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The Growth of Transport Sector CO_2 Emissions and Underlying Factors in Latin America and the Caribbean

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Abstract

This study examines the factors responsible for the growth of transport sector carbon dioxide emissions in 20 Latin American and Caribbean countries during 1980–2005 by decomposing the emissions growth into components associated with changes in fuel mix, modal shift, and economic growth, as well as changes in emission coefficients and transportation energy intensity. The key finding of the study is that economic growth and the changes in transportation energy intensity are the main factors driving transport sector carbon dioxide emissions growth in the countries considered. The results imply that fiscal policy instruments—such as subsidies to clean fuels and clean vehicles —would be more effective in reducing emissions in countries where the economic activity effect is the primary driver for transport sector carbon dioxide emissions growth. By contrast, regulatory policy instruments—such as vehicle efficiency standards and vehicle occupancy standards—would be more effective in countries where the transportation energy intensity effect is the main driver of carbon dioxide emissions growth. Both fiscal and regulatory policy instruments would be useful in countries where both economic activity and transportation energy intensity effects are responsible for driving transport sector carbon dioxide emissions growth.

This paper—a product of the Sustainable Rural and Urban Development Team, Development Research Group—is part of a larger effort in the department to study climate change and clean energy issues. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at gtimilsina@worldbank.org.

The Growth of Transport Sector CO_2 Emissions and Underlying Factors in Latin America and the Caribbean[†]

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1. Introduction

Carbon dioxide (CO_2) emissions released from fossil fuel consumption[1] increased from 760 million tons in 1980 to 1,327 million tons in 2005 in the Latin America and Caribbean (hereafter 'LAC') region, with an average growth rate of 2.3% per year (IEA, 2007). The transport sector is one of the main contributors to CO_2 emissions in the region, where its share increased from 33.1% in 1980 to 34.1% in 2005. Therefore, any attempt to address climate change in the LAC region must pay attention to transport sector emissions. The identification of key factors driving CO_2 emissions is essential for the formulation of effective climate change mitigation policies and strategies. One approach to accomplish this objective is the decomposition of the growth of emissions into the possible affecting factors.

The growth of emissions is often decomposed into the potential driving factors using different methods, such as the Laspeyres or Divisia methods. While studies, such as Lin et al (2007), Diakoulaki and Mandaraka (2007) and Diakoulaki et al (2006), Ebohon and Ikeme (2006) use the refined Laspeyres techniques, studies such as Liu et al (2007), Hatzigeorgiou et al (2007), Wang et al (2005) use the Arithmetic Mean Divisia Index (AMDI) and the Logarithmic Mean Divisia Index (LMDI) techniques.

Most existing studies concentrate on the decomposition of national CO_2 emissions and emission intensities or emissions and emission intensities of the industrial and power sectors. Examples of national CO_2 emissions (or emission intensities) decomposition studies include Wu et al (2005) and Wang et al (2005) for China, Kawase et al (2006) for Japan, Rhee and Chung (2006) for Japan and South Korea; Lise (2006) for Turkey, Diakoulaki et al (2006) for Greece, Saikku et al (2008) for 27 EU member States, Lee and Oh (2006) for APEC countries, Luukkanen and Kaivo-oja (2002) for ASEAN countries; Luukkanen and Kaivo-oja (2002) for Scandinavian countries, Ebohon and Ikeme (2006) for sub-Saharan African countries, and Han and Chatterjee (1997) for nine developing countries (Brazil, Chile, Colombia, India, Korea, Mexico, Philippines, Thailand and Zambia).

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[1] This study considers only fossil fuel consumption related CO_2 emissions as our analysis is for the transport sector which emits CO_2 through energy use.

Most of the studies decompose national CO_2 emissions growth into economic growth, fuel switching and changes in emission intensity. At the sectoral level, more studies are focused on the industrial sector than any other sector. Liu et al (2007) decompose CO_2 emissions growth in 36 industrial sectors in China over the period 1998-2005 to changes in emission coefficients and energy intensity, shifts in industrial structural, activity and fuel use. Yabe (2004) decomposes Japanese industrial CO_2 emissions growth between 1985 and 1995 to changes in environmental and production technologies. Liaskas et al (2000) and Schipper et al (2001) attribute changes in industrial sector CO_2 emissions during the 1973-1993 period to variations in output level, energy intensity, fuel mix and industrial structural in 13 EU countries. Similarly, Lin (1998) decomposes industrial CO_2 emission changes in Taiwan during 1981-1991; Bhattacharyya and Ussanarassamee (2004) do the same for Thai industrial CO_2 intensities during 1981-2000. Some studies concentrate on a particular industry instead of the industry sector as whole for the decomposition analysis. For example, Murtishaw et al. (2001) decompose changes in CO_2 emissions from the petroleum refining, agriculture, mining and construction sectors of eight IEA countries; Kim and Worrell (2002) for the iron and steel industry in Brazil, China, India, Mexico, South Korea and the United States; Ozawa et al (2002) for the Mexican iron and steel industry, and Lee and Lin (2001) for the petrochemical industry in Taiwan.

The changes in CO_2 emission intensities of the power sector, another key contributor to national CO_2 emissions in many countries, have also been decomposed into various factors such as shifts in electricity generation technologies and changes in fuel intensity. Shrestha and Timilsina (1996) explore the evolution of the CO_2 intensity of the electricity sector in 12 selected Asian countries during the period 1980-1990 using the Divisia index decomposition approach. Nag and Kulshrestha (2000) employ Divisia decomposition to break down sectoral carbon emission intensity of power consumption in India for the period 1974-1994 to emission coefficient of power, electricity intensity, and structural shift. Furthermore, they quantify the relative influences of fuel mix, fuel intensity, and generation mix on the emission coefficient for power consumption, and therefore carbon intensity. Shrestha and Marpuang (2006) develop a decomposition framework to analyze the total economy-wide changes in CO_2, SO_2 and NO_x emissions when power sector development follows the integrated resource planning approach instead of traditional supply-based electricity planning, and then apply it to the case of the power sector in Indonesia. Limmeechokchai and Suksuntornsiri (2007) assess reductions in economy-wide CO_2 emissions in Thailand from the hypothetical selection of several cleaner power generation options, including biomass power generation, hydroelectricity and integrated gasification combined cycle (IGCC), over pulverized coal-thermal technology for the undecided capacity.

Note that power, industry and transport are the three major sectors responsible for fossil fuel related CO_2 emissions in each country in the world. While the factors affecting CO_2 emissions and emission intensities of the industry and power sectors have been analyzed in many countries, transport sector emissions and emission intensities have not been examined except in a few developed countries. Lakshmanan and Han (1997) attribute the change in transport sector CO_2 emissions in the US between 1970 and 1991 to growth in people's propensity to travel, population, and GDP. Lu et al (2007) decompose changes in CO_2 emissions from highway vehicles in Germany, Japan, South Korea and Taiwan during 1990-2002 into changes in emission coefficient, vehicle fuel intensity, vehicle ownership, population intensity and economic growth.

Understanding the factors affecting the growth of CO_2 emissions from the transport sector is critical because of its increasing prominence as a source of emissions and its relevance to the preparation of climate change mitigation strategies. Moreover, the existing literature ignores most LAC countries when analyzing the factors affecting CO_2 emissions or emission intensities. This study aims to address this gap by executing a Divisia decomposition analysis of CO_2 emissions from the transport sector in 20 LAC countries during the 1980-2005 period. The study attributes the growth of transport sector CO_2 emissions during the period to five factors. These are: (i) fuel switching, (ii) modal shifting, (iii) change in emission coefficients, (iv) sectoral energy intensity change and (v) economic growth. Our study finds that among these five factors, two factors, namely, sectoral energy intensity change and economic growth are primarily responsible for driving transport sector CO_2 emissions in most LAC countries over the last 25 years.

This paper is organized as follows: Section 2 briefly highlights transport sector CO_2 emissions in LAC over the last 25 years as well as changes in fuel mix, modal mix and transportation energy intensity. This is followed by a discussion on methodology and data in Section 3. The main results of the study are presented in Section 4, followed by key conclusions.

2. Transport Sector CO_2 Emissions

2.1 CO_2 Emissions

The transport sector has been one of the largest consumers of energy as well as one of the primary sources of CO_2 emissions in LAC countries. At the regional level, the transport sector accounted for 29.3% of total energy consumption in 1980. This share exceeded 31.7% by 2005. The relatively high share of the transport sector in total energy consumption led this sector to be one of the primary sources of CO_2 emissions. Table 1 presents CO_2 emissions from the transport sector in LAC countries in 1980 and 2005. In 1980, the transport sector accounted for more than 40% of the total national emissions in 6 out of the 20 countries considered here. By 2005, the number of countries with transport sector emissions greater than 40% increased to 8, and the share of the transport sector in total regional CO_2 emissions grew to 34.1% in 2005 from 33.1% in 1980. The transport sector in some LAC countries, such as Paraguay, Bolivia, Brazil, El Salvador, Nicaragua, Costa Rica and Ecuador exhibit very high shares (greater than 80% in Paraguay) in total national emissions. This is because most fossil fuel consumption in these countries occur in the transport sector and CO_2 emissions from the power sector are very small (see Figure 1) due to pre-dominantly hydro-based electricity systems.

Transport sector shares of total national CO_2 emissions have increased in Costa Rica, Ecuador, Guatemala, Panama, Paraguay, Peru, Uruguay and Other Latin American countries. On the other hand, the shares have decreased in Argentina, Bolivia, Cuba, Honduras and Nicaragua. The shares of the transport sector remain almost unchanged in Brazil, Caribbean, Chile, Columbia, El Salvador, Mexico and Venezuela. Because the transport, power and industry sectors are the main contributors to national CO_2 emissions, changes in the magnitude of the emissions from the other two sectors, particularly the power sector, have a considerable impact on the transport sector's share of national CO_2 emissions (see Figure 1). For example, in Bolivia and Nicaragua, transport sector shares in 2005 are significantly smaller than those in 1980 as the power sector shares of total national emissions increased due to the reduction of these countries' reliance on hydropower. The reverse is the case for Ecuador and Paraguay, and currently, Paraguay is reliant exclusively on hydropower for its electricity generation.

Table 1: Contribution of the Transport Sector in National CO_2 Emissions

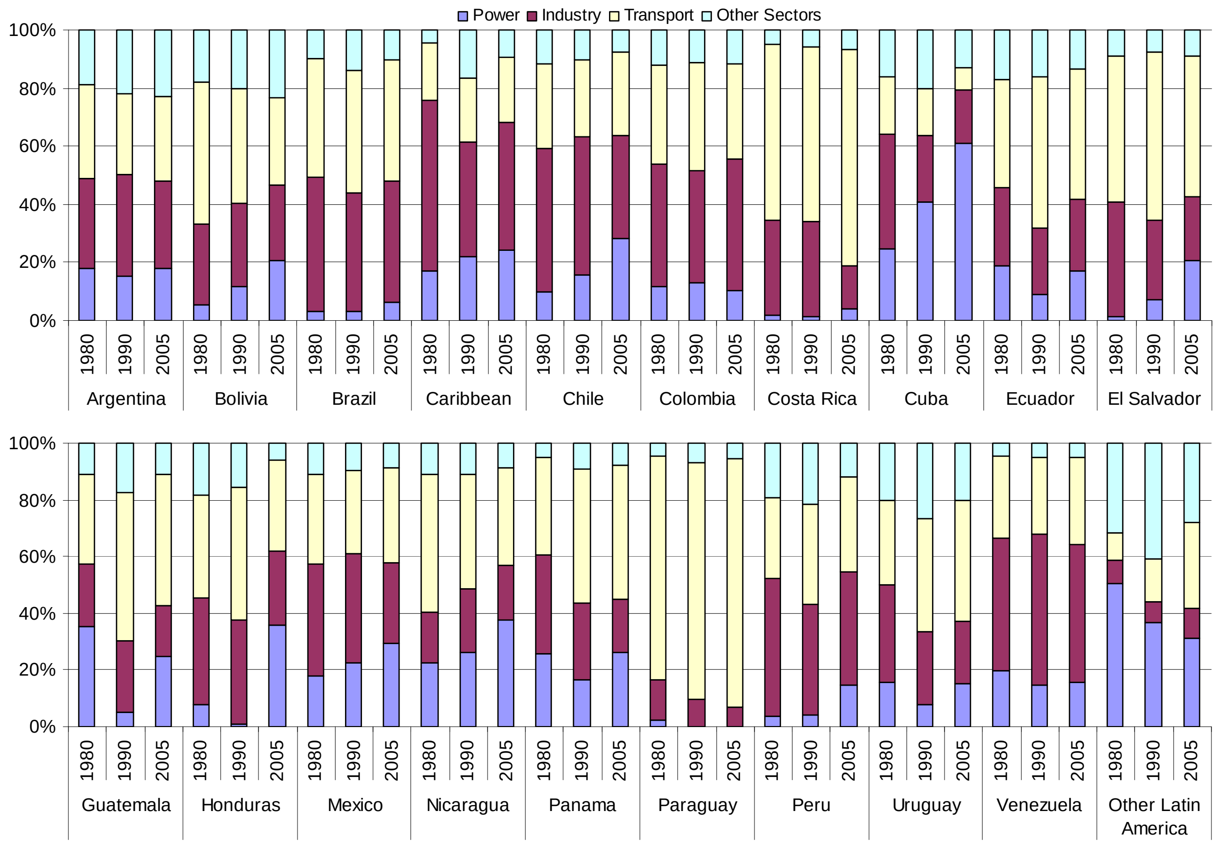
Country	1980		2005	
	Total CO_2 emissions from fossil fuel consumption ($MtCO_2$)	Share of the transport sector in the total (%)	Total CO_2 emissions from fossil fuel consumption ($MtCO_2$)	Share of the transport sector in the total (%)
Argentina	95.9	32.7	140.9	28.0
Bolivia	4.3	49.1	11.9	30.3
Brazil	178.0	41.1	329.3	42.1
Caribbean [a]	30.2	19.5	55.3	19.2
Chile	21.2	28.8	58.6	29.2
Colombia	33.8	34.5	59.9	33.2
Costa Rica	2.2	61.2	5.4	75.2
Cuba	28.5	21.8	23.8	8.1
Ecuador	10.6	37.6	23.4	45.5
El Salvador	1.7	50.9	5.9	49.3
Guatemala	4.2	31.9	10.5	46.1
Honduras	1.7	36.7	6.4	32.5
Mexico	212.8	32.1	389.4	33.7
Nicaragua	1.8	49.4	4.1	35.1
Panama	2.9	34.9	5.7	41.2
Paraguay	1.4	79.8	3.4	87.3
Peru	20.6	28.7	28.4	34.0
Uruguay	5.6	30.0	5.3	43.2
Venezuela	92.4	29.2	142.3	29.3
Other Latin America [b]	10.0	9.9	17.2	30.9
Total	759.7	33.1	1,327.1	34.1

Source: IEA (2007)

[a] Caribbean includes Dominican Republic, Haiti, Jamaica, Netherland Antilles, and Trinidad and Tobago.
[b] Other Latin America includes Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Dominica, French Guyana, Grenada, Guadeloupe, Guyana, Martinique, St. Kitts and Nevis, Anguilla, Saint Lucia, St. Vincent and Grenadines, and Surinam.
Source: IEA (2007)

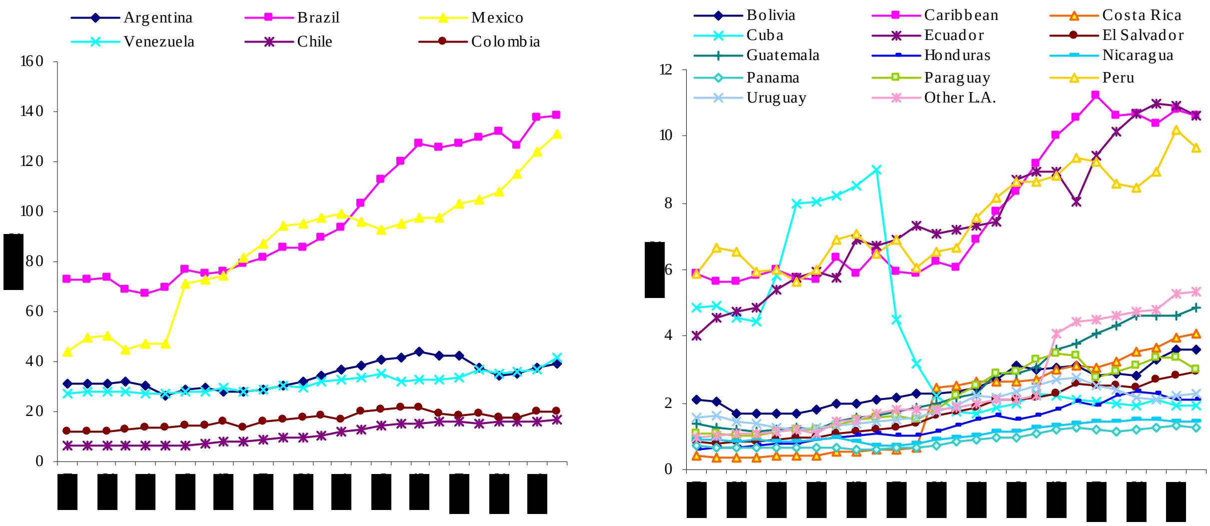
At the regional level, total CO_2 emissions from the transport sector more than doubled from 251 million tons to 453 million tons in 1980-2005 with an average annual growth rate of 2.4%. Given the size of Brazil's economy and population, it comes as no surprise that its transport sector has been the largest CO_2 emitter, and also the largest consumer of energy, compared to the transport sectors of other LAC countries. However, during 1989-1994, Mexico exceeded Brazil for the transport sector CO_2 emissions even though its transport sector energy consumption remained below than that of Brazil's (see Figure 2). Four large economies in the region – Argentina, Brazil, Mexico and Venezuela – alone have accounted for between 76-79% of the region's CO_2 emissions from transportation since 1980.

Figure 1: CO_2 Emission Mix by Sector



Source: IEA (2007)

Figure 2: CO_2 Emissions from the Transport sector



Source: IEA (2007)

2.2. Transport Sector Fuel Mix

Motor gasoline and diesel are the main fuels used in the transport sector in LAC countries (see Table 2). The comparison of fuel mix between 2005 and 1980 suggests significant substitution of gasoline with diesel in most LAC countries[2]. Obviously, CO_2 emissions largely originate from the combustion of diesel and motor gasoline (see Table 3), but whereas the bulk of the emissions in a majority of countries came from gasoline in 1980, diesel had supplanted motor

[2] The substitution of gasoline with diesel has been mostly driven by the low price of diesel relative to gasoline. The price of diesel has been maintained at a low level by the governments via price controls for socioeconomic reasons. In Mexico, for example, the state-owned oil company Pemex distributes gasoline and diesel. Although the country opened up gasoline prices to market forces in the early 1990s, prices for diesel are still set by the government. On top of the diesel price controls, the Mexican government also grants commercial motor carriers a 20 percent discount. Moreover, vehicles that run on diesel are growing in popularity due to the vehicles' superior fuel economy compared to gasoline-powered vehicles, as well as the tendency of diesel engines to last longer than gasoline engines (The Monitor, April 11, 2008). In Brazil, the price of gasoline was set at a high level, not only to reduce its use but also to finance Petrobrás's exploration effort and to subsidize other petroleum products. The prices of diesel and propane were maintained artificially low through subsidies. The low diesel price was intended to avoid a sharp increase of public transportation costs (Hudson, 1997; Reuters, May 12, 2008). In all Latin American countries considered in this study, the price of diesel is lower than that of gasoline. Whereas gasoline price in most Latin American countries is higher than that in the United States, diesel price is significantly lower (FMECD, 2007). Although diesel has a slightly higher carbon contents as compared to gasoline, the substitution of gasoline with diesel does not change CO_2 emissions significantly as diesel provides better fuel economy as compared to gasoline. A comparison of diesel and gasoline shares between Table 2 and Table 3 also demonstrate this fact.

gasoline as the source of most of the emissions from transportation in most countries by 2005. Still, Costa Rica and Panama exhibited almost complete reliance on motor gasoline in 1980. Thus, virtually all of their transport sector CO_2 emissions were from motor gasoline. However, while Costa Rica had diversified its transport sector fuel mix by 2005, Panama was still reliant exclusively on motor gasoline.

The combustion of aviation fuels represented another notable source of emissions from transportation in 1980, but only in a few countries such as Bolivia, Other Latin America, Argentina and Brazil. However, the share of aviation fuel in total transport sector fuel consumption as well as in emissions declined in all countries except Argentina. Utilization of electricity for transportation was negligible in 1980 and the share of electricity has not increased significantly in any LAC countries with exception of Cuba. Even in Cuba, the increased share of electricity has not helped reduce CO_2 emissions because of the high CO_2 emission coefficient for electricity in that country. Although liquefied petroleum gas (LPG) was not used at all for transportation in 1980, except in Mexico, where it represented less than 1% of the fuel mix, LPG use in Mexico and Peru has increased by 2005. Similarly, natural gas was not a source of fuel for transportation in LAC countries in 1980, but several countries had incorporated it into their fuel mix by 2005, particularly in Argentina, where 19.5% of fuel for transportation is derived from natural gas, resulting in 15.8% of CO_2 emissions from the transport sector in the country originating from natural gas. Finally, Brazil and Cuba, the two countries that used biofuels for transportation in 1980, were joined by Paraguay in increasing their usage of biofuels by 2005.

Table 2: Transport Sector Fuel Mix

	1980									2005								
	Total	Aviation Fuel	Electricity	Diesel	LPG	Biofuels	Motor Gasoline	Natural Gas	Residual Fuel Oil	Total	Aviation Fuel	Electricity	Diesel	LPG	Biofuels	Motor Gasoline	Natural Gas	Residual Fuel Oil
Country	(ktoe)	%	%	%	%	%	%	%	%	(ktoe)	%	%	%	%	%	%	%	%
Argentina	10,475	8.0	0.2	38.3	0.0	0.0	52.6	0.0	0.9	13,599	9.1	0.4	50.0	0.0	0.0	20.8	19.5	0.2
Bolivia	712	14.8	0.0	28.1	0.0	0.0	57.1	0.0	0.0	1,219	10.9	0.0	43.0	0.0	0.0	36.9	9.1	0.0
Brazil	25,654	6.8	0.3	49.5	0.0	5.5	34.3	0.0	3.7	52,998	5.0	0.2	50.9	0.0	13.0	26.3	3.1	1.5
Caribbean	1,975	2.9	0.0	39.5	0.0	0.0	57.6	0.0	0.0	3,579	2.5	0.0	30.9	0.0	0.0	66.7	0.0	0.0
Chile	2,040	n.a.	0.8	42.5	0.0	0.0	56.6	0.0	0.0	5,653	n.a	0.4	59.7	0.0	0.0	39.4	0.5	0.0
Colombia	3,975	n.a.	0.0	14.5	0.0	0.0	85.5	0.0	0.0	6,707	0.3	0.1	40.9	0.0	0.0	55.1	3.6	0.0
Costa Rica	440	n.a.	0.2	68.0	0.0	0.0	31.9	0.0	0.0	1,356	n.a	0.0	51.7	0.0	0.0	48.3	0.0	0.0
Cuba	2,172	n.a.	0.0	20.2	0.0	5.0	56.5	0.0	18.3	682	n.a	1.2	29.6	0.0	7.7	61.5	0.0	0.0
Ecuador	1,341	n.a.	0.0	16.1	0.0	0.0	71.2	0.0	12.3	3,537	0.1	0.0	53.7	0.0	0.0	46.2	0.0	0.0
El Salvador	285	n.a.	0.0	49.7	0.0	0.0	50.3	0.0	0.0	971	n.a	0.0	51.8	0.0	0.0	48.2	0.0	0.0
Guatemala	454	n.a.	0.0	38.7	0.0	0.0	61.3	0.0	0.0	1,614	n.a	0.0	45.5	0.0	0.0	54.5	0.0	0.0
Honduras	205	n.a.	0.0	49.4	0.0	0.0	50.6	0.0	0.0	694	n.a	0.0	50.7	0.0	0.0	49.3	0.0	0.0
Mexico	22,935	n.a.	0.2	34.5	0.7	0.0	64.6	0.0	0.0	44,296	n.a	0.2	29.2	3.5	0.0	66.9	0.0	0.2
Nicaragua	295	3.3	0.0	47.4	0.0	0.0	49.3	0.0	0.0	475	n.a	0.0	59.8	0.0	0.0	40.2	0.0	0.0
Panama	342	n.a	0.0	30.3	0.0	0.0	69.7	0.0	0.0	780	n.a	0.0	45.1	0.0	0.0	54.9	0.0	0.0
Paraguay	357	n.a	0.0	69.1	0.0	0.0	30.9	0.0	0.0	995	n.a	0.0	82.5	0.0	1.7	15.8	0.0	0.0
Peru	1,959	0.5	0.0	31.9	0.0	0.0	56.1	0.0	11.5	3,170	n.a	0.0	72.1	0.9	0.0	26.0	0.0	0.9
Uruguay	551	6.6	0.0	46.1	0.0	0.0	40.8	0.0	6.4	744	0.4	0.0	70.8	0.0	0.0	28.8	0.0	0.0
Venezuela	9,182	n.a.	0.0	14.7	0.0	0.0	82.7	0.0	2.5	14,201	n.a	0.2	15.6	0.0	0.0	84.1	0.0	0.1
Other L.A.	335	11.2	0.0	18.5	0.0	0.0	70.3	0.0	0.0	1,791	6.0	0.0	35.5	0.0	0.0	58.6	0.0	0.0

Source: IEA (2007)

Table 3: CO_2 Emission Mix by Fuel Type in the Transport Sector

	1980									2005								
	Total	Aviation Fuel	Electricity	Diesel	LPG	Biofuels	Motor Gasoline	Natural Gas	Residual Fuel Oil	Total	Aviation Fuel	Electricity	Diesel	LPG	Biofuels	Motor Gasoline	Natural Gas	Residual Fuel Oil
Country	('000 tCO_2)	%	%	%	%	%	%	%	%	('000 tCO_2)	%	%	%	%	%	%	%	%
Argentina	31,391	8.0	0.5	39.7	0.0	0.0	50.9	0.0	1.0	39,516	9.3	0.5	53.4	0.0	0.0	20.8	15.8	0.2
Bolivia	2,115	14.9	0.0	29.3	0.0	0.0	55.8	0.0	0.0	3,594	11.1	0.0	45.3	0.0	0.0	36.4	7.3	0.0
Brazil	73,186	7.1	0.1	53.8	0.0	0.0	34.8	0.0	4.2	138,596	5.7	0.1	60.4	0.0	0.0	29.2	2.7	1.9
Caribbean	5,893	2.9	0.0	41.1	0.0	0.0	56.0	0.0	0.0	10,614	2.5	0.0	32.3	0.0	0.0	65.2	0.0	0.0
Chile	6,108	n.a.	1.0	44.1	0.0	0.0	54.9	0.0	0.0	17,091	n.a.	0.5	61.2	0.0	0.0	37.8	0.4	0.0
Colombia	11,650	n.a.	0.0	15.3	0.0	0.0	84.6	0.0	0.0	19,880	n.a.	0.0	42.8	0.0	0.0	54.0	2.8	0.0
Costa Rica	1,335	n.a.	0.0	69.5	0.0	0.0	30.5	0.0	0.0	4,074	n.a.	0.0	53.4	0.0	0.0	46.6	0.0	0.0
Cuba	6,210	n.a.	0.0	21.9	0.0	0.0	57.3	0.0	20.7	1,935	n.a.	4.7	32.4	0.0	0.0	62.9	0.0	0.0
Ecuador	3,991	n.a.	0.0	16.7	0.0	0.0	69.5	0.0	13.4	10,645	n.a.	0.0	55.3	0.0	0.0	44.6	0.0	0.0
El Salvador	856	n.a.	0.0	51.4	0.0	0.0	48.6	0.0	0.0	2,917	n.a.	0.0	53.5	0.0	0.0	46.5	0.0	0.0
Guatemala	1,353	n.a.	0.0	40.3	0.0	0.0	59.7	0.0	0.0	4,832	n.a.	0.0	47.2	0.0	0.0	52.8	0.0	0.0
Honduras	616	n.a.	0.0	51.1	0.0	0.0	48.9	0.0	0.0	2,085	n.a.	0.0	52.4	0.0	0.0	47.6	0.0	0.0
Mexico	68,232	n.a.	0.4	36.0	0.6	0.0	63.0	0.0	0.0	131,057	n.a.	0.5	30.6	3.1	0.0	65.6	0.0	0.2
Nicaragua	885	3.3	0.0	49.0	0.0	0.0	47.7	0.0	0.0	1,434	n.a.	0.0	61.4	0.0	0.0	38.6	0.0	0.0
Panama	1,013	n.a.	0.0	31.7	0.0	0.0	68.3	0.0	0.0	2,334	n.a.	0.0	46.8	0.0	0.0	53.2	0.0	0.0
Paraguay	1,085	n.a.	0.0	70.5	0.0	0.0	29.5	0.0	0.0	3,004	n.a.	0.0	84.8	0.0	0.0	15.2	0.0	0.0
Peru	5,888	0.5	0.0	32.9	0.0	0.0	54.2	0.0	12.4	9,661	n.a.	0.0	73.4	0.8	0.0	24.8	0.0	1.0
Uruguay	1,665	6.6	0.0	47.4	0.0	0.0	39.1	0.0	6.9	2,265	0.4	0.0	72.1	0.0	0.0	27.5	0.0	0.0
Venezuela	26,991	n.a.	0.0	15.5	0.0	0.0	81.7	0.0	2.8	41,649	n.a.	0.2	16.6	0.0	0.0	83.2	0.0	0.1
Other L.A.	987	11.3	0.0	19.5	0.0	0.0	69.2	0.0	0.0	5,334	6.0	0.0	37.0	0.0	0.0	57.0	0.0	0.0

Source: IEA (2007)

2.3. Modal Mix[3] in the Transport Sector

Road was the predominant mode of transportation in LAC countries in 1980, especially in El Salvador, Guatemala, Honduras and Panama, where it was the only mode of transportation (see Tables 4 and 5). Because every country, except Argentina, Chile and Columbia, has increased their reliance on road transportation since then, this distribution was even more prominent in 2005. Road transport accounted for more than 90% of transport sector fuel consumption and CO_2 emissions in 18 out of the 20 countries in 2005. A few countries utilized domestic air transport, e.g., Uruguay, Brazil, Argentina, Other Latin America, and especially Bolivia (where it accounted for about 15% of the fuel consumption and CO_2 emissions in 1980), but the share of air transport in total transport sector fuel consumption and CO_2 emissions declined in all LAC countries by 2005 with the exception of Argentina.

Rail has not been an important mode of transportation in any of the countries since 1980, but Cuba experienced a dramatic increase in the share of CO_2 emissions from rail transport despite rail only accounting for 1.2% of fuel consumption for transportation in 2005 due to its use of electricity for rail transport and its high emission coefficient for electricity production. Inland waterways represented a significant mode of transportation in a few LAC countries in 1980 (Cuba, Ecuador and Peru). However, there has been a decline in fuel consumption and CO_2 emissions from inland waterways transportation in these countries, particularly Cuba and Peru, where inland waterways went from being responsible for, respectively, 22.6% and 11.5% of CO_2 emissions in 1980 to almost none in 2005. The general shift towards road transportation in LAC was accompanied by reduced reliance on domestic air and inland waterways.

[3] Ideally modal mix should be measured in terms of transport services (e.g., passenger kilometers, ton kilometers or any other equivalent unit) generated by each type of transportation mode. However, due to the lack of data, the study uses total fuel consumption by mode as a surrogate to illustrate modal mix. In energy literature, this is a common practice to measure modal mix in the transportation sector (see e.g., EIA, 2007; IEA, 2004)

Table 4: Modal Mix for Fuel Consumption in Transport Sector

	1980					2005				
	Total	Domestic Air	Inland Waterways	Rail	Road	Total	Domestic Air	Inland Waterways	Rail	Road
Country	(ktoe)	%	%	%	%	(ktoe)	%	%	%	%
Argentina	10,475	8.0	0.9	0.2	90.9	13,599	9.1	0.2	0.4	90.3
Bolivia	712	14.8	0.0	1.7	83.4	1,219	10.9	1.1	0.4	87.6
Brazil	25,654	6.8	6.4	2.6	84.2	52,998	5.0	2.1	1.3	91.6
Caribbean	1,975	2.9	0.0	0.0	97.1	3,579	2.5	0.0	0.0	97.5
Chile	2,040	0.0	5.3	1.3	93.3	5,653	0.0	6.2	0.4	93.4
Colombia	3,975	0.0	0.8	0.5	98.6	6,707	0.6	3.0	0.5	95.9
Costa Rica	440	0.0	2.6	0.2	97.3	1,356	0.0	0.2	0.0	99.8
Cuba	2,172	0.0	23.3	2.9	73.8	682	0.0	0.0	1.2	98.8
Ecuador	1,341	0.0	16.3	0.4	83.3	3,537	0.0	10.1	0.0	89.9
El Salvador	285	0.0	0.0	0.0	100.0	971	0.0	0.0	0.0	100.0
Guatemala	454	0.0	0.0	0.0	100.0	1,614	0.0	0.0	0.0	100.0
Honduras	205	0.0	0.0	0.0	100.0	694	0.0	0.0	0.0	100.0
Mexico	22,935	0.0	0.0	2.9	97.1	44,296	0.0	1.9	1.6	96.4
Nicaragua	295	3.3	2.8	0.0	93.9	475	0.0	3.0	0.0	97.0
Panama	342	0.0	0.0	0.0	100.0	780	0.0	0.0	0.0	100.0
Paraguay	357	0.0	0.9	0.0	99.1	995	0.0	0.0	0.0	100.0
Peru	1,959	0.5	11.5	0.0	88.0	3,170	0.0	0.9	0.0	99.0
Uruguay	551	6.6	6.4	0.0	86.9	744	0.4	0.0	0.0	99.6
Venezuela	9,182	0.0	0.0	2.5	97.5	14,201	0.0	0.0	0.3	99.7
Other Latin America	335	11.2	2.2	0.0	86.6	1,791	6.0	0.0	0.0	94.0

Based on the available data and following normal practices in energy accounting systems, the study considers four modes of transportation: road, rail, water and air. If data is available, road transportation, which is the primary mode for providing transportation services as well as energy consumption and associated emissions, can be disaggregated further into auto, bus etc.

Source: IEA (2007)

Table 5: Modal Mix for CO_2Emissions from Transportation

	1980					2005				
	Total	Domestic Air	Inland Waterways	Rail	Road	Total	Domestic Air	Inland Waterways	Rail	Road
Country	('000 tCO_2)	%	%	%	%	('000 tCO_2)	%	%	%	%
Argentina	31,391	8.0	1.0	0.5	90.6	39,516	9.3	0.2	0.5	90.0
Bolivia	2,115	14.9	0.0	1.8	83.2	3,594	11.1	1.2	0.4	87.3
Brazil	73,186	7.1	7.1	2.6	83.2	138,596	5.7	2.6	1.3	90.3
Caribbean	5,893	2.9	0.0	0.0	97.1	10,614	2.5	0.0	0.0	97.5
Chile	6,108	0.0	5.5	1.5	93.0	17,091	0.0	6.4	0.5	93.1
Colombia	11,650	0.0	0.9	0.6	98.5	19,880	0.6	3.1	0.5	95.9
Costa Rica	1,335	0.0	2.6	0.0	97.4	4,074	0.0	0.2	0.0	99.8
Cuba	6,210	0.0	26.2	3.2	70.7	1,935	0.0	0.0	4.7	95.3
Ecuador	3,991	0.0	17.6	0.4	82.0	10,645	0.0	10.4	0.0	89.6
El Salvador	856	0.0	0.0	0.0	100.0	2,917	0.0	0.0	0.0	100.0
Guatemala	1,353	0.0	0.0	0.0	100.0	4,832	0.0	0.0	0.0	100.0
Honduras	616	0.0	0.0	0.0	100.0	2,085	0.0	0.0	0.0	100.0
Mexico	68,232	0.0	0.0	3.2	96.8	131,057	0.0	2.0	1.9	96.0
Nicaragua	885	3.3	2.9	0.0	93.8	1,434	0.0	3.1	0.0	96.9
Panama	1,013	0.0	0.0	0.0	100.0	2,334	0.0	0.0	0.0	100.0
Paraguay	1,085	0.0	0.9	0.0	99.1	3,004	0.0	0.0	0.0	100.0
Peru	5,888	0.5	12.4	0.0	87.1	9,661	0.0	1.0	0.0	99.0
Uruguay	1,665	6.6	6.9	0.0	86.5	2,265	0.4	0.0	0.0	99.6
Venezuela	26,991	0.0	0.0	2.8	97.2	41,649	0.0	0.0	0.3	99.7
Other Latin America	987	11.3	2.2	0.0	86.5	5,334	6.0	0.0	0.0	94.0

Source: IEA (2007)

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3. Methodology and Data

3.1 Methodology

Total CO_2 emission from the transport sector in a country in year t ($CO2_t$) is the summation of CO_2 emissions from all fuels used in all transport modes in that year, i.e.,

$$CO2_t = \sum_{ij} CO2_{ijt} \qquad (1)$$

where,

$CO2_{ijt}$ = CO_2 emissions from fuel i in transportation mode j in year t

In order to decompose the emission to the potential factors affecting it, Equation (1) can be expressed as:

$$CO2_t = \sum_{ij} \frac{CO2_{ijt}}{FC_{ijt}} \times \frac{FC_{ijt}}{FC_{jt}} \times \frac{FC_{jt}}{FC_t} \times \frac{FC_t}{GDP_t} \times GDP_t \qquad (2)$$

where,

FC_{ijt} = consumption of fuel i (e.g., gasoline, diesel, fuel oil, natural gas, electricity) in transportation mode j (e.g., road, rail, domestic air and inland water) in year t

FC_{jt} = total fuel consumption in transportation mode j in year t

FC_t = total fuel consumption in the transportation sector in year t

GDP_t = Gross domestic product in year t

Ideally Equation (2) should be replaced with the following equation,

$$CO2_t = \sum_{ij} \frac{CO2_{ijt}}{FC_{ijt}} \times \frac{FC_{ijt}}{FC_{jt}} \times \frac{FC_{jt}}{TS_{jt}} \times \frac{TS_{jt}}{TS_t} \times \frac{TS_t}{GDP_t} \times GDP_t \qquad (3)$$

where,

TS_{jt} = transport services (e.g., passenger kilometers, tons kilometers or any equivalent measurement representing transport services[4]) provided by transport mode j in year t

[4] Includes transport services provided to all sectors (e.g., households, industry, government).

TS_t = total transport services in year t

Since transportation service data needed for the study (i.e., 20 LAC countries for 25 years between 1980 and 2005) are not available, the study uses Equation (2) instead of Equation (3). Note that Equation (3) can be expanded further to differentiate passenger and freight transportation, this would, however, complicates further in obtaining the necessary data.

Equation (2) can also be rewritten as:

$$CO2_t = \sum_{ij} EC_{ijt} \times FM_{ijt} \times MM_{jt} \times EI_t \times EA_t \tag{4}$$

where,

EC_{ijt} = emission coefficient of fuel i used in transportation mode j in year t (= $CO2_{ijt}/FC_{ijt}$)

FM_{ijt} = share of fuel i in transportation mode j (fuel mix) in year t (= FC_{ijt}/FC_{jt})

MM_{jt} = share of mode j in total transport sector fuel consumption (modal mix) in year t (= FC_{jt}/FC_t)

EI_t = transportation energy intensity in year t (= FC_t/GDP_t)

EA_t = economic activity in year t (= GDP_t)

Note that Equation (4) implicitly assumes the same energy intensity (e.g., kj per passenger kilometer or kj per ton kilometer) across the different modes of transport. This is a strong assumption. This does however, not affect the results of this particular study as modal shifting is insignificant in all countries considered over the study horizon.

Following Shrestha and Timilsina (1996) and Boyd et al. (1987), the change in transport sector CO_2 emission between year t and t-1 can be decomposed using the general Divisia index approach as:

$$\ln\frac{CO2_t}{CO2_{t-1}} = \ln\frac{EI_t}{EI_{t-1}} + \ln\frac{EA_t}{EA_{t-1}} + \sum_{ij}[\tilde{w}_{ijt}\ln\frac{MM_{jt}}{MM_{jt-1}} + \tilde{w}_{ijt}\times\ln\frac{EC_{ijt}}{EC_{ijt-1}} + \sum_{ij}\tilde{w}_{ijt}\times\ln\frac{FM_{ijt}}{FM_{ijt-1}}] \tag{5}$$

where

$$\tilde{w}_{ijt} = (w_{ijt}+w_{ijt-1})/2 \tag{6}$$

$$\text{with } w_{ijt} = \frac{EC_{ijt} \times FM_{ijt} \times MM_{jt}}{\sum_{ij} EC_{ijt} \times FM_{ijt} \times MM_{jt}}. \tag{7}$$

This study uses the logarithmic mean Divisia index (LMDI) approach (Ang et al. 1998; Ang and Liu, 2001) instead of the general Divisia index approach. The preference of LMDI approach to the general Divisia index approach is based on the fact that the former provides a residual-free decomposition. Moreover, the LMDI can accommodate the occurrence of zero values in the data set[5]. Using LMDI, the change in the transport sector CO_2 emissions from year t-1 to t is expressed as:

$$\begin{aligned} \frac{CO2_t}{CO2_{t-1}} &= \exp[\sum_{ij} \tilde{w}_{ij} \times \ln \frac{EC_{ijt}}{EC_{ijt-1}}] \times \exp[\sum_{ij} \tilde{w}_{ij} \times \ln \frac{FM_{ijt}}{FM_{ijt-1}}] \\ &\times \exp[\sum_{ij} \tilde{w}_{ij} \times \ln \frac{MM_{ijt}}{MM_{ijt-1}}] \times \frac{EI_t}{EI_{t-1}} \times \frac{EA_t}{EA_{t-1}} \end{aligned} \tag{8}$$

In Equation (8) $\tilde{w}_{ijt}$ is defined differently from that in Equation (6); following Ang (2005) $\tilde{w}_{ijt}$ is now given as:

$$\tilde{w}_{ijt} = \frac{CO2_{ijt} - CO2_{ijt-1}}{\ln CO2_{ijt} - \ln CO2_{ijt-1}} \Big/ \frac{CO2_t - CO2_{t-1}}{\ln CO2_t - \ln CO2_{t-1}} \tag{9}$$

The first term in the right hand side of Equation (8) represents the emission coefficient (EC) effect. Note that only the coefficient of electricity is changing due to variations in electricity generation mix over time. Emission coefficients (i.e., carbon contents) for other fuels are assumed to be constant over time. The second and third terms represent the fuel mix (FM) or fuel

[5] In this approach zero values are replaced with a small positive constant. Wood and Lenzen (2006) contend that this strategy is not necessarily robust if applied to a data set containing a large number or zeros and small values and recommend the use of analytical limits proposed in Ang et al (1998). However, while Ang and Liu (2007) concur that the use of analytical limits is superior on theoretical grounds, they demonstrate that the small value strategy is generally robust for index decomposition analyses when a sufficiently small value is utilized.

switching and the modal mix (MM) or modal shift effects, respectively. Finally, the fourth and fifth terms represent the transportation energy intensity (EI) effect and the economic activity (EA) effect, respectively. The study carries out decomposition analysis on an annual basis over the twenty five years period between 1980 and 2005.

3.2 Data

This paper uses transport sector energy consumption data by fuel type and mode from the International Energy Agency (IEA). Fuels included are biofuel (i.e., ethanol), natural gas, liquefied petroleum gases (LPG), motor gasoline, aviation fuels (i.e., aviation gasoline, kerosene and jet fuel), diesel oil, residual fuel oil, and electricity. The use of coal for transportation is negligible in LAC countries, and so the study excludes it. The modes of transportation considered are domestic aviation, road, rail and domestic water transport[6]. The study excludes energy consumption in oil and gas pipeline transport.

Emission coefficients are based on the carbon contents of fuels and are obtained from Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) for all fuels except electricity. Emission coefficients for electricity are derived using IEA data on electricity output and CO_2 emissions from electricity production (IEA, 2007a, 2007b, 2007c). While CO_2 emission factors for other transportation fuels (e.g., gasoline, diesel etc.) remain the same throughout the study period, CO_2 emission factors for electricity vary with time. This is because, the carbon content of a fossil fuel is not expected to change over time, but CO_2 emission coefficients of an electricity grid change over time as the electricity generation mix and thereby the input fuel mix for electricity generation changes every year. Moreover, the CO_2 emission coefficient of a particular fossil fuel is the same for all countries, whereas the coefficient for electricity varies across the countries depending on their electricity generation mix. CO_2 emissions are estimated by type of fuel and mode, using the corresponding fuel consumption and associated emission factors. Data on gross domestic product (GDP),

[6] In energy statistics, energy consumption by international aviation and maritime transportation are not considered part of national energy consumption. These are treated separately under their international conventions (i.e., International Civil Aviation Organization and International Maritime Organization).

expressed at 2000 constant dollar measured in purchasing power parity, are also taken from the IEA (IEA, 2007f, 2007g).

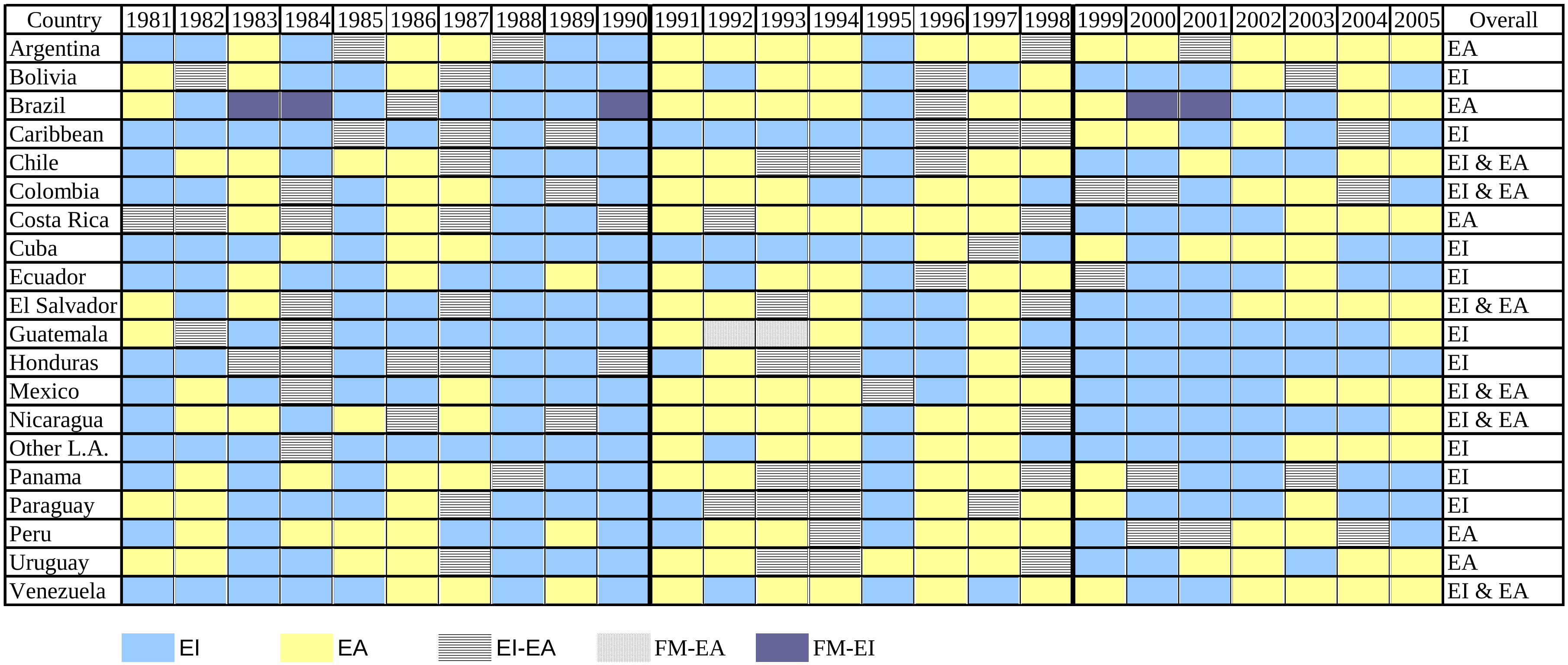
Data for “Other Latin America” are taken directly from the IEA at the aggregate level. Caribbean data are either the summation of the data for the constituent countries (e.g., GDP, fuel consumption) or their weighted average (e.g., CO_2 coefficients of electricity).

4. Results and Discussion

All countries in LAC, with the exception of Cuba, experienced significant growth in transportation sector CO_2 emissions during the 1980-2005 period. However, there remain significant differences in the magnitude of emissions growth and the factors driving it. Figure 3 summarizes the results of the decomposition of transport sector CO_2 emissions growth into fuel switching, modal shifting and changes in emission coefficients[7], transportation energy intensity, and economic activity (or GDP). Detailed results for each country considered are presented in the Appendix.

[7] Only the emission coefficients of electricity changes due to different electricity generation mix over time; emission coefficients of other fuels remain constant throughout the study period.

Figure 3: Factors Affecting CO_2 Emissions Growth in LAC Countries



Note: Overall factor selected if it is a main factor in at least 40% (10 out of 25 years) of the study period.

The modal mix effect, as defined in this study, considers only four modes: road, rail, water and air, and does not appear to influence emission growth. If necessary data is available to further disaggregate road transportation into auto, bus etc., modal mix might be found to influence CO_2 emission growth.

As illustrated in Figure 3, the energy intensity effect is found to be pre-dominant in influencing the growth of transportation sector CO_2 during the 1980-1990 period. Conversely, the economic activity effect is the primary factor driving transportation sector CO_2 emissions during the 1991-1998 period. Both energy intensity and economic activity effects are responsible for CO_2 emission growth in the transport sector during the 1999-2005 period.

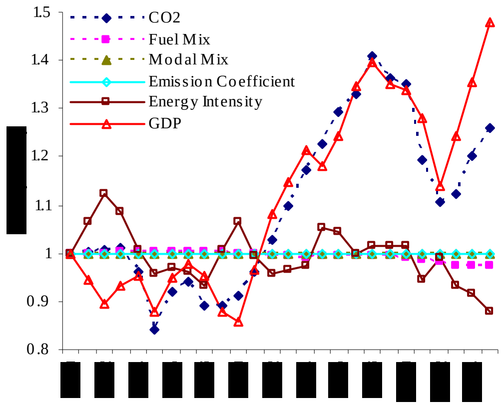
The economic activity effect (i.e., change in GDP) is the primary factor in the growth of transportation sector CO_2 emissions in Argentina, Brazil, Costa Rica, Peru and Uruguay. On the other hand, the transportation energy intensity effect is found to be the main driver of transport sector CO_2 emissions change in Bolivia, the Caribbean, Cuba, Ecuador, Guatemala, Honduras, Other Latin America, Panama and Paraguay. In the remaining LAC countries (i.e., Chile, Colombia, El Salvador, Mexico, Nicaragua, and Venezuela), both the economic activity effect and transportation energy intensity effect are found responsible for their transport sector CO_2 emission growth.

Although fuel switching is a common phenomenon in many LAC countries during the 1980-2005 period (see Table 2), interestingly, the fuel switching effect is not found to play a role in driving transport sector CO_2 emissions in these countries. This is because the substitution occurred between diesel and gasoline, but their CO_2 emission coefficients are not significantly different

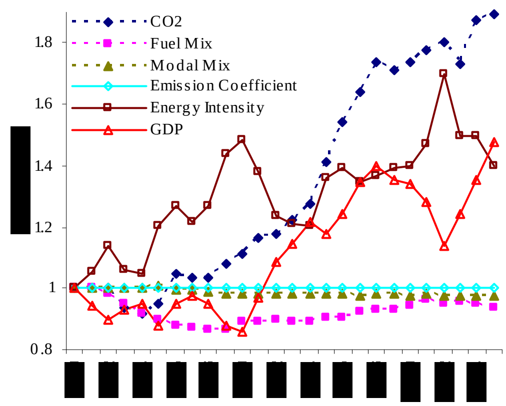
Figures 4 (a) – (e) present indexed time-series charts of the decomposition results for Argentina, Brazil, Costa Rica, Peru and Uruguay, where the economic activity effect is found to be the principal driver of transport sector CO_2 emission growth. In all five of these countries, the pattern of CO_2 emission growth looks similar: almost stagnant until 1990, sharp increase between 1990 and 1998, drop thereafter until 2002 and increase again after 2002. This pattern is consistent with the economic performance of these countries during the period as economic growth was stagnant during the 1980s, gradually increased in the 1990s until the economic crisis of the late 1990s, and then recovered after 2002.

Figure 4: Transport Sector CO_2 Emissions Growth and Driving Factors in Argentina, Brazil, Costa Rica, Peru and Uruguay.

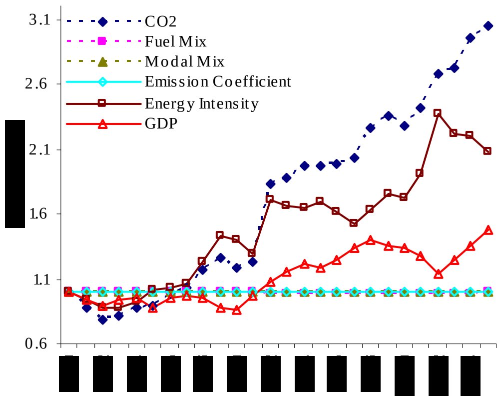
a) Argentina



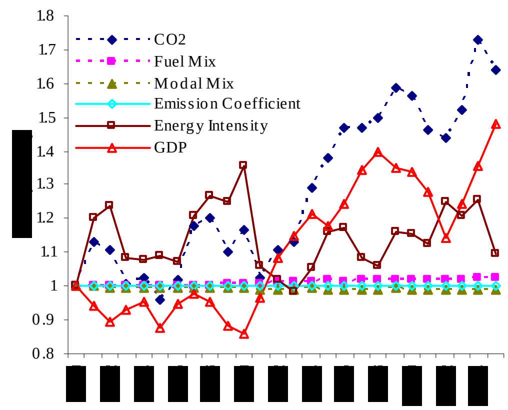
b) Brazil



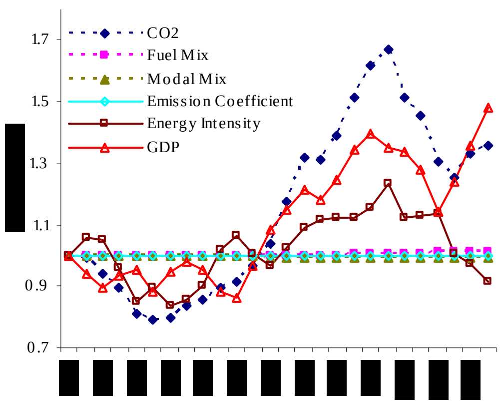
c) Costa Rica



d) Peru



e) Uruguay



The study finds that economic growth has been responsible for the growth of transport sector CO_2 emissions in Argentina, Brazil, Costa Rica, Peru and Uruguay, although the fuel mix effect is also found to contribute slightly to the change in CO_2 emissions in some years in Brazil. These countries are not expected to slow down their economic growth to control their CO_2 emissions because they have neither mandatory nor voluntary commitments to reduce CO_2 emissions under the Kyoto Protocol. Thus, the main strategy to limit the growth of CO_2 emissions in the transport sector in these countries in the future would likely be the decoupling (or weakening) of the growth of CO_2 emissions from economic growth, which has not been the case historically. Rapid switching to clean fuels and shifting over to public transportation, including rail and water transportation, could help achieve this objective. Policy instruments such as subsidies to public transportation, clean fuels and clean vehicles would be helpful in triggering the fuel switching and modal shifting activities. Although regulatory instruments such as fuel economy standards could also help reduce CO_2 emissions, such instruments, however, act only indirectly (e.g., through the improvement of transportation energy intensity, which is not found to be the main factor for driving CO_2 emission growth in these countries).

Indexed time-series charts of the decomposition results for Bolivia, Caribbean, Cuba, Ecuador, Guatemala, Honduras, Other Latin America, Panama and Paraguay, where transport sector CO_2 emission changes were primarily driven by changes in transportation energy intensity, are presented in Figures 5(a) to 5(i). With the exception of a few years, such as 1990-1993 and 2002-2005, the energy intensity effect is increasing in all of these eight countries. The reason for this is that the growth of energy consumption in the transport sector of each of these countries is outpacing GDP growth during the study period. Table 6 shows that the magnitude of the average annual growth rate of transport sector energy consumption is greater than that of GDP in Bolivia, the Caribbean, Cuba, Ecuador, Guatemala, Honduras, Other Latin America, Panama and Paraguay. Although further studies are needed to precisely determine the causes of increases in the transportation energy intensities[8], possible reasons could be an increase in the non-productive usage of transport services, traffic congestion, etc.

Since transportation energy intensity is the primary factor driving transport sector CO_2 emissions in these countries, policy instruments that could help reduce transportation energy intensity, such as vehicle efficiency or fuel economy standards and vehicle occupancy standards, would be more effective in slowing transport sector CO_2 emission growth in these countries.

[8] In order to determine the reasons for transportation energy intensity change, this indicator itself can be decomposed into its driving factors, such as fuel efficiency of transportation by mode and transport service intensity of the economy.

Figure 5: Transport Sector CO_2 Emissions Growth and Driving Factors in Bolivia, Caribbean, Cuba, Ecuador, Guatemala, Honduras, Other Latin America, Panama and Paraguay

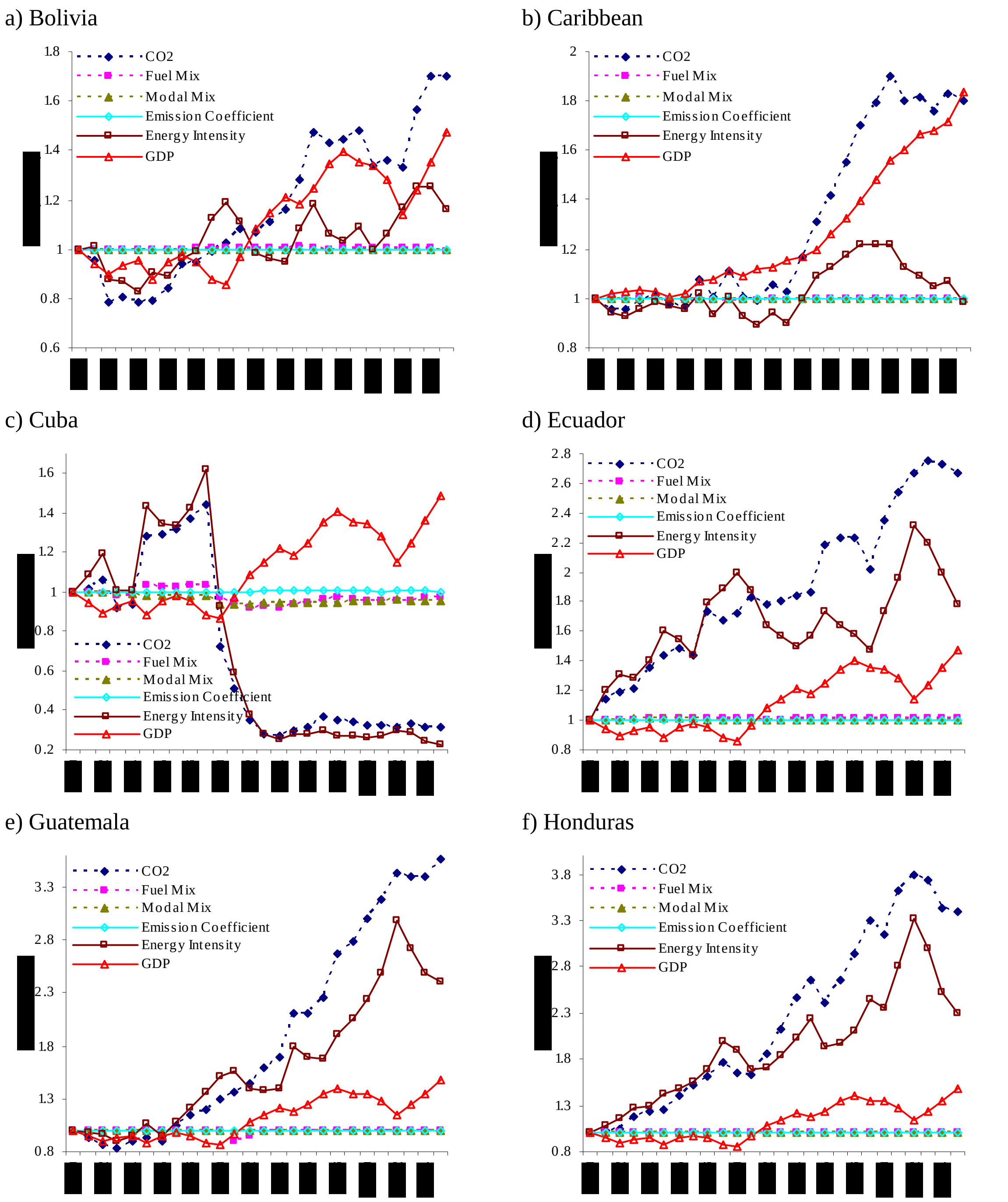
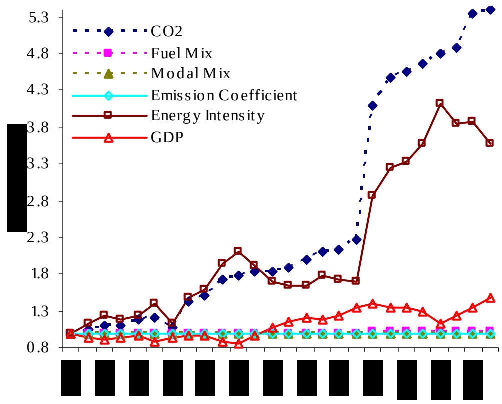
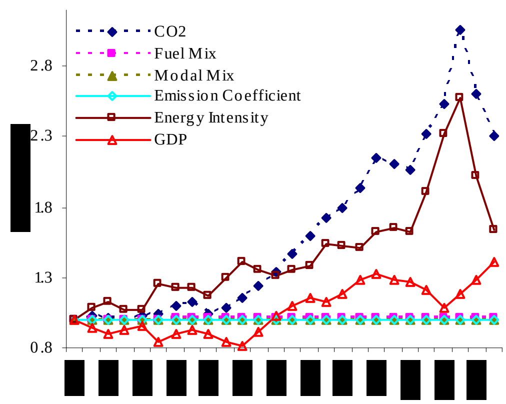


Figure 5 (continued): Transport Sector CO_2 Emissions Growth and Driving Factors in Bolivia, Caribbean, Cuba, Ecuador, Guatemala, Honduras, Other Latin America, Panama and Paraguay

g) Other Latin America



h) Panama



i) Paraguay

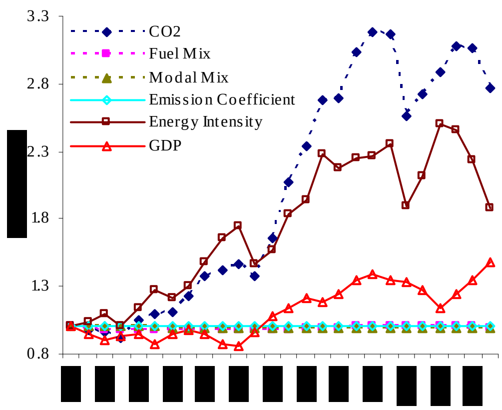


Table 6: Average Annual Growth Rate of GDP and Transport Sector Energy Consumption for the 1980-2005 Period (%)

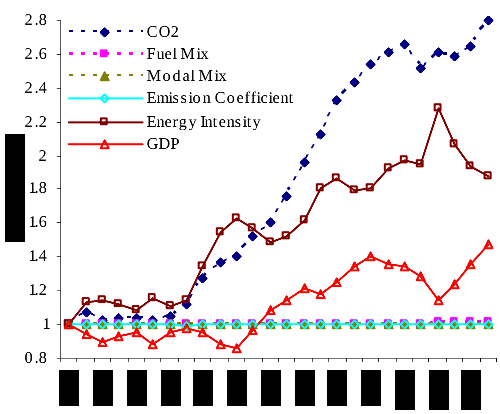
Country	GDP	Energy Consumption
Bolivia	2.18	2.44
Caribbean	2.49	2.60
Cuba	1.53	-3.12
Ecuador	2.61	4.19
Guatemala	2.51	5.48
Honduras	3.03	5.27
Other Latin America	2.84	7.86
Panama	3.51	3.62
Paraguay	2.20	4.60

Source: IEA (2007)

The study finds that both economic activity and transportation energy intensity effects are responsible for transport sector CO_2 emission growth in Chile, Colombia, El Salvador, Mexico, Nicaragua, and Venezuela. The indexed time-series charts of the decomposition results for these countries are presented in Figure 6(a) to 7(f). Although both effects influence transport sector CO_2 emissions most of the time during the study period, exceptions are noted in some years. For example, the energy intensity effect does not significantly affect transport sector CO_2 emission after 2003 in all of these countries, with the exception of Columbia and Nicaragua. Both the economic activity and energy intensity effects are driving CO_2 emissions gradually upwards between the mid-1980s to 2000 in Chile and El Salvador, while CO_2 emissions remained almost unchanged during the 1980s and then increased gradually in the 1990s along with energy intensity and economic activity effects in Costa Rica, Nicaragua and Venezuela. In Mexico, the energy intensity effect is the main driving factor for CO_2 emissions growth in the 1980s, but then the economic activity effect becomes the main contributor in the 1990s.

Figure 6: Transport Sector CO_2 Emissions Growth and Driving Factors in Chile, Colombia, El Salvador, Mexico, Nicaragua, and Venezuela

a) Chile



b) Colombia

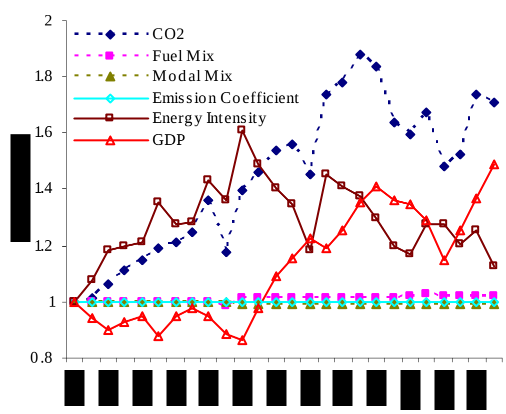
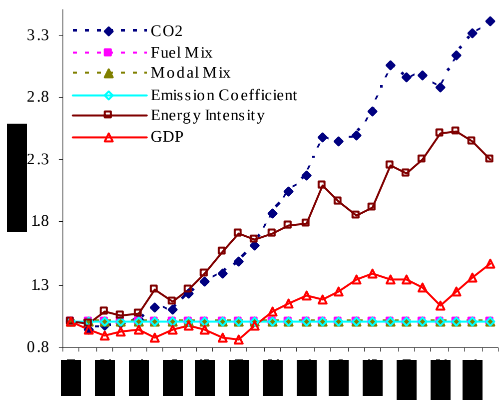
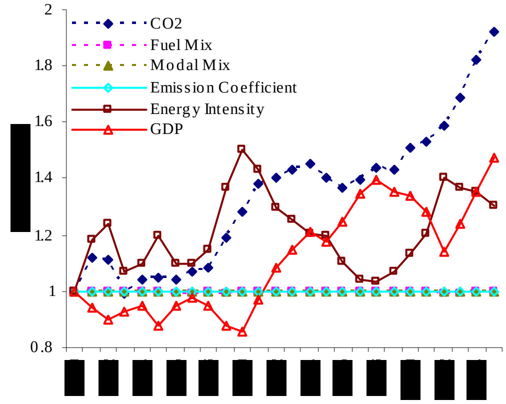


Figure 6 (continued): Transport Sector CO_2 Emissions Growth and Driving Factors in Chile, Colombia, El Salvador, Mexico, Nicaragua, and Venezuela

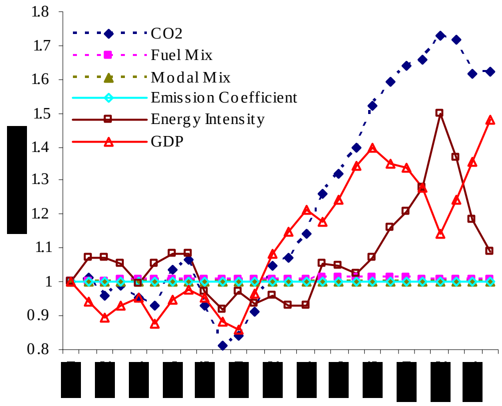
c) El Salvador



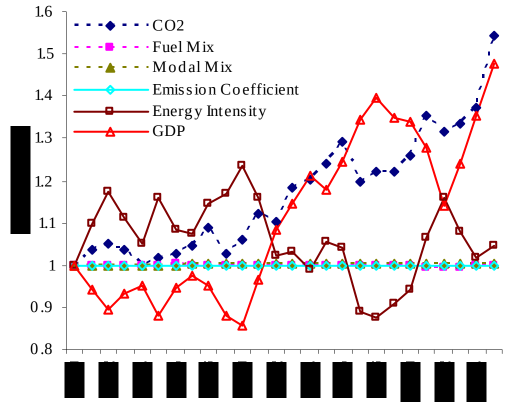
d) Mexico



e) Nicaragua



f) Venezuela



Note that energy intensity is declining in Columbia, Mexico and Venezuela in the 1990s, which appears to be unusual as transportation congestion has increased in the urban centers of these countries. The decreasing trend in energy intensity can be attributed to the relatively faster growth of economic activity as compared to energy consumption. This is also evident from figures 6(b), 6(d) and 6(f), where drops in energy intensity in the 1990s are accompanied by sharp increases in the economic activity effect.

Since economic growth and increased transportation energy intensity are responsible for the sectoral CO_2 emissions growth in Chile, Colombia, El Salvador, Mexico, Nicaragua and Venezuela, policy instruments, such as taxes on dirty fuels and subsidies to public transportation, clean fuels and clean vehicles would be needed to induce switching over to clean fuels and shifting over to public transportation (including rail and water transportation). Moreover, policy instruments, such as vehicle efficiency standards, vehicle occupancy standards, congestion charges, investments on road maintenance and congestion reduction would be required to reduce transportation energy intensity and thereby reduce transport sector CO_2 emissions in these countries.

5. Conclusions

This study examines the growth of transport sector CO_2 emissions and determines the underlying factors in 20 Latin American and Caribbean countries over 25 years between 1980 and 2005. To identify the driving factors, the study decomposes the emission growth to fuel switching, modal shifting, economic growth and changes in emission coefficients and transportation energy intensity using the logarithmic mean Divisia index (LMDI) approach. The study finds that economic growth and change in transportation energy intensity are the principal drivers of transport sector CO_2 emission growth in Latin American and Caribbean countries, whereas fuel switching, modal shifting and change in emission coefficients are not found to have a sizeable influence on the growth of transport sector CO_2 emissions in those countries. The economic activity effect (i.e., GDP growth) is found to be driving transport sector CO_2 emissions in most years in the study horizon in Argentina, Brazil, Costa Rica, Peru and Uruguay. On the other hand, the transportation energy intensity effect is found to be the main driver of CO_2 emissions change in Bolivia, Caribbean, Cuba, Ecuador, Guatemala, Honduras, Panama, Paraguay and "Other Latin America." In the remaining LAC countries (i.e., Chile, Colombia, El Salvador, Mexico, Nicaragua, and Venezuela), both the economic activity effect and transportation energy intensity effect are found responsible for transport sector CO_2 emissions growth.

The results also suggest some policy conclusions. In order to limit the growth of CO_2 emissions, emissions growth should first be decoupled from economic growth, which has not been the case historically. This can be done via rapid switching to clean fuels, shifting to public transportation (including rail and water transportation), and an increase in transportation energy efficiency through vehicles efficiency improvements, road maintenance, and the reduction of traffic congestion. Fiscal instruments such as emission taxes and subsidies for clean fuels and clean vehicles would be more effective in slowing CO_2 emission growth in countries where the economic activity effect is the primary driver for transport sector CO_2 emission growth. On the other hand, regulatory instruments such as fuel economy standards and vehicle occupancy standards would be more effective in countries where the transportation energy intensity effect is the main driver for CO_2 emission growth. Both fiscal and regulatory policy instruments would be useful in countries where both economic activity effect and transportation energy intensity effect are responsible for driving transport sector CO_2 emissions growth.

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Appendix

CO_2 Emissions Change and Contributing Factors

Argentina

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	0.00280	-0.00014	-0.00020	-0.00026	0.06198	-0.05858	EI
1982	0.00377	0.00090	0.00069	-0.00040	0.05338	-0.05081	EI
1983	0.00413	0.00114	-0.00009	-0.00004	-0.03488	0.03800	EA
1984	-0.05057	-0.00047	0.00014	-0.00044	-0.07166	0.02187	EI
1985	-0.13336	-0.00050	-0.00052	-0.00046	-0.05303	-0.07885	EI, EA
1986	0.08913	0.00148	-0.00049	0.00020	0.01221	0.07573	EA
1987	0.02281	-0.00015	0.00030	-0.00023	-0.00579	0.02868	EA
1988	-0.05626	0.00051	0.00014	0.00168	-0.03269	-0.02589	EI, EA
1989	0.00037	-0.00100	-0.00019	-0.00005	0.07953	-0.07791	EI
1990	0.02513	-0.00215	-0.00015	-0.00136	0.05307	-0.02427	EI
1991	0.05113	-0.00088	-0.00044	0.00016	-0.06691	0.11920	EA
1992	0.06935	-0.00349	0.00018	-0.00028	-0.03982	0.11275	EA
1993	0.06456	-0.00135	-0.00010	-0.00032	0.00896	0.05737	EA
1994	0.06540	-0.00150	0.00013	-0.00008	0.01014	0.05671	EA
1995	0.04743	0.00049	0.00004	-0.00048	0.07625	-0.02886	EI
1996	0.05064	0.00060	0.00088	0.00092	-0.00546	0.05370	EA
1997	0.03012	0.00035	-0.00014	-0.00043	-0.04761	0.07794	EA
1998	0.05696	0.00028	0.00017	0.00018	0.01857	0.03777	EI, EA
1999	-0.03451	-0.00112	-0.00009	0.00024	0.00089	-0.03443	EA
2000	-0.00978	-0.00160	0.00028	-0.00031	-0.00023	-0.00792	EA
2001	-0.12337	-0.00507	-0.00029	-0.00096	-0.07199	-0.04505	EI, EA
2002	-0.07629	-0.00419	-0.00028	-0.00013	0.04362	-0.11530	EA
2003	0.01724	-0.00755	-0.00020	0.00024	-0.05985	0.08460	EA
2004	0.06804	-0.00279	0.00014	0.00065	-0.01638	0.08644	EA
2005	0.04528	0.00002	-0.00021	-0.00016	-0.04219	0.08781	EA

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Bolivia

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	-0.04408	0.00001	0.00004	0.00000	0.01445	-0.05858	EA
1982	-0.19708	0.00004	-0.00003	0.00000	-0.14626	-0.05084	EI, EA
1983	0.02242	-0.00388	0.00005	0.00000	-0.01170	0.03795	EA
1984	-0.02221	0.00001	0.00018	0.00000	-0.04427	0.02188	EI
1985	0.00721	-0.00035	-0.00011	0.00000	0.08656	-0.07890	EI
1986	0.06214	0.00468	-0.00020	0.00000	-0.01797	0.07563	EA
1987	0.11016	0.00039	-0.00022	0.00000	0.08132	0.02868	EI, EA
1988	0.00490	0.00038	-0.00002	0.00000	0.03043	-0.02590	EI
1989	0.04962	0.00079	0.00002	0.00000	0.12674	-0.07792	EI
1990	0.03056	0.00138	0.00088	0.00000	0.05238	-0.02408	EI
1991	0.05620	0.00248	-0.00022	0.00000	-0.06527	0.11920	EA
1992	-0.01220	0.00042	0.00003	0.00000	-0.12546	0.11279	EI
1993	0.03894	0.00124	-0.00005	0.00000	-0.01964	0.05738	EA
1994	0.04066	-0.00043	0.00003	0.00000	-0.01559	0.05666	EA
1995	0.10336	0.00110	0.00003	0.00000	0.13109	-0.02886	EI
1996	0.13906	-0.00508	-0.00008	0.00000	0.09065	0.05358	EI, EA
1997	-0.03068	-0.00227	-0.00041	0.00000	-0.10584	0.07785	EI,
1998	0.00823	0.00164	0.00005	0.00000	-0.03122	0.03776	EA
1999	0.02388	0.00136	-0.00003	0.00000	0.05697	-0.03442	EI
2000	-0.09909	-0.00175	-0.00039	0.00000	-0.08903	-0.00792	EI
2001	0.01647	0.00279	-0.00018	0.00000	0.05891	-0.04505	EI
2002	-0.01995	-0.00002	0.00001	0.00000	0.09541	-0.11534	EA
2003	0.15902	-0.00029	-0.00018	0.00000	0.07487	0.08463	EI, EA
2004	0.08318	-0.00095	-0.00007	0.00000	-0.00224	0.08644	EA
2005	-0.00059	-0.00972	0.00010	0.00000	-0.07790	0.08693	EI

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Brazil

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	-0.00100	0.00277	0.00228	0.00012	0.05238	-0.05854	EA
1982	0.00171	-0.02358	0.00078	-0.00013	0.07547	-0.05083	EI
1983	-0.06686	-0.03394	0.00017	-0.00015	-0.07093	0.03801	FM, EI
1984	-0.01906	-0.02992	-0.00078	0.00004	-0.01026	0.02187	FM, EI
1985	0.03387	-0.02651	0.00265	-0.00004	0.13665	-0.07888	EI
1986	0.10016	-0.02039	-0.01011	0.00051	0.05444	0.07572	EI, EA
1987	-0.01670	-0.00215	-0.00297	-0.00015	-0.04009	0.02866	EI
1988	0.00389	-0.00768	-0.00205	-0.00013	0.03964	-0.02590	EI
1989	0.03994	-0.00226	-0.00707	-0.00012	0.12721	-0.07782	EI
1990	0.03174	0.02612	-0.00093	-0.00005	0.03087	-0.02427	FM, EI
1991	0.04540	0.00143	-0.00097	0.00003	-0.07438	0.11928	EA
1992	0.00757	0.00578	-0.00033	0.00005	-0.11072	0.11279	EA
1993	0.03923	-0.00173	0.00101	-0.00007	-0.01735	0.05737	EA
1994	0.04493	-0.00211	-0.00214	-0.00006	-0.00747	0.05671	EA
1995	0.10121	0.01063	-0.00019	0.00005	0.11959	-0.02886	EI
1996	0.08748	0.00604	0.00091	0.00002	0.02673	0.05378	EI, EA
1997	0.05943	0.01535	-0.00184	0.00005	-0.03208	0.07795	EA
1998	0.05971	0.01039	0.00074	0.00000	0.01080	0.03777	EA
1999	-0.01568	-0.00126	-0.00031	0.00019	0.02013	-0.03443	EA
2000	0.01519	0.01589	-0.00015	0.00005	0.00731	-0.00792	FM, EI
2001	0.02158	0.01832	0.00037	0.00015	0.04782	-0.04508	FM, EI
2002	0.01570	-0.01157	-0.00042	-0.00015	0.14313	-0.11529	EI
2003	-0.03983	0.00227	-0.00251	-0.00005	-0.12417	0.08463	EI
2004	0.07978	-0.00450	-0.00011	0.00005	-0.00211	0.08644	EA
2005	0.00919	-0.01108	0.00083	-0.00001	-0.06836	0.08781	EA

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

The Caribbean

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	-0.04168	-0.00157	0.00001	0.00000	-0.06207	0.02195	EI
1982	-0.00024	0.00284	0.00000	0.00000	-0.01077	0.00769	EI
1983	0.03274	-0.00130	-0.00001	0.00000	0.02845	0.00560	EI
1984	0.02370	-0.00158	0.00000	0.00000	0.03130	-0.00602	EI
1985	-0.03790	-0.00394	-0.00002	0.00000	-0.01398	-0.01997	EI, EA
1986	-0.00660	-0.00107	-0.00003	0.00000	-0.01591	0.01040	EI
1987	0.10541	-0.00040	-0.00001	0.00000	0.06020	0.04563	EI, EA
1988	-0.07301	0.00145	0.00001	0.00000	-0.08586	0.01139	EI
1989	0.10605	-0.00229	-0.00002	0.00000	0.07556	0.03280	EI, EA
1990	-0.10081	0.00152	0.00000	0.00000	-0.08187	-0.02047	EI
1991	-0.01301	0.00135	-0.00025	0.00000	-0.03813	0.02401	EI
1992	0.06063	0.00053	-0.00005	0.00000	0.05184	0.00831	EI
1993	-0.02548	-0.00107	0.00005	0.00000	-0.04582	0.02135	EI
1994	0.12410	0.00423	-0.00002	0.00000	0.10554	0.01434	EI
1995	0.11492	-0.00155	-0.00001	0.00000	0.09071	0.02578	EI
1996	0.08133	0.00061	-0.00001	0.00000	0.03123	0.04950	EI, EA
1997	0.09171	0.00032	-0.00001	0.00000	0.04165	0.04975	EI, EA
1998	0.08975	-0.00020	-0.00001	0.00000	0.03613	0.05383	EI, EA
1999	0.05334	-0.00018	0.00000	0.00000	-0.00214	0.05566	EA
2000	0.05797	-0.00124	-0.00001	0.00000	0.00455	0.05466	EA
2001	-0.05262	0.00125	0.00001	0.00000	-0.08119	0.02731	EI
2002	0.00515	0.00024	0.00001	0.00000	-0.03306	0.03797	EA
2003	-0.03195	-0.00178	0.00001	0.00000	-0.03902	0.00883	EI
2004	0.04010	-0.00071	0.00000	0.00000	0.02105	0.01976	EI, EA
2005	-0.01527	-0.00118	0.00001	0.00000	-0.08150	0.06741	EI

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Chile

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change: Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	Main Influencing Factors
1981	0.06512	0.00010	0.00001	-0.00040	0.12398	-0.05857	EI
1982	-0.04201	-0.00138	0.00038	-0.00215	0.01195	-0.05081	EA
1983	0.01124	0.00188	-0.00005	-0.00048	-0.02810	0.03800	EA
1984	-0.00093	0.00059	0.00028	0.00097	-0.02464	0.02188	EI
1985	-0.01379	0.00151	0.00004	-0.00153	0.06508	-0.07888	EA
1986	0.02661	-0.00061	0.00030	-0.00060	-0.04828	0.07580	EA
1987	0.06535	0.00077	-0.00025	-0.00058	0.03673	0.02868	EI, EA
1988	0.13277	0.00081	0.00018	0.00267	0.15501	-0.02590	EI
1989	0.07168	-0.00033	-0.00047	0.00358	0.14680	-0.07790	EI
1990	0.02693	-0.00143	0.00091	0.00114	0.05051	-0.02421	EI
1991	0.07559	0.00032	0.00109	-0.00398	-0.04101	0.11918	EA
1992	0.05623	-0.00019	-0.00076	-0.00241	-0.05315	0.11274	EA
1993	0.08719	0.00140	-0.00036	0.00004	0.02873	0.05737	EI, EA
1994	0.11257	0.00019	-0.00011	0.00136	0.05441	0.05672	EI, EA
1995	0.08127	0.00040	-0.00026	0.00015	0.10983	-0.02886	EI
1996	0.08873	0.00023	0.00038	0.00129	0.03304	0.05379	EI, EA
1997	0.04441	0.00034	-0.00013	0.00052	-0.03431	0.07799	EA
1998	0.04087	0.00038	-0.00042	0.00045	0.00269	0.03777	EA
1999	0.02864	0.00045	-0.00041	0.00052	0.06251	-0.03442	EI
2000	0.01867	0.00091	-0.00031	-0.00162	0.02761	-0.00792	EI
2001	-0.05606	0.00073	0.00023	-0.00102	-0.01092	-0.04508	EA
2002	0.03827	0.00076	-0.00005	0.00003	0.15284	-0.11532	EI
2003	-0.01102	0.00093	-0.00018	0.00023	-0.09667	0.08467	EI
2004	0.02491	-0.00030	0.00031	0.00087	-0.06240	0.08643	EA
2005	0.05578	0.00204	-0.00010	0.00024	-0.03418	0.08778	EA

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Colombia

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	0.01325	0.00008	-0.00007	0.00000	0.07182	-0.05858	EI
1982	0.04556	0.00023	-0.00002	0.00000	0.09619	-0.05084	EI
1983	0.04847	0.00040	0.00002	0.00000	0.01004	0.03802	EA
1984	0.03329	-0.00022	-0.00002	0.00000	0.01165	0.02188	EI, EA
1985	0.03348	-0.00004	0.00002	0.00000	0.11241	-0.07890	EI
1986	0.01883	0.00012	0.00001	0.00000	-0.05711	0.07581	EA
1987	0.03077	-0.00151	0.00001	0.00000	0.00359	0.02867	EA
1988	0.08472	0.00093	0.00010	0.00000	0.10951	-0.02582	EI
1989	-0.14366	-0.01588	-0.00450	0.00000	-0.05169	-0.07159	EI, EA
1990	0.17059	0.02717	-0.00343	0.00000	0.16912	-0.02227	EI
1991	0.04442	0.00158	-0.00009	0.00000	-0.07630	0.11924	EA
1992	0.05219	-0.00199	0.00001	0.00000	-0.05855	0.11273	EA
1993	0.01366	0.00099	0.00004	0.00000	-0.04474	0.05737	EA
1994	-0.07098	-0.00100	0.00298	0.00000	-0.12953	0.05657	EI
1995	0.17815	-0.00091	0.00004	0.00000	0.20788	-0.02886	EI
1996	0.02542	0.00121	-0.00002	0.00000	-0.02955	0.05378	EA
1997	0.05272	0.00190	-0.00239	0.00000	-0.02438	0.07759	EA
1998	-0.02173	0.00043	0.00000	0.00001	-0.05996	0.03778	EI
1999	-0.11474	-0.00019	0.00000	-0.00008	-0.08003	-0.03444	EI, EA
2000	-0.02741	0.00357	0.00005	0.00006	-0.02318	-0.00791	EI, EA
2001	0.04760	0.00655	0.00011	-0.00002	0.08587	-0.04490	EI
2002	-0.11960	-0.00619	-0.00009	-0.00001	0.00175	-0.11506	EA
2003	0.02677	0.00198	-0.00025	-0.00003	-0.05934	0.08441	EA
2004	0.13217	0.00193	0.00011	-0.00003	0.04400	0.08616	EI, EA
2005	-0.01953	0.00071	0.00005	0.00000	-0.10798	0.08769	EI

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Costa Rica

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	-0.12383	0.00030	-0.00097	-0.00005	-0.06454	-0.05858	EI, EA
1982	-0.11502	-0.00168	0.00081	-0.00001	-0.06331	-0.05083	EI, EA
1983	0.03568	0.00000	-0.00104	-0.00003	-0.00127	0.03802	EA
1984	0.06715	-0.00072	0.00058	-0.00008	0.04548	0.02188	EI, EA
1985	0.02699	0.00025	0.00047	0.00001	0.10516	-0.07890	EI
1986	0.09121	0.00004	0.00014	0.00000	0.01522	0.07581	EA
1987	0.05506	-0.00296	0.00021	0.00012	0.02902	0.02866	EI, EA
1988	0.12115	0.00115	0.00015	0.00001	0.14573	-0.02590	EI
1989	0.06863	0.00011	-0.00105	-0.00012	0.14762	-0.07792	EI
1990	-0.05312	-0.00131	-0.00013	0.00002	-0.02742	-0.02428	EI, EA
1991	0.03819	-0.00230	0.00018	0.00026	-0.07919	0.11924	EA
1992	0.38868	-0.00553	0.00113	0.00037	0.28083	0.11188	EI, EA
1993	0.02997	0.00141	0.00002	-0.00009	-0.02874	0.05737	EA
1994	0.05006	0.00155	-0.00003	0.00016	-0.00832	0.05671	EA
1995	-0.00007	0.00056	0.00028	0.00000	0.02795	-0.02886	EA
1996	0.00555	-0.00086	0.00003	0.00000	-0.04740	0.05379	EA
1997	0.02472	-0.00007	0.00013	0.00000	-0.05332	0.07798	EA
1998	0.10220	-0.00064	-0.00005	0.00000	0.06512	0.03776	EI, EA
1999	0.04066	-0.00092	0.00011	0.00000	0.07591	-0.03444	EI
2000	-0.03392	-0.00312	0.00070	0.00000	-0.02359	-0.00791	EI
2001	0.06392	0.00090	0.00008	0.00000	0.10804	-0.04509	EI
2002	0.09915	0.00219	-0.00062	0.00000	0.21280	-0.11522	EI
2003	0.01769	0.00032	0.00001	0.00000	-0.06731	0.08468	EA
2004	0.08425	0.00180	0.00008	0.00000	-0.00406	0.08643	EA
2005	0.03076	0.00282	-0.00091	0.00000	-0.05823	0.08708	EA

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Cuba

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	0.01753	-0.00083	-0.00432	0.00000	0.08122	-0.05855	EI
1982	0.04450	-0.00969	0.00657	0.00000	0.09828	-0.05066	EI
1983	-0.14266	-0.00809	-0.00314	0.00000	-0.16934	0.03790	EI
1984	0.01125	0.00087	-0.01027	0.00000	-0.00115	0.02180	EA
1985	0.32040	0.04849	-0.00485	0.00000	0.35361	-0.07686	EI
1986	0.00407	-0.00316	-0.00280	0.00001	-0.06575	0.07578	EA
1987	0.02180	-0.00048	-0.00110	0.00001	-0.00530	0.02867	EA
1988	0.03907	0.00389	0.00044	-0.00001	0.06065	-0.02590	EI
1989	0.05346	0.00430	-0.00118	-0.00001	0.12827	-0.07792	EI
1990	-0.69000	-0.06500	-0.04585	0.00022	-0.55756	-0.02181	EI
1991	-0.35484	-0.02322	0.00240	-0.00001	-0.45302	0.11902	EI
1992	-0.36143	-0.02791	0.00000	0.00261	-0.44888	0.11276	EI
1993	-0.22635	0.01052	0.00432	0.00378	-0.30234	0.05737	EI
1994	-0.03671	-0.01059	0.00023	0.00147	-0.08453	0.05670	EI
1995	0.08744	0.01831	0.00421	0.00111	0.09267	-0.02886	EI
1996	0.06002	0.00526	-0.00361	-0.00099	0.00559	0.05377	EA
1997	0.14655	0.01592	-0.00095	0.00007	0.05360	0.07790	EI, EA
1998	-0.03523	0.01229	0.00608	0.00198	-0.09335	0.03777	EI
1999	-0.03551	-0.00813	0.00616	-0.00536	0.00627	-0.03444	EA
2000	-0.04287	-0.00859	0.00405	-0.00035	-0.03006	-0.00792	EI
2001	-0.01518	0.00062	0.00055	-0.00156	0.03029	-0.04509	EA
2002	-0.02446	-0.00339	0.00151	0.00486	0.08789	-0.11533	EA
2003	0.07064	0.00333	-0.00248	0.00200	-0.01678	0.08457	EA
2004	-0.07145	0.01331	0.00159	-0.00562	-0.16717	0.08645	EI
2005	-0.00617	0.00474	-0.00045	-0.00128	-0.09699	0.08781	EI

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Ecuador

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	0.13711	0.00333	0.00397	0.00000	0.18811	-0.05830	EI
1982	0.03264	0.00183	-0.00133	0.00000	0.08294	-0.05081	EI
1983	0.02271	0.00087	0.00484	0.00000	-0.02095	0.03795	E
1984	0.11401	0.00125	0.00284	0.00000	0.08806	0.02186	EI
1985	0.06011	0.00116	0.00040	0.00000	0.13731	-0.07876	EI
1986	0.03150	0.00095	-0.00178	0.00000	-0.04344	0.07577	EA
1987	-0.03569	-0.00007	0.00078	0.00000	-0.06507	0.02868	EI
1988	0.18930	-0.00160	-0.00275	0.00000	0.21949	-0.02584	EI
1989	-0.03288	-0.00051	-0.00297	0.00000	0.04836	-0.07776	EA
1990	0.02684	0.00035	-0.00335	0.00000	0.05391	-0.02408	EI
1991	0.05712	-0.00012	-0.00125	0.00000	-0.06065	0.11913	EA
1992	-0.02555	-0.00146	-0.00063	0.00000	-0.13584	0.11237	EI
1993	0.01352	0.00044	-0.00001	0.00000	-0.04431	0.05739	EA
1994	0.01766	0.00162	0.00000	0.00000	-0.04060	0.05664	EA
1995	0.01746	0.00065	0.00004	0.00000	0.04562	-0.02885	EI
1996	0.15304	0.00355	0.00043	0.00000	0.09533	0.05374	EI, EA
1997	0.02486	0.00017	0.00002	0.00000	-0.05332	0.07799	EA
1998	0.00126	-0.00028	-0.00003	0.00000	-0.03621	0.03778	EA
1999	-0.10309	-0.00050	-0.00006	0.00000	-0.06810	-0.03444	EI, EA
2000	0.15441	0.00038	0.00004	0.00000	0.16191	-0.00792	EI
2001	0.07477	-0.00006	-0.00001	0.00000	0.11992	-0.04509	EI
2002	0.05094	-0.00131	-0.00015	0.00000	0.16773	-0.11533	EI
2003	0.03144	-0.00009	-0.00001	0.00000	-0.05314	0.08468	EA
2004	-0.00770	0.00323	0.00037	0.00000	-0.09767	0.08637	EI
2005	-0.02478	-0.00023	-0.00002	0.00000	-0.11234	0.08782	EI

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

El Salvador

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	-0.06018	0.00133	0.00000	0.00000	-0.00294	-0.05857	EA
1982	0.03856	0.00019	0.00000	0.00000	0.08921	-0.05084	EI
1983	0.01068	-0.00114	0.00000	0.00000	-0.02619	0.03801	EA
1984	0.03686	0.00046	0.00000	0.00000	0.01453	0.02188	EI, EA
1985	0.08667	0.00112	0.00000	0.00000	0.16444	-0.07889	EI
1986	-0.01327	0.00003	0.00000	0.00000	-0.08911	0.07581	EI
1987	0.10788	0.00036	0.00000	0.00000	0.07883	0.02868	EI, EA
1988	0.07253	0.00028	0.00000	0.00000	0.09815	-0.02590	EI
1989	0.04664	0.00049	0.00000	0.00000	0.12407	-0.07792	EI
1990	0.06565	0.00223	0.00000	0.00000	0.08769	-0.02427	EI
1991	0.08679	0.00123	0.00000	0.00000	-0.03372	0.11928	EA
1992	0.14608	-0.00164	0.00000	0.00000	0.03494	0.11277	EA
1993	0.08880	-0.00038	0.00000	0.00000	0.03179	0.05739	EI, EA
1994	0.06286	-0.00064	0.00000	0.00000	0.00677	0.05672	EA
1995	0.12943	0.00075	0.00000	0.00000	0.15755	-0.02886	EI
1996	-0.00965	-0.00127	0.00000	0.00000	-0.06216	0.05379	EI
1997	0.01761	-0.00066	0.00000	0.00000	-0.05972	0.07798	EA
1998	0.07094	-0.00103	0.00000	0.00000	0.03419	0.03778	EI, EA
1999	0.12912	0.00229	0.00000	0.00000	0.16126	-0.03443	EI
2000	-0.03166	0.00081	0.00000	0.00000	-0.02454	-0.00792	EI
2001	0.00613	-0.00024	0.00000	0.00000	0.05145	-0.04509	EI
2002	-0.02997	0.00075	0.00000	0.00000	0.08463	-0.11534	EA
2003	0.08479	-0.00247	0.00000	0.00000	0.00261	0.08464	EA
2004	0.05548	-0.00124	0.00000	0.00000	-0.02972	0.08644	EA
2005	0.02745	-0.00001	0.00000	0.00000	-0.06035	0.08782	EA

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Guatemala

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	-0.07421	0.00121	0.00000	0.00000	-0.01685	-0.05857	EA
1982	-0.07023	-0.00033	0.00000	0.00000	-0.01906	-0.05084	EI, EA
1983	-0.03971	-0.00269	0.00000	0.00000	-0.07501	0.03800	EI
1984	0.08362	0.00114	0.00000	0.00000	0.06060	0.02188	EI, EA
1985	0.03600	0.00127	0.00000	0.00000	0.11362	-0.07889	EI
1986	-0.04003	0.00094	0.00000	0.00000	-0.11678	0.07580	EI
1987	0.15388	-0.00751	0.00000	0.00000	0.13271	0.02868	EI
1988	0.08554	0.00019	0.00000	0.00000	0.11125	-0.02590	EI
1989	0.04495	0.00528	0.00000	0.00000	0.11758	-0.07791	EI
1990	0.07865	0.00045	0.00000	0.00000	0.10248	-0.02428	EI
1991	0.05206	-0.09933	0.00000	0.00000	0.03240	0.11899	EA
1992	0.05539	0.04708	0.00000	0.00000	-0.10443	0.11275	FM, EA
1993	0.09763	0.05729	0.00000	0.00000	-0.01703	0.05738	FM, EA
1994	0.06530	0.00006	0.00000	0.00000	0.00852	0.05672	EA
1995	0.22066	-0.00055	0.00000	0.00000	0.25008	-0.02886	EI
1996	-0.00007	-0.00232	0.00000	0.00000	-0.05152	0.05377	EI
1997	0.06324	0.00070	0.00000	0.00000	-0.01545	0.07798	EA
1998	0.17307	-0.00018	0.00000	0.00000	0.13546	0.03778	EI
1999	0.04059	-0.00054	0.00000	0.00000	0.07556	-0.03444	EI
2000	0.07143	-0.00034	0.00000	0.00000	0.07969	-0.00792	EI
2001	0.06320	0.00005	0.00000	0.00000	0.10824	-0.04509	EI
2002	0.07084	0.00234	0.00000	0.00000	0.18380	-0.11530	EI
2003	-0.00721	0.00059	0.00000	0.00000	-0.09248	0.08468	EI
2004	-0.00214	-0.00017	0.00000	0.00000	-0.08842	0.08645	EI
2005	0.05039	0.00038	0.00000	0.00000	-0.03781	0.08782	EA

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Honduras

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	0.02607	0.00151	0.00000	0.00000	0.08314	-0.05857	EI
1982	0.02061	0.00161	0.00000	0.00000	0.06983	-0.05083	EI
1983	0.12050	0.00110	0.00000	0.00000	0.08139	0.03801	EI, EA
1984	0.04697	0.00050	0.00000	0.00000	0.02459	0.02188	EI, EA
1985	0.01241	0.00008	0.00000	0.00000	0.09123	-0.07890	EI
1986	0.12012	0.00104	0.00000	0.00000	0.04328	0.07580	EI, EA
1987	0.07343	-0.00031	0.00000	0.00000	0.04506	0.02868	EI, EA
1988	0.05649	0.00130	0.00000	0.00000	0.08109	-0.02590	EI
1989	0.09447	0.00005	0.00000	0.00000	0.17233	-0.07792	EI
1990	-0.07290	-0.00116	0.00000	0.00000	-0.04746	-0.02428	EI, EA
1991	-0.00359	-0.00093	0.00000	0.00000	-0.12195	0.11928	EI
1992	0.12863	-0.00114	0.00000	0.00000	0.01698	0.11279	EA
1993	0.12635	-0.00053	0.00000	0.00000	0.06949	0.05739	EI, EA
1994	0.15267	-0.00018	0.00000	0.00000	0.09613	0.05672	EI, EA
1995	0.07234	0.00005	0.00000	0.00000	0.10116	-0.02887	EI
1996	-0.09524	0.00052	0.00000	0.00000	-0.14956	0.05379	EI
1997	0.09826	-0.00218	0.00000	0.00000	0.02248	0.07796	EA
1998	0.10046	-0.00089	0.00000	0.00000	0.06357	0.03778	EI, EA
1999	0.11591	0.00131	0.00000	0.00000	0.14904	-0.03444	EI
2000	-0.04696	-0.00161	0.00000	0.00000	-0.03742	-0.00792	EI
2001	0.13811	0.00271	0.00000	0.00000	0.18047	-0.04507	EI
2002	0.04925	0.00146	0.00000	0.00000	0.16312	-0.11533	EI
2003	-0.01647	-0.00021	0.00000	0.00000	-0.10095	0.08468	EI
2004	-0.08656	-0.00084	0.00000	0.00000	-0.17216	0.08644	EI
2005	-0.01168	-0.00225	0.00000	0.00000	-0.09721	0.08779	EI

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Mexico

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	0.10977	-0.00049	-0.00009	-0.00041	0.16933	-0.05857	EI
1982	-0.00319	-0.00081	-0.00008	0.00008	0.04845	-0.05084	EA
1983	-0.11358	-0.00036	0.00006	0.00013	-0.15141	0.03800	EI
1984	0.04835	-0.00206	-0.00002	-0.00003	0.02863	0.02184	EI, EA
1985	0.00792	-0.00062	-0.00001	-0.00015	0.08759	-0.07889	EI
1986	-0.01077	-0.00044	-0.00016	0.00035	-0.08631	0.07580	EI
1987	0.02585	-0.00085	0.00140	0.00017	-0.00354	0.02867	EA
1988	0.01814	0.00101	-0.00169	-0.00014	0.04484	-0.02589	EI
1989	0.09440	-0.00131	0.00038	-0.00008	0.17332	-0.07791	EI
1990	0.07260	0.00195	-0.00040	-0.00006	0.09535	-0.02425	EI
1991	0.07172	0.00054	-0.00081	-0.00001	-0.04729	0.11928	EA
1992	0.01541	0.00023	0.00000	-0.00022	-0.09740	0.11280	EA
1993	0.02091	0.00015	-0.00003	0.00000	-0.03661	0.05739	EA
1994	0.01751	-0.00137	0.00011	0.00048	-0.03841	0.05671	EA
1995	-0.03711	0.00052	0.00005	-0.00054	-0.00828	-0.02886	EA
1996	-0.02708	0.00028	0.00016	-0.00001	-0.08130	0.05379	EI
1997	0.02145	0.00100	-0.00066	0.00017	-0.05704	0.07798	EA
1998	0.02958	-0.00026	0.00032	0.00051	-0.00878	0.03778	EA
1999	-0.00162	-0.00026	-0.00022	-0.00011	0.03337	-0.03441	EA
2000	0.05018	-0.00087	0.00001	0.00005	0.05891	-0.00792	EI
2001	0.01695	-0.00054	-0.00025	0.00002	0.06280	-0.04509	EI
2002	0.03493	-0.00038	-0.00005	-0.00011	0.15082	-0.11534	EI
2003	0.06057	0.00012	-0.00014	0.00002	-0.02411	0.08468	EA
2004	0.07568	0.00086	0.00112	-0.00035	-0.01156	0.08561	EA
2005	0.05416	0.00061	0.00000	-0.00006	-0.03421	0.08781	EA

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Nicaragua

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	0.01202	0.00262	0.00011	0.00000	0.06784	-0.05855	EI
1982	-0.05039	0.00058	0.00004	0.00000	-0.00018	-0.05084	EA
1983	0.02681	0.00237	0.00013	0.00000	-0.01368	0.03799	EA
1984	-0.03729	-0.00072	-0.00008	0.00000	-0.05837	0.02188	EI
1985	-0.02275	0.00009	0.00002	0.00000	0.05604	-0.07890	EA
1986	0.10584	0.00009	-0.00002	0.00000	0.02997	0.07581	EI, EA
1987	0.03086	0.00043	-0.00002	0.00000	0.00176	0.02868	EA
1988	-0.13668	-0.00031	0.00005	0.00000	-0.11053	-0.02589	EI
1989	-0.13403	0.00327	0.00016	0.00000	-0.05962	-0.07783	EI, EA
1990	0.03434	-0.00055	-0.00003	0.00000	0.05920	-0.02428	EI
1991	0.08109	-0.00058	-0.00034	0.00000	-0.03713	0.11913	EA
1992	0.13485	-0.00127	0.00021	0.00000	0.02318	0.11274	EA
1993	0.02773	0.00096	0.00046	0.00000	-0.03104	0.05735	EA
1994	0.06302	0.00224	0.00115	0.00000	0.00306	0.05657	EA
1995	0.09625	0.00143	-0.00010	0.00000	0.12378	-0.02886	EI
1996	0.04788	0.00101	0.00017	0.00000	-0.00708	0.05379	EA
1997	0.05451	0.00068	-0.00016	0.00000	-0.02398	0.07798	EA
1998	0.08456	-0.00080	-0.00022	0.00000	0.04781	0.03777	EI, EA
1999	0.04527	-0.00006	-0.00046	0.00000	0.08020	-0.03441	EI
2000	0.03049	-0.00054	0.00028	0.00000	0.03865	-0.00791	EI
2001	0.01228	-0.00133	0.00019	0.00000	0.05850	-0.04508	EI
2002	0.03932	-0.00070	-0.00005	0.00000	0.15541	-0.11534	EI
2003	-0.00387	0.00090	-0.00045	0.00000	-0.08893	0.08461	EI
2004	-0.06314	-0.00277	-0.00038	0.00000	-0.14633	0.08635	EI
2005	0.00427	-0.00047	0.00029	0.00000	-0.08333	0.08778	EA

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Panama

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	0.02337	0.00385	0.00000	0.00000	0.07804	-0.05851	EI
1982	-0.00892	0.00043	0.00000	0.00000	0.04150	-0.05084	EA
1983	-0.01881	-0.00058	0.00000	0.00000	-0.05625	0.03802	EI
1984	0.02493	0.00063	0.00000	0.00000	0.00243	0.02188	EA
1985	0.02149	0.00143	0.00000	0.00000	0.16260	-0.12891	EI
1986	0.05228	0.00020	0.00000	0.00000	-0.02372	0.07581	EA
1987	0.03067	0.00013	0.00000	0.00000	0.00185	0.02868	EA
1988	-0.07891	0.00176	0.00000	0.00000	-0.05478	-0.02589	EI, EA
1989	0.02961	0.00074	0.00000	0.00000	0.10680	-0.07792	EI
1990	0.06428	0.00020	0.00000	0.00000	0.08836	-0.02428	EI
1991	0.07872	0.00152	0.00000	0.00000	-0.04207	0.11927	EA
1992	0.07660	-0.00070	0.00000	0.00000	-0.03549	0.11279	EA
1993	0.09266	-0.00024	0.00000	0.00000	0.03551	0.05739	EI, EA
1994	0.07899	-0.00016	0.00000	0.00000	0.02242	0.05672	EI, EA
1995	0.07554	0.00091	0.00000	0.00000	0.10349	-0.02886	EI
1996	0.04243	-0.00010	0.00000	0.00000	-0.01126	0.05379	EA
1997	0.07350	0.00002	0.00000	0.00000	-0.00451	0.07799	EA
1998	0.10673	-0.00015	0.00000	0.00000	0.06910	0.03778	EI, EA
1999	-0.01879	-0.00253	0.00000	0.00000	0.01816	-0.03442	EA
2000	-0.02228	0.00012	0.00000	0.00000	-0.01447	-0.00792	EI, EA
2001	0.11839	0.00688	0.00000	0.00000	0.15645	-0.04495	EI
2002	0.08498	0.00019	0.00000	0.00000	0.20014	-0.11535	EI
2003	0.18873	0.00534	0.00000	0.00000	0.09887	0.08452	EI, EA
2004	-0.16030	-0.00694	0.00000	0.00000	-0.23954	0.08618	EI
2005	-0.12185	-0.00215	0.00000	0.00000	-0.20748	0.08779	EI

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Paraguay

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	-0.02587	-0.00914	0.00000	0.00000	0.04182	-0.05856	EA
1982	-0.01444	-0.01302	-0.00011	0.00000	0.04951	-0.05082	EA
1983	-0.03919	0.00356	0.00014	0.00000	-0.08087	0.03798	EI
1984	0.12940	-0.00679	-0.00014	0.00000	0.11447	0.02187	EI
1985	0.04268	0.01018	0.00034	0.00000	0.11098	-0.07882	EI
1986	0.01850	-0.00762	-0.00218	0.00000	-0.04712	0.07542	EA
1987	0.09899	-0.00623	-0.00001	0.00000	0.07655	0.02868	EI, EA
1988	0.10755	0.00327	-0.00003	0.00000	0.13021	-0.02589	EI
1989	0.03366	-0.00050	-0.00015	0.00000	0.11221	-0.07790	EI
1990	0.03198	0.00330	0.00153	0.00000	0.05134	-0.02420	EI
1991	-0.06588	-0.00640	-0.00008	0.00000	-0.17868	0.11928	EI
1992	0.18564	0.00508	-0.00025	0.00000	0.06805	0.11276	EI, EA
1993	0.22353	0.00797	0.00012	0.00000	0.15807	0.05738	EI, EA
1994	0.12144	0.00752	0.00017	0.00000	0.05710	0.05664	EI, EA
1995	0.13596	0.00387	-0.00009	0.00000	0.16104	-0.02886	EI
1996	0.00867	0.00206	0.00000	0.00000	-0.04719	0.05379	EA
1997	0.11725	0.00592	0.00001	0.00000	0.03334	0.07798	EI, EA
1998	0.04690	0.00136	0.00000	0.00000	0.00776	0.03778	EA
1999	-0.00203	-0.00242	0.00000	0.00000	0.03481	-0.03442	EA
2000	-0.21731	0.00581	0.00008	0.00000	-0.21527	-0.00792	EI
2001	0.06539	0.00138	0.00000	0.00000	0.10910	-0.04509	EI
2002	0.05749	0.00103	0.00000	0.00000	0.17180	-0.11533	EI
2003	0.06360	0.00005	0.00000	0.00000	-0.02114	0.08468	EA
2004	-0.00240	0.00190	0.00000	0.00000	-0.09073	0.08643	EI
2005	-0.10343	-0.01803	0.00000	0.00000	-0.17320	0.08780	EI

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Peru

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	0.12389	-0.00042	0.00070	0.00000	0.18219	-0.05857	EI
1982	-0.02179	-0.00061	-0.00371	0.00000	0.03330	-0.05075	EA
1983	-0.09506	0.00054	-0.00062	0.00000	-0.13299	0.03801	EI
1984	0.01676	0.00190	-0.00031	0.00000	-0.00670	0.02187	EA
1985	-0.06478	0.00086	0.00033	0.00000	0.01292	-0.07889	EA
1986	0.05759	0.00018	-0.00127	0.00000	-0.01711	0.07579	EA
1987	0.14567	0.00057	0.00060	0.00000	0.11582	0.02868	EI
1988	0.02316	0.00110	-0.00074	0.00000	0.04870	-0.02589	EI
1989	-0.09033	0.00233	-0.00043	0.00000	-0.01436	-0.07788	EA
1990	0.06005	0.00124	-0.00165	0.00000	0.08472	-0.02425	EI
1991	-0.13073	-0.00049	-0.00144	0.00000	-0.24796	0.11916	EI
1992	0.07674	0.00320	-0.00053	0.00000	-0.03860	0.11267	EA
1993	0.01971	0.00190	-0.00011	0.00000	-0.03945	0.05737	EA
1994	0.13250	0.00206	0.00180	0.00000	0.07206	0.05658	EI, EA
1995	0.06976	0.00196	-0.00084	0.00000	0.09747	-0.02884	EI
1996	0.06140	-0.00103	0.00012	0.00000	0.00852	0.05379	EA
1997	0.00029	0.00265	-0.00013	0.00000	-0.08014	0.07791	EA
1998	0.01853	-0.00065	0.00007	0.00000	-0.01862	0.03774	EA
1999	0.05709	0.00044	0.00050	0.00000	0.09057	-0.03443	EI
2000	-0.01237	0.00179	-0.00026	0.00000	-0.00597	-0.00792	EI, EA
2001	-0.06921	0.00053	-0.00018	0.00000	-0.02448	-0.04509	EI, EA
2002	-0.01473	-0.00056	-0.00012	0.00000	0.10129	-0.11534	EA
2003	0.05442	0.00216	-0.00022	0.00000	-0.03215	0.08463	EA
2004	0.12935	0.00240	0.00000	0.00000	0.04054	0.08641	EI, EA
2005	-0.05266	-0.00093	-0.00016	0.00000	-0.13938	0.08780	EI

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Uruguay

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	0.03571	-0.00025	0.00000	0.00000	0.09454	-0.05858	EI
1982	0.01344	-0.00015	-0.00032	0.00000	0.06475	-0.05084	EI
1983	-0.01475	0.00028	-0.00051	0.00000	-0.05250	0.03798	EI
1984	-0.03401	0.00069	0.00040	-0.00011	-0.05685	0.02188	EI
1985	0.01850	0.00060	-0.00064	-0.00028	0.09770	-0.07889	EI
1986	0.00872	0.00100	-0.00098	-0.00004	-0.06705	0.07578	EA
1987	0.01963	-0.00371	0.00349	-0.00042	-0.00830	0.02857	EA
1988	0.03566	-0.00016	0.00005	-0.00006	0.06172	-0.02590	EI
1989	-0.05511	0.00095	0.00030	-0.00006	0.02160	-0.07789	EA
1990	0.03127	0.00078	0.00008	-0.00015	0.05484	-0.02428	EI
1991	0.05609	-0.00001	-0.00006	-0.00070	-0.06241	0.11928	EA
1992	-0.01628	-0.00165	0.00000	-0.00005	-0.12713	0.11256	EI
1993	0.06969	-0.00011	0.00000	0.00008	0.01232	0.05739	EA
1994	0.01457	-0.00051	0.00001	-0.00008	-0.04156	0.05672	EA
1995	0.03344	0.00022	0.00000	-0.00001	0.06210	-0.02887	EI
1996	0.03912	0.00050	0.00009	-0.00008	-0.01516	0.05377	EA
1997	-0.07631	0.00000	-0.00001	0.00011	-0.15439	0.07799	EI
1998	0.02107	0.00024	0.00000	0.00007	-0.01701	0.03778	EA
1999	-0.00009	-0.00175	-0.00033	-0.00010	0.03648	-0.03440	EA
2000	0.02901	-0.00041	-0.00003	-0.00005	0.03742	-0.00792	EI
2001	0.07516	-0.00038	0.00000	0.00051	0.12013	-0.04509	EI
2002	-0.02992	0.00001	0.00001	-0.00003	0.08544	-0.11535	EA
2003	0.01271	-0.00100	0.00000	-0.00023	-0.07073	0.08466	EA
2004	0.02822	0.00175	0.00001	0.00000	-0.05993	0.08639	EA
2005	0.11821	0.00106	0.00000	-0.00014	0.02949	0.08780	EA

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Venezuela

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	0.02607	0.00151	0.00000	0.00000	0.08314	-0.05857	EI
1982	0.02061	0.00161	0.00000	0.00000	0.06983	-0.05083	EI
1983	0.12050	0.00110	0.00000	0.00000	0.08139	0.03801	EI, EA
1984	0.04697	0.00050	0.00000	0.00000	0.02459	0.02188	EI, EA
1985	0.01241	0.00008	0.00000	0.00000	0.09123	-0.07890	EI
1986	0.12012	0.00104	0.00000	0.00000	0.04328	0.07580	EI, EA
1987	0.07343	-0.00031	0.00000	0.00000	0.04506	0.02868	EI, EA
1988	0.05649	0.00130	0.00000	0.00000	0.08109	-0.02590	EI
1989	0.09447	0.00005	0.00000	0.00000	0.17233	-0.07792	EI
1990	-0.07290	-0.00116	0.00000	0.00000	-0.04746	-0.02428	EI, EA
1991	-0.00359	-0.00093	0.00000	0.00000	-0.12195	0.11928	EI
1992	0.12863	-0.00114	0.00000	0.00000	0.01698	0.11279	EA
1993	0.12635	-0.00053	0.00000	0.00000	0.06949	0.05739	EI, EA
1994	0.15267	-0.00018	0.00000	0.00000	0.09613	0.05672	EI, EA
1995	0.07234	0.00005	0.00000	0.00000	0.10116	-0.02887	EI
1996	-0.09524	0.00052	0.00000	0.00000	-0.14956	0.05379	EI
1997	0.09826	-0.00218	0.00000	0.00000	0.02248	0.07796	EA
1998	0.10046	-0.00089	0.00000	0.00000	0.06357	0.03778	EI, EA
1999	0.11591	0.00131	0.00000	0.00000	0.14904	-0.03444	EI
2000	-0.04696	-0.00161	0.00000	0.00000	-0.03742	-0.00792	EI
2001	0.13811	0.00271	0.00000	0.00000	0.18047	-0.04507	EI
2002	0.04925	0.00146	0.00000	0.00000	0.16312	-0.11533	EI
2003	-0.01647	-0.00021	0.00000	0.00000	-0.10095	0.08468	EI
2004	-0.08656	-0.00084	0.00000	0.00000	-0.17216	0.08644	EI
2005	-0.01168	-0.00225	0.00000	0.00000	-0.09721	0.08779	EI

Appendix (Cont'd)

CO_2 Emissions Change and Contributing Factors

Other Latin America

Year	CO_2 Emissions Change	Factors Influencing the CO_2 Emissions Change					Main Influencing Factors
		Fuel Mix	Modal Mix	Emission Coefficient	Energy Intensity	Economic Activity	
1981	0.04995	-0.00043	0.00052	0.00000	0.10840	-0.05854	EI
1982	0.04636	-0.00167	0.00005	0.00000	0.09880	-0.05082	EI
1983	-0.00308	0.00087	-0.00058	0.00000	-0.04136	0.03799	EI
1984	0.06995	-0.00477	0.00001	0.00000	0.05293	0.02178	EI, EA
1985	0.03297	-0.00047	0.00160	0.00000	0.11053	-0.07869	EI
1986	-0.12682	0.00051	-0.00035	0.00000	-0.20198	0.07500	EI
1987	0.28718	0.00276	-0.00018	0.00000	0.25594	0.02865	EI
1988	0.06220	0.00044	-0.00038	0.00000	0.08803	-0.02589	EI
1989	0.12036	-0.00058	0.00063	0.00000	0.19818	-0.07788	EI
1990	0.04502	-0.00071	0.00010	0.00000	0.06991	-0.02428	EI
1991	0.02894	0.00196	0.00001	0.00000	-0.09226	0.11922	EA
1992	-0.00210	-0.00050	-0.00009	0.00000	-0.11430	0.11279	EI
1993	0.02240	0.00063	-0.00007	0.00000	-0.03555	0.05739	EA
1994	0.05262	0.00025	-0.00007	0.00000	-0.00429	0.05672	EA
1995	0.06021	-0.00041	-0.00009	0.00000	0.08958	-0.02886	EI
1996	0.01337	-0.00007	-0.00004	0.00000	-0.04031	0.05379	EA
1997	0.06336	0.00045	-0.00015	0.00000	-0.01492	0.07798	EA
1998	0.58953	0.02437	0.00024	0.00000	0.52795	0.03697	EI
1999	0.08597	-0.00204	-0.00002	0.00000	0.12245	-0.03443	EI
2000	0.01921	0.00033	0.00000	0.00000	0.02681	-0.00792	EI
2001	0.02200	-0.00029	0.00000	0.00000	0.06737	-0.04509	EI
2002	0.02908	0.00022	-0.00001	0.00000	0.14422	-0.11535	EI
2003	0.01762	-0.00035	0.00001	0.00000	-0.06672	0.08468	EA
2004	0.08967	0.00021	-0.00006	0.00000	0.00310	0.08642	EA
2005	0.01069	-0.00001	0.00000	0.00000	-0.07713	0.08782	EA