

# Reinforcing path marginalization: revealing the unaccounted labour organization at a mining frontier in Indonesia

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How could we conceptualize path development taking place in regions dominated by extracting industries and subsistence economies? The article expands existing Evolutionary Economic Geography theory by focussing on extractive economies in a peripheral region that has, thus far, barely been covered. It challenges existing conceptualizations by highlighting a tin producing island in Indonesia. The article introduces the concept of path marginalization and its reinforcing mechanisms that explain the dynamics between large and artisanal mining activities. It examines how the mining path is reproduced by the interaction between multiple forms of labour organization that are normally unaccounted for.

**Keywords:** path marginalizing, reinforcing mechanisms, mining industry, subsistence economies, reproductive labour, Indonesia

**JEL Classifications:** B52, O17, Q3, B

## Introduction

Large infrastructures of the mining industry have gained increasing relevance in line with intensified digitalization, renewable transition and green growth. These processes of extensive modernization unfolding at a global scale have economic, social and environmental implications for local economies and hosting communities. This is particularly relevant as the manufacturing of key equipment and components depends on the constant supply of metals and other critical raw materials. In regions specialized in extraction of a non-renewable natural resource we could imagine that depletion of an ore may undermine an existing industrial trajectory, and spur initiatives of post-extractive diversification. Yet, the opposite appears to occur. There is a general agreement that diversification seems more challenging in resource-dependent economies located in peripheries with highly specialized extractive industries (Ross, 2019; Breul and Atenza, 2022). Resource-rich countries might experience diversification at an aggre-

gated national level, yet extractive localities seem to face difficulties in diversifying their economies (Syahrir et al., 2020). Peripheral regions typically have poor endowments in technology and innovation that propel economic diversification (Isaksen, 2015) and extractive industries have proven to reinforce dependency in mining enclaves on the sites of production (MacKinnon, 2013; Arias et al., 2014; Mateo-Peinado, 2022).

In mining enclaves, an extensive subsistence economy serves a vital reproductive function for people in maintaining their livelihoods and forms a source of surplus for families lacking access to formal employment and public social services. We thus ask: how could we conceptualize path development taking place in peripheral regions dominated by extractive industries and subsistence economies? This question helps us understand how key industrial sectors, such as the mining industry maintain their activities, and what the implications for the economic evolution of regions are. As extractive industries appear crucial for recent development in the

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world economy due to the increasing push in energy transitions and digitalization reliant on critical raw materials, there is a quest for further conceptualizing path development regionally.

Evolutionary economic geography (EEG) has been instrumental in understanding the processes of path development in regional economies (Martin and Sunley, 2006), yet new approaches are required to reinterpret the foundations of the geographical political economy of global capitalist development (Pike et al., 2016; Martin and Sunley, 2022) and its connection with the expansion of the extractive frontier. Studies on path dependency have mostly been limited to understanding the conditions in the industrial market economy that lead to extension or diversification, focussing on how new technologies, innovations, knowledge linkages and external investments can avoid lock-in phenomena (Isaksen, 2015; Isaksen and Tripl, 2016; Martin and Sunley, 2022). Far less attention is paid to the articulation of the out-of-market interdependencies in the economies that lead to its continuation and contribute to processes of capital accumulation at a global scale.

The aim of this article is 2-fold. First, we aim to expand EEG theory that traditionally has focussed on the market aspects of an industry by examining the interconnections outside the market economy that allows its reproduction. In developing the concept of *path marginalization*, we firstly explain how unrecognized forms of labour organization become reinforcing forces that sustain the mining industry. Second, we aim to study mining economies in peripheral regions that have nearly been excluded from EEG discussions. A focus on the mining industry allows us to highlight the intricacies between large-scale mining (LSM), artisanal and small-scale mining (ASM) and other unaccounted economies. To recalibrate the research agenda, we highlight a case study on tin extraction in Belitung, Indonesia and examine the relation between industrial LSM, ASM, other forms of subsistence and reproductive labour. We argue that as minerals deplete, the industrial mining economy secures itself by forcing its marginal expansion to new frontiers of land and labour and reinforcing a dependency on out-of-market (semi- or non-capitalistic) forces that support its maintenance.

In the next section, we point at two gaps in the EEG literature connected to the analysis of path dependence in peripheral regions. The third section discusses the dynamics between LSM and ASM and introduces the interconnected forms of labour organization that reproduce the industrial path of mining. We then presents our case study and the historical narrative of tin path development in Belitung. Finally, we conclude by highlighting the article's contributions to EEG, reflecting over context-informed conceptualizations for future EEG analyses.

## EEG and path dependence in peripheral regions

EEG has become an influential strand of research within economic geography, and path dependence is a key concept among many economic geographers. Path dependence is understood as 'a road map in which an established direction leads more easily one way than another' (Walker, 2000, 126). It is based on ideas such as increasing returns leading to self-reinforcing processes and endogenous sources of change that may lead to an irreversible lock-in, whereby industry is transformed from within over time (Arthur, 1996; Henning et al., 2013). In mapping regional path dependence, Martin and Sunley (2006) identify seven different sources of path dependence, where the first one is the natural resource base. Yet, natural resources seem mostly left out of subsequent EEG debate on what shapes path dependence of regions.

Proponents of EEG have particularly investigated how industries and technologies within regions drive regional innovation and diversification processes (Frenken and Boschma, 2007; Neffke et al., 2011). In the process of diversification, core regions and clusters draw on a combination of different knowledge bases, technologies, a wide set of supporting organizations, research and development resources and vital entrepreneurial culture that spurs knowledge spillovers and consequently create new industrial paths (Boschma and Frenken, 2011; Neffke et al., 2011; Henning et al., 2013; MacKinnon et al., 2019).

Considering the above, EEG research has been quite firm-centric and focussed on applying quantitative approaches on endogenous changes (Frenken and Boschma, 2007; Neffke et al., 2011). A few studies also tend to rely on institutional approaches to path dependence (Evenhuis, 2017) and path creation, including global production networks (MacKinnon et al., 2019). Yet, we identify a first gap in the EEG literature as it tends to overlook the out-of-market economic relations that sustain the continuation of path development of specific sectors. Moreover, the research traditionally has a bias towards studies of core regions experiencing success in the manufacturing and service economies. Some recent contributions have addressed a multi-scalar view, and as such, taken non-local sources and influences more seriously (Hassink et al., 2019; MacKinnon et al., 2019).

EEG research has provided satisfactory explanations of path development in peripheral regions (Isaksen, 2015; Isaksen and Tripl, 2017). Academic attention in EEG is just recently paid to the extractive industries in emerging economies and peripheries (Breul and Atenza, 2022), despite the vast intellectual development related to the political economy/ecology of extractivism (Svampa, 2015; Bond, 2017; Bebbington et al., 2018; Smart, 2020). This is an important second gap of the EEG literature. Particularly in peripheral regions, the extractive industry has not been

connected to increasing returns (Arias et al., 2014), yet, extractive development has become locked-in in supplier regions by socio-economic structural conditions. Breul and Atenza (2022) detail the challenges that extractive regions face in attempting to diversify, and the need to pay attention to the regional context, conditions and economic structures, the temporality of cycles of boom and bust in such industries and the multi-scalar organization of transnational and sub-national actors. The authors suggest understanding the role of institutions in the way extractive industries influence local culture and how these institutions create or hinder diversification.

Since peripheral regions have, on their own, limited assets for economic diversification, they could thus be trapped into path extension in terms of continuity of the same industrial structure (Isaksen, 2015). Path extension corresponds with what Martin and Sunley (2006) characterize as positive lock-in as it points to increasing returns and incremental innovations taking place within existing industries (Isaksen, 2015; Isaksen and Trippel, 2016). In addition, Page (2006) suggests that negative externalities can create constraints, restrict choices and actions, and exclude other options for competing technologies. In this case, path extension may lead to stagnation and gradual decline of the industry due to a lack of resource renewal and even risk path exhaustion. Path exhaustion corresponds to negative lock-in as local firm's innovation potential is critically reduced or innovation is restricted to follow existing technology paths (Martin and Sunley, 2006; Isaksen, 2015). As long as the firms are unable to adapt to changes in technology and market, the regional industry could lead into decline (Isaksen, 2015, Isaksen and Trippel, 2016) (Figure 1).

The path development debate has explained how innovation, technology, knowledge and linkages are critical to avoid negative 'lock-in' in regions, while the focus is rather put on regions dominated by knowledge-intensive industries than natural resource-based regions. Due to depletion of resources, extractive industries are liable for decreasing returns. Some recent and exceptional contributions have highlighted the diversification challenges of resource-based regions. Hu and Yang (2019) for example show how institutions shape path development, depicting further difficulties for resource-depleted cities in China

trapped in path extension. In the city of Fuxin, a coal mining region, national authorities (in concert with the local state) stimulated the agriculture sector and later wind power industry as workforce alternatives. New mining openings in a neighbouring region led former miners to return to mining and trapped the city in institutionalized relations with less capabilities for economic diversification that resulted in path extension (Hu and Yang, 2019).

In contrast to path extension, we argue that other processes exist that feed the continuation of path dependence in peripheral resource-based economies, that is *path marginalization*. *Path marginalization* does not necessarily lead to the definitive end of a path. When extractive sectors organized by classical capital-labour relations experience diminishing returns (increasingly less surplus per unit of product) a process of *path marginalization* tends to be put in motion that forces the creation of marginal spaces of accumulation. *Path marginalization* would seem to result in path exhaustion, but prevents full depletion through spatial expansion into other land frontiers and the absorption of informal forms of labour exploitation.

One mechanism in *path marginalization* forces the expansion of the extractive frontiers into more marginal lands encroaching towards new ore deposits and/or contested spaces, which give increasingly less surplus per unit area (Arthur, 1996). Hu and Hassink (2017) reveal for example that in Fuxin, China, when facing coal resources exhaustion, local state actors and the mining company have sought for new coal-rich frontiers for path extension. The expansion of the extractive frontier in the region creates a spatial fix where capital mobilizes to ensure sufficient value creation and where labour moves to ensure their reproduction (Harvey, 1982). Moreover, such expansions are likely to set the industry in conflict with other local economic and alternative land uses. Evidence of extractivism-led conflicts has been quite notorious in the case of primary-producer regions (Dietz and Engels, 2017; Banoub et al., 2021).

In addition, we suggest a second unaccounted mechanism of *path marginalization* in which forms of labour organization in the outskirts of the market economy sustain whole economic systems. This mechanism explains under what conditions businesses, in their pursuit to capital expansion, rely on certain forms of labour organization

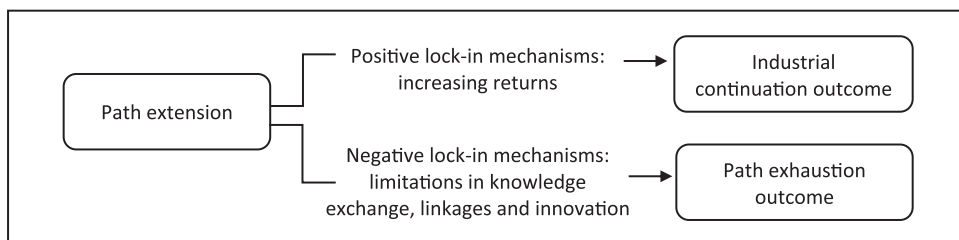


Figure 1. Path extension processes and outcomes.

outside the formal boundaries of the economy under observation (Benzanson and Luxton, 2006).

In explaining the labour maintenance of *path marginalization*, we seek inspiration in the literature of petty commodity production and social reproduction theory (Friedmann, 1978; Pansters, 1985; Bhattacharya, 2017) to examine the multiple forms of unrecognized labour that sustains the drive for capital accumulation. This helps us understand transformations of labour organization in which variegated forms of subsistence and reproductive economies become predominant in the economic dynamics of the extractive industry. To the best of our knowledge, such mechanisms are rarely discussed and conceptualized in the EEG literature. There are such reflections in labour geography debates discussing the role of social actors and livelihoods (MacKinnon, 2017), yet most of the EEG debate, however, neglects how industrial processes of capital accumulation absorb subsistence and reproductive labour in response to economic change.

We define the concept of *path marginalization* in extractive industries as a process explained by two different reinforcing mechanisms: (i) the expansion of the extractive frontier and (ii) the encroachment of out-of-market labour relations. As such, our conceptualization of ‘reinforcing’ deviates from the conceptualization of self-reinforcing associated with increasing returns in classical evolutionary economics. Self-reinforcing is generally related to endogenous actions or circumstances leading to positive lock-in such as innovations and knowledge spillovers actively motivated by existing industries. Instead, we look at the semi- or non-capitalistic forces included in *path marginalization*. In doing so, we unpack key mechanisms in which the mining industry is not maintained only by transformation *within* its own market economy, but by the labour interactions that occur *outside* the market economy. These reinforcing mechanisms point at the diverse socio-economic relations and multiple and interconnected forms of labour organization, which are historically produced, and establish relations of dominance and subordination in the socio-economic organization (Massey, 1995) (Figure 2).

We illustrate how ASM mining, subsistence and reproductive labour, prominent in precarious communities hosting extractive industries, feed the continuation of the

extractive activities as mineral extraction rests on the reproduction of semi- or non-capitalistic forms of labour organization (Arboleda, 2022). Understanding the historical element helps us circumscribe past and present forms of economic relations, subsistence and reproductive labour, and non-capitalistic formations that are part of the extractive industry in peripheral regions.

## Extractive industries and its associated economic practices

Much critical literature has presented the extractive industry as part of a capital-oriented project that locks regional and national economies in paths of dependency of primary extraction (Ross, 2019; Purcell et al., 2017). The expansion of extraction already has large consequences for path developments that lock local, regional and national economies (dependent on non-renewable resources) into low-added-value forms of primary production, particularly in peripheral regions (Breul and Atienza, 2022).

In such regions we could, however, imagine contradictions in path extension as the depletion of the resource may prevent the continuation of its existing path. We argue that this is counterbalanced by processes of *path marginalization* as extraction of non-renewables makes them inherently expansive. Mining is based on the extraction of non-renewable resources from earth, which eventually creates (sometimes perceived) scarcity due to the continuation of this activity. As ores deplete, LSM expands to novel territories causing conflicts over the use of land/sea and long-lasting impacts among the affected population, the environment, forcing dispossession and resource appropriation (Kramarz et al., 2021). While corporate initiatives have presented LSM as ‘smarter’ and a socially responsible industry, questions regarding socio-economic and environmental degradation remain of prime concern (Kemp and Owen, 2018).

The expansion of the extractive frontier has generally been enabled by mechanization and use of highly specialized technology, which has resulted in commodity-widening/deepening/transforming of land all around (Moore, 2015; Banoub et al., 2021). In many mining

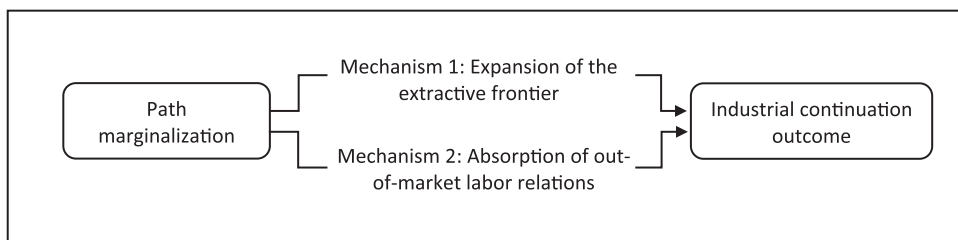


Figure 2. Path marginalization processes and outcome.

locations, the alienation of workers occurs at the same time as the systematic dispossession of rural lands and the degradation of other forms of livelihoods in the region, which increases poverty, inequality and violence (Bond, 2017). In a study connected to EEG, Mateo-Peinado (2022) reveal for example how increasing mining activities led to the reallocation of water rights to the mining regions in areas that highly depend on water for other livelihoods such as agriculture or the environmental functions, preventing the diversification of economic activities (Vela-Almeida et al., 2018).

Under these conditions, the ability for innovation in non-extractive sectors and prospects for post-extractive economic diversification is constrained in the name of supporting competitive advantages based on resource extraction (Walker and Minnitt, 2006). This situation mainly benefits the profit maximization of multinationals that negotiate favourable conditions from the hosting countries (Kemp and Owen, 2018). Locally, it creates an economic enclave of resource extraction reinforced by transnational demands for constant supply of raw material (Bury and Kolff, 2002) and accentuates processes of rent grabbing among elites, clientelism and corruption (Cuvelier, 2019).

The literature on extractivism has emphasized on the one hand the expansion of corporate LSM and on the other hand, the growth of ASM. While these trends have mainly been studied in isolation, Verbrugge and Geenen (2019) suggest these two sectors are interconnected, and they are both the outcome of the same structural process within the increasing global demand for raw material. ASM is, however, attached to stigma and its informality is a matter of rejection or even criminalization as deemed illegal, while (foreign) LSM enterprises tend to be favoured by current mining laws (Hilson, 2011).

ASM is defined as a low-tech mining activity involving minimal mechanization, often conducted informally, with low-capital investment and high labour, higher occupation risk and with limited access to support services (Hentschel et al., 2002). This type of mining operates often outside safety, health and environmental regulations, and expands often into new unlicensed lands or marginal deposits that are not profitable for LSM. Although ASM operates outside the frontiers of law, it contributes to regional mineral output and creates direct and indirect employment opportunities for people (Hilson and Maconachie, 2020). Contrary to LSM, ASM represents a significant source of livelihoods for millions of impoverished people worldwide (Geenen, 2014); yet artisanal miners are largely marginalized workers with vulnerable and dangerous working conditions (Hilson and McQuilken, 2014). Artisanal miners may obtain social mobility and emancipation (Engwicht, 2018); still, new research illustrates that the world-wide expansion of ASM cannot be only explained by how it contributes to poverty reduction but

also as a capital accumulation process for capital-strong investors (Cortés-McPherson, 2019).

The expansion of ASM has created tensions with LSM as the co-existence of these two forms of mining tend to increase competition for the same resources, conflict and violence (Aubynn, 2009; Geenen and Verweijen, 2017). In other cases, ASM and LSM seem to share the same mining spaces, with artisanal miners working in less attractive zones of the concession with the condition of handing in or paying companies with part of the miner's production (Aubynn, 2009). Other studies illustrate that mining activities are governed by a plural rights regime consisting of a corporate operation, an 'authorized' artisanal mining, and an 'unauthorized' artisanal mining operation of which boundaries are relatively fluid and changing. These regimes occur due to the incomplete enforcement of regulations, which gives artisanal miners a possibility to obtain or maintain access to resources (Katz-Lavigne, 2019). Despite these findings, there is still incipient literature analysing the connection between these two forms of organizing mining economies and the ways in which LSM has largely profited from the labour of ASM.

Contrary to most assumptions, we claim that LSM and ASM, when occupying the same space, are not necessarily conflictive economic processes competing for the same resources. Instead, we illustrate how processes of *path marginalization* of LSM are sustained by reinforcing mechanisms that partly take place within ASM and other subsistence and reproductive forms of labour organization. More specifically, we argue that the *path marginalization* of the mining industry is sustained by emerging changes in the interconnected forms of organization of labour embedded in such reproduction. As such, a region does not only contain one economic structure but it is the result of long and varied combinations of economic relations, historically produced through new cycles of investments, institutional development and labour opportunities (Massey, 1995). This explains how economic relations of productive and reproductive labour (between LSM, ASM and other subsistence and reproductive economies) invisibly, but fundamentally, sustain the continuation of the mining industry and path dependence in the region.

During the 1980s criticism emerged against the dual separation between capitalistic-formal and traditional-informal economies, and instead focussed on understanding the structural alliance of both economic activities and how labour relations are articulated among them (Pansters, 1985; Bernstein, 1986). With that understanding, we examine complex linkages and dependent relations that coordinate the wider productive system. This framework urges us to focus on the continuum of economic activities not properly encompassed in the atomized dualism between a formal and informal economy (Moser, 1978). In our study, such interconnected forms of mineral extraction have created specific socio-economic

structures that define the regional processes of labour organization (Massey, 1995): its reproduction is defined by the interaction, combination and superimposition of these forms of labour. As we explain below, we see three forms of labour organization present in the interconnections between (i) the productive industrialized mining economy and the petty commodity production, (ii) the subsistence economy linked to associated livelihoods and (iii) the unpaid reproductive economy that sustains the lives of miners and their families. This is what we understand as part of the reinforcing labour mechanisms of path marginalization.

### Industrialized mining economy and formal subsumption of labour

The first form of labour organization occurs in the interstices between LSM and ASM that encompass the industrialized mining economy. Focusing on the formal aspects of the mining industry often sidelines the fact that resource extraction would not be possible and equally profitable without the precarious and cheap labour put in by underpaid, unskilled workers, often poor and racialized people in peripheral regions (Arboleda, 2020). The fact that ASM is the largest mining workforce globally, contributing to 44.75 million people's direct jobs and providing raw material in significant proportions connected to global value chains for critical minerals (World Bank, 2020), can attest to the extensive interconnections of ASM to the highly industrialized extractive economy globally. Even when the tendency of LSM is to reduce the number of workers by increasing automatization, mining heavily relies on the expansion of the number of precarious workers involved in the continuation of the industry, which is the labour required for the realization of value (Arboleda, 2020).

The forms of peonage or payment to companies for the artisanal miners' production described by Aubynn (2009) are forms of formal subsumption of labour that benefits the LSM economy. We claim that LSM profits from ASM by means of what Marx called a formal subsumption of labour, in which the labour of artisanal miners is autonomous, and capital has not stepped in to reorganize the labour process. This explains that artisanal miners tend to expand their mining activity without embedding themselves in the formal economy. Instead, formal subsumption occurs when wage-labour relations do not impose a reorganization of the mode of production or any technological change. Formal subsumption of labour takes place via petty commodity production. This could happen by selling a commodity or subcontracting, where the producer of the commodity holds the ownership of the means of production, including their labour (Chevalier, 1982). Generally, petty commodity producers exist as combined labourers within a capitalistic economy that engage in unpaid household labour. The scale of the production is small and the producer can use unpaid family labour,

while there is little to none capital accumulation (Gibbon and Neocosmos, 1985).

### Subsistence economy in diversified livelihoods and labours

A second form of labour organization occurs when ASM, as a productive system itself, is maintained through various networks of labour interdependence on other subsistence economies. In cases of family-labour enterprises integrated into the market, although not fully commoditized, their economy acts as an organization intertwined with an economy of subsistence, gender division of labour, generational roles and reciprocal ties. This organization constituted (at least partly) through non-commodifying relations permits access to the means of production oriented to satisfy their needs of reproduction (Friedmann, 1978; Bernstein, 1986).

The precarious labour relation between LSM and ASM explains the need for artisanal miners to supplement their income through side subsistence livelihoods in agriculture, pastoralism, tourism and fisheries (McQuilken and Hilson, 2018). Indeed, ASM is a source of direct (44.75 million) and indirect employment for 134 million people supporting ASM worldwide (World Bank, 2020). For example, women are normally not involved in the digging and heavy labour of ASM but contribute in other activities such as processing of ores, handling of leftovers and food provisioning to miners (Buss and Rutherford, 2020).

Miners engage in ASM to escape poverty (Tschakert, 2009), while others seek to reduce risk and diversify their livelihoods (Maconachie, 2011), or engage in mining with the hope to obtain more personal freedom and gain a prosperous lifestyle (Werthmann, 2009). A study from rural Ghana investigates the connections between smallholder farming and artisanal mining. In an economy experiencing hardship at the household level, migrant miners stick to ASM out of necessity as they lack skills and competences outside mining (Hilson, 2011). Bersaglio and Cleaver (2018) found that artisanal miners in Southern Tanzania operate through multiple livelihoods and changing institutions for resource governance. Miners are proven to adapt and be flexible in their livelihood's strategies, while exploiting the 'irregularities' in a changing institutional environment that allows them to continue to mine. Yet, their livelihoods are increasingly becoming precarious and beyond their control.

### Reproductive labour in unpaid subsistence economy

A third form of labour organization that fundamentally sustains the mining industry is the reproductive labour required to support the workers deployed in the productive realm. Social reproduction theory pays attention to unrecognized relationships of the economic system. It allows us to explore the relationship between the market

and out-of-market taking place in the economic system and to explore the multiple forms of labour organization that make for value realization. Social reproduction questions the social networks and human relations outside of the confinement of the workplace that maintain the existence of the productive economy (Bhattacharya, 2017). As such, the continuation of the mining industry depends on a plurality of social relations, including care work, wage labour and debt peonage, family labour and kinship, among others, in which capitalistic relations rely upon (Arboleda, 2022). The mining industry, as any economy, heavily depends on all the reproductive labour carried out by poor women that historically have assumed the responsibility of the life reproduction of people, including workers (Mies, 2014). Understanding the reproductive labour within any industrial process helps us recognize the essential value of the often-unpaid work for the sustenance of the society (Federici, 2020).

This consideration underlines a 'thicker' understanding of economic processes, in which most people in capitalist economies are able to subsist themselves by combining paid labour and unpaid reproductive labour interlinked in ways that cannot be separated from the same socio-economic process (Bezanson and Luxton, 2006). This can also help to acknowledge the unequal conditions assigned to female workers who run essential activities that are part of the economic sphere of any place. Social reproduction theory stresses that exploitation and commodification are incomplete processes that rely upon non-commodified socio-economic relations, which is presented in the out-of-market practices, as well as several forms of social solidarity and non-monetary circuits (Karatani, 2014). Not least in situations of workers being laid off and industrial closures occurring, reproductive labour is likely to be key to make enclave economies run. In other words, labour relations outside the market economy will compensate for the *path of marginalization* inside the market economy.

## Methods

We conducted 28 semi-structured interviews and participatory observation in Belitung, Indonesia between December 2019 and March 2020, followed by three online interviews in 2021. Participants included representatives from the Belitung district and other local government representatives, policy-makers, State-owned company PT Timah, representatives, artisanal miners, ex-miners, peasants and fishermen, community members and representatives of environmental NGOs. Questions focussed on the historical economic development of the tin industry in Belitung, the policies and actions for economic diversification and the role of tin mining in the local economy and people's changing livelihoods. Additionally, we conducted a document analysis of reports and articles tack-

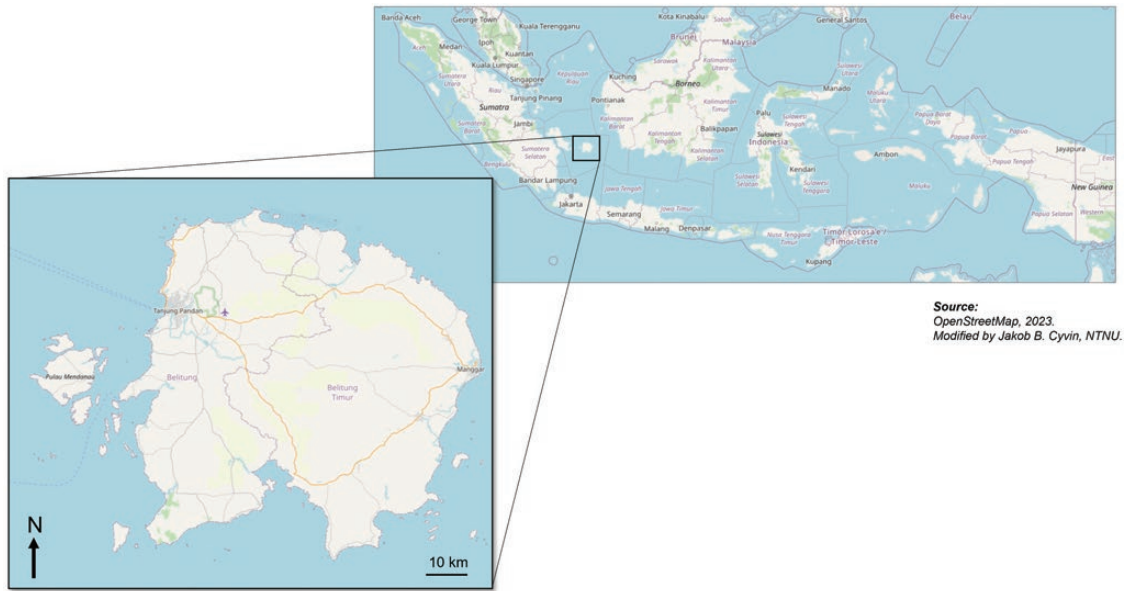
ling the history of the mining industry in Belitung. The resulting data permitted the construction of an empirically informed theoretical framework for understanding labour organization as reinforcing forces that sustain the tin industry in Belitung. By tracing the actions, decisions and strategies of actors, organizations and institutions in various contexts (Martin and Sunley, 2022), our paper presents a narrative historical account of the case study to acknowledge the contexts and mechanisms defining *path marginalization*.

## Historical account of path marginalization of a tin mining enclave in Indonesia

Indonesia is the world's second-largest tin exporter today. 99% of the country's extraction comes from the two-islands-province of Bangka-Belitung (Sulista and Rosyid, 2022; Diprose et al., 2022) and tin mining accounts for 26% of the province' GDP (Dahnur, 2019). This region has been known for its tin industry since 1860 when Indonesia was a Dutch colony. At that point, extraction was based on western capital, Chinese technology and migrant labour (Kaur and Diehl, 1996). As the colonial administration started to involve local people in tin mining, a large share of the island's population became rapidly acquainted with this activity (Heindhues, 1991; Ibrahim, 2016). After independence, the industry was nationalized (1953), tin was classified as a strategic resource and from 1976 extraction was managed by the newly established state-owned enterprise PT Timah. PT Timah sustained a mining enclave and fostered tin-dependent economic growth, with a high proportion of the population of Belitung possessing direct or indirect jobs associated with the industry.

The presumed depletion of tin reserves and the plummeting of global prices led PT Timah to divest assets from Belitung island (Figure 3) in the early 1990s. Towns succumbed to high levels of poverty and massive unemployment of ex-workers surged. The mining path appeared to end in path exhaustion. PT Timah concentrated their mining activity on the neighbouring Bangka Island. In the wake of the company's withdrawal, ex-miners struggled to find other livelihoods, and for many self-employment in subsistence farming, fishing and tourism were their most reasonable options. Since then, workers found employment in traditional pepper cultivation and newer palm oil plantations, and small-scale tourism as the sector attracted investments since the late 2000s. These various livelihoods became essential for social reproduction of the local economy.

Following the fall of the Suharto regime in 1998, tin lost status as a strategic resource to be managed under the central government and the authority for licensing tin extraction was transferred from central to the provincial



**Figure 3.** Belitung Island and its position in Indonesia.

and district governments. In the wake of the economic crisis and political transformation, people dedicated themselves to artisanal mining as tin extraction was not a sophisticated process nor did it require high-tech or capital investment. ASM tin extraction and smelting became an alternative livelihood for an increasing number of people at Belitung and a significant drive of local wealth. Even though in the early 1990s PT Timah regarded tin reserves in Belitung depleted and international price succumbed, artisanal miners recognized remaining deposits were available for them, which made ASM worthwhile to expand. *Path marginalization* took place not just in terms of the expansion of the extractive frontier but also in terms of the encroachment of out-of-market labour relations.

The first decade of the 21st century marked a boom in ASM tin extraction in the wake of the implementation of the decentralization policy in 2001. In 2006, 75 mining concessions, 37 tin smelters and 6507 artisanal tin mining units were in operation at Bangka and Belitung together (Yunianto 2009). The new structure in the local tin sector propelled a remarkable increase in tin production and led to a significant contribution to local revenues, including increasing income for the artisanal miners (Erman, 2007; Sulista and Rosyid, 2022). The district government of Belitung implemented their own mining regulation to capture revenues from remaining deposits and handed locals permits for ASM. ASM appeared as an attractive option but labour's occupational adaptations were flexible in the face of fluctuating market prices and thus balanced with alternative livelihoods availability. Most artisanal miners produced petty commodities by working in circumscribed locations and operating their own technology, some ex-

tracted in their own backyards, and a few extracted individually on unattended land.

After tin decentralization in the early 2000s, artisanal miners were not committed to deliver to PT Timah and sold their tin to other buyers. Meanwhile, PT Timah lost their monopoly and control over the tin supply chain. The growth of unauthorized mining activities, resulting in a drop of tin prices, turned to an existential threat for the company. During the following years, conflicts over shifting central and local regulations emerged and in 2004 the provincial government succeeded, at least formally, to hold stricter control, even though unauthorized practices (including smuggling of tin sand to Singapore and Malaysia) were present (Erman, 2007). During the mid 2010s, new regulations helped PT Timah to regain control over tin production and recapture market shares as a number of competing smelters and operators were pushed out of business. ASMs and smelters were forced to sell tin to PT Timah that exclusively held export approval (Diprose et al., 2022).

Along a chain of middlemen and informal smelters organized through trade, the tin entered once again under the control of PT Timah for further processing and export of tin from Indonesia. Yet, the *ex-ante* forms of labour organization become unaccounted for in the tin mining industry. Despite PT Timah not being primarily involved in the exploitation of tin in Belitung, processes of capitalist accumulation persist through a formal subsumption of labour in which artisanal miners sell the tin they extracted to PT Timah or another large mineral company. Meanwhile, PT Timah avoids liability over labour regulations, health risk management and environmental commitments to



land restoration. In this case, the integration of informal workforces into the tin value chain where the company exploits the labour of artisanal workers, as well as the expansion of mining into newer lands, expresses processes of *path marginalization*.

Alliances between the elites, miners and middlemen protect each other from being fined or punished for illegally mining on unauthorized land, like miners communicating when the police come to inspect. The company has retained its mining concessions in large parts of the island and a fluidity of mining rights regime between ASM and PT Timah occurs with authorized concessions and 'unauthorized' but tacitly accepted ASM. PT Timah managed to cost-shift its responsibilities over tin production to artisanal miners whose income reliance on mining has put them in a situation of informality, or in many cases illegality. This case illustrates the interconnected forms of labour organization sustaining the tin industry are socially expanded and historically enhanced over time by the non-marketized relations and interplays between the formalized LSM and the subsistence ASM activities.

A pertinent question is why a company is willing to lose the ability to make tin extraction more productive by organizing production in the form of capital-intensive and highly mechanized forms of LSM? The answer lies in examining the *path marginalization* mechanisms that explain how miners are left working with the residual reserves in less metal-rich landscapes. Because of the scarcity of resources, labour tends to rely on artisanal or small-scale miners as industrial mining eventually becomes unprofitable. Yet, it is in the outsourcing of costs and risks that the company can improve its cost-benefit while miners work for less than the cost of reproducing themselves. This form of formal subsumption of labour makes petty commodity production essential for the continuation of the mining industry, while PT Timah and other private smelters continue to benefit from not being the ones to organize the extraction of tin in many locations.

Petty commodity production is always articulated within a wider social formation and pre-existing economic structures. It performs an important role within the capitalistic system as it facilitates the extraction of surplus value for market-based economies that obtain a cheap supply of resources that otherwise are unprofitable or non-competitive for certain forms of large-scale capital (Moser, 1978). As such, the interconnected forms of labour organization do not create a tension between ASM and LSM, quite the contrary, it suits the industry to maintain the current conditions of production without accountability and secures the continuation of the economic system.

As an artisanal miner mentioned in an interview, mining is still present because it is internalized through culture and routines, and people stick to mining as they see 'no way out'. Yet, ASM is not a full-time job. Miners engage in side alternative jobs to support the subsistence of their households. Some people mine in the afternoon when

they have finished planting and some teenagers mine after school time. A malleability of livelihoods affords artisanal miners some degree of material autonomy as they engage in different livelihoods and operate under their own command. Many AS miners are skilful in adapting their multiple livelihoods to their particular needs and their interconnected labour organization grants AS miners a degree of flexibility in times of low tin prices.

We see these actions as a resilient strategy constituting a semi- or non-capitalistic domain that sustains household economies and the *path marginalization* of the mining economy of Belitung. People's livelihood adaptability remains precarious and with bounded options to sustain themselves. Although self-employed workers are able to be flexible and seem to be in control of their means of production, their labour is still subordinated to capital as it is defined by relations of unequal exchange. That is, cheap commodities and labour are sold to cover their means of reproduction under conditions where the capitalistic sector has control over the institutional means of accumulation: licenses, credits and contracts (Moser, 1978).

Meanwhile, *path marginalization* is also observable through the expansion of the extractive frontier. As the ore deplete onshore, the extractive frontier moves offshore with PT Timah's plans to develop large-scale mining into the sea around Belitung, which makes offshore extraction contested and subject of resistance. With reference to the environmental problems associated with offshore mining around the neighbouring Bangka island, this is a highly contested issue particularly among people that depend on fisheries around Belitung (Rosyida et al., 2017.) Plans for expansion have created conflicts with near shore fisheries and coastal tourism as it is expected to damage the corals and marine wildlife. Local resistance including street demonstrations since 2016 have so far prevented PT Timah from starting offshore mining around Belitung. Moreover, the central and sub-national governments have made concerted efforts to diversify the island's economy, by moving beyond tin extraction due to ongoing environmental concerns and depletion of reserves (Kusumah, 2017). However, the inner interconnected economic dynamics of mining in Belitung precludes miners to have access to the new jobs in professional sectors such as the hospitality service as their skills and knowledge are associated with primary production. As such, the nature of the extractive industry forces its expansion to new land, withdrawing natural assets (for example land and fisheries), while there is little investment in the formation of educated labour (for example lack of opportunities for artisanal poor miners). We see then that this *path marginalization* mechanism reinforces path dependence in Belitung.

A spike in the prices of global commodities has taken place in the wake of the COVID pandemic and the post-pandemic recovery, reinforcing tin extraction in Belitung. This explains how reinforcing mechanisms of the mining industry are sustained by the miners' flexible

adaptation to (or coping with) precarious economic situations in response to fluctuating prices of tin. Miners normally combine and switch between various subsistence economies supported by social reproduction functions at household and community level. Adaptations across gendered work appear to be a likely way to reorganize subsistence as part of the precarious market economy. The reproductive labour guarantees the survival of artisanal miners which secures the continuation of LSM production. This realm is mainly governed by the wives of miners because traditionally these essential activities fall disproportionately into women's shoulders. The different sources of income for the household are much supported by the diversified and mainly unpaid labour of the reproductive economy. This unaccounted form of labour maintains the market economic processes of tin extraction.

Miners' households are sustained by the non-commodified socio-economic relations that sustain the daily lives of people. As feminist economics has come far to stress this fact, we aim to be more specific about the context in Belitung. Women are not only in charge of most of the household activities, but they also perform additional forms of labour that sustain the mining economy. Some run stalls and provide food to miners, while others work in traditional mining using a cauldron or washing the tin residuals of the mining activity. We highlight some illustrative examples of the critical role of women connected to the reproductive labour that sustains household economies (Vela-Almeida, 2022).

We observed women collecting bamboo shells in Juru Sebrang on the west coastal side of Belitung. This is a former mine site and currently a popular local destination. When the sea recedes during low tide, dozens of women with small children gather on the shore to fill bags with bamboo shells they later sell or eat at home. In this space of labour women meet to collect food while children play. Another case is the Kelompok Wanita Tani farming project in Air Selumar. Here women grow vegetables and medicinal herbs in a communal space and in their home gardens in order to reduce their food expenses. Once a month, these women also gather for *Arisan*, a money lottery for helping fellows financially. Through this common practice of financial solidarity in Indonesia among groups of friends, family, members of an organization or neighbours, women in Air Selumar help each other economically and also provide family advice. These are just a few examples of the reproductive economy existing in Belitung that maintain non-commodified relationships among women and emotionally and materially support their households. These unaccounted but highly interconnected relations crucially maintain the mining path in Belitung by sustaining the lives of miners and other labourers in general.

## Conclusions

This article fills two critical gaps in the EEG literature that have thus far been explored only tangentially or, indeed, neglected. Firstly, by tradition evolutionary economics investigates the economic changes from within and has concentrated on firms' dynamics. EEG has until recently overlooked the out-of-market forces that influence economic systems and lacks nuance on the forms of labour organization and exploitation that sustain the path development of key economic sectors. Converse to traditional arguments in EEG, it is not increasing returns or the modernization in the form of technology innovation (more mechanization) that is driving the mining economy in Belitung. The driving motor is its interdependence between the subsumption of labour, subsistence economies and reproductive labour that reinforces its industrial path. *Path marginalization* has theoretical implications in this regard. *Path marginalization* mechanisms mean that path dependency of the mining industry remains through interconnected forms of labour exploitation that are normally unaccounted for.

Secondly, this article provides conceptualizations relevant for extractive industries, which have not received much attention in EEG debate. Especially it contributes to theory relevant for peripheral regions specialized in primary production. Analyzing the effect of variegated forms of labour exploitation is paramount in future studies that could point at the implications for *path marginalization* in different resource-rich areas. We believe that this phenomenon is not taking place exclusively in the Belitung context, but is likely to occur in peripheral enclave economies highly susceptible to the expansion of the extractive frontier. Moreover, the conceptualization may be relevant for other extractive sectors such as the agribusiness and plantations, large-scale fisheries and aquaculture and tourism sectors, whose resource-based economies are inclined to expand into more marginal land. Given the current drive for expanding the commodity frontier globally, this dynamic of labour exploitation should receive further academic attention by EEG.

Capitalistic economies depend on the resource-based (land and labour) and the historical forces of production existing in particular socio-political frameworks in which they operate. Thus its forms of accumulation and path development will depend on the nature of the out-of-market (semi- or non-capitalistic) modes of production in which they interact. Our case study in Belitung suggests that these forms of labour organization are not transitional to stages of more industrialized mining economies but are rather sustained over time. In the case of depreciated industrial sectors, with decreasing access to resources, scarcity of resources and petty economies, these forms of *path marginalization* are likely to be maintained as it increases the possibilities of capital accumulation with diminishing mineral reserves, very apparent in enclave economies.

Since the tendencies in the evolution of capitalism is to expand the extractive frontier that dominates primary-producer peripheral regions, this could be seen as a lingering form of a spatial fix and integration into larger processes and structures of capitalism, even after official investment has ceased (Harvey, 1982). In understanding different forms of labour organization, we need to be careful of associating the role of subsistence economies exclusively with peripheral accumulation. These forms of labour organization are not an isolated phenomena within peripheral capitalistic economies, they play a role within the interdependent power relations of global chains of production, distribution and consumption. This is particularly important due to the current and future demand for critical raw material for green transitioning in industrialized countries as it implies an aggressive increase of extraction over the coming years, entailing growing environmental and social impacts (Voskoboinik and Andreucci, 2022).

Finally, *path marginalization* mechanisms also have methodological implications for EEG analysis and approaches. Whereas EEG so far tends to focus on firms and formal institutions, our study demonstrates the need to take informal institutions and interconnected forms of labour organization that largely escape recognition and enumeration into account. As the knowledge about *path marginalization* is dependent on regional contexts, we suggest this as a direction for future EEG research that will require contextual historical accounts and field work.

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