Assessing Over-aged Car Legislation as an Environmental Policy Law in Ghana

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Abstract

In June 1998, The Government of Ghana implemented an import ban on all cars older than 10 years. Four years later, the ban was lifted, and replaced with an amendment that allowed for the importation of over-aged cars, with penalties. This paper finds that the ban did reduce used car imports in Ghana, but not significantly. Difference-In-Differences analyses, using Ivory Coast as a control group, indicate that the ban did not achieve its prime objective of reducing air pollution in Ghana. The paper therefore suggests that alternative air pollution control policies should be sought in lieu of resorting to over-aged car legislation.

Keywords: Over-aged cars, legislation, demand for cars, air pollution, Ghana

1. Introduction

Concerns for environmental safety and cleaner air have been growing across the world in recent years, especially in developed countries. Vehicles account for a considerable amount of air pollution. The US Environmental Protection Agency contends that personal automobile is the single greatest polluter across numerous cities in the US. This is true for most countries across the globe. Different countries have used different approaches in their quest to reduce air pollution and environmental degradation. Some wealthy nations tend to provide programs that serve as incentives for individuals to give up their old, less fuel-efficient cars. The "Cash-for-Clunkers" program in the US is an example. In some cases, public transport has been subsidized, and carpooling encouraged. However, these have not succeeded in reducing car mileage (Sipes and Mendelsohn, 2001) The demand for cars in Ghana has been burgeoning over the last decade. A good chunk of the cars imported into Ghana are used cars. About 80per cent of the cars entering the shores of Ghana are second-hand cars (Chalfin, 2008). Some of these cars are over-aged[1]. Obeng-Odoom(2009) indicates that about only 8per cent of the total number of cars imported into Ghana annually are brand new. The rest of these cars are second-hand, third-hand, fourth-hand, etc.

Experts have argued that the influx of used cars into Ghana poses dangers for the environment as these cars tend to cause air pollution. As of June 1998, the Government of Ghana had banned the importations of cars older than 10 years. However, following the Amendment of the Customs, Excise and Preventive Service (CEPS) Act 634 in 2002, this ban was lifted, and replaced with the imposition of high import penalties on cars exceeding 10 years old (Kehbila, et al (2009)). The amendment was done under the auspices of the Parliament of Ghana, which is Ghana's main law-making body, and became effective in August, 2002 (Ghana Web, 2002). Figure 1 in the Appendix shows the trend of car imports, Carbon dioxide (CO_2)emissions, and particulate matter (PM10) levels in Ghana between 1996 and 2008. It shows a fairly stable pattern for CO_2 emissions; a rise, stable, and declining pattern for PM10 levels, and of course, an undulating pattern for car imports between 1996 and 2002, and a sharp increase afterwards. This paper attempts to investigate the role of over-aged car legislation on these trends in Ghana.

1. Background and Motivation

According to the US Department of Commerce, Ghana implemented an import ban on all vehicles older than 10 years in June 1998. Ivory Coast, which borders Ghana on the west, on the other hand, has had no restrictions on the importation of used cars. However, a car that exceeds 10 years old attracts a penalty of $356 charged by the Trade Ministry, and an additional $24 per subsequent year above 10 years.

[1]For purposes of this paper, a car shall be termed over-aged if it exceeds 10 years from the year it was first manufactured

The amendment of the CEPS (Management Law) of 1993 in August, 2002 imposed penalties on over-aged cars. These penalties increased in strata, allowing old cars to be imported whilst maintaining a strong disincentive to import such old cars. For instance, whilst motor cars older than 10 years but less than 12 years attracted penalty of 5 per cent of the *cif*[2] value, those that aged between 12 and 15 years attracted a penalty of 20per cent of the *cif* value. Any car older than 15 years was slapped with a 50 per cent penalty of the *cif* value. For an elaborate description of all the penalties on various over-aged vehicles under that legislation, please see (Kehbila, *et al* (2009) Table 3, page 36. However one looks at it, the amendment, in spite of the penalties, present buyers (consumers) with greater freedom than the complete ban on the importation of used cars older than 10 years.
A cursory glance at the traffic congestion situation especially in Accra, road car fatalities/accidents, and air pollution make it compellingly necessary to investigate the determinants of car demand in Ghana. Is this increased demand a result of sustained increases in per capita income levels? Or are lending interest rates low enough to trigger this increased demand? How about the role of world crude oil prices?

In this paper, I sought to investigate whether the ban (amendment) dampened (stimulated) the demand for (importation of) used cars in Ghana? More importantly, how did this impact on the demand for cars affect air pollution levels in Ghana?

2. Literature Review

In the past decade, Ghana has been deluged with cars, especially used cars, from across the globe. This has tended to cause traffic congestions in cities like Accra (the capital) and Kumasi. The situation has become so deplorable that in order to avoid being caught in traffic for hours especially during rush hours, workers leave their homes early in the morning for work, and stay late in the evenings after work (Obeng-Odoom(2009)). Obeng-Odoom(2009) attributes the increased demand for cars in Ghana to two factors: that either population is increasing, or increased car ownership is due to increased per capita incomes, or both. This claim was intuitive. Sivak and Tsimhoni (2008) estimated the future demand for new cars for developing countries as a function of a country's population and its gross domestic product. They found the coefficient on population to be negative, which is counter intuitive as we would expect that the demand for cars would have a positive relationship with population. Hence, they attempted to justify their result by alluding to the fact that increasing population would tend to reduce per capita incomes (wealth). Clearly, this is identical to Obeng-Odoom(2009)'s reasoning.

As a result, I incorporated this intuition in the empirical model to ascertain the veracity or otherwise of this claim.
In his quintessential paper, "*The Market for "Lemons": Quality Uncertainty and the Market Mechanism*", Akerlof (1970) categorizes cars into four: good new cars, bad new cars, good used cars, and bad used cars. He argued that the demand for used automobiles depends most strongly on two factors – the price of the used automobile, and the average quality of used cars traded. Likening the average medical condition of insurance applicants and insurance premiums to the average quality of used cars and their prices, he argued that the average quality of used cars supplied fell as the price of used cars fell. It is therefore not unseemly to assume that used cars have relatively lower average quality than new cars. An implication of this is that used cars will tend to produce more air pollution than new cars, *ceteris paribus.*

Witt and Johnson (1986) estimated the demand for new cars for the UK. Their model takes the number of new cars registered *per capita* in a given year as the dependent variable as a function of the real personal disposable income per capita, the real price of new cars, the minimum percentage deposit on new cars, the interest rate, real price of motor oil, all in a given year. They also included a dummy for the effects of the 1973 oil crisis. Contrary to *apriori*expectation that the price of motor-fuel could be inversely related the demand for cars, their study found that the absolute magnitude of the estimated coefficient on motor-fuel was very low with a near zero *t*-value. When this variable was excluded from the model, the R^2 rose, and improved coefficient significance, a basis for which they chose the model that excluded motor-fuel prices as a better econometric model for estimating the demand for new cars in the UK.

[2]*Cost, insurance, and freight*

An attendant effect of the increased importation of used cars is increased air pollution levels. In countries such as the US, France, the United Kingdom, and Germany, concern for cleaner air and safer environment have triggered governments to institute measures that reduce the use of used cars, substituting newer, fuel efficient cars for such old cars (Li, Linn, and Spiller (2010)). Li, *et al* (2010) state that the US had spent about $3 billion on the "Cash-for-Clunkers" program, which aimed to stimulate the economy, and improve the environment by encouraging consumers to give up their older vehicles, and purchase new, fuel efficient cars. But such programs can be expensive and might not be socially efficient after all. Knitter (2009) argues that even though the "Cash-for-Clunker" program in the US was a success both as an environmental and stimulus program, the implied costs of carbon dioxide reductions far exceeded the Waxman-Markey bill by tenfold.

Small and Kazimi (1995) estimated the health costs emanating from air pollution from vehicles, and assert that even though there are other costs, the costs from particulate matter and ozone constitute the bulk of the economic damage caused by air pollution from motor vehicles in developed countries such as the United States. Using the Los Angeles region as a case study, they argue that poorly controlled vehicles have significant pollution costs.
Most studies that have examined the determinants of CO_2 emissions have modeled CO_2 emissions as a function of population growth, and GDP per capita, or economic growth (Holtz-Eakin and Selden(1995); Shi (2003)), and energy consumption (Schmalensee, Stoker, and Judson (1998)). Harrison, Deacon, Jones, and Appleby (1997) found road traffic as an important source of PM10.

Obviously, Ghana does not have the wherewithal for such programs in her bid to reduce air pollution. Accordingly, intuitively, it makes sense for the Government to ban the importation of old cars as an alternative way to curb air pollution levels in order to create a healthier environment. However, opponents of the ban contend that it is an absolute restriction on the freedom of consumers and so a "misuse" of the law. It was therefore unsurprising that after only 4 years of implementation, the ban was subsequently lifted and replaced with an amendment that allows for consumer freedom, whilst still attempting to keep older cars out through higher penalties as car ages increase.

Given that majority of the cars imported into Ghana (80 per cent (Chanfin, 2008)) are second-hand cars, it makes sense that the total car imports is nearly synonymous with used car imports. More so, some "accidented" or "totaled" in North America and Europe make their way into the country. They are then refurbished by skilled, yet cheap mechanics, and become nearly as good as brand new cars in terms of perceived social status of the owners (Chalfin, 2008). Asher Tishler(1982) in "*The Demand for Cars and the Price of Gasoline: The User Cost Approach*" argues that if all car services are perfect substitutes, then the demand for new and used can be aggregated in a single measure. For these reasons, coupled with the aggregated nature of the data on car imports, we can take car demand as an aggregated unit that encompasses both new and used cars.

3. Model Specification and Analytical Framework

Theoretically, we can think of the aggregate demand for cars in a given country to be determined by such factors as the country's population, the average price of cars, per capita income levels (or wealth), average lending rates from the banks and financial intuitions, and the price of gasoline or crude oil, among others. These translate into a basic empirical model:

$$lnN_t = \alpha_0 + \alpha_1 lnPOP_t + \alpha_2 lnPCY_t + \alpha_3 lnLIR_t + \alpha_4 lnAACOP_t + \mu_t \ldots \quad (1)$$

where $lnN_t$is the natural log of the total number of cars imported in year *t;* $lnPOP_t$is the natural log of the total population in year *t ;* $lnPCY_t$is the natural log of the gross domestic income per capita in year *t;* $lnLIR_t$is the lending interest rate in year *t;* and $lnAACOP_t$is the average annual crude oil price in year *t;* and $\mu_t$is the random error term.

The thrust of this paper is partly to investigate whether the over-aged car legislation in Ghana has had any impact on the demand for cars (both new and used), a dummy variable for the legislation is introduced, which takes on the value of zero for years prior to the ban (1996-1997), one for the period of the ban (1998-2002), and zero again for the period after the amendment was made (2003-2008)[3]. This yields the model:

$$lnN_t = \alpha_0 + \alpha_1 lnPOP_t + \alpha_2 lnPCY_t + \alpha_3 lnLIR_t + \alpha_4 lnAACOP_t + \alpha_5 D_t + \mu_t \quad \text{----------(2)}$$

[3]The amendment actually took effect in August 2002. But since 3 of the 4 quarters of that year were under the ban, I started the amendment effect in 2003

The variables are the same as defined above, and $D_t$which is the dummy for the effect of the legislation.

$$Dt = \begin{cases} 1 & if\ t\ \epsilon\ [1998-2002] \\ 0 & otherwise \end{cases}$$

The effect of the legislation (the ban and its subsequent repeal) on both the demand for cars and pollution levels can also be tested within a *Difference-in-Differences (DID)* framework. The air pollutants considered in this paper are carbon dioxide (CO_2) emissions measured in kilotons; and particulate matter (PM 10) measured in micrograms per cubic meter. Ghana is the treatment group whereas Cote D'Ivoire is the control group. Cote D'Ivore makes for a suitable control group because they have not had any used car importation restrictions (at least within the period under consideration). Furthermore, Cote D'Ivoire and Ghana are coterminous, so that the two countries do not have differences in terms of access to ports/harbors. Car imports rose in both countries during the time under consideration, and pollution levels were fairly similar.

The DID regression models for car imports and air pollution levels can be specified as:

$$ImpV_{it} = \beta_0 + \beta_1 Country_i + \beta_2 Legislation_{it} + \beta_3 Country_{it} * Legislation_{it} + \beta_4 POP_{it} + \beta_5 GDPPC_{it} + \varepsilon \quad ---(3)$$

where$ImpV_{it}$import value of cars for country *i* at time *t*; $Country_i$ is the country fixed effects for country *i*; $GDPPC_{it}$ is the GDP per capita of country *i* at time *t*, and ε is the random error term. The coefficient of interest is β_3, which is the DID estimator. The CO_2 emissions and PM10 equations are specified, respectively as:

$$CO2_{it} = \delta_0 + \delta_1 Country_i + \delta_2 Legislation_{it} + \delta_3 Country_i * Legislation_{it} + \delta_4 ImpV_{it} + \delta_5 POP_{it} + \delta_6 GDPPC_{it} + \delta_7 EnergyCon_{it} + \upsilon \quad .....(4)$$

$$PM10_{it} = \lambda_0 + \lambda_1 Country_i + \lambda_2 Legislation_{it} + \lambda_3 Country_i * Legislation_{it} + \lambda_4 ImpV_{it} + \lambda_5 POP_{it} + \lambda_6 GDPPC_{it} + \lambda_7 EnergyCon_{it} + \epsilon \quad .....(5)$$

$EnergyCon_{it}$ is energy consumption in country *i* at time *t*. Again, the coefficients of interest are δ_3 andλ_3.

5. Data

Data on the trade value of imported cars per year into Ghana and Cote D'Ivoire are drawn from the United Nations Trade Statistics Division. Data on pollutants (CO_2 emissions, and PM 10), per capita GDP, population, and energy use are from the World Bank's African Development Indicators. Data on the prime rate was taken from the Bank of Ghana's website. The prime rate is the policy rate set by the Bank of Ghana at the instance of its Monetary Policy Committee. Commercial banks determine their lending rate based on the prime rate. And so whenever the prime rate is increased, commercial banks raise their lending rates as well. However, these commercial banks are hesitant to reduce their lending rates whenever the prime rate is lowered. Therefore, I used the prime rate as a proxy for the lending interest rate.

Data on the annual average crude oil prices was drawn from the *Air Transport Association of America* website. Again, for lack of data on petroleum prices in Ghana, I used the world's annual crude oil price averages as a proxy. Petroleum prices in Ghana are deregulated such that when crude oil prices rise, petroleum prices are increased in Ghana. There is therefore a fairly high correlation between these two prices. Hence they should have identical effects on the demand for cars, *if* at all. As is conspicuous from the empirical models above, the average price of cars is absent. This is simply because there is no data available or the author could not find it at all.

6. Empirical Results and Analysis

First, Table 1 presents the results for the demand for cars. The results in column 1 indicate that population and GDP per capita are both positive and statistically significant at the 10per cent and 1per cent levels, respectively. This conforms with intuition because we expect that as population increases, the demand for cars will also increase. Also, as income levels rise, we expect to see, *apriori*, that more people acquire cars. Hence, my results confirm Obeng-Odoom's claim that the increase in demand for cars is a result of increasing population and rising incomes in Ghana.

In column 2, when the dummy for legislation is included, both population and GDP per capita still have their expected signs. However, population is no longer statistically significant. The coefficient of legislation is negative. *Apriori*, we would expect to see an inverse relationship between because the ban on over-aged cars was supposed to reduce the number of cars imported. However, it was not statistically significant, a suggestion that the ban did not have a significant impact on the demand for cars.

What remains murky is the fact that the data is aggregated, and unless we are able to disaggregate used cars from new cars, one cannot unambiguously say that the legislation was unsuccessful at reducing the importation of over-aged cars. But taking used and new cars together, the legislation was not successful. The F-statistic for models 1 and 2 are respectively 60.93 and 36.85, and are statistically significant at the 1per cent level.

Model 2 incorporates the average year-on-year prime rate, and the average annual crude oil prices. The results indicate that none of the explanatory was statistically significant; not even the GDP per capita. In fact, the inclusion of the prime rate variable hurts the model as the sign of GDP per capita and actually became negative (which is counter-intuitive). The estimate for crude oil prices is positive (contrary to an expected negative sign), but not significant. Of course, with rising income levels, crude oil prices should not have a significant effect on demand for cars. When legislation was introduced (model 4), its sign also changed from negative to positive. This also runs contrary to intuition because we do not expect that the ban would trigger higher demand for car imports. None of the variables is statistically significant in model 4. When the prime rate variable is dropped (model 5), the variables regain their *apriori* signs. However, only GDP per capita is statistically significant (at the 1per cent level).

The foregoing discussions imply that GDP per capita is the most important explanation for the increased demand for car imports in Ghana. Population growth is also a good explanatory variable, even though it is not so strong[4]. Table II (a-f) presents the results for the DID paired t-tests. Car imports rose sharply following the amendment of the act. The difference in the average car imports for the period when the ban was in effect and the period following the amendment nearly doubled and is statistically significant. This is also true for the pooling of the pre-ban and amendment periods versus ban period. However, when compared with Cote D'Ivoire, the control group, the differences-in-differences was not statistically significant. At the country levels, the differences in CO_2 emissions are not statistically significant at all in both countries. CO_2 emissions soared in both countries, and nearly doubled in Ghana between the two categories of periods. Accordingly, DID estimate is not statistically significant. The PM 10 levels actually declined significantly in both countries. However, the DID estimate is not significant.

The results for the DID regressions for car import values, CO_2 emissions, and PM 10 are presented in Table III. Note that the coefficient of interest is the interaction term between legislation (the pre-ban, ban and subsequent amendment) and country. The results show that the DID estimate was not statistically significant for all three variables of interest. This is consistent with the paired t-test results presented in Table II (a –f). PM10 levels declined in both countries, but the decline was not statistically significant. GDP per capita is statistically significant for car imports and CO_2 emissions. It is, however, not significant for PM10. Population is also statistically significant for car imports, but not for either CO_2 emissions or PM10.

7. Conclusion

This study examines over-age car legislation as an environmental policy law aimed at reducing air pollution (CO_2 and PM10 emissions) in Ghana. The policy was intended to suppress demand for used cars, and consequently reduce air pollution. The study finds that the increased car imports in Ghana could be attributed mainly to rising income levels (GDP per capita), and population growth. Whilst the ban on over-aged car importation between 1998 and 2002 reduced car imports, the reduction was not statistically significant.

Using Ivory Coast as control group and Ghana as the treatment group, this paper finds that the ban and the subsequent amendment had no significant impact on the car imports and air pollution levels. The ban was therefore unsuccessful at reducing air pollution through reduced (used) car imports. As a result, the over-aged car legislation was a failed environment policy law. Whilst it is obvious that Ghana cannot afford expensive air pollution control programs such as the US "Cash-for-Clunkers" program, alternative policies should be sought in government's bid to reduce air pollution rather than imposing ban or other stringent control laws on used cars.

[4]It is only statistically significant at the 10per cent level in model 1. It is not significant in the rest of the models

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Appendix

Table 1. Demand for Cars Regressions

Dependent Variable: *ln(Car Imports)*

Independent Variable	Model 1	Model 2	Model 3	Model4	Model 5
Intercept	-2.072	0.72	-56.4	-137.3	6.00
	(-0.23)	(0.05)	(-0.43)	(-0.76)	(0.28)
ln POP	1.0917*	0.9288	4.472	9.45	0.607
	(1.97)	(1.08)	(0.57)	(0.85)	(0.47)
ln GD Per Capita	0.6269***	0.6214***	- 0.0498	-0.3278	0.6003***
	(6.12)	(5.66)	(-0.11)	(-0.51)	(4.60)
Ln Prime Rate			- 0.0115	-0.2144	
			(-0.03)	(-0.41)	
ln AACOP	0.4039	0.1999	0.0738		
			(0.54)	(0.23)	(0.35)
Legislation		-0.0385		0.2287	-0.0333
		(-0.26)		(0.71)	(-0.21)
R^2 – *adj*	90.9%	90.0%	86.9%	92.0%	88.9%

*Note: t-ratios are in parenthesis; * significant at the10per cent level; **significant at 5per cent level; ***significant at 1per cent level*

Table II : Differences-In-Differences Tables - Paired T-tests

TableII a: Import Value ($million): (1996-2008)

C'try/Time	No Ban	Ban	Difference
Ghana	729.34	418.74	310.597*
Cote D	579.39	146.84	432.56
		D-I-D=	-121958.00

TableII b: Import Value($million) (1998-2008)

C'try/Time	Amendment	Ban	Difference
Ghana	823.90	418.74	405.154**
Cote D	689.87	146.84	543.03
		D-I-D=	-137.42

Table II c : CO2 Emissions (kt): (1996-2008)

C'try/Time	No Ban	Ban	Difference
Ghana	7547.84	6715.38	832.46
Cote D	6886.69	6990.91	-104.22
		D-I-D=	936.68

Table II d : CO2 Emissions (kt): (1998-2008)

C'try/Time	Amendment	Ban	Difference
Ghana	8138.48	6715.38	1423.10
Cote D	6905.91	6990.91	-85.00
		D-I-D=	1508.01

Table II e: PM 10(micrograms/cubic meter : (1996-2008)

C'try/Time	Amendment	Ban	Difference
Ghana	32.08	40.41	-8.33***
Cote D	41.52	48.54	-7.02***
		D-I-D=	-1.31

Table II f:PM 10(micrograms/cubic meter : (1998-2008)

C'try/Time	Amendment	Ban	Difference
Ghana	31.05	40.41	-9.37***
Cote D	36.46	48.54	-12.08**
		D-I-D=	2.71

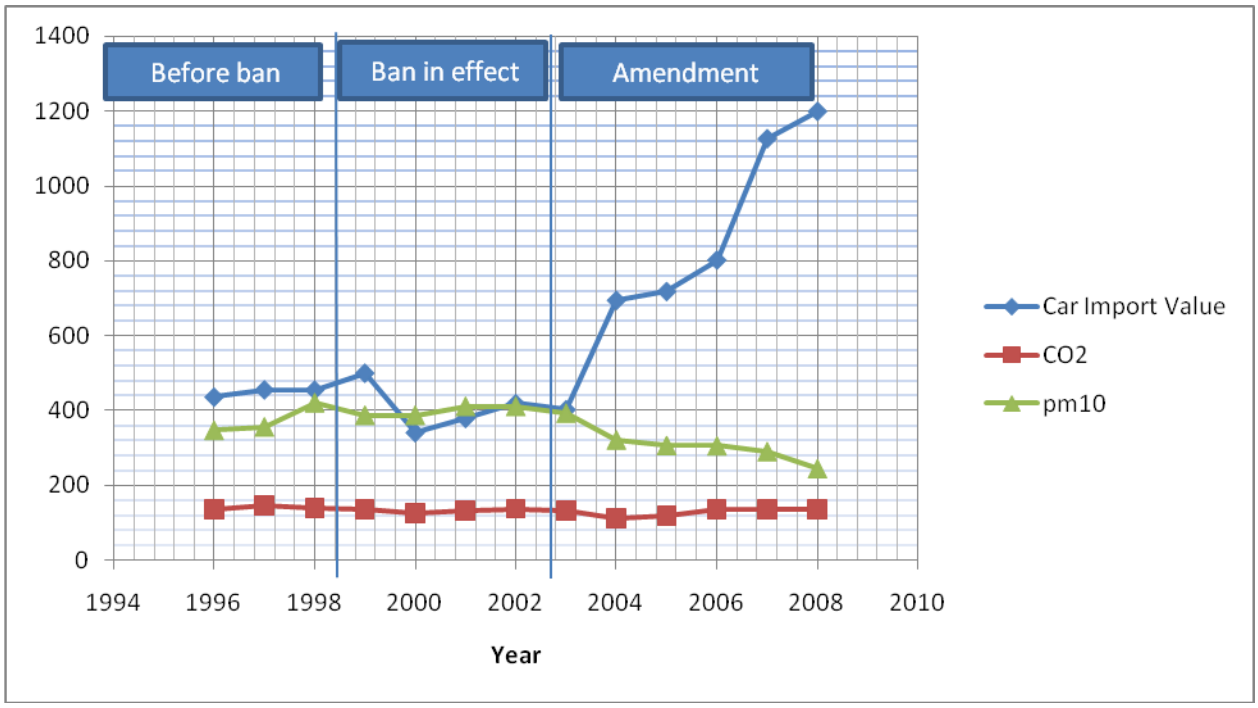
** significant at the10per cent level; **significant at 5per cent level; ***significant at 1per cent level*

Table III: Differences-in-Differences Regression Results

	Import Value	CO_2 Emissions	PM 10
Intercept	-1215.40**	3552	83.08 ***
	(-2.85)	(1.18)	(5.93)
Country	196.9	633.0	-5.131
	(1.48)	(0.68)	(-1.19)
Country*Legislation	-22.6	55.7	4.015
	(-0.20)	(0.09)	(1.32)
Import Value		0.273	-0.005289
		(0.22)	(-0.90)
Population	0.00006535**	0.0002186	-0.00000121
	(2.30)	(0.83)	(-0.98)
GDP Per Capita	0.5629**	2.911**	0.001131
	(2.67)	(2.18)	(0.18)
Energy Consumption		-0.3636	-0.002045
		(-1.15)	(-1.39)
R^2-adj	66.4%	29.8%	74.0%
F-Statistic	13.37***	2.77**	12.86***

*Note: t-ratios are in paranthesis; * significant at the10per cent level; **significant at 5per cent level; ***significant at 1per cent level*

Figure1: Annual Car Imports, CO2 Emissions and PM 10



Source: UN Comtrade/World Bank African Development Indicators