1.49* (0.0181)	–0.56 (0.3147)	0.31 (0.3833)	–0.22 (0.4804)
GDPD	–0.00* (0.0126)	–0.00 (0.9465)	–0.00* (0.0015)	–0.00* (0.0056)	–0.00 (0.2005)	–0.00* (0.0012)	0.00 (0.7186)
INF_CP	–0.68* (0.0855)	–0.22* (0.0015)	–0.14* (0.1169)	–0.07* (0.1049)	–0.32* (0.0024)	–0.11* (0.0362)	0.00 (0.9756)
LGDPG	0.15 (0.5237)	0.03 (0.8356)	–0.04 (0.8303)	0.35* (0.0574)	0.09 (0.5630)	–0.09 (0.4790)	–0.31* (0.0312)

Note: Parameter estimates denoted with an * are significant at the 10 percent level

Chapter 5
Summary and Conclusion

The purpose of this study is to gain a more complete understanding of the impact natural disasters have on the gross domestic product (GDP) growth rates of selected developing countries. Data suggests that the frequency and numbers of disasters have been increasing over the past thirty years (Figures 1.1-1.4). The majority of these disasters are affecting developing countries. Some research claims that these disasters have negative direct effects such as losses to infrastructure, delays in production, and death. Indirect effects are also thought to be greater in scope than the direct effects. Little research has been done to qualify the effects of natural disasters beyond the immediate losses that occur in the wake of the disaster. These direct and indirect effects are expected to translate into an overall negative effect on the growth rate of the country. The hypothesis of this paper is that the number of natural disasters that a country faces has a negative impact on economic growth rates as measured by GDP.

The hypothesis above was tested using a linear regression analysis. The primary hypothesis was tested using a fixed effects model and estimation country by country. Data from the seven developing countries of Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, and Nicaragua were included in the analysis. Data for the years 1970 to 1998 included the following variables: gross domestic product growth rate, country dummy, lagged disaster variable, official development assistance and official aid, gross domestic investment as a ratio to GDP, general government consumption as a ratio to GDP, gross domestic product, inflation, and a lagged domestic product growth rate. These variables are included based on economic theory and past studies.

Conclusions

Overall, the results of the model are in accordance with economic theory and previous studies. Consistency with economic theory, a high level of adjusted R2, and varying degrees of statistical significance indicate that the included data does a good job of explaining GDP growth. Using the results of the two estimations, insight is gained how natural disasters impact GDP growth. The natural disaster variable, which was hypothesized to have a negative effect on GDP growth, was found to have a positive impact and this impact was significant ($\alpha = 0.10$) in two of the seven case study countries. By increasing the sample size and by adding other developing countries, the significance of the natural disaster variable is expected to increase. These results reject the hypothesis that natural disasters negatively impact the GDP growth rates of the case study countries.

In an attempt to explain the positive and sometimes significant impact of natural disasters on GDP growth, previous studies are reinvestigated. Albala-Bertrand, although using simple mathematical comparisons to support his theory, hypothesized that the overall economic impact of natural disasters would be positive. Kunreuther and Freeman, along with Albala-Bertrand, argue that those most affected by natural disasters are the poor. The poor are, in general, the less productive sectors of society and contribute comparatively little to the overall economy. Specifically, Albala-Bertrand suggests that the poor or "those who have a weaker economic and political base" (p.92) have a negligible effect on the overall economy. Furthermore, the poor make up part of the informal sector that is not accounted for in the measurement of GDP. Thus the negative effects of this sector are not accounted for in the GDP growth rates and do not show up in the regression analysis.

Albala-Bertrand also suggests that aid in response to natural disasters provides an economic stimulus that compensates for the losses to the society as a whole. The poor, who often lack legal claim to the land on which they live, as is the case with squatters, are not entitled to financial aid or assistance in the wake of natural disasters to rebuild their homes. Consequently, aid does not always go to those directly affected by the disaster. It is more common for aid to go to rebuilding of infrastructure, etcetera. Thus the aid that pours into a country after a natural disaster goes to areas that positively affect GDP growth.

The positive results of natural disaster variable in the analysis are surprising. Even when accounting for the influence of aid, which, Albala-Bertrand hypothesizes, provides an economic stimulus that helps to overcome the effects of natural disasters on the overall economy, the parameter estimates for natural disasters are positive. This unexpected result could be due to the measurement of the aid variable. This aid variable used in the regression analysis consists of official development assistance and official aid, which is aid that comes from the "official" sector. The defining of this variable excludes aid by non-governmental organizations (NGOs). The official designation is defined as coming from governments directly or indirectly from various multilateral organizations. This aid from NGOs, which can be substantial, is not accounted for in this analysis. This unofficial aid could affect the sign of the disaster variable and account for the positive parameter estimates for the natural disaster variable.

Although surprising, this positive result is not without precedence. Consider positive economic affects of aid given to Europe following World War II. Even with the great individual losses experienced by many in Europe, the economic stimulus that followed helped compensate for the losses to the overall economy. Similar results have also been seen in the wake of the September 11, 2001 terrorist bombing of the world trade center. The wake of great destruction has also been followed by an economic stimulus.

The results indicating that natural disasters can have a positive effect on the economy as measured by GDP growth rates leads to discussion of development. It is important to remember that GDP, although commonly used to measure the level of development, is not a measure of well-being or wealth. Thus it is not the end goal in examining development. These results could lead to a discussion of what countries and what classes of people are negatively affected by disasters and what countries and what classes of people are gaining from the economic stimulus provided by aid dollars. Are these countries and classes of people being affected also those who are being compensated? Economic relief projects in the wake of natural disasters could be examined to see how they could be improved to compensate not only the economy as a whole, but also those who were directly affected by the natural disasters. This information could then be helpful in gaining support for relief projects that are well organized and targeted to meet the needs of such countries and peoples that are most affected. Thus, not only are immediate losses recognized and addressed to help the country return to its economic growth path, but help is also given to those most affected by disasters, the poor.

Future Research

Although the results are indicative of a significant positive relationship between disasters and economic growth, the data used in this study was limited. The potential of future research concerning the effects of natural disaster on economic growth is judged to be significant. First the sample size could be increased by adding more developing countries to the analysis or, as time passes, including information that is not currently available. Statistically, a larger sample size will mitigate problems associated with multicollinearity and increase the level of significance of the variables. Second, replacing the fixed effects model with a random effects model would allow model results to be generalized to all developing countries. Third, the variable for aid could be augmented to include all forms of aid that a country receives to better account for its effect on natural disasters.

Finally, the study could be augmented by looking at the effects of disasters on a broad definition of development that would include well-being or wealth, and social and health indicators in addition to economic growth. Such indicators could include the number of people living below the poverty level, employment levels, enrollment in varying levels of education, literacy rates, access to clean water supply, access to healthcare, and malnutrition levels. Still other studies could look at the effects of natural disasters directly on the poor. Focusing the study to the effects on the poor would also potentially lend more support for disaster and development assistance programs. Many of the social and economic indicators noted above and other valuable statistics have recently begun to be recorded for many developing countries. As the data becomes available, these variables and others could add real insight to the overall effects of natural disasters. Such information was not available for the current study, but would supplement the economic growth impact of natural disasters as presented in this thesis.
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Appendix A: Fixed Effects Model, SAS coding

```
options pagesize=54 linesize=80;

data stepfinal;
set thesis.sept12revdata;
te1 = te*cd1;
te2 = te*cd2;
te3 = te*cd3;
te4 = te*cd4;
te5 = te*cd5;
te6 = te*cd6;
te7 = te*cd7;
lcdd1 = lag2(te1);
lcdd2 = lag(te2);
lcdd3 = lag2(te3);
lcdd4 = lag2(te4);
lcdd5 = lag2(te5);
lcdd6 = lag(te6);
lcdd7 = lag(te7);

bad_inf = 1;
if inf_cp le 50 then bad_inf = 0;
*bi1 = 0;
*bi2 = 0;
*bi3 = 0;
*bi4 = 0;
*bi5 = 0;
*bi6 = 0;
*bi7 = 0;
*bi1 = bad_inf*cd1;
*bi2 = bad_inf*cd2;
*bi3 = bad_inf*cd3;
*bi4 = bad_inf*cd4;
*bi5 = bad_inf*cd5;
*bi6 = bad_inf*cd6;
*bi7 = bad_inf*cd7;

gdpi1 = cd1*192900000;
gdpi2 = cd2*984830144;
gdpi3 = cd3*1132920064;
gdpi4 = cd4*1904000000;
gdpi5 = cd5*723000000;
gdpi6 = cd6*35451712896;
gdpi7 = cd7*1092899968;

if gdpg = "." then delete;
```

```
if daa = "." then delete;
if gdi = "." then delete;
if cg = "." then delete;
if gdpd = "." then delete;
if pg = "." then delete;
if inf_cp = "." then delete;
lcdd = lcdd1+ lcdd2 +lcdd3 +lcdd4 +lcdd5 +lcdd6 +lcdd7;
run;

proc freq data=stepfinal;
table bad_inf;
run;

data dropfinal;
set stepfinal;
keep country year gdpg
             cd1 lcdd1 daa1 gdi1 cg1 gdpd1 inf_cp1
             cd2 lcdd2 daa2 gdi2 cg2 gdpd2 inf_cp2
             cd3 lcdd3 daa3 gdi3 cg3 gdpd3 inf_cp3
             cd4 lcdd4 daa4 gdi4 cg4 gdpd4 inf_cp4
             cd5 lcdd5 daa5 gdi5 cg5 gdpd5 inf_cp5
             cd6 lcdd6 daa6 gdi6 cg6 gdpd6 inf_cp6
             cd7 lcdd7 daa7 gdi7 cg7 gdpd7 inf_cp7;
if bad_inf=1 then delete;
run;

*Test Hetero 1;
data c1_1;
set dropfinal;
if cd1 = 1;
run;

proc reg data= c1_1;
model gdpg = cd1 lcdd1 daa1 gdi1 cg1 gdpd1 inf_cp1
             / noint vif;
output out=c1_e residual=e;
run;

data c1_2;
set c1_e;
lne2 = log(e*e);
run;

proc reg data=c1_2 outest=c1_3;
*Het1: model lne2 = lcdd1 daa1 gdi1 cg1 gdpd1 inf_cp1;
*test daa1=gdi1=cg1=gdpd1=inf_cp1=0;
Het1: model lne2 = lcdd1;
```

```
run;

*Test Hetero 2;
data c2_1;
set dropfinal;
if cd2 = 1;
run;

proc reg data= c2_1;
model gdpg = cd2 lcdd2 daa2 gdi2 cg2 gdpd2 inf_cp2
             / noint vif;
output out=c2_e residual=e;
run;

data c2_2;
set c2_e;
lne2 = log(e*e);
run;

proc reg data=c2_2 outest=c2_3;
Het2: model lne2 = lcdd2 daa2 gdi2 cg2 gdpd2 inf_cp2;
run;

*Test Hetero 3;
data c3_1;
set dropfinal;
if cd3 = 1;
run;

proc reg data= c3_1  outest=c3_3;
model gdpg = cd3 lcdd3 daa3 gdi3 cg3 gdpd3 inf_cp3
             / noint vif;
output out=c3_e residual=e;
run;

data c3_2;
set c3_e;
lne2 = log(e*e);
run;

proc reg data=c3_2 outest=c3_3;
*Het3: model lne2 =lcdd3 daa3 gdi3 cg3 gdpd3 inf_cp3;
*test lcdd3=daa3=gdi3=gdpd3=inf_cp3=0;
Het3: model lne2 = cg3 ;
run;

*Test Hetero 4;
```

```
data c4_1;
set dropfinal;
if cd4 = 1;
run;

proc reg data= c4_1;
model gdpg = cd4 lcdd4 daa4 gdi4 cg4 gdpd4 inf_cp4
             / noint vif;
output out=c4_e residual=e;
run;

data c4_2;
set c4_e;
lne2 = log(e*e);
run;

proc reg data=c4_2 outest=c4_3;
Het4: model lne2 = lcdd4 daa4 gdi4 cg4 gdpd4 inf_cp4;
run;

*Test Hetero 5;
data c5_1;
set dropfinal;
if cd5 = 1;
run;

proc reg data= c5_1;
model gdpg =  cd5 lcdd5 daa5 gdi5 cg5 gdpd5 inf_cp5
             / noint vif;
output out=c5_e residual=e;
run;

data c5_2;
set c5_e;
lne2 = log(e*e);
run;

proc reg data=c5_2 outest=c5_3;
*Het5: model lne2 = lcdd5 daa5 gdi5 cg5 gdpd5 inf_cp5;
*test daa5=gdi5=cg5=gdpd5=0;
Het5: model lne2 = lcdd5 inf_cp5;
run;

*Test Hetero 6;
data c6_1;
set dropfinal;
if cd6 = 1;
```

```
run;

proc reg data= c6_1;
model gdpg = cd6 lcdd6 daa6 gdi6 cg6 gdpd6 inf_cp6
             / noint vif;
output out=c6_e residual=e;
run;

data c6_2;
set c6_e;
lne2 = log(e*e);
run;

proc reg data=c6_2 outest=c6_3;
Het6: model lne2 = lcdd6 daa6 gdi6 cg6 gdpd6 inf_cp6;
*test lcdd6=daa6=cg6=gdpd6=0;
*Het6: model lne2 = daa6 gdi6 inf_cp6;
run;

*Test Hetero 7;
data c7_1;
set dropfinal;
if cd7 = 1;
run;

proc reg data= c7_1;
model gdpg = cd7 lcdd7 daa7 gdi7 cg7 gdpd7 inf_cp7
             / noint vif;
output out=c7_e residual=e;
run;

data c7_2;
set c7_e;
lne2 = log(e*e);
run;

proc reg data=c7_2 outest=c7_3;
*Het7: model lne2 = lcdd7 daa7 gdi7 cg7 gdpd7 inf_cp7;
Het7: model lne2 = lcdd7;
run;
*Correct Hetero in Country 1;
data c1_4;
set c1_3;
keep cd1 b1 b2 b3 b4 b5 b6;
cd1 = 1;
*b1 = 0;
b2 = 0;
```

```
b3 = 0;
b4 = 0;
b5 = 0;
b6 = 0;
b1 = lcdd1;
*b2 = daa1;
*b3 = gdi1;
*b4 = cg1;
*b5 = gdpd1;
*b6 = inf_cp1;
run;

data c1_5;
merge c1_1 c1_4;
by cd1;
*keep gdpg cd1 lcdd1 daa1 gdi1 cg1 gdpd1 inf_cp1;
wght = exp(b1*lcdd1+b2*daa1+b3*gdi1+b4*cg1+b5*gdpd1+b6*inf_cp1);
gdpg    = gdpg    /(sqrt(wght));
cd1     = cd1     /(sqrt(wght));
lcdd1   = lcdd1   /(sqrt(wght));
daa1    = daa1    /(sqrt(wght));
gdi1    = gdi1    /(sqrt(wght));
cg1     = cg1     /(sqrt(wght));
gdpd1   = gdpd1   /(sqrt(wght));
inf_cp1 = inf_cp1 /(sqrt(wght));
run;

*Correct Hetero in Country 3;
data c3_4;
set c3_3;
keep cd3 b1 b2 b3 b4 b5 b6;
cd3 = 1;
b1 = 0;
b2 = 0;
b3 = 0;
*b4 = 0;
b5 = 0;
b6 = 0;
*b1 = lcdd1;
*b2 = daa1;
*b3 = gdi1;
b4 = cg3;
*b5 = gdpd1;
*b6 = inf_cp1;
run;

data c3_5;
```

```
merge c3_1 c3_4;
by cd3;
*keep gdpg cd3 lcdd3 daa3 gdi3 cg3 gdpd3 inf_cp3;
wght = exp(b1*lcdd3+b2*daa3+b3*gdi3+b4*cg3+b5*gdpd3+b6*inf_cp3);
gdpg    = gdpg    /(sqrt(wght));
cd3     = cd3     /(sqrt(wght));
lcdd3   = lcdd3   /(sqrt(wght));
daa3    = daa3    /(sqrt(wght));
gdi3    = gdi3    /(sqrt(wght));
cg3     = cg3     /(sqrt(wght));
gdpd3   = gdpd3   /(sqrt(wght));
inf_cp3 = inf_cp3 /(sqrt(wght));
run;

*Correct Hetero in Country 5;
data c5_4;
set c5_3;
keep cd5 b1 b2 b3 b4 b5 b6;
cd5 = 1;
*b1 = 0;
b2 = 0;
b3 = 0;
b4 = 0;
b5 = 0;
*b6 = 0;
b1 = lcdd5;
*b2 = daa1;
*b3 = gdi1;
*b4 = cg1;
*b5 = gdpd1;
b6 = inf_cp5;
run;

data c5_5;
merge c5_1 c5_4;
by cd5;
*keep gdpg cd5 lcdd5 daa5 gdi5 cg5 gdpd5 inf_cp5;
wght = exp(b1*lcdd5+b2*daa5+b3*gdi5+b4*cg5+b5*gdpd5+b6*inf_cp5);
gdpg    = gdpg    /(sqrt(wght));
cd5     = cd5     /(sqrt(wght));
lcdd5   = lcdd5   /(sqrt(wght));
daa5    = daa5    /(sqrt(wght));
gdi5    = gdi5    /(sqrt(wght));
cg5     = cg5     /(sqrt(wght));
gdpd5   = gdpd5   /(sqrt(wght));
inf_cp5 = inf_cp5 /(sqrt(wght));
run;
```

```
*Correct Hetero in Country 7;
data c7_4;
set c7_3;
keep cd7 b1 b2 b3 b4 b5 b6;
cd7 = 1;
*b1 = 0;
b2 = 0;
b3 = 0;
b4 = 0;
b5 = 0;
b6 = 0;
b1 = lcdd7;
*b2 = daa1;
*b3 = gdi1;
*b4 = cg1;
*b5 = gdpd1;
*b6 = inf_cp1;
run;

data c7_5;
merge c7_1 c7_4;
by cd7;
*keep gdpg cd1 lcdd1 daa1 gdi1 cg1 gdpd1 inf_cp1;
wght = exp(b1*lcdd7+b2*daa7+b3*gdi7+b4*cg7+b5*gdpd7+b6*inf_cp7);
gdpg    = gdpg    /(sqrt(wght));
cd7     = cd7     /(sqrt(wght));
lcdd7   = lcdd7   /(sqrt(wght));
daa7    = daa7    /(sqrt(wght));
gdi7    = gdi7    /(sqrt(wght));
cg7     = cg7     /(sqrt(wght));
gdpd7   = gdpd7   /(sqrt(wght));
inf_cp7 = inf_cp7 /(sqrt(wght));
run;

data thesis.het6not_corrected;
set c1_5 c2_1 c3_5 c4_1 c5_5 c6_1 c7_5;
run;

data laggdpg1;
set thesis.sept12revdata;
keep year country lgdpg;
if country =1;
lgdpg = lag(gdpg);
run;
data laggdpg2;
set thesis.sept12revdata;
```

```
keep year country lgdpg;
if country =2;
lgdpg = lag(gdpg);
run;
data laggdpg3;
set thesis.sept12revdata;
keep year country lgdpg;
if country =3;
lgdpg = lag(gdpg);
run;
data laggdpg4;
set thesis.sept12revdata;
keep year country lgdpg;
if country =4;
lgdpg = lag(gdpg);
run;
data laggdpg5;
set thesis.sept12revdata;
keep year country lgdpg;
if country =5;
lgdpg = lag(gdpg);
run;
data laggdpg6;
set thesis.sept12revdata;
keep year country lgdpg;
if country =6;
lgdpg = lag(gdpg);
run;
data laggdpg7;
set thesis.sept12revdata;
keep year country lgdpg;
if country =7;
lgdpg = lag(gdpg);
run;

data thesis.lag_gdpg;
set laggdpg1 laggdpg2 laggdpg3 laggdpg4 laggdpg5 laggdpg6
laggdpg7;
if lgdpg = "." then delete;
run;

proc sort data = thesis.lag_gdpg;
by country year;
run;

proc sort data = thesis.het6not_corrected;
by country year;
```

```
run;

data thesis.March7_6not;
merge thesis.het6not_corrected thesis.lag_gdpg;
by country year;
if gdpg = "." then delete;
if lgdpg = "." then delete;
lgdpg1 = lgdpg*cd1;
lgdpg2 = lgdpg*cd2;
lgdpg3 = lgdpg*cd3;
lgdpg4 = lgdpg*cd4;
lgdpg5 = lgdpg*cd5;
lgdpg6 = lgdpg*cd6;
lgdpg7 = lgdpg*cd7;
run;
proc reg data = thesis.March7_6not;
model gdpg = cd1 lcdd1 daa1 gdi1 cg1 gdpd1 inf_cp1 lgdpg1
             cd2 lcdd2 daa2 gdi2 cg2 gdpd2 inf_cp2 lgdpg2
             cd3 lcdd3 daa3 gdi3 cg3 gdpd3 inf_cp3 lgdpg3
             cd4 lcdd4 daa4 gdi4 cg4 gdpd4 inf_cp4 lgdpg4
             cd5 lcdd5 daa5 gdi5 cg5 gdpd5 inf_cp5 lgdpg5
             cd6 lcdd6 daa6 gdi6 cg6 gdpd6 inf_cp6 lgdpg6
             cd7 lcdd7 daa7 gdi7 cg7 gdpd7 inf_cp7 lgdpg7
               /noint vif;
run;
data no;
set thesis.March7_6not;
cd =cd1+cd2+cd3+cd4+cd5+cd6+cd7;
lcdd=lcdd1+lcdd2+lcdd3+lcdd4+lcdd5+lcdd6+lcdd7;
daa =daa1+daa2+daa3+daa4+daa5+daa6+daa7;
gdi =gdi1+gdi2+gdi3+ gdi4+gdi5+gdi6+gdi7;
cg =cg1+cg2+cg3+cg4+cg5+cg6+cg7;
gdpd =gdpd1+gdpd2+gdpd3+gdpd4+gdpd5+gdpd6+gdpd7;
inf_cp =
inf_cp1+inf_cp2+inf_cp3+inf_cp4+inf_cp5+inf_cp6+inf_cp7;
gdpg1=gdpg  *cd1;
gdpg2=gdpg  *cd2;
gdpg3=gdpg  *cd3;
gdpg4=gdpg  *cd4;
gdpg5=gdpg  *cd5;
gdpg6=gdpg  *cd6;
gdpg7=gdpg  *cd7;
run;
proc means data =no;
var gdpg1   gdpg2   gdpg3   gdpg4   gdpg5   gdpg6   gdpg7
      cd1     cd2     cd3     cd4     cd5     cd6     cd7
    lcdd1   lcdd2   lcdd3   lcdd4   lcdd5   lcdd6   lcdd7
```

```
     daa1    daa2    daa3    daa4    daa5    daa6    daa7
     gdi1    gdi2    gdi3    gdi4    gdi5    gdi6    gdi7
      cg1     cg2     cg3     cg4     cg5     cg6     cg7
    gdpd1   gdpd2   gdpd3   gdpd4   gdpd5   gdpd6   gdpd7
  inf_cp1 inf_cp2 inf_cp3 inf_cp4 inf_cp5 inf_cp6 inf_cp7
   lgdpg1  lgdpg2  lgdpg3  lgdpg4  lgdpg5  lgdpg6  lgdpg7;
run;
```

Appendix B: Country by Country Model, SAS coding

```
options pagesize=54 linesize=80;

*Test Hetero 6;
data c6_1;
set dropfinal;
if cd6 = 1;
run;

proc reg data= c6_1;
model gdpg = cd6 lcdd6 daa6 gdi6 cg6 gdpd6 inf_cp6
             / noint vif;
output out=c6_e residual=e;
run;

data c6_2;
set c6_e;
lne2 = log(e*e);
run;

proc reg data=c6_2 outest=c6_3;
*Het6: model lne2 = lcdd6 daa6 gdi6 cg6 gdpd6 inf_cp6;
*test lcdd6=daa6=cg6=gdpd6=0;
Het6: model lne2 = daa6 gdi6 inf_cp6;
run;

*Correct Hetero in Country 6;
data c6_4;
set c6_3;
keep cd6 b1 b2 b3 b4 b5 b6;
cd6 = 1;
b1 = 0;
*b2 = 0;
*b3 = 0;
b4 = 0;
b5 = 0;
*b6 = 0;
*b1 = lcdd1;
b2 = daa6;
b3 = gdi6;
*b4 = cg1;
*b5 = gdpd1;
b6 = inf_cp6;
run;

data c6_5;
```

```
merge c6_1 c6_4;
by cd6;
*keep gdpg cd6 lcdd6 daa6 gdi6 cg6 gdpd6 inf_cp6;
wght = exp(b1*lcdd6+b2*daa6+b3*gdi6+b4*cg6+b5*gdpd6+b6*inf_cp6);
gdpg    = gdpg    /(sqrt(wght));
cd6     = cd6     /(sqrt(wght));
lcdd6   = lcdd6   /(sqrt(wght));
daa6    = daa6    /(sqrt(wght));
gdi6    = gdi6    /(sqrt(wght));
cg6     = cg6     /(sqrt(wght));
gdpd6   = gdpd6   /(sqrt(wght));
inf_cp6 = inf_cp6 /(sqrt(wght));
run;


data thesis.het6yes_corrected;
set c1_5 c2_1 c3_5 c4_1 c5_5 c6_5 c7_5;
run;

data thesis.lag_gdpg;
set laggdpg1 laggdpg2 laggdpg3 laggdpg4 laggdpg5 laggdpg6
laggdpg7;
if lgdpg = "." then delete;
run;

proc sort data = thesis.lag_gdpg;
by country year;
run;

proc sort data = thesis.het6yes_corrected;
by country year;
run;

data thesis.March7_6yes;
merge thesis.het6yes_corrected thesis.lag_gdpg;
by country year;
if gdpg = "." then delete;
if lgdpg = "." then delete;
lgdpg1 = lgdpg*cd1;
lgdpg2 = lgdpg*cd2;
lgdpg3 = lgdpg*cd3;
lgdpg4 = lgdpg*cd4;
lgdpg5 = lgdpg*cd5;
lgdpg6 = lgdpg*cd6;
lgdpg7 = lgdpg*cd7;
run;
data part1;
```

```
set  thesis.March7_6yes;
if cd1 gt 0;
run;
proc reg data = part1;
model gdpg = cd1 lcdd1 daa1 gdi1 cg1 gdpd1 inf_cp1 lgdpg1/ noint
vif dw;
output out=belize r=e1;
run;

data belize;
set belize;
if e1 = "." then delete;
run;
proc iml;
start barraj;
use belize;
read all var{e1} into e;
n  = nrow(e);
j  = ncol(z);
df = n - j;
i  = j(n,1,1);
sume2 = e`*e;
e3 = e##3;
e4 = e##4;
sume3 = i`*e3;
sume4 = i`*e4;
lambda = n * (     (((sume3/n)**2)/(6*((sume2/n)**3))) +
                   ((((sume4/n)-
(3*((sume2/n)**2)))**2)/(24*((sume2/n)**4)))   );
cchi = cinv(.95,2);
pval = 1 - probchi(lambda,2);
result  = lambda||cchi||pval;
cols    = {TestValue CriticalValue P_Value};
print "The Barra Jarque Test for Normality: Belize",,
       result [colname=cols];
finish;
run barraj;

data part2;
set  thesis.March7_6yes;
if cd2 gt 0;
run;
proc reg data = part2;
model gdpg = cd2 lcdd2 daa2 gdi2 cg2 gdpd2 inf_cp2 lgdpg2/ noint
vif dw;
output out=costa r=e2;
run;
```

```
data costa;
set costa;
if e2 = "." then delete;
run;

proc iml;
start barraj;
use costa;
read all var{e2} into e;
n  = nrow(e);
j  = ncol(z);
df = n - j;
i  = j(n,1,1);
sume2 = e`*e;
e3 = e##3;
e4 = e##4;
sume3 = i`*e3;
sume4 = i`*e4;
lambda = n * (    (((sume3/n)**2)/(6*((sume2/n)**3))) +
                  ((((sume4/n)-
(3*((sume2/n)**2)))**2)/(24*((sume2/n)**4)))  );
cchi = cinv(.95,2);
pval = 1 - probchi(lambda,2);
result  = lambda||cchi||pval;
cols    = {TestValue CriticalValue P_Value};
print "The Barra Jarque Test for Normality: Costa Rica",,
       result [colname=cols];
finish;
run barraj;

data part3;
set  thesis.March7_6yes;
if cd3 gt 0;
run;
proc reg data = part3;
model gdpg = cd3 lcdd3 daa3 gdi3 cg3 gdpd3 inf_cp3 lgdpg3/ noint
vif dw;
output out=elsal r=e3;
run;

data elsal;
set elsal;
if e3 = "." then delete;
run;

proc iml;
```

```
start barraj;
use elsal;
read all var{e3} into e;
n  = nrow(e);
j  = ncol(z);
df = n - j;
i  = j(n,1,1);
sume2 = e`*e;
e3 = e##3;
e4 = e##4;
sume3 = i`*e3;
sume4 = i`*e4;
lambda = n * (     (((sume3/n)**2)/(6*((sume2/n)**3))) +
             ((((sume4/n)-
(3*((sume2/n)**2)))**2)/(24*((sume2/n)**4)))   );
cchi = cinv(.95,2);
pval = 1 - probchi(lambda,2);
result  = lambda||cchi||pval;
cols    = {TestValue CriticalValue P_Value};
print "The Barra Jarque Test for Normality: El Salvador",,
       result [colname=cols];
finish;
run barraj;

data part4;
set  thesis.March7_6yes;
if cd4 gt 0;
run;
proc reg data = part4;
model gdpg = cd4 lcdd4 daa4 gdi4 cg4 gdpd4 inf_cp4 lgdpg4/ noint
vif dw;
output out=Guat r=e4;
run;

data Guat;
set Guat;
if e4 = "." then delete;
run;
proc iml;
start barraj;
use Guat;
read all var{e4} into e;
n  = nrow(e);
j  = ncol(z);
df = n - j;
i  = j(n,1,1);
sume2 = e`*e;
```

```
e3 = e##3;
e4 = e##4;
sume3 = i`*e3;
sume4 = i`*e4;
lambda = n * (     (((sume3/n)**2)/(6*((sume2/n)**3))) +
                   ((((sume4/n)-
(3*((sume2/n)**2)))**2)/(24*((sume2/n)**4)))   );
cchi = cinv(.95,2);
pval = 1 - probchi(lambda,2);
result  = lambda||cchi||pval;
cols    = {TestValue CriticalValue P_Value};
print "The Barra Jarque Test for Normality: Guatemala",,
       result [colname=cols];
finish;
run barraj;

data part5;
set  thesis.March7_6yes;
if cd5 gt 0;
run;
proc reg data = part5;
model gdpg = cd5 lcdd5 daa5 gdi5 cg5 gdpd5 inf_cp5 lgdpg5/ noint
vif dw;
output out=hond r=e5;
run;

data hond;
set hond;
if e5 = "." then delete;
run;

proc iml;
start barraj;
use hond;
read all var{e5} into e;
n  = nrow(e);
j  = ncol(z);
df = n - j;
i  = j(n,1,1);
sume2 = e`*e;
e3 = e##3;
e4 = e##4;
sume3 = i`*e3;
sume4 = i`*e4;
lambda = n * (     (((sume3/n)**2)/(6*((sume2/n)**3))) +
                   ((((sume4/n)-
(3*((sume2/n)**2)))**2)/(24*((sume2/n)**4)))   );
```

```
cchi = cinv(.95,2);
pval = 1 - probchi(lambda,2);
result  = lambda||cchi||pval;
cols    = {TestValue CriticalValue P_Value};
print "The Barra Jarque Test for Normality: Honduras",,
       result [colname=cols];
finish;
run barraj;

data part6;
set  thesis.March7_6yes;
if cd6 gt 0;
run;
proc reg data = part6;
model gdpg = cd6 lcdd6 daa6 gdi6 cg6 gdpd6 inf_cp6 lgdpg6/ noint
vif dw;
output out=Mexico r=e6;
run;

data Mexico;
set Mexico;
if e6 = "." then delete;
run;

proc iml;
start barraj;
use Mexico;
read all var{e6} into e;
n  = nrow(e);
j  = ncol(z);
df = n - j;
i  = j(n,1,1);
sume2 = e`*e;
e3 = e##3;
e4 = e##4;
sume3 = i`*e3;
sume4 = i`*e4;
lambda = n * (    (((sume3/n)**2)/(6*((sume2/n)**3))) +
              ((((sume4/n)-
(3*((sume2/n)**2)))**2)/(24*((sume2/n)**4)))  );
cchi = cinv(.95,2);
pval = 1 - probchi(lambda,2);
result  = lambda||cchi||pval;
cols    = {TestValue CriticalValue P_Value};
print "The Barra Jarque Test for Normality: Mexico",,
       result [colname=cols];
finish;
```

```
run barraj;

data part7;
set  thesis.March7_6yes;
if cd7 gt 0;
run;
proc reg data = part7;
model gdpg = cd7 lcdd7 daa7 gdi7 cg7 gdpd7 inf_cp7 lgdpg7/ noint
vif dw;
output out=Nica r=e7;
run;

data Nica ;
set Nica ;
if e7 = "." then delete;
run;

proc iml;
start barraj;
use Nica;
read all var{e7} into e;
n  = nrow(e);
j  = ncol(z);
df = n - j;
i  = j(n,1,1);
sume2 = e`*e;
e3 = e##3;
e4 = e##4;
sume3 = i`*e3;
sume4 = i`*e4;
lambda = n * (    (((sume3/n)**2)/(6*((sume2/n)**3))) +
             ((((sume4/n)-
(3*((sume2/n)**2)))**2)/(24*((sume2/n)**4)))   );
cchi = cinv(.95,2);
pval = 1 - probchi(lambda,2);
result  = lambda||cchi||pval;
cols    = {TestValue CriticalValue P_Value};
print "The Barra Jarque Test for Normality: Nicaragua",,
       result [colname=cols];
finish;
run barraj;

data new;
set thesis.March7_6yes;
cd =cd1+cd2+cd3+cd4+cd5+cd6+cd7;
lcdd=lcdd1+lcdd2+lcdd3+lcdd4+lcdd5+lcdd6+lcdd7;
daa =daa1+daa2+daa3+daa4+daa5+daa6+daa7;
```

```
gdi =gdi1+gdi2+gdi3+ gdi4+gdi5+gdi6+gdi7;
cg =cg1+cg2+cg3+cg4+cg5+cg6+cg7;
gdpd =gdpd1+gdpd2+gdpd3+gdpd4+gdpd5+gdpd6+gdpd7;
inf_cp =
inf_cp1+inf_cp2+inf_cp3+inf_cp4+inf_cp5+inf_cp6+inf_cp7;
gdpg1=gdpg  *cd1;
gdpg2=gdpg  *cd2;
gdpg3=gdpg  *cd3;
gdpg4=gdpg  *cd4;
gdpg5=gdpg  *cd5;
gdpg6=gdpg  *cd6;
gdpg7=gdpg  *cd7;
run;
proc means data =new;
var gdpg1   gdpg2   gdpg3   gdpg4   gdpg5   gdpg6   gdpg7
      cd1     cd2     cd3     cd4     cd5     cd6     cd7
    lcdd1   lcdd2   lcdd3   lcdd4   lcdd5   lcdd6   lcdd7
     daa1    daa2    daa3    daa4    daa5    daa6    daa7
     gdi1    gdi2    gdi3    gdi4    gdi5    gdi6    gdi7
      cg1     cg2     cg3     cg4     cg5     cg6     cg7
    gdpd1   gdpd2   gdpd3   gdpd4   gdpd5   gdpd6   gdpd7
  inf_cp1 inf_cp2 inf_cp3 inf_cp4 inf_cp5 inf_cp6 inf_cp7
   lgdpg1  lgdpg2  lgdpg3  lgdpg4  lgdpg5  lgdpg6  lgdpg7;
run;
```

Appendix C: F-Tests of the Fixed Effects Model, SAS coding

```
options pagesize=54 linesize=80;
data new;
set thesis.March7_6not;
lcdd= lcdd1+lcdd2+lcdd3+lcdd4+lcdd5+lcdd6+lcdd7;
cg= cg1+cg2+cg3+cg4+cg5+cg6+cg7;
daa = daa1+daa2+daa3+daa4+daa5+daa6+daa7;
run;

proc reg data = thesis.March7_6not;
model gdpg = cd1 lcdd1 daa1 gdi1 cg1 gdpd1 inf_cp1 lgdpg1
             cd2 lcdd2 daa2 gdi2 cg2 gdpd2 inf_cp2 lgdpg2
             cd3 lcdd3 daa3 gdi3 cg3 gdpd3 inf_cp3 lgdpg3
             cd4 lcdd4 daa4 gdi4 cg4 gdpd4 inf_cp4 lgdpg4
             cd5 lcdd5 daa5 gdi5 cg5 gdpd5 inf_cp5 lgdpg5
             cd6 lcdd6 daa6 gdi6 cg6 gdpd6 inf_cp6 lgdpg6
             cd7 lcdd7 daa7 gdi7 cg7 gdpd7 inf_cp7 lgdpg7
               /noint vif;
cd:Test cd1=cd2=cd3=cd4=cd5=cd6=cd7;
lcdd:Test lcdd1=lcdd2=lcdd3=lcdd4=lcdd5=lcdd6=lcdd7;
daa:test daa1=daa2=daa3=daa4=daa5=daa6=daa7;
gdi:test gdi1=gdi2=gdi3=gdi4=gdi5=gdi6=gdi7;
cg:test cg1=cg2=cg3=cg4=cg5=cg6=cg7;
gdpd:test gdpd1=gdpd2=gdpd3=gdpd4=gdpd5=gdpd6=gdpd7;
inf_cp:test
inf_cp1=inf_cp2=inf_cp3=inf_cp4=inf_cp5=inf_cp6=inf_cp7;
lgdpg:test lgdpg1=lgdpg2=lgdpg3=lgdpg4=lgdpg5=lgdpg6=lgdpg7;
run;
proc reg data = thesis.March7_6not;
model gdpg = cd1 lcdd1 daa1 gdi1 cg1 gdpd1 inf_cp1 lgdpg1
             cd2 lcdd2 daa2 gdi2 cg2 gdpd2 inf_cp2 lgdpg2
             cd3 lcdd3 daa3 gdi3 cg3 gdpd3 inf_cp3 lgdpg3
             cd4 lcdd4 daa4 gdi4 cg4 gdpd4 inf_cp4 lgdpg4
             cd5 lcdd5 daa5 gdi5 cg5 gdpd5 inf_cp5 lgdpg5
             cd6 lcdd6 daa6 gdi6 cg6 gdpd6 inf_cp6 lgdpg6
             cd7 lcdd7 daa7 gdi7 cg7 gdpd7 inf_cp7 lgdpg7
               /noint vif;
cd:Test cd1=cd2=cd3=cd4=cd5=cd7;
lcdd:Test lcdd1=lcdd2=lcdd3=lcdd4=lcdd5=lcdd7;
daa:test daa1=daa2=daa3=daa4=daa5=daa7;
gdi:test gdi1=gdi2=gdi3=gdi4=gdi5=gdi7;
cg:test cg1=cg2=cg3=cg4=cg5=cg7;
gdpd:test gdpd1=gdpd2=gdpd3=gdpd4=gdpd5=gdpd7;
inf_cp:test inf_cp1=inf_cp2=inf_cp3=inf_cp4=inf_cp5=inf_cp7;
lgdpg:test lgdpg1=lgdpg2=lgdpg3=lgdpg4=lgdpg5=lgdpg7;
run;
```

```
proc reg data = new;
model gdpg = lcdd cg
             cd1  daa1 gdi1  gdpd1 inf_cp1 lgdpg1
             cd2  daa2 gdi2  gdpd2 inf_cp2 lgdpg2
             cd3  daa3 gdi3  gdpd3 inf_cp3 lgdpg3
             cd4  daa4 gdi4  gdpd4 inf_cp4 lgdpg4
             cd5  daa5 gdi5  gdpd5 inf_cp5 lgdpg5
             cd6  daa6 gdi6  gdpd6 inf_cp6 lgdpg6
             cd7  daa7 gdi7  gdpd7 inf_cp7 lgdpg7
               /noint vif;
run;
proc reg data = new;
model gdpg = lcdd cg daa
             cd1  gdi1  gdpd1 inf_cp1 lgdpg1
             cd2  gdi2  gdpd2 inf_cp2 lgdpg2
             cd3  gdi3  gdpd3 inf_cp3 lgdpg3
             cd4  gdi4  gdpd4 inf_cp4 lgdpg4
             cd5  gdi5  gdpd5 inf_cp5 lgdpg5
             cd6  gdi6  gdpd6 inf_cp6 lgdpg6
             cd7  gdi7  gdpd7 inf_cp7 lgdpg7
               /noint vif;
run;
```

Appendix D: Results of the Fixed Effects Model

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The FREQ Procedure

bad_inf	Frequency	Percent	Cumulative Frequency	Cumulative Percent
0	172	91.98	172	91.98
1	15	8.02	187	100.00

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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	610.75825	87.25118	13.06	0.0002
Error	11	73.46559	6.67869		
Uncorrected Total	18	684.22384			

Root MSE	2.58432	R-Square	0.8926
Dependent Mean	4.52541	Adj R-Sq	0.8243
Coeff Var	57.10678		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd1	1	53.23760	16.26459	3.27	0.0074	712.96396
lcdd1	1	1.81727	1.32646	1.37	0.1980	1.58069
daa1	1	2.593428E-7	1.362831E-7	1.90	0.0835	23.39338
gdi1	1	-0.43861	0.25931	-1.69	0.1188	111.79210
cg1	1	-1.79306	0.49444	-3.63	0.0040	200.27820
gdpd1	1	-2.91078E-8	8.312065E-9	-3.50	0.0050	34.62624
inf_cp1	1	-0.45415	0.27980	-1.62	0.1328	3.97918

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The REG Procedure
Model: HET1
Dependent Variable: lne2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	27.71806	27.71806	4.60	0.0477
Error	16	96.45742	6.02859		
Corrected Total	17	124.17549			

Root MSE	2.45532	R-Square	0.2232
Dependent Mean	-0.30655	Adj R-Sq	0.1747
Coeff Var	-800.96438		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	0.21096	0.62703	0.34	0.7409
lcdd1	1	-2.32875	1.08605	-2.14	0.0477

The SAS System
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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	717.71973	102.53139	23.56	<.0001
Error	21	91.40015	4.35239		
Uncorrected Total	28	809.11988			

Root MSE	2.08624	R-Square	0.8870
Dependent Mean	4.60831	Adj R-Sq	0.8494
Coeff Var	45.27118		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd2	1	16.37210	7.16552	2.28	0.0328	330.31278
lcdd2	1	0.57194	0.38197	1.50	0.1492	2.34658
daa2	1	4.655783E-9	4.688882E-9	0.99	0.3320	2.52959
gdi2	1	0.11391	0.23244	0.49	0.6292	225.69643
cg2	1	-0.75626	0.39961	-1.89	0.0723	263.28544
gdpd2	1	-4.9854E-11	2.16656E-10	-0.23	0.8202	8.83901
inf_cp2	1	-0.21940	0.05024	-4.37	0.0003	5.22096

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The REG Procedure
Model: HET2
Dependent Variable: lne2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	19.39248	3.23208	0.66	0.6796
Error	21	102.27393	4.87019		
Corrected Total	27	121.66641			

Root MSE	2.20685	R-Square	0.1594
Dependent Mean	0.08349	Adj R-Sq	-0.0808
Coeff Var	2643.16325		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-2.56099	7.57978	-0.34	0.7388
lcdd2	1	0.21522	0.40406	0.53	0.5999
daa2	1	-7.40406E-9	4.959961E-9	-1.49	0.1504
gdi2	1	-0.02601	0.24587	-0.11	0.9168
cg2	1	0.26082	0.42272	0.62	0.5439
gdpd2	1	-2.4509E-10	2.29182E-10	-1.07	0.2970
inf_cp2	1	0.05001	0.05315	0.94	0.3574

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The REG Procedure

Model: MODEL1

Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	570.96119	81.56588	7.93	<.0001
Error	22	226.30583	10.28663		
Uncorrected Total	29	797.26702			

Root MSE	3.20728	R-Square	0.7161
Dependent Mean	2.22229	Adj R-Sq	0.6258
Coeff Var	144.32301		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd3	1	9.38117	7.05653	1.33	0.1973	140.38057
lcdd3	1	0.92027	0.82352	1.12	0.2758	1.91192
daa3	1	2.030824E-8	7.623166E-9	2.66	0.0142	10.89188
gdi3	1	0.51482	0.21731	2.37	0.0270	37.81522
cg3	1	-1.14643	0.35939	-3.19	0.0042	52.67035
gdpd3	1	-8.8748E-10	3.10616E-10	-2.86	0.0092	8.03119
inf_cp3	1	-0.21193	0.12437	-1.70	0.1025	10.03573

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The REG Procedure

Model: HET3

Dependent Variable: lne2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	48.96850	48.96850	13.24	0.0011
Error	27	99.87266	3.69899		
Corrected Total	28	148.84116			

Root MSE	1.92328	R-Square	0.3290
Dependent Mean	0.66773	Adj R-Sq	0.3041
Coeff Var	288.02979		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-5.66046	1.77554	-3.19	0.0036
cg3	1	0.53714	0.14763	3.64	0.0011

The SAS System

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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	528.09832	75.44262	21.54	<.0001
Error	22	77.05829	3.50265		
Uncorrected Total	29	605.15661			

Root MSE	1.87154	R-Square	0.8727
Dependent Mean	3.63217	Adj R-Sq	0.8321
Coeff Var	51.52666		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd4	1	17.86135	5.34046	3.34	0.0029	236.13363
lcdd4	1	-0.23835	0.42030	-0.57	0.5764	2.97553
daa4	1	2.224361E-8	7.298585E-9	3.05	0.0059	10.12609
gdi4	1	0.30093	0.12589	2.39	0.0258	31.24248
cg4	1	-2.13343	0.52783	-4.04	0.0005	109.41043
gdpd4	1	-6.7245E-10	1.46174E-10	-4.60	0.0001	15.75049
inf_cp4	1	-0.09971	0.04267	-2.34	0.0290	3.62995

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The REG Procedure

Model: HET4

Dependent Variable: lne2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	31.53555	5.25593	0.45	0.8380
Error	22	257.65158	11.71144		
Corrected Total	28	289.18713			

Root MSE	3.42220	R-Square	0.1090
Dependent Mean	-1.17310	Adj R-Sq	-0.1339
Coeff Var	-291.72188		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	8.20987	9.76529	0.84	0.4095
lcdd4	1	0.23832	0.76853	0.31	0.7594
daa4	1	1.229201E-9	1.334582E-8	0.09	0.9274
gdi4	1	-0.21189	0.23020	-0.92	0.3673
cg4	1	-0.54406	0.96517	-0.56	0.5787
gdpd4	1	-1.8483E-10	2.67286E-10	-0.69	0.4965
inf_cp4	1	-0.10702	0.07803	-1.37	0.1840

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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	510.76203	72.96600	6.97	0.0002
Error	22	230.32603	10.46937		
Uncorrected Total	29	741.08806			

Root MSE	3.23564	R-Square	0.6892
Dependent Mean	3.88195	Adj R-Sq	0.5903
Coeff Var	83.35083		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd5	1	5.91267	11.60104	0.51	0.6154	372.79650
lcdd5	1	0.59852	0.72902	0.82	0.4205	2.89357
daa5	1	5.01895E-10	1.089565E-8	0.05	0.9637	18.94963
gdi5	1	0.17741	0.19637	0.90	0.3761	59.59696
cg5	1	-0.23768	0.67897	-0.35	0.7296	186.08171
gdpd5	1	-4.3586E-10	9.64564E-10	-0.45	0.6558	24.20533
inf_cp5	1	-0.23776	0.10751	-2.21	0.0377	6.28927

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The REG Procedure

Model: HET5

Dependent Variable: lne2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	44.69705	22.34852	4.84	0.0163
Error	26	120.07491	4.61827		
Corrected Total	28	164.77196			

Root MSE	2.14902	R-Square	0.2713
Dependent Mean	0.67698	Adj R-Sq	0.2152
Coeff Var	317.43951		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	0.89665	0.68148	1.32	0.1997
lcdd5	1	-1.30774	0.42323	-3.09	0.0047
inf_cp5	1	0.08877	0.05300	1.67	0.1060

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The REG Procedure

Model: MODEL1

Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	803.12950	114.73279	36.17	<.0001
Error	15	47.57967	3.17198		
Uncorrected Total	22	850.70917			

Root MSE	1.78100	R-Square	0.9441
Dependent Mean	5.28957	Adj R-Sq	0.9180
Coeff Var	33.67011		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd6	1	-21.55660	6.20098	-3.48	0.0034	266.69396
lcdd6	1	0.42457	0.23000	1.85	0.0847	6.65448
daa6	1	4.028013E-9	6.246526E-9	0.64	0.5288	10.55909
gdi6	1	1.36539	0.28824	4.74	0.0003	311.64166
cg6	1	0.01772	0.37762	0.05	0.9632	95.07813
gdpd6	1	-1.7082E-11	6.66701E-12	-2.56	0.0217	20.19776
inf_cp6	1	-0.17854	0.04921	-3.63	0.0025	7.11001

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The REG Procedure
Model: HET6
Dependent Variable: lne2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	51.80640	8.63440	4.73	0.0068
Error	15	27.39301	1.82620		
Corrected Total	21	79.19942			

Root MSE	1.35137	R-Square	0.6541
Dependent Mean	-0.23492	Adj R-Sq	0.5158
Coeff Var	-575.24451		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	18.97975	4.70511	4.03	0.0011
lcdd6	1	-0.12835	0.17452	-0.74	0.4734
daa6	1	-9.10968E-9	4.739666E-9	-1.92	0.0738
gdi6	1	-0.68961	0.21870	-3.15	0.0066
cg6	1	-0.36983	0.28653	-1.29	0.2163
gdpd6	1	2.03669E-12	5.05871E-12	0.40	0.6929
inf_cp6	1	0.09086	0.03734	2.43	0.0279

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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	1100.63117	157.23302	12.26	0.0003
Error	10	128.29827	12.82983		
Uncorrected Total	17	1228.92943			

Root MSE	3.58187	R-Square	0.8956
Dependent Mean	1.42743	Adj R-Sq	0.8225
Coeff Var	250.93103		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd7	1	-17.40163	7.85524	-2.22	0.0511	81.76124
lcdd7	1	-0.70725	1.45972	-0.48	0.6385	3.81984
daa7	1	-2.64884E-9	3.995463E-9	-0.66	0.5223	2.88067
gdi7	1	1.04458	0.13783	7.58	<.0001	11.82408
cg7	1	-0.16623	0.39872	-0.42	0.6856	71.45029
gdpd7	1	4.63538E-10	5.349573E-9	0.09	0.9327	161.60834
inf_cp7	1	0.04304	0.14157	0.30	0.7674	14.64117

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The REG Procedure

Model: HET7

Dependent Variable: lne2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	25.94531	25.94531	4.72	0.0464
Error	15	82.53866	5.50258		
Corrected Total	16	108.48397			

Root MSE	2.34576	R-Square	0.2392
Dependent Mean	0.37825	Adj R-Sq	0.1884
Coeff Var	620.15323		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.81653	0.87316	2.08	0.0550
lcdd7	1	-1.63005	0.75068	-2.17	0.0464

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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	56	17412	310.92923	54.66	<.0001
Error	111	631.45495	5.68878		
Uncorrected Total	167	18043			

Root MSE	2.38512	R-Square	0.9650
Dependent Mean	4.57595	Adj R-Sq	0.9473
Coeff Var	52.12291		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd1	1	50.13188	15.40969	3.25	0.0015	5881.53305
lcdd1	1	1.84022	0.90388	2.04	0.0441	63.62461
daa1	1	2.64591E-7	1.013982E-7	2.61	0.0103	135.17630
gdi1	1	-0.42142	0.26582	-1.59	0.1157	1436.61460
cg1	1	-1.67650	0.53220	-3.15	0.0021	1608.04227
gdpd1	1	-2.72753E-8	7.870238E-9	-3.47	0.0008	349.01984
inf_cp1	1	-0.55099	0.31519	-1.75	0.0832	37.17584
lgdpg1	1	0.04859	0.20422	0.24	0.8124	32.23797
cd2	1	17.15141	9.60310	1.79	0.0768	437.69034
lcdd2	1	0.49899	0.44309	1.13	0.2625	2.41577
daa2	1	5.028414E-9	5.499361E-9	0.91	0.3625	2.66101
gdi2	1	0.05990	0.28275	0.21	0.8326	249.59171
cg2	1	-0.75983	0.50718	-1.50	0.1369	317.33170
gdpd2	1	8.95982E-12	2.64071E-10	0.03	0.9730	10.03453
inf_cp2	1	-0.20399	0.06428	-3.17	0.0019	6.52226
lgdpg2	1	0.02986	0.16383	0.18	0.8557	3.86341
cd3	1	15.73524	135.30554	0.12	0.9076	304.93320
lcdd3	1	-0.53878	2.75833	-0.20	0.8455	1.54664
daa3	1	9.311224E-9	1.113451E-7	0.08	0.9335	16.45944
gdi3	1	0.36611	3.68695	0.10	0.9211	72.79840
cg3	1	-1.51134	9.89161	-0.15	0.8788	158.11998
gdpd3	1	-4.7328E-10	3.586847E-9	-0.13	0.8953	11.90073
inf_cp3	1	-0.07701	2.00415	-0.04	0.9694	11.19843
lgdpg3	1	-0.10727	4.86412	-0.02	0.9824	11.24927
cd4	1	12.66632	8.11786	1.56	0.1215	324.35569

The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
lcdd4	1	-0.43982	0.41056	-1.07	0.2864	2.22225
daa4	1	2.09371E-8	9.128122E-9	2.29	0.0237	9.74514
gdi4	1	0.18100	0.19407	0.93	0.3530	44.62266
cg4	1	-1.50960	0.81956	-1.84	0.0681	154.94089
gdpd4	1	-4.9801E-10	2.28209E-10	-2.18	0.0312	23.60412
inf_cp4	1	-0.07252	0.06064	-1.20	0.2342	4.50971
lgdpg4	1	0.35507	0.23631	1.50	0.1358	5.68021
cd5	1	9.82582	7.52644	1.31	0.1944	861.02752
lcdd5	1	-0.07134	0.40525	-0.18	0.8606	20.08745
daa5	1	5.149099E-9	5.422709E-9	0.95	0.3444	36.84422
gdi5	1	0.30733	0.15165	2.03	0.0451	229.66969
cg5	1	-0.64346	0.40848	-1.58	0.1180	316.97492
gdpd5	1	-8.7267E-10	4.64639E-10	-1.88	0.0630	45.62775
inf_cp5	1	-0.31914	0.06920	-4.61	<.0001	18.79811
lgdpg5	1	0.09373	0.11621	0.81	0.4216	3.13701
cd6	1	-23.78484	8.52743	-2.79	0.0062	268.43304
lcdd6	1	0.19291	0.36706	0.53	0.6002	9.44970
daa6	1	5.473848E-9	9.295308E-9	0.59	0.5571	12.93944
gdi6	1	1.71600	0.45304	3.79	0.0002	410.64819
cg6	1	-0.30022	0.59471	-0.50	0.6147	128.21415
gdpd6	1	-1.7818E-11	9.4834E-12	-1.88	0.0629	22.76667
inf_cp6	1	-0.21682	0.07077	-3.06	0.0027	8.17503
lgdpg6	1	-0.23476	0.22690	-1.03	0.3031	6.80821
cd7	1	-18.21934	3.62181	-5.03	<.0001	336.50775
lcdd7	1	0.39270	0.55956	0.70	0.4843	24.90820
daa7	1	-3.11333E-9	1.159236E-9	-2.69	0.0083	7.11638
gdi7	1	1.04071	0.05253	19.81	<.0001	33.62416
cg7	1	-0.22021	0.16972	-1.30	0.1972	204.53995
gdpd7	1	1.484536E-9	2.264981E-9	0.66	0.5135	450.99355
inf_cp7	1	0.00258	0.04640	0.06	0.9558	24.65268
lgdpg7	1	-0.31297	0.06963	-4.49	<.0001	1.88561

The MEANS Procedure

Variable	N	Mean	Std Dev	Minimum	Maximum
gdpg1	167	6.5688671	75.8942682	-2.1060104	980.4621385
gdpg2	167	0.7277224	2.0005767	-2.2616599	8.9044733
gdpg3	167	0.0027103	0.0106130	-0.0064198	0.0723244
gdpg4	167	0.5965575	1.7581901	-3.5300889	7.8092208
gdpg5	167	2.2396297	13.2027107	-1.6429474	157.6360339
gdpg6	167	0.6578928	2.1058516	-6.1669946	9.6981697
gdpg7	167	2.0584820	16.3875333	-40.0100937	167.1756096
cd1	167	0.1896587	0.9014600	0	10.2651526
cd2	167	0.1616766	0.3692612	0	1.0000000
cd3	167	0.0085025	0.0223176	0	0.1048050
cd4	167	0.1676647	0.3746918	0	1.0000000
cd5	167	0.2340617	0.6824801	0	5.5860633
cd6	167	0.1257485	0.3325629	0	1.0000000
cd7	167	0.2528804	0.9026637	0	5.1041092
lcdd1	167	0.1672944	1.6250113	0	20.5303051
lcdd2	167	0.1796407	0.6238762	0	4.0000000
lcdd3	167	0.0122208	0.0825599	0	1.0000000
lcdd4	167	0.1856287	0.6458650	0	4.0000000
lcdd5	167	0.3959747	2.0084942	0	22.3442532
lcdd6	167	0.4491018	1.4834780	0	10.0000000
lcdd7	167	0.3392064	1.6157069	0	10.2082185
daa1	167	3933683.46	20856443.21	0	252830708
daa2	167	16268083.74	52431646.26	-11670000.00	280049984
daa3	167	1931344.41	6461005.04	0	39282947.48
daa4	167	21731017.96	59439037.73	0	263000000
daa5	167	53811972.62	200063619	0	1658111262
daa6	167	18696586.92	69141025.38	0	424910016
daa7	167	80244794.57	418331642	0	3349265520
gdi1	167	4.9565596	25.9234447	0	306.5237270
gdi2	167	4.1324231	9.4768164	0	29.7648220
gdi3	167	0.1477888	0.4019369	0	2.0747051
gdi4	167	2.5535908	5.8346304	0	21.6189499
gdi5	167	5.4037388	17.6883476	0	173.5705349
gdi6	167	2.9158445	7.7468183	0	27.3838692
gdi7	167	5.3457470	19.7180328	-5.7397380	122.4052697
cg1	167	3.0843008	13.6013097	0	147.5383862
cg2	167	2.5993065	5.9564913	0	18.2205257
cg3	167	0.0891836	0.2176690	0	0.8802310
cg4	167	1.1376581	2.5696722	0	7.9815044
cg5	167	2.7440024	7.5847423	0	46.5588737
cg6	167	1.2391586	3.2982506	0	11.5593309
cg7	167	4.1092530	15.0447375	0	94.7367721
gdpd1	167	80538779.55	431944372	0	4970899962
gdpd2	167	777381023	2079274651	0	10479118336
gdpd3	167	48518385.68	171265199	0	978394866
gdpd4	167	1433183753	3669577852	0	18941818880

The MEANS Procedure

Variable	N	Mean	Std Dev	Minimum	Maximum
gdpd5	167	719661284	2592642625	0	26377435995
gdpd6	167	28134534203	88763426360	0	424307000000
gdpd7	167	482514939	1666869496	0	9409153754
inf_cp1	167	0.6551999	3.5202202	-0.8708792	35.9624578
inf_cp2	167	2.5897754	6.8811910	0	37.0572128
inf_cp3	167	0.1024600	0.2915194	0	1.8333056
inf_cp4	167	2.0937600	6.1335258	-0.4535917	41.2218552
inf_cp5	167	2.7824329	11.2578276	0	112.6696082
inf_cp6	167	2.4156167	7.0761323	0	34.9992790
inf_cp7	167	4.8789369	19.1942416	0	137.9140463
lgdpg1	167	0.9791277	5.0523071	-2.1060104	48.5924611
lgdpg2	167	0.7055374	2.1052303	-7.2855649	8.9044733
lgdpg3	167	0.0333744	0.1231805	-0.1677008	0.7724213
lgdpg4	167	0.5999021	1.7674101	-3.5300889	7.8092208
lgdpg5	167	0.7490389	2.7196093	-3.1301224	20.5343254
lgdpg6	167	0.6230318	2.0350326	-6.1669946	9.6981697
lgdpg7	167	0.4676625	3.6206264	-26.4787884	18.9063023

Appendix E: Results of the Country by Country Model

The SAS System

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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	803.12950	114.73279	36.17	<.0001
Error	15	47.57967	3.17198		
Uncorrected Total	22	850.70917			

Root MSE	1.78100	R-Square	0.9441
Dependent Mean	5.28957	Adj R-Sq	0.9180
Coeff Var	33.67011		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd6	1	-21.55660	6.20098	-3.48	0.0034	266.69396
lcdd6	1	0.42457	0.23000	1.85	0.0847	6.65448
daa6	1	4.028013E-9	6.246526E-9	0.64	0.5288	10.55909
gdi6	1	1.36539	0.28824	4.74	0.0003	311.64166
cg6	1	0.01772	0.37762	0.05	0.9632	95.07813
gdpd6	1	-1.7082E-11	6.66701E-12	-2.56	0.0217	20.19776
inf_cp6	1	-0.17854	0.04921	-3.63	0.0025	7.11001

The SAS System

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The REG Procedure

Model: HET6

Dependent Variable: lne2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	47.99069	15.99690	9.23	0.0006
Error	18	31.20872	1.73382		
Corrected Total	21	79.19942			

Root MSE	1.31675	R-Square	0.6059
Dependent Mean	-0.23492	Adj R-Sq	0.5403
Coeff Var	-560.50562		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	17.37263	3.70904	4.68	0.0002
daa6	1	-9.63994E-9	2.328488E-9	-4.14	0.0006
gdi6	1	-0.76564	0.16363	-4.68	0.0002
inf_cp6	1	0.08255	0.03551	2.32	0.0320

The SAS System

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The REG Procedure

Model: MODEL1

Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	9778.63075	1222.32884	172.63	<.0001
Error	10	70.80434	7.08043		
Uncorrected Total	18	9849.43509			

Root MSE	2.66091	R-Square	0.9928
Dependent Mean	9.90137	Adj R-Sq	0.9871
Coeff Var	26.87416		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd1	1	50.17200	17.19153	2.92	0.0153	5881.54271
lcdd1	1	2.44865	1.06232	2.30	0.0439	70.45275
daa1	1	2.86847E-7	1.137815E-7	2.52	0.0303	136.75475
gdi1	1	-0.55186	0.30509	-1.81	0.1006	1520.44893
cg1	1	-1.55508	0.59747	-2.60	0.0264	1628.33018
gdpd1	1	-2.6656E-8	8.786861E-9	-3.03	0.0126	349.54364
inf_cp1	1	-0.68545	0.35931	-1.91	0.0855	38.81563
lgdpg1	1	0.15544	0.23527	0.66	0.5237	34.37707

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                The SAS System
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                 The REG Procedure
                   Model: MODEL1
             Dependent Variable: GDPG

      Durbin-Watson D                  1.712
      Number of Observations              18
      1st Order Autocorrelation        0.134
```

The Barra Jarque Test for Normality: Belize

RESULT		
TESTVALUE	CRITICALVALUE	P_VALUE
0.3510474	5.9914645	0.8390175

The SAS System

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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	662.40505	82.80063	17.40	<.0001
Error	19	90.41777	4.75883		
Uncorrected Total	27	752.82282			

Root MSE	2.18147	R-Square	0.8799
Dependent Mean	4.50110	Adj R-Sq	0.8293
Coeff Var	48.46538		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd2	1	18.36915	8.76612	2.10	0.0498	435.99236
lcdd2	1	0.56503	0.40417	1.40	0.1782	2.40282
daa2	1	4.737103E-9	5.028119E-9	0.94	0.3580	2.65921
gdi2	1	0.07794	0.25848	0.30	0.7663	249.34671
cg2	1	-0.84338	0.46235	-1.82	0.0839	315.25398
gdpd2	1	-1.6412E-11	2.41256E-10	-0.07	0.9465	10.01218
inf_cp2	1	-0.21626	0.05853	-3.69	0.0015	6.46489
lgdpg2	1	0.03152	0.14984	0.21	0.8356	3.86332

The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

Durbin-Watson D	2.023
Number of Observations	27
1st Order Autocorrelation	-0.070

The Barra Jarque Test for Normality: Costa Rica

RESULT

TESTVALUE	CRITICALVALUE	P_VALUE
2.6773575	5.9914645	0.2621919

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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	2.59284	0.32410	35.32	<.0001
Error	20	0.18353	0.00918		
Uncorrected Total	28	2.77637			

Root MSE	0.09579	R-Square	0.9339
Dependent Mean	0.19855	Adj R-Sq	0.9075
Coeff Var	48.24686		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd3	1	10.64936	6.00892	1.77	0.0916	372.82087
lcdd3	1	0.45469	0.51298	0.89	0.3860	4.48551
daa3	1	1.022566E-8	4.495722E-9	2.27	0.0341	16.63437
gdi3	1	0.40537	0.14940	2.71	0.0134	74.09961
cg3	1	-1.08622	0.45141	-2.41	0.0259	204.14252
gdpd3	1	-5.4571E-10	1.48616E-10	-3.67	0.0015	12.66524
inf_cp3	1	-0.14262	0.08703	-1.64	0.1169	13.08950
lgdpg3	1	-0.04301	0.19803	-0.22	0.8303	11.55862

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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

Durbin-Watson D	1.523
Number of Observations	28
1st Order Autocorrelation	0.206

The Barra Jarque Test for Normality: El Salvador

RESULT

TESTVALUE	CRITICALVALUE	P_VALUE
3.610829	5.9914645	0.1644063

The SAS System

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The REG Procedure

Model: MODEL1

Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	512.49079	64.06135	21.32	<.0001
Error	20	60.08588	3.00429		
Uncorrected Total	28	572.57667			

Root MSE	1.73329	R-Square	0.8951
Dependent Mean	3.55804	Adj R-Sq	0.8531
Coeff Var	48.71475		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd4	1	12.23866	5.50237	2.22	0.0378	282.17306
lcdd4	1	-0.34697	0.39355	-0.88	0.3884	3.04160
daa4	1	2.018077E-8	6.8218E-9	2.96	0.0078	10.30624
gdi4	1	0.19386	0.13784	1.41	0.1750	42.62848
cg4	1	-1.49025	0.57875	-2.57	0.0181	146.30869
gdpd4	1	-4.8757E-10	1.57055E-10	-3.10	0.0056	21.16901
inf_cp4	1	-0.07039	0.04144	-1.70	0.1049	3.98805
lgdpg4	1	0.34776	0.17246	2.02	0.0574	5.72853

The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

Durbin-Watson D	1.932
Number of Observations	28
1st Order Autocorrelation	0.000

The Barra Jarque Test for Normality: Guatemala

RESULT

TESTVALUE	CRITICALVALUE	P_VALUE
3.5790018	5.9914645	0.1670435

The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	1927.50016	240.93752	23.36	<.0001
Error	20	206.29994	10.31500		
Uncorrected Total	28	2133.80011			

Root MSE	3.21170	R-Square	0.9033
Dependent Mean	5.78572	Adj R-Sq	0.8646
Coeff Var	55.51073		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd5	1	8.31504	10.04684	0.83	0.4176	846.14983
lcdd5	1	0.02271	0.54833	0.04	0.9674	20.25303
daa5	1	4.544466E-9	7.286432E-9	0.62	0.5399	36.68740
gdi5	1	0.32461	0.20348	1.60	0.1263	228.04900
cg5	1	-0.56326	0.54619	-1.03	0.3147	312.55839
gdpd5	1	-8.2377E-10	6.22332E-10	-1.32	0.2005	45.14316
inf_cp5	1	-0.32340	0.09328	-3.47	0.0024	18.83662
lgdpg5	1	0.09200	0.15641	0.59	0.5630	3.13421

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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

Durbin-Watson D	2.045
Number of Observations	28
1st Order Autocorrelation	-0.044

The Barra Jarque Test for Normality: Honduras

RESULT

TESTVALUE	CRITICALVALUE	P_VALUE
5.6745596	5.9914645	0.0585848

The SAS System
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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	97582842976	12197855372	175.09	<.0001
Error	13	905684814	69668063		
Uncorrected Total	21	98488527791			

Root MSE	8346.73964	R-Square	0.9908
Dependent Mean	49679	Adj R-Sq	0.9851
Coeff Var	16.80136		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd6	1	-23.34645	5.39129	-4.33	0.0008	1030.07954
lcdd6	1	0.32167	0.14600	2.20	0.0462	19.08547
daa6	1	2.934884E-9	4.044669E-9	0.73	0.4809	47.14464
gdi6	1	1.29044	0.27774	4.65	0.0005	1592.42865
cg6	1	0.30697	0.34020	0.90	0.3833	457.05915
gdpd6	1	-1.5296E-11	3.71735E-12	-4.11	0.0012	56.95222
inf_cp6	1	-0.11016	0.04716	-2.34	0.0362	28.58605
lgdpg6	1	-0.08613	0.11818	-0.73	0.4790	18.42614

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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

Durbin-Watson D	2.066
Number of Observations	21
1st Order Autocorrelation	-0.045

The Barra Jarque Test for Normality: Mexico

RESULT

TESTVALUE	CRITICALVALUE	P_VALUE
0.7238236	5.9914645	0.6963438

The SAS System

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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	3764.59084	470.57385	26.63	<.0001
Error	9	159.06297	17.67366		
Uncorrected Total	17	3923.65381			

Root MSE	4.20401	R-Square	0.9595
Dependent Mean	5.13977	Adj R-Sq	0.9234
Coeff Var	81.79366		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd7	1	-18.21934	6.38379	-2.85	0.0190	336.50775
lcdd7	1	0.39270	0.98627	0.40	0.6998	24.90820
daa7	1	-3.11333E-9	2.043268E-9	-1.52	0.1619	7.11638
gdi7	1	1.04071	0.09259	11.24	<.0001	33.62416
cg7	1	-0.22021	0.29916	-0.74	0.4804	204.53995
gdpd7	1	1.484536E-9	3.992254E-9	0.37	0.7186	450.99355
inf_cp7	1	0.00258	0.08179	0.03	0.9756	24.65268
lgdpg7	1	-0.31297	0.12273	-2.55	0.0312	1.88561

The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

Durbin-Watson D	2.263
Number of Observations	17
1st Order Autocorrelation	-0.250

The Barra Jarque Test for Normality: Nicaragua

RESULT

TESTVALUE	CRITICALVALUE	P_VALUE
0.3034062	5.9914645	0.8592434

The SAS System

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The MEANS Procedure

Variable	N	Mean	Std Dev	Minimum	Maximum
gdpg1	167	6.5688671	75.8942682	-2.1060104	980.4621385
gdpg2	167	0.7277224	2.0005767	-2.2616599	8.9044733
gdpg3	167	0.0027103	0.0106130	-0.0064198	0.0723244
gdpg4	167	0.5965575	1.7581901	-3.5300889	7.8092208
gdpg5	167	2.2396297	13.2027107	-1.6429474	157.6360339
gdpg6	167	85024475.33	388836028	-54700136.83	2914292236
gdpg7	167	2.0584820	16.3875333	-40.0100937	167.1756096
cd1	167	0.1896587	0.9014600	0	10.2651526
cd2	167	0.1616766	0.3692612	0	1.0000000
cd3	167	0.0085025	0.0223176	0	0.1048050
cd4	167	0.1676647	0.3746918	0	1.0000000
cd5	167	0.2340617	0.6824801	0	5.5860633
cd6	167	1102.18	3694.77	0	23712.86
cd7	167	0.2528804	0.9026637	0	5.1041092
lcdd1	167	0.1672944	1.6250113	0	20.5303051
lcdd2	167	0.1796407	0.6238762	0	4.0000000
lcdd3	167	0.0122208	0.0825599	0	1.0000000
lcdd4	167	0.1856287	0.6458650	0	4.0000000
lcdd5	167	0.3959747	2.0084942	0	22.3442532
lcdd6	167	4692.50	18804.16	0	165990.03
lcdd7	167	0.3392064	1.6157069	0	10.2082185
daa1	167	3933683.46	20856443.21	0	252830708
daa2	167	16268083.74	52431646.26	-11670000.00	280049984
daa3	167	1931344.41	6461005.04	0	39282947.48
daa4	167	21731017.96	59439037.73	0	263000000
daa5	167	53811972.62	200063619	0	1658111262
daa6	167	218992911596	1.0775968E12	0	1.0075832E13
daa7	167	80244794.57	418331642	0	3349265520
gdi1	167	4.9565596	25.9234447	0	306.5237270
gdi2	167	4.1324231	9.4768164	0	29.7648220
gdi3	167	0.1477888	0.4019369	0	2.0747051
gdi4	167	2.5535908	5.8346304	0	21.6189499
gdi5	167	5.4037388	17.6883476	0	173.5705349
gdi6	167	26318.12	89259.67	0	514943.77
gdi7	167	5.3457470	19.7180328	-5.7397380	122.4052697
cg1	167	3.0843008	13.6013097	0	147.5383862
cg2	167	2.5993065	5.9564913	0	18.2205257
cg3	167	0.0891836	0.2176690	0	0.8802310
cg4	167	1.1376581	2.5696722	0	7.9815044
cg5	167	2.7440024	7.5847423	0	46.5588737
cg6	167	11279.85	39108.24	0	274104.81
cg7	167	4.1092530	15.0447375	0	94.7367721
gdpd1	167	80538779.55	431944372	0	4970899962
gdpd2	167	777381023	2079274651	0	10479118336
gdpd3	167	48518385.68	171265199	0	978394866
gdpd4	167	1433183753	3669577852	0	18941818880

The MEANS Procedure

Variable	N	Mean	Std Dev	Minimum	Maximum
gdpd5	167	719661284	2592642625	0	26377435995
gdpd6	167	3.1756581E14	1.2760242E15	0	1.0061533E16
gdpd7	167	482514939	1666869496	0	9409153754
inf_cp1	167	0.6551999	3.5202202	-0.8708792	35.9624578
inf_cp2	167	2.5897754	6.8811910	0	37.0572128
inf_cp3	167	0.1024600	0.2915194	0	1.8333056
inf_cp4	167	2.0937600	6.1335258	-0.4535917	41.2218552
inf_cp5	167	2.7824329	11.2578276	0	112.6696082
inf_cp6	167	20477.86	70511.52	0	509030.47
inf_cp7	167	4.8789369	19.1942416	0	137.9140463
lgdpg1	167	0.9791277	5.0523071	-2.1060104	48.5924611
lgdpg2	167	0.7055374	2.1052303	-7.2855649	8.9044733
lgdpg3	167	0.0333744	0.1231805	-0.1677008	0.7724213
lgdpg4	167	0.5999021	1.7674101	-3.5300889	7.8092208
lgdpg5	167	0.7490389	2.7196093	-3.1301224	20.5343254
lgdpg6	167	5644.60	22839.18	-44050.24	168289.51
lgdpg7	167	0.4676625	3.6206264	-26.4787884	18.9063023

Appendix F: Results of the F-test on the Fixed Effects Model

The SAS System
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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	56	17412	310.92923	54.66	<.0001
Error	111	631.45495	5.68878		
Uncorrected Total	167	18043			

Root MSE	2.38512	R-Square	0.9650
Dependent Mean	4.57595	Adj R-Sq	0.9473
Coeff Var	52.12291		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd1	1	50.13188	15.40969	3.25	0.0015	5881.53305
lcdd1	1	1.84022	0.90388	2.04	0.0441	63.62461
daa1	1	2.64591E-7	1.013982E-7	2.61	0.0103	135.17630
gdi1	1	-0.42142	0.26582	-1.59	0.1157	1436.61460
cg1	1	-1.67650	0.53220	-3.15	0.0021	1608.04227
gdpd1	1	-2.72753E-8	7.870238E-9	-3.47	0.0008	349.01984
inf_cp1	1	-0.55099	0.31519	-1.75	0.0832	37.17584
lgdpg1	1	0.04859	0.20422	0.24	0.8124	32.23797
cd2	1	17.15141	9.60310	1.79	0.0768	437.69034
lcdd2	1	0.49899	0.44309	1.13	0.2625	2.41577
daa2	1	5.028414E-9	5.499361E-9	0.91	0.3625	2.66101
gdi2	1	0.05990	0.28275	0.21	0.8326	249.59171
cg2	1	-0.75983	0.50718	-1.50	0.1369	317.33170
gdpd2	1	8.95982E-12	2.64071E-10	0.03	0.9730	10.03453
inf_cp2	1	-0.20399	0.06428	-3.17	0.0019	6.52226
lgdpg2	1	0.02986	0.16383	0.18	0.8557	3.86341
cd3	1	15.73524	135.30554	0.12	0.9076	304.93320
lcdd3	1	-0.53878	2.75833	-0.20	0.8455	1.54664
daa3	1	9.311224E-9	1.113451E-7	0.08	0.9335	16.45944
gdi3	1	0.36611	3.68695	0.10	0.9211	72.79840
cg3	1	-1.51134	9.89161	-0.15	0.8788	158.11998
gdpd3	1	-4.7328E-10	3.586847E-9	-0.13	0.8953	11.90073
inf_cp3	1	-0.07701	2.00415	-0.04	0.9694	11.19843
lgdpg3	1	-0.10727	4.86412	-0.02	0.9824	11.24927
cd4	1	12.66632	8.11786	1.56	0.1215	324.35569

The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
lcdd4	1	-0.43982	0.41056	-1.07	0.2864	2.22225
daa4	1	2.09371E-8	9.128122E-9	2.29	0.0237	9.74514
gdi4	1	0.18100	0.19407	0.93	0.3530	44.62266
cg4	1	-1.50960	0.81956	-1.84	0.0681	154.94089
gdpd4	1	-4.9801E-10	2.28209E-10	-2.18	0.0312	23.60412
inf_cp4	1	-0.07252	0.06064	-1.20	0.2342	4.50971
lgdpg4	1	0.35507	0.23631	1.50	0.1358	5.68021
cd5	1	9.82582	7.52644	1.31	0.1944	861.02752
lcdd5	1	-0.07134	0.40525	-0.18	0.8606	20.08745
daa5	1	5.149099E-9	5.422709E-9	0.95	0.3444	36.84422
gdi5	1	0.30733	0.15165	2.03	0.0451	229.66969
cg5	1	-0.64346	0.40848	-1.58	0.1180	316.97492
gdpd5	1	-8.7267E-10	4.64639E-10	-1.88	0.0630	45.62775
inf_cp5	1	-0.31914	0.06920	-4.61	<.0001	18.79811
lgdpg5	1	0.09373	0.11621	0.81	0.4216	3.13701
cd6	1	-23.78484	8.52743	-2.79	0.0062	268.43304
lcdd6	1	0.19291	0.36706	0.53	0.6002	9.44970
daa6	1	5.473848E-9	9.295308E-9	0.59	0.5571	12.93944
gdi6	1	1.71600	0.45304	3.79	0.0002	410.64819
cg6	1	-0.30022	0.59471	-0.50	0.6147	128.21415
gdpd6	1	-1.7818E-11	9.4834E-12	-1.88	0.0629	22.76667
inf_cp6	1	-0.21682	0.07077	-3.06	0.0027	8.17503
lgdpg6	1	-0.23476	0.22690	-1.03	0.3031	6.80821
cd7	1	-18.21934	3.62181	-5.03	<.0001	336.50775
lcdd7	1	0.39270	0.55956	0.70	0.4843	24.90820
daa7	1	-3.11333E-9	1.159236E-9	-2.69	0.0083	7.11638
gdi7	1	1.04071	0.05253	19.81	<.0001	33.62416
cg7	1	-0.22021	0.16972	-1.30	0.1972	204.53995
gdpd7	1	1.484536E-9	2.264981E-9	0.66	0.5135	450.99355
inf_cp7	1	0.00258	0.04640	0.06	0.9558	24.65268
lgdpg7	1	-0.31297	0.06963	-4.49	<.0001	1.88561

The REG Procedure
Model: MODEL1

Test CD Results for Dependent Variable GDPG

Source	DF	Mean Square	F Value	Pr > F
Numerator	6	42.43988	7.46	<.0001
Denominator	111	5.68878		

The REG Procedure
Model: MODEL1

Test LCDD Results for Dependent Variable GDPG

Source	DF	Mean Square	F Value	Pr > F
Numerator	6	6.50202	1.14	0.3424
Denominator	111	5.68878		

The REG Procedure
Model: MODEL1

Test GDI Results for Dependent Variable GDPG

Source	DF	Mean Square	F Value	Pr > F
Numerator	6	67.70675	11.90	<.0001
Denominator	111	5.68878		

The REG Procedure
Model: MODEL1

Test CG Results for Dependent Variable GDPG

Source	DF	Mean Square	F Value	Pr > F
Numerator	6	8.94352	1.57	0.1619
Denominator	111	5.68878		

The REG Procedure
Model: MODEL1

Test INF_CP Results for Dependent Variable GDPG

Source	DF	Mean Square	F Value	Pr > F
Numerator	6	20.30915	3.57	0.0028
Denominator	111	5.68878		

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The REG Procedure
Model: MODEL1

Test LGDPG Results for Dependent Variable GDPG

Source	DF	Mean Square	F Value	Pr > F
Numerator	6	15.80612	2.78	0.0148
Denominator	111	5.68878		

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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	56	17412	310.92923	54.66	<.0001
Error	111	631.45495	5.68878		
Uncorrected Total	167	18043			

Root MSE	2.38512	R-Square	0.9650
Dependent Mean	4.57595	Adj R-Sq	0.9473
Coeff Var	52.12291		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
cd1	1	50.13188	15.40969	3.25	0.0015	5881.53305
lcdd1	1	1.84022	0.90388	2.04	0.0441	63.62461
daa1	1	2.64591E-7	1.013982E-7	2.61	0.0103	135.17630
gdi1	1	-0.42142	0.26582	-1.59	0.1157	1436.61460
cg1	1	-1.67650	0.53220	-3.15	0.0021	1608.04227
gdpd1	1	-2.72753E-8	7.870238E-9	-3.47	0.0008	349.01984
inf_cp1	1	-0.55099	0.31519	-1.75	0.0832	37.17584
lgdpg1	1	0.04859	0.20422	0.24	0.8124	32.23797
cd2	1	17.15141	9.60310	1.79	0.0768	437.69034
lcdd2	1	0.49899	0.44309	1.13	0.2625	2.41577
daa2	1	5.028414E-9	5.499361E-9	0.91	0.3625	2.66101
gdi2	1	0.05990	0.28275	0.21	0.8326	249.59171
cg2	1	-0.75983	0.50718	-1.50	0.1369	317.33170
gdpd2	1	8.95982E-12	2.64071E-10	0.03	0.9730	10.03453
inf_cp2	1	-0.20399	0.06428	-3.17	0.0019	6.52226
lgdpg2	1	0.02986	0.16383	0.18	0.8557	3.86341
cd3	1	15.73524	135.30554	0.12	0.9076	304.93320
lcdd3	1	-0.53878	2.75833	-0.20	0.8455	1.54664
daa3	1	9.311224E-9	1.113451E-7	0.08	0.9335	16.45944
gdi3	1	0.36611	3.68695	0.10	0.9211	72.79840
cg3	1	-1.51134	9.89161	-0.15	0.8788	158.11998
gdpd3	1	-4.7328E-10	3.586847E-9	-0.13	0.8953	11.90073
inf_cp3	1	-0.07701	2.00415	-0.04	0.9694	11.19843
lgdpg3	1	-0.10727	4.86412	-0.02	0.9824	11.24927
cd4	1	12.66632	8.11786	1.56	0.1215	324.35569

The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
lcdd4	1	-0.43982	0.41056	-1.07	0.2864	2.22225
daa4	1	2.09371E-8	9.128122E-9	2.29	0.0237	9.74514
gdi4	1	0.18100	0.19407	0.93	0.3530	44.62266
cg4	1	-1.50960	0.81956	-1.84	0.0681	154.94089
gdpd4	1	-4.9801E-10	2.28209E-10	-2.18	0.0312	23.60412
inf_cp4	1	-0.07252	0.06064	-1.20	0.2342	4.50971
lgdpg4	1	0.35507	0.23631	1.50	0.1358	5.68021
cd5	1	9.82582	7.52644	1.31	0.1944	861.02752
lcdd5	1	-0.07134	0.40525	-0.18	0.8606	20.08745
daa5	1	5.149099E-9	5.422709E-9	0.95	0.3444	36.84422
gdi5	1	0.30733	0.15165	2.03	0.0451	229.66969
cg5	1	-0.64346	0.40848	-1.58	0.1180	316.97492
gdpd5	1	-8.7267E-10	4.64639E-10	-1.88	0.0630	45.62775
inf_cp5	1	-0.31914	0.06920	-4.61	<.0001	18.79811
lgdpg5	1	0.09373	0.11621	0.81	0.4216	3.13701
cd6	1	-23.78484	8.52743	-2.79	0.0062	268.43304
lcdd6	1	0.19291	0.36706	0.53	0.6002	9.44970
daa6	1	5.473848E-9	9.295308E-9	0.59	0.5571	12.93944
gdi6	1	1.71600	0.45304	3.79	0.0002	410.64819
cg6	1	-0.30022	0.59471	-0.50	0.6147	128.21415
gdpd6	1	-1.7818E-11	9.4834E-12	-1.88	0.0629	22.76667
inf_cp6	1	-0.21682	0.07077	-3.06	0.0027	8.17503
lgdpg6	1	-0.23476	0.22690	-1.03	0.3031	6.80821
cd7	1	-18.21934	3.62181	-5.03	<.0001	336.50775
lcdd7	1	0.39270	0.55956	0.70	0.4843	24.90820
daa7	1	-3.11333E-9	1.159236E-9	-2.69	0.0083	7.11638
gdi7	1	1.04071	0.05253	19.81	<.0001	33.62416
cg7	1	-0.22021	0.16972	-1.30	0.1972	204.53995
gdpd7	1	1.484536E-9	2.264981E-9	0.66	0.5135	450.99355
inf_cp7	1	0.00258	0.04640	0.06	0.9558	24.65268
lgdpg7	1	-0.31297	0.06963	-4.49	<.0001	1.88561

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The REG Procedure
Model: MODEL1

Test CD Results for Dependent Variable GDPG

Source	DF	Mean Square	F Value	Pr > F
Numerator	5	45.71430	8.04	<.0001
Denominator	111	5.68878		

The REG Procedure
Model: MODEL1

Test LCDD Results for Dependent Variable GDPG

Source	DF	Mean Square	F Value	Pr > F
Numerator	5	7.79995	1.37	0.2406
Denominator	111	5.68878		

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The REG Procedure
Model: MODEL1

Test GDI Results for Dependent Variable GDPG

Source	DF	Mean Square	F Value	Pr > F
Numerator	5	77.11659	13.56	<.0001
Denominator	111	5.68878		

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The REG Procedure
Model: MODEL1

Test CG Results for Dependent Variable GDPG

Source	DF	Mean Square	F Value	Pr > F
Numerator	5	10.65355	1.87	0.1048
Denominator	111	5.68878		

The SAS System

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The REG Procedure

Model: MODEL1

Test INF_CP Results for Dependent Variable GDPG

Source	DF	Mean Square	F Value	Pr > F
Numerator	5	22.39449	3.94	0.0025
Denominator	111	5.68878		

The SAS System

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The REG Procedure
Model: MODEL1

Test LGDPG Results for Dependent Variable GDPG

Source	DF	Mean Square	F Value	Pr > F
Numerator	5	18.77141	3.30	0.0081
Denominator	111	5.68878		

The SAS System

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The REG Procedure

Model: MODEL1

Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	44	17284	392.80932	63.58	<.0001
Error	123	759.88155	6.17790		
Uncorrected Total	167	18043			

Root MSE	2.48554	R-Square	0.9579
Dependent Mean	4.57595	Adj R-Sq	0.9428
Coeff Var	54.31745		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
lcdd	1	0.28490	0.18298	1.56	0.1220	11.61228
cg	1	-0.39900	0.12425	-3.21	0.0017	234.64489
cd1	1	2.15104	5.11267	0.42	0.6747	596.18040
daa1	1	2.675112E-7	9.817985E-8	2.72	0.0074	116.69790
gdi1	1	0.32287	0.14604	2.21	0.0289	399.29970
gdpd1	1	-6.59304E-9	4.003679E-9	-1.65	0.1022	83.17092
inf_cp1	1	-0.28579	0.25572	-1.12	0.2659	22.53279
lgdpg1	1	-0.03517	0.12246	-0.29	0.7744	10.67394
cd2	1	11.14337	6.66682	1.67	0.0972	194.25002
daa2	1	3.559999E-9	5.601586E-9	0.64	0.5263	2.54228
gdi2	1	0.12096	0.28812	0.42	0.6754	238.64752
gdpd2	1	-1.2617E-10	2.224E-10	-0.57	0.5715	6.55396
inf_cp2	1	-0.21264	0.06667	-3.19	0.0018	6.46211
lgdpg2	1	0.00192	0.16881	0.01	0.9909	3.77688
cd3	1	2.22431	63.22479	0.04	0.9720	61.30939
daa3	1	1.353824E-8	1.061802E-7	0.13	0.8988	13.78284
gdi3	1	0.41611	3.83331	0.11	0.9137	72.46261
gdpd3	1	-4.6743E-10	3.624987E-9	-0.13	0.8976	11.19282
inf_cp3	1	-0.19163	1.91524	-0.10	0.9205	9.41723
lgdpg3	1	0.14824	4.27104	0.03	0.9724	7.98662
cd4	1	2.29918	3.26493	0.70	0.4826	48.31299
daa4	1	1.257021E-8	8.869398E-9	1.42	0.1589	8.47212
gdi4	1	0.21776	0.19624	1.11	0.2693	42.01632
gdpd4	1	-2.8492E-10	1.67149E-10	-1.70	0.0908	11.66021
inf_cp4	1	-0.04840	0.05326	-0.91	0.3653	3.20333

The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
lgdpg4	1	0.49619	0.20947	2.37	0.0194	4.10988
cd5	1	5.44045	2.72630	2.00	0.0482	104.03121
daa5	1	3.204884E-9	4.000462E-9	0.80	0.4246	18.46442
gdi5	1	0.35627	0.10814	3.29	0.0013	107.54904
gdpd5	1	-7.8118E-10	4.11738E-10	-1.90	0.0601	32.99264
inf_cp5	1	-0.33789	0.06832	-4.95	<.0001	16.87164
lgdpg5	1	0.10037	0.11439	0.88	0.3820	2.79877
cd6	1	-23.77803	8.73434	-2.72	0.0074	259.32149
daa6	1	7.12617E-9	8.390327E-9	0.85	0.3973	9.70788
gdi6	1	1.74203	0.42394	4.11	<.0001	331.12958
gdpd6	1	-1.9583E-11	8.29661E-12	-2.36	0.0198	16.04545
inf_cp6	1	-0.21625	0.07349	-2.94	0.0039	8.11759
lgdpg6	1	-0.20332	0.20754	-0.98	0.3292	5.24521
cd7	1	-20.10457	2.38253	-8.44	<.0001	134.09102
daa7	1	-2.13231E-9	1.148971E-9	-1.86	0.0659	6.43744
gdi7	1	1.04580	0.05368	19.48	<.0001	32.32402
gdpd7	1	3.477829E-9	1.537585E-9	2.26	0.0255	191.38071
inf_cp7	1	0.04615	0.04038	1.14	0.2553	17.19338
lgdpg7	1	-0.33351	0.07178	-4.65	<.0001	1.84523

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The REG Procedure
Model: MODEL1
Dependent Variable: GDPG

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	38	17198	452.57360	69.03	<.0001
Error	129	845.69493	6.55577		
Uncorrected Total	167	18043			

Root MSE	2.56042	R-Square	0.9531
Dependent Mean	4.57595	Adj R-Sq	0.9393
Coeff Var	55.95398		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
lcdd	1	0.21557	0.17979	1.20	0.2327	10.56472
cg	1	-0.40137	0.12529	-3.20	0.0017	224.84417
daa	1	-1.32817E-9	1.140852E-9	-1.16	0.2465	7.81301
cd1	1	3.14995	5.14158	0.61	0.5412	568.18710
gdi1	1	0.61906	0.10543	5.87	<.0001	196.08829
gdpd1	1	-1.10322E-8	3.697727E-9	-2.98	0.0034	66.85585
inf_cp1	1	-0.65452	0.22131	-2.96	0.0037	15.90372
lgdpg1	1	-0.04713	0.12587	-0.37	0.7087	10.62726
cd2	1	10.75714	6.85125	1.57	0.1188	193.32122
gdi2	1	0.16549	0.29355	0.56	0.5739	233.44503
gdpd2	1	-1.5341E-10	2.26688E-10	-0.68	0.4998	6.41660
inf_cp2	1	-0.20540	0.06809	-3.02	0.0031	6.35139
lgdpg2	1	-0.02731	0.17098	-0.16	0.8733	3.65138
cd3	1	4.05943	63.75469	0.06	0.9493	58.74802
gdi3	1	0.22780	3.70566	0.06	0.9511	63.81379
gdpd3	1	-9.6035E-11	2.61411E-9	-0.04	0.9708	5.48518
inf_cp3	1	0.00876	1.33723	0.01	0.9948	4.32615
lgdpg3	1	0.26677	4.31729	0.06	0.9508	7.69012
cd4	1	2.32925	3.35613	0.69	0.4889	48.10742
gdi4	1	0.19235	0.20180	0.95	0.3423	41.86779
gdpd4	1	-8.4286E-11	1.19436E-10	-0.71	0.4816	5.61029
inf_cp4	1	-0.01522	0.05122	-0.30	0.7668	2.79153
lgdpg4	1	0.52814	0.21511	2.46	0.0154	4.08427
cd5	1	6.18569	2.78911	2.22	0.0283	102.60445
gdi5	1	0.30789	0.10537	2.92	0.0041	96.22450

The SAS System

14:22 Thursday, April 11, 2002

The REG Procedure

Model: MODEL1

Dependent Variable: GDPG

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|	Variance Inflation
gdpd5	1	-4.3929E-10	3.0962E-10	-1.42	0.1584	17.58130
inf_cp5	1	-0.29329	0.06109	-4.80	<.0001	12.71129
lgdpg5	1	0.10872	0.11742	0.93	0.3562	2.77912
cd6	1	-18.23567	6.89265	-2.65	0.0092	152.18356
gdi6	1	1.49892	0.35001	4.28	<.0001	212.68922
gdpd6	1	-1.2412E-11	4.86411E-12	-2.55	0.0119	5.19725
inf_cp6	1	-0.20740	0.07512	-2.76	0.0066	7.99305
lgdpg6	1	-0.23326	0.21237	-1.10	0.2741	5.17548
cd7	1	-20.12527	2.42775	-8.29	<.0001	131.20437
gdi7	1	1.03927	0.05519	18.83	<.0001	32.20031
gdpd7	1	3.344818E-9	1.546632E-9	2.16	0.0324	182.47816
inf_cp7	1	0.05768	0.04115	1.40	0.1634	16.82157
lgdpg7	1	-0.30780	0.07284	-4.23	<.0001	1.79081

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