# What Types of Bilateral Aids are Better Aligned with Foreign Direct Investment (FDI) for Mutual Gains from Trade?

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# 1. INTRODUCTION

## Major aims of the study

- To study on complementarities of **"public" ODA** and **"private" FDI** (Foreign Direct Investment) as development financial resources.
- To empirically investigate whether these two different types of development resources combined together promote bilateral trade flow.
  - Since these different types of financial resources have different roles and motivations, one may substitute with the other.

## Research results in brief

- ODA and FDI substitute one another overall.
- However, there should be times when two capitals complement each other, particularly when the partner (host) countries in transition from lower/upper middle to high income.
- There are some heterogeneity of the results by aid sectors (AfT and PSD)

# 1. INTRODUCTION

## Backgrounds

- **Rise of a "mutual interest" paradigm in the world development**
  - Paradigm of International Development Cooperation:

    **MDGs(Millennium Development) → SDGs(Sustainable Development Goals)**

    (Emphasis on forming partnership with the public and private sector working for the "Sustainable Development").

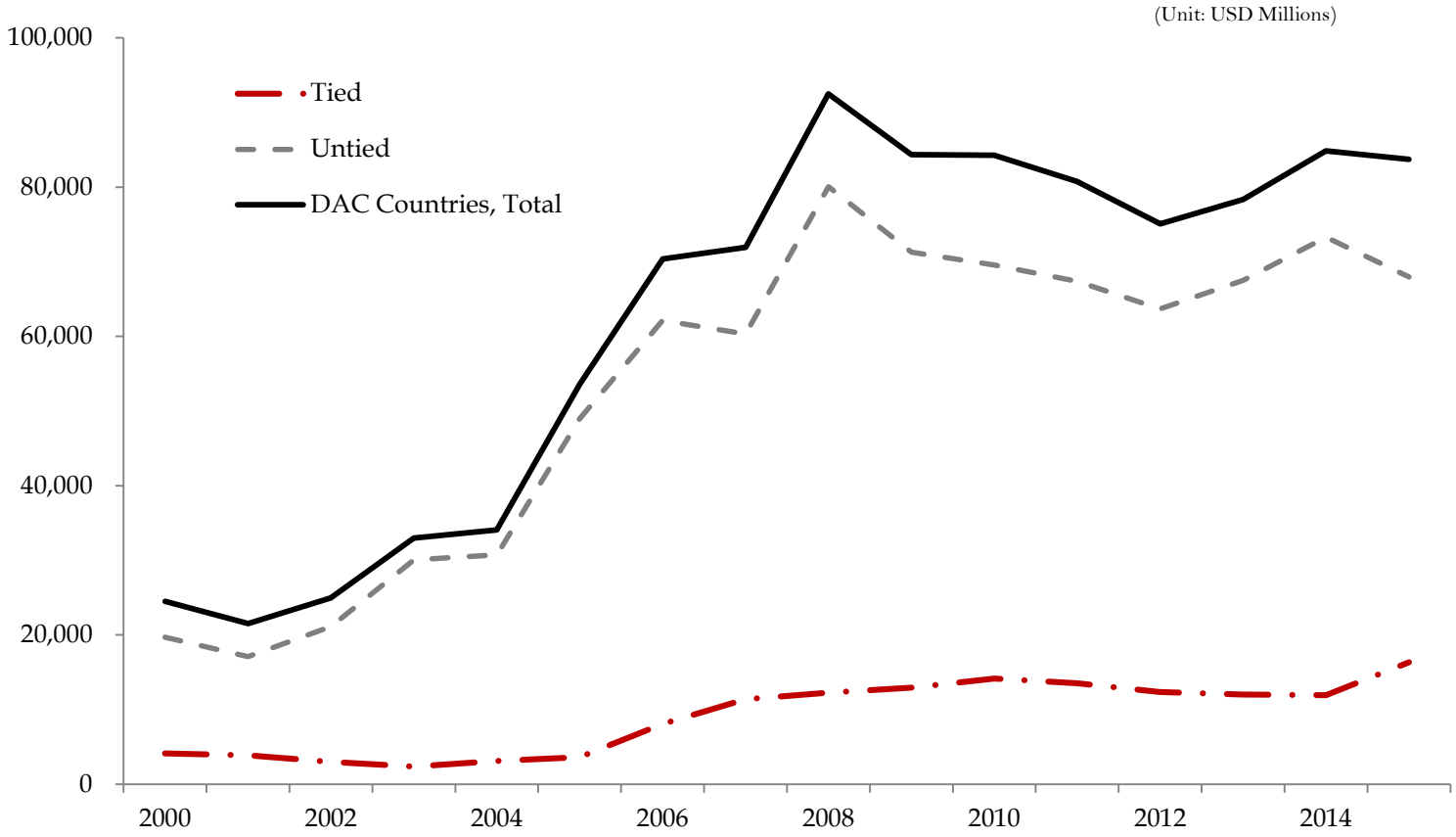
- Increasing doubts on "aid effectiveness" and its "own sustainability"
  → national development agencies to demonstrate concrete positive returns of aid provision to the donor-nation in the post-MDG period.
  (USA, UK, and even major Northern European DAC donors, so called "The Age of the National Interest," Gulrajani, 2017)

- The way of aid-giving can be **motivated by both altruistic and strategic interests.**
  - The relationship between **the two motivations may not be zero-sum, however, neither is it always mutually reinforcing.**

# 1. INTRODUCTION

## Recent Trends of Bilateral Aids from DAC Donors

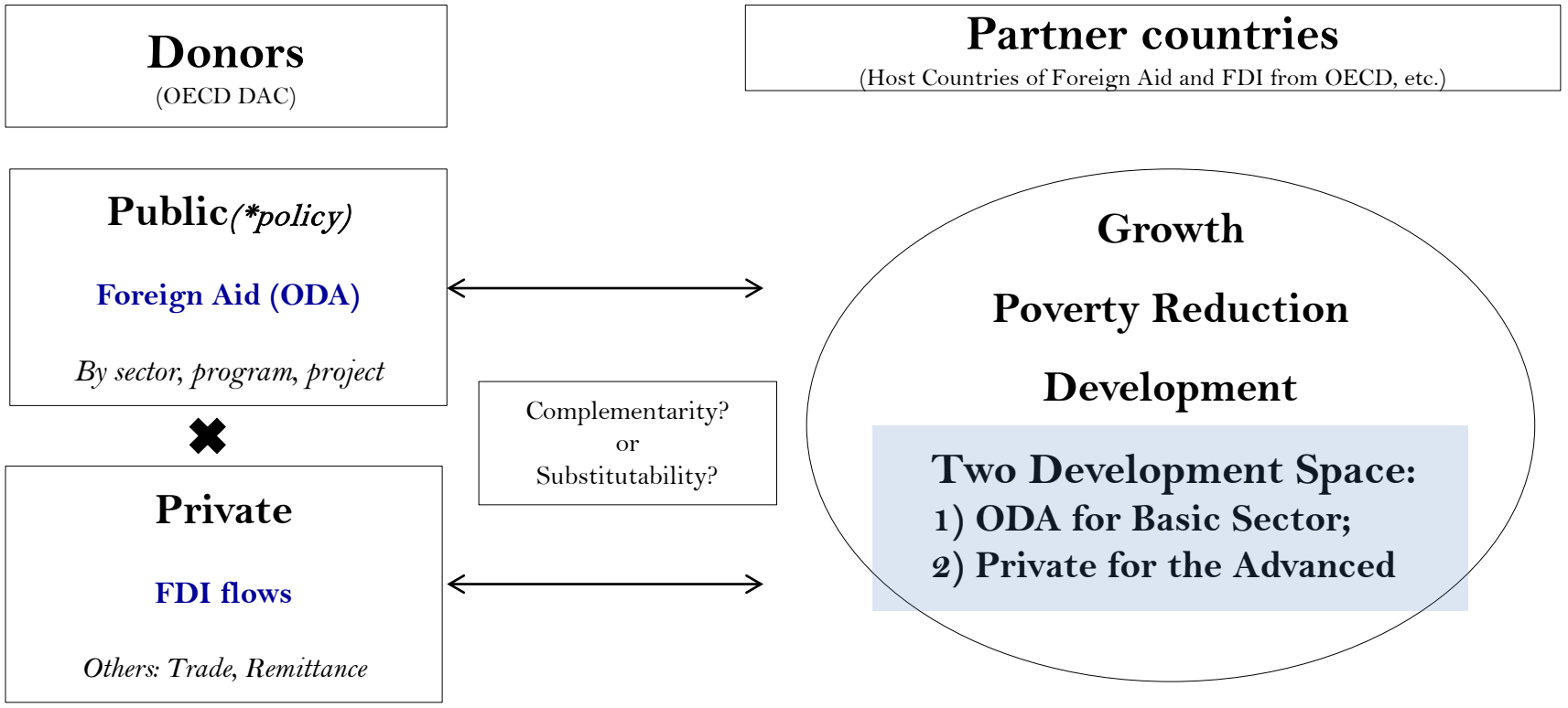
(Challenges for world development and DAC donors)




Note: Total bilateral commitments from donor countries of Development Assistant Committee (DAC) by tying status.
*Source*: Authors' self-compilation from http://stats.oecd.org/qwids/.

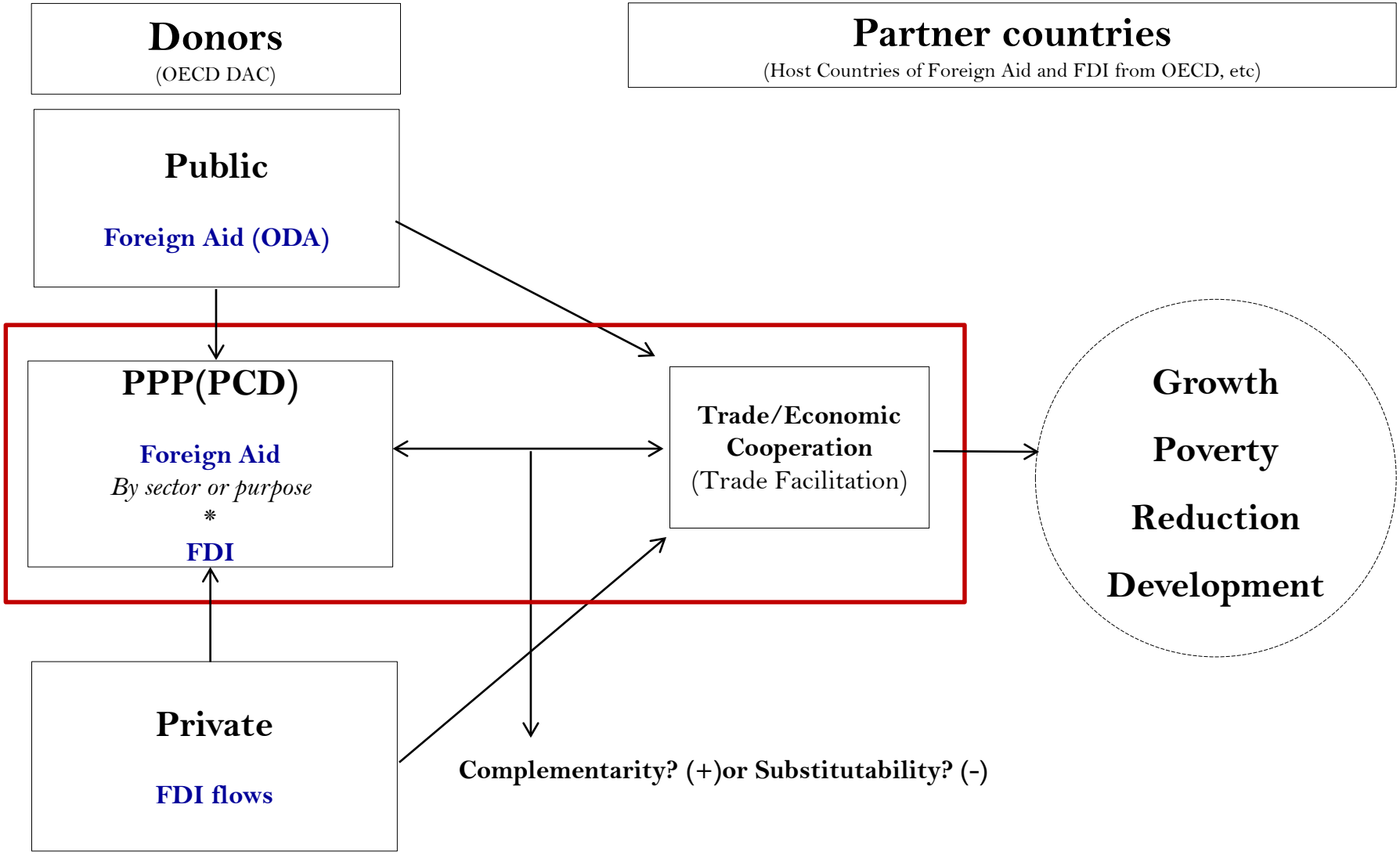
# Previous Studies(Analysis on effectiveness of ODA)

- Issues on ODA's effectiveness
  - Have been emerging under the SDGs that emphasize private sector's participation along with recent emphasis on national interest (protectionism) (Deaton, 2016, Gulrajani, 2017, Heinrich et al., 2016)
- Aids have effects conditioned on; good policy, governance, institutional quality
- Analysis on effectiveness by sector and by program/project
- Studies on the Aid's interaction with other Private resources such as FDI, Remittance, etc.



# Previous Studies(Paradigm change and private-government cooperation)

- Public flows from Donors Promote
  **Private flows from the Same Donors, and thus Growth?**

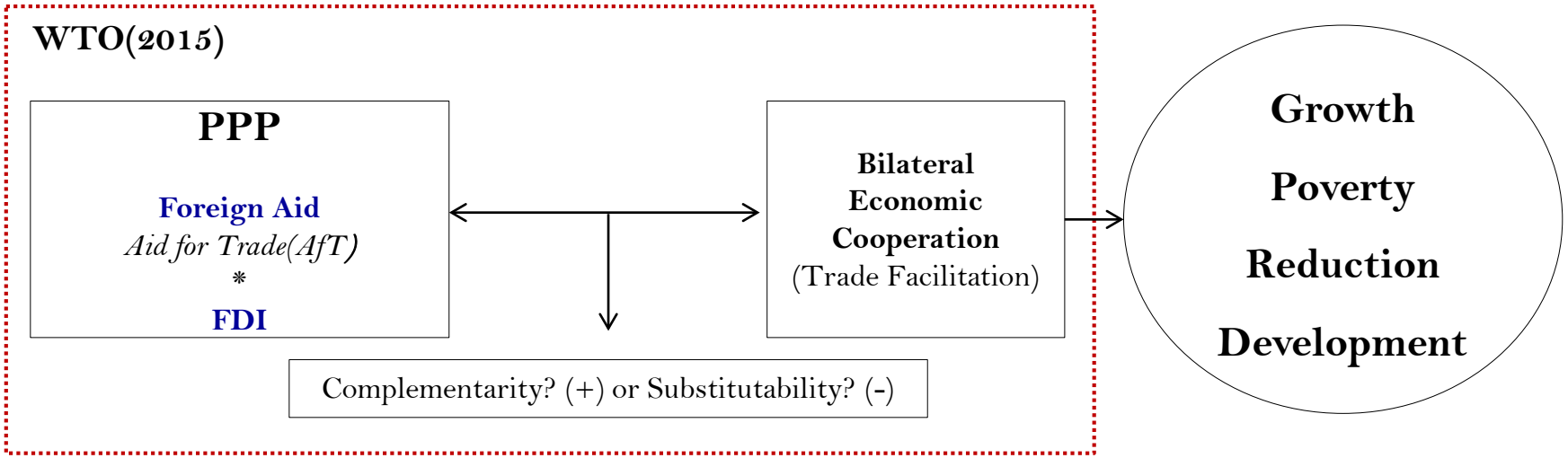


# Conceptual Framework : How this study is differentiated from the previous studies

- Examined economic/trade cooperation promotion through the interaction effect between Aid for Trade (AfT) and FDI
  - e.g.) Aid for trade, foreign direct investment and export upgrading in recipient countries (WTO, 2015)

- In this study, not only AfT, by analyzing interaction effect with FDI in key sectors of ODA, we examined in which sector, private-public (within-nation) cooperation is most active.
  - Cf.) Kimura & Todo (2010) Is Foreign Aid a Vanguard of Foreign Direct Investment?, Todo (2011) Impacts of Aid-Funded Technical Assistance Programs : Firm-Level Evidence from the Indonesia Foundry Industry

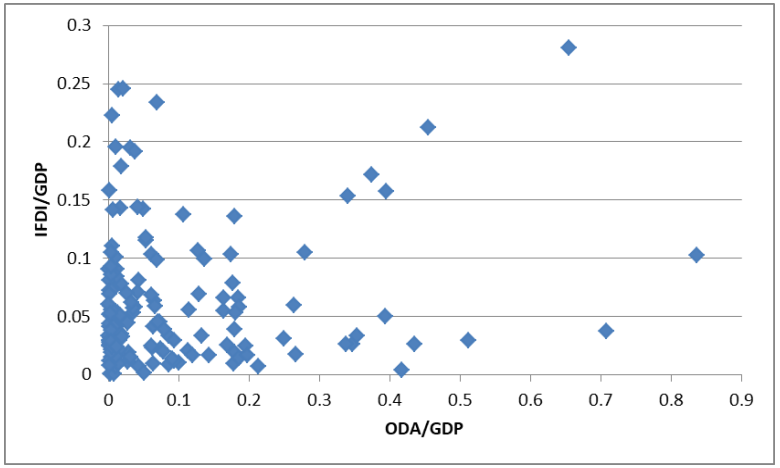
**This Study (ODA by sector, AfT, PSD)**

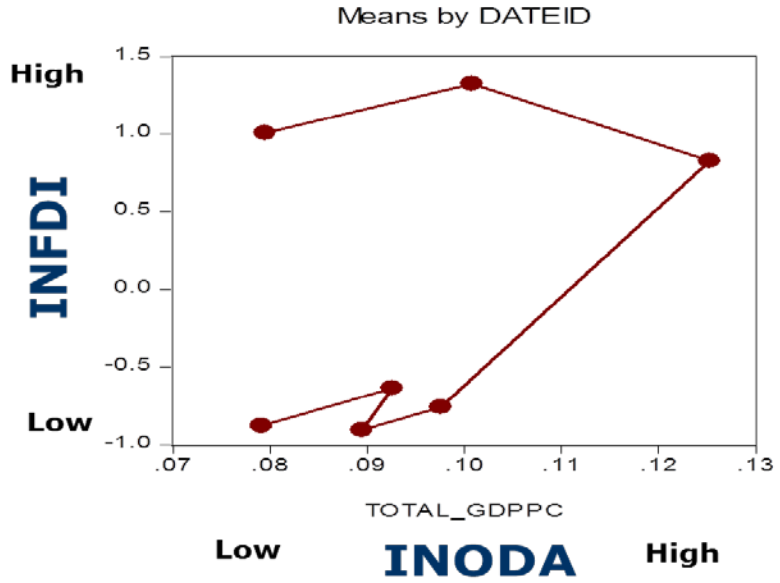


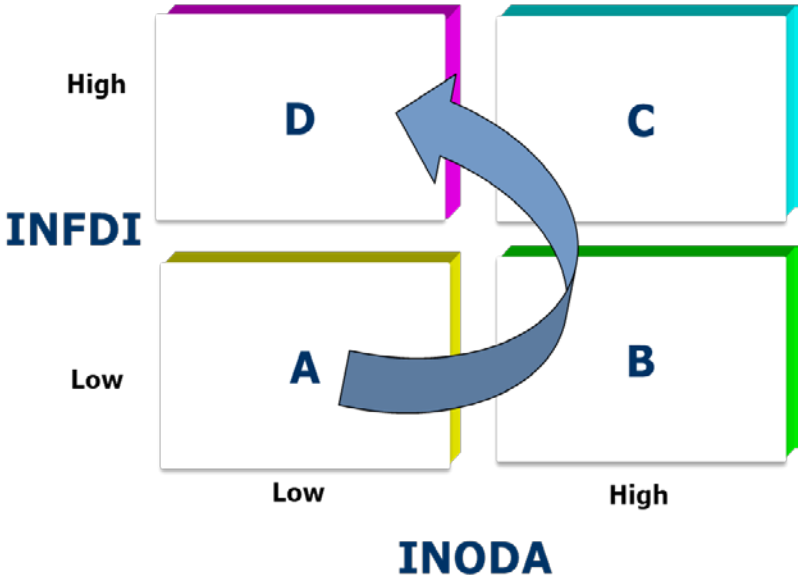
# Previous Studies: Nexus between ODA and FDI

**Q1**: Are ODA and Foreign Investment Complementarity, Substitutability, or Neither?
→ No clear-cut conclusion (Jansky, 2012)

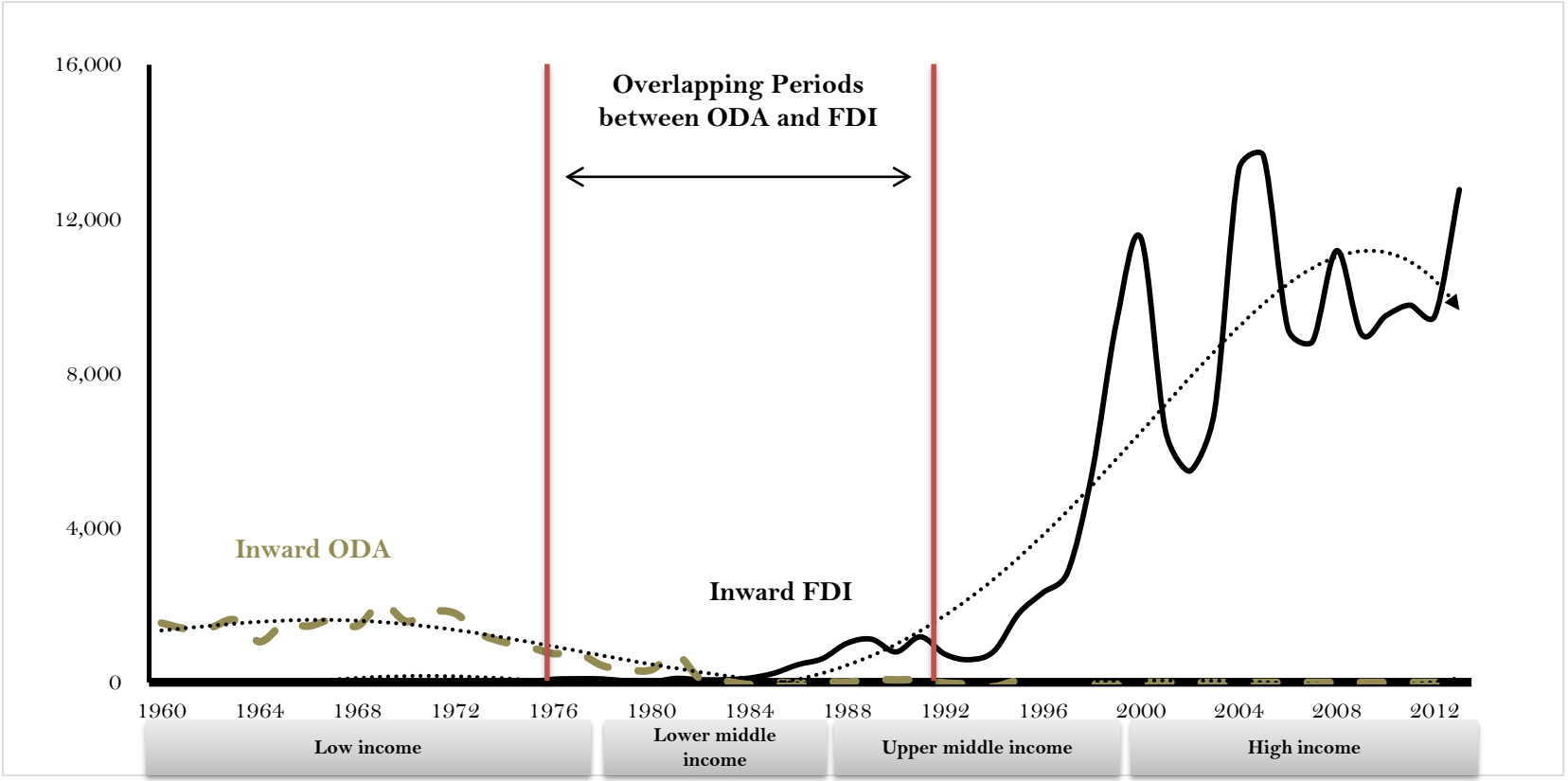
**Q2**: If the two is connected, then possible path of INODA and INFDI contribute to the economic growth of the recipients
- if disconnected, two may be a mere substitution.



# Korea's Development Path : from ODA Recipient to FDI Host Country




*Source:* Authors' self-compilation from OECD Stat., WB

## Korea's Development Strategy and the Role of ODA and Foreign Capital in the 1960s and 1970s

- The Korean government started its first 5-year economic development plan in 1962 with the purpose of transforming the Korean economic structure from a poverty-stricken and aid dependent one to a self-reliant.
- **In 1973, the Korean government announced that it would promote the industrialization of the heavy and chemical industries for further economic of the export-promotion development strategy effectively using foreign capital flows, the Korean economy recorded high growth, focusing on six sectors** in the heavy and chemical industries such steel, petrochemical, shipbuilding, machinery, non-ferrous metals, and electronic industries.
- As a result, **the economy made a successful economic growth in the 1960s and the 1970s.**

Source: Lee, (2013). Foreign capital in economic development in Korean experience and policies, Ministry of Strategy and Finance and KDI School

## Hypotheses

- **H1: Public Aid (ODA) and Private Capitals (FDI) as development finance promote simultaneously bilateral trade**

  1) Bilateral Aid (ODA) (from donors to recipients) promotes bilateral trade.

  2) Bilateral FDI also promotes bilateral trade.

- **H2: However, since role of two capitals differ, complementarities of two capitals on bilateral trade rise when the economy takes off; otherwise, generally two capitals substitute when the economy develops.**

  1) Bilateral Aid (ODA) and FDI particularly complements in the lower/upper middle income stage of recipients (host countries)

  2) These two different effects also may vary by sectoral differences.

# 3. DATA

## Data and Source

- All 29 DAC donors and 175 recipients using data averaged over three-year intervals during the period 1999-2015

| VARIABLES | EXPLANATIONS | SOURCES |
|---|---|---|
| **Export flow** | **Bilateral Export flow** (OECD DAC Donors to their recipients) | UN comtrade (https://comtrade.un.org/) |
| **Aid (ODA) Flow** | **Bilateral Aid (ODA) flow*** (OECD DAC Donors to their recipients) | OECD Statistics (http://stats.oecd.org/) |
| | **1. ODA flow by sector**<br>① Social Infrastructure & Services ② Economic Infrastructure & Services<br>③ Production Sectors ④ Multisector<br>⑤ Commodity Aid/General Program Assistance<br>⑥ Action Relating to Debt ⑦ Humanitarian Aid<br>⑧ Others (Administrative Costs of Donors, Support to NGOs, Refugees in Donor Countries, Unallocated/Unspecified) | |
| | **2. AfT (Aid for Trade)****<br>① Trade Policy and Regulations ② Economic Infrastructure<br>③ Productive Capacity Building ④ Trade-Related Adjustment | |
| | **3. PSD (Private Sector Development)*****<br>① Investment Climate, ② Productive Capacity, ③ Physical Infrastructure | |
| **FDI flow** | **Bilateral FDI flow** (OECD DAC Donors to their recipients) | |

Note: 1) Non-overlapping 3 year-average (6 periods): 1999-2001, 2002-2004, 2005-2007. 2008-2010, 2011-2013, 2014-2015 (2-year average)

2) Data sets are constructed based on the availability (Island nations such as British Virgin Islands, Marshall Islands, etc. excluded)

3) *Aid disbursements used due to the fact that the commitments are not usually fulfilled.

4) **Aid-for-trade statistical queries (http://www.oecd.org/dac/aft/aid-for-tradestatisticalqueries.htm)

5) ***OECD (2017). 'Development Co-operation for Private Sector Development: Analytical Framework and Measuring Official Development Finance'

# 3. Methodology (Empirical Specification)

## H1: Do bilateral AID and FDI actually increase trade?

- First-differenced panel gravity equations with country-and-time effects
  - to address endogeneity problems and the time-varying multilateral price terms (Baier and Bergstrand, 2007) by considering interaction effects and endogeneity problems between two variables.

$$\begin{aligned}&\mathrm{dln}X_{ij,t-(t-1)}\\&= \beta_0 + \beta_3\ \Delta\mathrm{lnAID}\ [\equiv \mathrm{dlnAID}_{ij,t-(t-1)}] + \beta_{03}\mathrm{dlnNAID}_{ij,t-(t-1)} + \beta_4\ \Delta\mathrm{lnOFDI}\ [\equiv \mathrm{dlnOFDI}_{ij,t-(t-1)}]\\&+ \beta_{04}\ \mathrm{dlnNOFDI}_{ij,t-(t-1)} + \beta_{34}(\Delta\mathrm{lnAID}_{ij} \times\ \Delta\mathrm{lnOFDI}_{ij}) + \beta_{i,t-(t-1)}\delta_{i,t-(t-1)} + \beta_{j,t-(t-1)}\delta_{j,t-(t-1)}\\&+ \delta_{ij,t-(t-1)}\end{aligned}$$

- **Independent Variable**
  - $dlnX_{ij,t-(t-1)}$: first-differencing the log of (real) exports from country $i$ (29 DAC donors) to $j$ (175 partners).

- **Dependent Variable**
  - $\Delta\mathrm{lnAID}\ [\equiv \mathrm{dlnAID}_{ij,t-(t-1)}]$ for total Aid (ODA), and $\Delta\mathrm{lnOFDI}\ [\equiv \mathrm{dlnOFDI}_{ij,t-(t-1)}]$ for total FDI
  - $\beta\mathrm{dlnAID}_{ij,t-(t-1)} = \beta\mathrm{dln}[\max(1, AID_{ij})]_{t-(t-1)} + \beta\mathrm{dln}NAID_{ij,t-(t-1)}$, where $NAID_{ij,}$ is a no-aid dummy, which
  - takes the value of 1 when AID = 0 and zero otherwise (Wagner, 2003; Cali and te Velde, 2001; Lee and Lies, 2016)
  - The same method applies to "$\Delta\mathrm{lnOFDI}\ [\equiv \mathrm{dlnOFDI}_{ij,t-(t-1)}] + \beta_{04}\ \mathrm{dlnNOFDI}_{ij,t-(t-1)}$" (Head and Ries, 2008; Lee and Lies, 2016)

# 3. Methodology (Empirical Specification)

**H2: Complementarities of two capitals on trade rise when the economy takes off; otherwise, generally two capitals substitute?**

Estimation Model (Following Baier and Bergstrand, 2007)

$$\begin{aligned}&\mathrm{dln}X_{ij,t-(t-1)}\\&= \beta_0 + \beta_3\ \Delta\mathrm{lnAID}\ [\equiv \mathrm{dlnAID}_{ij,t-(t-1)}] + \beta_{03}\mathrm{dlnNAID}_{ij,t-(t-1)} + \beta_4\ \Delta\mathrm{lnOFDI}\ [\equiv \mathrm{dlnOFDI}_{ij,t-(t-1)}]\\&+ \beta_{04}\ \mathrm{dlnNOFDI}_{ij,t-(t-1)} + \beta_5 Income\ Level_j + \beta_{34}\ [(\Delta\mathrm{lnAID}_{ij} \times\ \Delta\mathrm{lnOFDI}_{ij})\\&+ \beta_{345}[(\Delta\mathrm{lnAID}_{ij} \times\ \Delta\mathrm{lnOFDI}_{ij}) \times Income\ Level_j] + \beta_{i,t-(t-1)}\delta_{i,t-(t-1)} + \beta_{j,t-(t-1)}\delta_{j,t-(t-1)}\\&+ \delta_{ij,t-(t-1)}\end{aligned}$$

- **Additionally, we test the differential effects of two capitals by income level** to investigate the empirical net measure of the substitution or complementary effects between Total AID (ODA) and Foreign Investment on exports.

  - By examining on $\beta_{34} + \beta_{345}$, we would conclude for the differential effects depending on income level (low, lower middle, and upper middle, when high income are used as a reference group)

  - For example, $\beta_{34} < 0, but\ \beta_{345} > 0,$ and if its combined effects, $\beta_{34} + \beta_{345} > 0,$
  - Then the substitution effect between two capitals on export as economy goes high income
  - A complementarity effect in countries where estimated coefficients become significantly positive.

# 4. Estimation Results

<Table1> Overall Estimation Results (Exports & FDI flows)

| $\Delta lnExports_{ij,t-(t-1)}$ | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| $\beta_3$ ΔlnAID [≡ $dlnAID_{ij,t-(t-1)}$] | 0.01840*** | 0.01785** | 0.01848*** | 0.01789** | 0.01858*** | 0.01798** | 0.01784* | 0.01613 |
| | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) | (0.007) | (0.011) | (0.011) |
| $\beta_{03}$ $dlnNAID_{ij,t-(t-1)}$ | 0.25221** | 0.22734* | 0.25315** | 0.22797* | 0.25389** | 0.22858* | 0.25586** | 0.22739* |
| | (0.116) | (0.114) | (0.116) | (0.114) | (0.116) | (0.114) | (0.119) | (0.117) |
| $\beta_4$ ΔlnOFDI [≡ $dlnOFDI_{ij,t-(t-1)}$] | | | -0.00185 | -0.00243 | -0.00178 | -0.00238 | -0.00125 | -0.00195 |
| | | | (0.005) | (0.005) | (0.005) | (0.005) | (0.004) | (0.005) |
| $\beta_{04}$ $dlnNOFDI_{ij,t-(t-1)}$ | | | -0.01656 | -0.02793 | -0.00178 | -0.00238 | -0.00708 | -0.01904 |
| | | | (0.079) | (0.082) | (0.005) | (0.005) | (0.077) | (0.080) |
| $\beta_{34}(\Delta lnAID_{ij} \times \Delta lnOFDI_{ij})$ | | | | | -0.00007 | -0.00006 | -0.00072*** | -0.00077** |
| | | | | | (0.000) | (0.000) | (0.000) | (0.000) |
| $\beta_{345}(\Delta lnAID_{ij} \times \Delta lnOFDI_{ij} \times Low\_Income_j)$ | | | | | | | 0.00055 | 0.00060 |
| | | | | | | | (0.000) | (0.000) |
| $\beta_{346}(\Delta lnAID_{ij} \times \Delta lnOFDI_{ij} \times Lower\_Middle\_Income_j)$ | | | | | | | 0.00069** | 0.00079* |
| | | | | | | | (0.000) | (0.000) |
| $\beta_{347}(\Delta lnAID_{ij} \times \Delta lnOFDI_{ij} \times Upper\_Middle\_Income_j)$ | | | | | | | 0.00070*** | 0.00072* |
| | | | | | | | (0.000) | (0.000) |
| Constant | 1.18121*** | 0.32606*** | 1.18122*** | 0.32655*** | 1.18133*** | 0.32665*** | -0.02510 | 0.32570*** |
| | (0.224) | (0.018) | (0.224) | (0.018) | (0.225) | (0.018) | (0.075) | (0.019) |
| Time Fixed Effects (by non-overlapping 3 years) | Y | Y | N | N | N | N | N | N |
| Donor Fixed Effects | Y | Y | N | N | N | N | N | N |
| Partner Fixed Effects | Y | Y | N | | N | N | N | N |
| Donor-Partner Fixed Effects | N | Y | N | Y | Y | Y | N | Y |
| Donor-Time varying Fixed Effects | N | N | Y | Y | Y | Y | Y | Y |
| Partner-Time varying Fixed Effects | N | N | Y | Y | Y | Y | Y | Y |
| Observations | 24,950 | 24,950 | 24,950 | 24,950 | 24,950 | 24,950 | 24,950 | 24,950 |
| R-squared | 0.0278 | 0.079 | 0.0887 | 0.079 | 0.0887 | 0.079 | 0.0894 | 0.079 |
| Number of pair_id | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 |

Note: 1) First and second order interaction terms as well as other fixed effects are all included in the estimations, but not reported.
2) Estimations using clustered robust standard error by donor in parentheses at $p < 0.1$ (*), $p < 0.05$(**), and $p < 0.001$(***).
Other cases such as recipient or pair-id also provide consistent results.

# 4. Estimation Results

<Table 2> Estimation Results by Sector (Exports & FDI flows)

| $\Delta lnExports_{ij,t-(t-1)}$ | (1) **Social Infra.& Services** | (2) **Economic Infra.& Services** | (3) **Production Sectors** | (4) **Multi-Sector/ Cross-Cutting** | (5) Commodity Aid/Programme Assistance | (6) Action Relating to Debt | (7) Humanitarian Aid | (8) Others |
|---|---|---|---|---|---|---|---|---|
| $\beta_3$ $\Delta$lnAID [$\equiv$ dlnAID$_{ij,t-(t-1)}$] | -0.00188 | -0.00426 | 0.00305 | -0.01470 | -0.02193 | -0.01276* | -0.00868 | 0.00277 |
| | (0.008) | (0.007) | (0.009) | (0.009) | (0.017) | (0.007) | (0.007) | (0.006) |
| $\beta_{03}$ dlnNAID$_{ij,t-(t-1)}$ | 0.04430 | -0.01425 | 0.07492 | -0.02933 | -0.04415 | -0.09346 | 0.07956 | .0576601 |
| | (0.081) | (0.060) | (0.085) | (0.059) | (0.085) | (0.074) | (0.079) | ( 0.329 ) |
| $\beta_4$ $\Delta$lnOFDI [$\equiv$ dlnOFDI$_{ij,t-(t-1)}$] | 0.00059 | 0.00074 | 0.00077 | 0.00079 | 0.00077 | 0.00069 | 0.00082 | 0.00059 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| $\beta_{04}$ dlnNOFDI$_{ij,t-(t-1)}$ | 0.01882 | 0.02464 | 0.02556 | 0.02597 | 0.02502 | 0.02426 | 0.02702 | 0.02382 |
| | (0.084) | (0.082) | (0.083) | (0.082) | (0.082) | (0.083) | (0.082) | (0.082) |
| $\beta_{34}(\Delta\text{lnAID}_{ij} \times \Delta\text{lnOFDI}_{ij})$ | -0.00074** | -0.00007 | -0.00022 | -0.00075** | -0.00133 | 0.00067 | 0.00031 | -0.00091* |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) | (0.001) | (0.000) | (0.000) |
| $\beta_{345}(\Delta\text{lnAID}_{ij} \times \Delta\text{lnOFDI}_{ij} \times Low\_Income_j)$ | 0.00092** | 0.00023 | 0.00019 | 0.00088 | 0.00133 | -0.00064 | -0.00057 | 0.00000 |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.001) | (0.000) | (0.000) | (0.000) |
| $\beta_{346}(\Delta\text{lnAID}_{ij} \times \Delta\text{lnOFDI}_{ij} \times Lower\_Middle\_Income_j)$ | 0.00087*** | 0.00016 | 0.00039 | 0.00090** | 0.00103 | -0.00044 | -0.00036 | 0.00088** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) | (0.001) | (0.000) | (0.000) |
| $\beta_{347}(\Delta\text{lnAID}_{ij} \times \Delta\text{lnOFDI}_{ij} \times Upper\_Middle\_Income_j)$ | 0.00075** | 0.00010 | 0.00025 | 0.00096*** | 0.00167 | -0.00065 | -0.00010 | 0.00081* |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.000) | (0.000) |
| Constant | 0.35245*** | 0.34404*** | 0.34756*** | 0.35583*** | 0.33971*** | 0.34105*** | 0.33691*** | 0.00124** |
| | (0.040) | (0.036) | (0.034) | (0.037) | (0.034) | (0.033) | (0.032) | (0.000) |
| Donor-Partner Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Donor-Time varying Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Partner-Time varying Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Observations | 24,950 | 24,950 | 24,950 | 24,950 | 24,950 | 24,950 | 24,950 | 24,950 |
| R-squared | 0.012 | 0.012 | 0.012 | 0.012 | 0.012 | 0.012 | 0.012 | 0.012 |
| Number of pair_id | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 |

Note: 1) First and second order interaction terms as well as other fixed effects are all included in the estimations, but not reported.
2) Estimations using clustered robust standard error by donor in parentheses at $p < 0.1$ (*), $p < 0.05$(**), and $p < 0.001$(***).
Other cases such as recipient or pair-id also provide consistent results.

# 4. Estimation Results

<Table 3> Estimation Results : AfT & PSD

| $\Delta lnExports_{ij,t-(t-1)}$ | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | Aid for Trade (AfT) | | | | Private Sector Development (PSD) | | | |
| | Total AfT | TA for Trade Policy & Regulation | Economic Infra. | Building Productive Capacity | Total PSD | Investment Climate | Productive Capacity | Physical Infra. |
| $\beta_3$ ΔlnAID [≡ $dlnAID_{ij,t-(t-1)}$] | -0.00220 | 0.00787 | -0.00723 | -0.00156 | -0.01022 | -0.01608** | 0.00226 | -0.01100* |
| | (0.009) | (0.011) | (0.005) | (0.010) | (0.006) | (0.006) | (0.008) | (0.006) |
| $\beta_{03}$ $dlnNAID_{ij,t-(t-1)}$ | 0.01040 | 0.13210 | 0.01447 | 0.02854 | -0.04588 | -0.09152 | 0.10602 | -0.05066 |
| | (0.090) | (0.088) | (0.059) | (0.086) | (0.065) | (0.055) | (0.080) | (0.067) |
| $\beta_4$ ΔlnOFDI [≡ $dlnOFDI_{ij,t-(t-1)}$] | 0.00071 | 0.00068 | 0.00076 | 0.00071 | 0.00070 | 0.00070 | 0.00080 | 0.00072 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| $\beta_{04}$ $dlnNOFDI_{ij,t-(t-1)}$ | 0.02425 | 0.02420 | 0.02328 | 0.02490 | 0.02396 | 0.02428 | 0.02671 | 0.02429 |
| | (0.083) | (0.083) | (0.082) | (0.083) | (0.083) | (0.082) | (0.083) | (0.082) |
| $\beta_{34}(\Delta lnAID_{ij} \times \Delta lnOFDI_{ij})$ | -0.00020 | -0.00019 | **-0.00038** | 0.00011 | **-0.00051*** ** | **-0.00056** | -0.00043 | 0.00013 |
| | (0.000) | (0.000) | **(0.000)** | (0.000) | **(0.000)** | **(0.000)** | (0.000) | (0.000) |
| $\beta_{345}(\Delta lnAID_{ij} \times \Delta lnOFDI_{ij} \times Low\_Income_j)$ | 0.00047 | 0.00000 | **0.00070**** | 0.00014 | **0.00048** | **0.00081*** | 0.00002 | -0.00013 |
| | (0.000) | (0.000) | **(0.000)** | (0.001) | **(0.000)** | **(0.000)** | (0.001) | (0.001) |
| $\beta_{346}(\Delta lnAID_{ij} \times \Delta lnOFDI_{ij} \times Lower\_Middle\_Income_j)$ | 0.00041 | 0.00025 | **0.00057*** | -0.00001 | **0.00068***** | **0.00086**** | 0.00035 | -0.00004 |
| | (0.000) | (0.000) | **(0.000)** | (0.000) | **(0.000)** | **(0.000)** | (0.000) | (0.000) |
| $\beta_{347}(\Delta lnAID_{ij} \times \Delta lnOFDI_{ij} \times Upper\_Middle\_Income_j)$ | 0.00009 | 0.00031 | **0.00057**** | -0.00009 | **0.00061***** | **0.00056** | 0.00056 | -0.00014 |
| | (0.000) | (0.000) | **(0.000)** | (0.000) | **(0.000)** | **(0.000)** | (0.000) | (0.000) |
| Constant | 0.34137*** | 0.34137*** | 0.34184*** | 0.34887*** | 0.35434*** | 0.35319*** | 0.34973*** | 0.34628*** |
| | (0.033) | (0.033) | (0.035) | (0.035) | (0.037) | (0.036) | (0.034) | (0.036) |
| Donor-Partner Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Donor-Time varying Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Partner-Time varying Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Observations | 24,950 | 24,950 | 24,950 | 24,950 | 24,950 | 24,950 | 24,950 | 24,950 |
| R-squared | 0.012 | 0.012 | 0.012 | 0.012 | 0.012 | 0.012 | 0.012 | 0.012 |
| Number of pair_id | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 |

Note: 1) First and second order interaction terms as well as other fixed effects are all included in the estimations, but not reported.
2) Estimations using clustered robust standard error by donor in parentheses at $p < 0.1$ (*), $p < 0.05$(**), and $p < 0.001$(***).
Other cases such as recipient or pair-id also provide consistent results.

# 5. Conclusion

## Major findings of the study

- ODA and FDI substitute one another overall.
- However, when the economy of host countries develops (thank to public capitals such as aids to social infra), the two capitals complement each other; particularly this trend prevails when the partner (host) countries in transition from lower middle to upper middle income.

## Major findings by sectors

- By looking at the sectoral aid, social infra matters for all income level while multi-sector and overall PSD are better aligned with middle income groups.
- Also, by re-classifying aids into AfT and PSD sectors, giving aids to **economic infra in AfT** **and** **investment environment in PSD sectors** provide pure trade promotion effects **without substitution effects** between two types of capitals
- **These two sectors are found to make "public" and "private" capitals aligned better for trade cooperation!**

# Thank You!

# Appendix 1: Robustness Test using Real Exports and Other Controls

<Table 1> Estimation Results by Sector (Real Exports, Aid, FDI flows)

| $\Delta lnExports_{ij,t-(t-1)}$ | (1) Total AID | (2) Total AID | (3) Total AID | (4) Social Infra.& Services | (5) Economic Infra.& Services | (6) Production Sectors | (7) Multi-Sector/ Cross-Cutting | (8) Commodity Aid/ Programme Assistance |
|---|---|---|---|---|---|---|---|---|
| $\beta_3$ $\Delta$lnAID [$\equiv$ dlnAID$_{ij,t-(t-1)}$] | 0.00550 | 0.00548 | 0.00024 | -0.00026 | -0.00313 | 0.00427 | -0.01398 | -0.02072 |
| | (0.007) | (0.007) | (0.009) | (0.008) | (0.008) | (0.009) | (0.010) | (0.016) |
| $\beta_{03}$ dlnNAID$_{ij,t-(t-1)}$ | 0.11444 | 0.11420 | 0.10549 | 0.04851 | -0.01214 | 0.07328 | -0.03664 | -0.02308 |
| | (0.098) | (0.098) | (0.100) | (0.084) | (0.068) | (0.083) | (0.064) | (0.092) |
| $\beta_4$ $\Delta$lnOFDI [$\equiv$ dlnOFDI$_{ij,t-(t-1)}$] | | 0.00071 | -0.00042 | -0.00035 | -0.00027 | -0.00023 | -0.00019 | -0.00017 |
| | | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| $\beta_{04}$ dlnNOFDI$_{ij,t-(t-1)}$ | | 0.00799 | 0.00278 | 0.00363 | 0.00886 | 0.00977 | 0.01012 | 0.01050 |
| | | (0.084) | (0.089) | (0.088) | (0.086) | (0.087) | (0.086) | (0.086) |
| $\beta_{34}(\Delta\text{lnAID}_{ij} \times \Delta\text{lnOFDI}_{ij})$ | | | -0.00076** | -0.00079** | -0.00003 | -0.00022 | -0.00084*** | -0.00098 |
| | | | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) |
| $\beta_{345}(\Delta\text{lnAID}_{ij} \times \Delta\text{lnOFDI}_{ij} \times Low\_Income_j)$ | | | 0.00074* | 0.00088** | 0.00014 | 0.00028 | 0.00091* | 0.00085 |
| | | | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) |
| $\beta_{346}(\Delta\text{lnAID}_{ij} \times \Delta\text{lnOFDI}_{ij} \times Lower\_Middle\_Income_j)$ | | | 0.00095** | 0.00087** | 0.00010 | 0.00035 | 0.00097** | 0.00065 |
| | | | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) |
| $\beta_{347}(\Delta\text{lnAID}_{ij} \times \Delta\text{lnOFDI}_{ij} \times Upper\_Middle\_Income_j)$ | | | 0.00078** | 0.00075** | 0.00002 | 0.00017 | 0.00096*** | 0.00132 |
| | | | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) |
| Constant | 0.30854*** | 0.30833*** | 0.30870*** | 0.30196*** | 0.29602*** | 0.29968*** | 0.30757*** | 0.29233*** |
| | (0.053) | (0.053) | (0.053) | (0.053) | (0.048) | (0.047) | (0.048) | (0.046) |
| Time Fixed Effects (by non-overlapping 3 years) | Y | Y | Y | Y | Y | Y | Y | Y |
| Donor Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Partner Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Observations | 24,892 | 24,892 | 24,892 | 24,892 | 24,892 | 24,892 | 24,892 | 24,892 |
| R-squared | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 |
| Number of pair_id | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 |

Note: 1) First and second order interaction terms as well as other fixed effects are all included in the estimations, but not reported.
2) Estimations using clustered robust standard error by donor (other cases such as recipient or pair-id) provide consistent results.
3) Other ODA sectors such as Action Relating to Debt, Humanitarian Aid, Others are also conducted, but not reported.
4) Log of real GDP of country $i$ and $j$ are included in the estimations, but not reported.

# Appendix 2: Robustness Test using Real Exports and Other Controls

<Table 2> Estimation Results (Real Exports, Aid, FDI flows) : AfT & PSD

| $\Delta lnExports_{ij,t-(t-1)}$ | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| | Aid for Trade (AfT) | | | | Private Sector Development (PSD) | | | |
| | Total AfT | TA for Trade Policy & Regulation | Economic Infra. | Building Productive Capacity | Total PSD | Investment Climate | Productive Capacity | Physical Infra. |
| $\beta_3$ ΔlnAID [≡ $dlnAID_{ij,t-(t-1)}$] | -0.00100 | 0.00853 | -0.00702 | -0.00048 | -0.00813 | -0.01517** | 0.00447 | -0.00589 |
| | (0.009) | (0.010) | (0.005) | (0.010) | (0.006) | (0.006) | (0.008) | (0.006) |
| $\beta_{03}$ $dlnNAID_{ij,t-(t-1)}$ | 0.00869 | 0.11898 | 0.00751 | 0.02327 | -0.04042 | -0.09214 | 0.11373 | -0.00280 |
| | (0.089) | (0.087) | (0.055) | (0.086) | (0.064) | (0.057) | (0.080) | (0.060) |
| $\beta_4$ ΔlnOFDI [≡ $dlnOFDI_{ij,t-(t-1)}$] | -0.00027 | -0.00033 | -0.00024 | -0.00028 | -0.00025 | -0.00030 | -0.00015 | -0.00031 |
| | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) | (0.005) |
| $\beta_{04}$ $dlnNOFDI_{ij,t-(t-1)}$ | 0.00891 | 0.00821 | 0.00774 | 0.00943 | 0.00888 | 0.00850 | 0.01170 | 0.00825 |
| | (0.086) | (0.087) | (0.086) | (0.086) | (0.087) | (0.086) | (0.087) | (0.086) |
| $\beta_{34}(\Delta lnAID_{ij} \times \Delta lnOFDI_{ij})$ | -0.00020 | -0.00007 | -0.00029 | 0.00009 | -0.00052*** | -0.00054 | -0.00041 | 0.00021 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| $\beta_{345}(\Delta lnAID_{ij} \times \Delta lnOFDI_{ij} \times Low\_Income_j)$ | 0.00039 | -0.00001 | 0.00049 | 0.00008 | 0.00037 | 0.00077* | 0.00000 | -0.00026 |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.000) | (0.001) | (0.000) |
| $\beta_{346}(\Delta lnAID_{ij} \times \Delta lnOFDI_{ij} \times Lower\_Middle\_Income_j)$ | 0.00038 | 0.00011 | 0.00045 | -0.00002 | 0.00066*** | 0.00081** | 0.00029 | -0.00012 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| $\beta_{347}(\Delta lnAID_{ij} \times \Delta lnOFDI_{ij} \times Upper\_Middle\_Income_j)$ | 0.00006 | 0.00007 | 0.00045 | -0.00014 | 0.00058*** | 0.00048 | 0.00048 | -0.00026 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Constant | 0.30193*** | 0.29371*** | 0.29429*** | 0.30188*** | 0.30696*** | 0.30631*** | 0.30268*** | 0.29820*** |
| | (0.049) | (0.045) | (0.047) | (0.048) | (0.050) | (0.047) | (0.048) | (0.048) |
| Time Fixed Effects (by non-overlapping 3 years) | Y | Y | Y | Y | Y | Y | Y | Y |
| Donor Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Partner Fixed Effects | Y | Y | Y | Y | Y | Y | Y | Y |
| Observations | 24,892 | 24,892 | 24,892 | 24,892 | 24,892 | 24,892 | 24,892 | 24,892 |
| R-squared | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 |
| Number of pair_id | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 | 4,990 |

Note: 1) First and second order interaction terms as well as other fixed effects are all included in the estimations, but not reported.
2) Estimations using clustered robust standard error by donor (other cases such as recipient or pair-id) provide consistent results.
3) AfT (Trade-Related Adjustment) is included in the estimations, but not reported
4) Log of real GDP of country $i$ and $j$ are included in the estimations, but not reported.

# Appendix 3: Descriptive Statistics

- **Basic Model (Current USD)**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Ln of Exports flow from country *i* to *j* | 29,940 | 14.70399 | 6.701577 | 0 | 26.41531 |
| Ln of Total Aid flow from country *i* to *j* | 29,940 | 6.024045 | 7.229669 | 0 | 22.76925 |
| Ln of FDI flow from country *i* to *j* | 29,940 | 3.001051 | 6.401664 | 0 | 24.33074 |
| Δ Ln of Exports flow from country *i* to *j* | 24,950 | .2289842 | 1.429456 | -17.61458 | 15.53879 |
| Δ Ln of Total Aid flow from country *i* to *j* | 24,950 | 1.489587 | 5.203802 | -17.60702 | 21.36422 |
| Δ Ln of FDI flow from country *i* to *j* | 24,950 | .210645 | 6.068474 | -24.33074 | 23.09591 |

- **Robustness Test (Constant 2015 USD)**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Ln of Exports flow from country *i* to *j* | 29,940 | 14.81633 | 6.730363 | 0 | 26.44324 |
| Ln of Total AID flow from country *i* to *j* | 29,940 | 6.059101 | 7.269745 | 0 | 22.93076 |
| Ln of FDI flow from country *i* to *j* | 29,9400 | 3.026993 | 6.445182 | 0 | 24.36863 |
| Ln of GDP of country *i* | 29,940 | 26.87277 | 1.499206 | 23.53226 | 30.51069 |
| Ln of GDP of country *j* | 29,882 | 24.2747 | 2.230541 | 18.38974 | 30.00857 |
| Δ Ln of Exports flow from country *i* to *j* | 24,950 | .1784442 | 1.449126 | -17.56163 | 15.73527 |
| Δ Ln of Total Aid flow from country *i* to *j* | 24,950 | 1.49005 | 5.265769 | -17.81817 | 21.58414 |
| Δ Ln of FDI flow from country *i* to *j* | 24,950 | .2043 | 6.110189 | -24.36863 | 23.09589 |
| Δ Ln of GDP of country *i* | 24,950 | .0948447 | .1514886 | -.5193157 | .4451675 |
| Δ Ln of GDP of country *j* | 24,892 | .0647413 | .2400427 | -2.62327 | .9097919 |

# Appendix 4: 29 Donors and 175 Recipients

| # | DAC | Donors |
|---|---|---|
| 1 | DAC Members | Australia |
| 2 | | Austria |
| 3 | | Belgium |
| 4 | | Canada |
| 5 | | Czech Republic |
| 6 | | Denmark |
| 7 | | Finland |
| 8 | | France |
| 9 | | Germany |
| 10 | | Greece |
| 11 | | Hungary |
| 12 | | Iceland |
| 13 | | Ireland |
| 14 | | Italy |
| 15 | | Japan |
| 16 | | Korea |
| 17 | | Luxembourg |
| 18 | | Netherlands |
| 19 | | New Zealand |
| 20 | | Norway |
| 21 | | Poland |
| 22 | | Portugal |
| 23 | | Slovak Republic |
| 24 | | Slovenia |
| 25 | | Spain |
| 26 | | Sweden |
| 27 | | Switzerland |
| 28 | | United Kingdom |
| 29 | | United States |

&

| # | Recipients |
|---|---|
| 1 | Afghanistan |
| 2 | Angola |
| 3 | Albania |
| … | … |
| 172 | Yemen |
| 173 | South Africa |
| 174 | Zambia |
| 175 | Zimbabwe |