

Industrial upgrading of APEC economies in the Global Value Chains with intensive use of natural resources

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Problem

- Global value chains are a new stage in the international division of labor, diversifying production processes with increased speed, scale and depth (Elms & Low, 2013). In some of these chains, finished products make an intensive use of exhaustible natural resources, in such a way that its growth produces two possible effects in supplier economies:
- It opens opportunities for upgrading to a higher link in the value chain
- It encourages extraction activities posing challenges to its sustainability

Problem

- Therefore, we consider it useful to identify:
- Which global value chains make intensive use of minerals?
- Which companies lead the most important links in the chain?
- Which APEC economies have been able to make the leap to more sophisticated links in these chains?

Data and methodology

- This paper analyzes the input-output (I-O) tables published by the OECD (2017) with information of 33 economic sectors for 63 countries, and data between 1995 and 2011.
- Evaluation is performed using input-output tools, supplemented with centrality indices based on the network theory (Borgatti & Everett, 2006).
- Estimations are made at two levels: on the one hand, trade of intermediate goods between sectors is analyzed; and, on the other hand, the value added contained in them.

Data and methodology: Input-output analysis tools

- Leontief coefficients. The sum of the resulting coefficients measures the theoretical backward linkage of sector j , assuming that trade offers infinite exchanges.

$$B_j = \sum_{i=1}^n [(I - A)^{-1}]_{i,j}$$

- We took Los et. al (2015) suggestion to obtain the value added generated in each industry-country pair.

$$g = \hat{v}(I - A)^{-1}Fe$$

Data and methodology: Centrality indices based on network theory

- Degree counts the number of direct links that has a node p_k with the remaining nodes p_i , in a network of size n . The sector with more direct links can transmit its growth to more sectors, which means significant and real backward linkages.

$$C_D(p_k) = \frac{\sum_{i=1}^n a(p_i, p_k)}{n - 1}$$

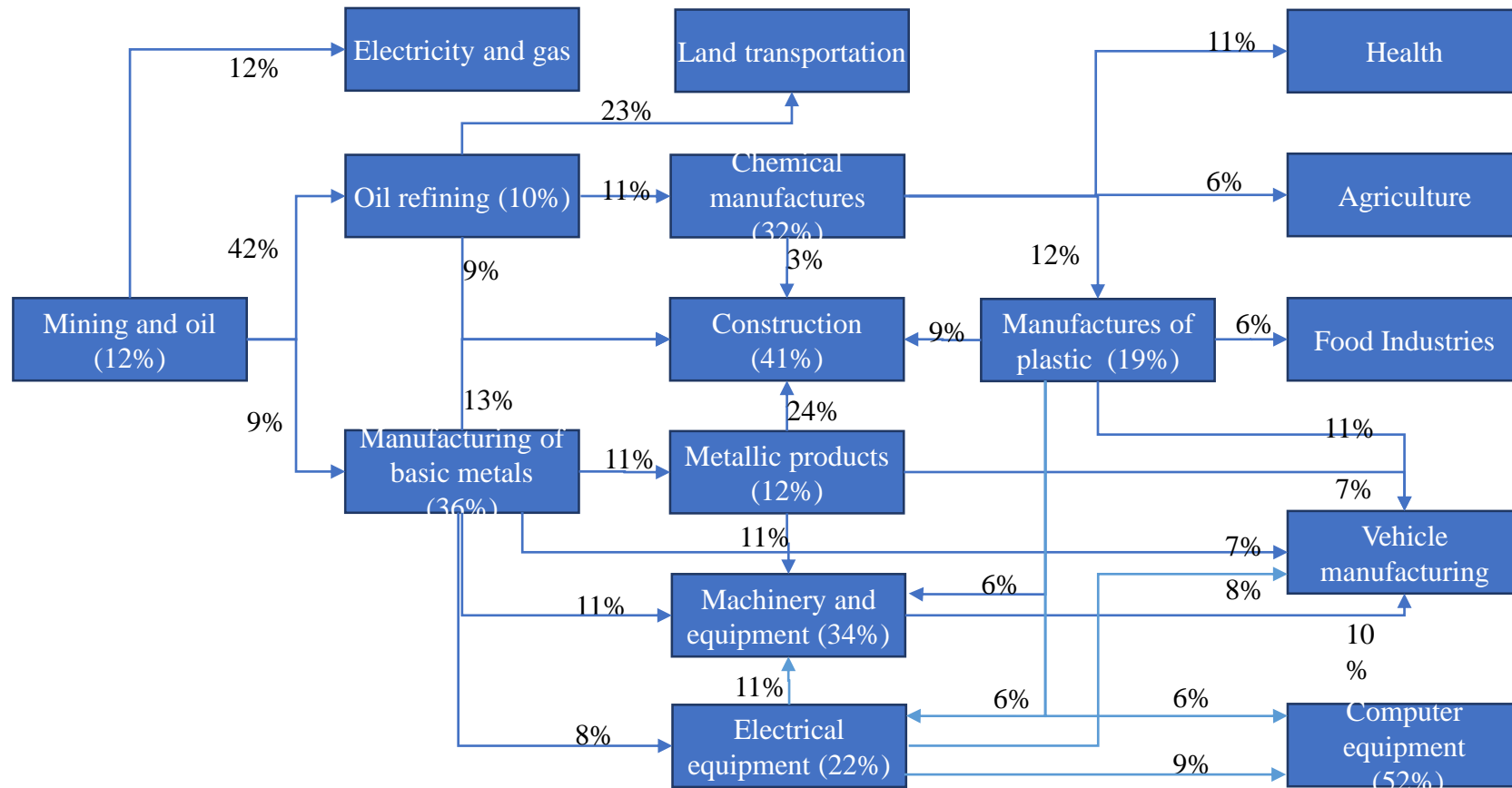
Data and methodology: Centrality indices based on network theory

- Closeness measures the number of jumps " d " required by a node p_k to reach all the nodes p_i of a network. The less a sector has to jump to reach the entire network, the faster it may spread its growth to the remaining sectors, expanding the scope its backward linkages.

$$C_C(p_k) = \left[\frac{\sum_{i=1}^n d(p_i, p_k)}{n-1} \right]^{-1} = \frac{n-1}{\sum_{i=1}^n d(p_i, p_k)}$$

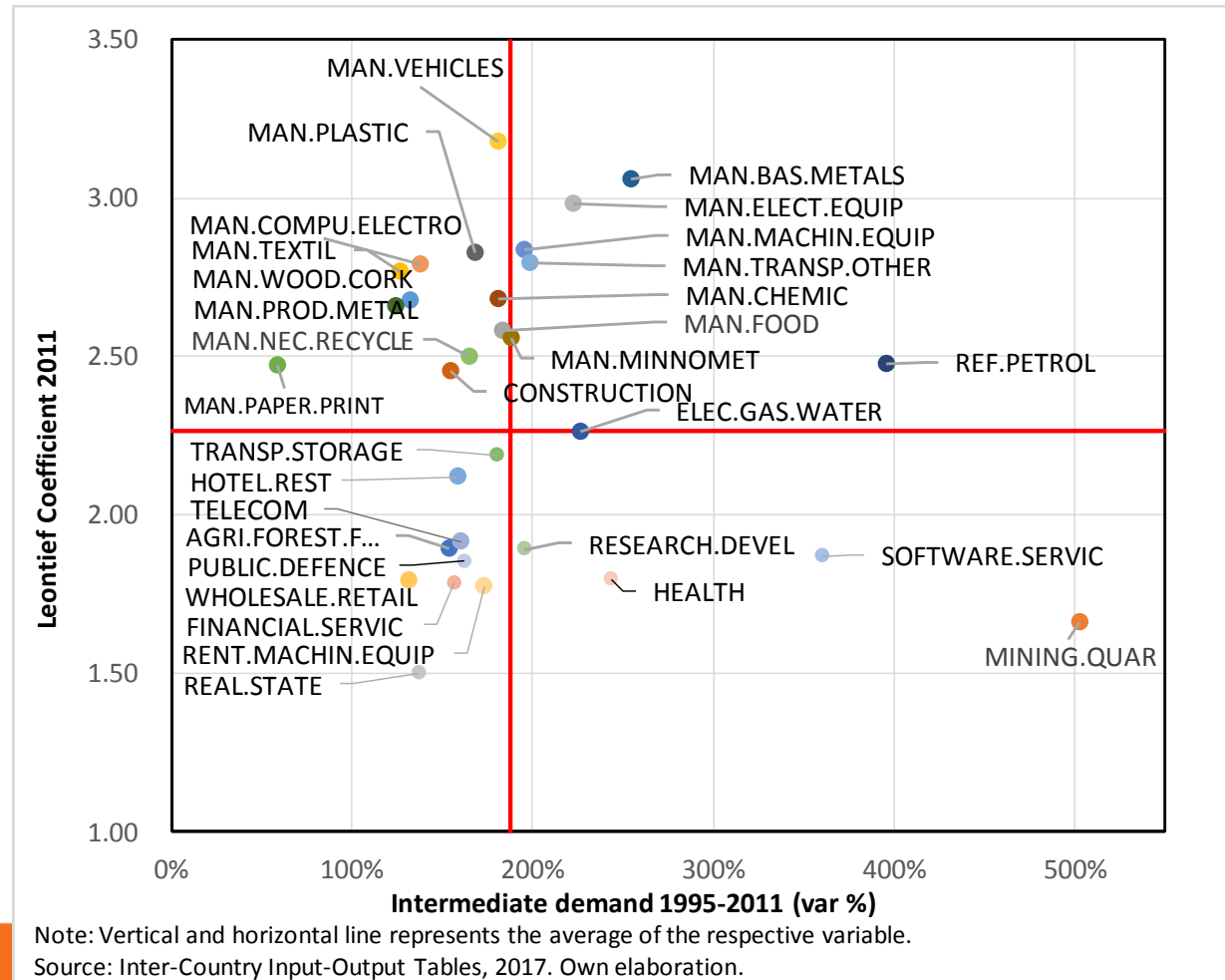
Results: Which sectors of the world economy make an intensive use of minerals?

Figure 1 Segments of international production with intensive use of minerals and oil, year 2011



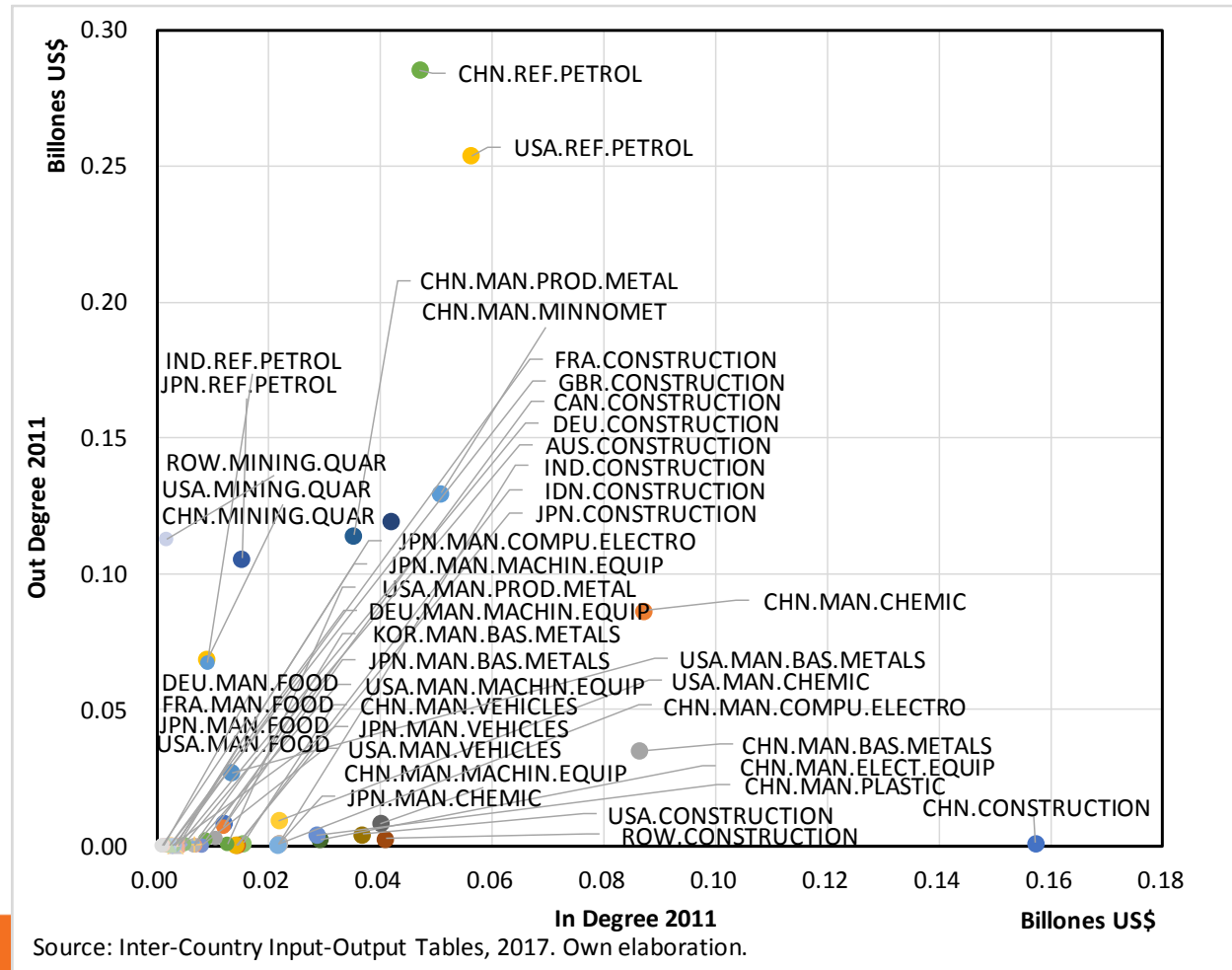
Results: Which sectors grew the most and had the most significant backward linkages to the rest of the world economy?

Figure 2 Intermediate demand 1995-2011 (var %) and Leontief coefficient per sectors 2011



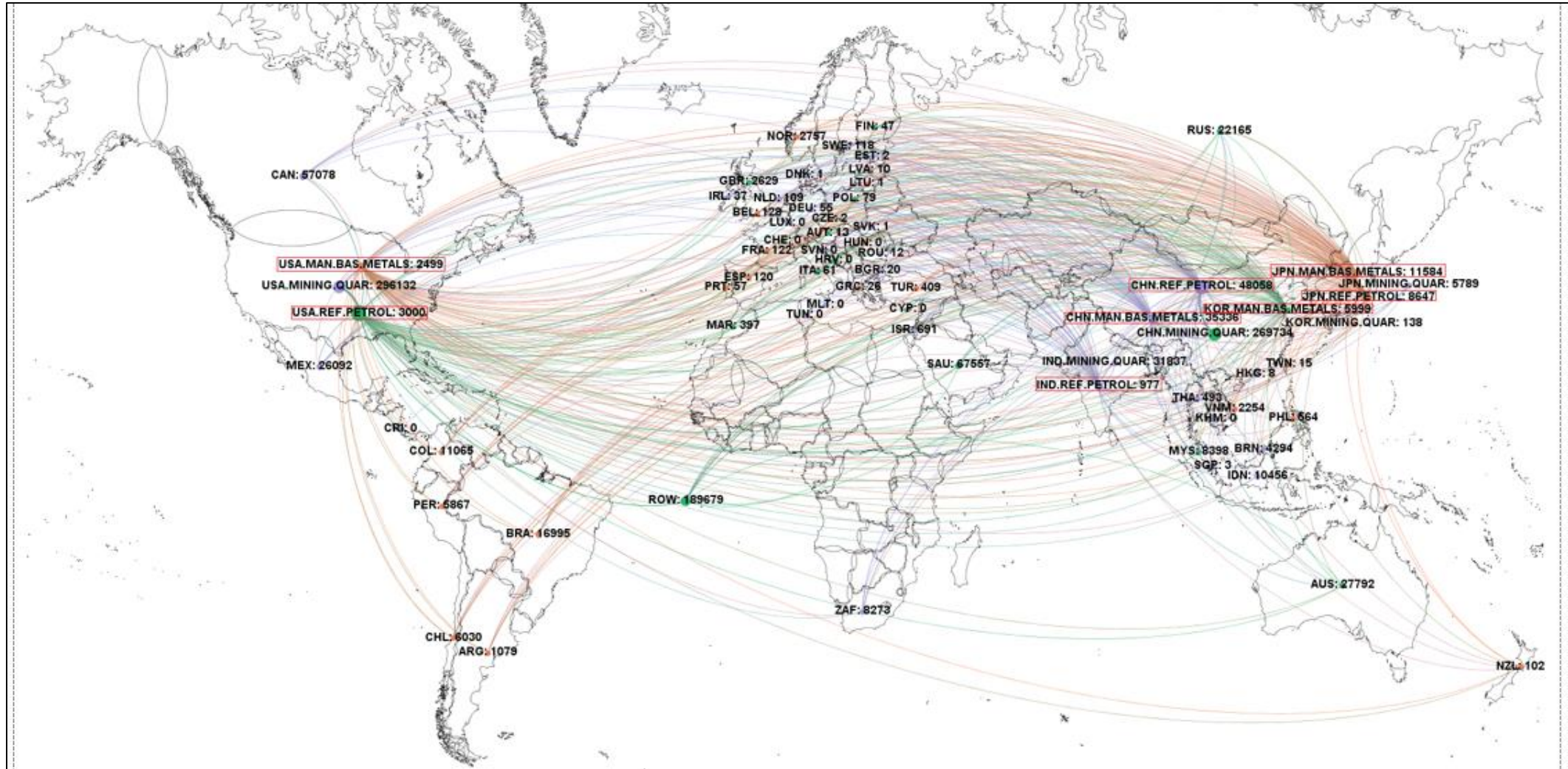
Results: Which country sectors are the largest consumers of minerals?

Figure 3 Input and output degree of sectors of high consumption of minerals, 2011



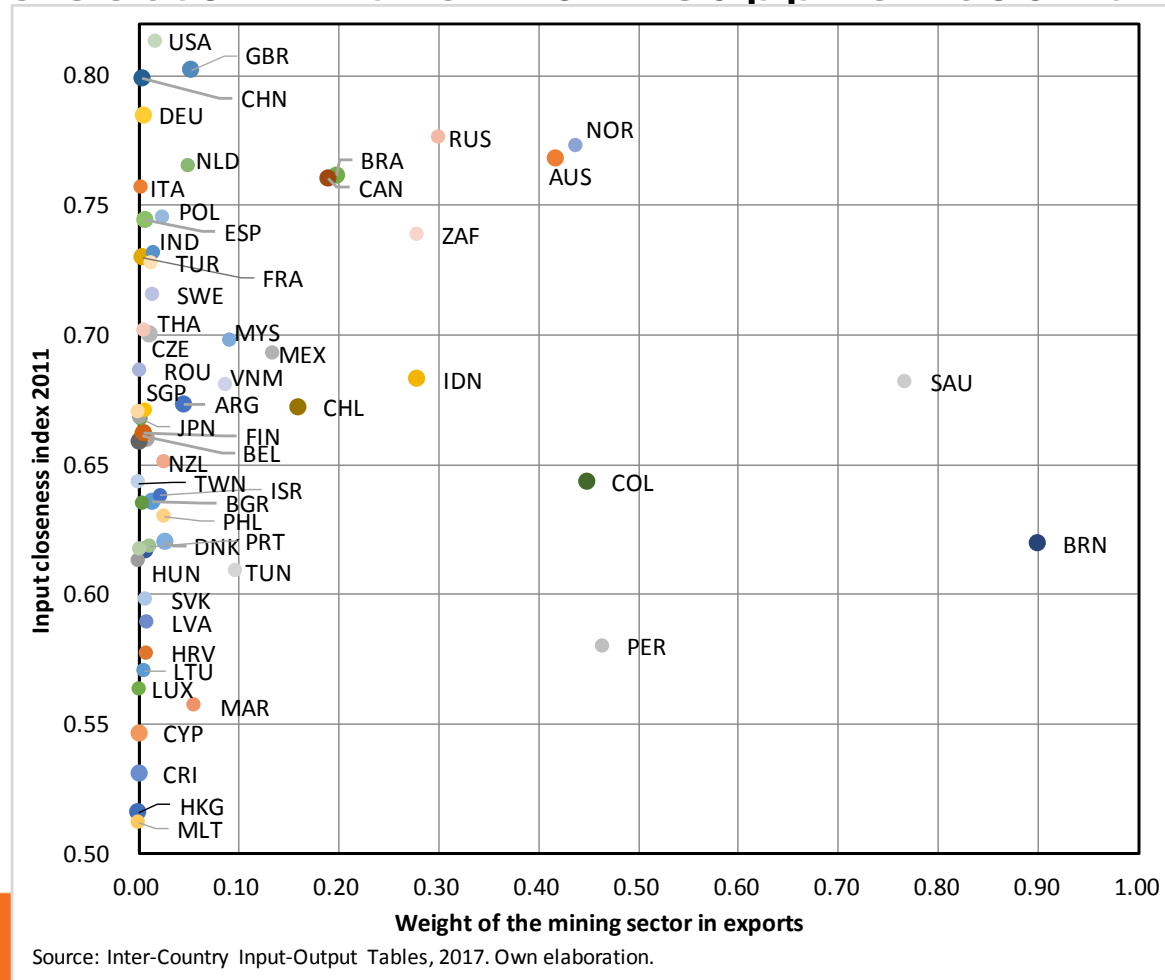
Results: Which economies were the major suppliers of minerals between 1995-2011?

Figure 4 Mineral Suppliers for refining oil and basic metal industries from China, USA, Japan, Korea and India, year 2011



Results: How strong is the backward linkage of the main mineral and oil supplier economies? and how much this sector weights on its own economy?

Figure 5 The weight of the mining sector exports and the Closeness Index of the same sector in the main supplier countries, year 2011



Results: Companies leading the most important links of the chains of mineral resources

- According to their origin, companies can be classified into two groups, companies of Anglo-Saxon and Asian origins.
- Mining companies of Anglo-Saxon origin do not become leaders of the value chains of final goods, but they are part of the production segments of value chains that end up in the construction, machinery & equipment, computer equipment and the automotive industries.
- As for companies of Asian origin, are more vertically integrated, forming production chains that range from extraction, refining and chemical industry, to construction, machinery and equipment manufacture, equipment for transportation, power generation and marketing; including side businesses such as engineering services and finance.

Results: APEC economies that have been able to make the leap towards a more sophisticated link in the mineral-intensive chains

Table 2 Value added and its growth in sectors linked to mining in supplier countries, 1995-2011

PAÍS	SECTOR	JPN		KOR		USA		CHN		IND	
		(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
BRN	MINING.QUAR	22.4%	2.7	5.1%	1.7	0.6%	2.9	4.5%	2.3	3.7%	3.1
	REF.PETROL	4.5%	-0.7	1.0%	-0.1	0.2%	0.0	1.7%	0.3	0.9%	1.1
	MAN.CHEMIC	2.2%	7.5	3.6%	5.1	1.9%	1.2	7.0%	2.0	0.8%	0.3
	MAN.BAS.METAL	2.1%	-0.8	1.7%	0.2	6.6%	2.6	3.3%	0.4	2.7%	0.8
	MAN.PROD.META	1.2%	-0.5	0.4%	0.1	0.6%	-0.1	1.5%	0.4	0.7%	0.6
CHL	MINING.QUAR	11.8%	2.6	2.4%	1.9	1.7%	1.0	12.3%	1.6	3.9%	2.3
	REF.PETROL	1.2%	1.1	0.4%	1.1	0.7%	0.9	2.5%	0.7	0.4%	1.1
	MAN.CHEMIC	0.8%	-0.1	0.4%	0.3	1.3%	0.1	1.5%	0.3	0.4%	0.4
	MAN.BAS.METAL	1.6%	1.2	2.9%	1.4	4.3%	1.7	15.1%	2.1	0.6%	0.4
	MAN.PROD.META	0.8%	0.3	0.3%	0.5	0.6%	0.3	1.7%	0.7	0.3%	0.6
IDN	MINING.QUAR	8.6%	0.8	3.5%	0.9	0.9%	1.1	7.7%	1.2	3.4%	1.3
	REF.PETROL	1.5%	0.7	0.5%	0.8	0.2%	0.3	0.9%	0.8	0.3%	0.5
	MAN.CHEMIC	0.8%	0.8	0.4%	0.8	0.6%	1.2	2.1%	1.0	0.6%	0.4
	MAN.BAS.METAL	11.8%	1.3	3.1%	1.5	2.2%	1.6	5.4%	1.4	2.1%	1.1
	MAN.PROD.META	0.4%	0.6	0.1%	0.8	0.2%	0.1	0.2%	0.5	0.4%	1.7
MEX	MINING.QUAR	0.4%	0.5	0.3%	2.0	13.8%	1.4	1.6%	2.4	0.8%	2.2
	REF.PETROL	0.1%	-0.1	0.1%	0.4	2.5%	0.7	0.2%	0.5	0.1%	0.6
	MAN.CHEMIC	0.2%	0.1	0.1%	0.4	3.4%	0.5	0.5%	0.5	0.2%	0.3
	MAN.BAS.METAL	0.8%	1.5	0.9%	1.2	15.8%	1.3	1.6%	0.8	0.7%	0.9
	MAN.PROD.META	0.2%	1.6	0.1%	1.1	10.9%	1.1	0.4%	1.0	0.1%	1.1
MYS	MINING.QUAR	13.4%	1.0	2.5%	0.9	0.7%	0.7	5.3%	0.9	2.9%	0.7
	REF.PETROL	2.3%	1.7	0.9%	1.2	0.5%	2.6	3.4%	1.6	0.8%	1.7
	MAN.CHEMIC	1.8%	0.9	0.9%	0.7	1.2%	0.8	5.1%	0.7	1.4%	0.8
	MAN.BAS.METAL	3.4%	0.7	2.8%	0.8	2.1%	0.7	12.0%	1.2	6.9%	0.7
	MAN.PROD.META	2.0%	2.1	0.7%	1.8	1.3%	1.3	3.1%	1.4	1.5%	1.9
PER	MINING.QUAR	4.9%	1.1	2.7%	1.4	3.9%	0.6	12.3%	1.2	1.0%	1.4
	REF.PETROL	0.9%	2.5	0.3%	1.6	3.1%	1.3	1.4%	1.5	0.2%	1.3
	MAN.CHEMIC	0.3%	0.9	0.1%	1.1	0.5%	0.8	0.8%	0.8	0.1%	0.8
	MAN.BAS.METAL	1.1%	0.1	0.5%	0.2	11.6%	1.0	5.2%	0.4	2.6%	0.8
	MAN.PROD.META	0.1%	0.3	0.1%	0.2	0.3%	0.4	0.2%	0.4	0.0%	0.6

Conclusions

- The growth of world production in automobile manufacturing and construction, has mobilized intermediary industries, specifically from China, Korea, USA, India and Japan, to absorb the mineral resources of the world.
- Evident upgrading cases occur in chemical industry of Brunei, Indonesia basic metals manufacturing and Malaysia oil refining and manufacturing of metal products. In Mexico, the US demand allowed a larger growth in the production of basic metals and its linked sector of metallic products. In Chile and Peru, upgrading is not shown so convincingly.
- The cases of industrial upgrading in which the transnational companies evaluated participate, correspond to forward movements along the value chains and not to backward movements. This should be considered for designing industrial policies.

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