Impact of FDI, Trade and Digitalization on CO$_2$ Emissions: Lessons from the Asia-Pacific Developing Economies

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❑ Structure of the Paper

➢ **Introduction**

➢ **Survey of Literature**

➢ **Data and Methodology**

➢ **Results**

➢ **Concluding Remarks**

❑ **Background of the Study**

▪ FDI - trade - economic growth relationship has been a burning topic during the vibrant age of globalization.

▪ There also exist some substantial debates regarding the environmental effects of FDI inflows and trade.

▪ MNEs shift investment preferences from developed to developing nations due to two reasons: low labour costs and relatively lax environmental regulations.

▪ Recent trends in more and more export-oriented FDI inflows operated in EPZ or SEZ support this view.

❑ **Background of the Study….**

- In this context, the dynamic influence of digitalization has to be given a greater emphasis globally nowadays.

- Evidences say that digitalization creates new inventive economy and market for all emerging sectors, and also promotes trade and FDI especially in developing nations.

- Digitalization may influence CO_2 emission through various ways. Through ICT expansion, it promotes environmental quality by reducing CO_2 emissions. It might enhance CO_2 emissions by increasing the energy consumption.

❑ Existing Studies

- Two views on FDI and CO_2 emissions relationship: one supports Pollution heaven hypothesis (Merican, 2007; Kivyiro and Arminen, 2014) and another one is neutral (Aliyu, 2005; Shaari et al. 2014).

- Ambiguous effect of trade on CO_2 emission: explained by scale, technology and composition effects (Antweiler et al. 2001; Farhani et al. 2004).

- Scale effect refers that trade leads to higher CO_2 emission through economic growth. Technology effect means the impacts of knowledge and technology transfer on environment.

- Composition effect implies that trade might change the production composition (more or less polluting) that can influence CO_2 emission.

❑ **Existing Studies….**

- There exist two schools of thought on the relationship of digitalization and CO_2 emissions.

- One group views that ICT promotes environmental quality through reducing CO_2 emissions (Moyer and Hughes, 2012; Salahuddin and Gow, 2016; Ozcan and Apergis, 2018).

- Another school argue that uses of ICT increase the energy consumption enhancing CO_2 emissions (Sadorsky, 2012; Belkhir and Elmeligi, 2018).

❑ Trends in FDI Inflows in Asia and Pacific Developing Countries
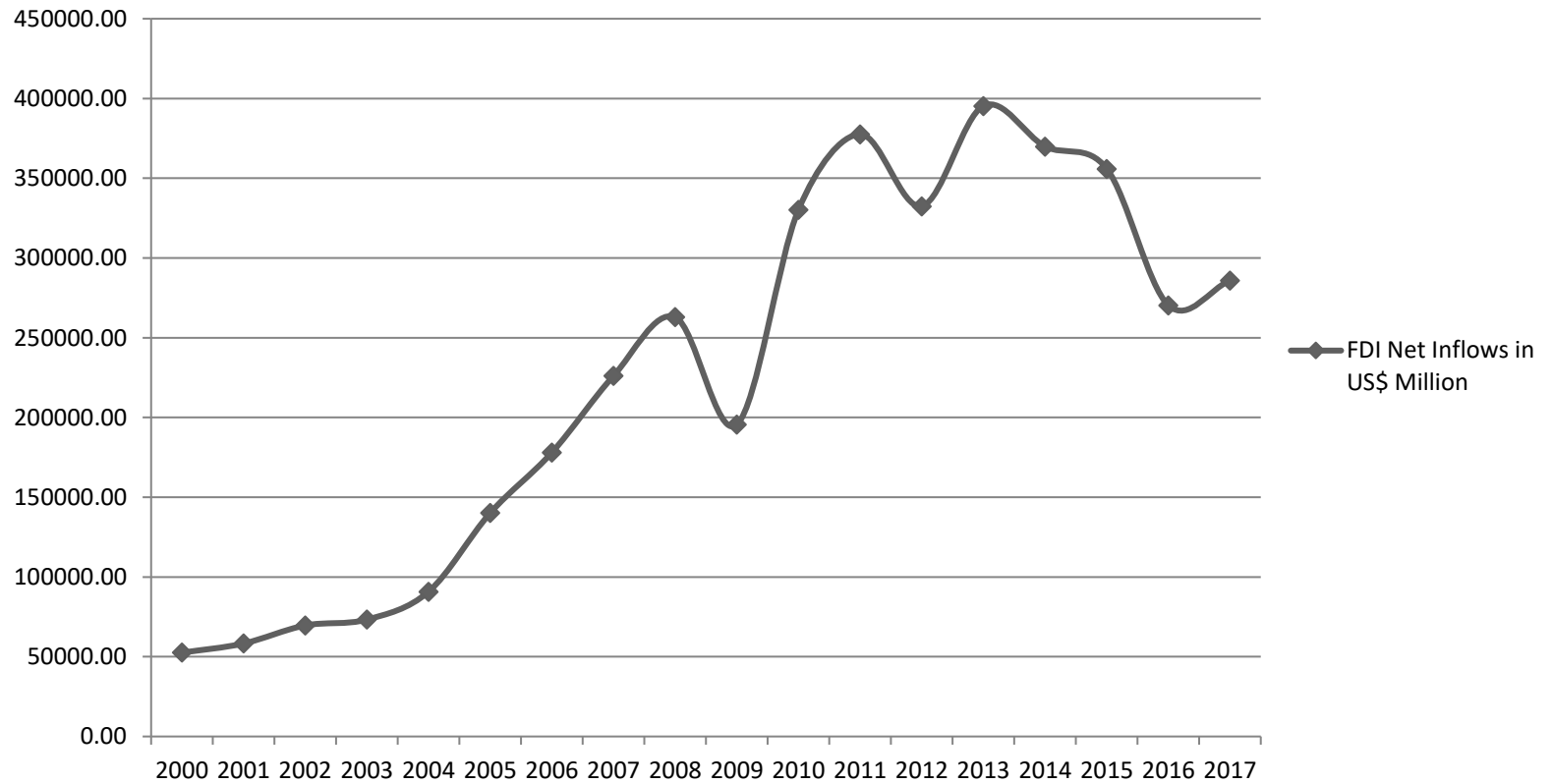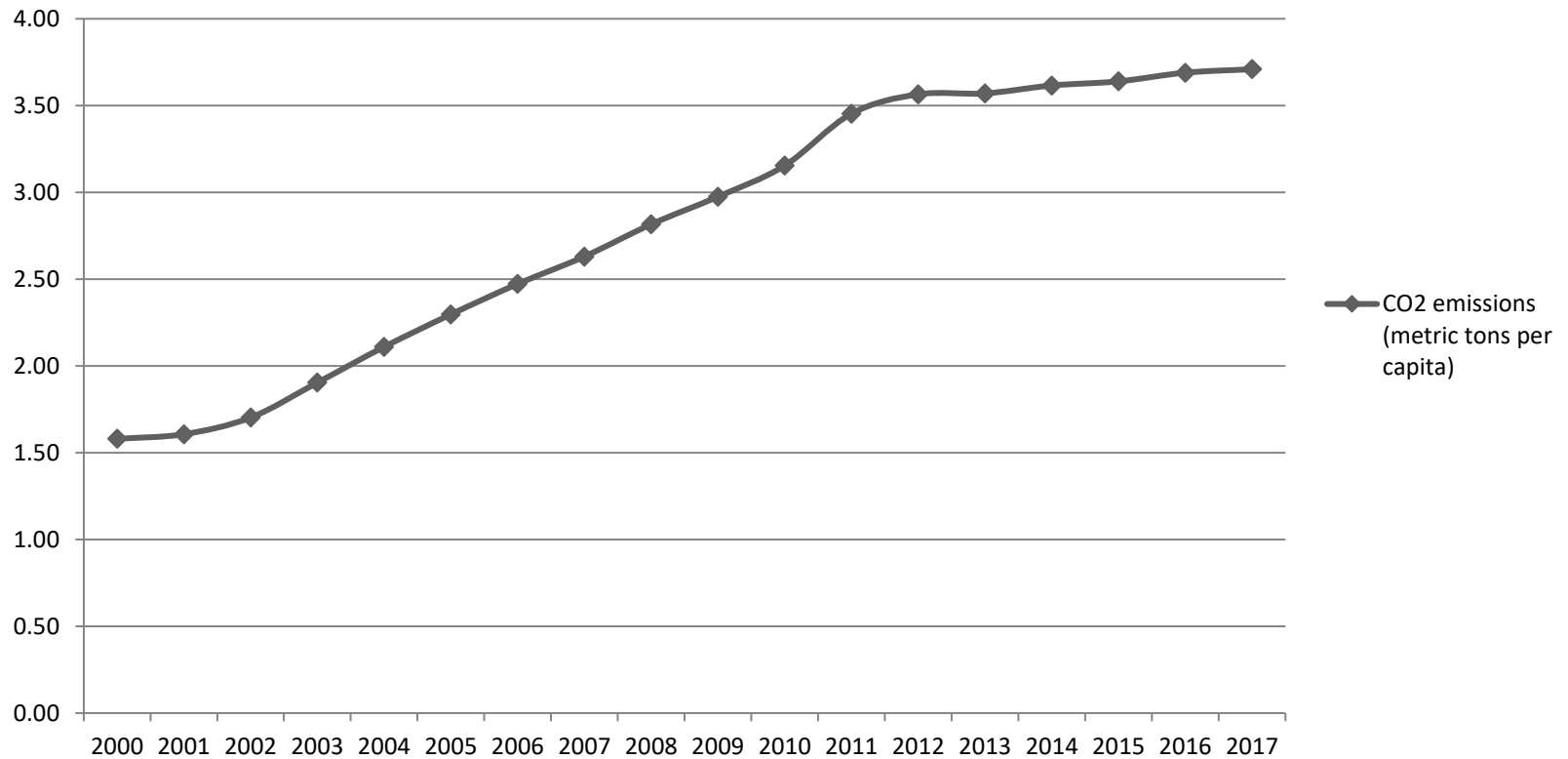

Source: Obtained from World Bank (2020)

❑ Trends in Trade in Asia and Pacific Developing Countries
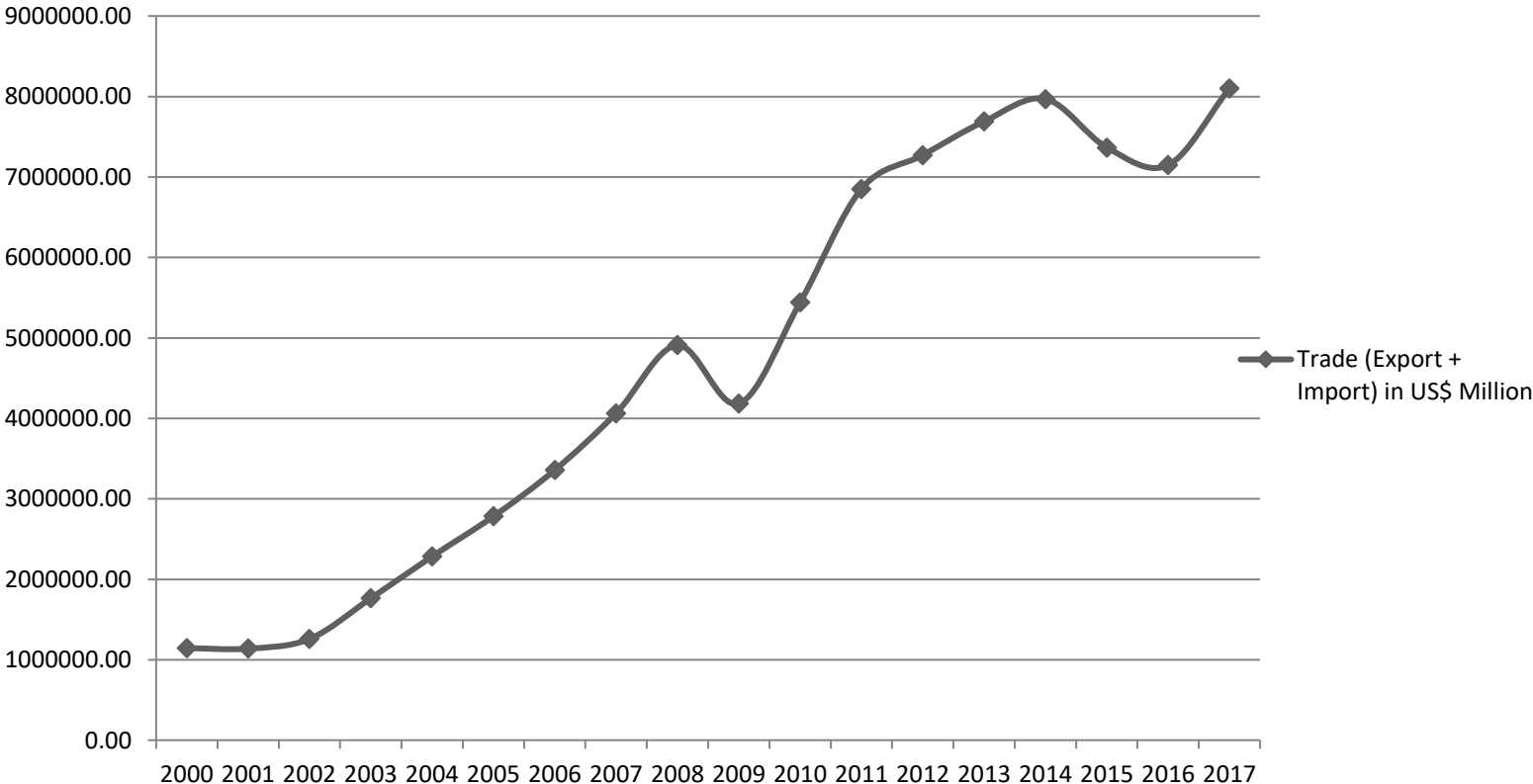
Source: **Obtained from World Bank (2020)**

Trends in CO$_2$ Emissions in Asia and Pacific Developing Countries

Source: Obtained from World Bank (2020)

❑ **Trends in Digitalization in Asia and Pacific Developing Countries**

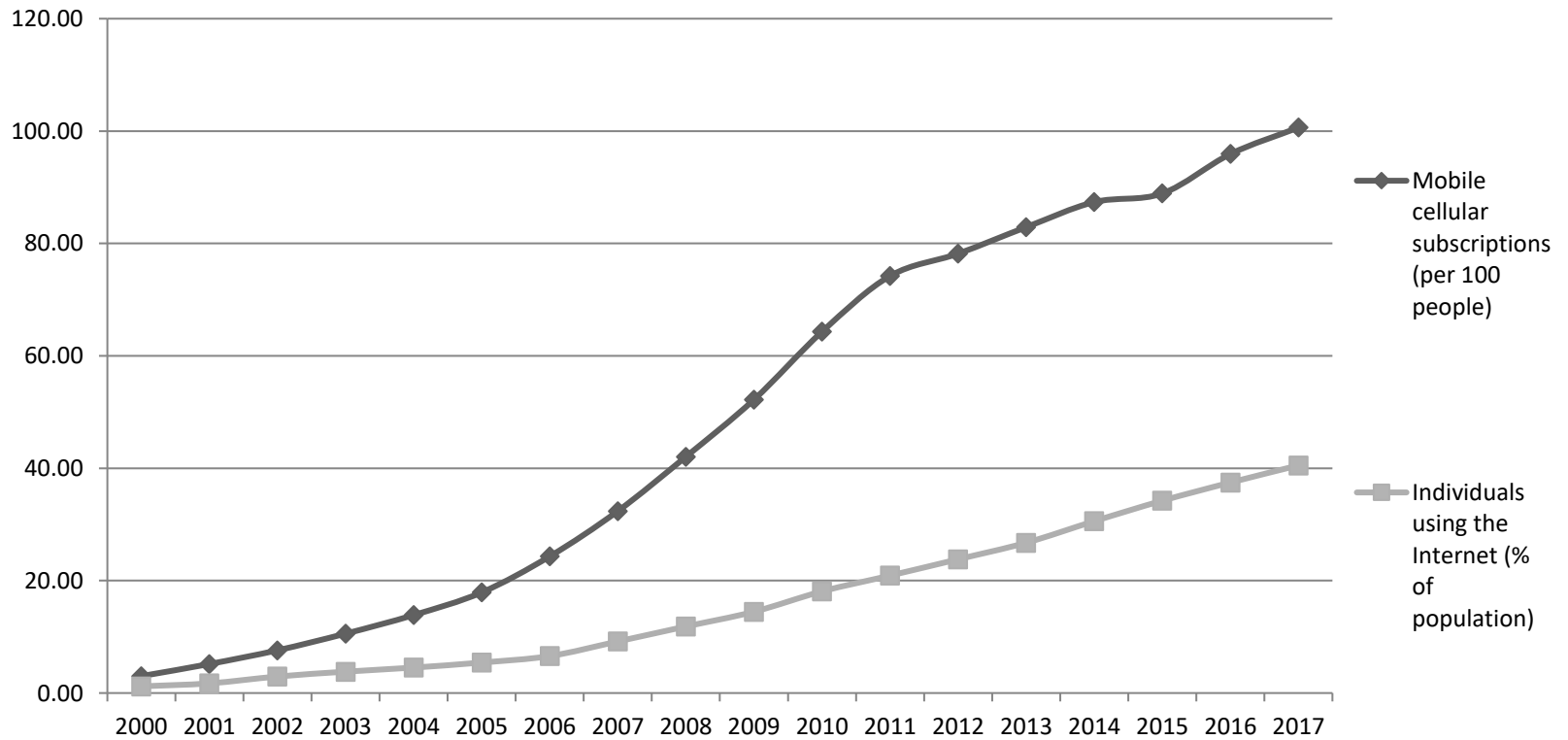**Source:** Obtained from World Bank (2020)

❑ **Objective**

- Basic objective of the study is to explore the dynamic effects of FDI inflows, international trade and digitalization on CO_2 emission across Asia and Pacific developing countries over 2000 - 2019.

❑ **Data**

- To conduct this empirical study, we collect the annual data on FDI, TRADE, CO2E, DIGI, GDPG, ENGU, GFCF, URB, INDO and POPG from World Development Indicators database of World Bank (2020) for 27 developing countries selected from Asia and Pacific Region over the period of 2000-2019.

Descriptions of Variables

Variables	Definitions
FDI	Foreign direct investment, net inflows (% of GDP)
TRADE	Trade (Export + Import) (% of GDP)
CO2E	CO_2 emissions (metric tons per capita)
DIGI	Index of digitalization having values between 0 and 100
GDPG	Annual Growth rate of GDP (%)
ENGU	Energy use (kg of oil equivalent per capita)
GFCF	Gross fixed capital formation (% of GDP)
URB	Urbanization (urban population as % of total population)
INDO	Industrialization (output of secondary sector as % of GDP)
POPG	Population growth (annual %)

Source: **Authors' presentation from World Bank (2020) definitions**

❑ **Hypothesis**

■ We form balanced panel of selected Asia and Pacific countries and carry out the testing of null hypothesis of the present empirical study as follows:

✓ *FDI inflows, trade and digitalization do not cause CO_2 emissions in Asia and Pacific developing countries.*

❑ Econometric Methodology

- In testing panel unit roots, the ADF specification is:

$$\Delta y_{it} = \rho y_{i,t-1} + \sum_{j=1}^{p_i} \eta_{ij} \Delta y_{i,t-j} + X'_{it}\delta + \varepsilon_{it}$$

- Levin et al. (2002) test allows the intercepts, the time trends, the residual variances and the order of autocorrelation to vary freely across the cross section units.

- In the Im et al. (2003) test, autocorrelation coefficient is considered to be different for each cross section unit even in the case of a heterogeneous panel.

- The dynamic panels with fixed effects in literature is the GMM estimator by Arellano and Bond (1991). The model, with one period lag will be:

$$y_{it} = \alpha_i + \theta_t + \beta y_{i,t-1} + x_{it}'\eta + \varepsilon_{it}$$

➢ Where, α_i represents fixed effect, θ_t is time dummy, x_{it} is a (k-1)×1 vector of exogenous regressors and $\varepsilon_{it} \sim N(0, \sigma^2)$ is a random disturbance.

- By differencing the above equation:

$$\Delta y_{it} = \Delta \theta_t + \beta \Delta y_{i,t-1} + \Delta x_{it}'\eta + \Delta \varepsilon_{it}$$

❑ Model Specification

- The equation is hereby proposed to be estimated using the panel data as follows:

$$\Delta CO2E_{it} = \beta_1 \Delta CO2E_{it-1} + \beta_2 \Delta x'_{1it} + \beta_3 \Delta x'_{2it} + \Delta \varepsilon_{it}$$

- Where, x'_{1it} denotes the component matrix of focussed independent regressors - FDI, TRADE and DIGI; and x'_{2it} shows another component matrix of other control variables including GDPG, ENGU, GFCF, URBN, INDS and POPG.

❑ Empirical Findings

❑ Descriptive Statistics of Variables

Variables	Mean	Median	Maximum	Minimum	Std. Dev.	Observations
FDI	3.26	3.1	4.17	2.41	0.57	540
TRADE	61.08	57.73	73.03	53.03	7.30	540
CO2E	4.18	4.22	5.79	2.31	1.28	540
DIGI	47.51	40.20	96.01	17.33	10.05	540
GDPG	8.55	8.43	12.16	6.71	1.53	540
ENGU	1353.57	1378.85	1876.98	842.78	352.85	540
GFCF	37.44	36.86	41.71	30.99	3.69	540
URB	48.22	50.81	57.94	36.11	7.03	540
INDO	30.65	28.07	41.73	11.64	6.59	540

Source: **Estimated by authors using World Bank (2020) database**

❑ Results of Panel Unit Root Tests

Variables	Levin et al. (2002)		Im et al. (2003)	
	Level	First Difference	Level	First Difference
FDI	2.11	-6.54***	-1.89	-6.98***
TRADE	2.11	5.07***	-1.23	-4.89**
CO2E	-3.94	-7.24***	-2.08	-8.23***
DIGI	2.02	-6.88***	-1.93	-6.91**
GDPG	2.34	-7.48***	-2.01	-6.75**
ENGU	1.87	-6.25**	-1.95	-7.35***
GFCF	-2.71	-6.41**	-2.18	-6.85***
URB	1.96	-5.77***	-1.09	-5.08**
INDO	0.88	-4.97**	-1.43	-5.99***
POPG	-1.11	-5.02***	-1.31	-4.67**

Source: **Estimated by authors using World Bank (2020) database**

❑ Results of GMM Estimations

Dependent Variable: ΔCO2E (it)							
Method: Panel GMM							
Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
ΔCO2E (it-1)	0.1898*** (0.00)	0.1696*** (0.00)	0.1909*** (0.00)	0.1801*** (0.00)	0.2011*** (0.00)	0.1779*** (0.00)	0.1804*** (0.00)
ΔFDI (it)	0.0384** (0.02)	0.0307** (0.02)	0.0346** (0.01)	0.0202** (0.01)	0.0266** (0.04)	0.0200*** (0.00)	0.0201** (0.01)
ΔTRADE (it)	0.0332*** (0.00)	0.0376** (0.01)	0.0291** (0.02)	0.0321** (0.01)	0.0262*** (0.00)	0.0257** (0.02)	0.0222** (0.01)
ΔDIGI (it)	-0.0077** (0.04)	-0.0008 (0.13)	0.0447 (0.17)	-0.0021* (0.06)	-0.0010 (0.21)	-0.0008** (0.04)	-0.0011* (0.09)
ΔGDPG (it)			0.0409*** (0.00)	0.0361** (0.02)		0.0360** (0.02)	0.0343** (0.01)
ΔENGU (it)		0.0784*** (0.00)			0.0890** (0.01)		0.0545** (0.02)
ΔGFCF (it)					0.0008 (0.19)		0.0017 (0.13)
ΔURB (it)		0.0058** (0.03)		0.0031*** (0.00)			0.0040** (0.04)
ΔINDO (it)			0.0011** (0.04)			0.0026** (0.02)	0.0009** (0.03)
ΔPOPG (it)						0.1082** (0.01)	0.0823** (0.02)
Observations	513	513	513	513	513	513	513
No of Instruments	13	12	12	15	11	14	15
Arellano-Bond Test for AR(2)	0.22	0.22	0.19	0.27	0.18	0.25	0.22
Sargan Test p-value	0.24	0.23	0.37	0.29	0.27	0.19	0.21
Hansen Test p-value	0.20	0.28	0.22	0.26	0.26	0.33	0.27
Wald Test p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: **Own estimation of authors using World Bank (2020) database**

❑ **Conclusion**

- The statistically significant estimated outcomes imply that changes in the lag of CO2E, FDI, and TRADE directly, and changes in DIGI, are negatively effect the changes in CO2E in selected developing nations in the Asia-Pacific economy

- Findings also point out that CO2E carries direct influences from GDPG, ENGU, URBN, INDS and POPG, but GFCF does not cause CO2E in those counties.

- Results refer that issues on environmental degradation must be given an attention towards the goal of sustainable development mainly in developing countries welcoming chunk FDI inflows.

Thank You

❑ **Selected Countries**

- Armenia, Azerbaijan, Bangladesh, Cambodia, China, Fiji, Georgia, India, Indonesia, Jordan, Kazakhstan, Kyrgyz Republic, Lao PDR, Malaysia, Maldives, Mongolia, Myanmar, Nepal, Pakistan, Papua New Guinea, Philippines, Solomon Islands, Sri Lanka, Thailand, Turkey, Vanuatu and Vietnam.