

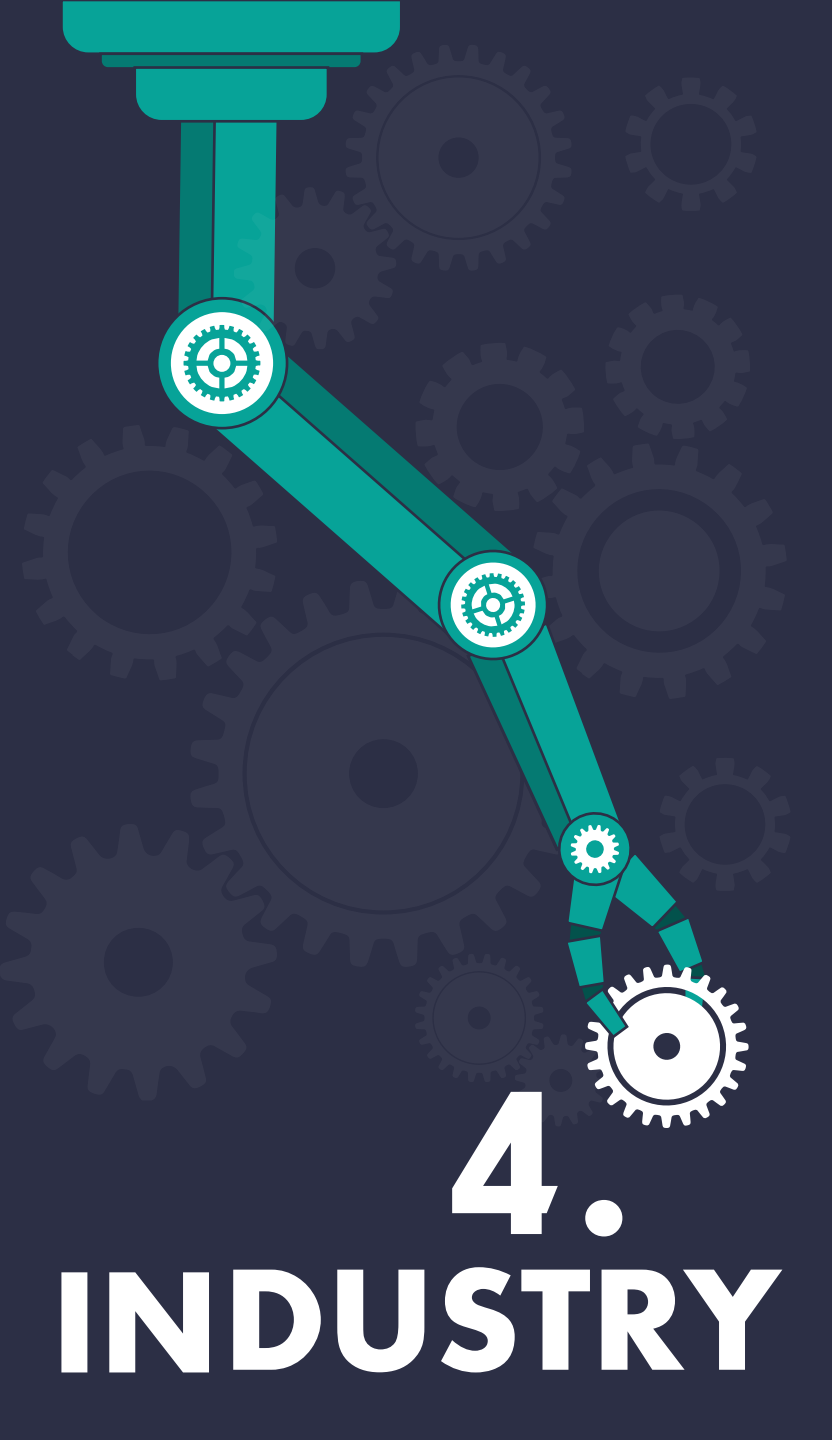


Development of the Global Steel Industry: Implications of Technology Choice



Naoki SEKIGUCHI
Daito Bunka University

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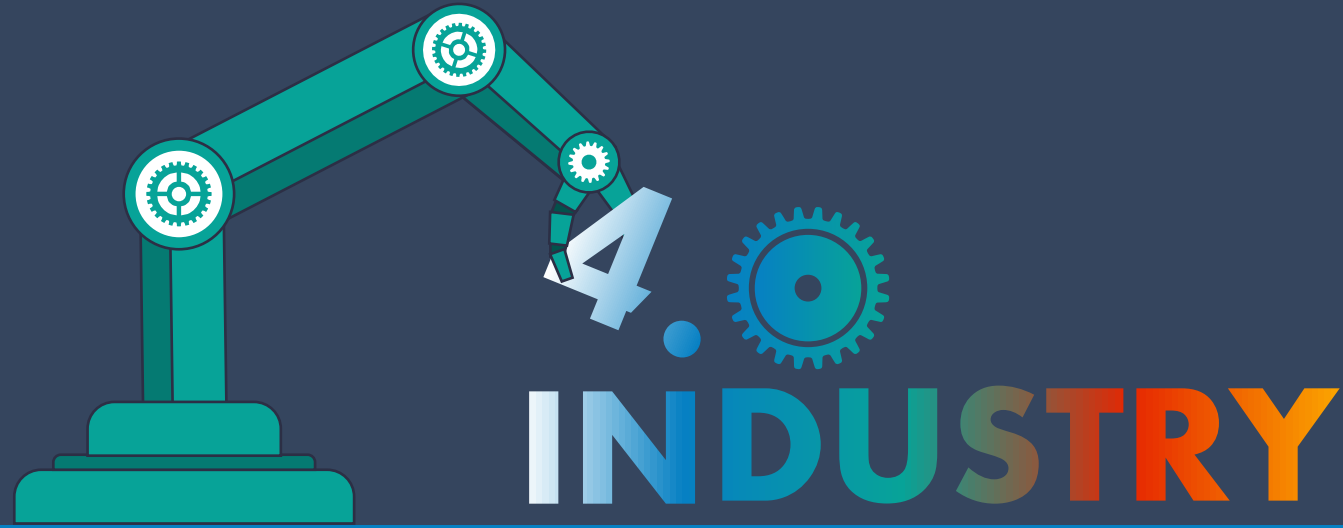
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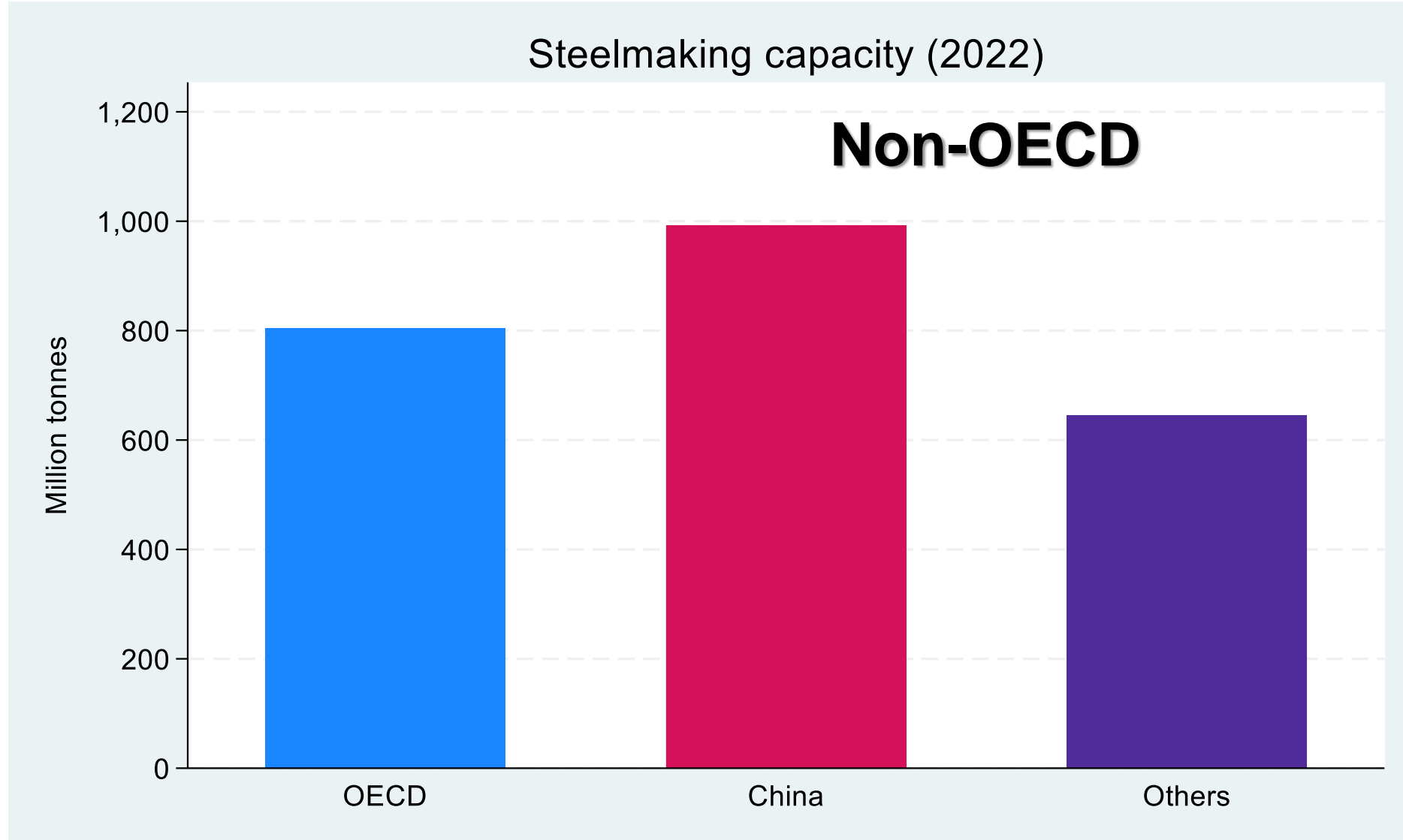
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Appendix



01 Global-Level Analysis

Non-OECD economies have played a dominant role in steelmaking capacity

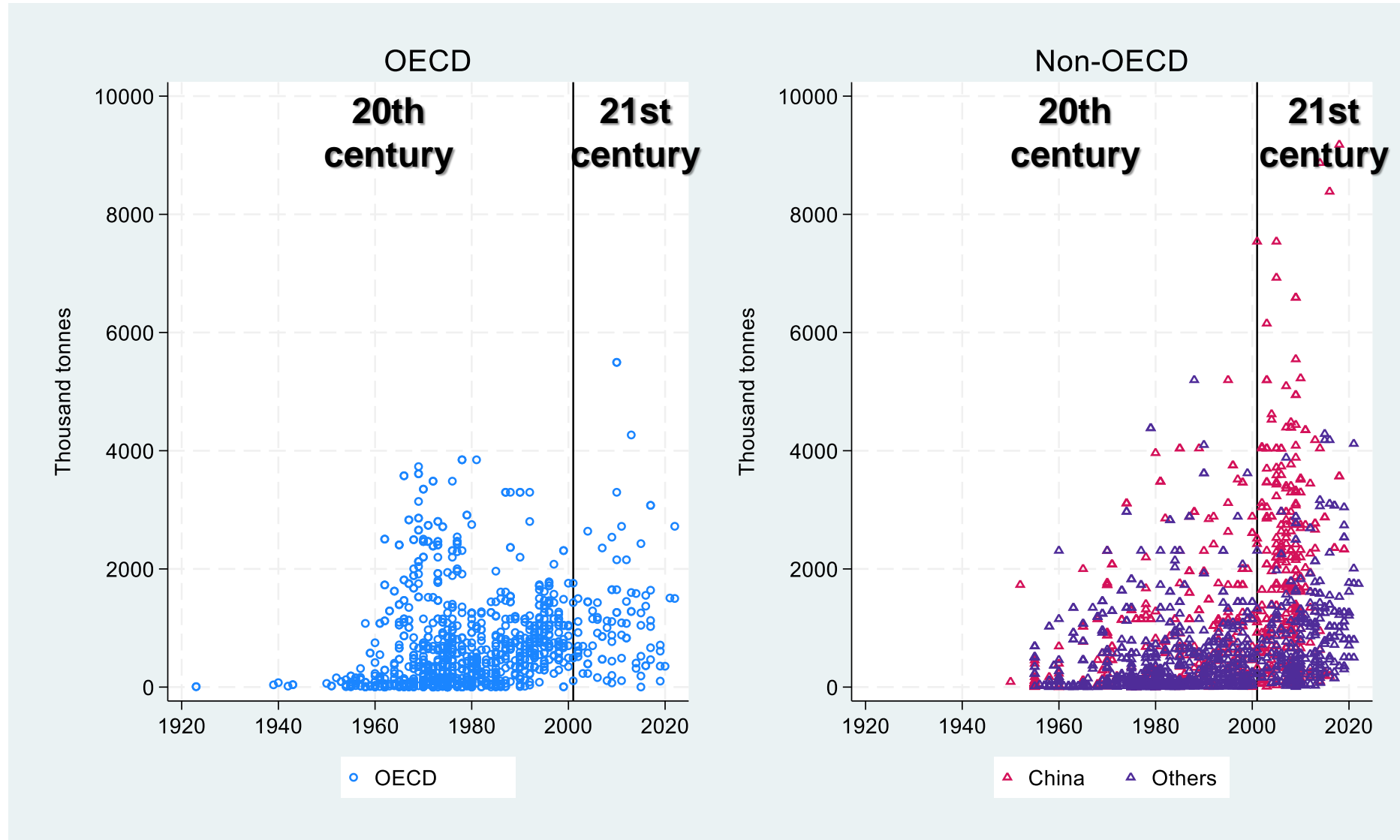


Research Question

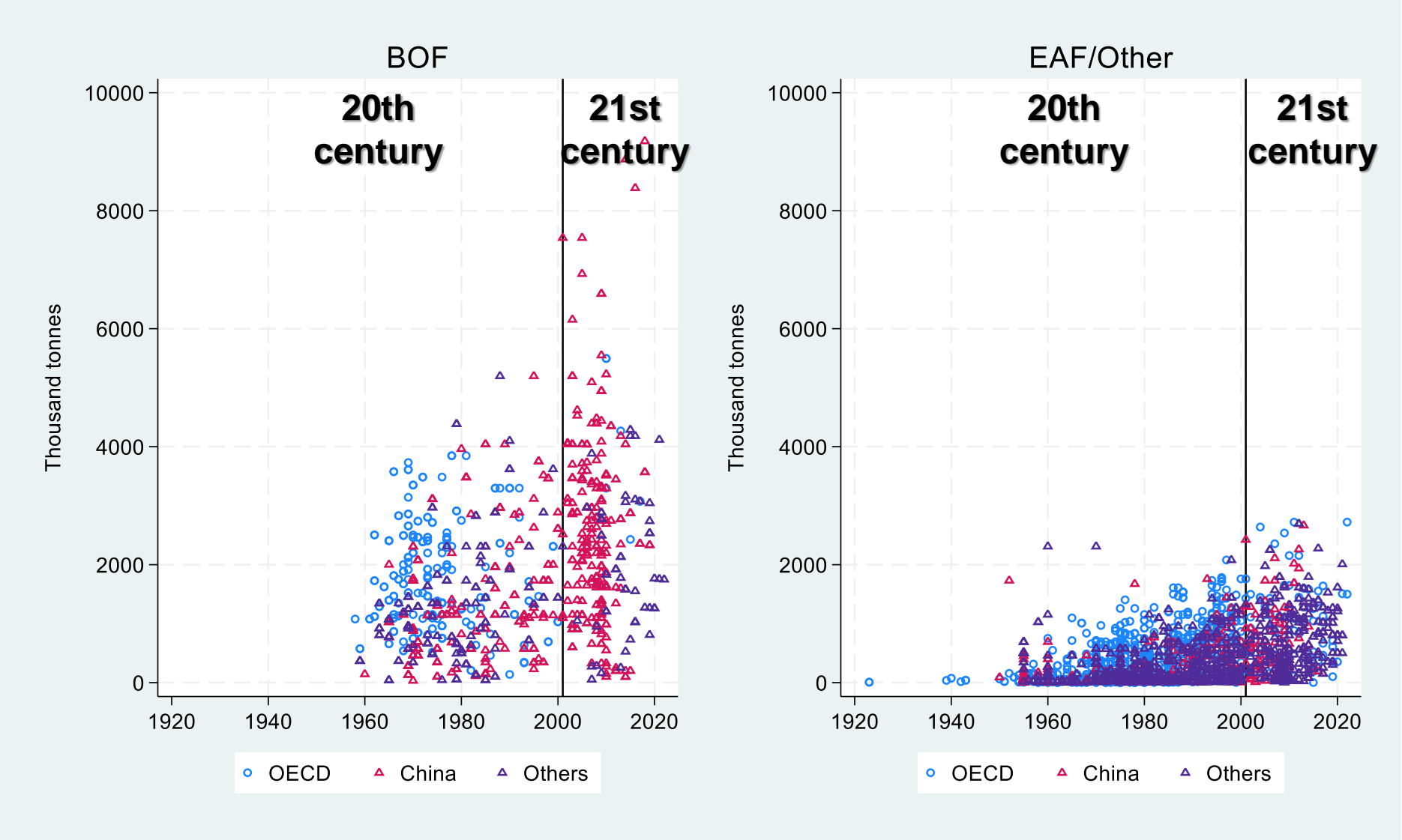


- How was the existing capacity established in the global steel industry?

Capacity additions in the 20th and early 21st centuries have shaped the existing capacity

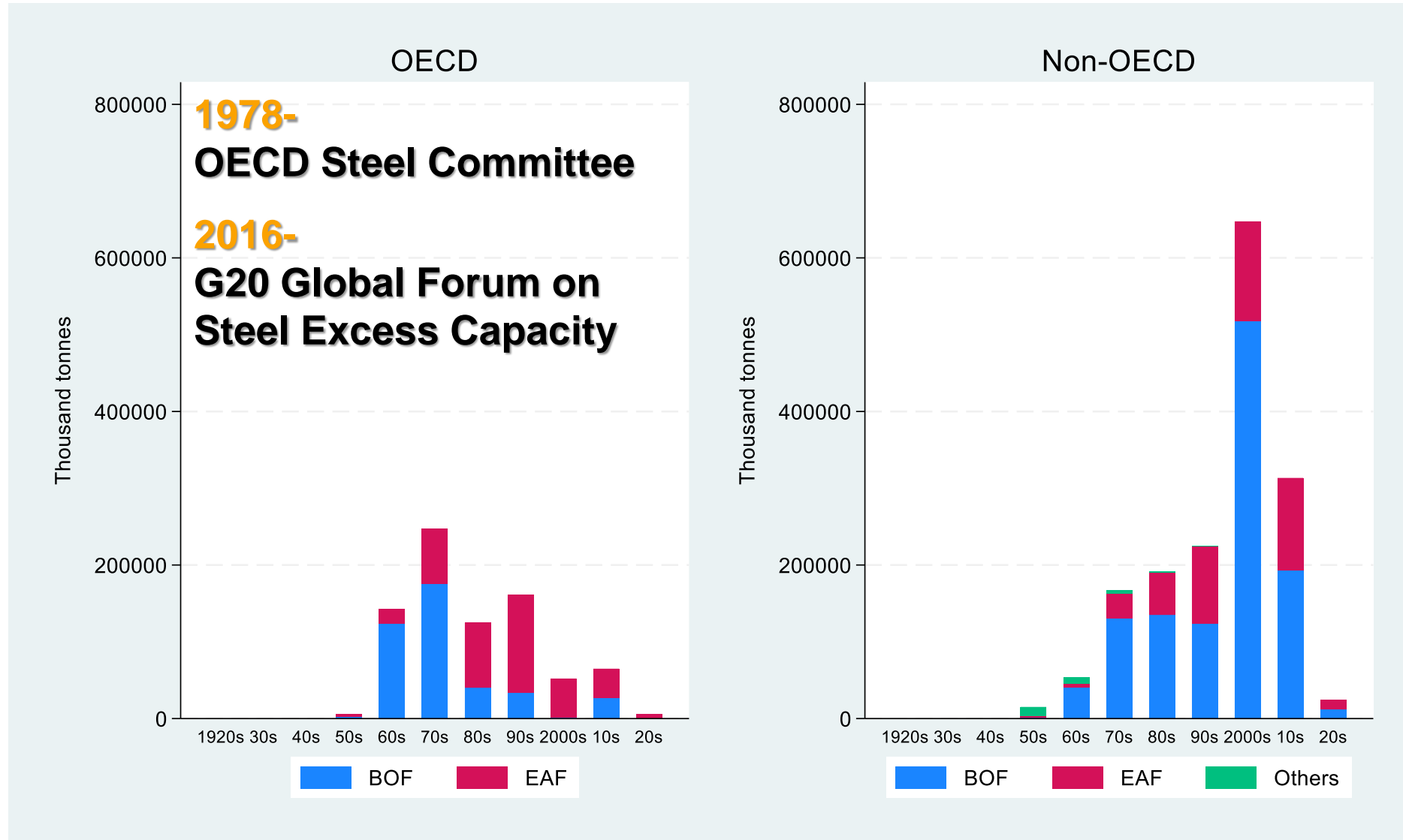


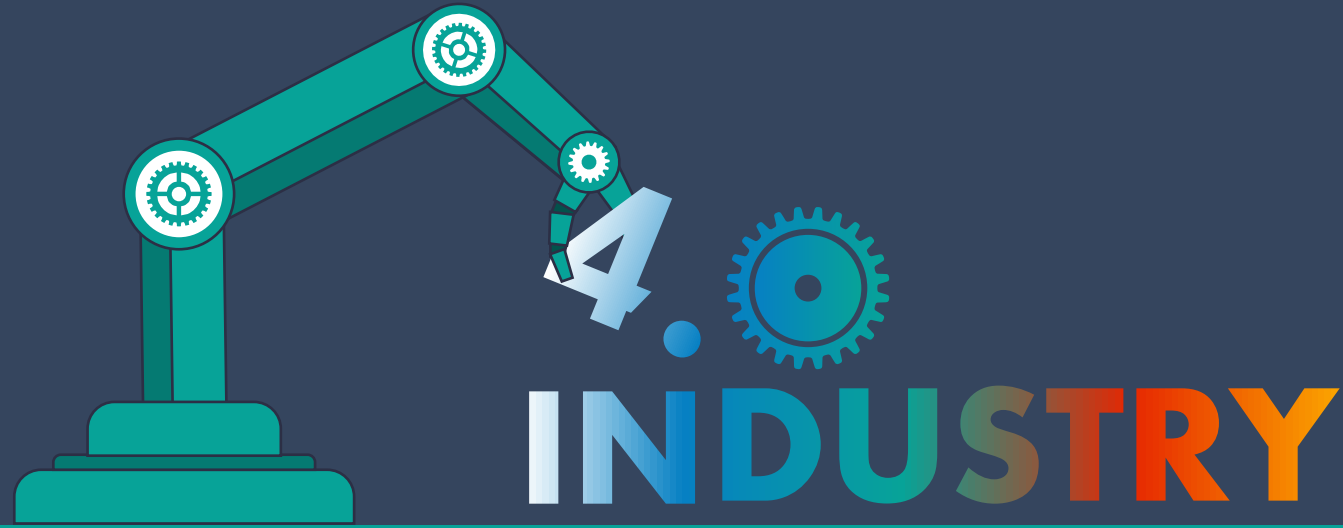
BOFs and EAFs have shown divergent investment patterns



Source: Author based on King (2023)

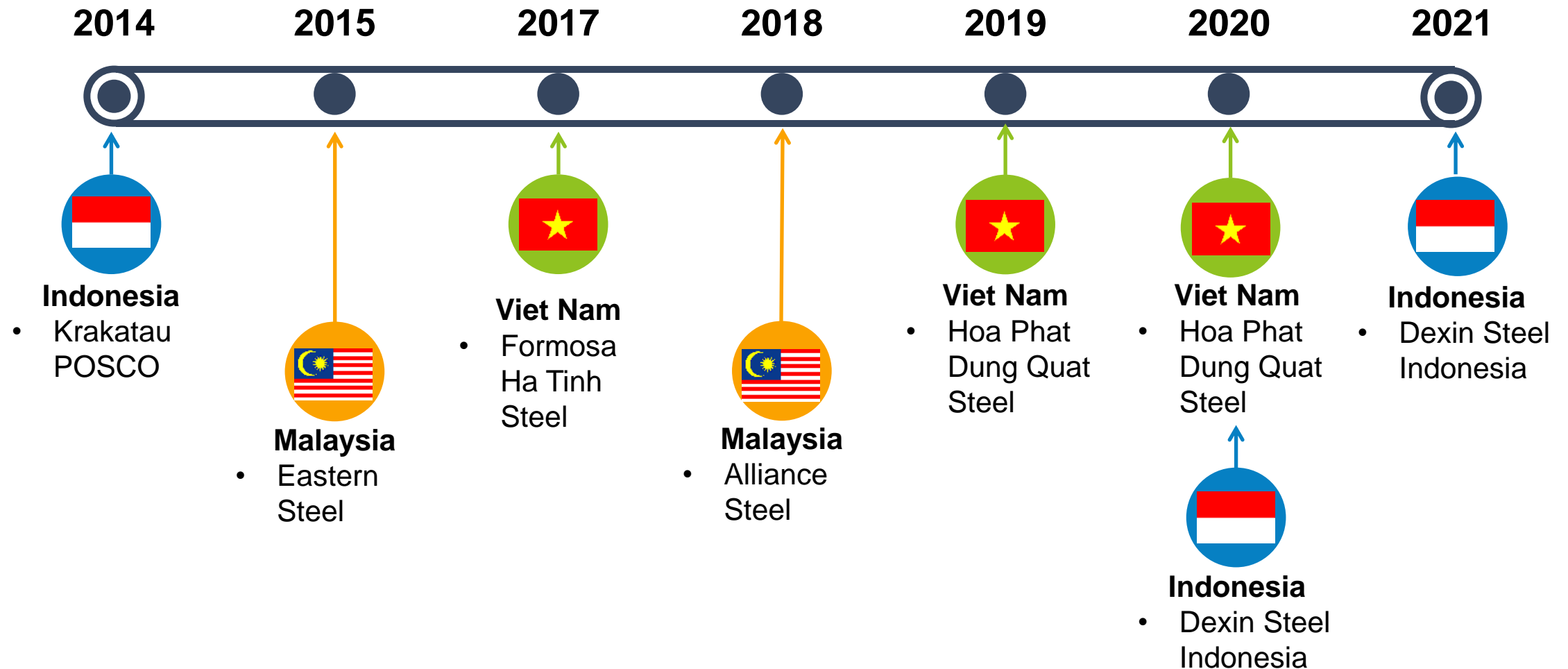
Key forums have been established to address the rapid developments in capacity





02 Regional-Level Analysis

Steel firms in the ASEAN region have recently built several integrated steel mills

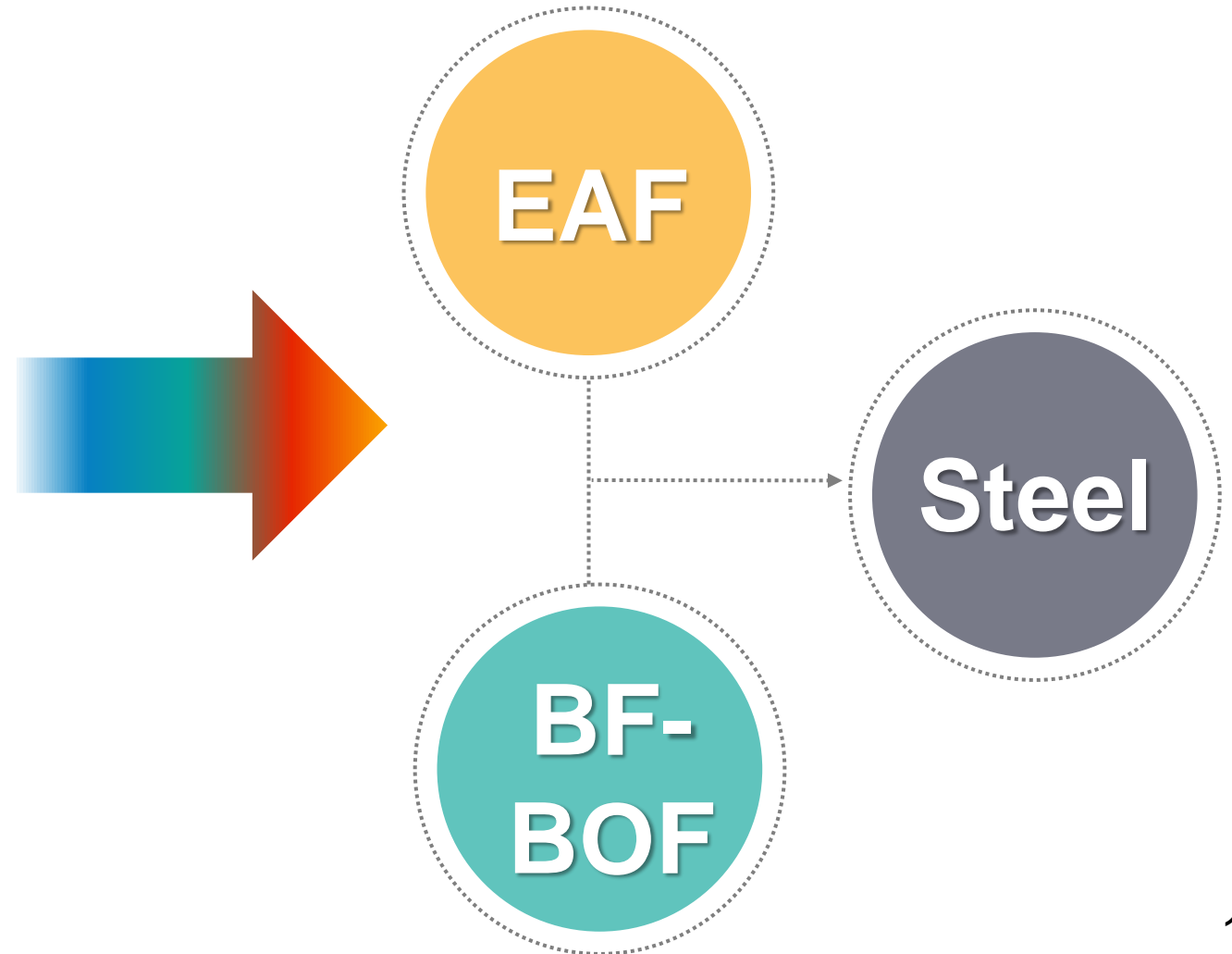


Production patterns have shifted from exclusively using EAFs to a combination of EAFs and BF-BOFs

Before the 2010s



Since the 2010s

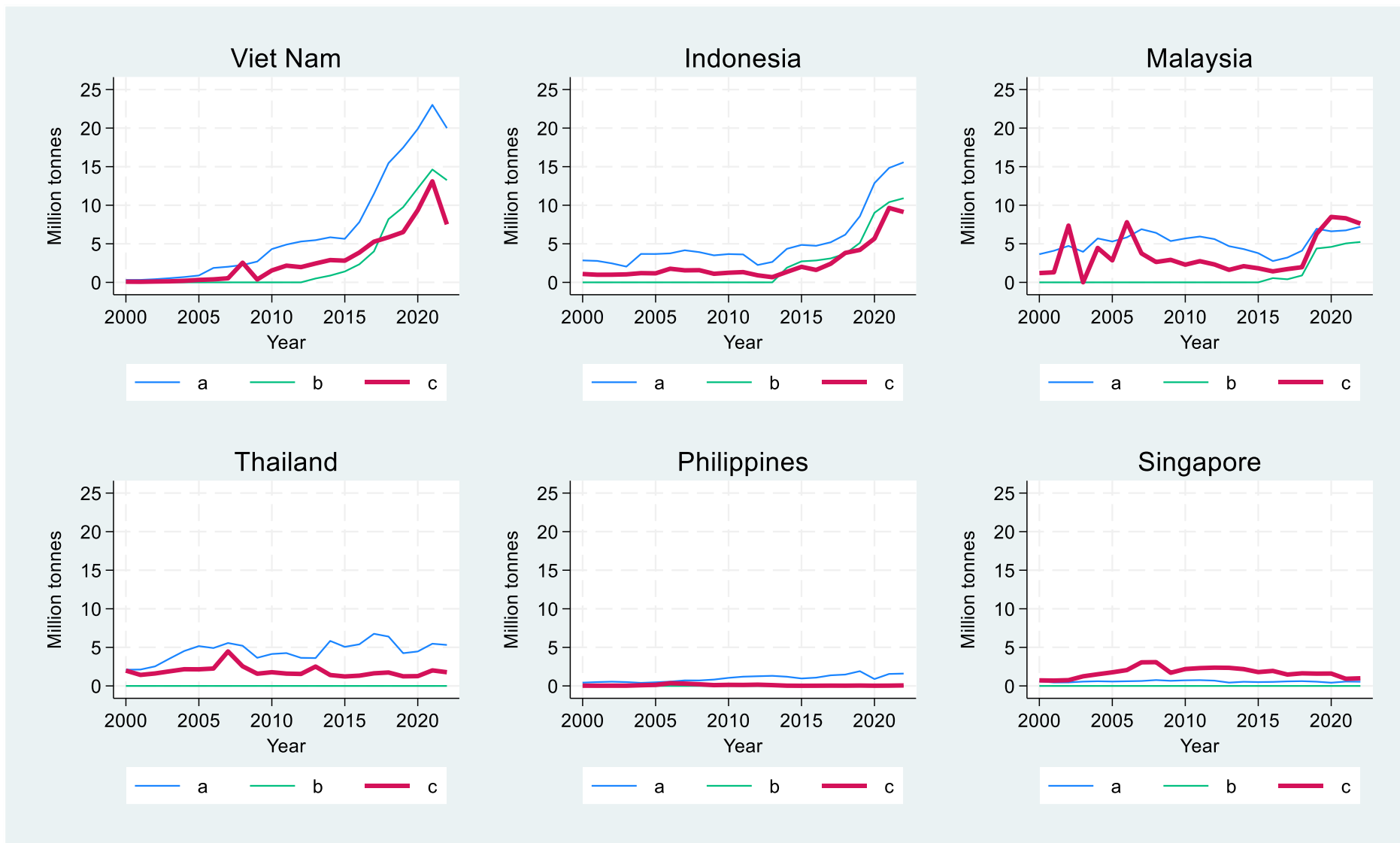


Research Question



- How has the installation of integrated steel mills in ASEAN countries affected their steel trade?

Steel exports have increased alongside the expansion of steel production



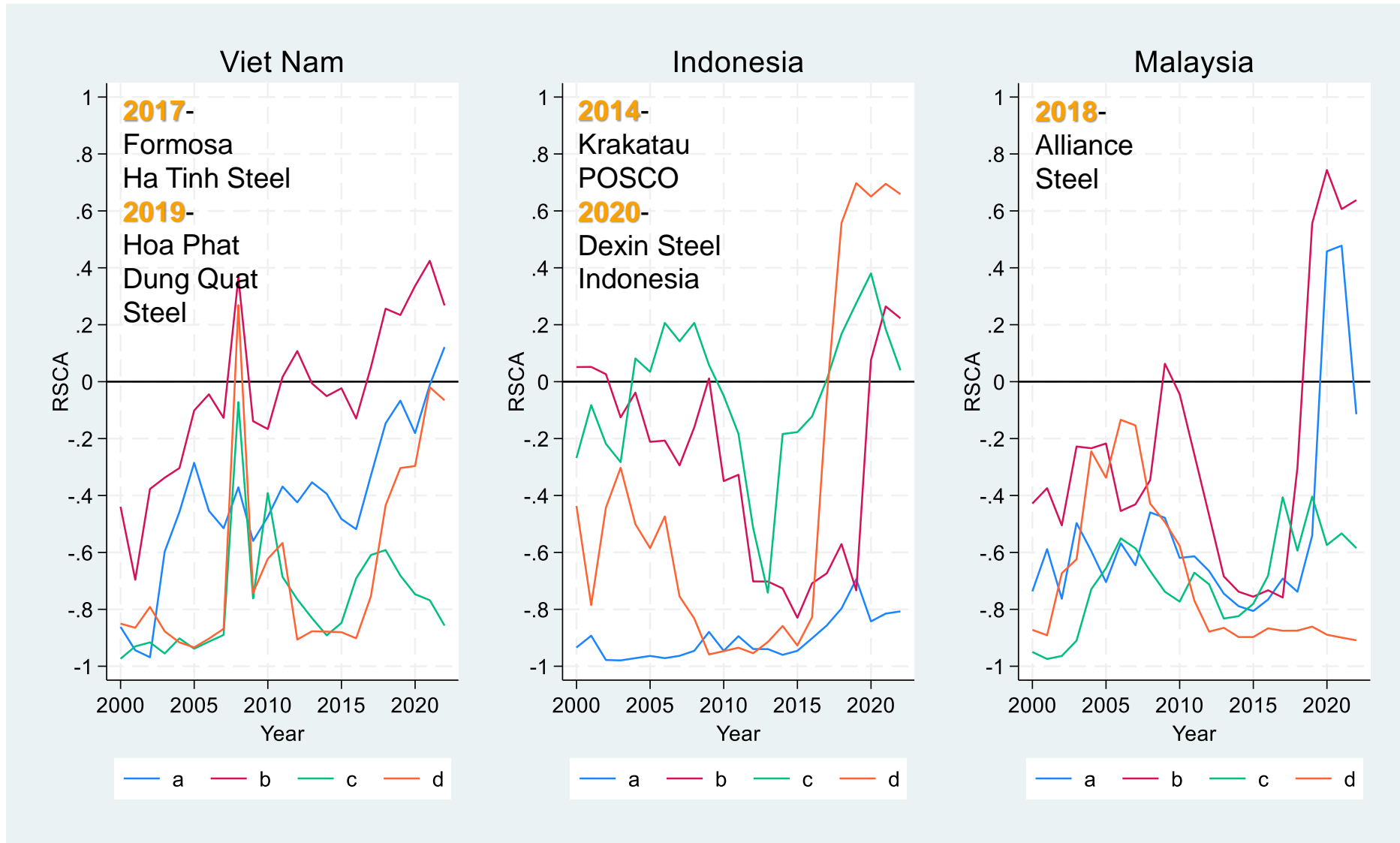
Dep. Variable: Steel exports	(1)	(2)	(3)	(4)	(5)
In distance	-1.363*** (0.208)	-1.351*** (0.206)	-1.337*** (0.208)	-1.325*** (0.212)	-1.335*** (0.212)
contiguity	-0.106 (0.257)	-0.250 (0.257)	-0.127 (0.264)	-0.137 (0.269)	-0.140 (0.269)
common language	0.0673 (0.348)	0.102 (0.343)	0.0722 (0.350)	0.0912 (0.366)	0.0740 (0.359)
colonial ties	0.614 (0.378)	0.642* (0.379)	0.612 (0.406)	0.573 (0.419)	0.572 (0.418)
trade agreements	0.778*** (0.234)	0.473** (0.204)	0.350 (0.248)	0.341 (0.246)	0.333 (0.269)
In GDP expoter		5.380*** (0.619)	5.297*** (0.693)	1.716** (0.823)	0.760 (1.022)
In GDP importer			1.020*** (0.368)	0.977** (0.382)	0.995*** (0.358)
In crude steel production				0.801*** (0.132)	0.763*** (0.133)
In crude steel production * bof dummy					0.0409** (0.017)
Number of observations	2477911	2477911	2394277	2394277	2394277
Pseudo R-squared	0.6094	0.6184	0.5723	0.5777	0.5792
Importer*year FE	Yes	Yes	No	No	No
Product*year FE	Yes	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes	Yes
Importer FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

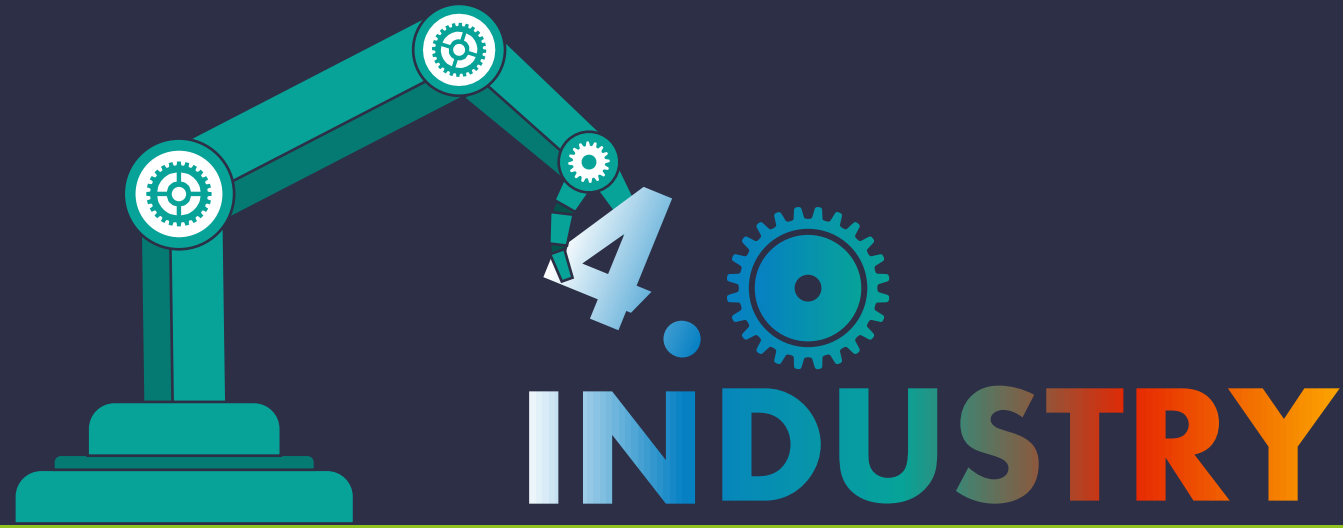
Note: Estimates are obtained using data from six ASEAN countries (Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam) on bilateral trade covering all years from 2000 to 2022. All regressions use the Poisson pseudo-maximum likelihood (PPML) method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors are clustered at the exporter-importer pair level.

Source: Author

The establishment of integrated steel mills appears to have altered trade specialisation patterns

a: Bars
b: Wire rods
c: Plates
d: HRCs





03 Implications

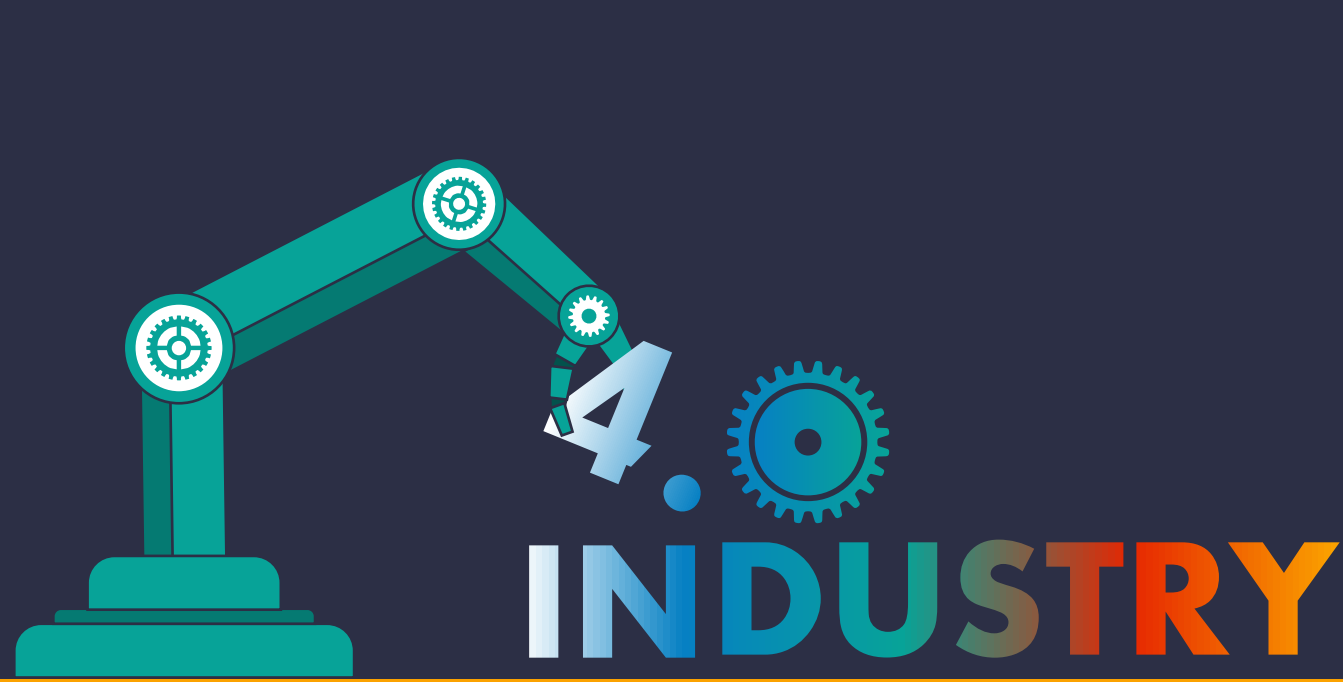


Implications

1. Capacity additions in **OECD** economies have slowed down during the early 21st century.
2. Investments in BOFs have primarily occurred in **non-OECD** economies during the early 21st century.
3. Demand for scrap has increased due to investments in EAFs by both **OECD** and **non-OECD** economies.
4. The nature of excess capacity may be changing.



Thank You



04 Appendix

Data Sources

Type of data	Data source	Aggregation	Time span
Steel exports	UN Comtrade	Product (up to 6 digit)/Economy/Year	2000-2022
Crude steel production	World Steel Association	Economy/Year	2000-2022
Production of crude steel in basic oxygen furnaces	World Steel Association	Economy/Year	2000-2022
GDP (constant 2015 US\$)	World Bank	Economy/Year	2000-2022
Gravity variables	CEPII	Exporter/Importer	invariant
Regional trade agreements	Mario Larch's Regional Trade Agreements Database	Exporter/Importer	2000-2022

Empirical Framework (Gravity Model)

$$\begin{aligned} & Export_{ikpt} \\ & = \exp\{\alpha_1 \cdot \ln Crudepro_{it} + \alpha_2 \cdot \ln Crudepro_{it} \times BOF_{it} + \alpha_3 \cdot \ln GDP_{it} + \alpha_4 \cdot \ln GDP_{kt} + \alpha_5 \cdot \ln DIST_{ik} \\ & + \alpha_6 \cdot CONT_{ik} + \alpha_7 \cdot LANG_{ik} + \alpha_8 \cdot CLNY_{ik} + \alpha_9 \cdot RTA_{ikt} + \delta\} \cdot \varepsilon_{ikpt} \end{aligned}$$

where $Export_{ikpt}$ represents the exports in ASEAN-6 countries (Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Viet Nam) of product p from exporter i to importer k at time t .

$\ln Crudepro_{it}$ is the log of crude steel production for exporter i in year t . BOF_{it} is a dummy variable that takes a value of one if exporter i produces crude steel via the BF-BOF route at time t and zero otherwise. $\ln GDP_{it}$ is the log of GDP for exporter i in year t . $\ln GDP_{kt}$ is the log of GDP for importer k in year t . $\ln DIST_{ik}$ is the log of bilateral distance. $CONT_{ik}$ is a dummy variable that takes a value of one if exporter i and importer k are contiguous, and zero otherwise. $LANG_{ik}$ is a dummy variable that takes a value of one if exporter i and importer k share a common official or primary language, and zero otherwise. $CLNY_{ik}$ is a dummy variable that takes a value of one if exporter i and importer k were in a colonial relationship post-1945. RTA_{ikt} is a dummy variable that takes a value of one if exporter i and importer k engaged in a regional trade agreement at time t and zero otherwise. This model controls for various fixed effects, denoted by δ . ε_{ikpt} is the error term. This equation uses the Poisson pseudo-maximum likelihood (PPML) method.

Revealed Comparative Advantage

Balassa (1965)

- Revealed Comparative Advantage (RCA) index
- If x_{ki} represents exports of product i from country k , then the RCA is expressed as follows:

$$RCA_{ki} = \frac{x_{ki} / \sum_i x_{ki}}{x_{wi} / \sum_i x_{wi}}$$

where the subscript w refers to world exports

Dalum et al. (1998) and Laursen (2015)

- Revealed Symmetric Comparative Advantage (RSCA) index is expressed as follows:

$$RSCA_{ki} = \frac{RCA_{ki} - 1}{RCA_{ki} + 1}$$

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