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EXAMINING THE RELATIONSHIP BETWEEN TRADE AND ENVIRONMENT

Master of Science Thesis

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ABBREVIATIONS

ACT	: Antweiler-Copeland-Taylor Model
CIA	: Central Intellegence Agency
CO	: Carbon monoxide
CO_2	: Carbon dioxide
DC	: Developed Countries
EKC	: Environmental Kuznets Curve
EU	: European Union
FDI	: Foreign Direct Investment
FE	: Fixed-Effects
GDP	: Gross Domestic Product
GHG	: Greenhouse gas
GEMS	: Global Environmental Monitoring System
GLS	: Generalized Least Squares
GNP	: Gross National Product
HINC	: High Income Countries
HO	: Heckscher-Ohlin
HOV	: Hechscher-Ohlin-Vanek
ISIC	: International Standard Industrial Classification
LDC	: Least Developed Countries
LINC	: Low Income Countries
MINC	: Middle Income Countries
NO_x	: Nitrogen oxide
OECD	: Organization for Co-operation and Development
OLS	: Ordinary Least Squares
PH	: Pollution Haven
PHH	: Pollution Haven Hypothesis
PP	: Polluting Products

Cont. ABBREVIATIONS

RCA	**:** Revealed Comparative Advantage
RE	**:** Random-Effects
SITC	**:** Standard International Trade Classification
SO_2	**:** Sulphur dioxide
SO_x	**:** Sulfur oxide
US	**:** United States
VOC	**:** Volatile Organic Compound
2SLS	**:** Two-Stage Least-Squares

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RÉSUMÉ

Après avoir adopté des politiques économiques libérales, de nombreux pays développés et en voie de développement ont expérimenté le développement économique rapide. Avec la connaissance croissante de l'environnement dans l'économie industrielle lors des années 60, les régulations environnementales, spécialement pour la régulation de la pollution, ont été de plus en plus strictes. Mais malheureusement ces mesures sont restés minces et régionales et l'être humain est resté spectateur durant de nombreuses années à cette détérioration de l'environnement.

Après ce désintérêt dans le monde face à l'environnement, l'intérêt a commencé à naître dans les pays développés et ces pays ont cherché à ériger une coopération internationale. Par conséquent, les Nations Unies ont organisé la première grande conférence internationale sur les problèmes evironnementaux à Stockholm en Suède en 1972.

Les conditions de vie du monde ont entrainé un désir chez les habitants des pays développés à vivre dans un environnement plus vert/meilleur. Avec les sanctions régionales comme celles des politiques environnementales de l'UE, les pays les plus développés ont baissé leur emission grâce au respect des régulations strictes à ce niveau.

Ces circonstances apparues dans les pays développés ont eu pour effet de délocaliser les industries très polluantes dans des regions où les regulations sont plus laxistes voire inexistantes. Ces régions sont situées pour la plupart dans des pays en voie de développement ou moins développés. Ainsi les régions développées sont donc devenues plus propres et les régions en voie de développement ont récupéré toute leur pollution en leurs terres.

Sur ce point, la courbe de Kuznets et les hypothèses d'un havre de pollution ont retenues l'attention des chercheurs internationaux.

Afin d'étudier la relation entre l'environnement et le commerce international, les travaux concernant ces deux hypothèses ont été regroupés dans la littérature. Comme les études récentes, nous allons également étudier ces deux hypothèses dans cette étude.

La raison pour laquelle nous regroupons les études de ces deux hypothèses dans la littérature est que la littérature récente concernant la courbe de Kuznets a pris en compte les hypothèses du havre de pollution dans ses études.

Comme dans les etudes récentes de la literature, les données-panel ont été utlisées afin de contrôler l'hétérogénéité non observée.

Les resultats de la régression et les graphiques du modèle 1 montrent en effet qu'il est impossible d'atteindre une courbe de Kuznets mondiale. Comme nous pouvons voir sur les graphiques, les émissions par habitant et le PIB par habitant augmentent. Cependant il est impossible de trouver une courbe de Kuznets mondiale globale. Selon les hypothèses de la courbe de Kuznets, le PIB par habitant et le PIB au carré sont respectivement de signe postif et négatif. Mais comme nous pouvons voir avec le modèle des effets fixes, les deux signes sont positifs. Même si les données sont statistiquement significantes, il ne peut y avoir d'effet de courbe de Kuznets mondial.

Les résultats de régression du deuxième modèle nous montrent des résultats insignifiants de la courbe de Kuznets pour les pays développés. Les signes du PIB, du PIB au carré et du PIB au cube sont respectivement positif, négatif et positif. Malheureusement nous n'avons pas trouvé de résultats significatifs pour la courbe de Kuznets. Les graphiques des pays ont été faits donc séparemment pour chaque pays développé pour mettre en exergue le statut spécifique de chaque pays développé.

Comme nous pouvons voir sur les graphiques par pays, dans la plupart des pays développés, l'emission de CO_2 est en baisse. Pour le Danemark, la France, l'Allemagne, Israël, les Pays-Bas, Singapour, la Suède, la Suisse, le Royaume-Uni et les Etats-Unis, cette tendance est significative.

Exceptés Israel, Singapour et les Etats-Unis, la plupart de ces pays sont dans l'UE.En considérant les mesures de l'UE concernant l'environnement, nous pouvons donc conclure que faire partie/ être membre d'une institution peut forcer les pays à contrôler leur niveau d'émission.

Lorsque nous examinons ces pays par groupes (pays à hauts revenus, pays à hauts revenus de l'OCDE, pays à hauts revenus hors OCDE), nous pouvons voir que la tendance de baisse est un peu en suspens.

Excepté au Japon, dans tous les pays développés, le PIB par habitant est en hausse.

Nous pouvons voir aussi que les pays comme le Danemark, la France, l'Allemagne, l'Allemagne, l'Icelande, l'Irelande, Israël, Singapour, la Suède, le Royaume-Uni et les Etats Unis suivent des tendances identiques à la courbe de Kuznets.

Les resultats du modèle 3 des effets fixes pour les 25 pays développés montrent que les signes du PIB par habitant, du PIB par habitant au carré et du PIB par habitant au cube sont comme attendus mais le PIB par habitant au carré est statistiquement insignificant. Cependant dans ce modèle nous ne pouvons trouver aucune preuve pour la courbe de Kuznets.

Sur les graphiques spécifiques par pays, nous pouvons voir que les pays comme la Hongrie, la Roumanie, la Pologne, et l'Afrique du Sud ont des émissions en CO_2 par habitant en baisse. Cette tendance a commencé dans le milieu des années

80 pour ces pays de l'Europe de l'Est. Pour l'Algérie, le Koweit, le Nigéria, le Qatar, l'Arabie-Saoudite, les Emirats Arabes, la croissance s'est désamorcée au milieu des années 80 et la courbe est à peu près constante depuis.

Comme nous l'avons prédit, le PIB par habitant suit une tendance croissante dans les pays développés.

Seulement les pays comme la Hongrie, la Pologne, l'Afrique du Sud et le Venezuéla, suivent les tendances de la courbe de Kuznets. Les autes pays semblent être dans une phase pré-industrielle.

Les résultats de régression du 4ème modèle pour la Turquie montrent que malgré des signes de coefficients correspondant aux hypothèses de la courbe de Kuznets, le PIB au carré par habitant n'est pas statistiquement significatif. Quand nous incluons le PIB au cube dans le modèle, la seule variable significative qu'est le PIB par habitant perd de sa signification.

Pour et l'émission de CO_2 et le PIB par habitant, les tendances sont croissantes dans le temps. Comme nous pouvons voir sur le graphique, la Turquie semble toujours être dans une ère pré-industrielle.

L'examen des résultats des effets fixes pour le monde entier est partiellement siginificatif. Les investissements directs à l'étranger et les taux d'intérêt sotn les variables siginificatives. Afin d'avoir de réfuter l' HHP, la variable CO_2 doit être considéré comme significative. Hors comme nous pouvons voir dans les résultats, elle ne l'est pas.

Et finalement, les resultats de régression pour la Turquie du modèle HHP montrent que seulement le CO_2 et le taux d'intérêt sont significatifs. Ainsi nous pouvons conclure que le modèle de HHP presentment quelques faiblesses pour la Turquie. Le taux d'intérêt peut être une variable significative mais à ce moment là la pollution ne devrait affecter pas seulement l'industrie lourde mais aussi les taux d'intérêt de toutes les industries.

ABSTRACT

After adopting liberal economic policies, many developed and developing countries have experienced rapid economic development in 1960s. With the rising environmental awareness in industrial economies in the 1960s, environmental regulations, especially pollution regulations, started to become stricter. But this tightening of the regulations remained slight and regional and unfortunately, the human race seemed to look on the environmental deteriorations for a quite long time.

After this worldwide ignorance for the environment, in developed regions the concerns for the pollution intensities increased and developed countries were in search of an international cooperation. Consequently, United Nation's first major conference on international environmental issues was carried out at Stockholm, Sweden in 1972.

The existing circumstances of the world causes the developed countries' residents desire for a better/greener environment to live in. With the regional sanctions like European Unions Environmental Policy, the mostly developed countries decrease their emission levels with the help of strict environmental regulations, in order to obey the rules.

These circumstances in developed countries appeared to cause the pollution intensive industries to find theirselves places where the environmental regulations are relatively laxer, or places where no environmental regulations exist. These places exist mostly in developing or less developed regions. In this manner, the developed regions become cleaner and developing regions load up the burden of the pollutions of the developed regions.

At this point, the Environmental Kuznets Curve and the Pollution Haven Hypotheses attract attentions of the researchers worldwide.

In order to examine the relationship between environment and international trade, the two investigations of the two important hypotheses in the literature have been merged. Like the recent studies, we investigate the both hypotheses in this study.

The reason why we merged the two investigations of these two hypotheses in the literature is that, the recent literature of Environmental Kuznets Curve has added the examinations of the Pollution Haven Hypothesis into the studies.

Like the recent studies in the literature, the panel-data sets were used in order to control for unobserved heterogeneity

The regression results and the graphs for the Model 1 indeed show that, a worldwide EKC is unreachable. As we can see from the graphs, both worldwide per capita CO_2 emissions and the per capita GDP are increasing. Thus, it is impossible to find a EKC for worldwide. According to EKC hypothesis, the expected signs of per-capita GDP and per-capita GDP-squared are positive and negative, respectively. But as we can see the Fixed- Effects results, both of the signs are positive. Even they are statistically significant, there is no such EKC effect worldwide.

The regression results for Model 2 show us statistically insignificant evidence of EKC for developed countries. The signs of per-capita GDP, per-capita GDP-squared and per-capita GDP-cubed are positive, negative and positive, respectively. Unfortunately, we didn’t find evidence of EKC. The graphs of the countries were drawn separately for each developed country in order to see the country-specific statuses of the developed countries.

As we can see from the country-specific graphs, in most of the developed countries, per-capita CO_2 levels have a decreasing trend. For Denmark, France, Germany, Israel, Netherlands, Singapore, Sweden, Switzerland, United Kingdom and United States we can see that decreasing trends evidently.

Except for Israel, Singapore and United States, most of these countries are members of European Union (E.U.). With regard to EU's environmental stringencies, we may conclude that, being a member/part of an institution might be forcing countries to control their emission levels.

When we examine these countries as country groups (High Income Countries, High Income OCED Countries and High Income non-OCED countries) we can see that increasing trend in per-capita CO_2 has slowed down.

Expect for Japan, in every developed country, per-capita GDPs have increasing trend.

We can see EKC-likely trends for Denmark, France, Germany, Iceland, Ireland, Israel, Singapore, Sweden, United Kingdom, and United States.

The Fixed-Effects results of 25 developing countries in Model 3 show that, the signs of the per-capita GDP, per-capita GDP-squared and per-capita GDP-cubed are as expected but per-capita GDP-squared is statistically insignificant. Thus, in this model we couldn't find evidence about EKC.

In country-specific graphs, for Hungary, Poland, Romania and South Africa, per-capita CO_2 emission are in a decreasing trend. In the midst of 1980s in Hungary, Poland and Romania the trend turned to decrease. For Algeria, Kuwait, Nigeria, Qatar, Saudi Arabia, United Arab Emirates and Venezuela, the increasing trend slowed down in the midst of 1980s and until today the trend seems to be steady.

As we predicted, in every developing country, the per-capita GDPs have increasing trend..

Only for Hungary, Poland, South Africa and Venezuela there seems to be EKC-likely trends. The other countries seem to be at the Pre-Industry stage.

The regression results of the 4th model for Turkey show that, although the signs of the coefficients are perfectly fit for the EKC assumptions, per-capita GDP-squared is not statistically significant. When we include the per-capita GDP-cubed into the model, the only statistically significant variable per-capita GDP loses its significance.

Both for the per-capita CO_2 emission and the per-capita GDP, there are increasing trends over time. As we can see from the graph, Turkey still seems to be in the pre-Industrial period.

The Fixed-Effects results examined for the worldwide pollution haven hypothesis are partly statistically significant. *Exchange rate* and *FDI* are the significant variables in the data set. In order to find evidence for the PHH, the variable CO_2 was expected to be statistically significant. But, as we can see from the results, CO_2 is not statistically significant.

And finally, the regression results for Turkey examining the PHH show that, only CO_2 and *exchangerate* are statistically significant. Thus, we can conclude that, there is some weak evidence of PHH with CO_2 for Turkey. The significance of *exchangerate* seems quite plausible, since not only the pollution-intensive industries but also every industry may be affected by exchange rate trends.

ÖZET

Bir çok gelişmiş ve gelişmekte olan ülke, 1960lı yıllarda, liberal ekonomi politikaları benimsedikten sonra, hızlı ekonomik büyüme tecrübe etmiştir. Yine aynı yıllarda artan çevre bilinciyle, çevresel düzenlemeler, özellikle kirlilikle ilgili düzenlemeler, sıkılaşmaya başlamıştır. Fakat kirlilik düzenlemeleriyle ilgili bu sıkılaşma, bölgesel ve önemsiz kalmış, ve ne yazık ki insanoğlu çevresel kötüleşmeye uzun yıllar boyunca seyirci kalmıştır.

Çevre için dünya çapında oluşan bu görmezden gelişten sonra, gelişmiş ülkelerdeki kirlilik yoğunluğuyla ilgili endişeler giderek artmış ve bu yüzden gelişmiş ülkeler uluslararası bir işbirliği arayışı içerisine girmişlerdir. Tüm bu gelişmelerin sonucu olarak, Birleşmiş Milletler'in uluslararası çevre meseleleriyle ilgili ilk büyük çaplı konferansı 1972 yılında Stockholm, İsveç'te gerçekleştirilmiştir.

Dünyanın içinde bulunduğu mevcut koşullar, gelişmiş ülkelerde yaşayan insanların daha temiz, daha yeşil bir çevre arzusu içinde olmalarına sebep olmuştur. Avrupa Birliği Çevre Politikası gibi bölgesel yaptırımlarla, gelişmiş ülkeler kurallara uyarak emisyon seviyeleri azaltmışlardır.

Gelişmiş ülkelerde ortaya çıkan bu koşullar, kirlilik yaratan endüstrileri çevresel yaptırımların nispeten daha az sıkı olduğu ya da çevresel yaptırımların olmadığı yerler bulmaya zorlamıştır. Çevresel yaptırımların daha az sıkı olduğu ya da hiç bir çevresel yaptırımın bulunmadığı bu yerler dünyada genellikle gelişmekte olan ya da az gelişmiş bölgelerde buluşmaktadır. Bu durumun sonucu olarak, kalkınmış bölgeler temiz hale gelirken, kalkınmakta olan bölgeler, kalkınmış bölgelerin kirlilik yükünü de yüklenmiş durumdadırlar.

Tam da bu noktada, Çevresel Kuznet Eğrisi ve Kirlilik Sığınağı hipotezleri dünya çapında araştırmacıların ilgisini çekmektedir.

Çevre ve uluslararası ticaret arasındaki ilişkiyi incelemek için literatürdeki bu iki hipoteze ait çalışmalar birleştirilmiştir. Bu çalışmada, yakın zamanda yapılan literatür çalışmalarında yapıldığı gibi iki hipotez beraber incelenmiştir.

Yapılacak çalışmada iki hipotezin de incelenecek olmasının sebebi, yakın zamanda yapılan Çevresel Kuznet Eğrisi çalışmalarına Kirlilik Sığınağı Hipotezi incelemelerinin de eklenmiş olmasıdır.

Literatürdeki benzer çalışmalarda da kullanıldığı gibi, bu çalışmada da gözlenmeyen çoktürelliğin kontrol edilebilmesi için panel-veri yöntemi kullanılmıştır.

Birinci modelin regresyon sonuçları ve grafikleri tüm dünya için çevresel Kuznets eğrisnin ulaşılamaz olduğunu göstermiştir. Grafiklerden de gördüğümüz gibi, hem kişi başına düşen CO_2 miktarı hem de kişi başına düşen gelir artmaktadır. Bu yüzden, evrensel bir çevresel Kuznets eğrisi bulmak imkansızdır. Çevresel Kuznets Eğrisi Hipotezine göre, kişi başına düşen gelir ve bu gelirin karesinin beklenen işaretleri sırasıyla pozitif ve negatif olmalıdır. Sabit etkiler modelinin sonuçlarından da gördüğümüz gibi, her iki işaret te pozitiftir. Istatistiki olarak anlamlı olmalaına rağmen, evrensel bir çevresel Kuznets eğrisi oluşmamaktadır.

Ikinci modelin sonuçları, gelişmiş ülkeler için istatiki olarak anlamsız sonuçlar ortaya koymaktadır. Kişi başına düşen milli gelir, karesi ve küpünün ortaya çıkan işaretleri sırasıyla, pozitif, negatif ve pozitiftir. Dolayısıyla, bu modelde de çevresel Kuznets eğrisi için kanıt bulunamamıştır. Ülkelerin kişi başına düşen CO_2 emisyonları ve kişi başına düşen gelirleri ülkelerin zaman içindeki durumlarını ortaya koyabilmek için, her ülke için ayrı çizilmiştir.

Ülke grafiklerinden de görüldüğü gibi, çoğu gelişmiş ülkedeki kişi başına düşen CO_2 emisyonaları azalan bir trend içindedir. Almanya, Amerkia Birleşik Devletleri, Birleşik Krallık, Danimarka, Fransa, Hollanda, İsrail, İsveç , İsviçre, ve Singapur 'da bu azalan trendi açıkça görebilmekteyiz.

Amerika Birleşik Devletleri, İsrail ve Sinagapur dışında kalan bu ülkeler Avrupa Birliği'ne üye olan ülkelerdir. Avrupa Birliği'nin sıkı çevresel tavırına bağlı olarak, bir birliğini parçası ya da üyesi olmak, bu ülkeleri emisyon seviyeleri kontrol etmeye zorladığını sonucuna ulaşabiliriz.

Modelde bulunan bu ülkeleri, Yüksek Gelir grubu, Yüksek Gelir Grubu OECD Ülkeleri, Yüksek Gelir Grubu OECD'te üye olmayan ülkeler olarak 3 gruba ayırdığımız takdirde, kişi başına düşen CO_2 emisyonlarındaki artış trendin yavaşlamış olduğunu görmekteyiz.

Japonya haricindeki tüm gelişmiş ülkelerdeki kişi başına düşen gelir artış trendindedir.

Çevresel Kuznets Eğrisine benzer bir trendi, Almanya, Amerika Brileşik Devletleri, Birleşik Krallık, Danimarka, Fransa, İrlanda, İsrail, İsveç ve İzlanda için görebilmekteyiz.

3.Modeldeki 25 gelişmekte olan ülke için olan sabit-etkiler modeli sonuçları, kişi başına düşen milli gelir, karesi ve küpünün işaretlerinin hipoteze uygun olduğunu fakat, kişi başına düşen gelirin karesinin istatistiki olarak anlamlı olmadığını ortaya koymaktadır. Bu yüzden bu modelde de çevresel Kuznets Eğrisi saptanamamıştır.

Ülke grafiklerinde, Güney Afrika, Macaristan, Polonya ve Romanya için kişi başına düşen CO_2 seviyesi azalış trendi içerisindedir. 1980lerin ortasında itibaren azalış trendi bariz bir şekilde görülmemktedir.Birleşik Arap Emirlikleri, Cezayir, Katar, Kuveyt, Nijerya, Sudi Arabistan ve Venezuela için aynı trend 1980lerin ortasında yavaşlamış ve bu güne kadar sakin bir trend göze çarpmaktadır.

Önceden de tahmin edildiği gibi kişi başına düşen gelir tüm ülkelerde artış trendi içerisindedir.

Sadece Macaristan, Polonya, Sudi Arabistan ve Venezuella için Çevresel Kuznets Eğrisine benzer bir trend görülmektedir. Ülke grafiklerinden, kalan diğer tüm ülkeler endüstrileşmek öncesi dönemde olduğu görülmektedir.

Türkiye için yapılan 4.modelde tüm katsayıların işaretleri Çevresel Kuznets Eğrisini kusursuzca destekliyor gibi görünse de kişi başına düşen milli gelirin karesinin istatistiki olarak anlamlı olmadığı görülmektedir. Kişi başına düşen gelirin kübünün modele kattığımızda ise, tek anlamlı değişken olan kişi başına düşen milli gelir de istatistiki anlamlılığını kaybetmektedir.

Kişi başına düşen CO_2 emisyonları için de kişi başına düşen gelir için de zamanla artan bir trend söz konusudur. Türkiye'nin hala endüstrileşme öncesi dönemde olduğu grafikleden görülebilmektedir.

Tüm dünya için Kirlilik Sığınağı Hipotezini test eden sabit-etkiler sonuçları istatistiki olarak kısmen anlamlıdır. Faiz oranı ve doğudan yabancı yatırım değişkenleri istatistiki olarak anlamlı değişkenlerdir. Hipotezin doğruluğunun kanıtlanması için, CO_2'nin istatistiki olarak anlamlı olması beklenirken, modeldeki CO_2 istatistiki olarak anlamlı değildir.

Ve son olarak, Türkiye için test edilen Kirlilik Sığınağı Hipotezi'nin regresyon sonuçları sadece CO_2 ve faiz oranı için istatistiki olarak anlamlılık ortaya koymaktadır. Bu yüzden, CO_2 değişkeni açısından Türkiye için Kirlilik Sığınağı Hipotezi'nin zayıf olarak anlamlı olduğu sonucuna ulaşabiliriz. Faiz oranı değişkeninin anlamlı olması makul derecede mantıklıdır keza, sadece kirlilik yoğun endüstriler değil, diğer tüm endüstrilerin faiz oranından etkilenmesi beklenebilir.

1. INTRODUCTION

After adopting liberal economic policies, many developed and developing countries have experienced rapid economic development in 1960s. With the rising environmental awareness in industrial economies in the 1960s, environmental regulations, especially pollution regulations, started to become stricter. But this thightening of the regulations remained slight and regional and the human race seemed to look on the environmental deteriotions for a quite long time.

After this worldwide ignorence for the environment, in developed regions, the concerns for the pollution intensities increased and developed countries were looking to request an international cooperation. Consequently, United Nation's first major conference on international environmental issues was carried out at Stockholm, Sweden in 1972.

This conference was a turning point in the development of international environmental politics. For the first time, 113 countries, 19 inter-governmental agencies, and more than 400 inter-governmental and non-governmental organizations were united for the environment. it is widely recognized as the beginning of modern political and public awareness of global environmental problems. The meeting agreed upon a declaration containing 26 principles concerning the environment and development; an Action Plan with 109 recommendations, and a resolution. (Baylis and Smith, 2005)

As a regional result, this conference had a real impact on the environmental policies of the European Community (became later as The European Union). For example, in 1973, the E.U. created the Environmental and Consumer Protection Directorate, and composed the first Environmental Action Program. Such increased interest and research collaboration arguably paved the way of further understanding of global warming, which has led to such agreements as the Kyoto Protocol. (Baylis and Smith, 2005)

In 1997, delegates from 194 nations met in Kyoto, Japan, and collectively promised to reduce greenhouse gas emissions by about 5 percent below 1990 levels by 2012, as a first step toward global cooperation on limiting carbon-driven climate change. The treaty they produced, known as the Kyoto Protocol, expires at the end of 2012. The treaty required the major industrialized nations to meet targets on emissions reduction but imposed no mandates on developing countries, including emerging economic powers and sources of global greenhouse gas emissions like China, India, Brazil and South Africa.

The United States is not a party to the protocol. Some major countries, including Canada, Japan and Russia, have said they will not agree to an extension of the protocol unless the unbalanced requirements of developing and developed countries are changed. That is similar to the United States' position, which is that any successor treaty must apply equally to all major economies.

But the European Union, the major developing countries, and most African and Pacific island nations would like to see the Kyoto process extended as a prelude to a more ambitious, binding international agreement that would take effect 2020. The goal would be to reduce emissions enough to keep the average global temperature from ever rising more than 2 degrees Celsius, or about 3.6 degrees Fahrenheit, above its current level.

The fate of the Kyoto agreement was a central topic at the international gathering on global warming in Durban, South Africa, in December 2011.

But the issue was left unresolved at the meeting, which ended with modest accomplishments: the promise to work toward a new global treaty in coming years. The future treaty deal renewed the protocol for several more years. It also began a process for replacing the protocol with something that treats all countries —

including the economic powerhouses China, India and Brazil — equally. The future treaty deal was the most highly contested element of a package of agreements that emerged from the extended talks among the 200 nations that met in Durban. The expiration date of the protocol — 2017 or 2020 — and the terms of any agreement that replaces it will be negotiated at future sessions. (The NewYork Times, Dec. 12.2011). Latterly, the prime minister of Canada declared that, Canada will formally withdraw from the Kyoto Protocol on climate change.

With these recent news, the future of the world seems to create anxiety. Unexistance of reductions of greenhouse gases' (GHG) emissions is one f the main reasons of the climate change.

The existing circumstances of the world causes the developed countries' residents desire for a better/greener environment to live in. With the regional sanctions like European Unions Environmental Policy, the mostly developed countries decrease their emission levels with the help of strict environmental regulations, in order to obey the rules.

These circumstances cause the pollution intensive industries to find theirselves places where the environmental regulations are relatively laxer, or places where no environmental regulations exist. These places exist moslty in developing or less developed regions. In this manner, the developed regions become cleaner and developing regions load up the burden of the pollutions.

At this point, the Environmental Kuznets Curve (EKC) and the Pollution Haven Hypothesis (PHH) attract attentions of the researchers worldwide.

According to the Pollution Haven Hypothesis, strengthening environmental regulations in this manner will drive production offshore. The flip side of this theory suggests that a (short-sighted) nation might encourage inflows of foreign direct investment by weakening their restrictions. Though theoretically plausible, there has been only limited empirical evidence in support of the Pollution Haven Hypothesis.

The PHH is the idea that, polluting industries will relocate to jurisdictions with less stringent environmental regulations.The PHH posits that jurisdictions with weaker environmental regulations (pollution havens) will attract polluting industries recolating from more stringent locales[1].

Environmental quality could decline through tha scale effect as increasing trade volume (especially export) would expand the size of the economy thereby increasing the extent of pollution. It should be mentioned that, a polluting activity in a high-income country normally faces higher regulatory costs than its counterpart in a developing country (Mani and Wheeler (1998)). Under these circumstances the pollution intensive industries will have a natural tendency to migrate to countries with weaker environmental regulations. (Copeland and Taylor (1995)). This is refered to as the PHH. (See for example, Boomer (1999), Cole (2003, 2004). "*...The PHH refers to the possibility that polluting industries concentrate in developing countries with low environmental standards...*" (Dinda, 2006)

The PHH predicts that, under free trade, multinational firms will recolate the production of their polluting goods to developing countries, taking advantage of the low environmental monitoring in these countries.

In this manner, developing countries will develop a comparative advantage in pollution-intensive industries and become "haven" for the world's polluting industries. Thus, developed countries are expected to benefit in terms of environmental quality from trade, while developing countries will lose. (Dinda, 2006)

Hettige et al. (1992) observe that, toxic intensity grew rapidly in high-income countries during the 1960s and this pattern was sharply reversed during the 1970s and 1980s, after the advent of stricter environmental regulations in the OECD countries. Concurrently, toxic intensity in "low-developed countries" manufacturing

[1] From Lecture Notes of Arik Levinson (Georgetown University)

grew quickly. Lucas et al. (1992), Low and Yeats (1992) confirm this displacement hypothesis.

Agras and Chapman (1999), and Suri and Chapman (1998) analyse the composition of international trade and observe that manufacturing goods exporting countries tend to have higher energy consumption. They find the poor and rich countries to be net exporters and net importers of pollution-intensive goods, respectively.

Although there is a growing literature on the determinants of global environmental quality, little research has been done to the PHH. Instead much of the literature focuses on the relationship between income, growth and pollution. Grossman and Krueger (1995), postulate an inverted "U-curve". This empirical relationship has been proved by other studies in the literature. (see, for example, Selden and Song, 1994).

The hypothesis, supported by the empirical analyses states that, pollution will first increase with income, then decrease at higher income levels. The initial upward relationship occurs because of a positive relationship between output and emissions. The downward tendency occurs when higher demand for environmental quality at higher income levels forces the introduction of cleaner technologies (the technique effect) and an output combination which is less polluting (the composition effect). (Eskeland and Harrison, 2003)

By the help of the studies about the PHH above, a much better understanding of the links between economic development, regulation and pollution have occured around the world. Wheeler (2002) has summarized these results as,

1. Economic Development and Pollution Regulation: Empirical research has repeatedly shown a very strong association between income per capita and the strictness of environmental regulation, both across countries and across regions within countries. There appear to be three main reasons for this association. First, pollution damage gets higher priority after society has made basic invesments in health and education. Second,c higher income societies have more technical personnel and larger budgets for regulatory monitoring and enforcement. Third, higher income and education empower local communities to enforce higher environmental standards, whatever stance is taken by the national government. The result of these mutually-reinforcing factors is a very close relationship between national pollution regulation and income per capita.

2. Economic Development and Pollution Intensity: Recent research on air and water pollution in developing countries has suggest a strong, negative relationship between industrial pollution intensity (or pollution per unit of output) and regional or national income per capita. This is partly because regulation is positively associated with development, and partly because factories operating with less-skilled workers and managers use materials less efficiently than their counterparts in industrial societies. Some of the residual waste materials contribute pollution. As a result, steel, paper and chemical factories are, on average, dirtier in developing countries.

3. Environmental Damage in Developing Countries: Recent mortality estimates for developing countries suggest that at least 500000 people die annualy from urban ait pollution. Numerous benefit-cost studies have indicated that air and water pollution control are competitive with other social investments,even in very poor countries that have pressing needs for basic education and health care.

4. Factory-level Environmental Performance: Recent studies of factory-level pollution in weakly-regulated developing countries have revealed striking diversity in environmental performance. Some plants are very dirty, but others maintain high environmental standards. In-depth studies have identified several reasons for this diversity, including variations in “informal” regulations by local communities, technology, management training and ownership. In general, state enterprises are significantly dirtier than their private counterparts, large enterprises have lower pollution intensity than small ones, and publicly-traded private firms have greater sensitivity to environmental objectiveness than family-owned enterprises.

5. Pollution Control Costs: Research in both high-and low-income countries suggests that pollution control does not impose high costs on business firms. Jaffe et. al (1995) have shown that compliance costs for OECD industries are surprisingly small, despite the use of command-and-control regulations that are economically inefficient. Firms in developing countries frequently have even lower costs, because the labor and materials used for pollution control ara less costly than in the OECD economies. Big polluters also have lower average control costs per unit of pollution because abatement is subject to scale economies. A recent study made in Colombia shows that colombian factory managers have found that, cleaning up is cheaper than paying charges, even when they are set relatively low levels. No participating factory seems to have experienced financial difficulties in the process. Similar conclusions have emerged from studies of regulation and control costs in Malaysia.

Wheeler (2002), summarizes his study as , *"...in poor countries, regulation is generally much weaker than in the OECD economies. Furthermore, industrial pollution intensity (pollution/output) is generally higher. At the same time, many factories comply with relatively strict pollution regulations, and some exhibit world-class environmental performance even in the poorest countries. Conservative benefit-cost analyses based on quantifiable health effects suggest that, many developing countries should tighten their regulation of pollution. Although Porter (1999) cites countervailing pressure from trade competition, recent evidence suggests that, rapidly-industrialized countries are responding to such environmental concerns. Wheeler (2001) finds that, the three largest recipients of foreign investment among developing countries (Mexico, Brazil and China) have realized significant improvements in urban air quality during the past decade..."*

The research summarized above suggests that, both weak regulation and higher pollution intensity are naturally associated with more general development problems, so their existence does not depend on political decisions to create pollution havens. (Wheeler, 2002)

Merely observing that industrial production has shifted toward developing countries is not sufficient to establish the case, because industry sectors vary widely in pollution intensity. Metals, chemicals and paper production are intensive in their production of all major pollutants, but activities such as garments and electronic assembly are not generally heavy polluters. Both kinds of production have grown rapidly in developing countries during the past two decades. A persuasive case for the pollution havens hypothesis has to show that expansion in the pollution-intensive sectors has been more rapid than growth in more environmentally-benign sectors. If not, then expansion in both kinds of industrial activity is more plausibly attributed to other factors (wage differentials, raw material access, falling international transport costs, and expanding local markets) than to differences in environmental regulation. (Wheeler, 2002)

In order to find evidence for the Pollution Haven Hypothesis and the Environmental Kuznets Curve, there are numerous types of studies in the literature. With different approaches, all of the studies try to find empirical evidence for the PHH and EKC. All of the approaches will be explained beloved.

2. LITERATURE REVIEW OF ENVIRONMENTAL KUZNETS CURVE

2.1. The Kuznets Curve

In 1954, at the 67th annual meeting of American Economic Association, Simon Kuznets first delivered his “Economic Growth and Income Inequality” study. In his study, he suggests that, as per capita income increases, income inequality also increases at first, but then, after some turning point, starts declining (Kuznets 1955, 23–24). Kuznets believed that, the distribution of income becomes more unequal at early stages of income growth but that the distribution eventually moves back toward greater equality as economic growth continues. This changing relationship between per capita income and income inequality is represented by an inverted U-shaped curve, now known as the Kuznets Curve, for which Simon Kuznets was awarded by the Nobel Prize in economics in 1971. The Kuznets curve hypothesis posits that, initially, at lower levels of per capita income, income distribution is skewed toward higher income levels. As incomes rise, skewness is reduced. Income inequality becomes relatively lower.

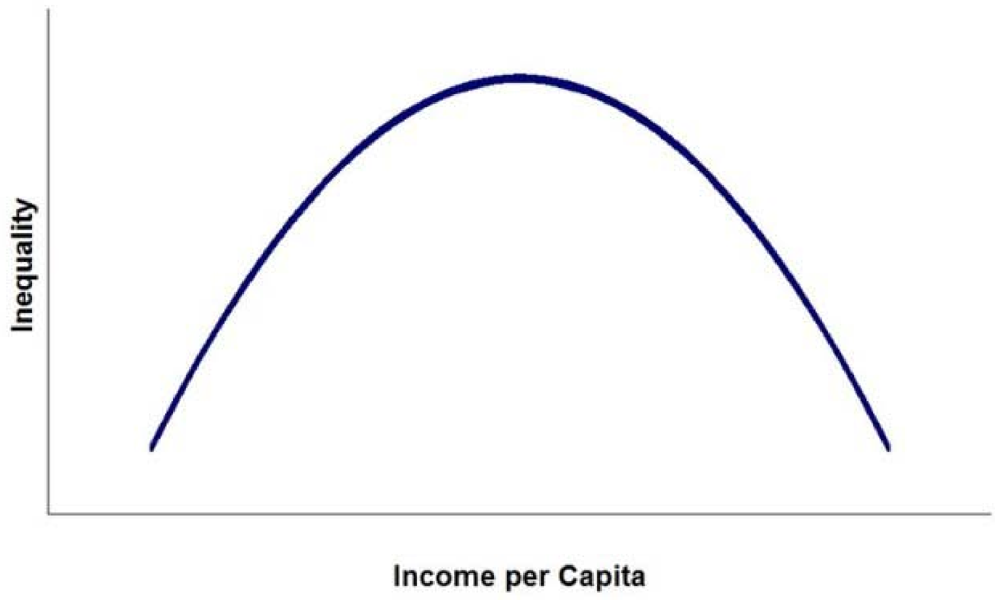
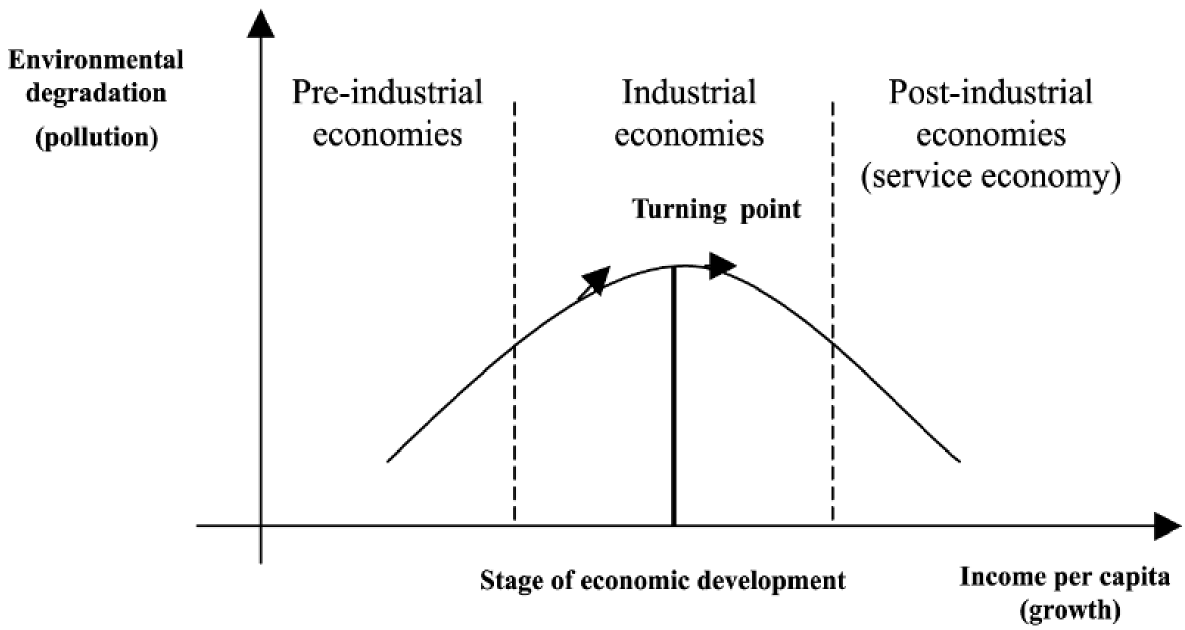


Figure 2.1 Kuznets Curve

2.2. The Environmental Kuznets Curve

In 1990s, the Kuznets Curve was first used by Grossman and Krueger (1991) in order to describe the relationship between the levels of environmental quality and related measures of per capita income. As economists were able to collect data on the environment for larger samples of countries and income levels, evidence began to appear that, as countries develop, certain measures of the quality of life might initially deteriorate but then improve. Specifically, there is evidence that the level of environmental degradation for some pollutants and conventionally measured per capita income follows the same inverted U-shaped relationship as does income inequality and per capita income in the original Kuznets curve. With only little modifications, the original Kuznets Curve figure can be converted to the Environmental Kuznets Curve.



Source: Panayotou (1993)

Figure 2.2 Environmental Kuznets Curve

The structural composition of GDP first moved in favor of pollution intensive industrial sector whilst the share of agriculture in the economy declines. At higher stages of development, the share of industry begins to fall whilst that of non-pollution-intensive service sectors rises (Syrquin and Chenery, 1988).

In other words, as development and industrialization progress, environmental damage increases due to greater use of natural resources, more emission of pollutants, the operation of less efficient and relatively dirty technologies, the high priority given to increases in material output, and disregard for, or ignorance of, the environmental consequences of growth. However, as economic growth continues and life expectancies increase, cleaner water, improved air quality, and a generally cleaner habitat become more valuable as people make choices at the margin about how to spend their incomes. Much later, in the post-industrial stage, cleaner technologies and a shift to information and service-based activities combine with a growing ability and willingness to enhance environmental quality (Lindmark 2002, Munasinghe 1999).

As Yandle *et al.* (2004) states out *"…Generally speaking, the transition from lower to higher levels of per capita income occurs over a long period of time, perhaps as much as a century, if not more. But the transition from destruction to enhancement of the environment may take place in a much briefer time period. For example, a population may be just at the enhancement threshold when rising incomes from trade expansion (or development) generate the necessary demand for environmental improvement. While an expansion of export production may initially degrade the environment, the later income effects can lead to environmental improvements - sometimes quickly..."*

According to Levinson *"...in the years since original observations were made, researchers have examined a wide variety of pollutants for evidence of the EKC pattern, including automotive lead emissions, deforestation, greenhouse gas emissions, toxic waste, and indoor air pollution. Some investigators have* *experimented with different econometric approaches, including higher-order polynomials, fixed and random effects, splines, semi- and non-parametric techniques, and different patterns of interactions and exponents. Others have studied different groups of jurisdictions and different time periods, and have added control variables, including measures of corruption, democratic freedoms, international trade openness, and even income inequality (bringing the subject full circle back to Kuznets's original idea)..."*

2.3. Empirical Evidence

The basic model of the relationship between economic growth and pollution is the general model used by Grossman and Krueger (1991, 1995), Lucas *et al.* (1992), Shafik and Bandopadhyay (1992), Selden and Song (1994), Holtz-Eakin and Selden (1995) in the early literature. It is:

$$Y_{it} = \alpha_i + t_\gamma + \beta_1 X_{it} + \beta_2 X_{it}^2 + \beta_3 X_{it}^3 + \beta_k Z_{kit} + \varepsilon_{it}$$

Where i is 1,...N, countries or cities; t is 1...T, years or time intervals; Y_{it} is the environmental stress variable; α_i is the country or city specific effect; t_γ is the time specific effect; X_{it} is the real GDP per-capita; X_{it}^2 is the real GDP per-capita-squared; X_{it}^3 is the real GDP per-capita-cubed; Z_{kit} are the other variables that impact environmental quality and ε_{it} is the error term.

The explanatory variables common to all econometric studies for the growth-environmental relationship are real GDP per-capita and its square. The GDP variable represents the scale of economic activity or income. Ceteris paribus, the larger the scale of economic activity, the higher is the generation of pollutants. On the other hand, the GDP-squared terms represents the aspects of the economy that, do not remain the same as GDP grows. These include structural transformation in the composition of GDP and increasing environmental awareness and regulation. At high income levels, the composition of GDP pushes the economies towards lower pollution intensity. Accordingly, the emission growth in per capita terms reduces. Thus, the GDP-squared term is expected to have a negative sign. The term GDP-cubed is not always included into the model. In the models that include GDP-cubed, the inverted U-shaped can be generated by different combinations of sing and magnitudes of the coefficients' on the GDP terms. In some models with the cubic term (see for example: Grossman and Krueger, 1995), the estimated relationship turns up again at very high income levels, a feature which may not have a clear economic interpretation (Suri and Chapman 1998).

Examples of variables included in Z_k are population density and openness to trade. Grossman and Krueger (1991), and Shafik and Bandyopadhyay (1992), use the trade intensity variable, defined as the ratio of imports plus exports to GDP, to measure the openness to international trade. Another variable used in order to study the impact of trade orientation is the Dollar's index of openness. Suri and Chapman (1998). Generally, this index is a measure of the extent of price level distortion in an economy. The higher its value, the more open the trade regime. This index is used by Lucas *et al.* (1992), Shafik and Bandyopadhyay (1992).

In the existing literature Grossman and Krueger (1991) were the first to articulate the concept which has come to be known as the EKC. Using different versions of the model above, they applied a critical test to the hypothesis that, greater openness to trade will lead to lower environmental standards in order to retain international competitiveness. They use comparable measures of three air pollutants in a cross-section of urban areas located in 42 countries to study the relationship between air quality and economic growth. They find for two pollutants (sulfur dioxide and smoke) that, concentrations increase with per capita GDP at low levels of national income, but decrease with GDP growth at higher levels of income. For atmospheric urban concentrations of sulfur dioxide, they found evidence contrary to the hypothesis and concluded that *"...sulfur dioxide levels are significantly lower in cities and are located in countries that conduct a great deal of trade...'* For other pollutants they did not find a significant association with trade.

Their basic model is $E_{it} = \beta_0 + \beta_1 Y_{it} + \beta_2 Y_{it}^2 + \gamma_i + \lambda_t + \varepsilon_{it}$ where E_{it} is a measure of emissions per capita for a given pollutant for country i in year t, Y_{it} is GDP per-capita in country i at time t, γ_i is a fixed-effect term which controls for country-specific heterogeneity; λ_t controls for global year effects; and ε_{it} is treated as a stochastic, normally distributed error term, often after correcting for serial correlation and heteroskedasticity. The coefficients β_0, β_1, and β_2 and the intercepts for each country and year are estimated using a panel fixed-effect regression.

Evidence supporting the EKC is found if, $\beta 1>0$ and $\beta_2<0$. If $\beta_2<0$, peak emissions per capita is $Y^* = -\beta_1/2\beta_2$. If the variable Y is measured in logs, then exp(Y^*) will yield the monetary value representing the turning point, or the peak, of the EKC.

They distinguish 3 separate mechanisms by which a change in trade and foreign investment policy can affect the level of pollution and the rate of depletion of scarce environmental resources.

The first one is the *scale effect*, that is, if trade and investment liberalization causes an expansion of economic activity, and if the nature of that activity remains unchanged, then the total amount of pollution generated must increase.

The second one is the *composition effect*, that is, trade liberalization will lead each country to shift their resources into the sectors that make intensive use of its abundant factors. The net effect of this on the level of pollution in each location will depend upon whether pollution intensive activities expand or contract in the country that on average has the more stringent pollution controls.

The third and the last one is the *technique effect*, that is, the output need not be produced by exactly the same methods subsequent to a liberalization of trade and foreign investment as it has been prior to the change in regime. In particular, the output of pollution per unit of economic product need not remain the same.

According to Grossman and Krueger (1991), *"...there are at least two reasons to believe that, pollution per unit of output might fall, especially in a less developed country. The first reason is that, foreign producers may transfer modern technologies to the local economy when restrictions on foreign investment are relaxed. More modern technologies due to the growing global awareness of the urgency of environmental concerns. The more important other reason is that, if trade liberalization generates an increase in income levels, then the body politic may demand a cleaner environment as an expression of their increased national wealth. Thus, more stringent pollution standards and stricter environmental enforcement of existing laws may be a natural political response to economic growth..."*

Cole, Rayner, Bates (1997) examines the relationship between per capita income and a wide range of environmental indicators using cross-country panel sets. The manner in which that has been done overcomes several of the weaknesses associated with the estimation of environmental Kuznets curves (EKCs) outlined by Stern *et al.* (1996).

Their paper extends the previous empirical analysis of EKCs in a number of ways. First, it is more extensive in that it investigates a wider range of environmental indicators and employs more recent data, thereby serving as a check on earlier results. Second, it utilizes a generalized least squares (GLS) estimation procedure to correct for heteroscedasticity and autocorrelation, by giving more efficient estimations in contrast to many earlier studies, which rely on ordinary least squares (OLS) . Third, standard errors at the estimated turning point level of income are calculated to indicate the accuracy of the estimates like Grossman and Krueger (1993, 1995). Fourth, the possibility of contemporaneous feedback from environmental degradation to economic growth, which would lead to simultaneity bias in the estimation of EKCs, has been examined by testing the null of exogeneity of the income variables.

The results suggest that, meaningful EKCs exist only for local air pollutants whilst indicators with a more global, or indirect, impact either increase monotonically with income or else have predicted turning points at high per capita income levels with large standard errors – unless they have been subjected to a multilateral policy initiative. Two other findings are also made: that concentration of local pollutants in urban areas peak at a lower per capita income level than total emissions per capita; and that transport-generated local air pollutants peak at a higher per capita income level than total emissions per capita. Given these findings, suggestions are made regarding the necessary future direction of environmental policy.

Grossman and Krueger (1995) again examines the relationship between national GDP and various indicators of local environmental conditions using panel data from Global Environmental Monitoring System (GEMS) . Their indicator variables are related to urban air pollution and contamination in river basins. They find no evidence that economic growth does unavoidable harm to the natural habitat. Instead, they find that; whilst increases in the national GDP may be correlated to worsening environmental conditions in very poor countries, air and water quality seem to benefit from economic growth when some critical level (the peak level) of income has been reached. They note that, the downward sloping portion of the EKC could arise *''...because as countries develop, they cease to produce certain pollution intensive goods and begin instead to import these from other countries with less restrictive environmental protection laws...''*. They rely on their own study (see, for example, Grossman and Krueger, 1991; Tobey, 1990) to conclude that the magnitude of this impact is small.

Stern *et al.* (1996) propose that, there is an inverted U-shape relation between environmental degradation and income per capita, so that, eventually, growth reduces the environmental impact of economic activity. Their concept is dependent on a model of the economy in which there is no feedback from the quality of the environment to production possibilities, and in which trade has a neutral effect on environmental degradation. The actual violation of their assumptions gives rise to fundamental problems in estimating the parameters of an EKC. The paper identifies other econometric problems with estimates of the EKC, and reviews a number of empirical studies. The inference from some such EKC estimates that further development will reduce environmental degradation is dependent on the assumption that world per capita income is normally distributed when in fact median income is far below mean income. They carry out simulations combining EKC estimates from the literature with World Bank forecasts for economic growth for individual countries, aggregating over countries to derive the global impact. Within the horizon of the Bank's forecast (2025) global emissions of SO_2 continue to increase. Forest loss stabilizes before the end of the period but tropical deforestation continues at a constant rate throughout the period.

According to Antweiler *et al*. (1998), *"...Empirical work by Grossman and Krueger (1993), Jaffe et al. (1995) and Tobey (1990) cast serious doubt on the strength of the simple pollution haven hypothesis because they find trade flows are primarily responsive to factor endowment considerations and apparently not responsive to differences in pollution abatement costs…"*. In order to find an answer whether international trade has any effects on the environment, they set out a theory of "*how openness to international goods markets affects pollution levels to assess the environmental consequences of international trade*". They develop a theoretical model to divide international trade's impact on pollution into the three effects (scale, composition and technique effects) which were defined by Grossman and Krueger (1991) and then examine that theory by using data on sulfur dioxide concentrations from Global Monitoring Project System (GEMS). They find that, international trade creates relatively small changes in pollution concentrations when it alters the composition, and hence the pollution intensity, of national output. They conclude that, *"…Combining this result with our estimates of scale and technique effects yields a somewhat surprising conclusion: if trade liberalization raises GDP per person by 1%, then pollution concentrations fall by about 1%. In the case of sulfur dioxide concentrations, free trade is good for the environment…"*

With a different aspect from the other literature studies, Suri and Chapman (1998) examined the inverted U-shaped relationship of growth with a reduction in energy use (the source) instead of a reduction in emissions per unit of energy (the emission coefficient) through end-of-pipe cleanup. In their paper they quantified the effect that growth, structural change and international trade with commercial energy requirements. They present two different models one of which is similar to the earlier literature studies that, the impact if structural change and trade were implicitly captured in GDP-squared. In the second model, they examine the impact of international trade on commercial energy consumption. They found that, the introduction of trade variables considerably raised the turning point of the curve for energy consumption to about $224000. Ceteris paribus, according to them, *"…this would imply that incorporating trade effects would also tend to increase the turning point for pollutant emissions related to energy use…"*

Again according to Stern and Common (1998) , in the existing EKC literature, most of the studies whose estimations based on sulfur, use samples of mainly high-income countries, indicate a maximum emissions turning point at middle to lower high-income levels of GDP per capita. They use a larger and more globally representative sample than previous sulfur EKC studies. The results show that, sulfur emissions per capita are a monotonic function of income per capita when we use a global sample and an inverted-U shape function of income when we use a sample of high-income countries. A model estimated in first differences results in a monotonic EKC when estimated with both high-income and global samples. Reductions in emissions are time-related rather than income-related.

Harbaugh et al. (2002) use an updated and revised panel data set on ambient air pollution in cities worldwide to examine the robustness of the evidence for the existence of an inverted U-shaped relationship between national income and pollution. They test the sensitivity of the pollution-income relationship to functional forms, to additional covariates, and to changes in the nations, cities, and years sampled. The results are highly sensitive to these changes. Finally, they conclude that, there is little empirical support for an inverted U-shaped relationship between several important air pollutants and national income in these data.

Different from the early literature of EKC, in 2000s as an extensition of the studies, authors and researchers begun to combine their researches with the Pollution Haven Hypothesis (PHH) studies.

Cole (2004) criticizes the EKC literature as the “trade patterns” weren’t taken into consideration. According to him, these trade patterns may partially explain a reduction in pollution in high income (developed) countries, reversely an increase in low income (developing/less developed) countries. He claims that, PHH could potentially generate these trade patterns. And adds that, *“...if PHH holds, then the EKC may not imply a net reduction in pollution but simply a transfer of pollution from developed North (developed countries) to South (developing countries)...”*. In one sense, The PHH would provide evidence to those who claim that, the EKC’s inverted U-shape is simply caused by the developed countries, whose polluting industries are shifting to developing countries.

He examines the extent to which the EKC inverted-U relationship can be explained by international trade and especially the migration/displacement of “dirty” industries from developed countries or regions to developing countries or regions (defined in the literature as “Pollution Haven Hypothesis”).

With a detailed data on North-South trade flows, he examines the evidence for PHH, assesses the extent to which trade patterns are influencing pollution emissions and ascertains whether those trade patterns could be determined by different environmental regulations between the North (Developed Countries) and the South (Developing Countries). In order to examine EKC, he analyses the EKC relationship with a very wide range of environmental indicators.

The analysis of net exports of pollution intensive goods relative to domestic consumption for develeloped-developing trade pairs provided little evidence of pollution havens. It's been concluded that, the pollution havens are more likely to be temporary and limited to some certain regions and industries.

The EKC analyses also have two strong results. One of which is that, the share of manufacturing output in GDP has, in general, a positive, statistically significant relationship with pollution. Thus, the relative contraction of the manufacturing industry as a whole has proven beneficial to OECD pollution emissions. Finally, having controlled for structural change, income and possible pollution havens effects, trade openness still exhibits a negative statistically significant relationship with pollution.

In order to investigate the EKC, Copeland and Taylor (2004) , use a simple pollution demand-and-supply system connecting the pollution levels to national – specific features (e.g. incomes, factor endowments and technologies) and trading opportunities (e.g.. comparative advantage and current trade restrictions) .

As they stated out, *"...they do not provide unequivocal answers to the questions we pose. Instead we try to report on the current state of affairs and identify the set of important but as yet unanswered questions that we need to resolve to better understand the trade, growth, and environment link…."*

In a more recent study by Kearsly and Riddel (2009), according to them, if the PHH holds, then omitting exports and imports from industries, such as manufacturing, that are associated with relatively high emission levels i.e. dirty industries, may bias with the estimate of the EKC's turning point. (Cole, 2004). In this paper, they pay attention to the effect of trade on EKC relationship in developed countries for seven oft-studied emissions such as carbon dioxide, GHGs in aggregate, CO, SO_x, VOC, NO_x, and suspended particulate matter using a panel data for 100 developing countries. They estimate six models of the relationship between emissions per capita and GDP per capita for each of the seven pollutants.

The major finding of their paper is that, they couldn't find statistically significant EKC relationship for the majority of their models. And for the PHH, they find little evidence. They conclude that, *"...there is no stable pattern of import sectors that, decrease emissions, as one would expect when emission types are so highly correlated...."*

3. LITERATURE REVIEW OF POLLUTION HAVEN HYPOTHESIS

3.1.Introduction

The studies in the PHH literature that have been examined more than three decades can be divided into two main areas, depending on the proxy that has been used as a left-hand-side variable. In order to find empirical evidence for the PHH, the authors and the researchers start with the determination of the method that should be used. In the existing literature, we can classify the studies into two main areas as, examining the foreign (direct) investment on a sector, industry, firm or country basis and the studies examining international trade flows again of a sector, industry, firm or country basis. The previous studies in the literature will be explained respectively beloved.

3.2. Studies Examining the Foreign (Direct) Investment Flows

More than two decades, global FDI flows, especially those from industrialized (developed countries) to developing/less developed countries have increased significantly. Such trends have encouraged a larged-scale literature of PHH to examine the structural determinants of FDI flows (see, for example, Froot, 1993) and the relationship between FDI and productivity spillovers (see, for example, Aitken et al, 1996; Aitken and Harrison, 1999; Görg and Strobl, 2001).

Several papers have investigated the relationship between environmental regulations and FDI. These studies have taken a variety of approaches. One approach is a statistical comparison of countries. These studies do not utilize OLS. A second approach is to look at the variation in environmental regulations within a region or a country. Lastly, another approach uses US FDI outflows to several partner countries.

In the literature, the majority of these studies that have examined the relationship between FDI and the environment find no link between industry abatement costs and developed country outbound FDI flows. (see, for example, Dean, 1992; Zarsky, 1999; Fabry and Zenghi, 2000; Eskeland and Harrison, 2003)

According to Xing and Kolstad (2002); the differences between the strictness of environmental regulations of industrialized (developed) and developing countries cause much controversy and debate on the influence of environmental regulations on economic growth in an open economy. One of the most important aspects of the debate is the impact of environmental regulations on international competitiveness and the location of polluting industries. Here, the basis hypothesis is that, environmental regulations have a strong effect on industrial location and those different regulations between two countries will at minimum, induce specialization and probably significant capital movements to the country with weaker regulations.

The primary aim of their study was to evaluate the effect of the stringency of environmental policy on the location of polluting industries. At this point, their methodology differs from the previous studies. Particularly, they examine the relationship between the capital outflow of several US industries and the environmental policy of the host country.

They find in their study confirmation of theoretical predictions about effects of weaker/stricter environmental regulations on industry locations. They present a statistical test of the impact of environmental regulations on the capital movement of polluting industries.

The study examines foreign direct investments (FDIs) of several US industries, some of which are polluting intensive (chemicals and primary metals) and others are relatively less polluting (electrical and non-electrical machinery, transportation equipment, and food products). They compare the econometrical results of the two industry groups. Thus, they extent the existing literature by using a more direct measure of capital movements as well as a better measure of the strictness of environmental regulations. For the polluting industries, they find a significant effect of strictness of environmental regulations on FDI. They find that, weaker environmental regulations do tent to attract capital, but this result doesn't hold for the less polluting industries.

They used a semi-log linear model of FDI determination using instrumental variables of these six US industries. In their model, they include the stringency of environmental regulation as one of the determinants. They used aggregate national sulfur emissions as the pollutant.

The results suggest that, there exists a significant negative linear relationship between the FDI of the US' two polluting industries (chemical and metal industries) and the stringency of environmental regulations in a foreign host country. These results mean that, lax environmental policies tend to attract more capital inflows from the pollution intensive industries of US into the host developing countries. These findings provides indirect support to the PHH, which assumes that, developing countries may utilize lax environmental regulations as a strategy to compete for the investment of polluting industries from developed countries.

Finally they emphasize that, *"...our empirical study only identifies the impact of environmental regulations on capital outflows and reveals the role of environmental regulations in the decision-making of the FDI of polluting industries. It would not be appropriate to conclude that, environmental regulations alone can decide the direction of FDI flows of a polluting industry..."*

According to Eskeland and Harrison (2003); there is a growing literature on the determinants of global environmental quality, but little research has been done to test the PHH. Instead, much of the literature focuses on the relationship between income, growth and pollution.

Their paper tests, whether multinational firms are accumulating in developing country "pollution havens" to take the advantage of lax environmental standards.

In their paper, they focus on three related issues. They begin by analyzing the pattern of foreign investments in a number of developing countries, looking for evidence which reflects increasing costs of pollution-intensive activities at home (in industrialized country). To control for other factors which may be important in helping to attract foreign investment, they create different kinds of trade policy measures, industrial concentration, the domestic regulatory environment, factor endowments and wages at home. They use data from four host developing countries; Cote d'Ivoire, Morocco, Mexico and Venezuela. The major FDI source to these four developing countries are; the US, for Mexico and Venezuela, and, France; for Cote d'Ivoire and Morocco.

Second, they compare the behaviors of these multinational firms with their counterparts in these host countries. Especially, they focus on the emission behaviors of foreign and domestic plants within the same manufacturing sector. Since emission rates are not available, they use energy consumption and the composition of fuel types as a proxy for emissions. They present evidence from the US to confirm that, fuel and energy intensities can be used as proxies for differences in pollution intensities within an industry.

Third, they test whether the pattern of outbound US investment during the 1980s and early 1990s can be explained by variations in the pollution abatement costs across different sectors of the economy.

Their focus is consequently on two related issues;

(1) The impact of pollution abatement costs on the composition of foreign investment and,

(2) the role by foreign investors in improving the environment but using more energy-efficient technology as well as cleaner sources of energy.

Grossman and Krueger (1991) label these issues as the composition and the technique effect, respectively.

Using a number of different measures of pollution, they find some evidence that foreign investors are concentrated in sectors with high levels of air pollution, although the evidence is weak at best. They find no evidence that, foreign investment in these developing countries is related to abatement costs in industrialized countries. They proceed to test whether, within industries, there is any tendency for foreign firms to pollute less or more than their local counterparts. Their proxy for pollution intensity is the use of energy and dirty fuels they find that, foreign plants are significantly more energy efficient and use cleaner types of energy.

And finally, they turn to an analysis of the "originating country" by examining the pattern of outbound US investment between 1982 and 1993. Although there is some evidence that, the pattern of US foreign investments is skewed towards industries with high costs of pollution abatement, the results are no robust to the inclusion of other variables, once they include other controls in the analysis or allow for industry effects, the results are reversed: outbound foreign investment is highest in sectors with low abatement costs.

According to Cole and Elliott (2005); the only study theoretically model the effect of capital intensity and environmental regulations on outbound FDI is Eskeland and Harrison (2003).

They summarize their model as;

(1) A firm in a given sector stays at home, keeps the old technology and pays the abatement costs,

(2) Moves location and keeps the old technology and pays lower abatement costs,

(3) Remains at home and invest in cleaner technology and pays lower abatement costs.

Using a gravity equation approach (based on an equation consistent with the Eskeland and Harrison's theoretical framework) they examine the relationship between a sector's outbound FDI and abatement costs. They also control for a number of other related variables such as; capital-labor ratios, market size, transport costs, wage differentials, availability of skilled labor and trade openness which is commonly used in many empirical FDI papers. (See for example, recent studies by Brainard, 1997; Braconier and Ekholm, 2000; Carr et al., 2001, Eskeland and Harrison, 2003).

They examine the US' multi-sector outbound FDIs to Brazil and Mexico and found that, the capital requirements of a sector to be a key determinant of FDI. It's been also found that, the level of pollution abatement costs in a US industry to be a statistically significant determinant of that industry's FDI providing evidence of a PH effect.

Finally they account for why Eskeland and Harrison (2003) find no evidence of PH effects in Morocco and Cote d'Ivoire. According to Cole and Elliott, these countries do not have capital endowments that are necessary to attract investment in capital (pollution) intensive industries. And also they are not sure why they find no PH evidence for Venezuela and Mexico. They predict that, one reason may be that, their analysis is undertaken using total FDI into these countries rather than FDI from the US or from developed countries as a whole. Furthermore, the analysis for Mexico is based on data for 1990, alone. By focusing on the relationship between capital intensity and pollution intensity, they are able to identify the likeliest countries to be considered as PHs. Examining these countries alone, provides reasonably robust evidence that the higher the abatement costs in a US industry, the greater the FDI from that industry.

Another recent study in the literature is McDermott (2009). He examines the relationship between bilateral FDI flows between 26 OECD countries from 1982 to 1997. The study uses a variation for gravity model to panel date in order to investigate the relationship, if any exists, between environmental regulations and FDI.

To address the unobservable nature of environmental regulations, the study uses the approach established by Xing and Kolstad (2002) wherein an observable measure of pollution is substituted for unobservable environmental regulations. This coupled with measures of the cost of labor and capital, host and source country GDP, as well as distance, makes up the core of the independent variables.

The study faces a similar problem that found in most studies in the literature of quantifying the strictness of environmental regulations. This study uses the method of Xing and Kolstad (2002), replacing the unobservable environmental regulations with observable and quantifying variables.

Finally, the study finds strong evidence in support of the PHH. That means, firms appear to be attracted to countries with weaker environmental regulations. In addition, FDI does not fall with distance and contrary to expectations, GDP, nor the prices of capital or labor are found to influence the investments.

3.3. Studies Examining International Trade Flows

In the early literature, Tobey (1990), tests the impact of domestic environmental policies on trade patterns. He uses a multi- factor, multi-commodity extension of the Heckscher-Ohlin model of international trade (Heckscher-Ohlin-Vanek). He regresses trade in a specific commodity (dirty commodities are defined in function of pollution abatement costs in the US) on country characteristics. He conducts estimations, where environmental stringency appears as an explanatory variable (the sample includes 23 countries) and also applies the omitted variable test. In any case, even when extending the model with non-homothetic preferences or scale economies and product differentiation, does he find that the introduction of environmental control measures have caused a deviation of trade patterns from the

HOV model. The study finds that, differences in the stringency of environmental regulations do not affect trade patterns. This conclusion is supported by the fact that, pollution abatement costs are very small measured in function of total costs and thus not likely to influence firms' production function decisions. Although this early test is quite general, its assumptions can be questioned and other methods have been used to test the PHH.

Another approach in the empirical literature of the PHH based on cross-country analysis for one or for limited number of countries. This approach narrows the scope of findings but allows for a better control for country-specific factors. A number of studies based on US data have tried to extend the empirical analysis of Grossman and Krueger (1991), who found no positive link between the level of abatement costs in the industry and the amount of imports from South. In general, these studies on the US tend to indentify PH-effects once appropriate variables are endogenous (abatement costs in the case of Ederington and Minier (2001)). However, as these methodologies are very data demanding, they are hard to apply to developing countries. Even though the recent paper of Eskeland and Harrison (2002) and Smarzynska and Wei (2001) tend to suggest that, some pollution emissions are/or environmental standards play a certain role in the localization of multinationals, these impacts are very limited in scope, so it is fair to say that overall, the empirical evidence regarding PH-effects in developing countries are rather scant.

And another important study in the literature is Antweiler, Copeland and Taylor (2001). They emphasize the two alternative explanations of trade flows in polluting products, the PHH and the factor endowment motive.

They develop a general equilibrium model where pollution abatement is resource-consuming and environmental policy is endogenously determined and becomes more stringent when income per capita rises. In this framework, comparative advantage in dirty products depends on both factor endowments and environmental taxes. This leads to a reduced form of expression where pollution emissions depend on three basic effects described as the scale, technique and composition effect.

The data base includes 108 countries around the world and an almost perfect pollutant as sulphur dioxide (SO_2) concentrations.

As expected, the trade-induced scale effect on pollution emissions turn out to be positive, while the technique effect has a negative impact (higher income per capita leads to higher regulation). The composition effect depends on the relative capital/labor ratio and on the income per capita of the country.

In appears that, for rich countries, factor endowment motives are offsetting tighter pollution policy. This may explain why other investigations have failed to find a significant relationship between the strictness of pollution regulations and decreased trade in capital-intensive dirty goods.

Matys (2002) examines in her license thesis, the reasons why the polluting industries tend to locate where environmental regulations are low. (Especially in developing countries)

In her study, she examines Fredriksson's (1999) PHH definition "*...whether reduced trade barriers will result in a specialization by developing countries in pollution intensive industries...*"

The objective of her work is to provide empirical evidence on the PHH following two routes. Firstly, using a large sample of countries (both developing and developed), the paper analyses trade flows in polluting activities over the last decades. Simple ratios, indices of revealed comparative advantage and regressions are computed in order to indentify empirical regulataries. Although informative, this approach is often data-constrained and fails to identify effects that are specific to each country. Thus, on the other hand, case studies are provided that analyze in more details the impact of trade and environmental policy on production and trade of dirty products in particular countries. Overall, it turns out that, some PH effects are indeed identified. However, they are not systematic, neither across countries, nor between countries.

The data, that's been used in the study, contains 3-digit ISIC (International Standard Industrial Classification) on imports, exports and mirror exports (*"mirror exports are exports calculated using import data reported by partner countries. For fiscal reasons, import data are in general of better quality. Thus, mirror exports may be more reliable than exports. Unless otherwise specified, the former is used"*).

In order to examine the PHH, she classifies the countries into different income groups. Using the World Bank's criteria (GNP per capita), she divides the countries into 3 groups as: low income countries (LINC); (less than 635$), middle income countries (MINC); (between 635 and 7910$) and high income countries (HINC); (more than 7910$). The sample includes 52 countries (5 LINKs, 25 MINCs and 22 HINCs) for the period of 1981-1998. In the cross-country analysis, she groups the LINCs and MINCs together as developing countries because of the small number of Links in the sample.

In order to classify polluting industries, instead of using a classification based on a single parameter such as abatement costs in the US industries, the multidimensional and more direct criterion detailed by Mani and Wheeler (1999) has been chosen. This latter classification takes into account emission intensities per unit of output in three different areas, namely conventional air pollutants, water pollutants and heavy metals. The five most polluting industries have been determined as; paper and products, industrial chemicals, other non-metallic mineral products, iron and steel, and lastly non-ferrous metals.

To examine the representativity of the sample, World Bank's Economic Indicators (2001) used. And also to use an indicator for polluting products (PP), she used the standardized import-export ratio.

In world trade, the share of developing countries' polluting production has quietly increased in the sample period. Compared to polluting imports, the growth in polluting exports has also increased. According to the author, these findings suggest a delocalization of polluting activities from developed (DC) to developing (LDC) countries, which exactly what the pollution haven hypothesis predicts. She adds that, we must take into account the change in the share of LDC in all products, polluting and non-polluting combined. These criterions reveal even more flagrant increases in the share of LDC in world exports. When computing aggregate indices (the ratio of PP over all products for imports and exports respectively) we can find a decreasing revealed comparative advantage for LDC. This means polluting industries are moving out of LDC, which supports the factor endowment hypothesis, rather than the PHH that predicts the right opposite.

The same calculations have been applied to each polluting ISIC category separately but only limited evidence found for PHH.

When we put all these results together, there is no existing confirmation of PHH. Contrary to the expectations, these results suggest a reverse delocalization of polluting industries from LDCs to industrialized countries instead.

After examining the computing indices, the author also looks at the means and the variances within the two income groups. According the author, if PHH holds, the average share of PP for developing (developed) countries should increase (decrease) for both groups. But the reported results are not as they expected to be. The mean of the share of polluting products in exports decrease in both groups. It decreases for developing countries less than for developed countries. Furthermore, the standard deviation decreases indeed in both income groups. But at this point, the decrease for the higher income group is more important. That's why these results may be accepted as some support for PHH.

The same calculations have also been applied to disaggregated ISIC data. Only in non-ferrous metals category is in contradiction with delocalization hypothesis.

To sum up, the results based on PP in total products report some evidence for the PH or delocalization hypothesis. But these measures do not control for the worldwide change of the share of PP in total products. In order to put in order that default and to improve the general view of those results, revealed comparative advantages (RCA) which measures the relative export performance of each country also have been calculated. By calculating the country RCAs, the author finds evidence in favor of the PHH.

To sum up, the author finds some evidence in favor of the PHH. For both developing and developed countries the results show a general decrease in the shares of polluting products in exports. In the range of world's top ten exporters of PP, the number of LDCs increased and most of the LDCs report increased RCA in PP. However the findings are not clear and the results vary with respect to the polluting industry analyses and because of the composition effect, LDCs as a group, report decreased RCA in PP. Thus she finds some evidence for PHH, but as Mani and Wheeler (1999) pointed out before, the phenomenon seems to be relatively unimportant and probably transient.

One of the *a priori* results of the PHH is that, while the developed countries get cleaner with the help of transaction of the polluting industries to the developing countries, the LDCs are getting dirtier. With the general definition of the EKC we can suppose that, LDCs are situated at the left side of the critical income (maximal pollution level), while high-income countries are situated to the right side.

For cross-country analysis, the author runs two kinds of regressions; first one is to test this EKC-like effect. By the way of running the regression, the share of polluting exporters (or equivalently imports) in GDP would be explained by per capita income and its square term, to specify the inverted-U relationship. The regressions by period are not significant. When the author divides the data by income groups, the coefficients become significant. Thus she gets two significant regression curves for each income groups.

Running the same regression by ISIC category gives expected and significant coefficients for the industry "other non-metallic mineral products". The other industries report also expected signs but these are not significant. When the regression is run by country; for 15 countries out of 51, the results are significant. They report an inverted-U shape and the rest have normal U.

Finally, the same regression has been run to explain the import shares of polluting products. The coefficients continue to remain non –significant even when the sample divided for period, income, or for ISIC category. But when it's been run by country, the coefficients turn out to be significant for 8 countries. For 6 LDCs and for 2 HINCs inverted-U shape has been found.

The second regression examines the relationship between the shares of polluting exports and imports in GDP and the variable which captures the length of the period since the trade liberalization and its squared term. The aim of running that kind of regression is to provide a simple test of the decomposition proposed by Dean (1996)[2]

[2] Dean (1996) decomposes the influence of trade liberalization on pollution into two opposite effects; a negative direct one due to the increase in the relative price of dirty goods. (thus increased speacialisation in this sector) and a positive indirect one through increased factor productivity (which increases income and thus decreases the supply of environment).

Using export shares as explained variable, the coefficients at the aggregate level are insignificant, which is also true for the split into the different ISIC categories. However, for the end of the period, the coefficients have the expected signs and are highly significant. This result is clearly favorable to the argument that the PHs, if they exist, is transient.

For the cross-country analysis, the first regression model has been run pooling up annual data using a random effect model to control for unobserved factors. This time the coefficients are strongly significant and report the expected inverted-U shape.

All these regressions show that there is indeed a link between exports of PP relative to GDP and income per capita. Most of them follow an inverted-U shape.

In the case studies, in order to expose the *a priori* PH effects, three countries (Malaysia, Mexico and India) have been used. The reason why especially these countries have been chosen is that, all of these three countries had trade liberalization at different times in the period of time, that's been used in the sample. If the PHH holds and these countries have lax environmental regulations, these countries may produce more dirty goods as a result of their trade liberalization.

All of the same stages and the methods that have been used in examining the cross-country analysis are used in this examination too. The database was the same as in the previous section and this time not only trade but also production data are exploited.

The author explains the regression results as; *"For Malaysia, with the help of globalization, there is an increased importance of PP in the period. There is some evidence of the PHH. Mexico may have experienced some consequences predicted by the PHH. The production of PP relative to total products may have gone up but, the impact may be only transitory and it is possible that emissions per unit of output* *have gone down, so the effect on total emissions is unclear. India shows increased specialization in PP with increased globalization. Moreover, one could see some evidence for the PHH when looking at the trajectory (though not at precise dates) of the indicators after trade reforms. Note also, that in this case most polluting industries behave in the same way."*

In conclusion, the author uses two different approaches in the paper. Using the cross-country data for 52 countries, she finds no evidence for the delocalization hypothesis. But when she examines the same approach with industry level data, except for the "non-ferrous metals" industry there is some evidence of PH effect. With the second approach, she examines three "country basic" regressions. And she finds that, for some industries and for some indicators of these three countries there is an increase in the importance of PP.

In another study Mathys (2003) again interrogate the PHH. In her term paper, her aim is to test the PHH and she discusses which methods may be used in order to overcome the missing data problem.

In this work, one of the possible effects, namely the implication predicted by PHH will be tested empirically. She estimates a large number of countries over more than ten years. Also she investigates each polluting industry separately, in order to take into account the differences between them.

She uses Liddle's (2001) PHH definition. For this author the PHH is verified if low environmental standards become a source of comparative advantage and therefore drive shifts in trade pattern. To be more specific she assumes developed countries are severe concerning environmental regulation and developing countries are less strict (increased GDP per capita leads to a stronger concern about the environment. (See, for example, Mani and Wheeler (1999)). This leads to a comparative advantage in polluting products for developing countries.

An early study on the PHH is Tobey (1990), who tests in a Hechscher-Ohlin-Vanek (HOV) framework the impact of domestic environmental policies on trade patterns. More precisely, he regresses trade in a specific "polluting" commodity on country characteristics. He uses two approaches. The first one has environmental stringency as an explanatory variable in the equation (23 countries in the sample), while the second one is a so called omitted variable test (58 countries), where he examines the signs of the estimated error terms. In no case, even when extending the basic HOV model of international trade with non-homothetic preferences or scale economies and product differentiation, he finds that the introduction of environmental control measures has caused a deviation of trade patterns from the HOV predictions.

The HOV model is an extension of the HO model which simply predicts that a country should export goods which use intensively than factor of production that is relatively abundant in this country. Mani and Wheeler (1999) and Cole and Elliott (2002) show that polluting industries are typically capital intensive. One easily accepts that developed countries are relatively capital abundant compared to developing countries and would therefore specialize in polluting industries. Hence, the HOV prediction of trade flows is exact opposite of the PHH. This work tries to figure out whether the coefficient on environmental stringency is significant and has the right sign when controlling for endowment (HOV) effects.

To do this, or each polluting industry she runs a regression with a "net exports" dependent variable. In contrast with Cole and Elliott (2003), the preferred specification will estimate a separate regression for each polluting industry. She suggests that, if there is indeed a PHH story in the data, it is more likely to be found at the disaggregated level.

The data in the study includes 52 developing and developed countries. Basically, there are three different categories of data. Firstly, the explained variable is net exports (exports-imports) of the five most polluting industries, which are defined by Mani and Wheeler (1999) but using emission intensities per unit of output in three different areas (conventional air pollutants, water pollutants and heavy metals) based on the 3-digit ISIC classification. And secondly, there are two groups of explanatory variables. One group contains variables relative to the classical Heckscher-Ohlin-Vanek (HOV) trade model, while the other group captures the PHH. The variables that account for HOV theory are relative factor endowments of capital, human capital, labor capital, labor force and land.

Relative factor endowment in each factor can be defined as the ratio between the country's share of endowment of the factor and the share of the country in world GDP. Equivalently, it is the ratio between actual endowment and theoretical endowment. This is very similar to the relative endowments defined by Vanek but it has the advantage that is comparable over factors.

And finally as a measure of environmental stringency average maximum least content of gasoline has been used. The average has been worked out by using different types of gasoline and weightining them by their market share. Therefore, the proxy constructed takes into account the importance of the different types of gasoline in the overall market. Since it is impossible for the moment to get a good global index of environmental stringency, the average maximum lead content represents at least one of the most important environmental policies. And also Damania et al (2000) qualified the lead content in gasoline as the "most viable dynamic consumption proxy" for environmental stringency at the country level.

In order to determine whether the data has indeed a panel structure, she looks at the summary statistics which decompose the overall variation into the between and within variation. The listed variables report variation between countries as well as variation for each country over the different years. This clearly points at panel techniques. To be more sure, the Breusch- Pagan test has been applied to the sample. This test examines the poolability of the samples that's been used. The test rejects the null of no dimension for all polluting industries pooled, so all the polluting industries will be examined separately.

And also, in order to determine whether random effects model or fixed effects model would be used, the author applies Hausman Test. And according to the results, for three industries fixed effects, and for two industries random effects model will be used.

All of the regression results suggest that, in four out of five polluting industries, there exists indeed a PHH effect. According to the author, these results mean that, lower environmental standards increase (through revealed comparative advantages) net exports in polluting sectors.

Again Mathys (2003) in her master's thesis examines whether environmental regulations influence trade patterns as predicted by PHH. I.e. *do polluting industries indeed tend to locate where environmental standards are low, especially in developing countries?*

The objective of her study is to provide recent empirical evidence on the PHH, firstly by using data on a large scale of countries including both developing and developed countries in a more than 10 years period of time, traditional regressions which explains dirty and clean exports by factor endowment and environmental stringency will be run and secondly, using country and industry data in a more efficient way, the predictions by the factor endowment and the PH theory are tested by using interaction terms between country and industry characteristics.

She uses in her model several trade flow determinants that have been mentioned in the theoretical ACT model. In order to test the PHH, a variable for environmental stringency, an income measure as well as pollution intensity and a factor endowment measure are used.

She uses two different approaches. First one is similar to the HO approach which explains trade flows of polluting industries by factor endowments and environmental regulation, treating the policy choice as endogenous.

She again uses the approach of Mani and Wheeler's (1999) in order to indentify polluting industries as in her previous studies. This time she identifies the five cleanest industries beside the five dirtiest industries.

In her second regression approach, the panels have country and industry dimensions, which allow to introduce interaction terms and to use data more efficiently.

According to the author, by the help of the interaction terms, it is possible to test the standard predictions made by the theories. When she examines a standard HO model with capital and labor as factors of production, theory predicts that, labor (capital) abundant countries should specialize in labor (capital) intensive industries. When she examines the PHH, the countries which have lax environmental regulations should specialize in pollution intensive industries. In order to confirm these hypotheses, coefficients of the interaction terms should be positive.

The results for the first approach show that, when the environmental standards treated endogenously, they affect dirty trade flows. This results are hold for the cleans sectors too. And the results for the second approach shows that, comparing the first four yeared period and the last four yeared period, countries specialize in pollution intensive sectors and this effect is getting stronger from the first period to the last one. When the author uses simple OLS estimation methods, the increase in magnitude is steady, but when the 2SLS method is used, then there appears to be two waves of PH effect during the sample year.

In another study, Dinda (2006) examines the factor endowment and PHH that predict how international trade flows affect the environment. The aim of the paper is "*...to explore whether globalization hurts the environment.*"

The panel data includes annual per capita real GDP, capital per worker (capital-labor ratio), trade intensity and annual per capita CO_2 emissions as the measures of income, K/L ratio, openness and the emission variable, respectively. The data set includes 54 countries for the time period of 1965-1990. The countries have been grouped into three country groups as; developed (OECD), developing (non-OECD) and the world as a whole.

By the use of panel data technique, he examines the impacts of globalization on pollution level, pollution intensity and relative changes of pollution for the three main groups. The estimations have been done in four different equations, two of which include the openness interaction with country characteristics. In these estimations the Fixed Effects (FE) and the Random Effects (RE) models have been used. The main focus in the estimations is the coefficient of openness (the proxy of globalization).

The empirical findings for the first two equations find evidence for the PHH. These findings support the earlier studies (see, for example, Low and Yeats, (1992); Agras and Chapman, (1999); Suri and Chapman, (1998)) and suggest that developing countries produce pollution intensive goods increasingly in comparison with the developed countries.

The other two equation sets' results show the impact of comparative advantage (interaction with country characteristics) on emission level, emission intensity and relative change of emissions. The results are surprisingly differentiates. All the results show that, the coefficient of openness is positive and significant for all three measures of pollution for three groups, except negative and insignificant openness coefficient for emission level in non-OECD country group. It shouldn't be underestimated that, adding the country characteristics has made a large impact on openness to explain the CO_2 emissions. The signs of the coefficient of openness have changed opposing the previous results which show evidence for PHH, with high significant level. It's been examined that, the interaction terms (on relative capital and openness) are negative and positive for all three measures in the world and OECD, respectively. These results mean that, if a country has sufficiently higher capita-labor ratio than the rest of the world, more openness makes this country cleaner. All these findings suggest that, globalization increases the pollution, particularly the CO_2 emissions and the impact of globalization on environment heavily depends on the basic characteristics of a country and it's dominating comparative advantage.

And finally, Levinson and Taylor (2004) include both the theoretical and empirical methods to examine the PH-effect while arguing that previous studies are lack of evidence because of unobserved heterogeneity and endogeneity of pollution abatement cost measures. Some of the studies have found weak evidence that, industries which have relatively high pollution abatement costs are leading exporters. (See, for example, Kalt, (1988); Grossman and Krueger, (1993); Osang and Nandy (2000)).

In their paper, they re-examine *the link between abatement costs and trade flows using both theory and empirics, in the hope of identifying and accounting for several important econometric and data issues. They believe that, these issues –and not the relatively small costs of pollution abatement not the Porter Hypothesis*[3]*- are responsible for the mixed results produced thus far.*

To examine this link, they use a simple, multi-sector, partial-equilibrium model to examine the statistical and theoretical sources of endogeneity that confront attempts to measure the effect of environmental regulations on trade flows. They examine an equation derived from the model to data on US regulations and net trade

[3] *Porter hypothesis claims that, regulations bring cost reducing innovations.*

outflows from US to Mexico and Canada, for 130 manufacturing industries for the period of time 1977-1986.

They first estimate a fixed effects model and show that the industries whose abatement costs increased most have the highest levels of net imports. Later they use their model to demonstrate several reasons why the fixed effects estimates are likely to understate the PH-effect. They develop a set of instruments based on the geographic dispersion on industries across the US states, and estimate 2SLS'. The results are consistently and robustly larger than fixed effects.

The estimated effects of pollution abetment costs on net imports are positive and statistically significant and also they are economically significant too. For the country groups that have been studied, the industries' pollution abatement costs have increased most and the increase in net exports because of increased pollution costs represent an increase in total trade volumes.

4. MODELS

4.1. Introduction

There are six models which will be examined in our study. First of all, we are going to examine the world as a whole in order to find some evidence about EKC. Then we are going to investigate the same evidences for 25 selected developing and developed countries, respectively. And finally as a case study for the same period of time, data samples will be examined for Turkey.

For the same period of time, for the same country groups, by adding different variables, the PHH will be also examined in order to find evidence.

As explained above, recent studies in the EKC literature add into their studies examinations about PHH, in order to find more explanations and more evidence about the relationship between trade and environment. At this point with a wide range of data sets, it was unavoidable to examine both of the hypotheses.

4.2. Examining the Environmental Kuznets Curve

With a similar aspect with Grossman and Krueger (1991), the model will be used for world, developing and developed countries, respectively is;

$$E_{it} = \beta_0 + \beta_1 Y_{it} + \beta_2 Y_{it}^2 + \beta_3 Y_{it}^3 + \gamma_i + \lambda_t + \varepsilon_{it}$$

where E_{it} is a measure of CO_2 emissions per capita for a given pollutant for country i in year t, Y_{it} is GDP per-capita in country i at time t, γ_i is a fixed-effect term which controls for country-specific heterogeneity; λ_t controls for global year effects; and ε_{it} is treated as a stochastic, normally distributed error term, often after correcting for serial correlation and heteroskedasticity. The coefficients β_0, β_1, β_2 and β_3 are the intercepts for each country and year are estimated using a panel fixed-effect regression.

In the early literature, studies based on cross sections of data which found no significant effect of regulations on industry locations. Newer studies that use panels of data to control for unobserved heterogeneity or instrumental variables to account for simultaneity have found statistically significant, reasonably sized effects. Similar to recent studies, we use panel data estimations in our models.

4.2.1. Examining a Worldwide Environmental Kuznets Curve

The data sets for the world as a whole, includes 177 countries for the 1960-2008 period of time. The country list can be seen in Appendix I. All of the data which have been used in the models are from World Bank's Indicators Data Sets. In theory, finding an EKC for the world data seems unapproachable since, in order to reach an EKC, a world wide reduction in emission levels must be reached. The relocation of pollution intensive industries from developed countries to the developing countries may be the reason for the non-decreasing pollution levels. The EKC hypothesis is alone quite logical in theory but the world, as a whole, is not developed. With respect to International Monetary Fund's World Economic Outlook Report (April 2011), there are 145 developing countries (see Appendix D) and again according to International Monetary Fund's World Economic Outlook Report (September 2011), there are only 35 developed countries in the world (see Appendix C). When we take into account these quantitative values, it is not plausible to see a worldwide EKC.

4.2.2. Examining an Environmental Kuznets Curve for Developed Countries

According to the EKC hypothesis, as income rises, the expectation of a greener environment rises. With global concerns, international institutions try to assemble countries in order to live in a desirable green world for more than four decades.

With the simple theoretical logic, for developing countries, one may find evidence for EKC. As countries develop, with the international sanctions *e.g. Kyoto Protocol, European Union Environmental Policy*, overtime, they start to pay attention to the environment, especially the Greenhouse gases (GHG) emissions.

According to European Commission's Environment Department *"...Industrial activities play an important role in the economic well-being of Europe contributing to sustainable growth. However, industrial activities also have a significant impact on the environment...The largest industrial installations account for a considerable share of total emissions of key atmospheric pollutants and also have other important environmental impacts, including emissions to water and soil, generation of waste and the use of energy...."*

With respect to International Monetary Fund's World Economic Outlook Report (September 2011), there are 35 developed countries in the world. In our model, considering the List of Countries by Export (The World Factbook of the CIA, February 2010), we determine 25 developed countries. (See Appendix- III)

4.2.3. Examining an Environmental Kuznets Curve for Developing Countries'

As mentioned in the EKC literature, in 2000s, besides searching for an EKC, researchers added a PHH hypothesis investigation in their studies in order to find *a priori* evidence.

In today's world, developing countries seem to be as loaded pollution-intensities of the world. That's why, capturing an EKC seems to be infeasible in these countries because of this pollution intensities.

With respect to International Monetary Fund's World Economic Outlook Report (April 2011), there are 145 developing countries in the world. (See the list in Appendix III). Like the previous model for the developed countries above, in this model, considering the List of Countries by Export (The World Factbook of the CIA, February 2010) (see, Appendix D), we determine 25 developing countries (see Appendix F). Especially, newly industrialized 9 countries (Brazil, China, India, Malaysia, Mexico, Philippines, South Africa, Thailand and Turkey) were added to the country list.

4.2.4. Case Study: Examining an Environmental Kuznets Curve for Turkey

The studies in the EKC literature which examines the relation between the environment and the growth for Turkey are quite few. Atıcı and Kurt (2007) examined the relationship between international trade, national income and environment with an EKC perspective with a time-series data for the 1968-2000 period of time. The data set includes the per-capita CO_2 emissions, the per-capita GDP, total and agricultural export and import values. The peak point was found as 4.090$. Thus, they found evidence for EKC for Turkey.

Zanbak (2007) examined the relationship between per-capita CO_2 emissions and economic development level for 40 countries for the 1990-2004 period of time. He found that, as economic development increase, the per-capita GDP created by per-capita CO_2 emissions increases. And also, he confirms that, with the same levels of CO_2, developing countries generate fewer national incomes than developed countries.

Solakoglu (2007) examines the relationship between the property rights, economic growth and the environment in transition economies, in the 1987-2000 period of time. The peak point was found as 5.477$. The study confirms the existence of the EKC.

Akbostanci et al. (2006), explains the relationship between the environment and the income for Turkey with two different aspects. They examine the CO_2 emissions and the per-capita income with cointegration analysis and dynamic model for the 1960-2000 period of time with time series. The relationship between air pollution (SO_2 and particulate matter) and income was examined with panel data method. The peak points were points were found as 1934\$-5816\$ for SO_2 , and 1609\$-5446\$ for particulate matter. The EKC were found as reversed-N.

The regression results show that, although the signs of the coefficient are perfectly fit the EKC assumptions, they are not statistically significant. When we exclude the per-capita GDP-cubed from the model, the per-capita GDP gains significance.

The country-specific graphs show that, both per-capita CO_2 and per-capita GDP increases over time. The third graph shows us that, Turkey still seems to be in the Pre-Industry stage. The peak point of EKC hasn't been reached yet.

4.3. Examining the Pollution Haven Hypothesis

In the literature review of PHH, the studies have been classified into three main groups depending on the choice of "dependent variable". All the variables are used in log-form. In order to search and hopefully find evidence of PHH, the model which will be adopted is

$$\text{export}_{i,t} = \text{exchange rate}_{i,t} + GDP_{i,t} + CO_{2i,t} + FDI_{i,t} + \varepsilon_{it},$$

Where *i* is 1,...N, countries or cities; *t* is 1...T, years or time intervals, $\text{export}_{i,t}$ is manufacturing export which is the share of the merchandise export industries in the total export rates. It comprises commodities in SITC sections 5 (chemicals), 6 (basic manufactures), 7 (machinery and transport equipment), and 8 (miscellaneous manufactured goods), excluding division 68 (non-ferrous metals) which are the most polluting industries in the world, exchange $rate_{i,t}$ refers to the exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar), GDP per capita is gross domestic product divided by midyear population. $GDP_{i,t}$ is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current U.S. dollars, *per-capita* $CO_{2i,t}$ *emissions* are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring, $FDI_{i,t}$ is net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows total net, that is, net FDI in the reporting economy from foreign sources less net FDI by the reporting economy to the rest of the world. Data are in current U.S. dollars and ε_{it} is there is treated as a stochastic, normally distributed error term, often after correcting for serial correlation and heteroskedasticity.

4.3.1 Examining the Pollution Haven Hypothesis for the World

With same aspect which has been explained above, PHH will be examined for the worldwide data. The panel-data set includes variables of 177 countries for the 1960-2008 period of time. (See Appendix H for the county list).

4.3.2. Examining the Pollution Haven Hypothesis for Turkey

The data set includes variables of Turkey for the 1960-2008 period of time with the same variables as used above. (See, Appendix I).

The PHH studies in the literature are limited for Turkey. Akbostanci et al. (2004) examined the PHH for Turkey for 1994-1997 periods. With trade perspective, they examined the Turkish manufacturing industries with 4-digit ISIC detailed panel data approach. They provided some statistically significant evidence of PHH and found that, as the dirtiness of the industries increase export also increases.

Gokalp and Yildirim (2004) evaluated the propositions of the PHH, which state that *"...less developed and developing countries will have more pollution-intensive industries and will experience a deteriorating quality of environment in the process of liberalization of trade..."*, and they concluded that *"...the quality of environment in Turkey has not worsened but rather improved in this process..."*

And finally, Yilmazer and Ersoy (2009) summarize their study as *"..In this study, the pollution haven hypothesis analyzed in the literature by Merican et al, is tested by using panel cointegration technique and 1975-2006 data sets of six emerging markets. Contrary to the findings of Merican et al, a co-integration relationship between variables does not exist...."*

5. RESULTS

The regression results and the graphs for the Model 1 indeed show that, a worldwide EKC is unreachable (Table 5.1). As we can see from the graphs, both worldwide per capita CO_2 emissions and the per capita GDP are increasing. (See Figure B.1 and B.2) Thus, it is impossible to find an EKC for worldwide. Figure.B.3 shows that, EKC hasn't occurred. According to EKC hypothesis, the expected signs of per-capita GDP and per-capita GDP-squared are positive and negative, respectively. But as we can see the Fixed- Effects results, both of the signs are positive. Even they are statistically significant, there is no such EKC effect worldwide.

The regression results for Model 2 show us statistically insignificant evidence of EKC. The signs of per-capita GDP, per-capita GDP-squared and per-capita GDP-cubed are positive, negative and positive, respectively. Unfortunately, we didn't find evidence of EKC. The graphs of the countries were drawn separately for each developed country in order to see the country-specific statuses of the developed countries. (See Appendix III).

As we can see from the country-specific graphs, in most of the developed countries per-capita CO_2 levels have a decreasing trend. For Denmark (see, Figure E.10), France (see, Figure E.16), Germany (see, Figure E.19), Israel (see, Figure E.34), Netherlands (see, Figure E.46), Singapore (see, Figure E.58), Sweden (see, Figure 64), Switzerland (see, Figure E.67), United Kingdom (see, Figure E.70) and United States (see, Figure E.73) we can see that decreasing trends evidently.

Except for Singapore and United States, most of these countries are members of EU. With regard to EU's environmental stringencies, we may conclude that, being a member/part of an institution might be forcing countries to control their emission levels.

When we examine the countries as country groups (High Income Countries, High Income OCED Countries and High Income non-OCED countries) we can see that increasing trend has slowed down. (See, Figure E.76, 79 and 82 in Appendix E).

Expect for Japan (see, Figure E.41), in every developed country, per-capita GDPs have increasing trend.

We can see EKC-likely trends for Denmark (see, Figure E.12), France (see, Figure E.18), Germany (see, Figure E.21), Iceland (see, Figure E.30), Ireland (see, Figure E.33), Israel (see, Figure 36), Singapore (see, Figure E.60), Sweden (see, Figure E.66), United Kingdom (see, Figure E.72), and United States (see, Figure E.75).

The Fixed-Effects results of 25 developing countries show that, the signs of the per-capita GDP, per-capita GDP-squared and per-capita GDP-cubed (see, Table 5.1) are as expected but per-capita GDP-squared is statistically insignificant. Thus, in this model we couldn't find evidence about EKC.

In country-specific graphs, for Hungary (see, Figure F.19), Poland (see, Figure F.49), Romania (see Figure F.55) and South Africa (see, Figure F.61) per-capita CO_2 emission are in decreasing trend. In the midst of 1980s in Hungary, Poland and Romania the trend turned to decrease. For Algeria (see, Figure F.1), Kuwait (see, Figure F.31), Nigeria(see, Figure F.40), Qatar (see, Figure F.52), Saudi Arabia (see, Figure F.58), United Arab Emirates (see, Figure F.70) and Venezuela (see, Figure F.73) the increasing trend slowed down in the midst of 1980s and until today the trend seems to be steady.

As we predicted, in every developing country, the per-capita GDPs have increasing trend.

Only for Hungary (see, Figure F.21), Poland (see, Figure F.51), South Africa (see, Figure F.63) and Venezuela (see, Figure F.75) there seems to be EKC-likely trends. The other countries seem to be at the Pre-Industry stage.

The regression results of the 4th model for Turkey show that (see, Table 5.1), although the signs of the coefficient are perfectly fit the EKC assumptions, per-capita GDP-squared is not statistically significant. When we include the per-capita GDP-cubed into the model, the only statistically significant variable per-capita GDP loses its significance.

Both for the per-capita CO_2 emission and the per-capita GDP, there are increasing trends over time (see, Figure G.1 and Figure G.2). As we can see from the Figure G.3, Turkey still seems to be in the pre-Industrial period.

The Fixed-Effects results examined for the worldwide pollution haven hypothesis are partly statistically significant (see, Table 5.1). $Exchange\ rate_{i,t}$ and $FDI_{i,t}$ are the significant variables in the data set. In order to find evidence for the PHH, the variable $CO_{2i,t}$ was expected to be statistically significant. But, as we can see from the results, $CO_{2i,t}$ is not statistically significant.

And finally, the regression results for Turkey examining the PHH show that, only $CO_{2i,t}$ and exchangerate$_{,t}$ are statistically significant. Thus, we can conclude that, there is some weak evidence of PHH with $CO_{2i,t}$ for Turkey. The significance of exchangerate$_{i,t}$ seems quite plausible, since not only the pollution-intensive industries are affected by the exchange rate trends.

Table 5.1: Regression Results of Models 1,2,3 and 4.

Variable Name	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 4**[4]
per-capita CO_2	Dependent variable	Dependent variable	Dependent variable	Dependent variable	Dependent variable
per-capita GDP	.5862 (3.32)	7.4097 (5.95)	2.6996 (8.36)	1.8687 (6.23)	1.9653 (0.52)
per-capita GDP-squared	.0546 (2.26)	-.2492 (.5.04)	-.2252 (-5.02)	-.0922 (-4.52)	-1.1054 (-0.20)
per-capita GDP-cubed	-.0057 (-5.42)	.0027 (4.26)	.0056 (2.79)	-	.0005 (0.03)
R-squared	0.4697	0.5783	0.6468	0.9345	0.9345
Number of Observations	6632	1033	1089	49	49

Note: t-statistics are in the parentheses.

[4] Per-capita GDP-cubed has been added into the Model 4.

Table 5.2: Regression Results of Models 5 and 6

Variable Name	**Model 5**	**Model 6**
manufactures export	Dependent variable	Dependent variable
per-capita CO_2	.0036433	1.5460
	(0.07)	(4.10)
per-capita GDP	.04138	-.5739
	(1.18)	(-4.62)
FDI	.0786	.0420
	(6.37)	(1.41)
exchange rate	.04867	.0618
	(7.81)	(2.77)
R-squared	0.0849	0.8925
Number of Observations	2795	35

Note: t-statistics are in the parentheses

6. CONCLUSION

In order to examine the relationship between the environment and the trade, we merged the two investigations of the two important hypotheses in the literature. As repeated a few times above, the recent literature of Environmental Kuznets Curve has added the examinations of the Pollution Haven Hypothesis into the studies.

Like the recent studies in the literature, the panel-data sets were used in order to control for unobserved heterogeneity.

Like the recent studies, we investigate the both hypothesis in this study. Starting with the worldwide Environmental Kuznets Curve examinations, we found no EKC effect around the world. The main reason for this result may be that, the development of the world as a whole is not a feasible.

With respect to the basic logic of Environmental Kuznets Curve Hypothesis, developed countries were examined and found that, the Environmental Kuznets Curve was both statistically and graphically significant for developed countries as a whole and separately. Especially, we can see the EKC-likely trend in Denmark, France, Iceland, Israel, Netherlands, Singapore, Sweden, and United Stated evidently. This may means that, these countries are Post-industrial (service economies).

For the developing countries, we found no evidence of Environmental Kuznets Curve as a whole but, with the country-specific graphs, we saw that, only for Hungary, Poland, South Africa and Venezuela there seems to be EKC. The remain countries seems to be at the Pre-Industry stage.

As a case study, Turkey was examined, in order to find an Environmental Kuznets Curve. The regression results show that, although the signs of the coefficient are perfectly fit in the EKC assumptions, they are not statistically significant. When we exclude the per-capita GDP-cubed from the model, the per-capita GDP gains significance. The country-specific graphs show that, both per-capita CO_2 and per-capita GDP increases over time. The third graph shows us that, Turkey still seems to be in the Pre-Industry stage. The peak point of EKC hasn't been reached yet.

Finally, the Pollution Haven Hypothesis was examined for worldwide panel-data and for Turkey.

The Fixed-Effects results are partly statistically significant for $exchange\ rate_{i,t}$ and $FDI_{i,t}$ in the data set. In order to find evidence for the PHH, the variable $CO_{2i,t}$ was expected to be statistically significant. Thus, there is no evidence for PHH for a worldwide data-set.

The regression results show that, only $CO_{2i,t}$ and $FDI_{i,t}$ is statistically significant. Thus, we can conclude that, there is some weak evidence of PHH with $CO_{2i,t}$ for Turkey. The significance of $FDI_{i,t}$ seems quite plausible, since in the literature, foreign direct investment is always expected to affect a country's export positively.

In order to find evidence for both of the hypothesis, the data bases of the developed countries are quite sufficient but it is hard to say the same thing for developing countries. Not only for these two hypotheses, but also for other literature studies the importance of the data is a great deal. With well endowed data sets, especially the Pollution Haven Hypothesis would be explained efficiently.

But needless to say, in order to explain the relationship between international trade and the environment, these hypotheses of course are not sufficient. For example, the reasons why the pollution levels in developing countries increase recently can not be explained only with the stricter regulations in developed countries or the outflows of FDIs into these countries. We can only conclude that, proving the PHH may be only transient since, the conjunctional circumstances of the countries are transient too. Countries can not keep the same political or economical status' decades long.

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APPENDIX A: List of World Countries

Afghanistan	Brunei Darussalam	Dominica	Guyana
Albania	Bulgaria	Dominican Republic	Haiti
Algeria	Burkina Faso	Ecuador	Honduras
American Samoa	Burundi	Egypt, Arab Rep.	Hong Kong SAR, China
Andorra	Cambodia	El Salvador	Hungary
Angola	Cameroon	Equatorial Guinea	Iceland
Antigua and Barbuda	Canada	Eritrea	India
Argentina	Cape Verde	Estonia	Indonesia
Armenia	Cayman Islands	Ethiopia	Iran, Islamic Rep.
Aruba	Central African Republic	Faeroe Islands	Iraq
Australia	Chad	Fiji	Ireland
Austria	Channel Islands	Finland	Isle of Man
Azerbaijan	Chile	France	Israel
Bahamas, The	China	French Polynesia	Italy
Bahrain	Colombia	Gabon	Jamaica
Bangladesh	Comoros	Gambia, The	Japan
Barbados	Congo, Dem. Rep.	Georgia	Jordan
Belarus	Congo, Rep.	Germany	Kazakhstan
Belgium	Costa Rica	Ghana	Kenya
Belize	Cote d'Ivoire	Gibraltar	Kiribati
Benin	Croatia	Greece	Korea, Dem. Rep.
Bermuda	Cuba	Greenland	Korea, Rep.
Bhutan	Curacao	Grenada	Kosovo
Bolivia	Cyprus	Guam	Kuwait
Bosnia and Herzegovina	Czech Republic	Guatemala	Kyrgyz Republic
Botswana	Denmark	Guinea	Lao PDR
Brazil	Djibouti	Guinea-Bissau	Latvia

Cont. APPENDIX A

Lebanon	Myanmar	San Marino	Tajikistan
Lesotho	Namibia	Sao Tome and Principe	Tanzania
Liberia	Nepal	Saudi Arabia	Thailand
Libya	Netherlands	Senegal	Timor-Leste
Liechtenstein	New Caledonia	Serbia	Togo
Lithuania	New Zealand	Seychelles	Tonga
Luxembourg	Nicaragua	Sierra Leone	Trinidad and Tobago
Macao SAR, China	Niger	Singapore	Tunisia
Macedonia, FYR	Nigeria	Sint Maarten (Dutch part)	Turkey
Madagascar	Northern Mariana Islands	Slovak Republic	Turkmenistan
Malawi	Norway	Slovenia	Turks and Caicos Islands
Malaysia	Oman	Solomon Islands	Tuvalu
Maldives	Pakistan	Somalia	Uganda
Mali	Palau	South Africa	Ukraine
Malta	Panama	South Sudan	United Arab Emirates
Marshall Islands	Papua New Guinea	Spain	United Kingdom
Mauritania	Paraguay	Sri Lanka	United States
Mauritius	Peru	St. Kitts and Nevis	Uruguay
Mayotte	Philippines	St. Lucia	Uzbekistan
Mexico	Poland	St. Martin (French part)	Vanuatu
Micronesia, Fed. Sts.	Portugal	St. Vincent and the Grenadines	Venezuela, RB
Moldova	Puerto Rico	Sudan	Vietnam
Monaco	Qatar	Suriname	Virgin Islands (U.S.)
Mongolia	Romania	Swaziland	West Bank and Gaza
Montenegro	Russian Federation	Sweden	Yemen, Rep.
Morocco	Rwanda	Switzerland	Zambia
Mozambique	Samoa	Syrian Arab Republic	Zimbabwe

APPENDIX B: Country List of the Model 1

Albania	Bulgaria	Ecuador	Honduras
Algeria	Burkina Faso	Egypt, Arab Rep.	Hong Kong SAR, China
Angola	Burundi	El Salvador	Hungary
Antigua and Barbuda	Cambodia	Equatorial Guinea	Iceland
Argentina	Cameroon	Eritrea	India
Armenia	Canada	Estonia	Indonesia
Aruba	Cape Verde	Ethiopia	Iran, Islamic Rep.
Australia	Central African Republic	Fiji	Iraq
Austria	Chad	Finland	Ireland
Azerbaijan	Chile	France	Israel
Bahamas, The	China	French Polynesia	Italy
Bahrain	Colombia	Gabon	Jamaica
Bangladesh	Comoros	Gambia, The	Japan
Barbados	Congo, Rep.	Georgia	Jordan
Belarus	Costa Rica	Germany	Kazakhstan
Belgium	Cote d'Ivoire	Ghana	Kenya
Belize	Croatia	Greece	Kiribati
Benin	Cyprus	Grenada	Korea, Rep.
Bolivia	Czech Republic	Guatemala	Kuwait
Bosnia and Herzegovina	Denmark	Guinea	Kyrgyz Republic
Botswana	Djibouti	Guinea-Bissau	Lao PDR
Brazil	Dominica	Guyana	Latvia
Brunei Darussalam	Dominican Republic	Haiti	Lebanon

Cont. APPENDIX B

Liberia	New Zealand	Sierra Leone	Trinidad and Tobago
Libya	Nicaragua	Singapore	Tunisia
Lithuania	Niger	Slovak Republic	Turkey
Luxembourg	Nigeria	Slovenia	Turkmenistan
Macao SAR, China	Norway	Solomon Islands	Uganda
Macedonia, FYR	Oman	Somalia	Ukraine
Madagascar	Pakistan	South Africa	United Kingdom
Malawi	Panama	Spain	United States
Malaysia	Papua New Guinea	Sri Lanka	Uruguay
Maldives	Paraguay	St. Kitts and Nevis	Vanuatu
Mali	Peru	St. Lucia	Venezuela, RB
Malta	Philippines	St. Vincent and the Grenadines	Vietnam
Mauritania	Poland	Sudan	West Bank and Gaza
Mauritius	Portugal	Suriname	Yemen, Rep.
Mexico	Romania	Swaziland	Zambia
Moldova	Russian Federation	Sweden	Zimbabwe
Mongolia	Rwanda	Switzerland	
Morocco	Samoa	Syrian Arab Republic	
Mozambique	Sao Tome and Principe	Tajikistan	
Namibia	Saudi Arabia	Tanzania	
Nepal	Senegal	Thailand	
Netherlands	Serbia	Togo	
New Caledonia	Seychelles	Tonga	

Cont. APPENDIX B

Figures[5] of the Model 1

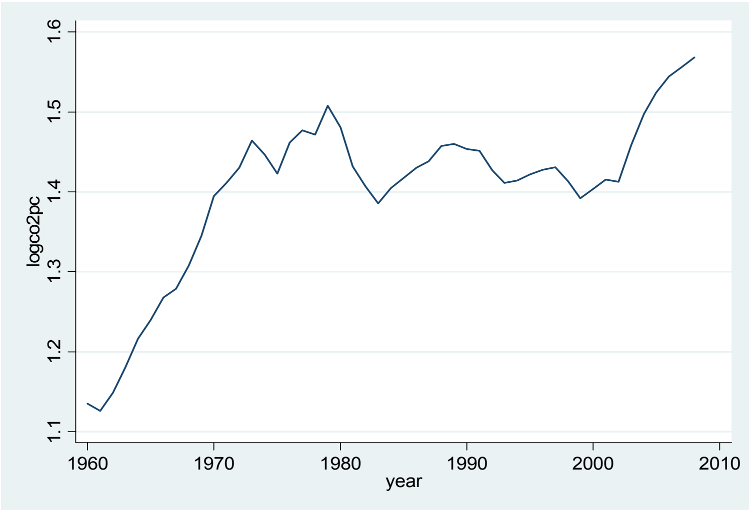

Figure B.1: The Change in per-capita CO_2 over 1960-2008 period.

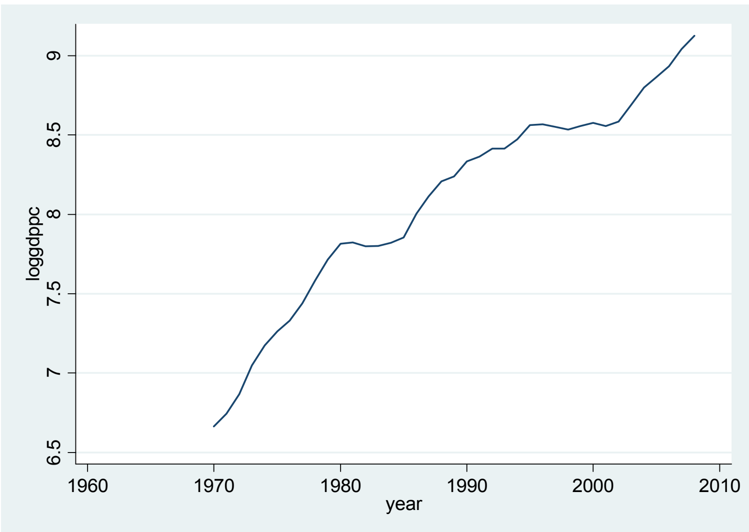

Figure B.2: The Change in per-capita GDP over 1960-2008 period

[5] All of the values are in log form.

Cont. APPENDIX B

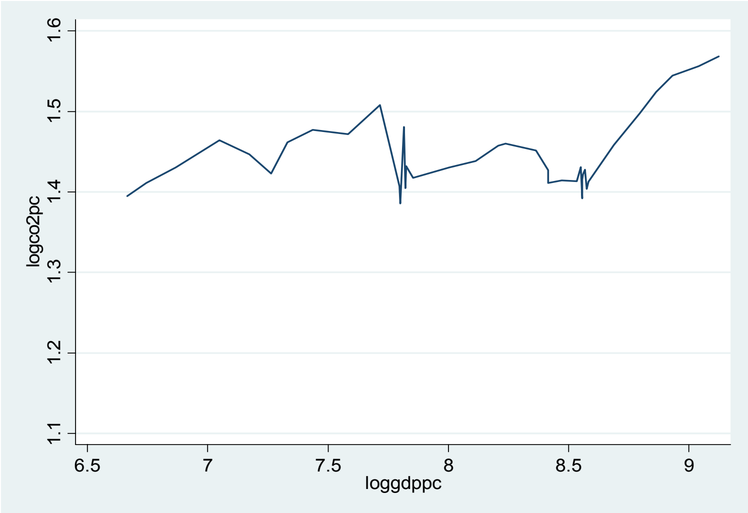

Figure B.3 The EKC over 1960-2008 period

Table B.1: Regression Results of Model 1

```
Fixed-effects (within) regression               Number of obs      =      6632
Group variable: countryname                     Number of groups   =       177

R-sq:  within  = 0.4697                         Obs per group: min =         4
       between = 0.8231                                        avg =      37.5
       overall = 0.7340                                        max =        49

                                                F(3,6452)          =   1904.72
corr(u_i, Xb)  = 0.7049                         Prob > F           =    0.0000
```

logco2pc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
loggdppc	.586251	.1763584	3.32	0.001	.2405301	.931972
loggdppc2	.054602	.0241206	2.26	0.024	.0073177	.1018863
loggdppc3	-.0057967	.0010704	-5.42	0.000	-.007895	-.0036985
_cons	-4.461154	.4189354	-10.65	0.000	-5.282407	-3.639902
sigma_u	1.1637257					
sigma_e	.37907377					
rho	.90407122	(fraction of variance due to u_i)				

F test that all u_i=0:   F(176, 6452) =   167.35   Prob > F = 0.0000

APPENDIX C

List of Developed Countries

Australia
Austria
Belgium
Canada
Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Germany
Greece
Hong Kong
Iceland
Ireland
Israel
Italy
Japan
Luxemburg
Malta
Netherlands
New Zealand
Norway
Portugal
San Marino
Singapore
Slovakia
Slovenia
South Korea
Spain
Sweden
Switzerland
Taiwan
United Kingdom
United States

Appendix D

List of Developing Countries

Afghanistan	Bulgaria	Dominica	Honduras
Albania	Burkina Faso	Dominican Republic	Hungary
Algeria	Burma	Ecuador	Iran
Angola	Burundi	Egypt	Iraq
Antigua and Barbuda	Brunei	El Salvador	Jamaica
Argentina	Cambodia	Equatorial Guinea	Jordan
Armenia	Cameroon	Eritrea	Kazakhstan
Azerbaijan	Cape Verde	Ethiopia	Kenya
Bahamas	Central African Republic	Fiji	Kiribati
Bahrain	Chad	Gabon	Kuwait
Bangladesh	Chile	The Gambia	Kyrgyzstan
Barbados	Colombia	Georgia	Laos
Belarus	Comoros	Ghana	Latvia
Belize	Democratic Republic of the Congo	Grenada	Lebanon
Benin	Republic of the Congo	Guatemala	Lesotho
Bhutan	Costa Rica	Guinea	Liberia
Bolivia	Côte d'Ivoire	Guinea-Bissau	Libya
Bosnia and Herzegovina	Croatia	Guyana	Lithuania
Botswana	Djibouti	Haiti	Macedonia

Cont. APPENDIX D

Madagascar	Oman	Serbia	Tuvalu
Malawi	Pakistan	Seychelles	Uganda
Maldives	Palau	Sierra Leone	Ukraine
Mali	Panama	Solomon Islands	United Arab Emirates
Marshall Islands	Papua New Guinea	Somalia	Uruguay
Mauritania	Paraguay	South Sudan	Uzbekistan
Mauritius	Peru	Sri Lanka	Vanuatu
Federated States of Micronesia	Poland	Sudan	Venezuela
Moldova	Qatar	Suriname	Vietnam
Mongolia	Romania	Swaziland	Yemen
Montenegro	Russia	Syria	Zambia
Morocco	Rwanda	Tajikistan	Zimbabwe
Mozambique	Saint Kitts and Nevis	Tanzania	
Namibia	Saint Lucia	Timor-Leste	
Nauru	Saint Vincent and the Grenadines	Togo	
Nepal	Samoa	Tonga	
Nicaragua	São Tomé and Príncipe	Trinidad and Tobago	
Niger	Saudi Arabia	Tunisia	
Nigeria	Senegal	Turkmenistan	

APPENDIX E:

Country List of Model 2

Australia
Austria
Canada
Denmark
Finland
France
Germany
Greece
Hong Kong SAR, China
Iceland
Ireland
Israel
Italy
Japan
Korea, Rep.
Netherlands
New Zealand
Norway
Portugal
Singapore
Spain
Sweden
Switzerland
United Kingdom
United States

Cont. APPENDIX E

Table E.1: Regression Results of Model 2

```
Fixed-effects (within) regression               Number of obs      =      1033
Group variable: countryname                     Number of groups   =        25

R-sq:  within  = 0.5783                         Obs per group: min =        18
       between = 0.1464                                        avg =      41.3
       overall = 0.3136                                        max =        49

                                                F(3,1005)          =    459.39
corr(u_i, Xb)  = -0.1556                        Prob > F           =    0.0000

------------------------------------------------------------------------------
logdevelop~c |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
logdevelop~p |   7.409757   1.244749     5.95   0.000     4.967153    9.852361
logdevelop~2 |  -.2492499   .0494955    -5.04   0.000    -.3463763   -.1521235
logdevelop~3 |    .002787   .0006536     4.26   0.000     .0015045    .0040696
       _cons |  -70.91605    10.3936    -6.82   0.000    -91.31169    -50.5204
-------------+----------------------------------------------------------------
     sigma_u |  .41938295
     sigma_e |  .24015537
         rho |  .75305949   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(24, 1005) =   121.93            Prob > F = 0.0000
```

Cont. APPENDIX E

Figures[6] of the Model 2

Austalia

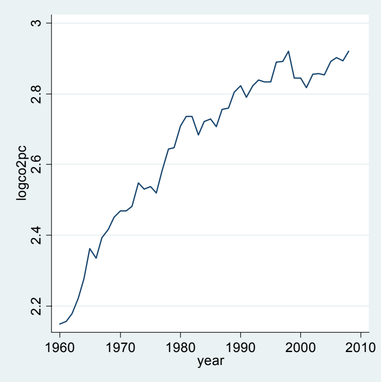

Figure E.1

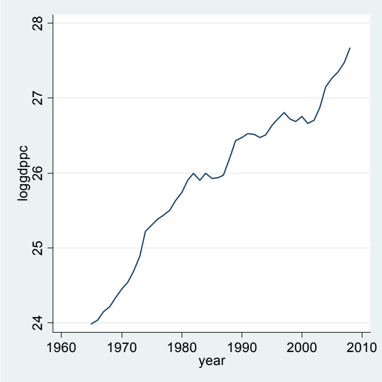

Figure E.2

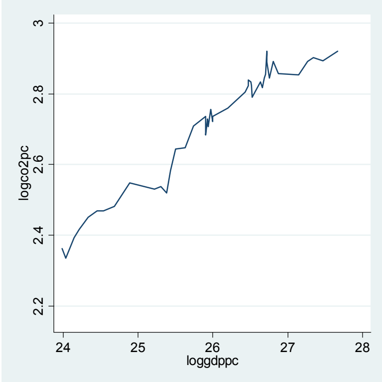

Figure E.3

Austria

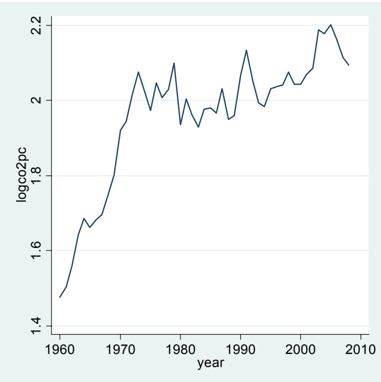

Figure E.4

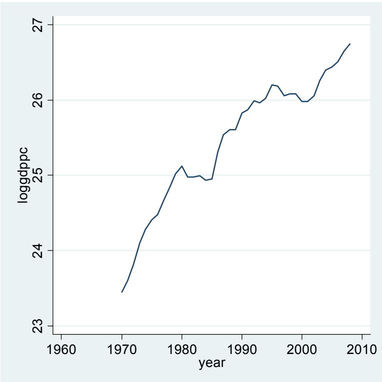

Figure E.5

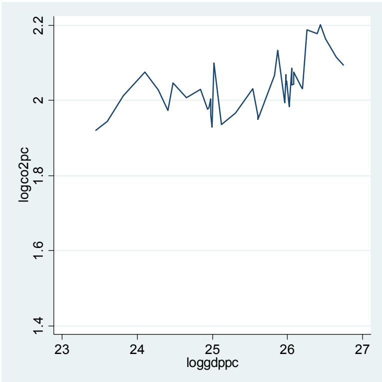

Figure E.6

Canada

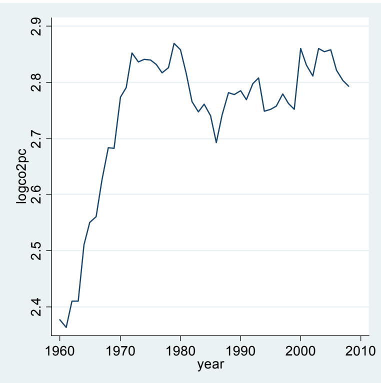

Figure E.7

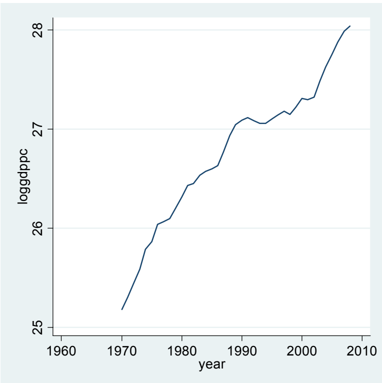

Figure E.8

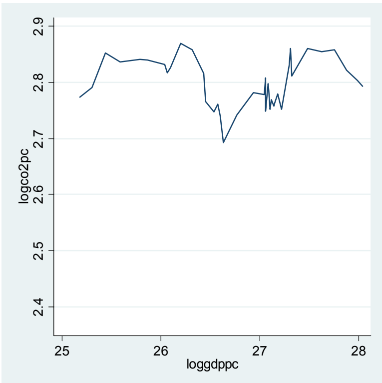

Figure E.9

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[6] All of the values are in log form.

Cont. APPENDIX E

Denmark

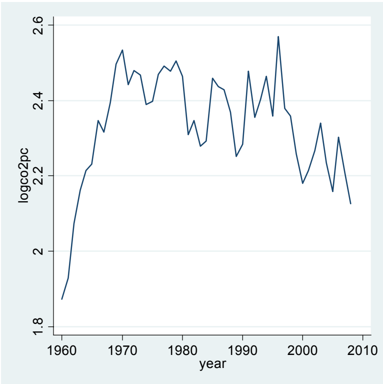

Figure E.10

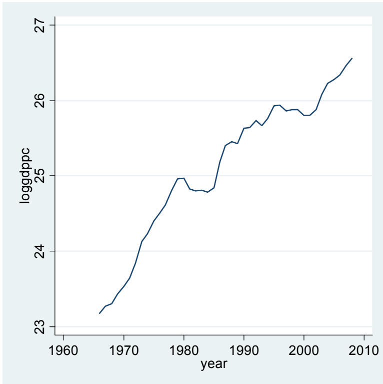

Figure E.11

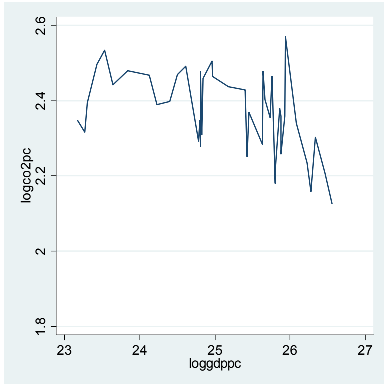

Figure E.12

Finland

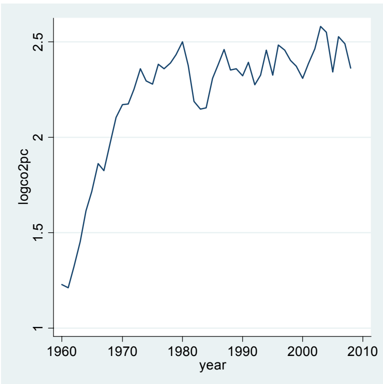

Figure E.13

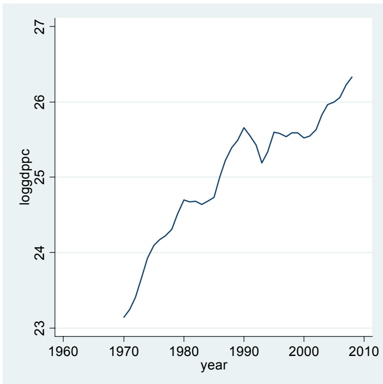

Figure E.14

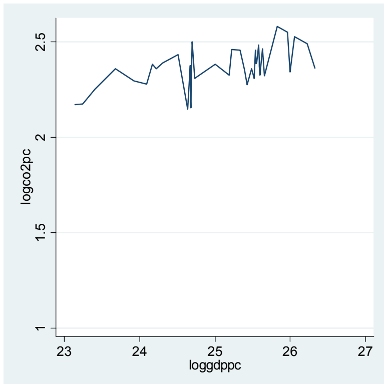

Figure E.15

France

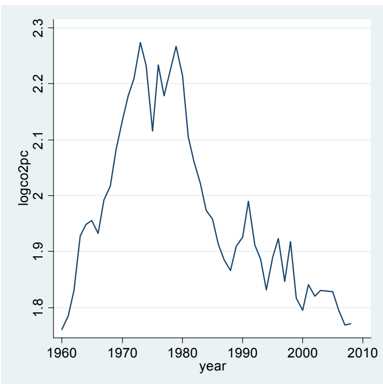

Figure E.16

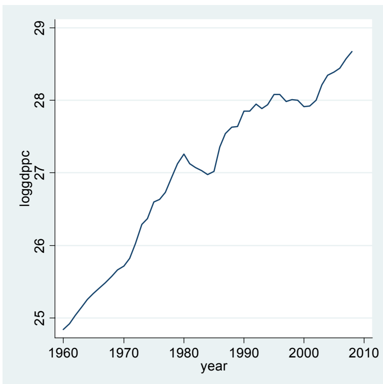

Figure E.17

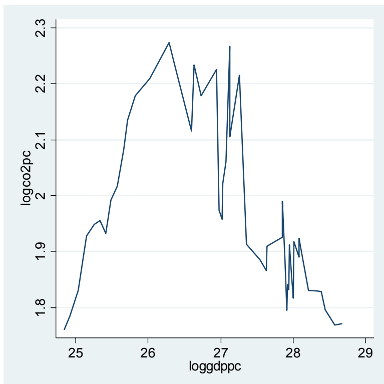

Figure E.18

Cont. APPENDIX E

Germany

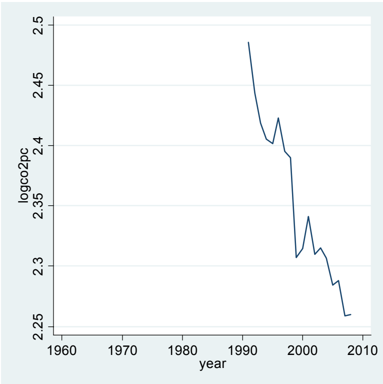

Figure E.19

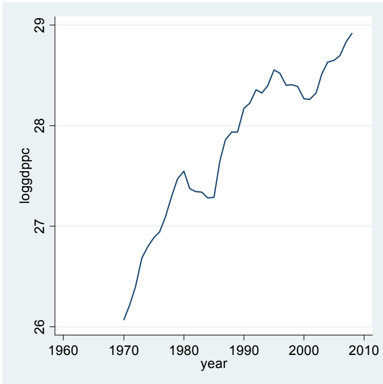

Figure E.20

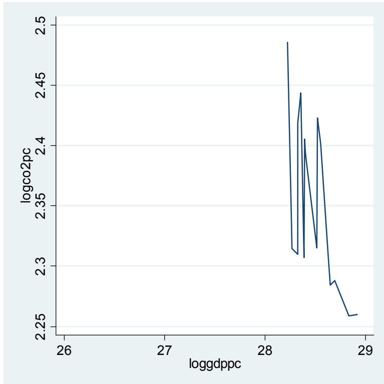

Figure E.21

Greece

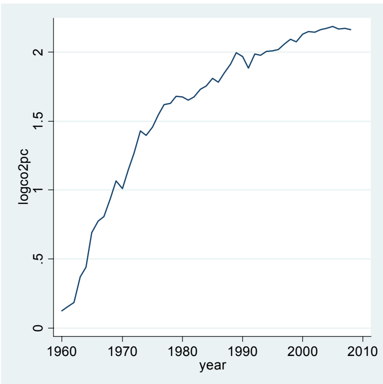

Figure E.22

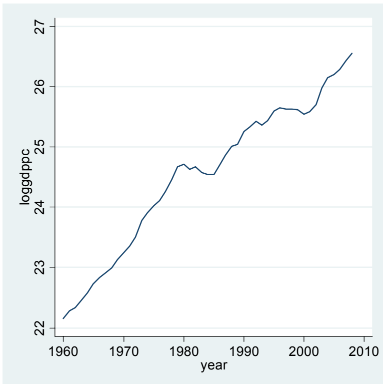

Figure E.23

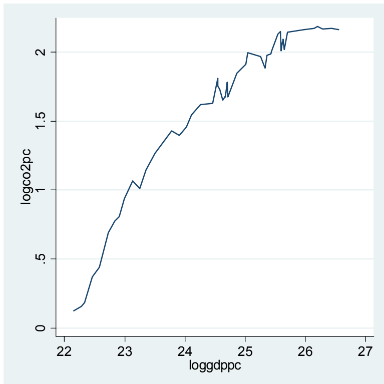

Figure E.24

Hongkong

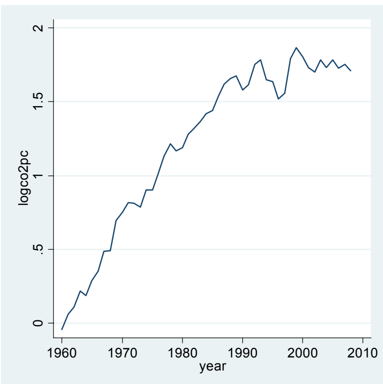

Figure E.25

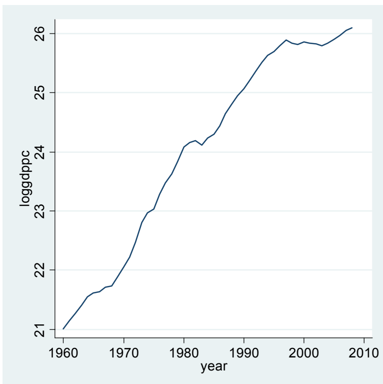

Figure E.26

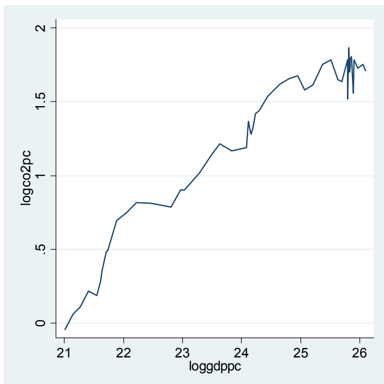

Figure E.27

Cont. APPENDIX E

Iceland

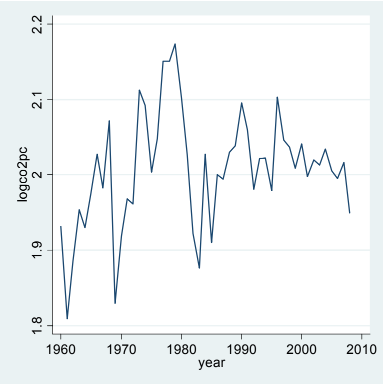

Figure E.28

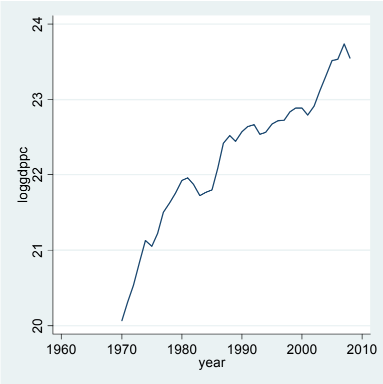

Figure E.29

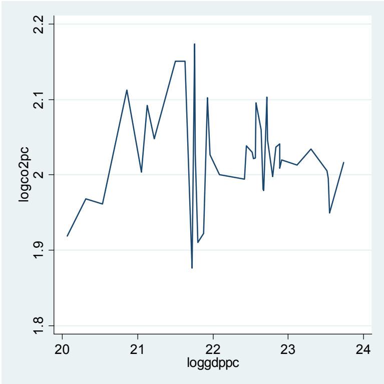

Figure E.30

Ireland

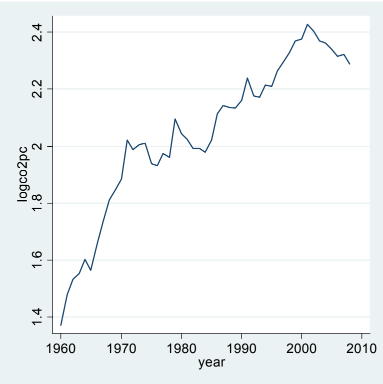

Figure E.31

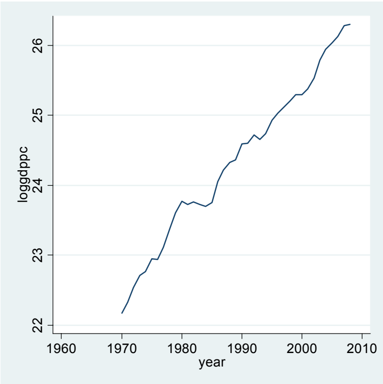

Figure E.32

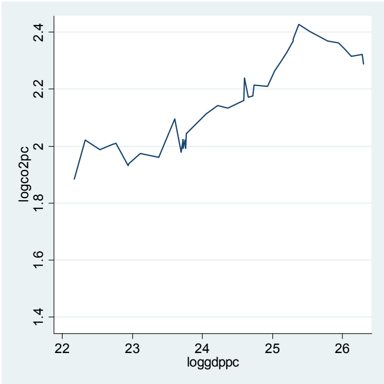

Figure E.33

Israel

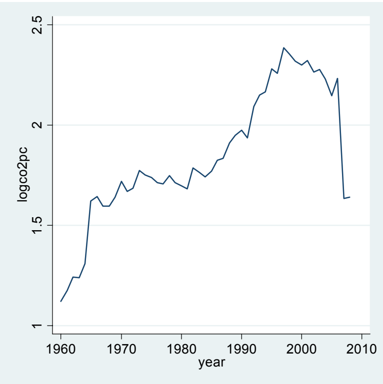

Figure E.34

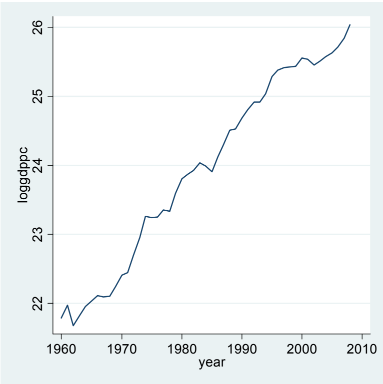

Figure E.35

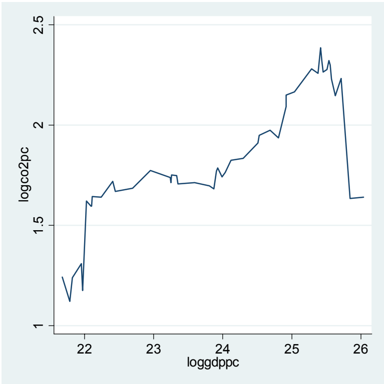

Figure E:36

Cont. APPENDIX E

Italy

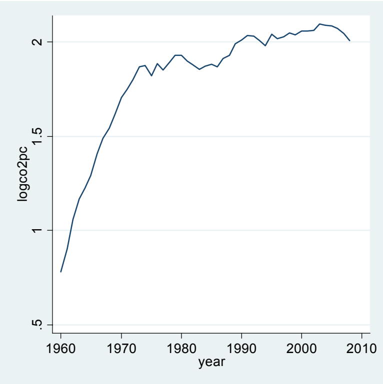

Figure E.37

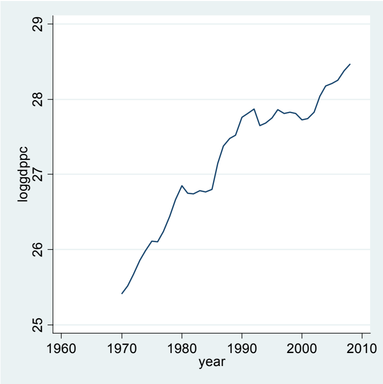

Figure E.38

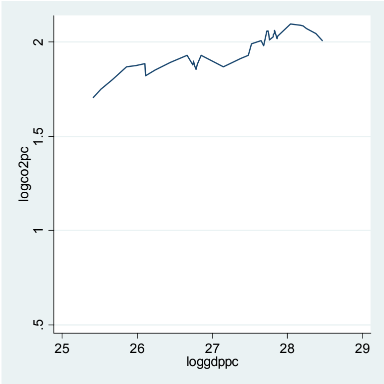

Figure E.39

Japan

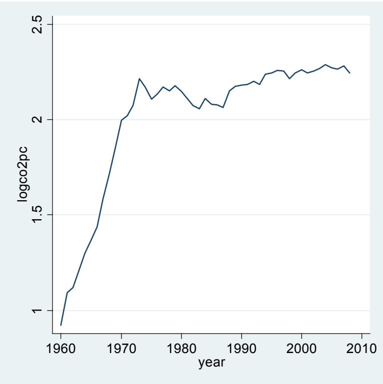

Figure E.40

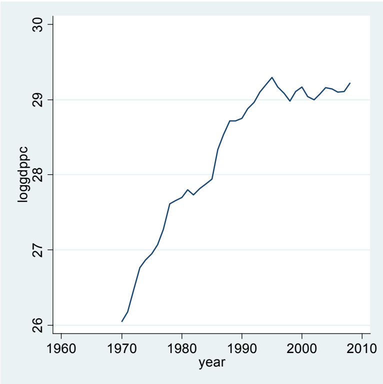

Figure E.41

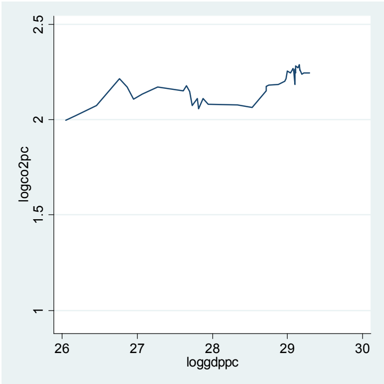

Figure E.42

Korea, Rep.

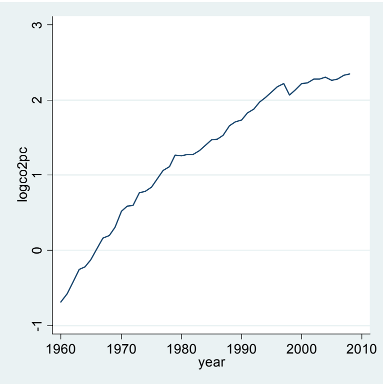

Figure E.43

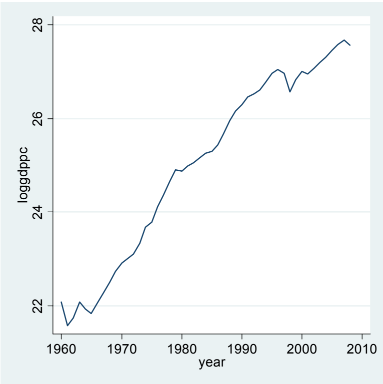

Figure E.44

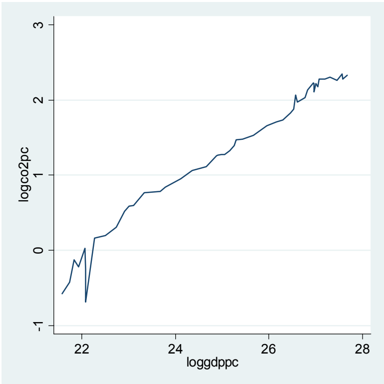

Figure E.45

Cont. APPENDIX E

Netherlands

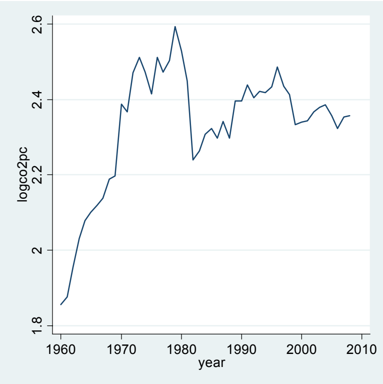

Figure E.46

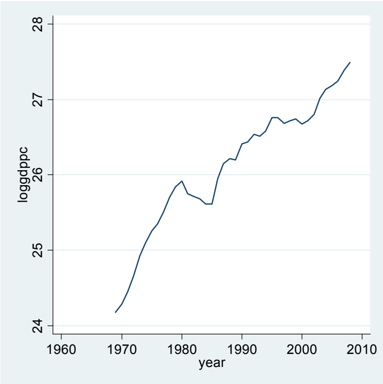

Figure E.47

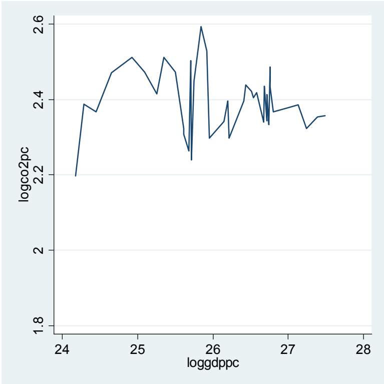

Figure E.48

New Zealand

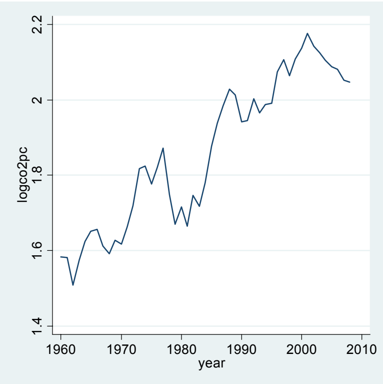

Figure E.49

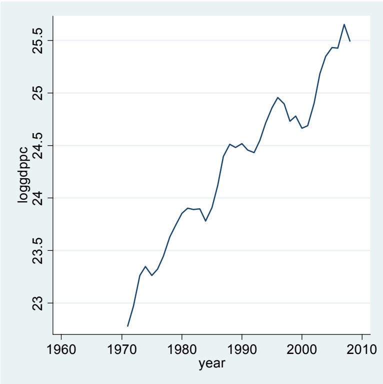

Figure E.50

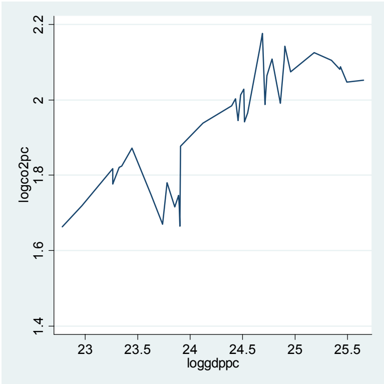

Figure E.51

Norway

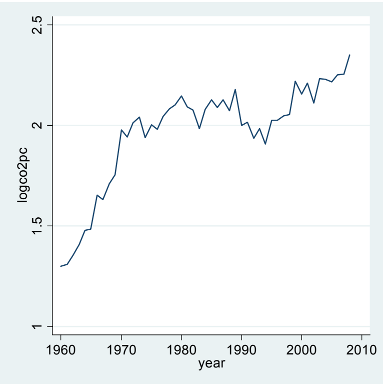

Figure E.52

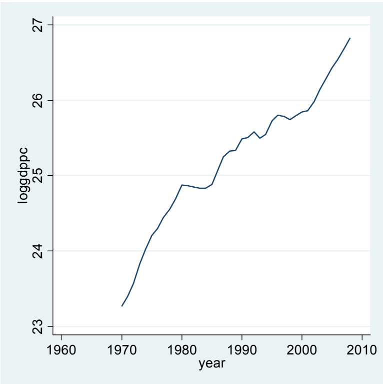

Figure E.53

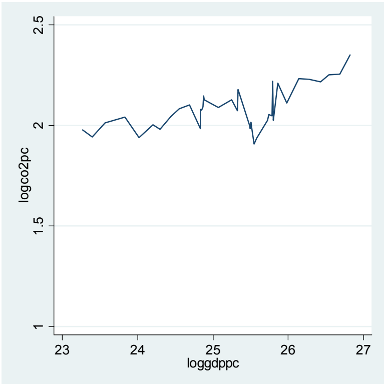

Figure E.54

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Portugal

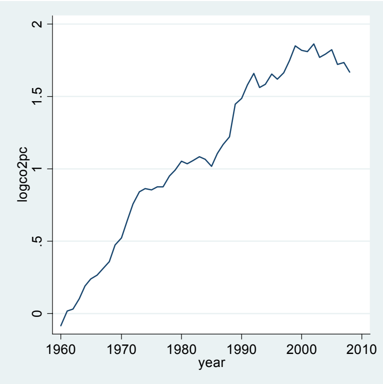

Figure E.55

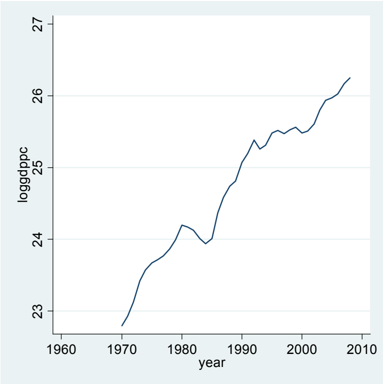

Figure E.56

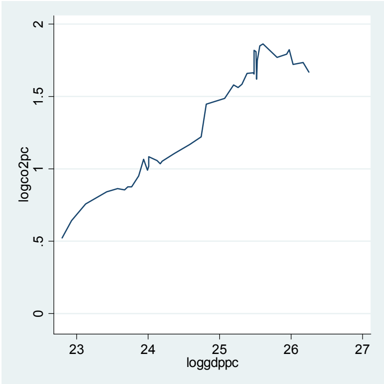

Figure E.57

Singapore

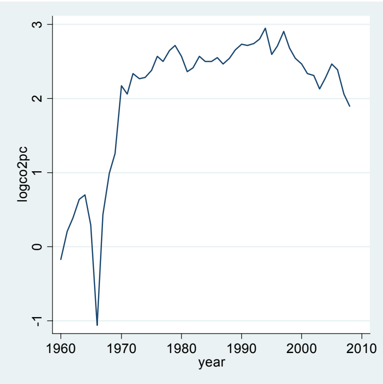

Figure E.58

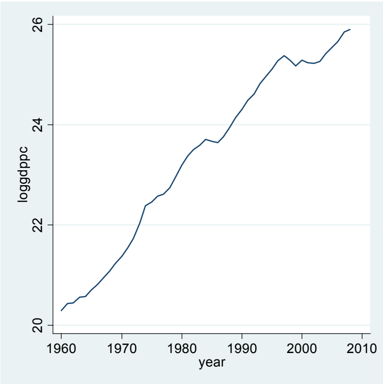

Figure E.59

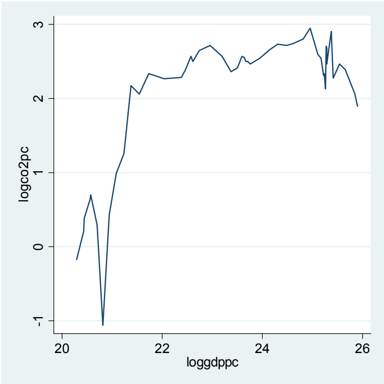

Figure E.60

Spain

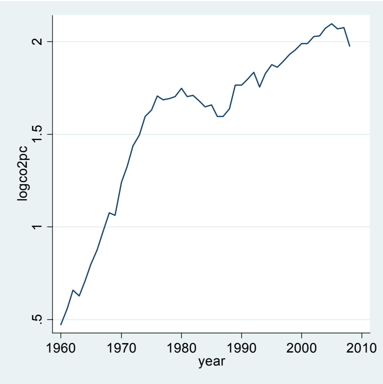

Figure E.61

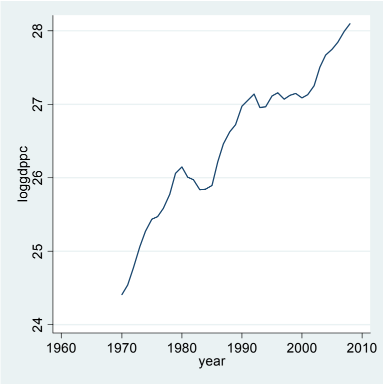

Figure E.62

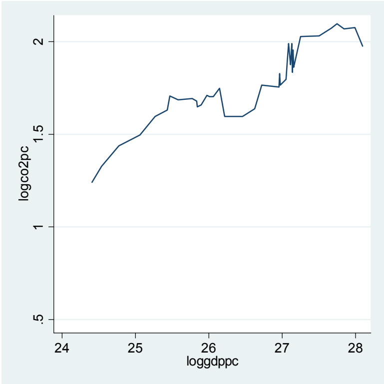

Figure E.63

Cont. APPENDIX E

Sweden

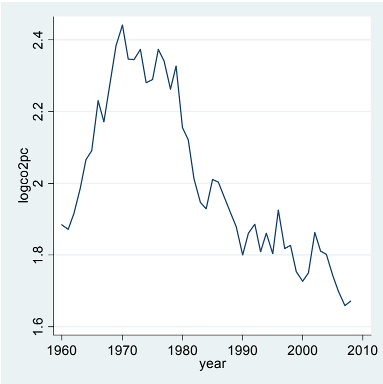

Figure E.64

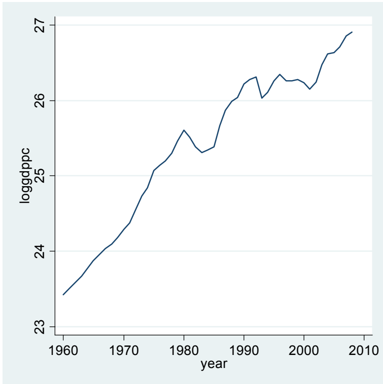

Figure E.65

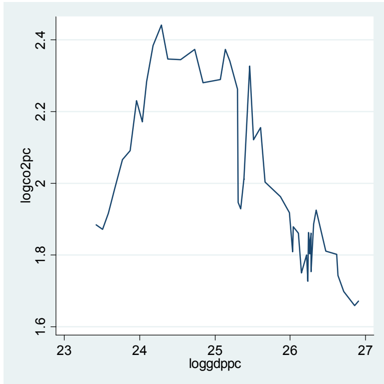

Figure E.66

Switzerland

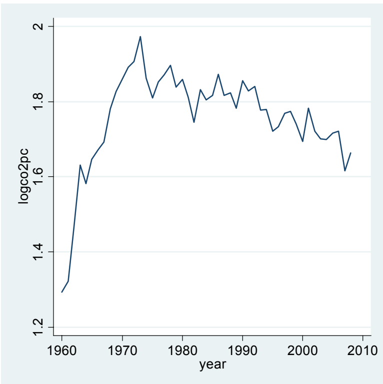

Figure E.67

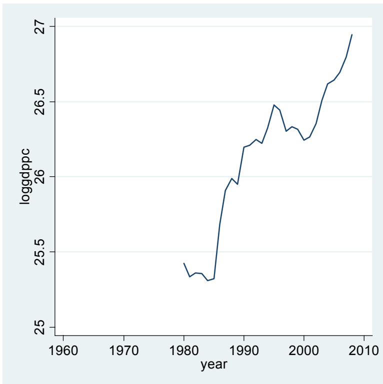

Figure E.68

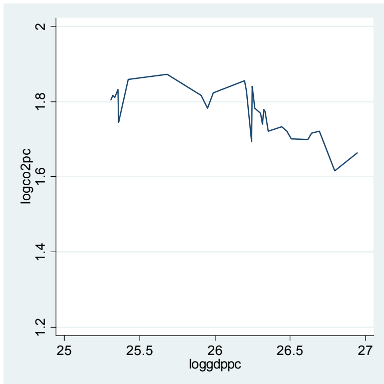

Figure E.69

United Kingdom

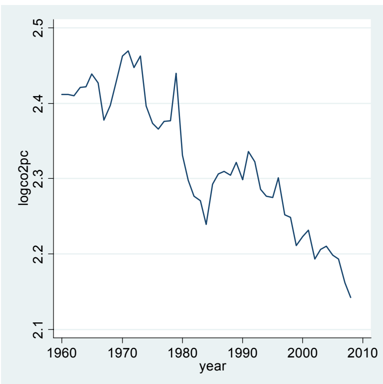

Figure E.70

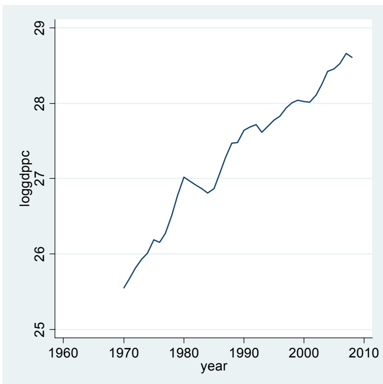

Figure E.71

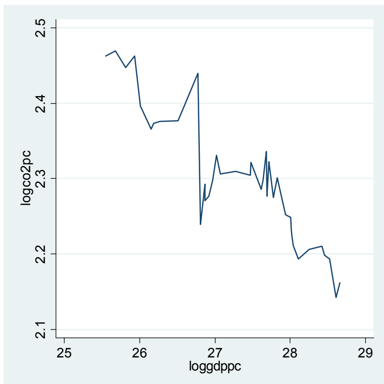

Figure E.72

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United States

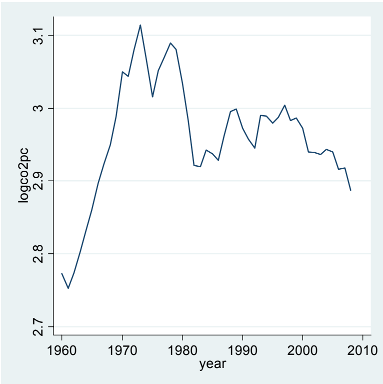

Figure E.73

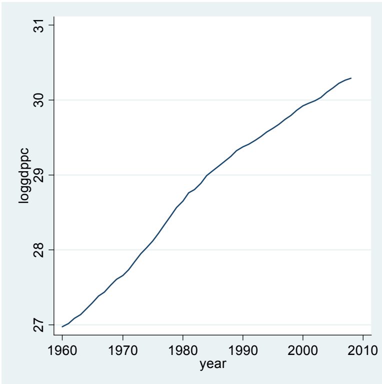

Figure E.74

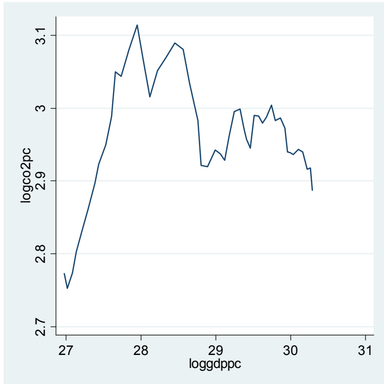

Figure E.75

High Income Countries

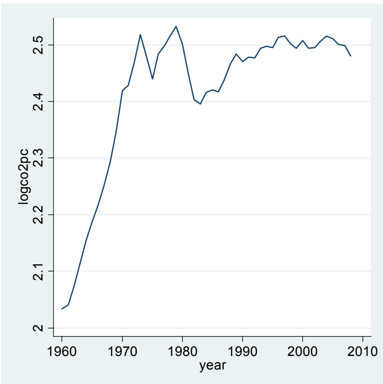

Figure E.76

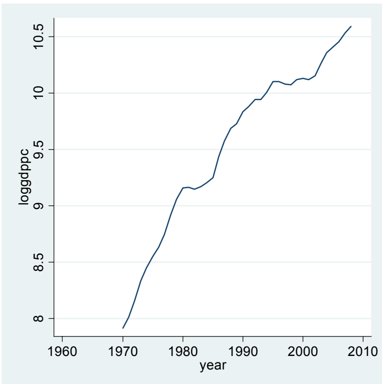

Figure E.77

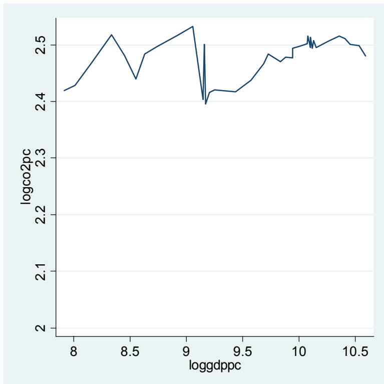

Figure E.78

High Income Non-OECD Countries

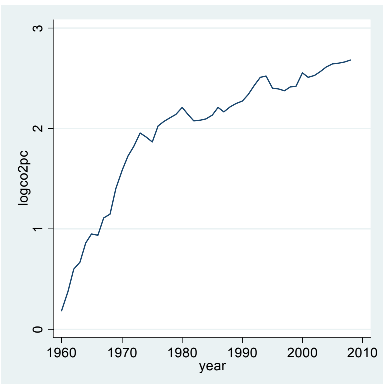

Figure E.79

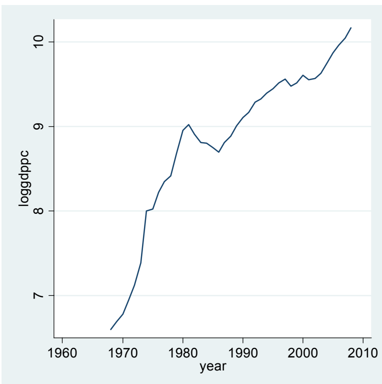

Figure E.80

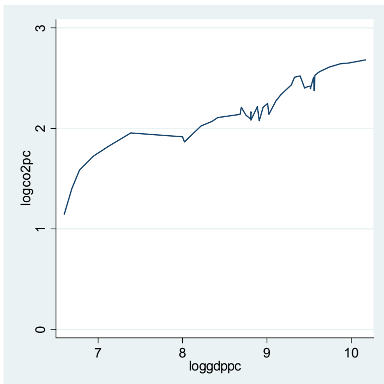

Figure E.81

Cont. APPENDIX E

High Income OECD Countries

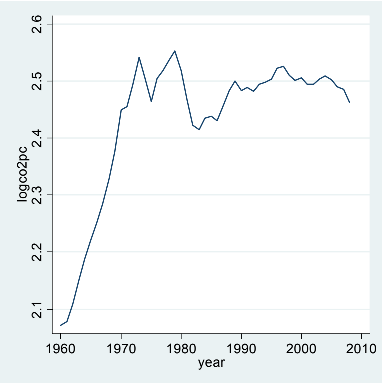

Figure E.82

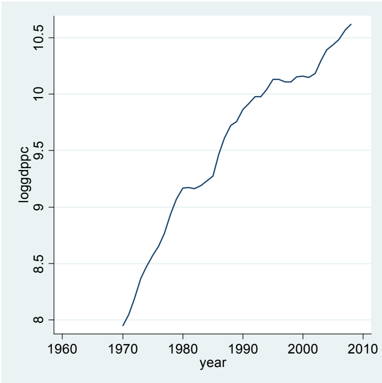

Figure E.83

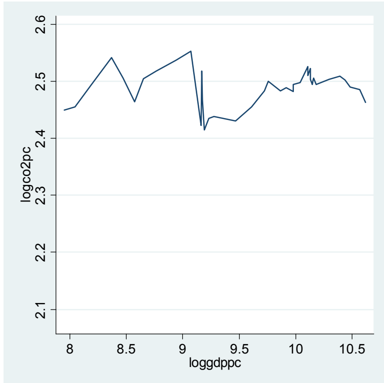

Figure E.84

APPENDIX F

Country List of Model 3

Algeria
Argentina
Bangladesh
Brazil
Chile
China
Hungary
India
Indonesia
Iran, Islamic Rep.
Kuwait
Malaysia
Mexico
Nigeria
Pakistan
Philippines
Poland
Qatar
Romania
Saudi Arabia
South Africa
Thailand
Turkey
United Arab Emirates
Venezuela, RB

Cont. APPENDIX F

Table F.1: Regression Results of Model 3

```
Fixed-effects (within) regression               Number of obs      =      1089
Group variable: countryname                     Number of groups   =        25

R-sq:  within  = 0.6468                         Obs per group: min =        22
       between = 0.7202                                        avg =      43.6
       overall = 0.5880                                        max =        49

                                                F(3,1061)          =    647.72
corr(u_i, Xb)  = 0.5255                         Prob > F           =    0.0000
```

logco2pc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
loggdppc	2.699643	.3228557	8.36	0.000	2.066135	3.333151
loggdppc2	-.2252753	.0448577	-5.02	0.000	-.3132951	-.1372555
loggdppc3	.0056818	.002036	2.79	0.005	.0016866	.0096769
_cons	-8.71801	.7586867	-11.49	0.000	-10.20671	-7.229314
sigma_u	1.0948011					
sigma_e	.27620724					
rho	.94015872	(fraction of variance due to u_i)				

F test that all u_i=0:   F(24, 1061) =   263.56   Prob > F = 0.0000

Cont. APPENDIX F

Figures[7] of the Model 3

Algeria

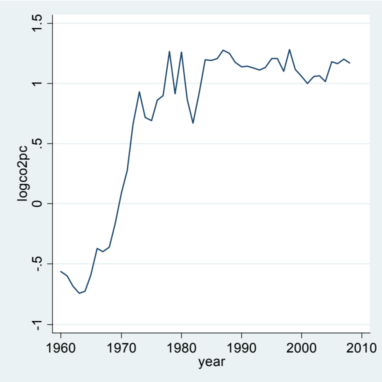

Figure F.1

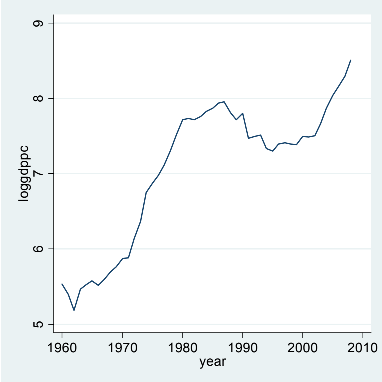

Figure F.2

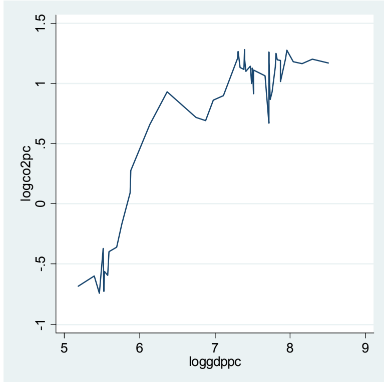

Figure F.3

Argentina

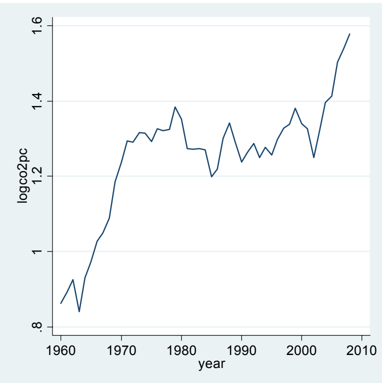

Figure F.4

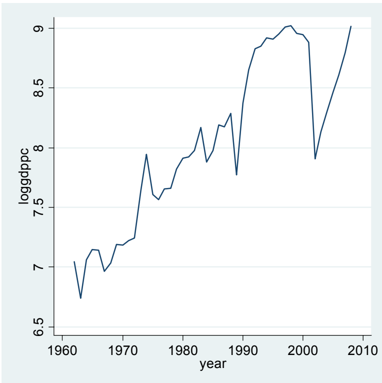

Figure F.5

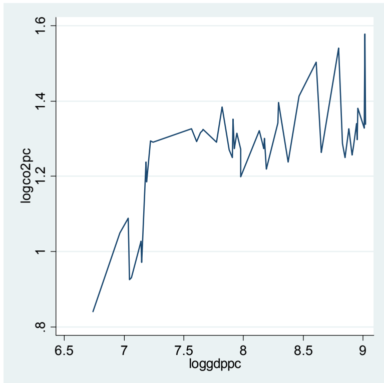

Figure F.6

Bangladesh

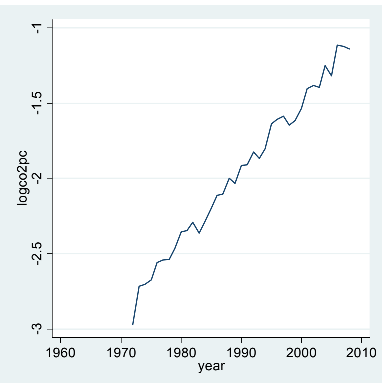

Figure F.7

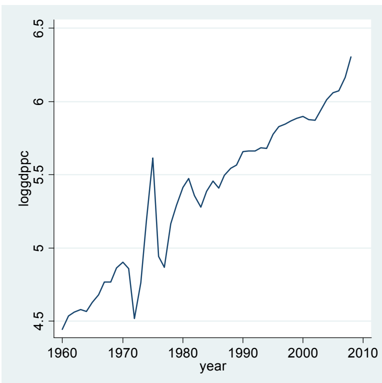

Figure F.8

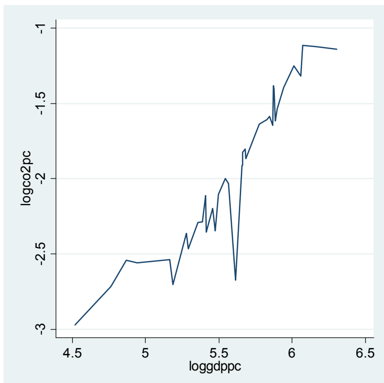

Figure F.9

[7] All of the values are in log form.

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Brazil

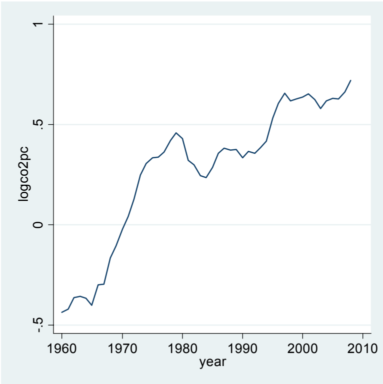

Figure F.10

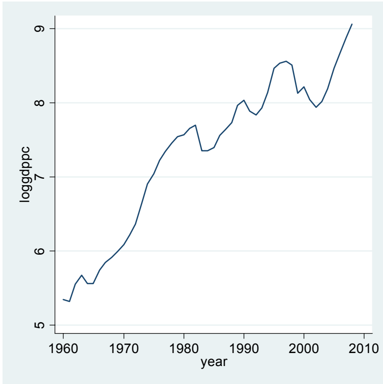

Figure F.11

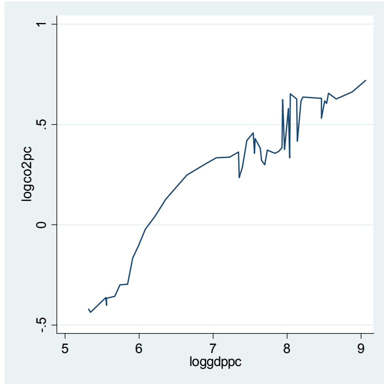

Figure F.12

Chile

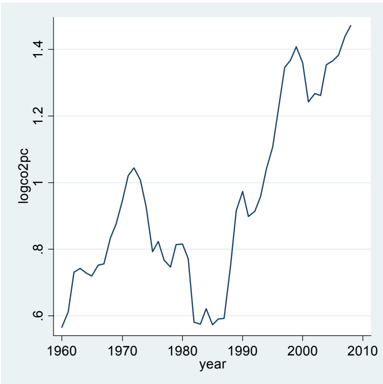

Figure F.13

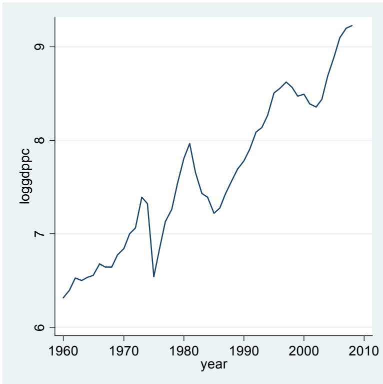

Figure F.14

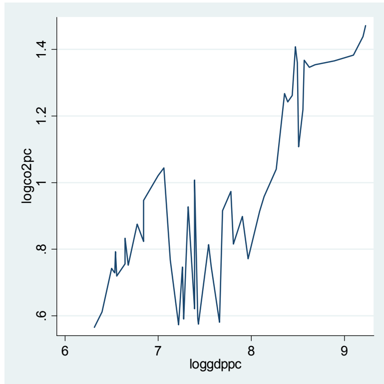

Figure F.15

China

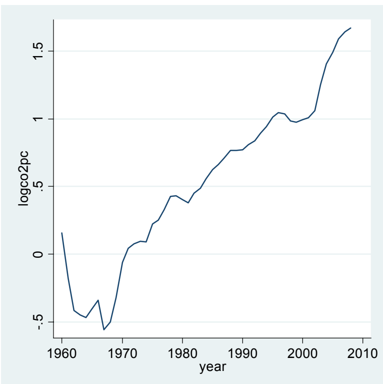

Figure F.16

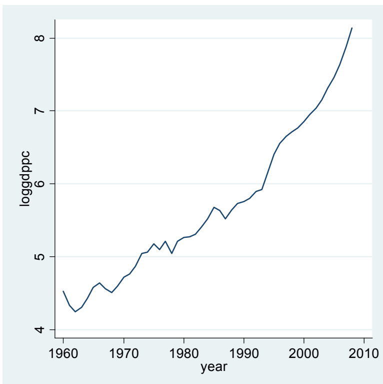

Figure F.17

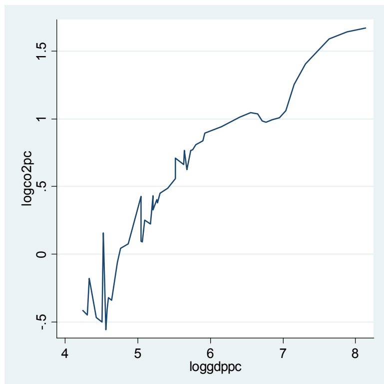

Figure F.18

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Hungary

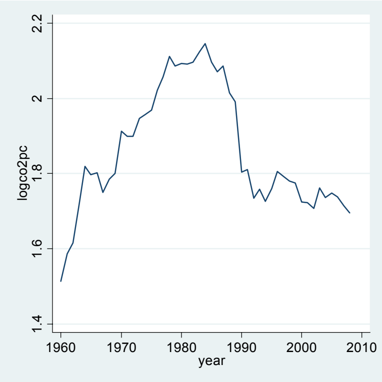


Figure F.19

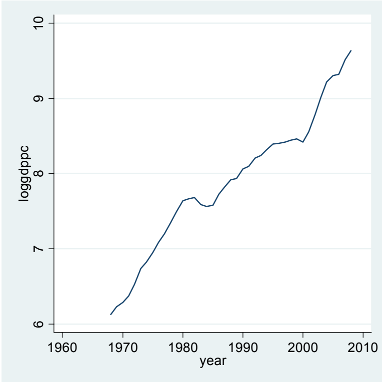


Figure F.20

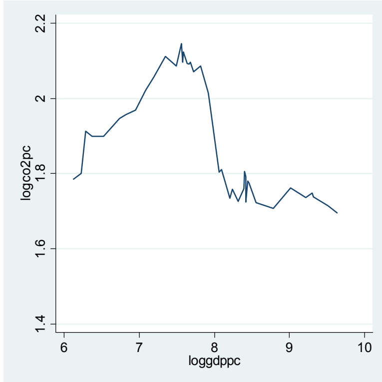


Figure F.21

India

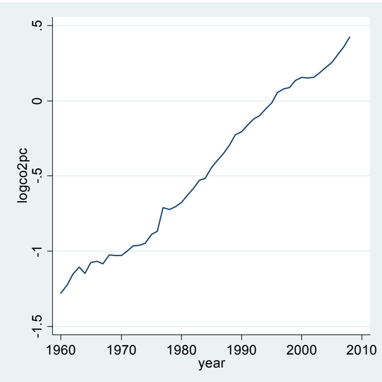
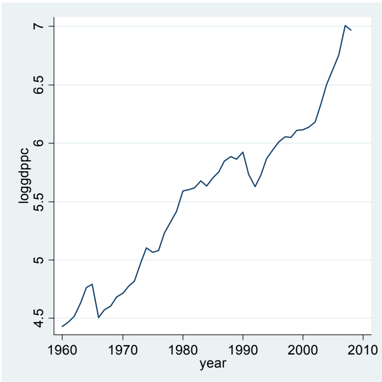


Figure F.22



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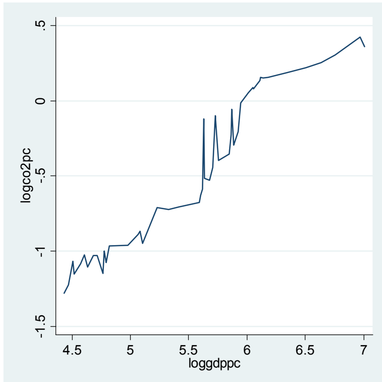

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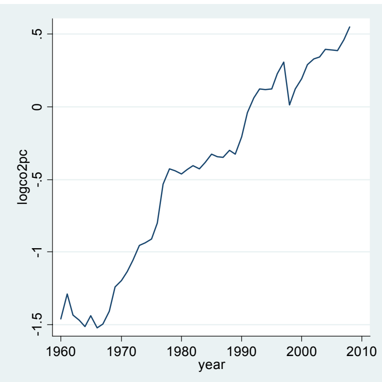
Indonesia



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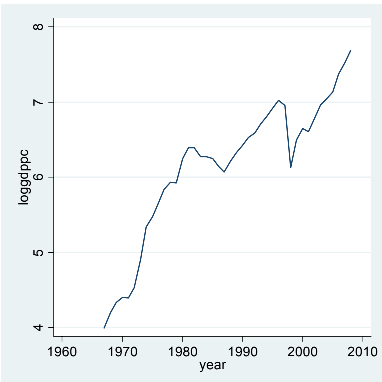

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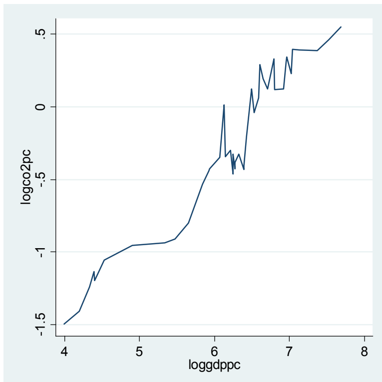
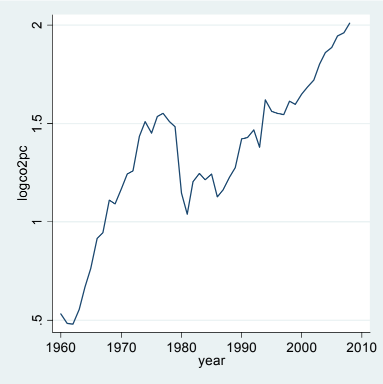


Figure F.27

Cont. APPENDIX F

Iran, Islamic Rep.



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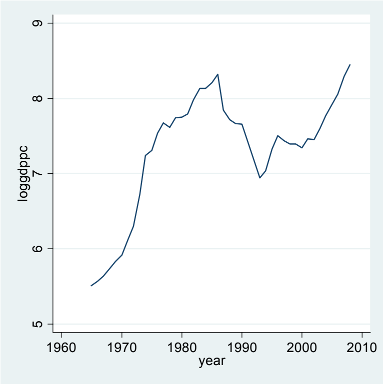

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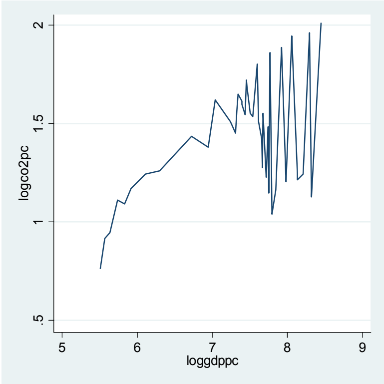
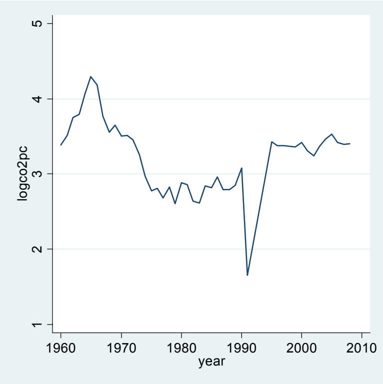


Figure F.30

Kuwait



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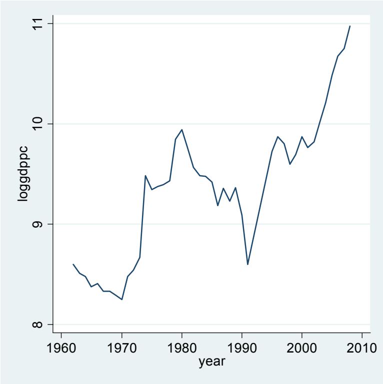

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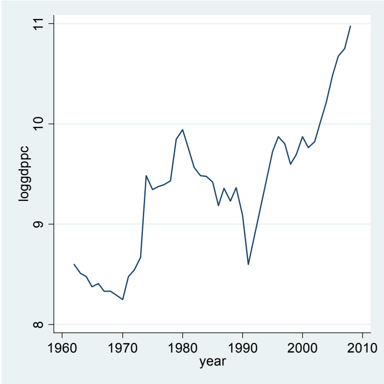

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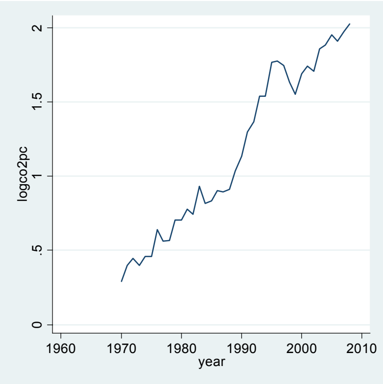
Malaysia



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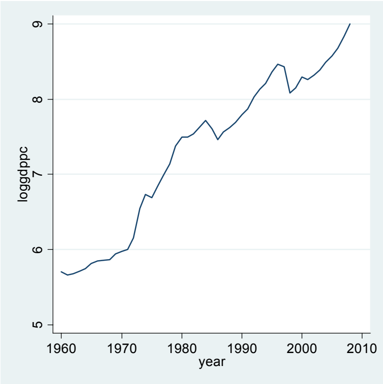

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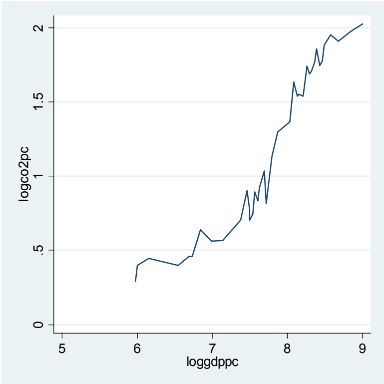
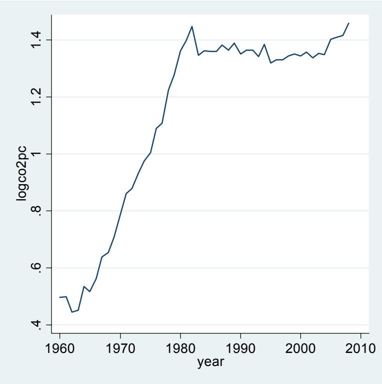


Figure F.36

Cont. APPENDIX F

Mexico



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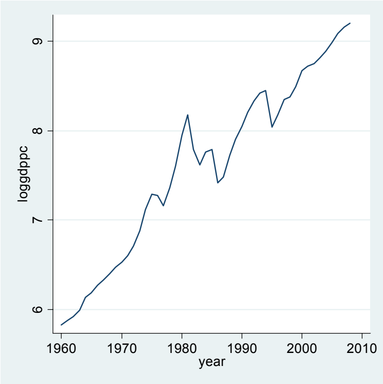


Figure F.38

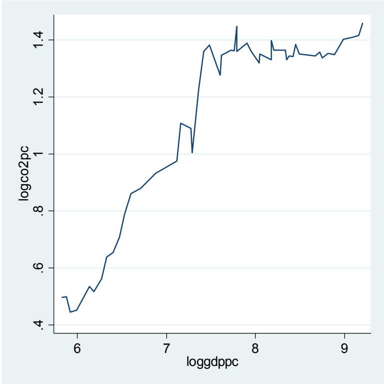


Figure F.39

Nigeria

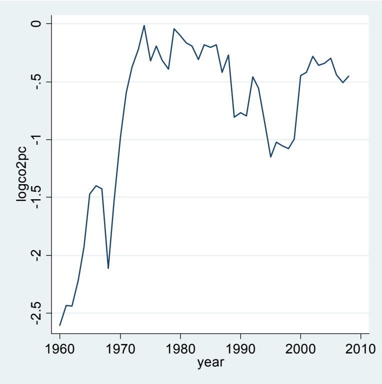
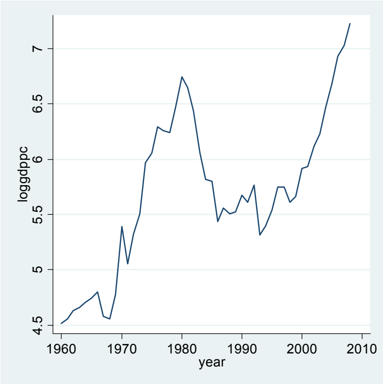


Figure F.40



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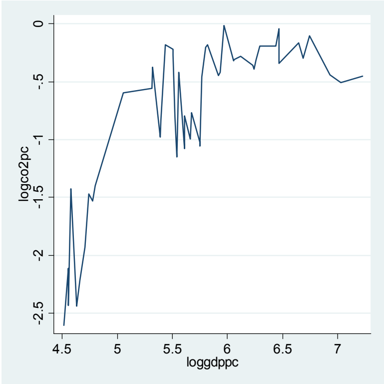
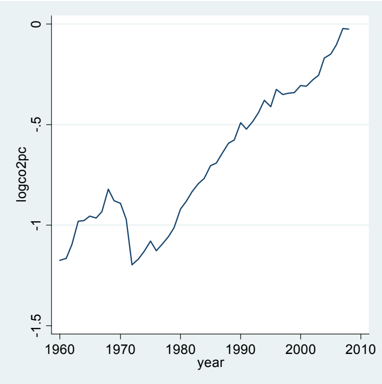


Figure F.42

Pakistan



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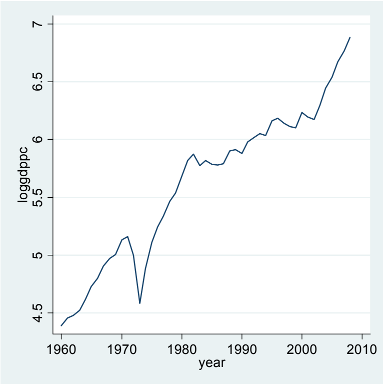

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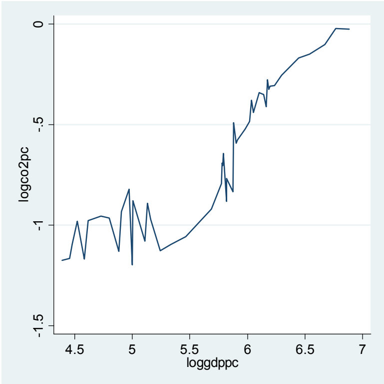


Figure F.45

Cont. APPENDIX F

Philippines

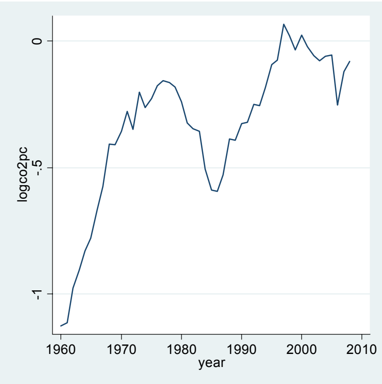
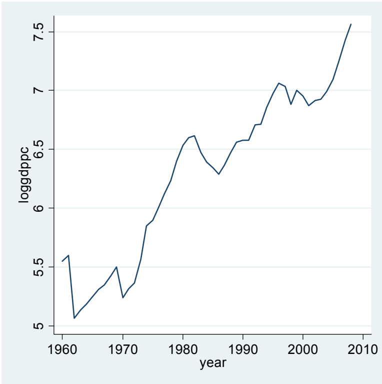


Figure F 46



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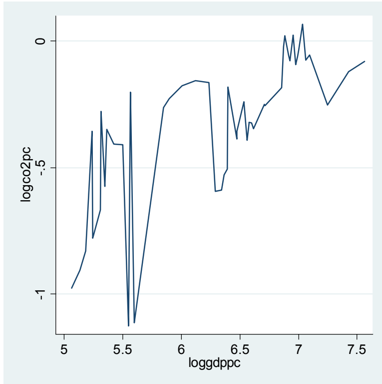


Figure F.48

Poland

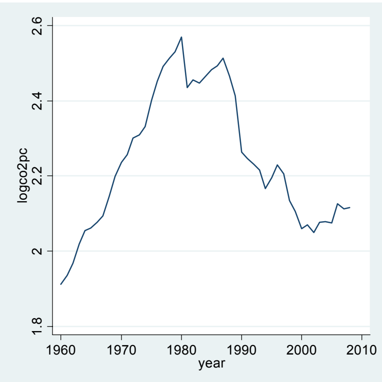


Figure F.49

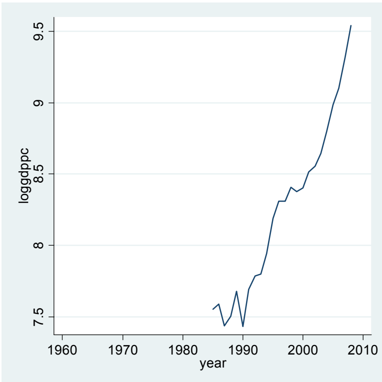


Figure F.50

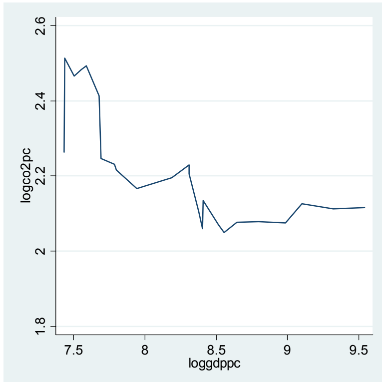


Figure F.51

Qatar

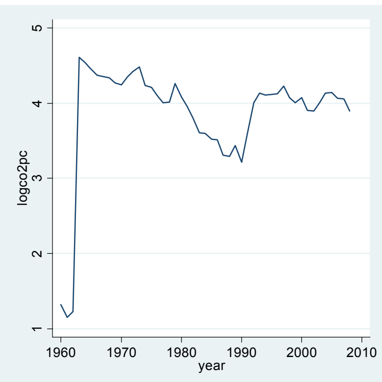
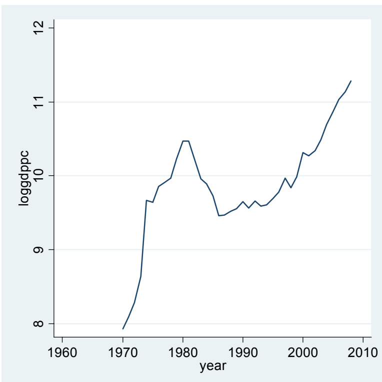


Figure F.52



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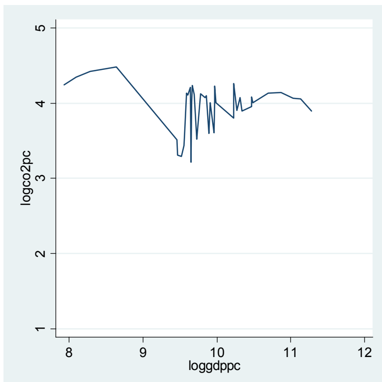
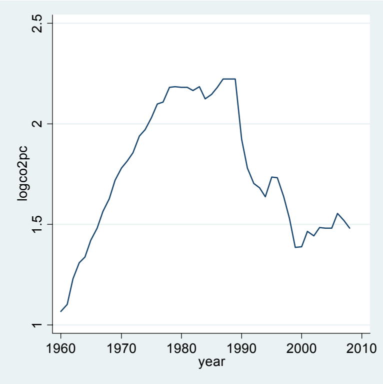


Figure F.54

Cont. APPENDIX F

Romania



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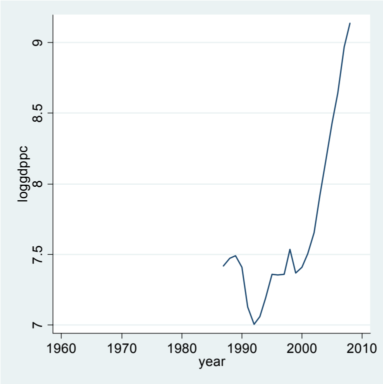


Figure F.56

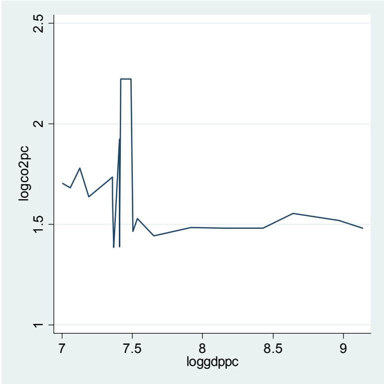


Figure F.57

Saudi Arabia

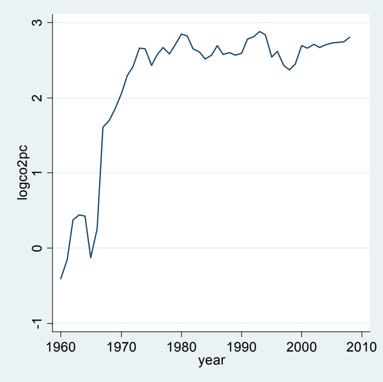
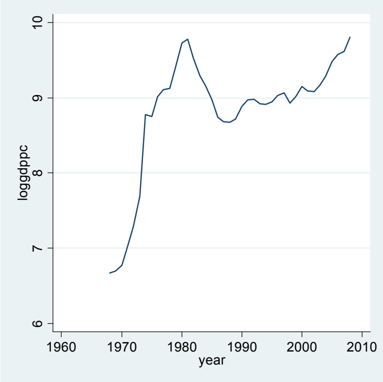


Figure F.58



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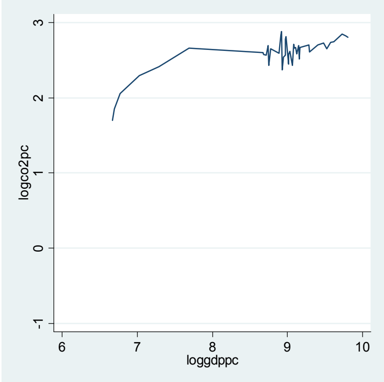


Figure F.60

South Africa

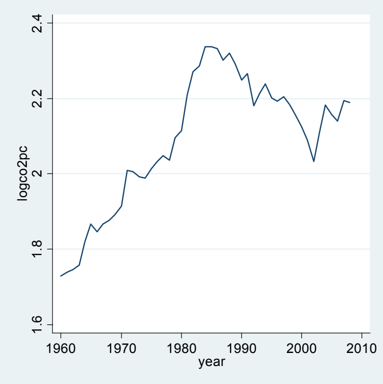
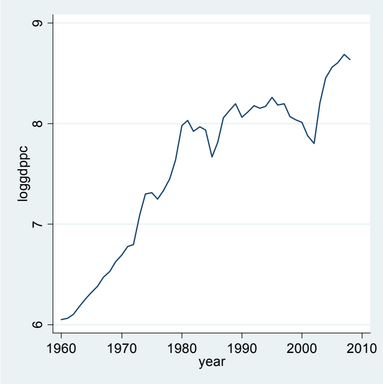


Figure F.61



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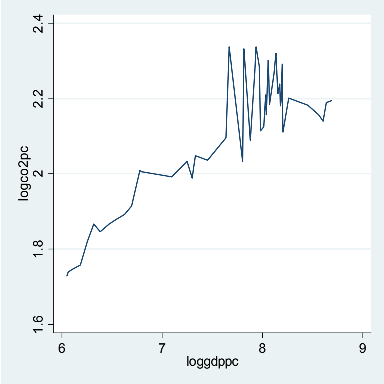
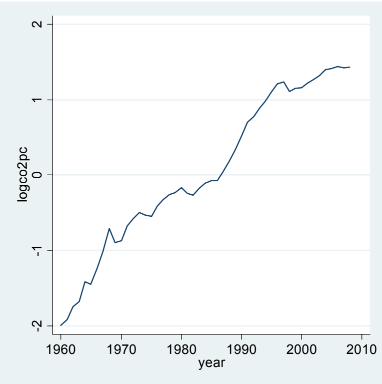


Figure F.63

Cont. APPENDIX F

Thailand



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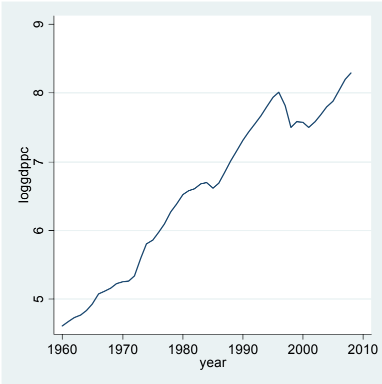

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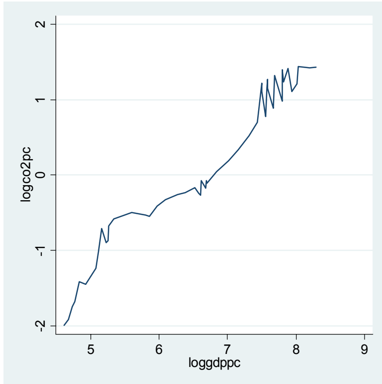
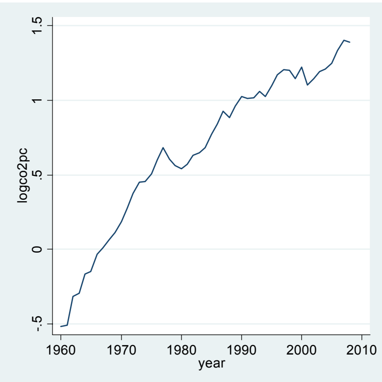


Figure F.66

Turkey



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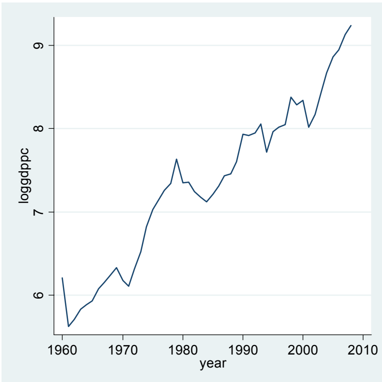


Figure F.68

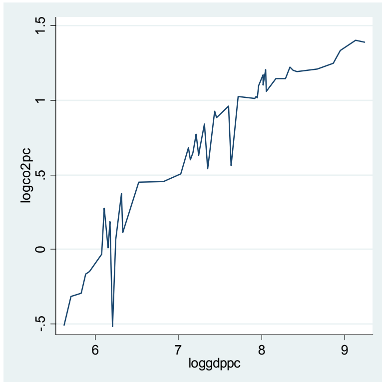


Figure F.69

United Arab Emirates

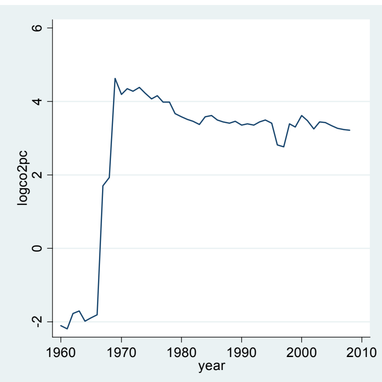


Figure F.70

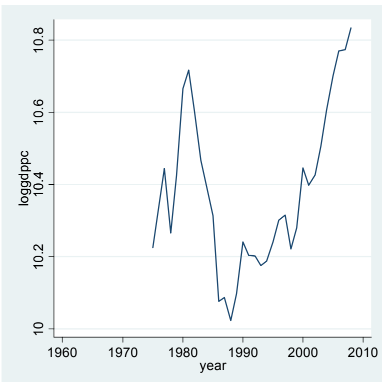


Figure F.71

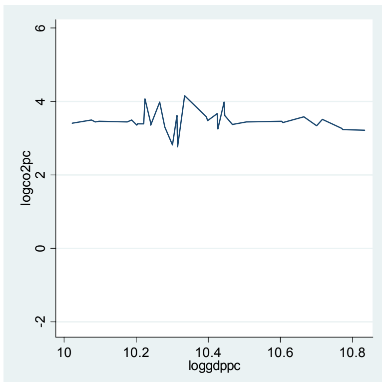
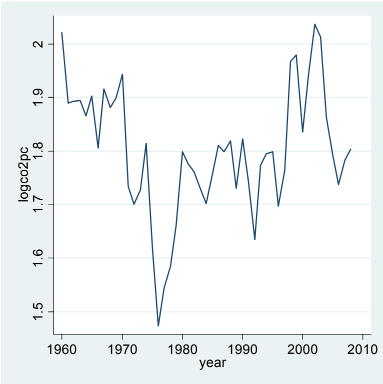


Figure F.72

Cont. APPENDIX F

Venezuela



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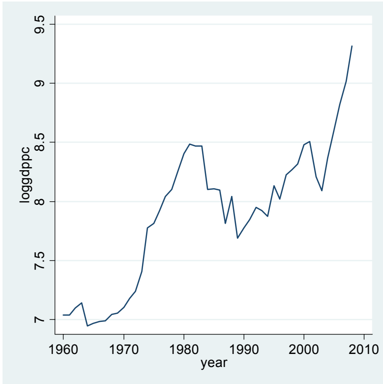

Figure F.74

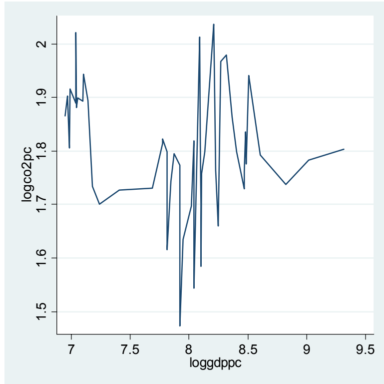

Figure F.75

Low and Middle Income Countries

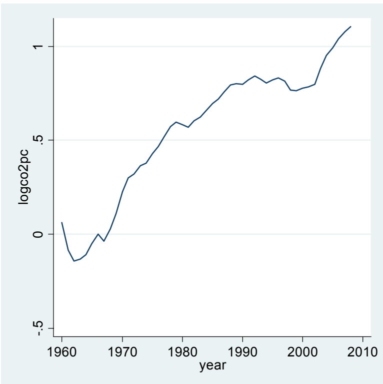

Figure F.76

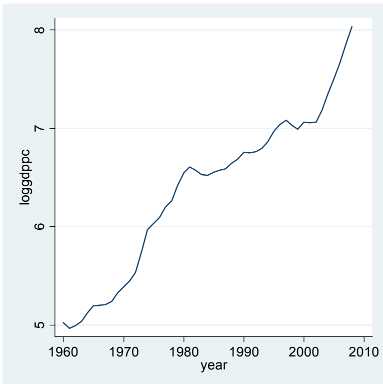

Figure F.77

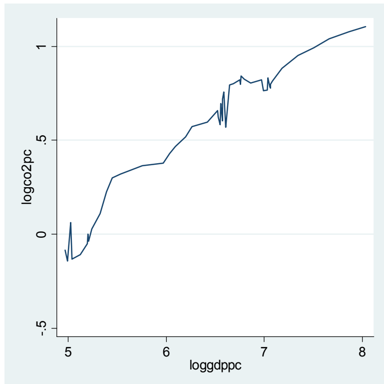

Figure F.78

APPENDIX G

Figures[8] of the Model 4

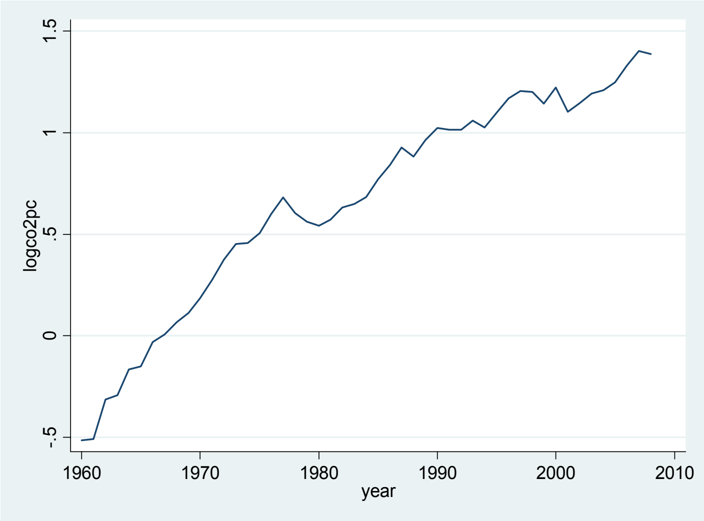

Figure.G.1: The Change in per-capita CO_2 over 1960-2008 period.

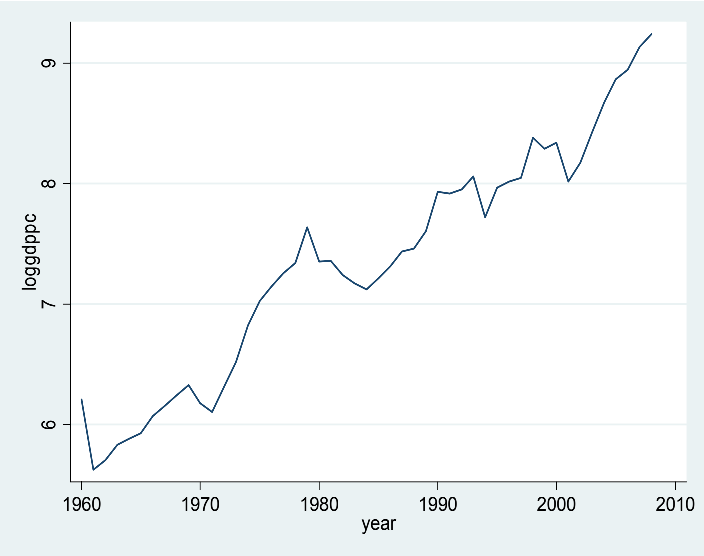

Figure.G.2: The Change in per-capita GDP over 1960-2008 period

[8] All of the values are in log form.

Cont. APPENDIX G

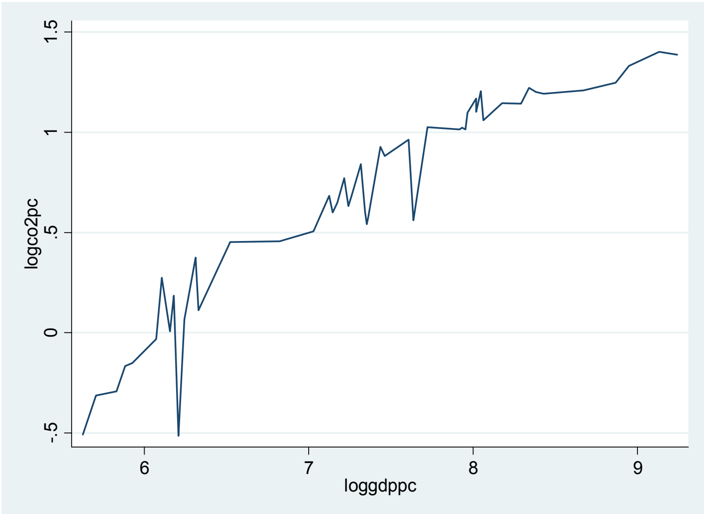

Figure G.3: The EKC over 1960-2008 period

Table G.1: Regression Results of Model 4

Source	SS	df	MS		
Model	12.6456066	2	6.32280331	Number of obs =	49
Residual	.885780404	46	.019256096	F(2, 46) =	328.35
				Prob > F =	0.0000
Total	13.531387	48	.281903896	R-squared =	0.9345
				Adj R-squared =	0.9317
				Root MSE =	.13877

logco2pc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
loggdppc	1.868731	.2998732	6.23	0.000	1.265117	2.472344
loggdppc2	-.0922643	.0204317	-4.52	0.000	-.1333911	-.0511374
_cons	-7.995749	1.086757	-7.36	0.000	-10.18328	-5.808221

Table G.2: Regression Results of Model 4*

Source	SS	df	MS		
Model	12.6456195	3	4.21520649	Number of obs =	49
Residual	.885767559	45	.019683724	F(3, 45) =	214.15
				Prob > F =	0.0000
Total	13.531387	48	.281903896	R-squared =	0.9345
				Adj R-squared =	0.9302
				Root MSE =	.1403

logco2pc	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
loggdppc	1.965339	3.79386	0.52	0.607	-5.675887	9.606565
loggdppc2	-.1054025	.5147096	-0.20	0.839	-1.142081	.9312758
loggdppc3	.0005885	.0230351	0.03	0.980	-.0458066	.0469835
_cons	-8.229538	9.217383	-0.89	0.377	-26.7943	10.33522

APPENDIX H: Country List of Model 5

Albania	Bulgaria	Ecuador	Honduras
Algeria	Burkina Faso	Egypt, Arab Rep.	Hong Kong SAR, China
Angola	Burundi	El Salvador	Hungary
Antigua and Barbuda	Cambodia	Equatorial Guinea	Iceland
Argentina	Cameroon	Eritrea	India
Armenia	Canada	Estonia	Indonesia
Aruba	Cape Verde	Ethiopia	Iran, Islamic Rep.
Australia	Central African Republic	Fiji	Iraq
Austria	Chad	Finland	Ireland
Azerbaijan	Chile	France	Israel
Bahamas, The	China	French Polynesia	Italy
Bahrain	Colombia	Gabon	Jamaica
Bangladesh	Comoros	Gambia, The	Japan
Barbados	Congo, Rep.	Georgia	Jordan
Belarus	Costa Rica	Germany	Kazakhstan
Belgium	Cote d'Ivoire	Ghana	Kenya
Belize	Croatia	Greece	Kiribati
Benin	Cyprus	Grenada	Korea, Rep.
Bolivia	Czech Republic	Guatemala	Kuwait
Bosnia and Herzegovina	Denmark	Guinea	Kyrgyz Republic
Botswana	Djibouti	Guinea-Bissau	Lao PDR
Brazil	Dominica	Guyana	Latvia
Brunei Darussalam	Dominican Republic	Haiti	Lebanon

Cont. APPENDIX H

Liberia	New Zealand	Sierra Leone	Trinidad and Tobago
Libya	Nicaragua	Singapore	Tunisia
Lithuania	Niger	Slovak Republic	Turkey
Luxembourg	Nigeria	Slovenia	Turkmenistan
Macao SAR, China	Norway	Solomon Islands	Uganda
Macedonia, FYR	Oman	Somalia	Ukraine
Madagascar	Pakistan	South Africa	United Kingdom
Malawi	Panama	Spain	United States
Malaysia	Papua New Guinea	Sri Lanka	Uruguay
Maldives	Paraguay	St. Kitts and Nevis	Vanuatu
Mali	Peru	St. Lucia	Venezuela, RB
Malta	Philippines	St. Vincent and the Grenadines	Vietnam
Mauritania	Poland	Sudan	West Bank and Gaza
Mauritius	Portugal	Suriname	Yemen, Rep.
Mexico	Romania	Swaziland	Zambia
Moldova	Russian Federation	Sweden	Zimbabwe
Mongolia	Rwanda	Switzerland	
Morocco	Samoa	Syrian Arab Republic	
Mozambique	Sao Tome and Principe	Tajikistan	
Namibia	Saudi Arabia	Tanzania	
Nepal	Senegal	Thailand	
Netherlands	Serbia	Togo	
New Caledonia	Seychelles	Tonga	

Cont. APPENDIX H

Table H.1 : Regression Results of Model 5

```
Fixed-effects (within) regression               Number of obs      =      2795
Group variable: countryname                     Number of groups   =       164

R-sq:  within  = 0.0849                         Obs per group: min =         1
       between = 0.2061                                        avg =      17.0
       overall = 0.0780                                        max =        41

                                                F(4,2627)          =     60.97
corr(u_i, Xb)  = 0.0956                         Prob > F           =    0.0000
```

logmanexp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
logco2pc	.0036433	.053689	0.07	0.946	-.1016336	.1089202
loggdppc	.0413878	.0350561	1.18	0.238	-.0273527	.1101282
logexrate	.0486716	.0062326	7.81	0.000	.0364503	.0608929
logfdi	.0786663	.0123404	6.37	0.000	.0544683	.1028642
_cons	1.235917	.2289827	5.40	0.000	.7869121	1.684922
sigma_u	1.5998445					
sigma_e	.64689823					
rho	.8594761	(fraction of variance due to u_i)				

```
F test that all u_i=0:     F(163, 2627) =    50.85            Prob > F = 0.0000
```

APPENDIX I

Table I.1: Regression Results of Model 6

Source	SS	df	MS
Model	6.60799398	4	1.65199849
Residual	.795688666	30	.026522956
Total	7.40368264	34	.217755372

Number of obs =	35
F(4, 30) =	62.29
Prob > F =	0.0000
R-squared =	0.8925
Adj R-squared =	0.8782
Root MSE =	.16286

logmanexp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
logco2pc	1.546031	.3769077	4.10	0.000	.7762827	2.315779
loggdppc	-.5739903	.1242467	-4.62	0.000	-.8277358	-.3202447
logexrate	.0618233	.0223509	2.77	0.010	.0161766	.10747
logfdi	.0420419	.0297326	1.41	0.168	-.0186802	.102764
_cons	6.548835	.867398	7.55	0.000	4.777372	8.320298

APPENDIX J

Table J.1: Data Description Table

Name of the Variable[9]	Definition
CO2 emissions (metric tons per capita)	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring
Foreign direct investment, net (BoP, current US$)	Foreign direct investment is net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows total net, that is, net FDI in the reporting economy from foreign sources less net FDI by the reporting economy to the rest of the world. Data are in current U.S. dollars.
GDP per capita (current US$)	GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current U.S. dollars
Manufactures exports (% of merchandise exports)	Manufactures comprise commodities in SITC sections 5 (chemicals), 6 (basic manufactures), 7 (machinery and transport equipment), and 8 (miscellaneous manufactured goods), excluding division 68 (non-ferrous metals).
Official exchange rate (LCU per US$, period average)	Official exchange rate refers to the exchange rate determined by national authorities or to the rate determined in the legally sanctioned exchange market. It is calculated as an annual average based on monthly averages (local currency units relative to the U.S. dollar).

[9] All the variable are used from World Bank Indicators 2012.

ÖZGEÇMİŞ

1986 yılında Edirne'de doğan Bahar MANAV, ortaokul ve lise öğrenimini 1997-2004 yılları arasında Edirne Anadolu Lisesi'nde tamamladıktan sonra 2005 yılında Trakya Üniversitesi İktisadi ve İdari Bilimler Fakültesi İktisat Bölümü'nü kazanmıştır. 2009 yılında lisans eğitimini bu üniversitede tamamladıktan sonra, aynı yılın Eylül ayında Galatasaray Üniversitesi İktisat Yüksek Lisans Bölümüne girmeye hak kazanmıştır.