

WHO REFINES AND WHY?

An econometric analysis

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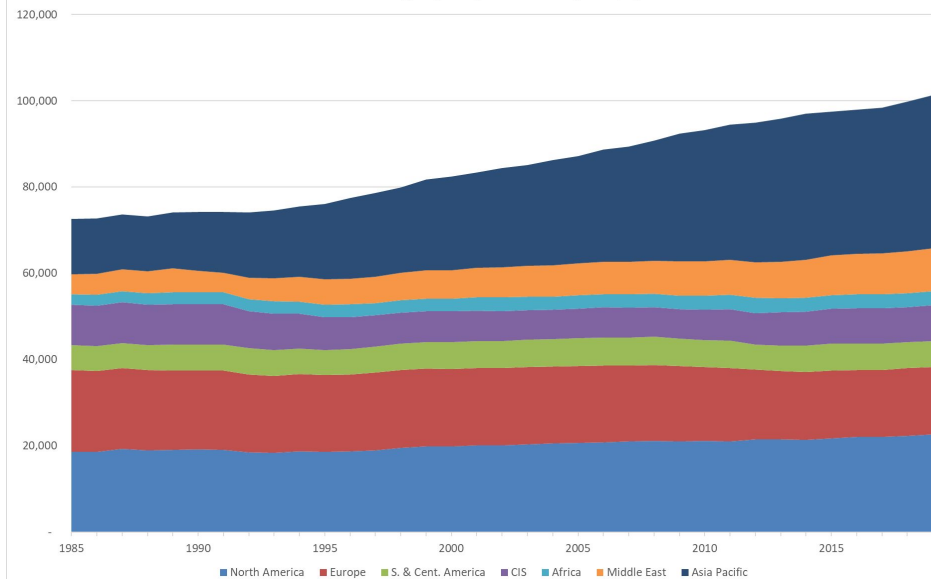
Very preliminary

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BACKGROUND: THE GLOBAL SCENE

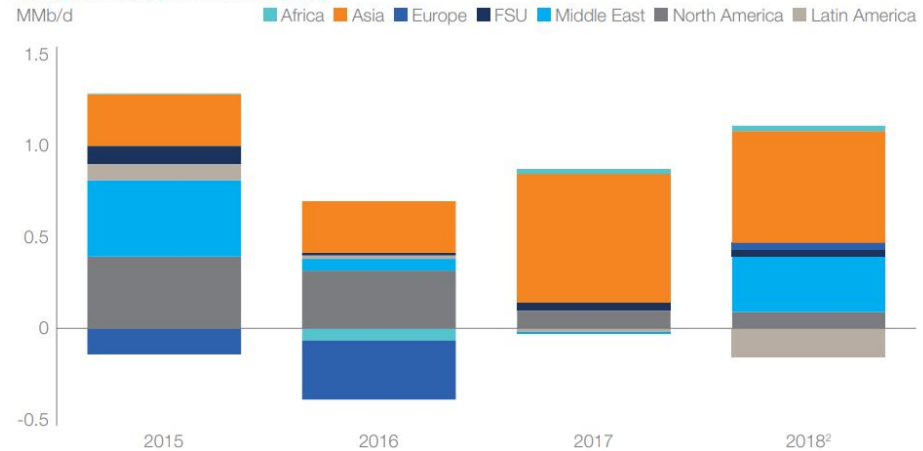
- The global refining industry
 - 2019 value added: about \$170 billion
 - A growing sector
 - With a changing spatial organization (see the fast-growing and declining regions below)
 - a competitive industry (> 620 plants)

Oil Refining Capacity 1985-2019 (kboe/d)



Change in refining distillation capacity¹

MMb/d



¹ Based on date of capacity start up ² Does not include partial capacity additions from Aliaga, Hengli, and RAPID assumed to come online partially in 2019, representing 325 Kb/d in Asia and 186 Kb/d in Europe
Source: McKinsey Refining Capacity Database

A large diversity of cases

- **Some resource-rich countries have large-scale**

export-oriented facilities

e.g. Saudi Arabia.

- **Others don't and seem to overlook downstream activities**

e.g. Norway.

- **Some oil-importing economies have a large refining industry**

e.g. Singapore, South Korea.

- **Others don't or only concentrate on import substitution strategies**

What are the determinants of these different patterns?

WHY DO COUNTRIES INVEST IN REFINING?

A REVIEW OF POSSIBLE MOTIVATIONS (1)

- For resource-rich countries

The ambition to export processed products instead of the raw material

=> To control a larger portion of the value chain,

Refinery as a type of Resource-Based Industrialization (see Gelb and Auty 1986)

=> RBI is expected to trigger knowledge spillovers

=> RBI is expected to provide export diversification

- But:

- Refineries are **capital-intensive** assets

- The sector requires **skilled labour**

- Refined products are the output of a **complex value chain**

- Managing that supply chain is reputed to be more complex than that of crude oil.

WHY DO COUNTRIES INVEST IN REFINING?

A REVIEW OF POSSIBLE MOTIVATIONS

- For resource-poor nations
 - Refineries are an **import-substitution** strategy (Herman, 1975)
 - Security of supply** motivations
- Crude and refined products are **internationally traded commodities**
 - What determines the specialization into raw materials vs refined products?
 - Possible determinants include:
 - Trade theoretic considerations
 - cf. factor endowment hypothesis: HOS workhorse model (Owens and Wood, 1997)
 - Industrial organization issues
 - economies of scale at the resource processing stage
 - vertical integration as a hedging strategy (Ghoddusi and Wirl, 2020)
 - Institutional factors (e.g., considerations related to ownership and resource nationalism)

RESEARCH QUESTIONS AND SUMMARY

- Research questions:
 - What are the determinants of refining for countries?
 - Which purpose serves refining?
 - What drives private/public investments in refining?
 - What is the specificity with oil producing countries?
- Methodology:
 - An empirical study based on a panel of countries
 - Based on data from Oil & Gas Journal, IEA, WB, complemented by expert views, from 1991 to 2018
- Key takeaways:
 - Refining happens in rich countries, or oil producing countries.
 - At the aggregate level, refining seems to serve export strategies without inducing import substitution
 - Private refining is more driven towards export than public
 - In oil producing countries:
 - Public refining only induce import substitution
 - Export increases are lowered
 - Evidence of a hedging strategy (to be confirmed in future works)

METHODS: DATA

- Oil & Gas Journal:
 - annual inventory of world refineries (from 1986 to 2018)
- IEA:
 - oil products exports, import, consumption (in volume);
 - crude oil export, imports and production (in volume).
- World Bank:
 - GDP per capita, country area,
- Information on ownership :
 - web searches for each company of the data set.
 - Type of companies : NOC, IOC (Europe,US, Russia), small companies, conglomerates, Joint Ventures (NOC/IOC, IOC/IOC, conglomerate/IOC...)

EMPIRICAL STRATEGY

1. What are the determinants of refining for countries
 - Panel logit regression on whether country i refines or not at t
 - Explanatory variables: geographic (size, landlocked), economic (gdp...)
2. Which purpose serves refining?
 - Two panel regressions
 - on the level of country i 's oil products exports
 - on the level of country i 's oil products imports
 - Explanatory: Refining capacity and oil products consumption
3. What drives private/public investments in refining?
 - Two panel regressions
 - on the level of country i 's oil products exports
 - on the level of country i 's oil products imports
 - Explanatory: Refining capacity from private and public companies and oil products consumption
4. What is the specificity with oil producing countries?
 - Two panel regressions
 - on the level of country i 's oil products exports
 - on the level of country i 's oil products imports
 - Explanatory: Oil products consumption and refining capacity from private and public companies with a distinction whether the country is producing or not (i.e., capacity * Dummy_oil_producing_country)

RESULT 1: DRIVERS OF REFINING

- Logit panel regression (fixed effect)

As expected, refining happens in rich countries, or oil producing countries.

Refining is stimulated by trade intensity

	<i>Dependent variable:</i>
	IS_refining
log(Surface area)	0.115*** (0.040)
Landlocked (<i>dummy</i>)	-1.271*** (0.125)
log(GDP/capita)	0.496*** (0.045)
Industry (%GDP)	0.012* (0.007)
Total Exports (%GDP)	0.019*** (0.005)
Total Imports (%GDP)	-0.044*** (0.005)
Oil Producer (<i>dummy</i>)	1.401*** (0.142)
Constant	-3.436*** (0.726)
Observations	3,299
Log Likelihood	-1,245.629
Akaike Inf. Crit.	2,507.258

Note: *p<0.1; **p<0.05; ***p<0.01

RESULT 2 : DOES REFINING INCREASE EXPORTS OR REDUCE IMPORTS?

- Panel regression (fixed effect)

Marginal increase of capacity induce:

- Increase of exports,
- No effect on imports

Interpretation: at the aggregate level, refining seems to serve export strategies

	<i>Dependent variable:</i>	
	Exports (1)	Imports (2)
Processing Capacity	0.021*** (0.001)	-0.0004 (0.0005)
Consumption	-0.185*** (0.012)	0.168*** (0.009)
Observations	3,043	3,043
R ²	0.368	0.183
Adjusted R ²	0.342	0.150
F Statistic (df = 2; 2922)	850.713***	327.374***
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01	

RESULT 3: DOES THIS EFFECT DEPEND ON THE OWNERSHIP STRUCTURE?

- Panel regression (fixed effect)

Marginal increase of **public** capacity induce:

- Increase of exports
- Decrease of imports

Marginal increase of **private** capacity induce:

- (higher) Increase of exports
- (Slight) increase of imports

Interpretation: public refining is less driven towards export (security of supply etc.). This may reflect differences in specializations of refining activities.

This point will have to be further investigated using data on the capacity of the complex conversion units (not only those of the distillation one)

	<i>Dependent variable:</i>	
	Exports (1)	Imports (2)
Processing Capacity (Public)	0.009*** (0.001)	-0.007*** (0.001)
Processing Capacity (Private)	0.021*** (0.001)	0.002*** (0.0004)
Consumption	-0.048*** (0.013)	0.237*** (0.011)
Observations	3,043	3,043
R ²	0.382	0.222
Adjusted R ²	0.357	0.190
F Statistic (df = 3; 2921)	602.387***	278.633***

Note:

*p<0.1; **p<0.05; ***p<0.01

RESULT 4: IS THERE A SPECIFICITY FOR OIL PRODUCERS?

- Panel regression (fixed effect)

Public refining only induce import substitution within oil producing countries

Export increases are lowered within oil producing countries

Evidence of hedging strategy from oil producers

	<i>Dependent variable:</i>	
	Exports (1)	Imports (2)
Oil Producer (<i>dummy</i>)	1.668* (0.869)	1.862*** (0.700)
Capacity (public)	0.016*** (0.003)	0.004 (0.002)
Capacity (private)	0.024*** (0.001)	0.004*** (0.001)
Consumption	-0.039*** (0.013)	0.247*** (0.011)
Capacity (public) x Oil Producer (<i>dummy</i>)	-0.008** (0.003)	-0.011*** (0.003)
Capacity (private) x Oil Producer (<i>dummy</i>)	-0.003*** (0.001)	-0.002*** (0.001)
Observations	3,043	3,043
R ²	0.386	0.230
Adjusted R ²	0.360	0.197
F Statistic (df = 6; 2918)	306.204***	145.048***

Note:

*p<0.1; **p<0.05; ***p<0.01

CONCLUSIONS

- Contributions:
 - We collect and provide data about information on ownership of refining plants
 - We provide an up to date analyse of the determinant of:
 - The country-based refining strategy
 - The impact of ownership structure on these strategies
- Key takeaways:
 - Refining happens in rich countries, or oil producing countries.
 - At the aggregate level, refining seems to serve export strategies without inducing import substitution
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 - Export increases are lowered
 - Evidence of a hedging strategy (to be confirmed in future works)
- Possible future extensions:
 - Examine the complexity of the **refining** equipment installed in the countries
 - Examine whether the sector's reconfiguration supports the possibility of carbon leakage



Thank you!

RESULTS 4 : DOES THIS EFFECT DEPENDS ON THE OIL PRODUCTION

- Panel regression (fixed effect)

	<i>Dependent variable:</i>	
	Exports (1)	Imports (2)
Crude	0.023*** (0.001)	0.001 (0.001)
Oil Producer (<i>dummy</i>)	1.440* (0.868)	1.545** (0.710)
Consumption	-0.184*** (0.012)	0.169*** (0.009)
Processing Capacity x Oil Producer (<i>dummy</i>)	-0.002*** (0.001)	-0.001** (0.001)
Observations	3,043	3,043
R ²	0.370	0.185
Adjusted R ²	0.343	0.151
F Statistic (df = 4; 2920)	428.068***	165.736***
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01	