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The fragility of the copper demand for the Chilean economy

Is the increasing demand of China and India of Peruvian copper a threat for Chile?

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1 INTRODUCTION

As one of the world leading copper producers, Chile`s economy is strongly focused on copper: 14 % of its GDP is based on the mining sector, 30 % of the country's total investments (including FDI) and around 45% of Chilean exports originate from copper. Hence, the dependency of Chile on this metal is high. The fact that governmental spending is directly linked to the projected copper price from the copper reference price committee emphasizes the importance of the price for Chile`s economic development. For this purpose the ministry of finance convenes ten national copper experts to a panel and asks them for a copper price projection in constant prices for the next decade. By taking the average of the given projections corrected by the highest and lowest projection, the committee obtains the projected copper price. Due to the current international trade conflicts in between China and the USA the copper demand slowed down especially because China is one of the world`s biggest copper importers. In the two years before the trade conflicts began, an optimistic mood in the world copper market prevailed as worldwide demand and prices rose constantly. In a mid-term perspective, copper demand can be expected to remain at a high and stable level since climate change with its growing environmental demands nourishes copper demand through an increasing market for electromobility and renewable energy. In comparison to combustion engines or conventional energy, these new technologies require a far higher amount of copper (Uken (2011), Warren Centre (2016)). For Chile, these tendencies are promising. But China has started to enlarge its copper purchase from Peru (Fajardo (2017), Ortiz (2017)). The imported Peruvian copper misses the purity of the Chilean one but Chinas refinery capacities gives the country the possibility to import the cheaper one and refine it by themselves (Campodónico (2016), El Comercio (2017)). The reflexion of the present scenario analysis is based on the question if Chile`s northern neighbour could become a serious competitor. To answer this question, Chilean exports are reduced and the macroeconomic effects for Chile are analysed. For this projection the forecasting and simulation model COFORCE is applied.

2 COFORCE – THE CHILEAN FORECASTING MODEL

In train of the research project "Development of sustainable strategies in the Chilean mining sector through a regionalized national model" the national forecasting and simulation model COFORCE (copper forecasting Chile) was developed from scratch. The project is funded by the BMBF [1] and supports the cooperation and exchange of knowledge between a Chilean team of the University Adolfo Ibañez in Viña del Mar and the Institute of Economic Structures Research - GWS - in Osnabrück, Germany. In the

[1] German Federal Ministry of Education and Research

first phase of the project the national model was built. Subsequently the model was regionalized to be able to analyse regional disparities.

2.1 DATA

To guarantee the quality of the data used, only official data sources, in particular national accounts and input-output tables are used in COFORCE. They are delivered in particular by the National Statistical Institute (INE) and the Chilean Central Bank. The input-output-data and the national accounts are available for 73 industries and products. Employment data is available for 32 industries. The historic database contains data for the period from 1996 until 2013. The projection thus starts in the year 2014 and goes until 2035.

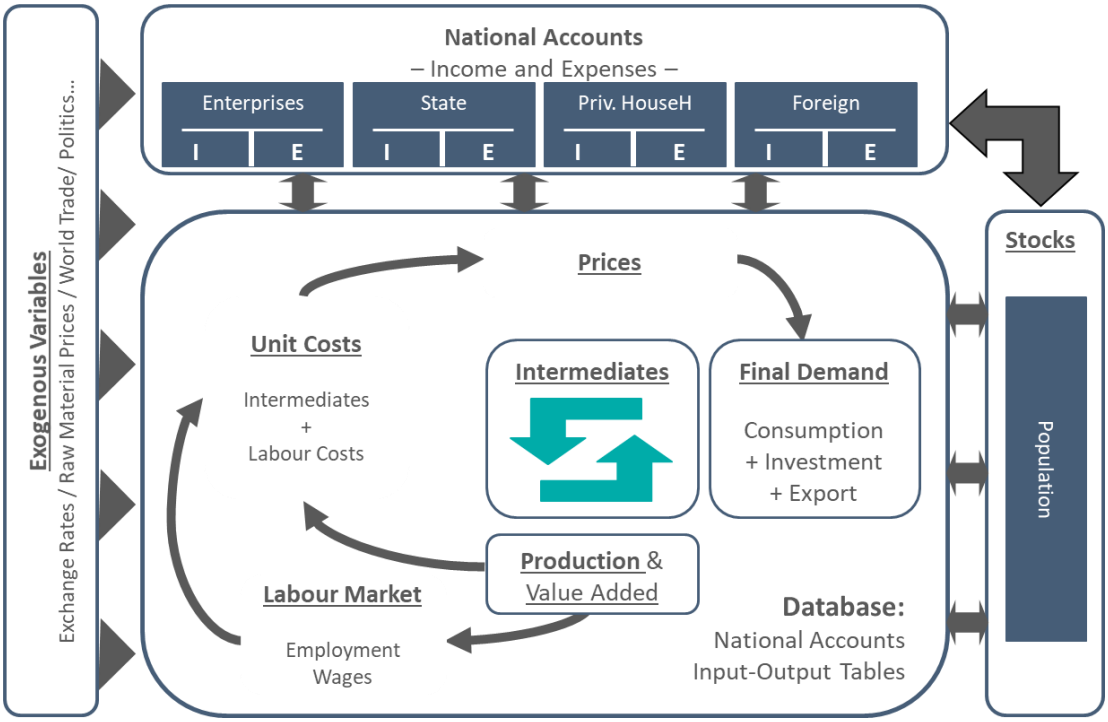
Detailed trade data in COFORCE derives from the global trade model TINFORGE, which uses bilateral trade data from the STAN databank of the OECD. The specifications for export demand take into account not just the economic power of Chile's trading partners and their proportion of trade, but also distinguish between tradable goods categories. The model incorporates data for a total of 154 countries and the rest of world and 33 goods categories. This detailed treatment of Chilean export demand enables in-depth analysis of the Chilean economy and especially the copper mining industry against the backdrop of globalisation.

Next to the world trade data, the exchange rate and raw material prices are integrated as exogenous variables in COFORCE. So is the stock-data for population. These variables also date from national and international official sites as the Central Bank in Chile or the IMF.

2.2 MODEL CHARACTERISTICS

COFORCE is based on the modelling philosophy of the INFORUM group and is characterized as a macro-econometric input-output-model, where all parameters besides the exogenous variables and the stock-data are estimated. The model equations are solved iteratively over time and no equilibrium condition has to be met. That means for instance, that the labour market does not necessarily balance in the long run. It is distinguished by its empirical specification and is constructed around the interrelationships between individual industrial sectors.

Figure 1: Scheme of the model COFORCE



In Figure 1 the general operation of COFORCE is illustrated in the central block, showing the input-output relations of intermediate demand, final demand components and primary inputs. By using the Leontief multiplier production is defined in COFORCE. Labour market data relates to wages and employment and is part of the core of the model, from which unit costs and prices derive. National account data and stock data such as population are linked to the input-output world as well as some exogenous variables such as central bank interest rates, raw material prices, world trade and the exchange rate. These exogenous variables are given by either third party information or by setting own assumptions. The data in this inner block is estimated using least square method. The last given historical year is 2013. A detailed description of the methodology can be found in Mönnig, Bieritz (2019).

The main features of the model are bottom-up modelling on a 73 industry level. Input-output tables are consistently linked with national accounts. Inter-industry relations as well as income generation, distribution and use are explicitly captured. Further characteristics are bounded rationality of economic actors, imperfect markets as well as price rigidities. Demand and supply are both treated equally. The projection horizon of the model is the year 2035.

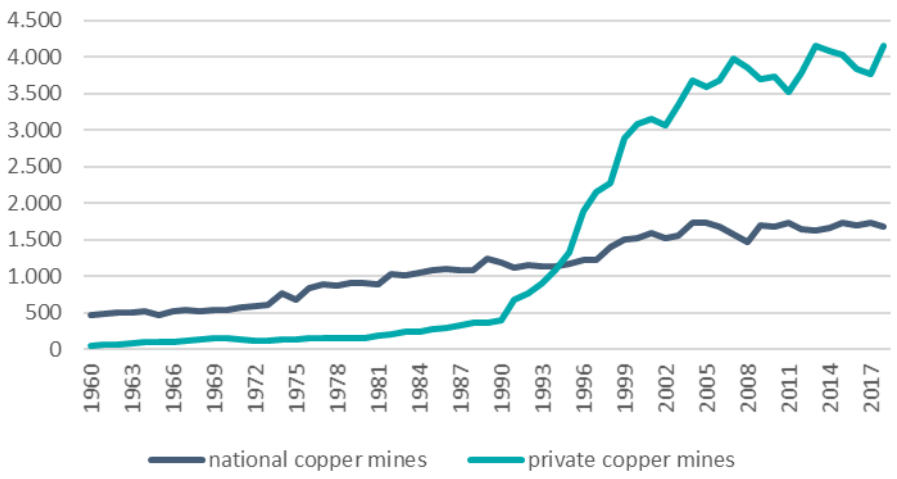
3 THE CHILEAN COPPER MARKET

Investment in copper

The production of the copper industry is characterized by a dynamic development. Its

development is strongly linked to investment conditions. In the years 1960 to 1980 conditions for private investment were limited and therefore the production stemmed mainly from state-owned companies. From 1990 on, investment conditions were liberalized in Chile with the effect that production rose dynamically through private activity (see Figure 2) (Rodríguez Cabello et. al. (2015)). Whilst private companies produced only a tenth of the national companies' amount at the beginning of the 60s, from 1995 onwards private companies' production surpassed and in 2018, it was 250% higher than the national one.

Figure 2: Copper production of private and state-owned companies in Chile 1960–2018 (in tons)



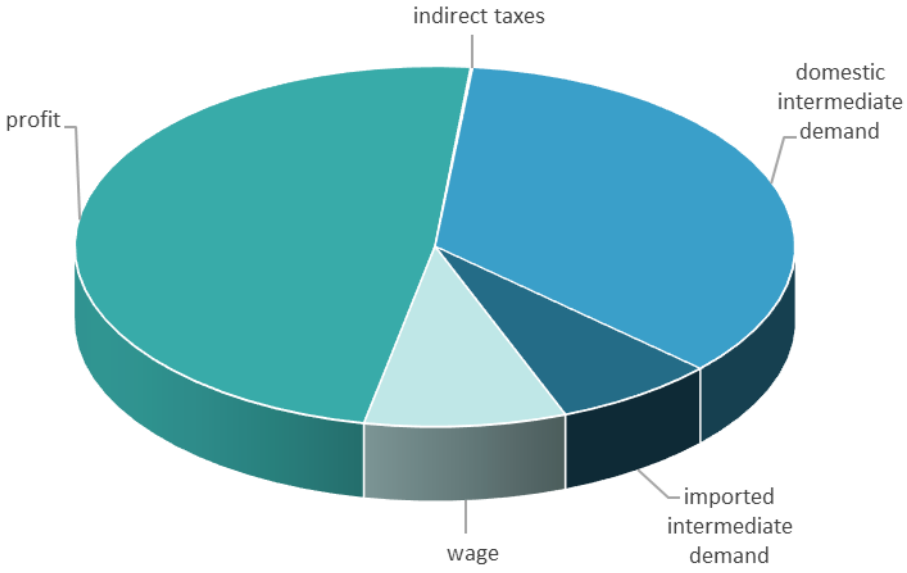
Source: Cochilco (2020)

Whereas the production in tons in Figure 2 fell through the global financial crash in 2008/ 2009 by 4.1%, the production in current prices declined only by 2.4%. After the crisis copper production swung with the world copper price and returned to its former growth path.

Production components

The remarkable increase of private investment in copper mining in Chile can be deduced to the high possibility to gain profits. Recently the share of profit moves to over 48% and is therefore outstanding. Intermediate demand has a share of 42% of production, whereas the domestic one is predominant over the imported one (see Figure 3). In the projection, the share of the domestic intermediate demand decreases constantly down to 35% of production while the imported intermediate demand keeps constant at 7%. With a quota of 65%, intermediate demand for copper products originates from the copper industry itself, followed by the basic industries of non-ferrous metals (10.5%), commerce, construction and business services (around 2.5% each) in the ranking of important purchasers of copper products.

Figure 3: Production of the copper industry (2013)



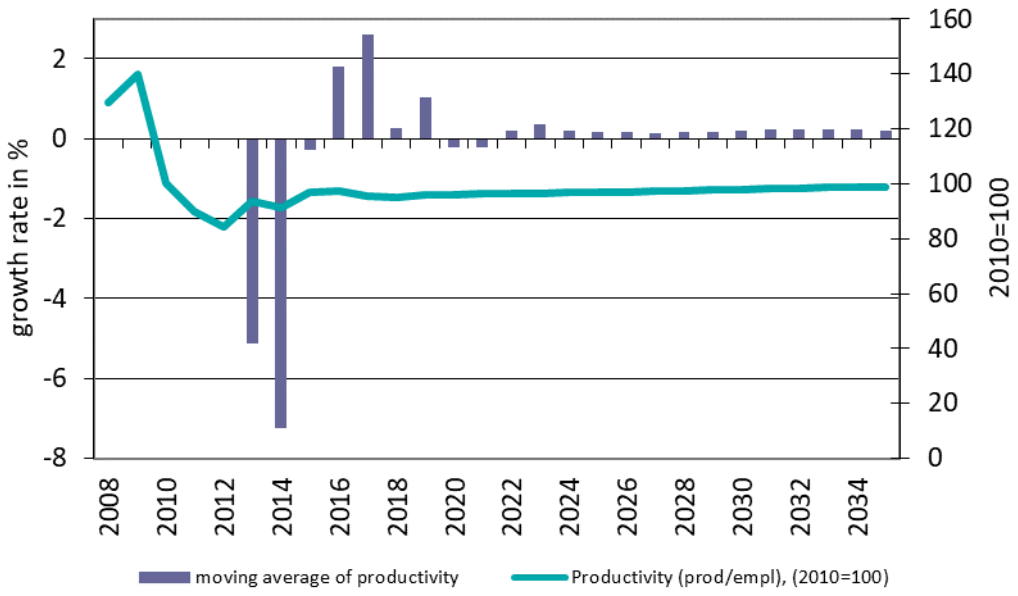
Source: COFORCE, own calculation

Next to the high share of profits on value added, wages take a share of nearly 16% of value added of the copper production. They are paid to over 220.000 employees in the copper and mining extraction sector.

Productivity

For the mining industry, the variation of the quality of ore is playing an important role in productivity. Recent analyses show that productivity declines constantly as the extraction requires more energy, longer transport routes and a longer process to obtain the metal (Ulloa et. al. (2017)). In COFORCE productivity is measured as the result of production in constant prices per employment. Since 2010 the development of both variables show a similar progression because the dynamics in employment are higher but productivity growth is negative. In the forecast, employment grows more slowly than in production in constant prices. In consequence, the ongoing productivity of the copper industry will rise at a very modest level (see blue bars in Figure 4).

Figure 4: Productivity of the copper industry (2008–2035)

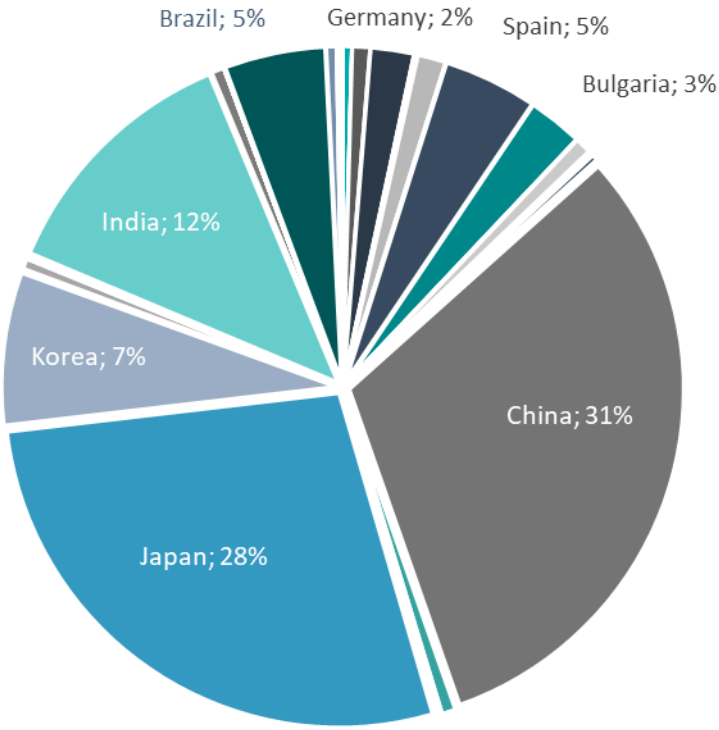


Source: COFORCE, own calculation

World Copper Demand

The world copper market plays a decisive role in the Chilean production as 45% of total Chilean exports are copper. Only 2% of the final demand of copper correspond to the domestic demand at purchaser prices. The other 98% are exports. The main Chilean trading partners for copper are China, Japan, India and Korea (see Figure 5). Together, the demand of these four Asian countries amounts to nearly 80% of Chilean copper. Especially China is a very important import nation with a share of more than 30% of Chile's copper exports, followed by Japan with a share of over 27%. Nearly one eight of Chilean copper is exported to India and 7.3% go to Korea. But the importance of India as a copper consumer is growing constantly as India's population and economy is growing notably and even stronger than China`s one.

Figure 5: Chilean trading partners for copper exports (2015)



Source: COFORCE, own calculation

4 SCENARIO – A DEMAND SHIFT TOWARDS PERU

The idea of a copper demand shift towards Peru is set up on the one hand with respect the fact that Peru`s copper mining activities are growing quickly and on the other hand due to the growing demand for copper in Asian countries through sustainable necessities set up by governmental aims. In the next chapter the Peruvian copper production and the expectation for the world's copper demand will be elaborated, followed by the scenario calculation and analysis.

4.1 A RISING COPPER DEMAND IN GROWING COUNTRIES – THE COPPER DEMAND IN CHINA AND INDIA

The development of industrialized countries has been strongly influenced by copper as it was needed for electricity, plumbing and communication. Even though new materials replaced partly the use of copper, its conducting characteristics and power storage capacities are still vital for the actual challenges of growing and densely urbanized cities. Mobility solutions with low exhaust emissions are getting essential in urban areas, where air pollution, climate concerns and congestions are achieving critical levels. Furthermore,

communication keeps crucial, especially with the requirements of the industry 4.0 and a higher demand of labour mobility. The latter increases the need for housing in cities where industry sectors are concentrated and technical appliances in private housing are improving in a cleaner power generation to achieve international decarbonization aims (Warren Centre (2016)).

A recent study from the Warren Centre of the University of Sydney (Australia) about the impact on copper demand in Asia by 2030 concludes that the growing sustainability awareness in Asian countries will favour copper intensity (Warren Centre (2016)). Based on the fast growing and ageing population in China and India combined with its highly centralized economic development, the copper demand from these countries will be outstanding. A main factor will be the electricity demand in Asia that is predicted to represent half of the world`s demand by 2030 – out of which China will consume two thirds.

For pollution reasons China is shifting away from fossil fuels to renewable energy production and India also pursues an ambitious renewable policy. In contrast to a fossil fuel power generation, the use of copper in renewables are four to twelve times higher (Warren Centre (2016), McHugh (2017), Spiegel Online (2014), Uken (2011)). The electrification of personal transport will also lead to a rise in copper demand because light vehicles that use electromobility instead of primary energy sources need 80 kg of copper instead of 25 kg (Toyama (2017), Warren Centre (2016), McHugh (2017)). Until 2030, the Warren Centre predicts 75 million electric and plug-in hybrid cars out of which 55% will circulate in China and nearly 20% in India. In total, more than 55 million of “clean” passenger vehicles are expected to be sold only in these two countries, which in turn has a very positive impact in copper demand. The expansion to efficient public transport systems like high speed or urban rails and electric buses will also lead to significant additional copper demand. The study by Warren Centre (2016) assumes a high implementation of these transport systems for China.

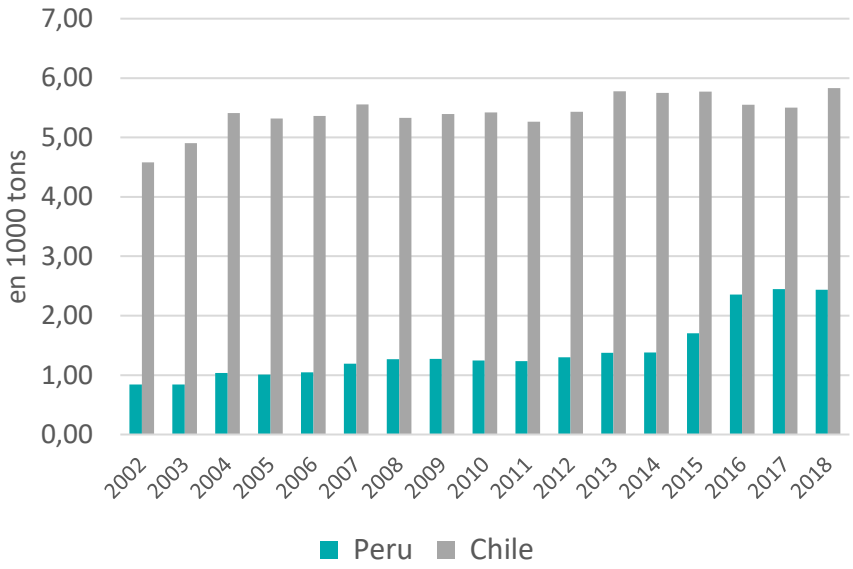
The building necessity in China and India is another decisive factor to increase copper demand. As a consequence of the population development in these countries, construction needs will rise. For the year 2024, the UN expects India`s population to surpass China`s one. Each of them will have around 1.44 billion people by then. Until 2030, the population in India is projected to surpass the level of 1.5 billion while China is expected to remain stable (United Nations (2017)). In consequence of a lower urbanisation in India, the additional copper demand will be equivalent to 55% of China’s demand with an urbanisation degree of 65%. Additional appliance-demand is forecasted at 790 kt in China and 430 kt in India until the year 2030 (Warren Centre (2016)).

4.2 PERU – A SERIOUS COMPETITOR?

Peru has the third biggest copper reserves in the world and accounts for the second biggest producer after Chile (ICSG (2017), Chong et. al. (2016), Marchesi et. al. 2013)). The copper mining industry has expanded its production from the year 2002 onwards and have intensified its activities especially from 2010 on. From 2002 until 2017, the Peruvian production doubled and achieved an amount of 2.5 million tons or the equivalent of one eighth of the world production (see Figure 6). This production-increase strengthened the dominant role of mining products for the Peruvian economy as

it has a share of over 60% of all Peruvian exports (Chong et. al. (2016)).

Figure 6: Copper production in Peru and Chile (2002–2018), in tons and growths rates



Source: USGS (2017), own calculation

The latest increase is the result of an intensification of production in the southern copper belt of Peru. Especially the exploration of Las Bambas, a mine owned by the Chinese company MMG Ltd. contributes to the strong increase in recent years. The mine`s output started with 300 thousand tons in 2016 and in its first complete year of activity (2017) the output was of more than 450 thousand tons. This is equivalent to 18% of the national production in that year (Las Bambas (2018 b), SEMANA económica (2017), Taj (2018), Trading Economics (2018). The Peruvian mining policy puts emphasis on promoting mining investments. Although investments declined from 2013 on, the recent rise of metal prices favors further activities (Chong et. al. (2016), La República (2017)).

The capacity of the Las Bambas mine is of over 50 million tons and therewith one of the world`s largest copper mines. Once in full production, Peru will rise to one of the main copper producers worldwide. In order to respond to the rising protests against the exploitation and its social and environmental consequences for the region, infrastructural projects like a railway of 600 km that stretches to the coast are being evaluated to lower the dust and noise of the trucks carrying the concentrates (Taj (2018)). Once this project will be realized an acceleration of production is possible.

Protests against a stronger exploitation actually became stronger and forced the management of Las Bambas to interrupt the production for more than 20 days in 2018. As a consequence, copper production in Peru fell by 0.3% (Energía y Negocios (2019), Gestión (2019), Las Bambas (2018a)). This development was not foreseen when the scenario was calculated, but it shows on the one hand the fragility of mining projects. On the other hand it underlines the thesis that Chile and Peru are serious competitors who profit from each other's weaknesses as Chile`s production grew in 2018, while the one of Peru declined (see Figure 6).

4.3 SCENARIO ASSUMPTIONS AND SETTING

4.3.1 IDEA OF THE SCENARIO

The aim of the described scenario is to quantify the impact of a demand shift on the Chilean economy, especially on Chilean GDP, the governmental income and on selected sectoral productivity. Therefore China's and India's demand for Chilean copper will be reduced from 2018 onwards for a period of five years. Assuming that Peru is continuing to develop its mining capacity and its infrastructure to transport copper concentrates to the coast, copper demand from Chile will diminish constantly in this scenario.

In sum, the volume of Chilean foreign copper demand will be reduced for a period of 5 years until 2022. It is assumed that by 2023 the decline in copper exports will come to an end and that exports will return to their former growth path. The scenario will be compared to the baseline scenario that represents the COFORCE model results without an intervention, i.e. without changing copper exports.

4.3.2 SCENARIO SETTING

The Chinese and Indian demand shift takes into account the production rise at the Las Bambas mine, which corresponds to an equivalent of 8.2% of Chilean production in the year 2017. The output of over 450 thousand tons in 2017 is absorbed by the Asian market. However, Chilean copper gets repressed because of lower production prices in Peru than in Chile and due to direct access to Peruvian copper on account of Chinese ownership.(Las Bambas (2018 b), SEMANA económica (2017), Taj (2018)). But because of the remarkable purity of the Chilean product, the output of the new Peruvian mine doesn`t completely replace copper demand from Chile. In the scenario we assume that China and India reduce their copper demand from Chile by 5% p. a. each for a period of five years (2018 – 2022). Further, it is taken into account that the international copper demand will continue to rise. This means that Chilean copper exports won`t fall by 5% p.a. directly, but the former growth path will be weakened (see Table 1).

Table 1 Scenario setting for the Chilean copper exports

	2017	2018	2019	2020	2021	2022	2035
	Development of Chilean copper exports to the world in baseline and in the scenario (2017 = 100)						
baseline	100,0	106,1	109,1	112,3	115,5	119,0	164,6
scenario	100,0	103,5	103,9	104,4	104,8	105,3	145,7

In the year before the intervention, Chinese shares are of 33.8% of Chilean copper exports and Indian shares amount to 12.9%. When reducing copper imports of China and India, China's share of Chilean copper exports still amount to 31.7% and India's share to 12.7% at the end of the scenario-period (see Table 2).

Table 2 Share of Chilean copper exports in % to

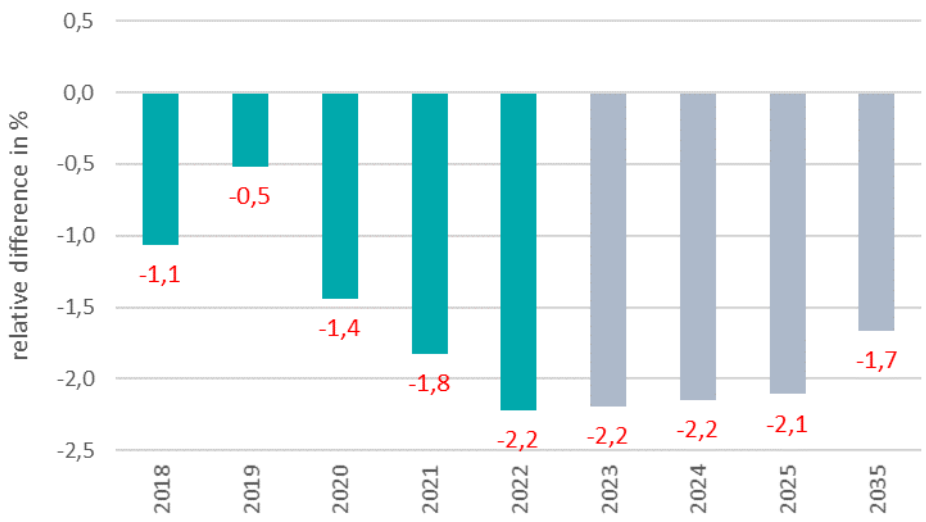
	2017	2018	2019	2020	2021	2022
China	33,8	33,7	33,0	32,7	32,3	31,7
India	12,9	12,9	13,1	12,9	12,8	12,7

4.4 EFFECTS OF THE EXPORT DEMAND SHIFT

4.4.1 EFFECT ON THE CHILEAN GDP

The export reduction to China and India directly lowers Chilean GDP. In the first year of the export shift, GDP falls by 1.1%. After a weak recovery of the GDP-effect in the second year of the scenario, GDP falls constantly with the reduced copper export and reaches its lowest level in 2022, when GDP is reduced by 2.2% (see relative difference Figure 7). In 2023, when copper import demand from China and India are assumed to get back to its former path, GDP reduction remains at -2.2% to the baseline and doesn`t recover completely from shift of demand until the end of the projected period in 2035.

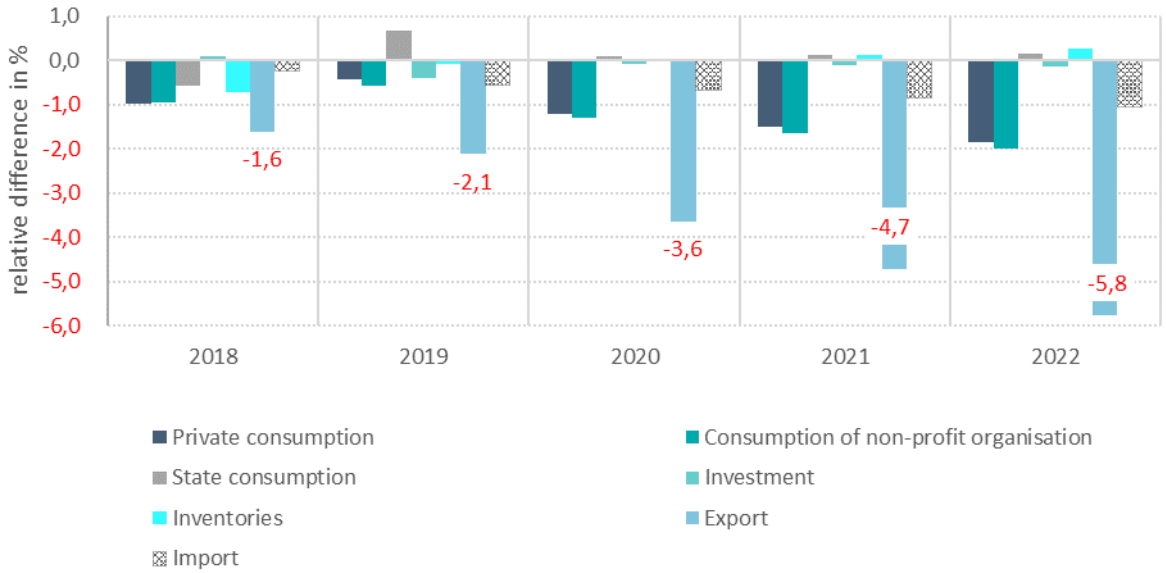
Figure 7: Gross Domestic Product in constant prices (relative difference to baseline)



Source: COFORCE, own calculation

Figure 8 shows the decomposition of relative differences to the baseline scenario of all GDP components for the impact years 2018 to 2022. The strongest negative impact can be observed by the real exports (pale blue bar in Figure 8) followed by consumption of NGOs and private households. Total exports in constant prices are reduced by 1.6% in the first year of the scenario and fall by 5.8% in comparison to the baseline in 2022, while consumption expenditures fall by around 1% (2018) and 2% (2022) (dark blue and dark green bar in Figure 8). The reduced export demand induces a shift in import demand (patterned bar) which is mainly induced by less imported intermediate goods, as the imported intermediates of copper have a share of 84% of total imports.

Figure 8: Gross Domestic Product-Components in constant prices (relative differences to baseline)



Source: COFORCE, own calculation

The less strong GDP decline in the second year of the scenario is a consequence of a decline of imports and a rise of governmental consumption expenditures (see grey bar in Figure 8). The latter are strongly concentrated on three sectors: public administration, public health and education and are predominantly independent from exogenous influences. The aggregate price index for government expenditures is explained by producer prices, which are reduced due to the shift in export demand.

4.4.2 EXPORT-EFFECTS ON THE CHILEAN PRODUCTION

The effect of demand shift on foreign trade as well as on consumption (see 4.4.1) implies a production decline in nearly all industries. Comparing the national production in the baseline scenario with the copper demand-shift-scenario a relative difference of -0.7% (2019) to -2.3% (2022) in constant prices can be observed.

Focusing on the single industries the strongest effect of a lower copper export manifests in the copper mining industry itself, where the relative difference to the baseline scenario rises up to nearly -15% at the end of the demand shift in 2022 (see Table 3). Hereafter, production decreases in industries linked to copper production like manufacturing of machinery (with and without electrical equipment) and of transportation equipment, iron mining, railway transport as well as the supply of electricity and gas.

We also achieve positive effects on production in constant prices by a shift in copper export demand. The wood production (including products of wood), construction and public administration sectors for example show a production increase because production prices fall comparatively weaker than production itself. As a result, production in constant prices rises.

Table 3 Top fifteen affected industries in production in 2022 by a copper export-demand shift (constant prices; relative difference in %)

	2018	2019	2020	2021	2022	2035
Iron Mining	-2,8	-0,6	-2,8	-3,7	-4,6	-4,2
Copper Mining	-3,9	-5,3	-9,1	-11,9	-14,7	-14,9
Manufacture of footwear	-2,1	-0,4	-1,8	-2,1	-2,5	-0,2
Manufacture of rubber products	0,3	-2,0	-1,6	-2,1	-2,6	-2,0
Manufacture of machinery and non-electrical equipment	-0,7	-1,4	-1,6	-2,1	-2,6	-2,3
Manufacture of machinery and electrical equipment	-2,4	-2,3	-3,7	-4,7	-5,7	-3,8
Manufacture of transportation equipment	-0,3	-2,4	-2,0	-2,5	-3,0	-1,8
Electricity supply	-1,4	-1,9	-3,4	-4,4	-5,3	-4,2
Gas supply	-1,7	-1,2	-2,7	-3,4	-4,2	-3,1
Railway transport	-1,2	-0,9	-2,0	-2,5	-3,0	-2,2
Other Mining Activities	-0,8	0,1	0,3	0,3	0,4	0,1
Production of wood and its products	-0,2	0,2	0,3	0,4	0,5	0,4
Construction	1,1	-1,0	0,5	0,7	0,8	0,3
Marine transport	-0,3	0,3	0,0	0,1	0,2	0,6
Public administration	0,4	0,8	1,1	1,4	1,7	1,6

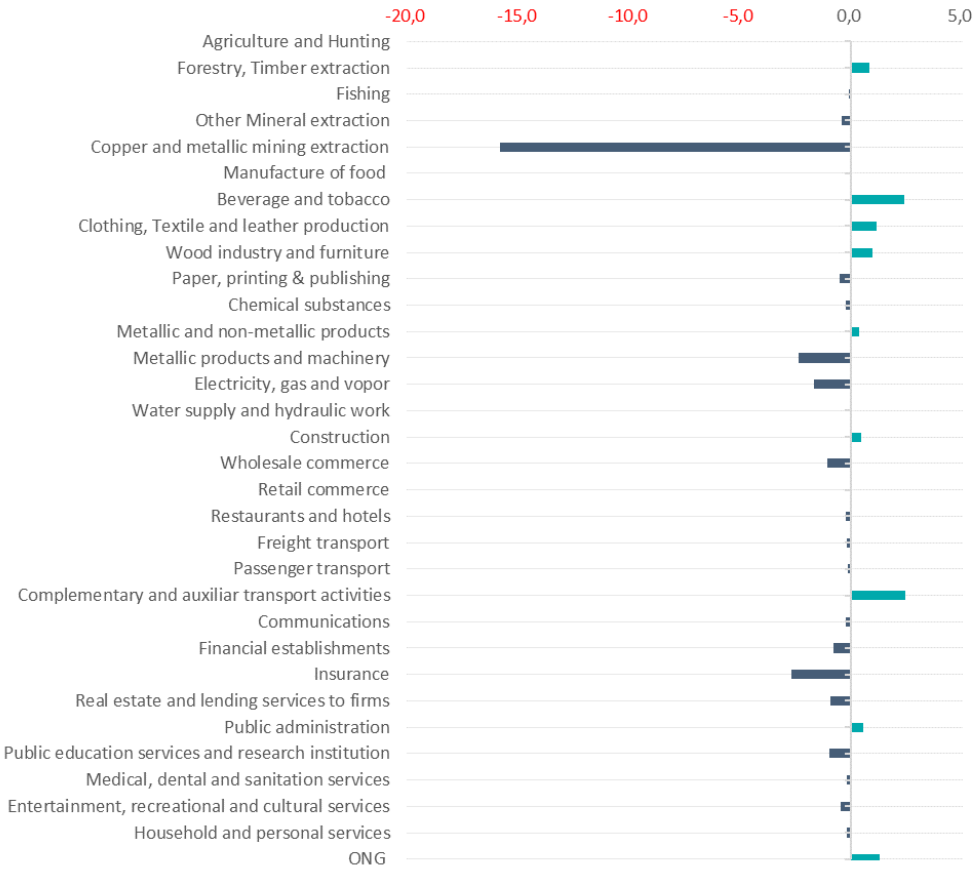
Source: COFORCE, own calculation

4.4.3 LABOUR MARKET REACTIONS

The production decline goes along with a soft employment effect in a range of -0.2% (2019) to -0.7% (2022). Unemployment increases by 2.6% at the beginning and by 5.3% at the end of the scenario in 2022.

The single industries react diversely: whereas most show a lower employment level after the shift in export demand, employment increases in a few industry sectors. A positive employment effect can be observed in forestry, public administration, transport activities, construction and in few manufacturing industries like beverages, clothing, furniture and metallic products (see Figure 9). The reason behind the rising employment effect is that in COFORCE employment is estimated with real production and real wages. Production in basic prices declines in all industries. But in some cases real wages are not so elastic and develop at a slower pace. In sum, production in a few industries rise because of price effects.

Figure 9: Main labour market reactions to an export-decline in 2022 (in %)



Source: COFORCE, own calculation

The strongest employment effect is seen in the copper mining industry itself, where employment falls by 15.8% (2022) in comparison to the baseline scenario, followed by the insurance industry, manufacturing of metallic products and machinery, electricity, wholesale commerce and education (see Figure 9).

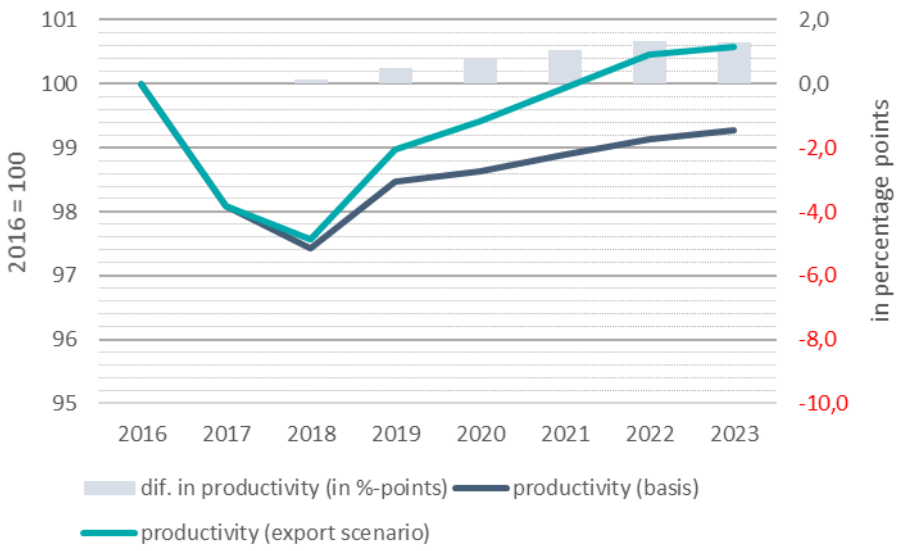
4.4.4 THE PRODUCTIVITY OF THE COPPER INDUSTRY

For the Chilean copper industry itself the shift in demand towards the copper supply of other countries has two effects. On the one hand production falls (see chapter 4.4.2) and on the other hand it has a direct effect on productivity.

Interestingly, as employment declines stronger through a shift in demand than production (in constant prices) does, productivity reaches a higher level in the export demand shift-scenario than in the baseline scenario. In the baseline scenario (blue line in Figure 10) productivity declines in 2017 and 2018 and manages to recover from 2019 on. Nevertheless, productivity doesn`t reach the index level of 2016 again until 2022. In the export-demand shift scenario (green line in Figure 10) the recovery of productivity is instead achieved already in 2021 (see Figure 10) because the copper industry doesn`t increase its employment in the same speed than real production grows. In conclusion the dismissals in the export shift scenario lead to an improved productivity of the Chilean copper industry.

Regarding the productivity of the whole Chilean economy, a fall in productivity can be observed due to the shift in demand. Productivity declines in the scenario and differs up to 1.8 percentage points from the baseline scenario in the year 2022.

Figure 10: Productivity in the copper mining industry compared to the baseline scenario

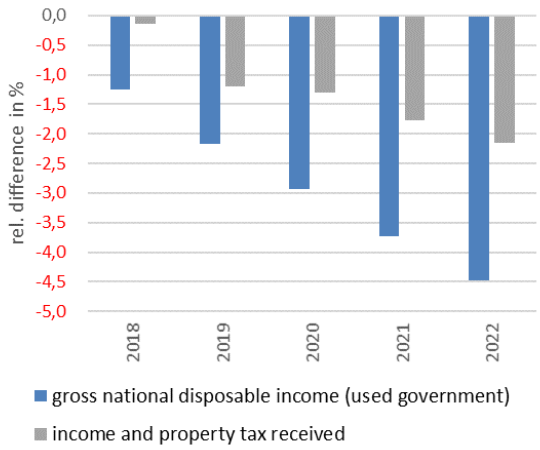


Source: COFORCE, own calculation

4.4.5 EFFECTS ON GOVERNMENTAL INCOME

As a consequence of the production decline in nearly all industries, the gross Chilean governmental income decreases in moments of reduced copper exports. The decreasing effect on gross national disposable income intensifies as export reduction continues (see blue bar in Figure 11). Starting with a relative difference of -1.3% (2018) compared to baseline, the gross national disposable income declines further to -4.5% in the year 2022.

Figure 11: Effects on selected state accounts (relative differences to the baseline scenario in %)



Source: COFORCE, own calculation

The governmental income is not only reduced by smaller profits of the copper mines but especially by negative effects of reduced copper exports on the labour market: Employment declines by 60 thousand persons in 2022 and, as a result, income and property taxes decline, too (grey bar in Figure 11). Furthermore, consumption by private households shrinks together with value added taxes. To balance the reduced gross national disposable income, the Chilean government is forced to reduce savings and rise its net lending during the period of decreased copper export.

5 SUMMARY

The focus of the scenario presented was to analyse the vulnerability of the Chilean economy with respect to a shift in copper demand. A generally rising world copper demand - especially by China and India - is assumed. But higher production capacities in Peru through the exploitation of the Las Bambas mine in the south of the country, manage to absorb a part of the worldwide rising copper demand and to deviate it from the world`s strongest copper producer Chile. The scenario stipulates a reduction of Chilean copper demand by India and China of 5% each p.a. for a period of five years. After this intervention, a return to the former growth path of Chilean exports to these countries is assumed.

In sum, a lower copper demand reduces the whole Chilean production in constant prices by 2.3% in 2022. The production of the copper industry itself decreases especially strong by nearly 15% in comparison to the baseline scenario (situation without reduced exports). Next to this direct loss in production, the production in the sectors manufacturing of machinery and electrical equipment are heavily negatively affected. So are the production in the electricity and gas supply sector, in manufacturing of transport equipment and in railway transport. But as production prices do not fall equally to the production decline, a few industries like the production of wood and its products, construction or public administration show an increase in real production.

Employment does not decline in the same pace than production because the decline of real wages overcompensates the decline in production. Regarding productivity, the Chilean economy loses up to 1.8% in 2022. Surprisingly, the copper industry itself is able to strengthen its productivity in the export scenario. The reason for this development is the disproportionately high reduction of employment through the shift in export demand, whereby productivity increases. For the state accounts, the decrease of copper demand means a reduction of its gross national disposable income of 4.5% in 2022, which is the outcome of less income and property taxes as well as less value added taxes through the decrease of private consumption. Consequently, the possibilities of the Chilean government to enforce intended policy measures fall with a reduction of copper exports.

Hence, although the intermediate demand for copper is concentrated on a few industries, the scenario analysis shows that an export reduction of copper affects the development of all industries in Chile. By a shift in export demand Chile loses part of its GDP in the long run. The negative GDP effects get stronger the longer the export reduction lasts.

Therefore, the exploitation and development in the northern neighbourhood should be observed and taken as an incentive to improve its own production and productivity against the backdrop of rising environmental and sustainable requirements. The most affected industries concerning production and employment should thereby work on a stronger diversification of their clients to be better prepared for a possible shift in demand and to increase the degree of flexibility in the labour market.

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