

# THE GDP, FDI AND CO<sub>2</sub> TRIANGLE

- **Fariha Sanam Sharif and Ishan Deep Ghosh**



# ABOUT THE PAPER

- In this paper we examined the impact of increased trade among nations on the components of environment
- The impact of Foreign Direct Investment (FDI), a relatively modern phenomenon representing increased trade liberalization on the environment and GDP growth rates of the host nations
- Although an insignificant causal impact of FDI on GDP growth is ascertained, an attempt has been made to derive a marginal sector-specific positive correlation between FDI and CO<sub>2</sub> emissions especially in the context of developing countries
- USA and India are taken as two countries representing the first and third world respectively with a significant inflow of FDI in the recent years
- According to world rankings of highest FDI recipient countries USA ranks number 1, while India occupies the 23<sup>rd</sup> rank

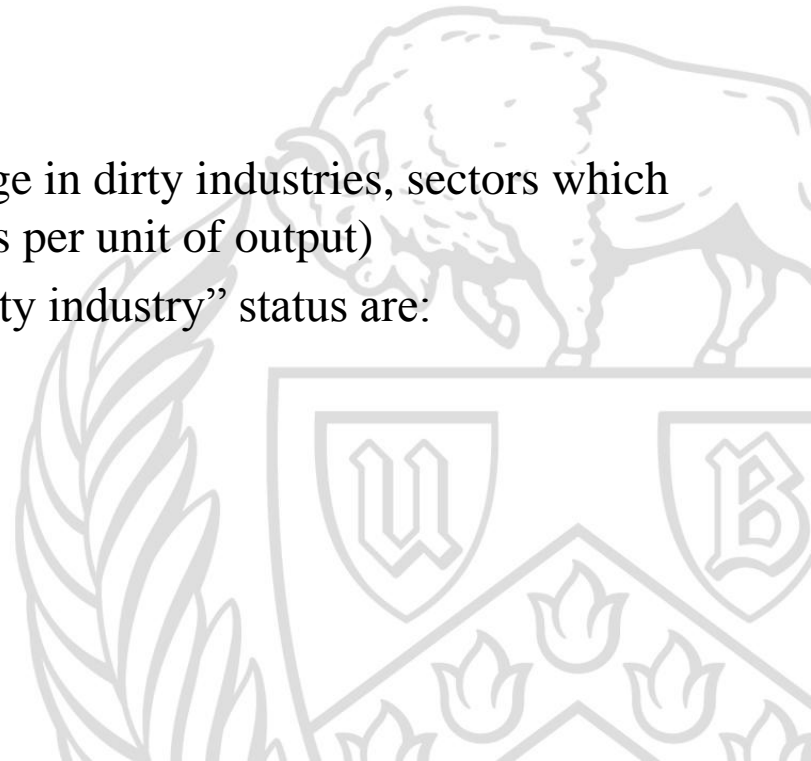
# INTRODUCCION

- FDI inflow has increased exponentially over the last two decades
- One of the most significant channels through which this spillover of foreign technology and investment takes place is FDI
- It is a widely supported phenomenon that technological advancement fosters economic growth but the access to scientifically advanced production technology and R&D amenities is not constant across the world
- The benefits to the host country are numerous in the form of capital and technology transfer, development of human capital and employment generation to name a few
- Djankov and Hoekman (2000) supported this positive relationship between FDI and economic growth although the support was conditional in nature

- Blomstrom, *et al.* (1994) established that there existed a positive effect of FDI inflows on the average growth rate of per capita income of 78 developing and 23 developed countries, he also argued that the effect is stronger if the country is richer in terms of per capita income
- Borensztein, *et al.* (1998) linked impact of FDI inflow and available human capital endowment of the host country, referring to a “minimum threshold stock of human capital” and “absorptive capability of the advanced technologies,” necessary to exploit the actual capacity of an investment inflow
- According to Banga (2005), FDI has a direct impact on the level of wages and employment and that countries with higher FDI tend to have higher levels of wages and employment
- Aitken and Harrison (1999) have detected a negative relationship between FDI and economic growth, questioning whether there actually has been any technology “spillover” to the domestic firms as a result of the entry of their foreign counterparts

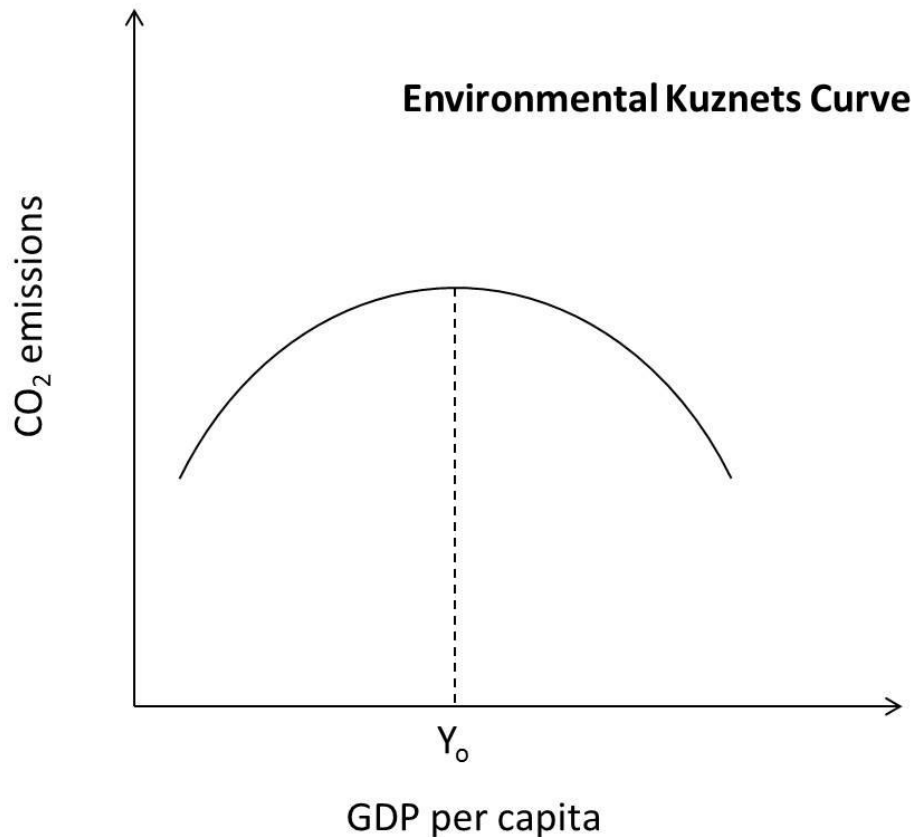
# POLLUTION HAVEN HYOTHESIS

- Pollution Haven Hypothesis has been the core subject of literature across the last two decades
- Pollution Haven Hypothesis (PPH) is described as the migration of polluting industries to mostly developing countries where the enforcement of environmental standards is not as stringent as developed countries
- Race to the Bottom
- Race to the Top
- Developing countries enjoy comparative advantage in dirty industries, sectors which rank high on actual emissions intensity (emissions per unit of output)
- By this criteria top five sectors that fulfill the “dirty industry” status are:
  - Iron and Steel
  - Non-Ferrous Metals
  - Industrial Chemicals
  - Pulp and Paper
  - Non-Metallic Mineral Products



# EMPIRICAL UNDERSTANDING

- Environmental Kuznets Curve



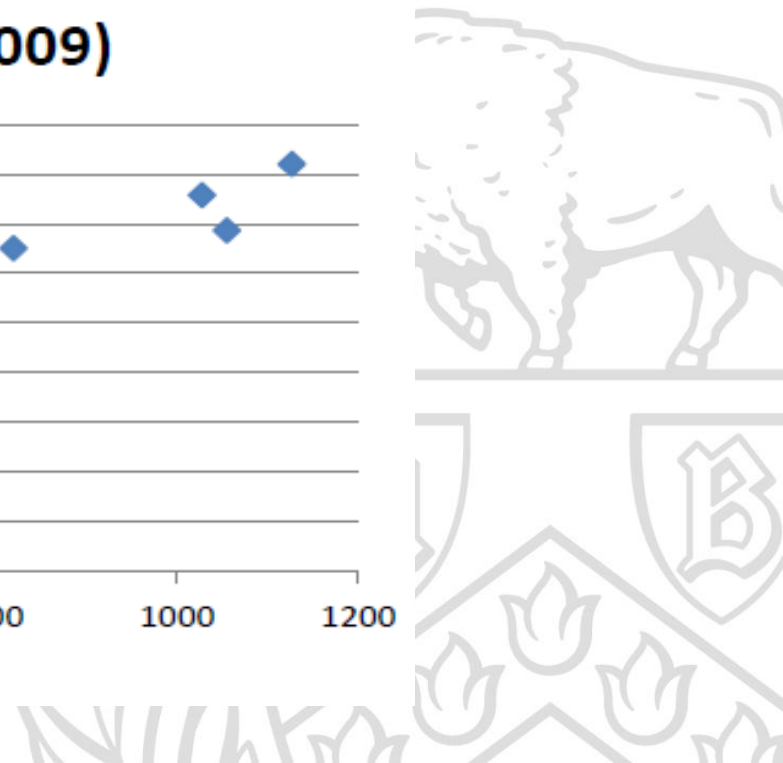
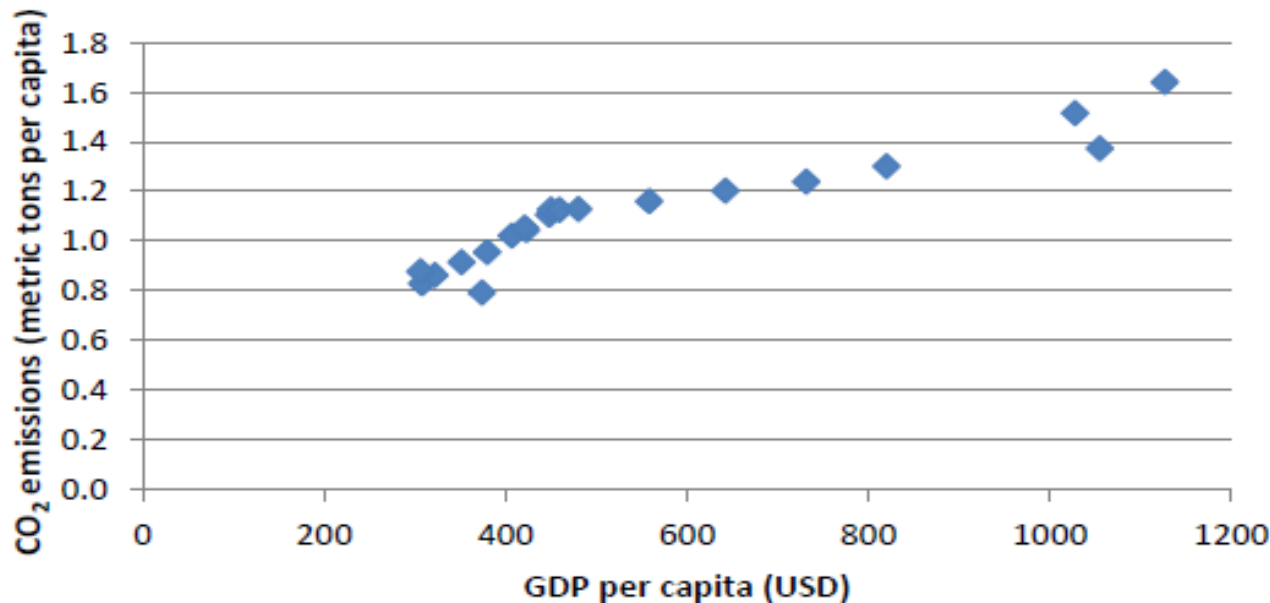
A tradeoff on the part of developing countries as increase in GDP growth is as important as reduction in pollution levels. A popular concept dominating this literature is the inverted U shaped environmental Kuznets Curve (EKC) which argues that with the increase in per capita GDP, the pollution level follows a U shaped trajectory.



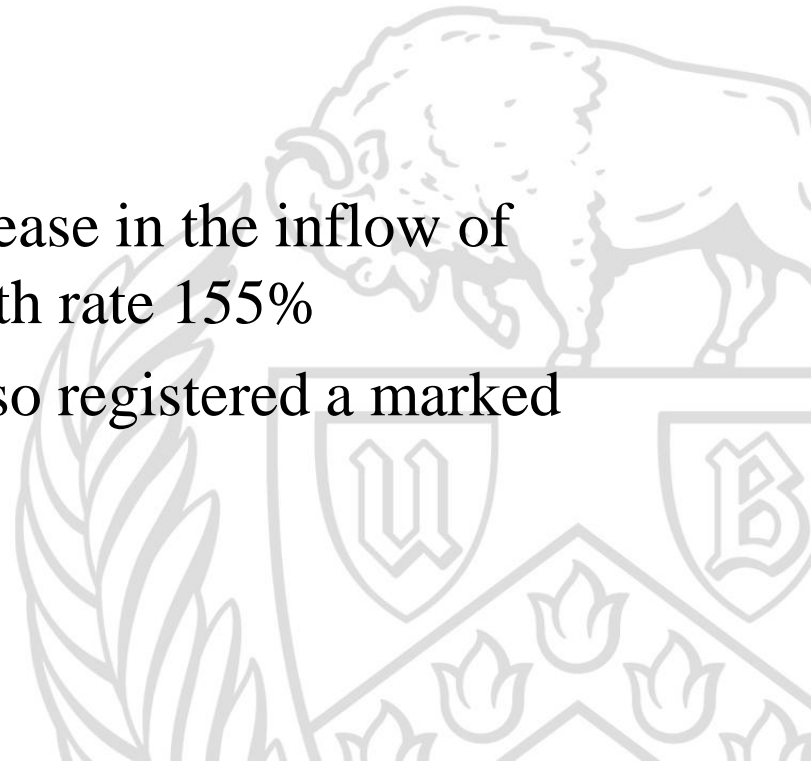
## But can the EKC be supported with significant empirical evidence?

- A comparative study on USA and India is done to show how the inverted U-shaped trajectory exists in the two countries
- The time horizon taken into account is from 1990-2009
- By taking the GDP per capita in US dollars on the horizontal axis and CO<sub>2</sub> emissions (metric tons per capita) on the vertical axis, we plot a scatter diagram plotting the relationship between the two.

**EKC for India (1990-2009)**



- Positive correlation between CO<sub>2</sub> emissions and GDP growth
- Transition from agriculture to industrial economy
- India experienced a fall in GDP in 1991 and 1993 while CO<sub>2</sub> emissions indicate a gradual increase
  - Currency crisis in India in 1991
  - Large current account deficit
  - Lack of foreign exchange reserves
- Year 2006 marked the highest increase in the inflow of foreign funds with an annual growth rate 155%
- Interestingly pollution emission also registered a marked increase over the same year

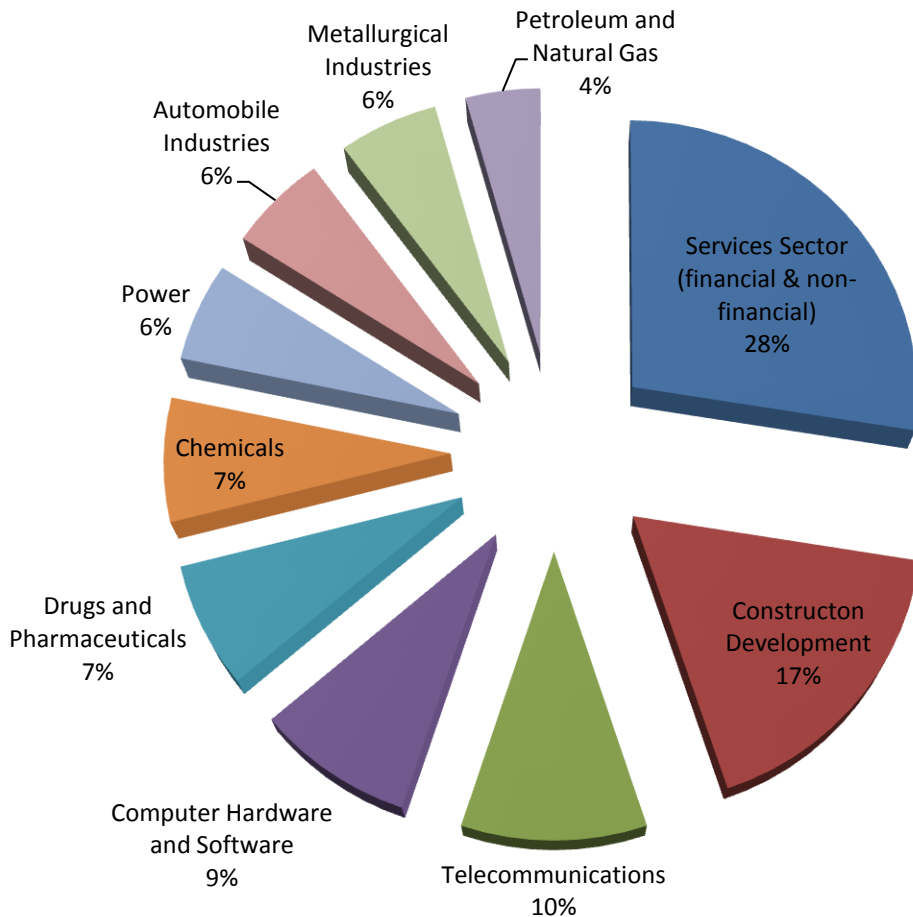




# TOP COUNTRY INVESTORS IN INDIA (AUGUST 2008-AUGUST 2011)

Ranks	Countries	Percentage to total Inflows (USD)
1	Mauritius	42
2	Singapore	9
3	USA	7
4	UK	5
5	Netherlands	4
6	Japan	4
7	Cyprus	4
8	Germany	2
9	France	2
10	UAE	1

# SECTORS ATTRACTING HIGHEST FDI INFLOW IN INDIA

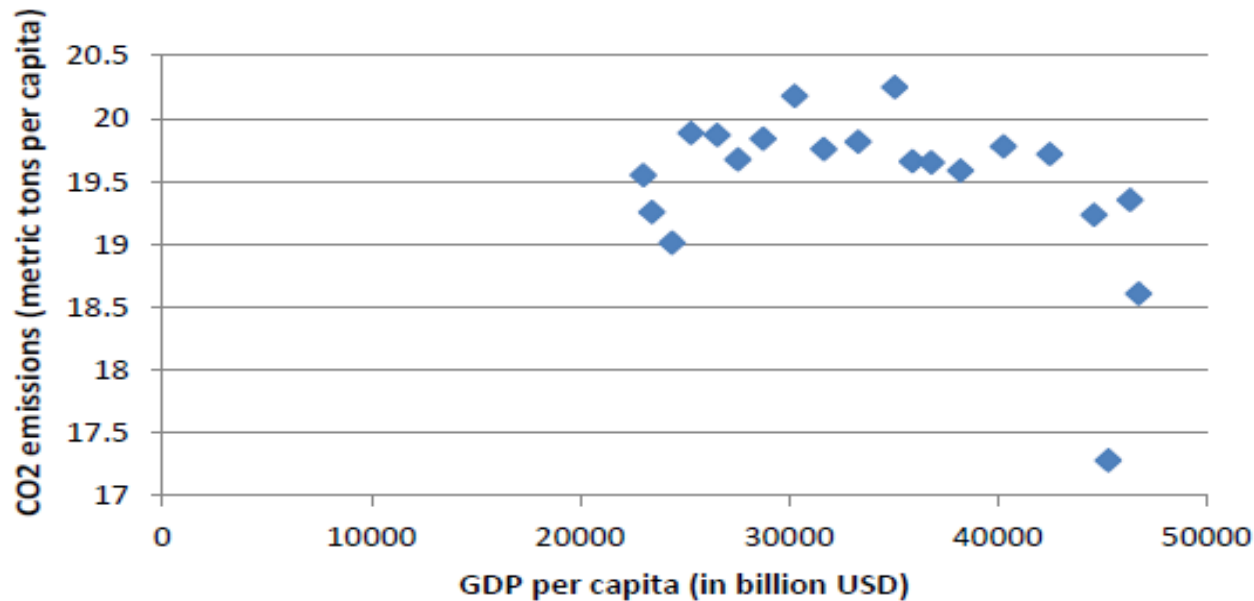


Services Sector (financial & non-financial)	19
Constructon Development	12
Telecommunications	7
Computer Hardware and Software	6
Drugs and Pharmaceuticals	5
Chemicals	5
Power	4
Automobile Industries	4
Metallurgical Industries	4
Petroleum and Natural Gas	3

Now we plot the estimated EKC curve analyzing USA data over the same time horizon of 1990-2009. The U-shaped trajectory can be significantly derived from the following scatter diagram, which leads us to interesting observations.

This proves that developed countries' increasing per capita GDP can be accompanied by declining pollution levels in spite of an increased flow of foreign investments

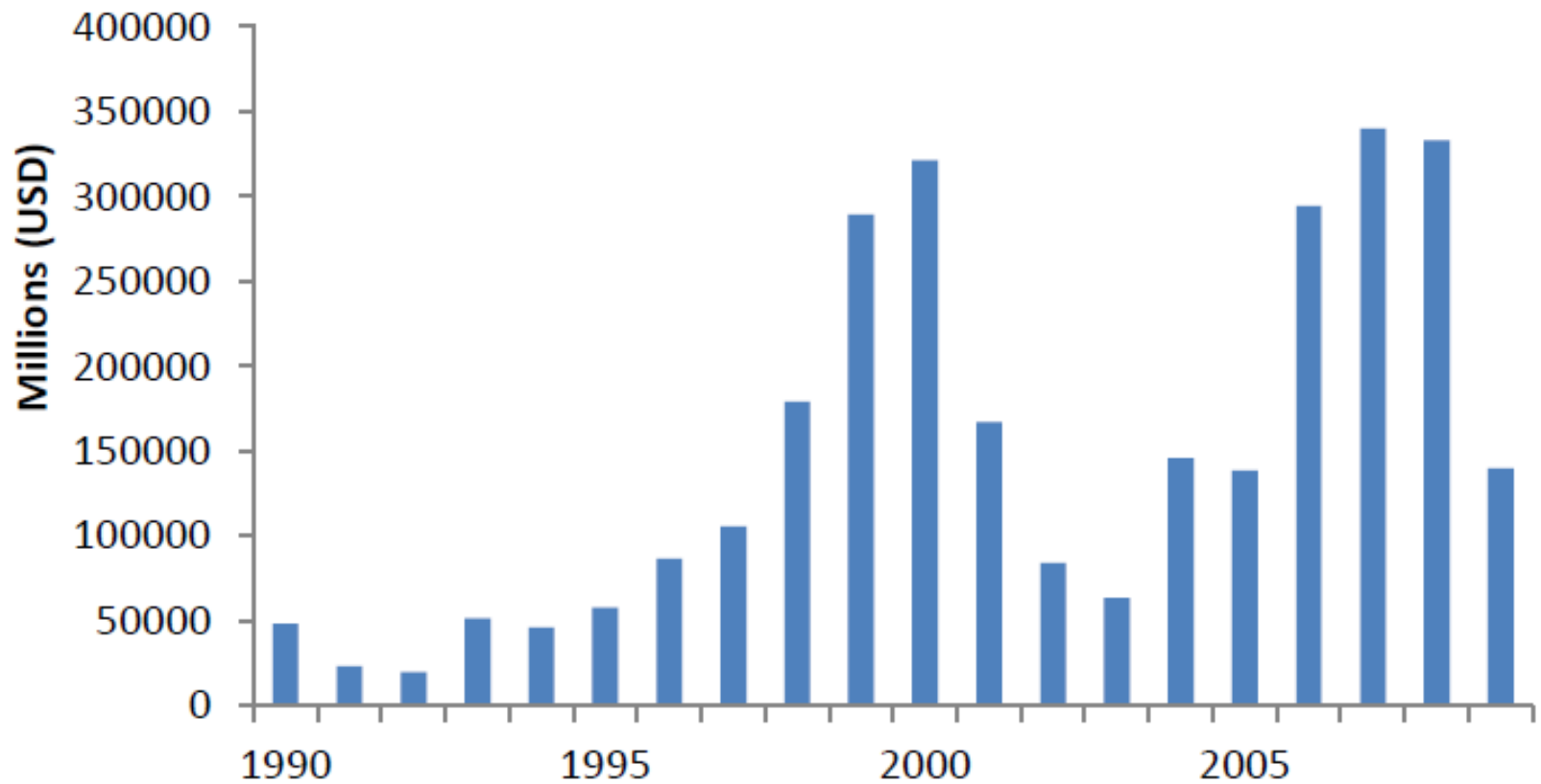
**EKC for USA (1990-2009)**



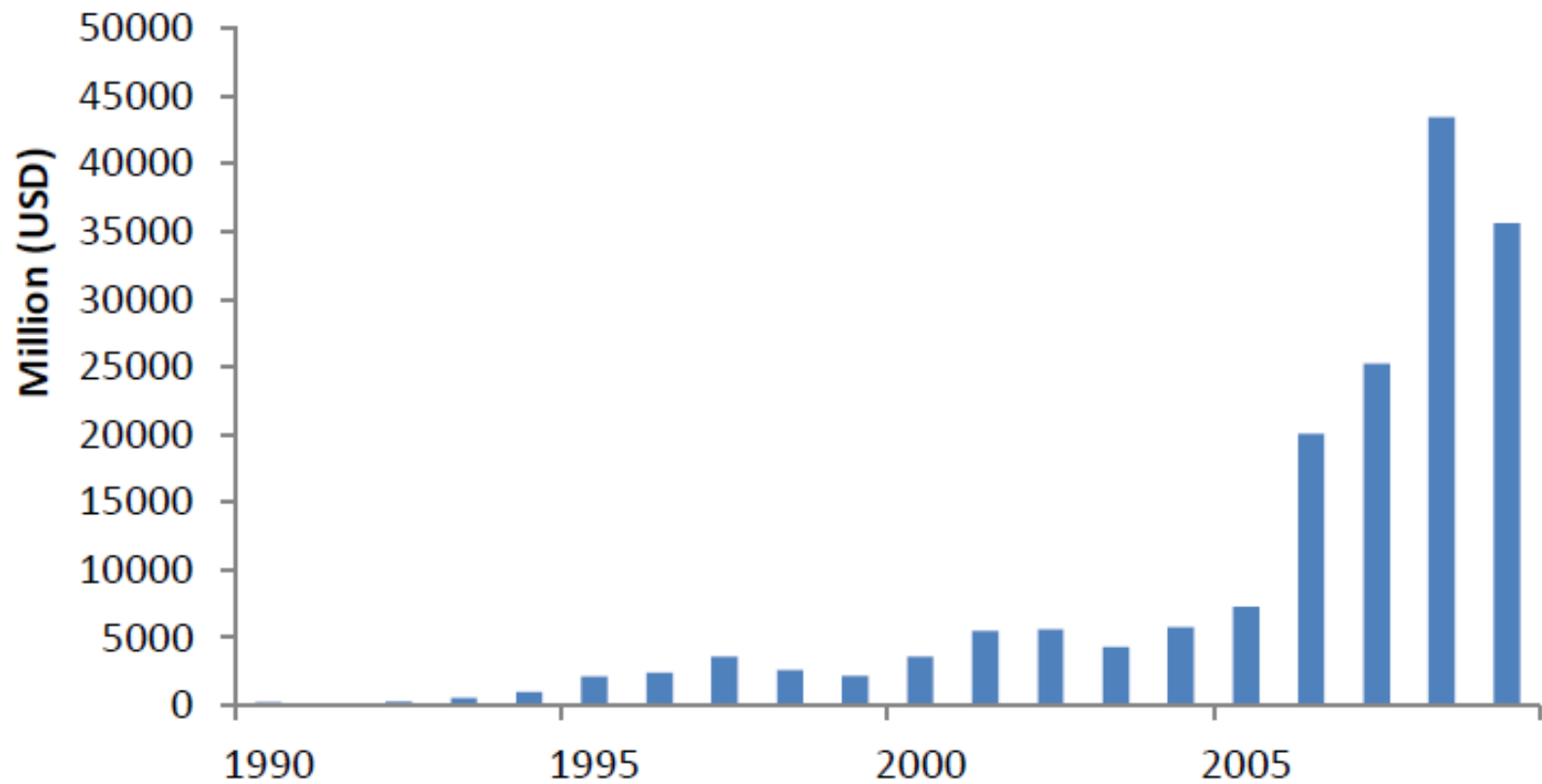
- USA per capita GDP has shown a steady increase except for the year 2008
- In 2009 the USA per capita GDP marked a decline. This can be attributed to the global financial crisis of 2008
- CO2 emissions have registered significantly less increments with a majority of years experiencing marginal reductions
- Transitional phase from an industrial to services sector
- Declining pollution levels



## Yearly FDI (USA)



## Yearly FDI (India)

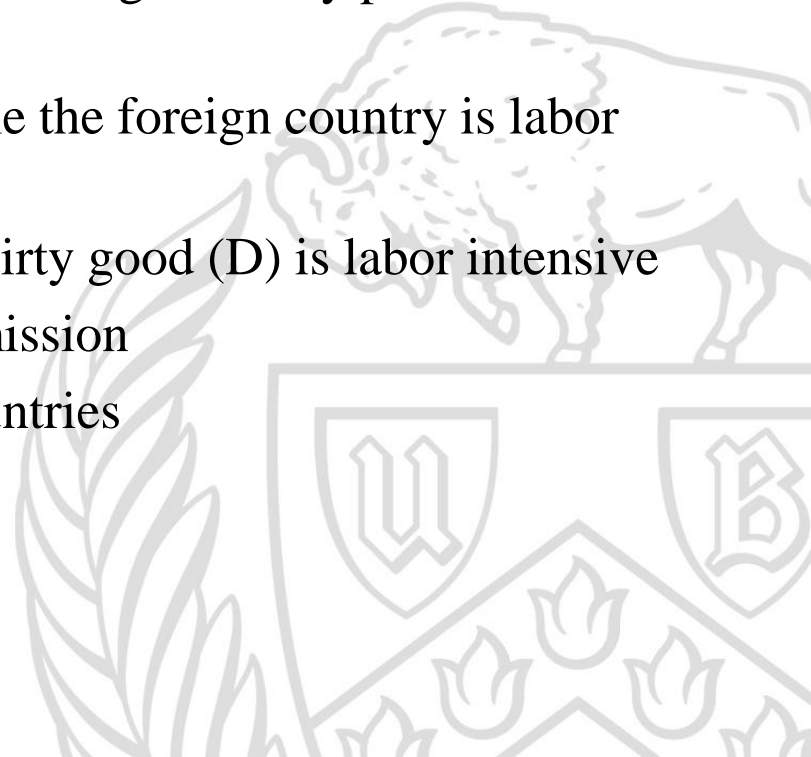


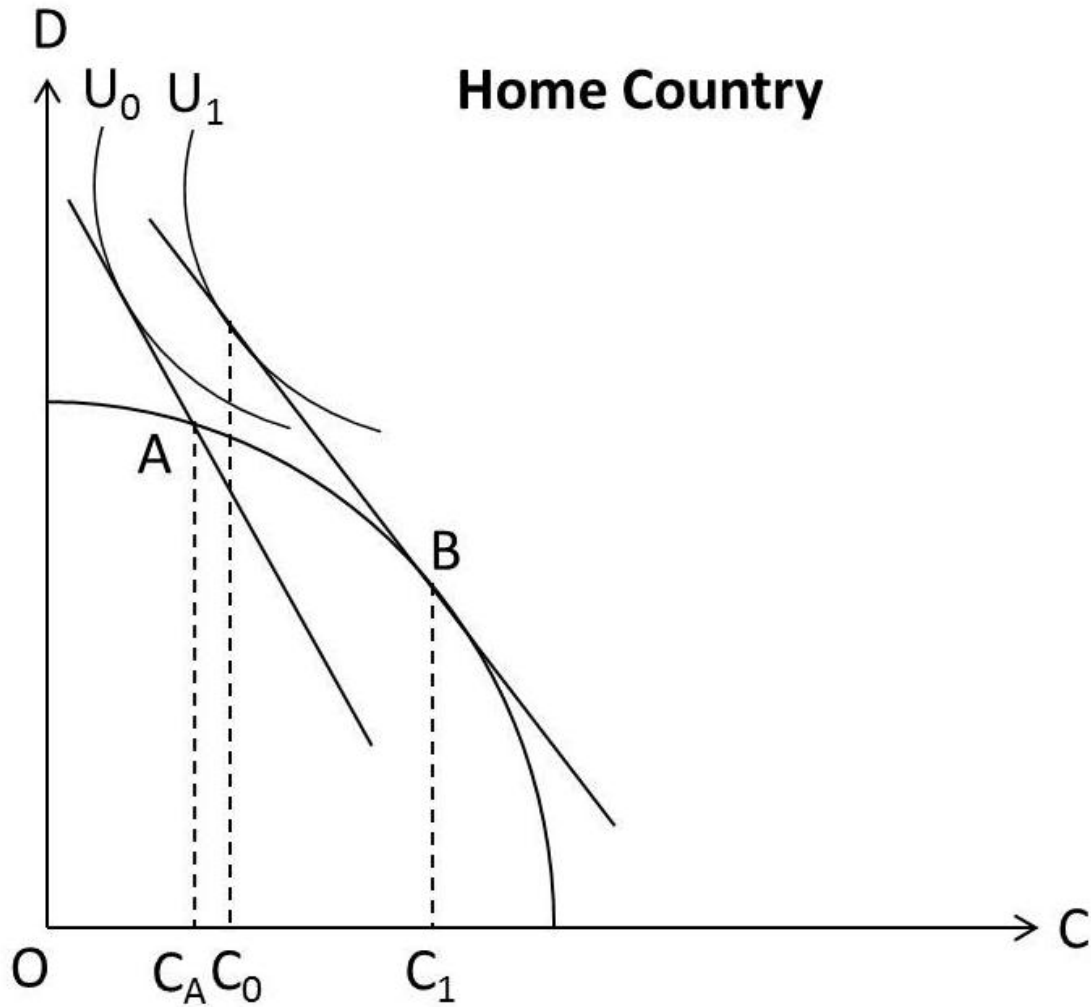


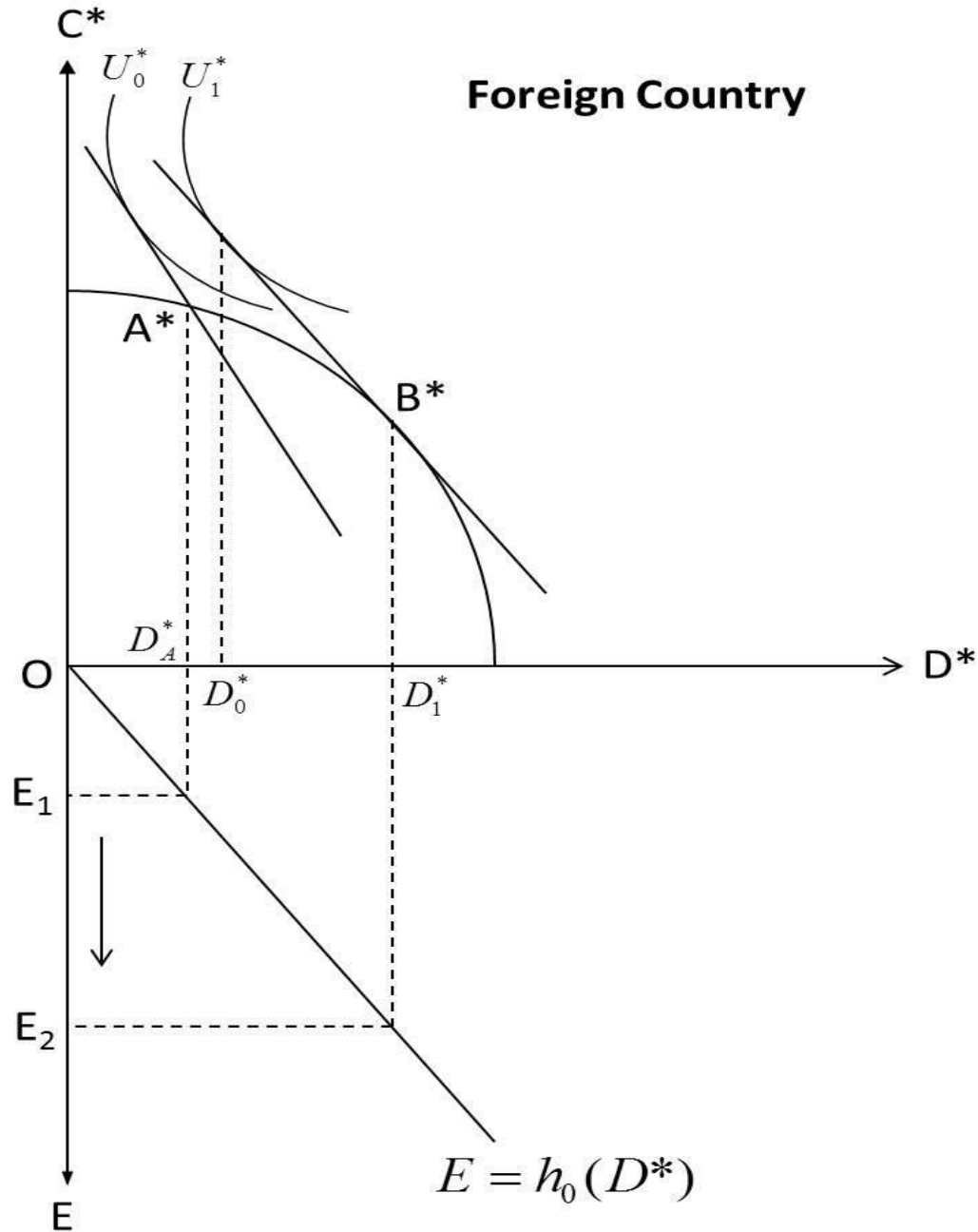
# ECONOMIC MODEL

## ➤ Assumptions

- Two countries, home (USA) and foreign (India)
- Two goods, Clean (C) and Dirty (D)
- Home country produces C and D, while the foreign country produces C\* and D\* amounts of two goods respectively
- The home country is capital abundant, while the foreign country is labor abundant
- Clean good (C) is capital intensive, while dirty good (D) is labor intensive
- Production of clean good results in zero emission
- Identical homothetic taste between two countries

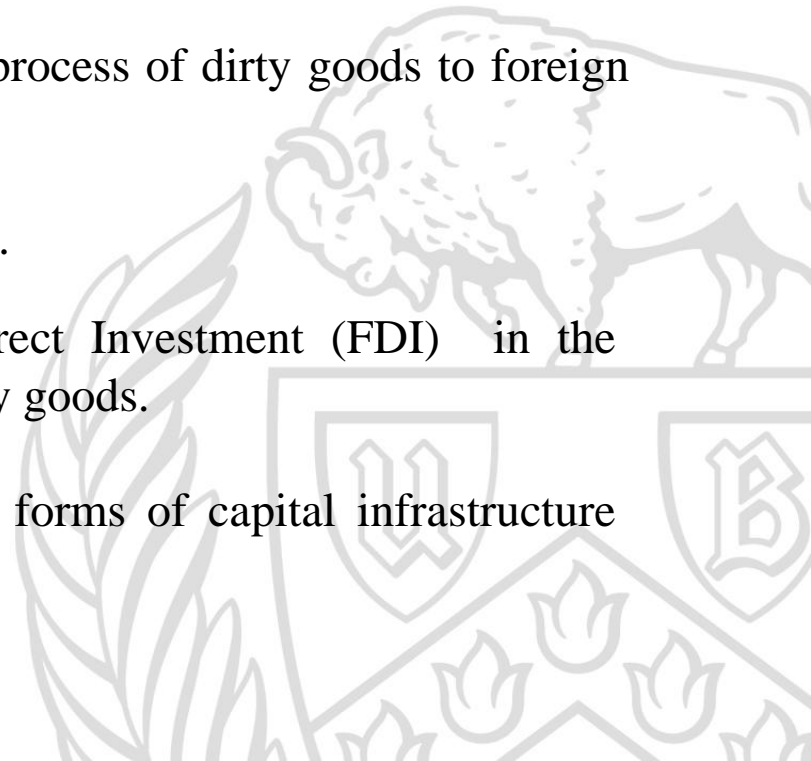


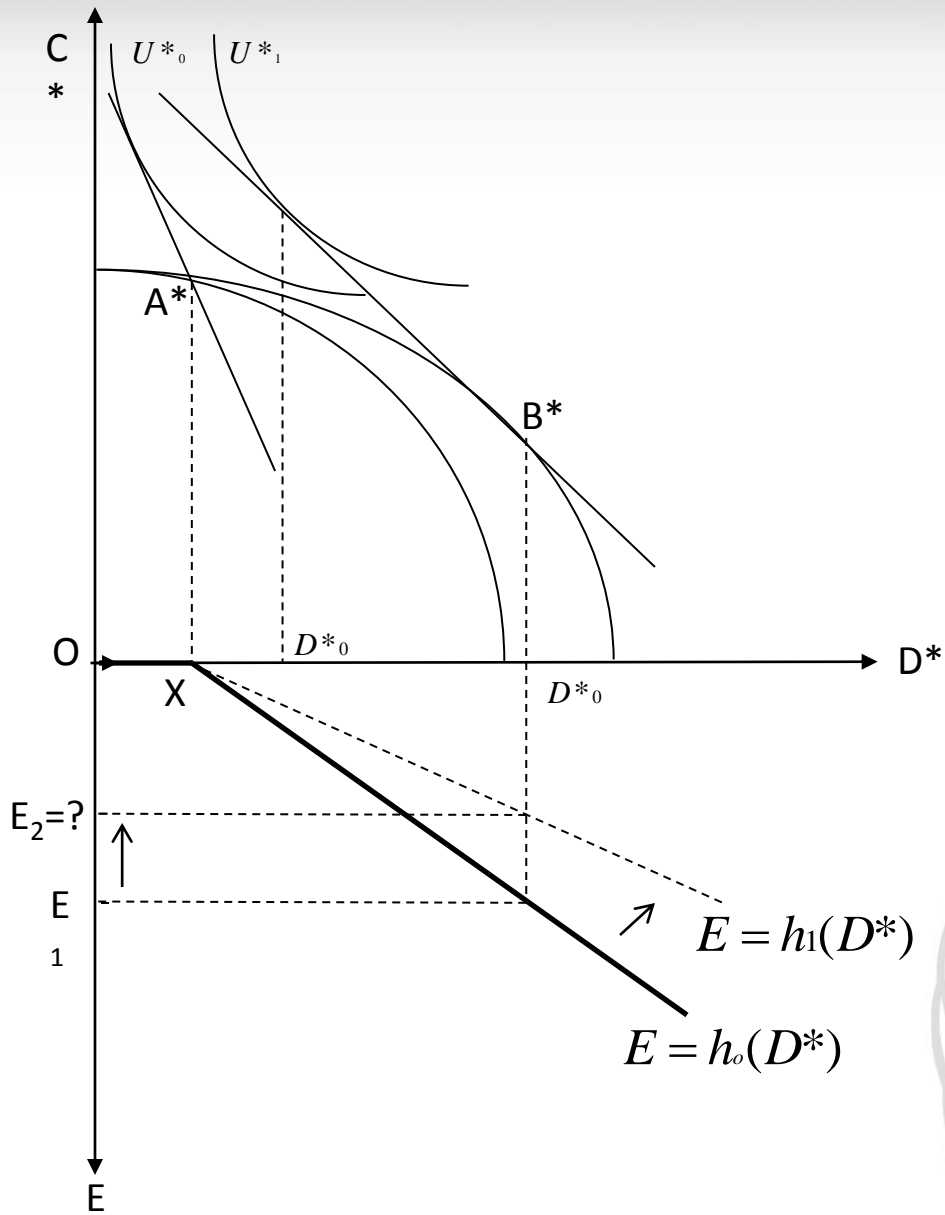




- Now we extend this model by reversing a few assumptions. We consider the case where the clean good is labor intensive while the dirty good is capital intensive, contrary to the initial assumption.
- According to the Hecksher-Ohlin neoclassical theory of trade:
  - Home country should specialize in the production of the dirty good (D)
  - Foreign country should specialize in the production of the clean good (C)
- Reasons for the migration of the production process of dirty goods to foreign country:
  - Presence of strict environmental standards
  - Huge costs involved in the production process.
- Home country thus undertakes Foreign Direct Investment (FDI) in the foreign country to facilitate production of dirty goods.

Note: Cost of transferring machinery and other forms of capital infrastructure from the home to the foreign country is ignored.





# ECONOMETRIC MODEL

$$\log C = \alpha_0 + \alpha_1 \log FDI + \theta t + d_1 D_1 FDI + d_2 D_2 FDI$$

where,

C = Carbon Emissions per year

F = Foreign Direct Investment (FDI) inflow per year

t = Time Trend

$D_1$  and  $D_2$  are two dummies.

$D_1 = 1$  if Year 2002-2005  
= 0 if Year 2005-2009

$D_2 = 1$  if Dirty Industry  
= 0 if Clean Industry

The variable 't' is used as an additional regressor to de-trend the data over the concerned time horizon via the Frisch-Waugh method.





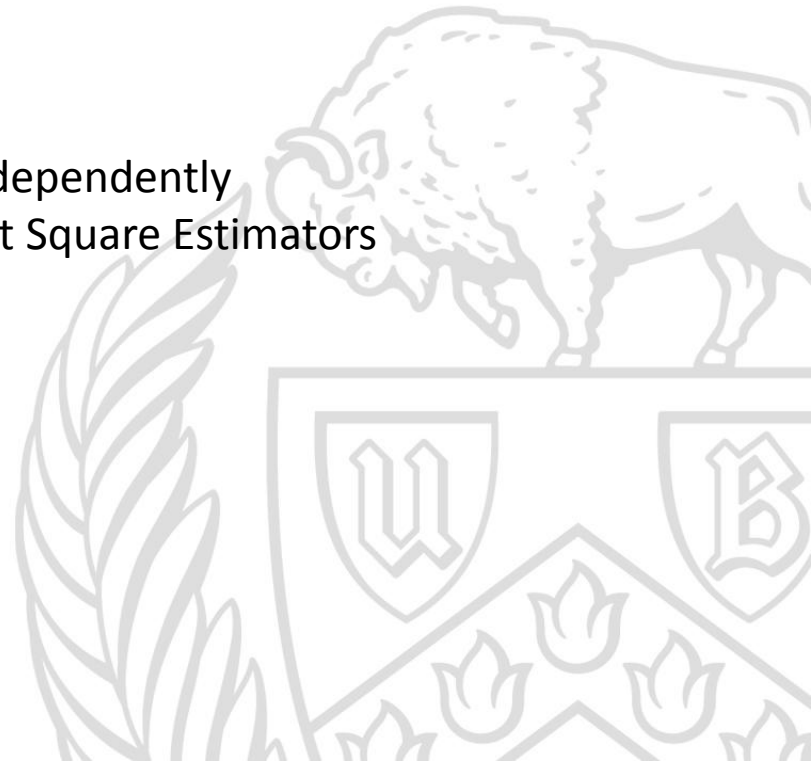
$$U_t = \rho U_{t-1} + v_t$$

is the measure of serial correlation where the estimate of is found out by using the Cochrane-Orcutt Method.

Here,

$$v_t \stackrel{i.i.d}{\approx} (0, \sigma_v^2)$$

Now since the disturbances are identically and independently distributed with zero mean, we can apply the Least Square Estimators to get the respective estimates.



Source	SS	df	MS			
Model	.848210464	1	.848210464	Number of obs = 72		
Residual	.246735749	70	.003524796	F( 1, 70) = 240.64		
Total	1.09494621	71	.015421778	Prob > F = 0.0000		
				R-squared = 0.7747		
				Adj R-squared = 0.7714		
				Root MSE = .05937		

C	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
ti	.1649614	.010634	15.51	0.000	.1437525	.1861703
_cons	.0502125	.0157372	3.19	0.002	.0188257	.0815993



Source	SS	df	MS			
Model	.12288014	1	.12288014	Number of obs = 71		
Residual	.130293906	70	.001861342	F( 1, 70) = 66.02		
Total	.253174046	71	.003565832	Prob > F = 0.0000		
				R-squared = 0.4854		
				Adj R-squared = 0.4780		
				Root MSE = .04314		

u	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
u1	.7019328	.0863908	8.13	0.000	.5296317	.8742339



Source	SS	df	MS
Model	.045995434	3	.015331811
Residual	.070893807	67	.001058117
Total	.116889241	70	.001669846

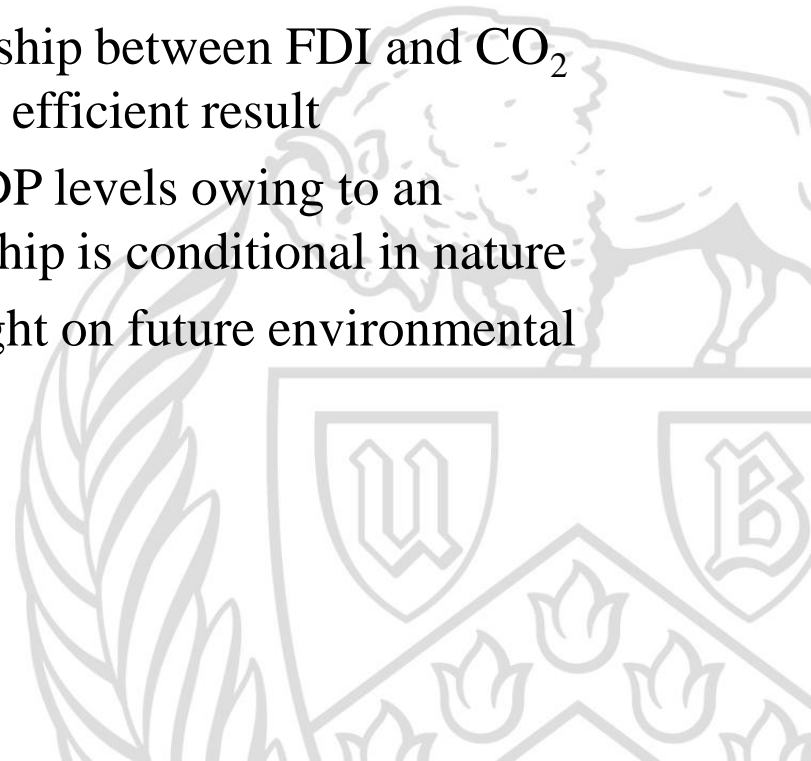
Number of obs = 71  
 F( 3, 67) = 14.49  
 Prob > F = 0.0000  
 R-squared = 0.3935  
 Adj R-squared = 0.3663  
 Root MSE = .03253

C_difference	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
F_difference	-.0004448	.0005792	-0.77	0.445	-.0016008	.0007112
D1F_difference	.0059669	.0009544	6.25	0.000	.0040619	.0078718
D2F_difference	.0000332	.000787	0.04	0.966	-.0015377	.0016042
_cons	.0724715	.0049097	14.76	0.000	.0626716	.0822713



# CONCLUSION

- The correlation between FDI and CO<sub>2</sub> emissions is a highly debatable topic
- Evidence of a trend of increasing FDI inflows in dirty industries in developing countries
- A sector specific study of the relationship between FDI and CO<sub>2</sub> emissions is likely to generate a more efficient result
- Although traces exist of increased GDP levels owing to an increased inflow of FDI, the relationship is conditional in nature
- The study is important as it throws light on future environmental concerns



**THANK YOU**

