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Noxious deindustrialisation and extractivism: Quintero-Puchuncaví in the international division of labour and noxiousness

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ABSTRACT

This article examines the paradox of ‘noxious deindustrialisation’ – employment deindustrialisation in areas where significantly noxious industries are still operating – in the context of an extractivist economy in the Global South. Analysing the copper-centred industrial area of Quintero-Puchuncaví (Chile), we argue that a key element shaping patterns of local noxious deindustrialisation is the mode of insertion of the affected area in the international division of labour and noxiousness. The latter refers to the global socioecological hierarchy constituted by interconnected differentials in technological capabilities, wage levels, and environmental degradation. In countries marked by extractivism, the simple closure of polluting industries deepens the dependence of their economies on rent-bearing primary product exports, while the permanence of such industries often results in the perpetuation of ‘sacrifice zones’, where communities are exposed to severe noxiousness while receiving only meagre benefits in return. In our view, tackling the ecological crisis requires a more balanced international division of labour, as a step towards decommodifying production and nature. Without transformations in this direction, the current attempts at an energy transition risk provoking an unsustainable deepening of extractivism and inequality.

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Deindustrialisation; extractivism; environmental justice; imperialism; energy transition

Introduction

On 11 September 1973, Chilean armed forces traversed the Quintero Bay and stormed the Ventanas copper smelter and refinery, breaking into its fences from the beach and swiftly occupying the premises. The CIA-backed *coup-d'état* against Salvador Allende’s democratically elected government is usually visualised through the traumatic images of Hawker Hunter jets bombing the presidential palace La Moneda and soldiers dragging thousands of political prisoners to Santiago’s National Stadium, where many faced torture and assassination. On the same day, however, the army also took over the country’s key industries with the strategic aim of breaking the strongholds of labour militancy that had pushed towards the radicalisation of the governmental programme for a transition to socialism (Winn 1986, Salazar 2010, Gaudichaud 2016). Almost fifty years later, copper is centre stage again. For example, S&P Global claimed that – if the shift from ‘a fuel-intensive

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to a mineral-intensive energy system' gets on track – copper demand will double by 2035 and continue to grow afterwards, with the supply-demand gap endangering the energy transition and becoming 'a key destabilizing threat to international security' (S&P Global 2022, p. 9).

This article explores the paradox of noxious deindustrialisation – employment deindustrialisation in areas where significantly noxious industries are still operating (Feltrin *et al.* 2022) – in an extractivist economy, in Chile's industrial area of Quintero-Puchuncaví. We argue that – on a local level – noxious deindustrialisation takes different forms depending also on the mode of insertion of a given space in the international division of labour and noxiousness. By noxiousness, we mean production-induced harm against both human and non-human life (Feltrin and Sacchetto 2021). The international division of labour and noxiousness, then, refers to the planetary articulation of place-specific modes of insertion in the globally unified production of both value and noxiousness. Quintero-Puchuncaví's experience of noxious deindustrialisation is marked by its role as a mineral-processing hub within an extractivist economy, dependent on primary or 'quasi-primary' product exports (Svampa 2019), characterised by relatively limited endogenous technological capabilities and the related scarcity of good-quality employment alternatives.

Quintero-Puchuncaví constitutes Chile's most emblematic 'sacrifice zone' and has thus attracted a great wealth of research on community-industry relations (e.g. Malman *et al.* 1995, Sabatini *et al.* 1996, Folchi 2006, Buschmann and Jacob 2012, Sandoval Gajardo 2013, Tironi 2014, Rojas Barrera 2015, Bolados García 2016, Bolados García and Sánchez Cuevas 2017, Tironi *et al.* 2018, Benavides Peña 2019, Liberona Céspedes and Ramírez Rueda 2019, Peragallo Díaz 2020). We build on these works and integrate them with an empirical focus on employment relations and the conceptual frame of noxious deindustrialisation.

This paper is mainly based on qualitative interviews, archival research, and the analysis of socio-economic statistics and legislation. The case study of Quintero-Puchuncaví is grounded on a six-month fieldwork in Chile, which featured 30 semi-structured interviews with former and current industrial and port workers, trade unionists, local residents, environmental activists, and experts. The fieldwork also involved archival research in Santiago's Chilean National Library, which – among other useful documents – hosts most issues of the Ventanas workers' journal *La unidad* (1969–73). We also built a digitalised archive of news articles and a wide variety of reports.

The first section moulds a theoretical framework to show how uneven patterns of noxious deindustrialisation are related to the international division of labour and noxiousness. The second section delineates the origins of the Quintero-Puchuncaví industrial area in the 1960s and its role in Chile's popular struggles challenging the global socioecological hierarchy of the time, after which the military coup violently entrenched the country's economy in its 'classic' colonial function as an exporter of primary products. The third section analyses recent conflicts around pollution in the industrial area, in which the impact of noxious deindustrialisation was compounded by Chile's extractivist role in today's global economy.

Profit, rent, wage: the 'trinity formula' and the international division of labour and noxiousness

In *Capital Volume III*, Marx wrote: 'Capital-profit (profit of enterprise plus interest), land-ground-rent, labour-wages, this trinity form holds in itself all the mysteries of the social production process' (Marx 1991 [1894], p. 953). This trinity formula 'profit-rent-wage' *ipso facto* also holds in itself the mysteries of the international division of labour and noxiousness. In capitalism, value – i.e. the average labour time needed to produce a commodity – is the dominant form of wealth. In Marx's frame all value is generated by labour, yet the global pool of total value is divided up into wages (and other forms of labour income treated here under the 'wage' label for the sake of brevity) returning to the workers and surplus value appropriated by the capitalists as profit and by the landlords as rent. This section discusses how the global production and distribution of value – and its ecological impacts – are shaped by such social forms, drawing on three theoretical traditions: dependency theory (see

Frank 1966, Bambirra 1978), *operaismo* (see Alquati 1974, Tronti 2019 [1966]), and *iñiguismo* (see Charnock and Starosta 2016, Iñigo Carrera 2017, Rojas Cifuentes *et al.* 2023).

Tackling uneven development and imperialism, *dependentista* authors such as Ruy Mauro Marini and Enrique Dussel highlighted how the equalisation of the *profit* rate, coupled with international disparities in the development of *capital*, generated a systematic transfer of surplus value from ‘peripheral’ to ‘core’ countries (Dussel 2001 [1988], Marini 2022 [1973]). As an enduring legacy of colonisation (Quijano 2000, Mariátegui 2011), core countries dominate the technological frontier and thus the production of capital goods (Dos Santos 1972). Therefore, peripheral economies usually feature lower average ‘organic compositions of capital’ (i.e. they are more labour intensive) (Bauer 2000) or depend on technology imports from the core if they are to raise their capital compositions.

According to Marx, other things being equal, the products of capital-intensive branches trade above their value while the opposite is true for labour-intensive branches (Marx 1991 [1894], pp. 254–72). Imagine two firms with similar ‘variable capitals’ (wage bills) but different levels of capital intensity. The value produced by the workers of the capital-intensive firm is spread on say 100 units of ‘constant capital’ (i.e. the cost of means of production). The workers of the labour-intensive firm produce the same amount of value, but this is spread on 50 units of constant capital only. Yet, as there is a tendency for the rate of profit to be equalised through price formation (Marx 1991 [1894], pp. 273–301), the two firms gain a similar profit rate. While the unevenness between the two firms is rooted in production, value is transferred from the labour-intensive firm to the capital-intensive one via exchange.

This is the basis of an ‘unequal exchange’ that, coupled with profit-repatriations by capitals from the core invested in the periphery, results in the fact that capitalist development reproduces the core–periphery relationship rather than eroding it (Dussel 2001 [1988], Marini 2022 [1973]). This unequal exchange, due to different capital compositions, can be called ‘capital-based’ unequal exchange. In the core, class struggle can be integrated in capitalist accumulation to raise wages, expand consumer markets, and propel innovation. In the periphery, however, this route is barred by limited capabilities for endogenous technological development (Marini 2022 [1973]). While acknowledging extreme wage differentials between core and peripheral labour, Marini and Dussel saw them as derived from uneven levels of technological development, with low wages forced upon peripheral workers to compensate for their lower productivity.¹

In contrast, both Arghiri Emmanuel (an author close to dependency theory) and the *operaistas* emphasised a dialectic between class struggle and technological development in the determination of wages (Emmanuel 1972 [1969], Tronti 2019 [1966], see also Amin 1977 [1973]). According to Marx, the price of *labour power* (the *wage*) does not reflect the productivity of labour, it rather oscillates around the value of labour power, the cost of its reproduction. In the determination of the latter, Marx saw a ‘historical and moral element’ (Marx 1976 [1867], p. 275). This element is contingent to some extent, as shown by the fact that wage levels and wage dispersion vary across firms with similar technological endowments, and across countries with comparable development levels. *The wage is political*, not in the narrow sense of being related to the state, but *as an expression of power relations subject to change via social conflict*.

Emmanuel theorised ‘wage-based’ unequal exchange as the transfer of value from low-wage to high-wage firms (at similar levels of labour skill and intensity) (Emmanuel 1972 [1969], pp. 61–4). Imagine two firms have the same capital intensity but different wage levels. Their products embody the same value but trade at different prices due to the divergence in the value of their workers’ labour power. The low-wage workers thus deliver more surplus value than their high-wage colleagues, but this surplus value is not fully captured by their employers. It rather joins the global pool of surplus value to be redistributed ‘equally’ to total capital, as capital’s movement in search of the highest revenues tends to equalise profit rates. Through this ‘wage-based’ unequal exchange high-wage firms receive more labour time for less (Hickel *et al.* 2021).

In an economy where workers freely compete for jobs, wage-based unequal exchange cannot last long, as labour flows to the higher-wage jobs as rapidly as possible (just like capital flows to the

higher-profit firms), equalising wages for similar skills. However, if labour market competition is systematically hindered, this unequal exchange becomes systematic too. Indeed, even if capital accumulation is globally unified, labour mobility is restricted by national borders while the freer movement of capital pushes towards a global average profit rate. Obviously, this does not imply a full international immobility of labour, but rather a structuration of its mobility able to prevent a global wage convergence (Mezzadra and Neilson 2013). Wage differentials also exist within states, because of the viscosity of movements from one region to another and – more significant – race and gender discrimination. However, such domestic wage divergences are not comparable in scale to those among national economies (Smith 2016).

Similarly, the *operaistas* stressed that the wage is not an expression of the capital-labour power relation only but also a vector of power relations *within* the working class, a vector of intra-class stratification and division (Clever 2000 [1979]). This is why wage egalitarianism was an *operaista* tenet, not merely as an ethical commitment but as an element of a strategy for working-class re-composition through the overcoming of its material divisions (Wright 2002, pp. 119–25). Initially, however, working-class stratification was understood mainly as expressed by pay scales in a national context. It was feminism that uncovered the gendered and racialised elements in wage hierarchies, showing how the working class is not only stratified by wage differentials, but also by the very presence or absence of a wage (Dalla Costa and James 1972, Federici 2021, see also Gago 2020). Selma James and then Luciano Ferrari Bravo took this perspective further by applying it on a global scale (James 2012 [1975], Ferrari Bravo 2018 [1975]). Indeed, the divisive nature of the global wage hierarchy should be taken seriously to avoid solely cultural explanations of working-class support for the Right.

Last in the trinity comes *ground rent*, which stems from the ownership of resource-rich *land* allowing to sell its products above their prices of production (costs plus average profit) (Marx 1991 [1894], pp. 751–950). Resource-rich countries with laggard endogenous technological development tend to be inserted in the international division of labour as providers of rent-bearing primary commodities, mainly scarcely processed food, minerals, or hydrocarbons (Iñigo Carrera 2017).² Rent appropriation generates conflicts between national and foreign actors, including the state-as-landlord (Grinberg 2023). When the latter manages to recover a significant share of rent, the country can escape the coercion to compete in global markets through low wages. Yet the resulting overvaluation of the national currency keeps industry uncompetitive and dependent on subsidies from rent itself (Galdini 2023).

Quantitatively, the value outflows generated by laggard technological development or low wages may (or may not) be mitigated or even exceeded by rent inflows. In times of high demand, rent-bearing exports can generate fast national GDP growth, as it was indeed the case for Chile (Meller 2002). Unequal exchange, profit repatriations, and rent thus generate an intricate, multidirectional web of value transfers, whose net flows are difficult to pin down (see Osorio 2017). *Qualitatively*, nonetheless, rent as a line of income is very different from profits and wages. In fact, it tends to engender high inequality and to bar advanced endogenous technological development (Iñigo Carrera 2017).

We hold that the ‘trinity formula’ critiqued by Marx also indicates three broad patterns of insertion in today’s global economy. Hi-tech zones – the so-called ‘Global North’, which is perhaps being gradually joined by China – mainly claim their share of value through capital, via profits. Their cumulative technological advantage allows them to constantly re-create export sectors combining average or beyond-average profit rates with relatively high wages. Low-tech zones – the so-called ‘Global South’ – must compete through the abundance of their natural resources or the misery of their wages, both a compensatory mechanism to push laggard capitals closer to (or even beyond) the average profit rate. The areas endowed with rich soils but deprived of advanced endogenous technological capabilities – several countries in South America, Africa, and the Middle East – make their claim to value through ‘cheap nature’ (Moore 2015), via rents. The countries whose large workforces are more decisive than their resource endowments – for example much of East Asia – compete

through 'cheap labour' (Smith 2016), via low wages. However, looking beyond the mystification veil of the trinity formula, these are all claims on the total value produced by global labour under capitalist social forms.

Of course, the whole world is crossed by class relations cutting horizontally through its population. The picture just sketched is then a highly simplistic one, as all countries – as well as sub-national and super-national zones – combine the three modes of insertion in the global economy in different and to some extent contingent amalgams. Nonetheless, this outline provides a frame for detailed investigation into concrete local insertions in global value accumulation, and the related compositions of specific segments of the planetary working class.

The international division of labour is also an international division of noxiousness. This phrase echoes Fernando Coronil's brilliant analysis of the 'international division of labour and nature' (Coronil 1997). However, Coronil's wording refers to labour and nature as the trans-historical producers of wealth. Our terminology, instead, emphasises capitalist labour as the producer of value, a social form inherently noxious as it necessarily deepens the 'metabolic rift' between society and nature (Saito 2023).

The Global North can afford stricter health and environmental regulations relative to the Global South. In the latter, cheap-nature economies rely on large-scale resource depletion, becoming 'nature-exporting societies' (Coronil 1997), while cheap-labour ones are characterised by unhealthy and polluting factories. Loose regulations and austere welfare services are instrumental to ensuring this cheapness, which comes however at the cost of high emissions, water exhaustion, soil erosion, waste accumulation, biodiversity loss, etc., along with the dispossession of indigenous populations from ancestral commons (Alimonda 2011, Gudynas 2021). The labour hierarchy and the noxiousness hierarchy are thus mutually reinforcing, as in capitalism low technological capabilities constitute a pressure towards high pollution.

Within countries, the workers with low employable skills are more likely to reside close to highly polluting facilities (where housing is usually more affordable) and to work in dangerous jobs, which often provide an implicit 'noxiousness bonus'. This phenomenon is known as 'monetisation of health' (Feltrin and Sacchetto 2021). Internationally, the countries with low endogenous technological capabilities are more likely to specialise in exports characterised by high noxiousness at the source, in what could be described as an international monetisation of health and nature. Similar to wage differentials, international environmental inequalities are compounded by militarised borders restricting labour mobility.

The relationship between social and ecological inequalities is evident in World Bank average life-expectancy figures: 80 years in high-income countries versus 62 in low-income ones (bearing in mind that national averages notoriously conceal intersectional class, racial, and spatial inequalities within countries). However, depending on their political histories, extractivist countries can allocate a share of their rents towards the import of *relatively* advanced technologies and the improvement of regulations and services. For example, life expectancy in Chile is remarkably higher than in the United States (79 versus 76 years in 2021), despite the obvious disparity in their incomes per capita and endogenous technological capabilities.

Both labour and environmental struggles in the Global North generate incentives for capital to transfer industries to Global South countries with lower wages and looser health and environmental regulations. This led to the shift of much manufacturing employment from Northwest to Southeast in the neoliberal period (Smith 2016). However, the 'spatial fix' of delocalisation (Silver 2003) is not the only reaction. There are also the productivity-raising technological fixes which ensured that manufacturing employment was not merely reshuffled around the world, but also downsized relative to material output and total employment.

According to recently updated estimates by the International Labor Organization (ILO), the global share of manufacturing employment slowly declined from 15.7 per cent in 1991 to 13.6 per cent in 2021, to the benefit of employment shares in construction and services (Figure 1). Part of this decline stems from productivity gains in manufacturing more rapid relative to other sectors, while another

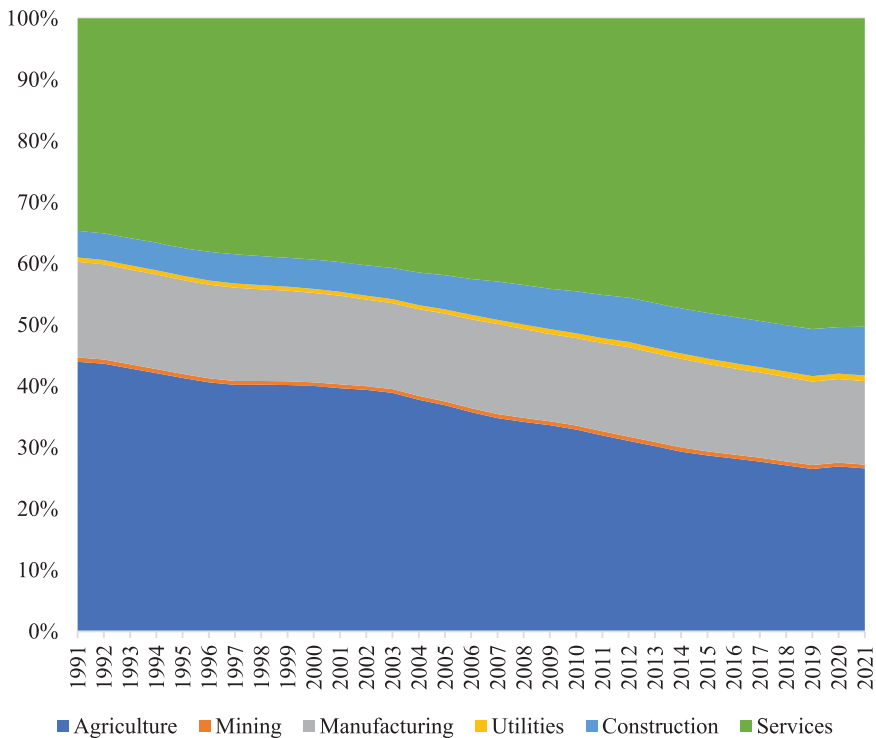


Figure 1. Shares of global employment by sector.

Source: Calculated by the authors based on ILOSTAT.

factor is the outsourcing of previously in-house jobs from manufacturing to service sector firms. This outsourcing is not a mere accounting artifice, as subcontracted jobs are on average more precarious and less paid than in-house ones. These processes resulted in the paradox of ‘global noxious deindustrialisation’, the coexistence of a falling global manufacturing employment share and the ecological crisis engendered by industrialised production, including the deployment of factory-produced machinery and inputs in non-manufacturing sectors and final consumption (Feltrin *et al.* 2022).

Employment deindustrialisation originates in the fact that productivity gains increase material output while lowering its prices; this strains profitability, leading to falling investment rates and thus to economic stagnation (Moraitis 2022). In fact, in the last decades, productivity gains in manufacturing – although slow by historical comparison – have been faster than output growth as measured in prices (Benanav 2020). The result is not apocalyptic joblessness but precarity rising where job security was high, and precarity persisting where it always existed, because – to keep the economy moving – declining profitability must be countered by cutting costs. Employment precarity and environmental degradation are both manifestations of the capitalist imperative to economise for the sake of profitability.

In times of global noxious deindustrialisation, the governments of extractivist countries face a difficult double-bind. On the one hand, they want to diversify their economies to improve their position in the international division of labour. On the other hand, as this requires protecting their industries, the result can be even higher noxiousness – because the best available technologies are usually out of their reach – and meagre direct employment gains. Extractivist countries in the Global South thus encounter additional difficulties in addressing noxious deindustrialisation relative to the Global North, as the case study presented below contributes to show. This dilemma is of renewed significance now that the energy transition attempts led by the Global North are generating a scramble for

'critical minerals' – including copper and lithium, both abundant in Chile – that risks deepening extractivism rather than mitigating it (Arboleda 2020, Riofrancos 2023).

'The wage of Chile': Ventanas' copper industry from import substitution to neoliberalism

Since the sixteenth century, Chile's history has been embedded in global transformations and crises. By the early twentieth century, Chile had an open, export-led economy, based on 'outward-oriented growth' (Salazar and Pinto 2002). Exports were centred on rent-bearing raw materials – mainly minerals (copper, gold, and nitrate) and agricultural products (notably wheat) – with little processing involved and minimal diversification in terms of both products and international buyers. These limitations were inherited from Chile's colonial past and preserved by local elites as junior partners in rent appropriation, which mainly benefitted foreign capitals.

Even if an incipient industrialisation to satisfy internal demand began (Palma 1984), Chile's manufacturing base remained limited, while political power and wealth stayed concentrated at the top (Bauer 1990). By the late 1930s, outward-oriented growth had suffered recurrent crises due to external factors, the most severe being the Great Depression. Consensus for a change in trajectory gained ground, leading to increased state involvement in fostering infrastructure development and import-substitution industrialisation (Fajardo 2022). The post-World War II period was also marked by an intensification of struggles led by unionised workers, students, women, slum dwellers, and farmers.

This was the context in which the decision to build a copper-processing complex in Ventanas – an agricultural and fishing community in the town of Puchuncaví, bordering with the town of Quintero – was finalised on 31 December 1957 (*La unidad*, September 1971, p. 5). While the Puchuncaví council competed with other locations to obtain the siting of the smelter and electrolytic refinery in Ventanas (Bravo Carrasco 2005, pp. 181–9), since the beginning local farmers expressed their fears over the factories' impact on the surrounding territory (Buschmann and Jacob 2012, pp. 22–6). This attempt by the state to keep a larger share of rent within its borders through the creation of state-owned industries, in fact, required the import of outdated machinery from the Global North. The authorities tasked a West German consortium with building the complex and established the state-owned Chilean Mining Company (ENAMI) to take it over. Construction began in 1960, but the smelter was inaugurated only on 30 September 1964 – after the opening of a coal-fired power station in the same year – and the refinery on 11 November 1966. The project did not feature an emission capture system even if the technology already existed (Folchi 2006, pp. 461–78), and it was ridden with delays, cost overruns, and accidents.

A worker remembered the early months of ENAMI Ventanas in such terms:

The machinery was so faulty that we entered at 7am but never knew when we'd get out. Usually, for three months in a row, we finished at between 3 and 5am of the following day. It was quite a heavy job, we had to lift and check approximately 3,000 bars weighting 120 kilos each. After the moulding, we had to caulk the moulds and heat them at almost 200°. With the little food we brought, I don't know how we're alive. It was such an inferno I don't even want to think of it. And, worst of all, the product was worth nothing, because the chemical tests delivered bad results. [...] It was such a failure that the boss of the Germans himself attempted suicide. (*La unidad*, September 1970, p. 2)

Following an interviewee's terminology,³ the first Ventanas workers can be roughly categorised in three main groups: *nortinos* (Northerners), *pitucos* (posh), and *huasos* (peasants). The *nortinos* were mostly skilled workers from the desertic Copiapó mining region, where ENAMI already operated the Paipote smelter. Often the children of miners, they had grown up in a culture steeped in familiarity with the red metal. The legend goes that some Northern *horneros* (furnace operators) could bare-handedly assess the quality of copper samples before the analysts even set their devices on them. The Northern mines were also the cradle of the Chilean labour movement, and many *nortinos* thus brought with them a culture of working-class radicalism that found a fertile ground in the late 1960s.

The *pitucos* were formally educated technicians, white-collar, and managers. Most commuted on company buses from the urban centres of Valparaíso, Viña del Mar, and Quilpué. Almost all women employed by ENAMI Ventanas at the time – a small minority of the workforce – fell under this category. However, their white-collar status afforded them little protection from sexism, so much so that the workers' journal *La unidad* – directed by the shop steward Carlos García – had to publish several appeals to stop gendered harassment (e.g. *La unidad*, June 1972, p. 33). As the Ventanas complex started operating under Eduardo Frei's Christian Democratic government, many *pitucos* were initially recruited from the ranks of the party membership. However, when the leftist coalition Popular Unity (UP) brought Allende to the presidency by winning the 4 September 1970 elections, a new cohort of young, left-leaning graduates and students began crossing the factory gates.

The *huasos* were the 'unskilled' workers, mostly hailing from the nearby agricultural communities. They had little formal education, some were illiterate, and strenuously learnt by doing on the job: 'All the company wanted [to hire them] was good health. I don't know why, if then they got ill inside'.⁴ Acid rains devastated fenceline farming (Malman *et al.* 1995), against which protests were held also at the time (Buschmann and Jacob 2012, pp. 28–31). Dispossessed by noxious accumulation, many farmers dropped their sickle to pick up the hammer in the factories, where they encountered sulphur at the source, condemned to the most hellish labours. 'They're all dead' is the laconic answer we often received when asking about Puchuncaví residents who had begun working in ENAMI Ventanas in the early years. Some did not adapt to factory discipline and quit, while others toiled on, occasionally finding relief in the observance of Saint Monday (or its shift-worker equivalents).

Mario Cisterna, a Puchuncaví worker who was imprisoned and fired with the coup, recalled:

My first job was agriculture. Then, when that business started there [ENAMI Ventanas], we sowed but didn't harvest ... The factories, the smoke, wrecked the harvests and we had to look for something else. So I started working in construction, at 16, I was loading trucks to fill the ground for the factories. [...] There, I learnt about the unions and got involved in political stuff. So they blacklisted us, we looked for jobs and couldn't find any, until when Salvador Allende's government came about. [...] We worked in the smelter, with all the smoke, so that we'd die afterwards. The best at this were those who had worked in the fields, the most brute, because we were all used to physical effort. The gentlemen from the city were not for the hammer. Without us, those fellas [*weones*] would've been dead.⁵

When the UP government took charge, restrictions on blacklisted workers were lifted. For example, forty workers who had been laid off for a strike in 1968 were reinstated (*La unidad*, November 1970, pp. 7–8). The main UP parties – the Socialist Party, Communist Party, and Popular Unitary Action Movement (Left-Christian) – all had factory groups in Ventanas. José Carrasco, president of the Ventanas workers' association, was a Communist Party member. The extra-parliamentary Revolutionary Left Movement (MIR) also had a member on the association's board, Guillermo Sotomayor, also known as Caballo Loco (Crazy Horse). Nonetheless, the centrist Christian Democracy kept a large following, and the debate amongst the workers was thus lively and sometimes harsh. However, when on 11 July 1971 the Chilean Congress unanimously approved the nationalisation of all large-scale copper mines (Vergara 2008, pp. 155–77), support was broad among the population, including Ventanas' workers (*La unidad*, May-June 1971). Allende defined copper as 'the wage of Chile' (Allende 2018 [1971], pp. 263–75), which pointed to a programme of state-led rent appropriation to finance individual and social wage increases, turning rents into wages, raising the value of labour power in the long run.

Internal noxiousness was acutely felt at ENAMI Ventanas, as regularly decried by *La unidad* since the very first issue (*La unidad*, October 1969, p. 2). The workers denounced a long list of health and safety hazards: toxic gases and powders containing sulphur and arsenic, extreme temperatures, heavy weights, dangers of falling, ergonomic injuries, long hours, etc. Before the coup, preventive measures and protective equipment were gradually improved, but severe gaps remained. In 1972, ENAMI constituted a national bipartite health and safety committee, which drafted a scathing report and stressed the urgency of reform (*La unidad*, July-August 1972, pp. 10–1).

External noxiousness was discussed less frequently on the workers' journal (e.g. *La unidad*, September 1971, pp. 5–6), yet a retired female white-collar employee had the following memories:

You won't believe it, but people were very aware about the environment in those times, because they saw the impacts of sulphur pollution, and the workers had raised the issue. We wanted filters, new technologies, many things, even at that time! But then with the dictatorship we couldn't do it.⁶

Pollution, in fact, was to be reduced through the expansion and upgrading of the complex, as part of the governmental strategy to further industrialise the recently nationalised copper. By early 1973, ENAMI had prepared a plan featuring the installation of a sulphuric acid plant to capture part of the sulphur dioxide emissions, a flash smelting system, and other more up-to-date technologies (*La unidad*, February–March 1973, pp. 11–2). *La unidad* noted that the acid plant would mitigate the 'massive amounts of sulphurous gases that are currently dispersed in the atmosphere, causing serious problems to the farmers and the population in general' (*La unidad*, April–May 1973, p. 12).

However, factory life was soon caught up in the troubles caused by the US-backed economic boycott and coup preparations, and intra-Left divisions on how to respond (Salazar 2010). While Allende attempted in vain to strike a deal with Christian Democracy, militant workers scrambled to prepare for the coup (Gaudichaud 2016). Some Ventanas employees made political contacts with the *pirquineros*, the small miners whose copper ENAMI was tasked to buy and process, as they were 'very much on the Left'⁷ and – more importantly – regularly handled dynamite as part of their job. Yet, eventually, the anti-coup workers were faced with the abysmal asymmetry of firepower between the labour movement and the armed forces, as witnessed by former ENAMI Ventanas employee and then political prisoner Rafael Maldonado:

We held meetings in the factory itself, and people were desperate because they saw the coup coming but didn't know what to do. [...] The electricity pylons in Valparaíso were being constantly sabotaged [by the opposition], with the city remaining in the dark. So we used to guard ENAMI's transmission towers and, amongst all of us, we didn't have one rifle! [...] The army knew very well what to do, they cut the telephones and attacked [ENAMI Ventanas] from the beach. And met no resistance. They occupied the factory in five minutes.⁸

The coup brutally quashed any open form of labour organising, and Ventanas was no exception:

The coup was horrible, for over one year we worked with armed soldiers in uniforms running the factory. Horrible. We never saw some of our work comrades again. [...] They had lists, if somebody's name was on them, the soldiers called them and took them away. They threw them on the ground and then on the trucks, and took them away. It was horrible because they put them in layers, one above the other.⁹

Our interviewees estimated that hundreds of Ventanas workers were laid off in the aftermath of the coup, chiefly based on political criteria. Of these, many were imprisoned and tortured in different detention centres. For example, the Navy stationed a coal bulker ship called *Lebu* in Valparaíso Bay and used it as a secret detention and torture hub (Hernández 2021). Tens of Ventanas workers were amassed there together with hundreds more political prisoners. Once released, some went into exile, while others faced a life of deprivation on the blacklists of Pinochet's regime.

The neoliberal dictatorship oversaw Chile's deindustrialisation, with the double result of erasing the strongholds of labour militancy and mediating the functionality of the country's economy to the 'global market' and its appetite for metals and monocrops (Quiroga Martínez 2001). The terrorist repression of organised labour at copper manufacturer MADECO, the privatisation of the firm, and its eventual decline are emblematic (Stillerman 2004).

In 1979, the regime allowed the reconstitution of trade unions, albeit with very limited powers. The weakening of unions and private sector dominance through financialisation (including in utilities, pensions, and education) were legally locked in by the Labour Code and the Constitution of 1980, both still essentially in place (Pérez Ahumada 2021). An extreme deregulation of private enterprises, for example regarding subcontracted employment, was coupled with an extreme regulation of workers' organising, severely restricting collective bargaining and the right to strike (Echeverría Tortello 2010, Durán and Narbona 2021, Julio Medel 2022). The return of electoral democracy and

the succession of Centre-Left governments saw an improvement of civil rights, rapid economic growth, and a significant reduction of absolute poverty, yet inequality remains stubbornly high (Atria 2013).

On the surface, employment deindustrialisation in Chile indicates a convergence with Global North countries, for example the United States (Figure 2). However, if one considers export compositions, the persisting divergence is stark. Chile's economic complexity index is at -0.2 – mainly due to its overwhelming reliance on raw and quasi-raw copper exports – while the United States' stands at 1.56 (Figure 3).

Concurrently, environmental degradation gained ground with few obstacles:

The military government (1973–90) had no environmental policy other than ignoring the environment as much as possible. It is not by chance that in the mid-1980s, an influential economic adviser to the government, who later became the minister of finance, told a meeting of North American businesspeople that they would find investing in Chile to be advantageous because they would not have to comply with any environmental law. (Lagos and Velasco 1999, p. 112)

In sum, neoliberal restructuring – in line with the global trend – defeated the post-World War II attempts to build a more egalitarian international division of labour and noxiousness. While Chile fared well compared to the other South American countries, mainly because of rents stemming from the high global demand for copper, the civic-military dictatorship entrenched extractivism, keeping the national copper industry subordinate to Chile's role as an exporter of raw or 'quasi-raw' minerals.

Noxious deindustrialisation in extractivism: Quintero-Puchuncaví in the 'commodity supercycle'

On 24 August 2018, hundreds of protesters broke into the Ventanas copper processing complex – which had been bought in 2005 by the National Copper Corporation of Chile (CODELCO, also a Chilean state-owned enterprise) – stoning its windows to the dismay of its astonished workers. The crowd – mostly composed of local residents – was enraged about a dramatic accident that began on 21 August 2018, when around seventy people – mostly children – sought medical attention due to a massive peak in air pollution. Similar episodes continued in the following weeks, so that

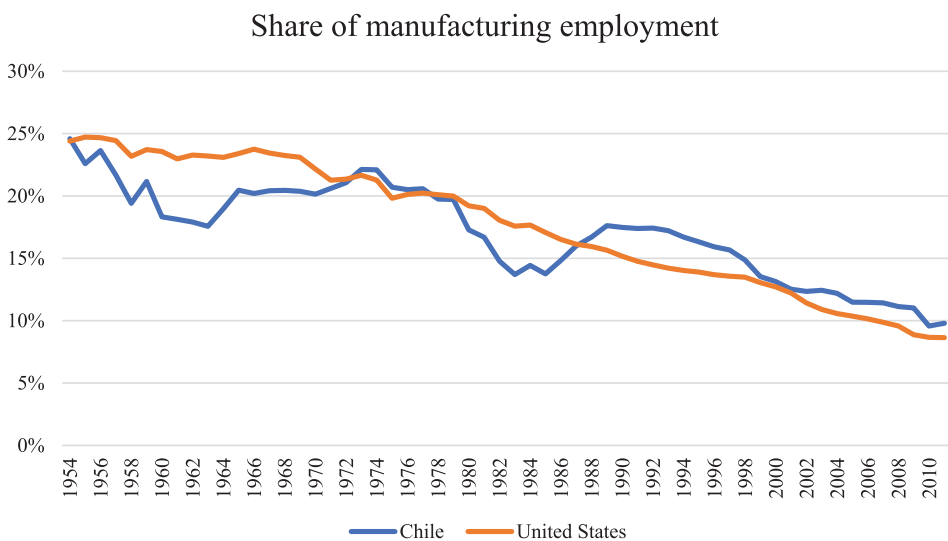


Figure 2. Employment deindustrialisation in Chile and the United States.

Source: Calculated by the authors based on GGDC 10-Sector Database.

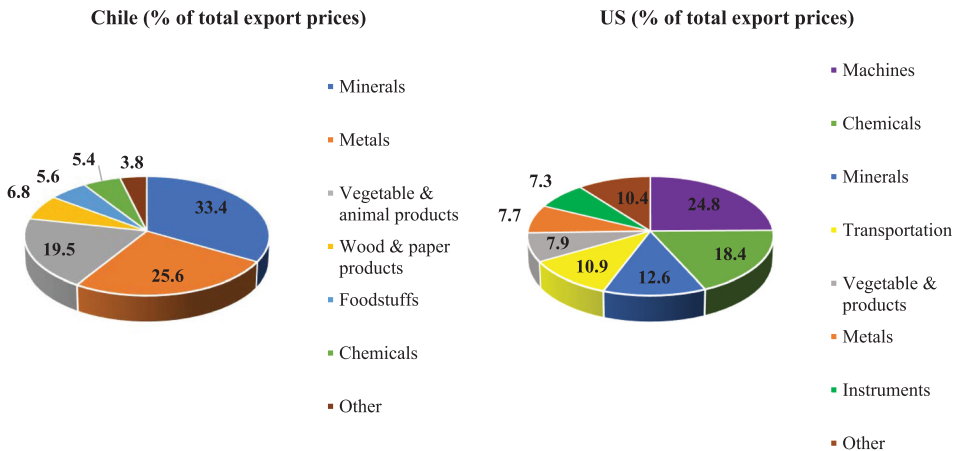


Figure 3. Chile vs United States exports, 2020.

Source: Observatory of Economic Complexity.

at least 1400 people sought medical attention (Cámara de diputadas y diputados 2018). The causes of the accidents were unclear, although in 2023 three managers of Chile's National Petroleum Enterprise were found guilty over the transport of dangerous substances (sulphur-rich crude oil) in Quintero Bay. This section shows how the impact of noxious deindustrialisation in Quintero-Puchuncaví was exacerbated by Chile's extractivist role in the international division of labour and noxiousness.

Pinochet's coup meant that ENAMI Ventanas' upgrading was postponed for almost twenty years, until the democratic transition of 1988–90 (Folchi 2006, p. 471). For decades, the plants operated without an emission capture system, and by the 1980s the environmental degradation of the area – caused by sulphur oxides, particulate matter, and metals such as arsenic, copper, lead, mercury, and cadmium – was extreme (Gayo *et al.* 2022), as the earliest studies led by Dr Jaime Chiang contributed to show (Chiang *et al.* 1985). Fenceline community protests against pollution and its denial thus made a comeback during the last years of the dictatorship (Sabatini *et al.* 1996). Moreover, in 1989, the press exposed the case of the so-called 'Green Men', cancer-struck Ventanas workers whose organs had changed colour allegedly because of exposure to noxious powders in the factory (APSI, 12–18 June 1989, pp. 22–5).

Ventanas' first sulphuric acid plant began operating only in 1990. However, toxic emissions remained beyond the *relatively* higher standards set by the new environmental legislation (e.g. Decree 185-1992; Law 19, 300-1994). In 1992, a 'decontamination plan' aimed at reducing emissions was initiated. However, the following year, the recently installed air monitoring system showed that sulphur dioxide and particulate matter emissions exceeded the limits set by Decree 185-1992, and the Ministry of Agriculture declared Ventanas as an area saturated with pollution. In late 1994, ENAMI Ventanas was thus forced to partially suspend its operations. This wake-up call spurred a major technological upgrading, whereby successive rounds of investment significantly reduced Ventanas' sulphur and particulate matter emissions, although its environmental performance stayed below the best international industry standards.

The dictatorship also coincided with a lack of meaningful progress in improving health and safety inside the factory. By 1990, ENAMI Ventanas had become the Chilean smelter with the highest accident index (Espinosa 2009, p. 4). To face this dire situation, in 1995, the Ventanas union proposed that the decontamination plan be coupled with a reduction of internal noxiousness through an adaptation of the participative 'worker-led model' (*modello operaio*) pioneered by the Italian labour movement in the late 1960s (Davigo 2017). Luis Guerra, a Ventanas union leader, commented:

The [early] '90s were terrible. If you checked the accident board, we only needed two numbers: 0 and 1. Zero days without accidents was the norm, one was rare. [...] The environmental question does not concern emissions towards the neighbouring communities only, it begins at the source, and here the orientation provided by the unions is key. These reflections helped us a lot to understand health has no price. [...] It took much sacrifice, but eventually we obtained very good occupational health standards.¹⁰

However, even though the 1990s indisputably marked a break with the unrestricted pollution that had characterised the former decades, part of the local population remained discontent. In fact, the post-dictatorship period was marked by a whopping expansion of noxious facilities in the area, including hydrocarbon, chemicals, and asphalt terminals, the enlargement of the industrial and commercial port, a gas-fired power plant, and two additional and highly polluting coal-fired power stations (Peragallo Díaz 2020). The new infrastructure added significant hazards, noise, traffic, and emissions (particularly nitrogen oxides and volatile organic compounds) to the mix, and the leaks of coal, oil, and metals into the sea further compromised artisanal fishing. Moreover, despite scientific publications pointing to severe pollution-related health risks (e.g. Ginocchio 2000, González *et al.* 2014, Madrid *et al.* 2022), and widespread worries over them, no encompassing epidemiological study was conducted.¹¹

In 2003, some local residents founded the activist group Consejo Ecológico de Quintero y Puchuncaví to limit the siting of polluting facilities in their territory. In 2005, the organisation successfully pushed back plans to build an industrial waste dump, but their efforts against the coal power plants were less fortunate, so that the US company AES Corporation opened two new units there in 2010 and 2013 (Sandoval Gajardo 2013, Rojas Barrera 2015). Grievances targeting the industries also came from a group of former ENAMI Ventanas employees who, in 2006, founded an association to claim compensation from ENAMI and CODELCO, maintaining that the spread of cancers and other diseases among the retired workforce was caused by exposure to toxic substances.

Therefore, when on 23 March 2011 around thirty elementary school students and teachers from the nearby Escuela La Greda sought medical attention due to a severe sulphur leak from CODELCO Ventanas, the mood for protest was ripe. A coalition of local associations and schools promoted a campaign, and filed a legal complaint, demanding the closure of the Ventanas smelter. The matter was eventually settled with financial compensations, the relocation of the school, and a clean production agreement. Nonetheless, smaller accidents of this kind continued and – on 24 September 2014 – a tanker produced a massive 38,700-litre oil spill in the Quintero Bay.

The 2018 accidents described above spurred a cycle of mobilisations against pollution, including an open-ended occupation of Quintero's square. A prominent role in this movement was taken by the group Mujeres de Zonas de Sacrificio en Resistencia de Puchuncaví-Quintero (MUZOSARE) and by the artisanal fishers' unions, particularly Quintero's S24 Union. Established in 2016, MUZOSARE stressed the connections between extractivism, productivism, and the patriarchy, and how women are on the frontline of the care work needed to address the effects of noxiousness (Bolados García and Sánchez Cuevas 2017, MUZOSARE 2020). The S24 Union, instead, had emerged in 2014 during the fishers' movement over the great oil spill, articulating an anti-capitalist discourse focused on territorial and food sovereignty. One of its leaders, Alejandro Castro, died in unclear circumstances on 4 October 2018, becoming a widely known symbol of the protest.

Local tensions are probably not unrelated to the employment transformations engendered by the transition from import-substitution industrialisation to neoliberalism. The combined share of Puchuncaví and Quintero residents employed in manufacturing decreased from 16.6 per cent in 1982 to 3.8 per cent in 2019, making of Quintero-Puchuncaví a clear case of noxious deindustrialisation.¹² Productivity gains and outsourcing contributed to an absolute decline in the number of manufacturing workers residing locally – from 1158 in 1982 to 441 in 2019 –, a fall whose impact on the labour market was magnified by population growth. These tendencies were compounded when CODELCO took over the plants and introduced new technologies and managerial styles, and more centralised and formalised recruitment procedures. If in 1973 ENAMI Ventanas had almost 1800 direct employees (*La unidad*, June-July 1973, 20), in 2022 they had become about 800, in

addition to a fluctuating magnitude of outsourced employment oscillating around 1000 workers (these include workers outsourced to service sector firms in cleaning, catering, security, transport, logistics, etc.). Productive capacity, instead, had increased from 150,000 to 420,000 yearly tonnes for the smelter, and from 84,000 to 400,000 yearly tonnes for the refinery.

Local employment grew especially in precarious service sector jobs. On the one hand in tourism, which offers seasonal work with a high degree of informality. On the other hand, the neoliberal rise of outsourcing turned formerly in-house and relatively secure jobs into flexible and riskier contractor employment. Both sectors are associated with a surge in the floating population. The vigorous Chilean *contratista* movement (Durán-Palma and López 2009) – which in Ventanas saw important mobilisations by the copper workers since the mid-2000s and the dockers since the mid-2010s – successfully mitigated the asymmetries between contractor and in-house employment, but significant disparities obviously remain.

As discussed above, wage differentials act as a divisive wedge within the working class, and were exacerbated by such trends. In 2021, the base wages of CODELCO Ventanas direct employees ranged between 360,000 Chilean Pesos (468 US dollars) and 1,300,000 Chilean Pesos (1690 US dollars) per month, but a significant portion of the actual wage is made of a long list of extra bonuses (CODELCO 2021). This means that – as confirmed by the interviews – CODELCO direct employee wages are significantly above both *contratista* wages – that, according to the 2022 framework collective agreement, should not be lower than 500 Chilean pesos (650 US dollars) per month – and the net median wage in Puchuncaví, which stood at 310,000 Chilean Pesos (403 US dollars) in 2020 according to Caracterización Socioeconómica Nacional (CASEN) estimates.

The effects of employment precarity were aggravated by Chile's weak welfare state. The targeted donations offered by the industries were deemed as insufficient by the interviewees, and community activists also saw them as prone to take clientelist slants. Most participants noticed how, despite the large production of wealth and pollution in the area, fenceline communities are deprived of basic services. For example, a dockers' labour leader asserted:

This place has been abandoned by the state. We should have a first-class hospital here, we should at least have a sewage network. There's none of this!¹³

In 2020, 32.1 per cent of the Puchuncaví population lacked access to basic services, compared to a national average of 13.8 per cent (BCN 2021a). Additionally, the multidimensional poverty rate in both Puchuncaví and Quintero was at about 27 per cent in 2017, compared to a national average of 20.7 per cent (BCN 2021a, 2021b). As often occurs, income and residential proximity to the polluting facilities are inversely proportional (Herrera *et al.* 2022).

The overall result is an employment and residential fragmentation of the working class, parallel to similar – albeit even more pronounced – trends in mining (Hernández Román and Pavez Ojeda 2012). Direct basic industry employees earn relatively high wages, but a significant share does not live in the immediate vicinities of the polluting factories, while fenceline community members are disproportionately in the low-paid jobs. This mismatch between workplace and community, shaped by wage hierarchies, increases the chances of intra-working-class tensions between those employed in polluting industries but living far from them and those living nearby but working in other sectors (Feltrin 2022).

The decoupling between the negative impacts of noxious production and its benefits turned Ventanas into an emblematic 'sacrifice zone', as the phrase gained popularity in Chile's public debate (however, this expression has also been criticised due to its dangers of stigmatisation). Nonetheless, such inequalities do not apply on a local or national scale only, they also reflect the global socioecological hierarchy analysed in the first section. As local activists sharply pointed out, Ventanas' industrial area is rather an 'extractivist area' (MUZOSARE 2020, p. 61), because even its factories are subordinated to Chile's role as a raw or quasi-raw copper exporter, whereby the virtual totality of Chile's red metal is further processed elsewhere.

Table 1. Chile's export of goods (percentage of total prices of exported goods in USD FOB).

	2003	2005	2007	2009	2011	2013	2015	2017	2019	2021
Mining	40.4	52.2	61.7	57.2	59.9	56.6	52.0	53.9	51.4	61.9
Copper	36.8	47.3	57.0	53.3	54.5	51.8	48.2	49.3	47.3	56.3
Cathodes	21.5	25.4	29.9	31.0	31.9	24.5	22.8	21.4	19.4	22.1
Concentrates	12.7	18.2	21.4	17.7	17.8	21.6	20.9	24.0	25.6	31.5
Other Mining	3.5	4.8	4.6	3.8	5.3	4.7	3.6	4.4	4.0	5.6
Agriculture/livestock, forestry & fishing	9.9	6.1	4.8	6.6	6.1	7.3	8.4	8.3	9.9	7.0
Manufacturing industry	49.8	41.7	33.5	36.2	34.0	36.0	39.6	37.8	38.7	31.1

Source: Calculated by the authors based on Central Bank of Chile data.

Today, Chile is by far the world's largest copper miner (26.3 per cent of global production) and the country with the largest known reserves (200 million metric tonnes) (S&P Global 2022). The 'commodity supercycle' deepened Chile's dependence on mining exports, particularly copper concentrates, which in less than twenty years saw a spectacular rise of 148 per cent in their share of total exports (Table 1).

Chile dominates copper extraction, but now industrial processing is mostly located in China at all stages: 47 per cent of global smelting, 42 per cent of refining, and 54 per cent of further usage, while Chile only refines 8.9 per cent of the world's copper (S&P Global 2022). Chinese competition, with its combination of more advanced technologies and lower wages, increased the minimum scale of profitable plants and pushed most Chilean smelters into the red, including CODELCO Ventanas (Pérez *et al.* 2021), which has been essentially subsidised by rents stemming from copper concentrate exports (see Castro Rivas and Kornblihtt 2023). China substituted Global North countries as the main raw copper importer with spectacular rapidity, given that in 1995 it only refined 8.9 per cent of the world's copper. Yet final manufactured products containing copper are made by Asian low-wage workers to be disproportionately exported to high-wage countries (Yu *et al.* 2014).

The interviewed actors had diverging views on how to address noxiousness and employment deindustrialisation in an extractivist context. The copper workers' unions embraced a strategy that could be called 'sovereign sustainable industrialisation' (see Salazar 2011, Palma 2014), in which state-led endogenous technological development would push Chile further up the commodity chain of the 'metal of electrification', reducing pressures to extract raw materials at a fast rate or to process them with outdated machinery. For example, a Ventanas union representative said:

I'm not for working at any cost. I also declare myself a defender of the environment, I don't want the damage to continue, I live here with my daughter and grandchildren, so it'd be an abomination to say I'm not interested. It's all about investing in environmental responsibility. [...] If you want to progress with renewable energy, you'll need copper most! Copper will run out and this country is not smelting and refining it, it just delivers the concentrate. Chile can comply with the carbon reduction agreements only by stopping to ship the concentrate, smelting all the copper here.¹⁴

Instead, community organisations, such as Mujeres por el Buen Vivir (see Gudynas 2009, Varea and Zaragocin 2017), challenged the very idea of the expanded industrialisation of natural resources. Activist Marta Aravena declared:

If we change our vision of how we develop life, we'll start consuming less, there will be less companies, less everything. [...] We need to build hope in the sense of teaching that happiness is in what people have. It's not brutally working all day long to amass a bunch of stuff, it's developing and enjoying your life.¹⁵

These perspectives are not totally irreconcilable, they rather constitute – to use García Linera's phrase – a 'creative tension' about which priorities to follow (García Linera 2011). In Ventanas, the practical point of contention was the fate of CODELCO's smelter, with the copper workers' unions claiming further investments in cleaner technologies and several community organisations demanding its closure. A new episode of mass contamination, occurred on 6 June 2022, led CODELCO and the government to announce the smelter's gradual decommissioning, along with plans to relocate

all direct employees to other CODELCO plants, assist outsourced workers in finding alternative jobs, and build a larger ‘mega-smelter’ elsewhere in the country.

The S&P Global report quoted at the beginning, however, runs counter the perspectives of both our union and environmentalist interviewees: ‘The [copper] shortfall will worsen if mine developments and utilization rates are suppressed by disruptions from labor strikes, protests, environmental activism, domestic political rivalries, governmental shifts, and contractual disputes and renegotiations’ (S&P Global 2022, p. 66). Such a thirst for raw copper and other ‘critical minerals’ is a symptom of the green capitalist approach to global heating which, simply put, promises to substitute fossil fuels with renewables while leaving the core structures of the global economy untouched. It is however doubtful that an energy transition based on the permanence of productivism and steep global inequalities – including the relegation of some areas to an extractivist role – will be successful in tackling the ecological crisis.

Conclusion

Noxious deindustrialisation is a planetary reality, meaning that in both the Global North and South there are fenceline communities facing the loss of manufacturing employment while polluting industries remain in operation. Nonetheless, each local experience of this paradox varies depending on contextual factors. By analysing the employment and environmental history of Ventanas’ copper industry, we argued that a key element shaping patterns of local noxious deindustrialisation is the mode of insertion of the affected area in the international division of labour and noxiousness.

Colonisation in the Global South was a condition for the industrialisation of the North, which still dominates the technological frontier. This means that noxious deindustrialisation in the Global North can more easily be mitigated through the deployment of cutting edge industrial technologies and the expansion of good-quality employment in services. However, even in the Global North, there are many ‘left-behind places’ characterised by laggard, highly polluting industrial processes and depressed labour markets (Bez and Feltrin 2023).

In a Global South and extractivist context like that of Quintero-Puchuncaví, noxious deindustrialisation is marked by the economy’s reliance on rent-bearing primary product exports. Here, industries stemming from downstream ‘forward linkages’ to mining usually operate with laggard technologies and therefore fall below the best environmental standards, yet their simple closure results in a deepening of extractivism itself. Additionally, most employment outside large-scale mining and industry is significantly worse in such areas than in the Global North. Future research could investigate the workings of noxious deindustrialisation in Global South countries inserted in the global economy on the basis of ‘cheap labour’ rather than ‘cheap nature’.

The shift to renewables and further digitalisation – the emblem of the green-capitalist quest to reach ‘net zero’ greenhouse-gas emissions by 2050 – is projected to inflate the demand for ‘critical minerals’, including copper and lithium. However, this energy transition is unlikely to deliver if it remains confined to the realm of technological fixes, without also changing the social relations shaping trajectories of innovation. In this sense, it is also necessary to make political space for a more balanced international division of labour and noxiousness. This is not about ensuring a ‘fair share’ of wages and pollution to all, it is rather a step towards reducing the global intra-working-class stratification that stands in the way of the decommodification of production and nature needed to address the ecological crisis. In the absence of transformations in this direction, the energy transition will merely intensify extractivism and perpetuate – in new forms – the global socioecological hierarchy.

Notes

1. Dussel (2001 [1988]) takes issue with Marini’s formulation that ‘the foundation of dependency is the super-exploitation of labour’ (Marini 2022 [1973]). However, it seems clear from Marini’s work that – just like Dussel – he considered low wages to be a consequence of laggard endogenous technological development.

2. Iñigo Carrera and his associates refuse theories of unequal exchange. However, a discussion of the divergences between this school and dependency theory is beyond the scope of this paper.
3. Interview with a retired ENAMI/CODELCO Ventanas employee, Valparaíso, 12 January 2022.
4. Interview with a retired ENAMI/CODELCO Ventanas employee, Viña del Mar, 12 November 2021.
5. Interview with Mario Cisterna, a former ENAMI Ventanas employee and political prisoner, Puchuncaví, 20 January 2022.
6. Interview with a retired ENAMI/CODELCO Ventanas employee, Viña del Mar, 12 November 2021.
7. Interview with a former ENAMI Ventanas employee and political exile, online, 1 March 2022.
8. Interview with Rafael Maldonado, a former ENAMI Ventanas employee and political exile, Santiago, 22 February 2022.
9. Interview with a retired ENAMI/CODELCO Ventanas employee, Viña del Mar, 12 November 2021.
10. Interview with Luis Guerra, a retired ENAMI/CODELCO Ventanas employee and union representative, Viña del Mar, 9 November 2021.
11. As writing, one is under way.
12. Calculated by the authors based on Chilean Census and Internal Fiscal Services data.
13. Focus group with five Puerto Ventanas employees and union representatives, Chocota, 23 November 2021.
14. Interview with an ENAMI/CODELCO Ventanas employee and union representative, Quintero, 4 November 2021.
15. Interview with Marta Aravena, a Puchuncaví Council employee and community activist, Horcón, 5 November 2021.

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Ethics declaration

The fieldwork for this research involved human participants, who have provided informed consent by receiving and approving an appropriate research information sheet. This fieldwork was approved by the University of Birmingham's Humanities and Social Sciences (HASS) Ethics Committee (application number ERN_21-0822).

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