The Impact of Extractive Industries on Regional Diversification: Evidence from Vietnam

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Abstract:

Economic diversification is perceived as imperative to reduce resource-dependent economies' vulnerability to a broader resource curse. Despite its importance, we know surprisingly little about the relationship between natural resource-dependence and economic diversification. The few insights that exist, remain on a country-level. But, since the importance of natural resource extraction differs across regions in the same country, it would be odd to assume that the effects of extractive industries on the diversification performance would be felt evenly countrywide. Also, extractive regions in the same country can manage to develop new non-extractive industries with varying success. Understanding this relationship on a regional level is important in order to identify conditions under which diversification of extractive regions is likely to materialize. This paper therefore aims to bring the study of the relationship between extractive industries and diversification to a regional level. To this end, we analyze how the regional importance of extractive industries has affected the entrance of non-extractive industries to Vietnamese provinces between 2006 and 2010. Furthermore, the study investigates to what extent region-specific conditions – that is the regional industrial profile and institutions - moderate the effect of the regional presence of extractive industries on regional diversification. Our findings reveal that extractive industries tend to constrain non-extractive industry entries on a regional level. However, the results also show that adequate regional institutions can moderate this negative effect on the regional diversification performance. Thereby the study underlines the need and value of studying the relationship between extractive industries and diversification also on a regional level.

Keywords: Regional diversification, extractive industries, resource curse, relatedness, regional institutions, Vietnam

1 Introduction

Economies marked by natural resource extraction are routinely advised to promote economic diversification in order to reduce their vulnerability to a broader resource curse and to prepare for a future with depleted or less demanded resources (e.g. Gelb, 2012; International Monetary Fund, 2016; Furlonge and Auty, 2019). A diversified economy is less exposed to commodity price volatility, creates employment outside extractive industries and has the potential to increase productivity and income (Gelb, 2012). Overall, it has been shown that diversified economies perform better in the long term (Lederman and Maloney, 2007; Hesse, 2009).

Despite this imperative of economic diversification, we know relatively little about the relationship between natural resource-dependence or extractive industries and economic diversification. Understanding this relationship is central in order to be capable of designing effective measures (Ahmadov, 2014; Ross, 2019; Lashitew et al., 2020). Existing empirical evidence tends to reveal the struggles of resource dependent economies to diversify, although to varying degrees (Ross, 2019; Lashitew et al., 2020).

Yet, these existing insights remain on a country-level, even though extractive industries are spatially bound to particular regions within a country and their importance for regional economies varies considerably. Therefore, it is only reasonable to assume that economic consequences resulting from extractive industries, such as effects on the ability to diversify, also tend to be unevenly felt intra-nationally (Manzano and Gutiérrez, 2019; Atienza et al., 2021b). A region that relies by 90 percent on extractive industries will be confronted with different conditions for diversification than another region in the same country where extractive industries account for only 10 percent of the total regional economy. Moreover, commodity source regions in the same country can diversify away from natural resource extraction with varied success, since they are characterized by region-specific industrial capabilities and institutions. Therefore, understanding the relationship between extractive industries and diversification on a regional level is important in order to identify conditions under which diversification of extractive regions is likely to materialize. It would add to the yet limited understanding of the diversification performance of natural resource-dependent economies (Ross, 2019; Lashitew et al., 2020) and provide valuable insights for developing transformation strategies for extractive regions.

This paper therefore aims to bring the study of the relationship between extractive industries and the diversification towards new non-extractive industries to a regional level. To this end, we analyze how the regional importance of extractive industries has affected the entrance of non-extractive industries to Vietnamese provinces between 2006 and 2010. Through the empirical focus on the entrance of new non-extractive industries to regions, the study explores a crucial mechanism for diversification. Furthermore, the study investigates to what extent region-specific conditions moderate the effect of the regional importance of extractive industries on non-extractive industry entries. For the analysis we apply an industry entry model allowing to assess the influence of the aforementioned regional variables on the development of new non-extractive industries. Information on the provincial industrial dynamics are drawn from the Vietnamese firm census (VFC).

For the Vietnamese economy the extraction of mineral resources has been an important component (Nguyen et al., 2017). In 2006, natural resources rents accounted for 12.31% of the GDP (World Bank, 2021). At that time, about one fifth of the Vietnamese exports were mineral resources. Despite this focus, the Vietnamese economy has been able to undergo an enormous industrial transformation (Revilla Diez, 2016). Zooming in to the provincial level, both the diversification dynamics as well as the importance of extractive industries (see also figure 2) differ significantly. It therefore provides an interesting case to investigate to what extent and under which conditions the varying regional importance of extractive industries affected the diversification performance of provinces.

The findings reveal that extractive industries tend to have impeded the entry of new non-extractive industries. Yet, appropriate regional institutions can moderate this effect. The results thereby underline the regional dimension of the relationship between extractive industries and diversification.
The next section reviews how resource-dependence could affect economic diversification and elaborates this effect on a regional level. It follows a presentation of the case study Vietnam and a description of the methods. Section 4 analyzes how the regional importance of extractive industries has influenced the entrance of new non-extractive industries to Vietnamese provinces. The final section summarizes the main findings and discusses their contribution for the broader research agenda.

2 Extractive industries and diversification – from a national towards a regional perspective

"Resource abundance per se need not do any harm: many countries have abundant natural resources and have managed to outgrow their dependence on them by diversifying their economic activity. An important challenge to policy makers in many developing countries with abundant natural resources is to find ways to reduce their dependence on these resources, through successful diversification of economic activity." (Gylfason, 2005, p. 202).

A crucial first step to adequately address this challenging task is to understand how natural resource-dependence affects economic diversification. The **Dutch Disease** suggests that a specialization in extractive industries can act like a barrier to economic diversification in non-resource industries (see Gylfason, 2005; Ross, 2019; Lashitew et al., 2020). As Corden and Neary (1982) theorize, resource booms can decrease the competitiveness of productivity-enhancing nonresource industries and ultimately cause the displacement of the latter from the economy through two channels: the appreciation of the currency and increased input prices (for a detailed description see Harvie, 2019). First, increasing export volumes of extracted minerals will lead to the appreciation of the exchange rate causing a loss of competitiveness in other tradable non-extractive industries and an increase in demand for non-resource imports. Second, a booming resource sector withdraws factors of production from non-resource sectors, since the former is able to pay higher prices for inputs (e.g. wages, interest rates) than the latter. This resource movement effect increases prices for inputs and thereby crowds out non-resource sectors in the economy (Gylfason, 2005; Harvie, 2019). These two channels of the Dutch Disease, thus, describe how a boom in extractive industries can reduce the degree of diversification (especially export diversification) into non-extractive industries. It also suggest that the entry of new industries to the economy is likely to be hampered by a booming resource sector. There exists empirical evidence that supports the Dutch Disease effect on the degree of diversification. A study by Harding and Venables (2016) reveals that an increase of resource revenues by an additional dollar tends to reduce non-resource exports by 74 cents.
In contrast to the Dutch Disease , the **linkage-based approach** is more positive about the relationship between extractive industries and economic diversification. Building on the seminal work by Hirschmann (1981), the approach stresses the potential of different types of linkages (fiscal linkages, consumption linkages, forward and backward production linkages, horizontal linkages) from extractive industries that could promote industrial diversification (Morris et al., 2012; Bastida, 2014). However, if these production linkages are weak because they unfold elsewhere (e.g. Breul and Revilla Diez, 2021), the economy runs the risk of falling into a staple trap.
Existing empirical evidence reveals the struggles of resource dependent economies to diversify which rather reflect effects of the Dutch Disease and rent-seeking activities. Ross (2019) observes a divergence in export concentration between oil-producing countries and other countries in the period between 1962 and 2010. Ross (2019, p. 792) concludes that "oil exporters have developed the most narrowly-specialized economies in the global market". Consistent with these findings, Lashitew et al. (2020) reveal a poorer diversification performance of resource-rich countries between 1981 and 2014. However, the authors also identify resource-rich countries such as Indonesia and Laos that were able

to develop a growing manufacturing sector. Reforms by the government as a response to the oil price collapse in the 1980s are seen as one critical condition for the successful developments in Indonesia. For the case of Laos, Lashitew et al. (2020) outline that the attraction of foreign direct investment through suitable institutional conditions and international integration have been a cornerstone for developing new non-resource industries.

These studies make important first efforts towards improving our understanding of the diversification performance of resource-dependent economies. However, one should also consider that within resource-rich countries, effects of extractive industries on the ability to diversify are likely to be felt unevenly across regions.

(1) Extractive industries are spatially bound to particular regions within a country and their importance for regional economies therefore varies considerably. Recent studies that deploy a global production network perspective reveal the sub-national organization of extractive industries and thereby highlight these interregional differences in the same national context (e.g. Breul and Revilla Diez, 2018; Atienza et al., 2021a; Irarrázaval, 2021). (2) This is one reason why resource extraction "can have distinctive effects across local economies, as extractive regions face particular economic consequences unlikely to be observed in nonresource regions" (Fleming et al., 2015, p. 624; see also Orihuela and Gamarra Echenique, 2019). A burgeoning line of research on the subnational or regional resource curse has revealed this regional dimension of consequences stemming from extractive industries in the last years (e.g. Fleming et al., 2015; Cust and Viale, 2016; Carrillo Hoyos, 2019; Manzano and Gutiérrez, 2019; Gutiérrez Rodríguez, 2020). Besides macroeconomic implications (e.g. currency appreciation) that play out at the country-level, there are influences from resource extraction (e.g. resource movement effect) that operate on the regional scale (Fleming et al., 2015; Cust and Viale, 2016; Fitjar and Timmermans, 2019) and therefore rather affect the diversification performance of regions, not entire countries. For this reason, it is possible that a country manages to increase economic diversification and avoid the resource curse at a national level, while some extractive regions in the country still suffer from a very narrow resource-oriented industrial profile (see for instance Syahrir et al., 2020 who make this observation for the Indonesian context). (3) Another important argument for the need to study the effects of extractive industries on economic diversification on a regional level is provided by insights from Evolutionary Economic Geography (EEG) that show how the region-specific context shapes how regions diversify rather than national conditions (Boschma et al., 2013). According to these arguments, the effect of extractive industries on diversification is likely to be felt differently across regions within the same resource-rich country, since these are characterized by different conditions (e.g. importance of extractive industries for regional economy, existing industrial structure, regional institutions). National-scale analyses oversee these interregional differences which contain important explanatory power in regard to the relationship between extractive industries and economic diversification.

While the aforementioned global production network studies on extractive industries as well as studies on the subnational resource curse stress the need to acknowledge the subnational dimension of resource extraction and its broader developmental outcomes, its consequences for diversification have not been addressed yet. We argue that bringing the relationship between extractive industries and diversification to a regional level can especially benefit from insights of EEG and broader research on regional industrial path development since explaining how new industries emergence in space stands at the center of this line of research. In the following two subchapters we built on these insights in order to conceptualize how extractive industries affect regional diversification and how region-specific contexts, such as regional institutions, may condition to what extent these effects materialize.

2.1 Extractive industries as a component of the regional diversification environment

EEG and broader research on regional industrial path development provide helpful insights and arguments to bring the relationship between extractive industries and diversification to a regional level. In EEG the development of new industries is theorized as a regional branching process, where

new industries grow out of existing related ones. This conceptualization builds on two arguments: First, spillovers are more likely to take place between related industries (Frenken et al., 2007). Second, knowledge transfer mechanisms that drive diversification like firm diversification, labour mobility, and spin-offs underlie a regional bias (Boschma and Frenken, 2011). There exists ample empirical evidence that regions tend to diversify into industries that are related to the existing regional industry composition (Neffke et al., 2011; Boschma et al., 2013; Essletzbichler, 2015). Conversely, this means that a narrow set of regional capabilities due to high degrees of specialization - as often the case in extractive regions - can constrain regional diversification. In addition, more recent contributions stress that existing regional industrial structures not only provide an enabling environment but may also impede the rise of new paths, e.g. through competition over scarce resources or vested interests (Steen and Hansen, 2018).

In sum, these insights highlight that the existing regional industrial structure serves as an enabling and constraining environment for diversification processes. From this perspective, the regional presence of extractive industries would also shape this environment. But how could the regional presence of extractive industries affect a region's ability to develop new non-extractive industries?

On the one hand, the competition over factors of production (resource movement effect described in chapter 2) has the potential to contribute to a regional environment that constrains the entry of new industries. The demand for scarce resources such as skilled labor, capital, land and other natural resources (e.g. water in arid regions) by extractive industries can cause a crowding-out effect in other industries as resource rents in extractive industries allow firms to pay higher prices (Corden, 1984; Fleming et al., 2015). This effect not only draws away and increases prices for factors of production in already established industries in the region (see for instance Xie et al., 2021), but can also impede the mobilization of resources needed for the development of new industrial paths. In contrast to above described macroeconomic channels such as currency appreciation, different studies in various geographical contexts indicate that the resource movement effect operates at a regional scale. For instance, Xie et al. (2021) find that the concentration of extractive industries crowds out non-extractive industries in Chinese prefectures. In a study on 25,777 firms across nine resource-rich countries De Haas and Poelhekke show that "producers of tradeables that are close to active mines report tighter business constraints (as compared with similar firms that are not close to mines). These firms are especially hampered in their ability to access transport infrastructure and educated workers" (2019, p. 110). Thus, the consequences of competition over production factors stand in relation to the importance of extractive industries in a particular region[1] and therefore tend to affect the diversification performance of the region, rather than the entire country. Furthermore, Fitjar and Timmermanns (2019, p. 235) argue, that industries related to extractive industries are expected to be more affected "from resource competition, since they depend on more similar inputs, for example, employees with related skills". It suggests that industries related to extractive industries are less likely to enter into extractive regions due to the high-cost environment.

On the other hand, capabilities as well as demand effects created by extractive industries could create opportunities for new economic activities to emerge in the region. Building on the relatedness argument in EEG, Fitjar and Timmermanns (2019) expect especially industries that are related to extractive industries to benefit from knowledge spillovers. As knowledge transfer mechanisms are characterized by a strong regional bias (Boschma and Frenken, 2011), these opportunities could promote commodity source regions to diversify into industries related to extractive industries. A similar argument has been made by the linkage-based approach which argues that extractive activities can promote the development of different types of production linkages ranging from specialized (e.g. oilfield service firms) to less-specialized ones (e.g. construction, catering) (Morris et al., 2012). Here the emphasis of the argument is on the demand generated by extractive industries rather than on knowledge spillovers.

[1] It should be noted that the regional extent of this resource movement effect can be expected to be smaller in regions where extractive industries rely to a high degree on workers that use fly-in fly-out systems due to what Atienza et al. (2020, p. 297) call the "hollowing out of regional labour markets".

Summing up, the above describes two possible channels through which the regional presence of extractive industries can affect a region's diversification performance. It depicts how the presence of extractive industries can shape the regional diversification environment which will therefore differ from the diversification environment in nonresource regions in the same country. Based on these two opposed channels and in line with the approaches presented in section 2, Fitjar and Timmermans conclude that the regional "presence of resource industries can be both a blessing and a curse" (2019, p. 237). Their findings suggest that both influences can occur in parallel. Which of the two effects dominates depends, among other things, on the region-specific institutions which we will elaborate on in the next section.

In addition to these direct channels caused by the regional presence of extractive industries, other regional factors exist that affect the ability of extractive regions to diversify. Understanding regions as enabling as well as constraining environment for new path developments also emphasizes the fact that the remaining industrial structures of extractive regions matter for their capability to diversify towards non-extractive industries. This is why extractive urban agglomerations that host many other industries provide more advantageous conditions to develop new industries compared to peripheral extractive regions fully dominated by the extraction of resources (see also the discussion of Phelps et al., 2015 on the development prospects of different landscapes of extractive industries).

2.2 The role of regional institutions for diversification in extractive regions

Research of the last two decades has repeatedly shown that the quality of institutions is a critical determinant for avoiding the resource curse and turning resource wealth into positive outcomes (e.g. Robinson et al., 2006; van der Ploeg, 2011). While most research has focused on national institutions, a growing number of recent work points to the influential role of subnational institutions (e.g. Lawer et al., 2017; Manzano and Gutiérrez, 2019). A central argument is the increasing decentralization of resource governance over the last decades, where subnational governments have gained responsibility for enforcing regulations and investing resource revenues (Manzano and Gutiérrez, 2019). Fleming et al. (2015, p. 627) argue that "Unsustainable policies may have national effects, but also distinctively affect local economies through poor planning and strategic thinking when regions can appropriate and use some of the revenues generated by mining". This suggests that regional institutions may condition to what extent the regional presence of extractive industries affects a region's diversification performance. From recent research in EEG on regional diversification we know that regional institutions influence the ability of regions to diversify (Cortinovis et al., 2017; He et al., 2018). A central reason for this crucial role of institutions for diversification is that the existence of "knowledge is not sufficient, but that the right institutions are needed to turn this latent capacity into economic development" (Boschma, 2017, p. 357). Industry entry mechanisms such as firm diversification or the establishment of new firms rely on suitable institutions that ensure rewards for the productive use of resources. The institutional environment can therefore determine the direction of diversification processes (Boschma and Capone, 2015).

Based on these insights, we expect that regional institutions affect whether resource-dependent regions fail or manage to develop non-extractive industries. This does not mean that national institutions do not matter for the development of regions (see for instance Poncian, 2019). For instance, spatially blind policies such as the Chilean mining cluster policy (Atienza et al., 2020) can increase challenges that extractive regions face for diversification. However, since this paper focuses on interregional differences of the effect in the same national context, in the analysis that follows we concentrate on the role of region-specific institutions.

In the following we focus on two features of regional institutions that have been highlighted as influential whether new industries emerge and suit well to typical challenges faced by extractive industries – that is political lock-ins as well as the proactivity and openness of promoting new activities.

Political lock-ins are defined as "thick institutional tissues aiming at preserving existing traditional industrial structures and therefore unnecessarily slowing down industrial restructuring and indirectly hampering the development of indigenous potential and creativity" (Hassink, 2010, p. 452). The concept originates from Grabher's (1993) seminal work on the decline of the Ruhr area. He finds that strong alliances between the subnational government and the industry hampered the restructuring process and blocked the entry of new industries into the formerly successful mining and steel cluster. When relations between the politico-administrative system and the industry are too close, they run the risk of forming a self-sustaining coalition. Subnational governments might not see the need to diversify the regional economy and the dominant industry lobbies for sectoral policy interventions. This can create a biased policy environment towards the dominant sector, constraining entrepreneurial activities in other sectors. Hassink (2010) explains that especially mono-structured regions in sectors that are capital-intensive, marked by high entry barriers and overproportioned company size are prone to the appearance of a political lock-in. Thus, extractive regions are particularly endangered to suffer from political lock-ins. For instance, resource revenues could set aside the need for subnational governments to promote productive activities or postpone the implementation of reforms needed for enhancing competitiveness in non-extractive sectors (Fleming et al., 2015).

Consequently, opposed to a policy-bias towards preserving existing traditional industrial structures, openness to the development of new economic activities is crucial to promote the diversification away from dominant industrial structures. Research on new regional path creation emphasizes the influential role subnational governments can play in this process. Various case studies show that through proactive regional policies and the provision of facilitative conditions regions were able to develop new industries (Hu, 2014; Dawley et al., 2015; Isaksen and Trippl, 2017).

Building on these insights, the effect of extractive industries on diversification is likely to differ across regions in the same national context depending on the quality of regional institutions. In other words, we expect regional institutions to condition to what extent the effect of extractive industries on a region's diversification performance materializes.

3 Case study and methods

3.1 Measuring regional diversification in non-extractive industries

Existing empirical studies have used the growth of the manufacturing and services sectors (Lashitew et al., 2020) as well as measures of export concentration (Ross, 2019) to investigate the diversification performance of resource-dependent countries. They also underline the "need for further research with more disaggregated measures" (Lashitew et al., 2020, p. 29). Based on the insights from EEG (see section 2.1), a crucial shortcoming of diversification measures with a high level of aggregation is that it conceals the multitude of possible non-extractive industries which all have different likelihoods to enter into an economy. Various studies have shown that the probability of industries to enter a region is higher when they are related to existing regional industrial structures (e.g. Neffke et al., 2011). For instance, it is more likely for a coal mining region to diversify into manufacturing drilling equipment than into manufacturing air and spacecraft as the former can grow out of the existing coal mining path and draw from related capabilities. In order to consider these industry-specific probabilities of regional diversification away from the extractive sector we apply an industry entry model on a regional level - a common approach for analyzing regional diversification in EEG.

We make use of the Vietnamese firm census (VFC) between 2006 and 2010 in order to detect industry entries at a regional level. The VFC is conducted by the General Statistics Office (General Statistics Office of Vietnam, 2017). It provides information on firms' location in the 63 Vietnamese provinces, on revenues and the industrial classification (distinguished into the main and second activity). The latter follows the Vietnam's Standard Industrial Classification (VSIC) which differentiates at a four-digit level between 286 industries.

Based on this information we construct an industry entry measure *(Entry*) as binary dependent variable. In order to properly detect diversification dynamics, we consider a 5-year interval (for a similar approach see Cortinovis et al., 2017; Mewes and Broekel, 2020) between 2006 and 2010. The binary *Entry* variable is equal 1 if no firm is present in industry *i* in region *r* at the beginning of the period (2006) and if at least one firm enters industry *i* in region *r* within the 5-year period. The value of the *Entry* variable is 0 for any other scenario. Since, the study aims to understand regional diversification into non-extractive industries, we excluded all extractive industry entries, that is VSIC-codes 1000 to 1429, from the dataset[2]. Moreover, to make it an entry model, the sample is reduced to observations in which a new industry entry is possible. In other words, the sample includes all observations in which industry *i* is not present in the industrial composition of region *r* at the beginning of the period (2006). We apply a logit regression to estimate the probability that a new non-extractive industry enters into a region using the following model:

$$Entry_{i,r,t+5} = \beta_0 + \beta_1\, ExtInd_{i,r,t} + \beta_2\, RelDen_{r,t} + \beta_3\, SOEbias_{r,t} + \beta_4\left(ExtInd_{i,r,t} \times SOEbias_{r,t}\right) + \beta_5\, EntryCost_{i,r,t} + \beta_4\left(ExtInd_{i,r,t} \times EntryCost_{r,t}\right) + \beta_6\, GDPcapita_{r,t} + \beta_7\, Population_{r,t} + \varepsilon_{i,r,t}$$

The binary dependent variable $Entry_{i,r,t+5}$ indicates the status of diversification of region *r* into the new non-extractive industry *i* within the five-year period (2006 – 2010).

3.2 Explanatory variables

Regional importance of extractive industries

Our main explanatory variable of interest, *ExtInd*, depicts the regional importance of extractive industries. To quantify the regional importance of extractive industries we compute the share of revenue generated by extractive industries in region *r* at time *t*. Extractive industries are defined by the VSIC-codes 1000 to 1429. The data is obtained from the VFC.

Regional institutions

We make use of the provincial competitiveness index (PCI) in order to consider the role of regional institutions in the analysis (Vietnam Chamber of Commerce and Industry, 2021). The PCI has been conducted annually since 2005 by the Vietnam Chamber of Commerce and Industry and USAID. The PCI is constructed based on a business survey of about 7000 domestic private firms which is subsequently paired with economic data to avoid perception biases (Malesky and Taussig, 2009). Based on this data provincial-level scores ranging from 1 (worst institutional performance) to 10 (best institutional performance) are created for ten sub-indices. In order to approximate the degree of a political lock-in in Vietnamese provinces we include the PCI sub-index 'state-owned enterprise bias' (*SOEbias*). It measures "the perceived bias of provincial governments toward SOEs, equitized firms, and other provincial champions in terms of incentives, policy, and access to capital" (Malesky and Taussig, 2009, 259f.)[3]. Second, we include the PCI sub-index 'entry costs' (*EntryCosts*) which measures the entry costs of new firms for the 62 Vietnamese provinces[4]. The variable *EntryCosts* implicitly reflects the openness and efforts of provinces to promote new economic activities. In order

[2] This distinction does not allow to consider for possible linkage effects, e.g. that extractive firms hire non-specialized firms from non-extractive industries. Future studies would benefit from input-output-tables to explicitly take into account possible linkage effects.

[3] The PCI sub-index 'SOE bias' is based on survey responses to topics like "Provinces give privileges to state-owned economic group, corporations, causing difficulties to your business (% Agree) - Land access as a privilege to state-owned economic group (% Agree) - Credit access as a privilege to state-owned economic group (% Agree) […] - Faster and simpler administrative procedures as a privilege to state-owned economic group (% agree)" (Vietnam Chamber of Commerce and Industry, 2021).

[4] The PCI sub-index ‚Entry Costs' considers for instance the length of business registration, the number of licenses and permits required before starting operations, share of firms registering via one-stop-shops, etc. (Vietnam Chamber of Commerce and Industry, 2021).

to analyze to what extent regional institutions influence the effect of extractive industries on a region's diversification performance we created the interaction terms *ExtInd x SOEbias* and *ExtInd x EntryCosts*. The interaction terms allow to test whether the quality of regional institutions moderates or amplifies the effect of extractive industries on a region's diversification performance.

Relatedness density

Building on the insights from EEG that regional diversification is conditioned by existing industrial structures and regions tend to diversify into industries that are related to the existing regional industrial portfolio (see section 2.1), we include a relatedness density variable (Hidalgo et al., 2007) into the model. Relatedness density (*RelDen*) measures how close a potential new industry is to a region's industrial portfolio. On the one hand, we use the variable to control for the industry- and region-specific likelihood that a new non-extractive industry enters into a region based on how well it fits to the existing industrial profile. On the other hand, an interaction term between the relatedness density and the regional importance of extractive industries (*ExtInd x RelDen)* allows to test whether the effect of extractive industries on the diversification performance of regions differs across related and unrelated industry entries. In other words, it assesses whether the presence of extractive industries exerts an effect on the type of regional diversification as suggested in section 2.1.

RelDen is constructed in two steps. First, the relatedness between every pair of industries is measured. We follow approaches that measure relatedness based on the co-occurrence of industries in organizational entities (Neffke et al., 2011). If industries co-occur in many cases, it is expected that both rely on related capabilities. The VFC provides information on firms' main and second activity classified according to VSIC-codes at the four-digit level. Based on this information we count how often industries co-occur at firm level. The cosine similarity is applied to the co-occurrence of industries and provides a measure of relatedness between every industry pair (for a similar procedure see Mewes and Broekel, 2020). Second, we determine which industries are part of regions' industrial portfolios defined by the presence of at least one firm in a given four-digit VSIC-code.

Both inputs form the basis to measure the relatedness density following Hidalgo et al. (2007):

$$Relatedness\ Density_{i,r} = \frac{\sum_m \chi_m\ \rho_{i,m}}{\sum_m \rho_{i,m}}\ \text{x}\ 100$$

where $\rho_{i,m}$ indicates the relatedness between industries *i* and *m*. χ_m specifies whether industry *m* is present (=1) or absent (=0) in the region's industrial portfolio. The equation generates a 63 x 286 matrix containing the relatedness density for every 286 industries in all 63 Vietnamese provinces.

Control variables

Besides these main explanatory variables of interest, we control for further regional conditions at time *t* that have been revealed to be crucial determinants of regional diversification. Petralia et al. (2017) have revealed that regional diversification depends on the level of economic development. We account for this effect and include the provincial GDP per capita (*GDP/capita*). Furthermore, the size of a region tends to have a positive influence on diversification (Balland et al., 2019). We therefore include the provincial *Population* in our model to control for the size effect of provinces. The variables *GDP/capita* and *Population* were obtained from the General Statistical Office of Vietnam (General Statistical Office of Vietnam, 2019).

3.3 Case study overview

In addition to fossil fuels like oil, natural gas and coal, Vietnam is well endowed with a variety of mineral resources encompassing 70 different types that have been discovered across five thousand deposits. In 2008, Vietnam produced approximately 1% of the world's barite, cement, and tin, and ranked 7th in the production of crude petroleum in the Asia-Pacific region. The country also produced chromium ore, coal, copper, natural gas, lead, lime, salt, steel, and zirconium (U.S. Geological Survey,

2010). Extractive industries are dominated by the oil and gas sector which accounted for 64% of the total contribution to GDP, with coal representing around 20% and non-fuel minerals 15% (Vietnam Chamber of Commerce and Industry, 2011). Due to the rich endowment with natural resources extractive industries have been a crucial component in Vietnam's economy (World Bank, 2011; Nguyen et al., 2017). Especially during the latest commodity super cycle extractive industries gained in importance. For instance, the output of the mining industry increased ten times between 2000 and 2013, from USD $2.13 million to USD $20.58 million (Nguyen et al., 2017). In 2006, 12.31% of the Vietnamese GDP originated from natural resources rents increasing to a peak of 14,18% in 2008 (World Bank, 2021). Additionally, this sector contributed to the creation of a significant number of jobs. The number of workers directly involved in the sector has increased slightly from 255,000 in 2000 to 300,000 in 2010 (General Statistic Office, 2020). Also, the number of firms in extraction industries has increased during this period from 423 in 2000 to 2545 in 2010 (General Statistics Office of Vietnam, 2017).

However, it is noteworthy, that due to the uneven distribution of mineral resources across the country (see table 1), their importance for regional economies varies considerably (see figure 2). For example, coal deposits are found mainly in Quang Ninh province and the mountainous northwest provinces are home of ores deposit. In addition, bauxite is found in high volume deposits in the Central Highlands, whilst gold deposits are found in the central parts of the country (Nguyen et al., 2017). A large share of the oil and gas exploration and production is concentrated in the Cuu Long and Nam Con Son basins off the south-eastern coast. Therefore, the oil and gas industry concentrates in South Vietnam, in particular in the province Ba Rịa/Vung Tau (Kalvelage and Breul, 2017).

Table 1: Overview of large- and medium-sized mineral deposits (Source: Own illustration based on Vietnam Chamber of Commerce and Industry, 2011)

Type of mineral	Unit	Potential	Proven reserve	Geographical distribution
Bauxite	Million ton	8.000	672.1	Central Highland
Rare earth	Million ton	9.467	1,1	Lai Chau, Yen Bai
Apatite	Million ton	2,5	0,778	Lao Cai
Titanium	Million ton	300-500	15,71	Central coastal areas (Ninh Thuan, Binh Thuan, Northern Ba Ria – Vung Tau
White sand	Million ton	3.000	123	Central coastal areas
Limestone	Million ton	NA	10.692	Mainly in the Northern provinces like Hoa Binh, Cao Bang, Tuyen Quang and Ha Giang
White marble	Million ton	2000	1.170	Mainly in Yen Bai, Nghe An, Tuyen Quang
Coal	Million ton	40.930	3.520	Concentrated in Quang Ninh, Thai Nguyen, Quang Nam and the Red River Delta
Granite	Million m^3	1.000	15	Scattered in some regions
Iron	Million ton	960,6	760,6	Lao Cai, Cao Bang, Thai Nguyen, Ha Tinh
Chromites	Million ton	NA	33,8	Concentrated in Thanh Hoa
Manganese	Million ton	40,34	12,31	Cao Bang, Tuyên Quang
Copper	Thousand ton	1.018	718	Lao Cai
Tin	Thousand ton	129	11	Tuyen Quang, Nghe An, Cao Bang
Lead-zinc	Thousand ton	3.466	466	Bac Kan, Tuyen Quang, Thai Nguyen

In regard to institutions, the former socialist country initiated a decentralization process with Doi Moi in 1986, which was gradually expanded (Huong, 2016). By the mid-2000s, seven major areas were included in the decentralization agenda granted to the provincial level, namely state budget; investment; administration and personnel; land and natural resources; planning management; state-owned enterprises (SOEs); and public services. According to this, provinces are for instance authorized to license foreign investments up to a certain value, approve certain local socioeconomic development plans and formulate their own budgets. Due to the decentralization reforms the quality of institutions, such as in regard to doing business, vary significantly across Vietnamese provinces (see Vietnam Chamber of Commerce and Industry, 2021).

An increasing responsibility for resource governance is also part of this decentralization process. While the majority of mining policies are administered by the Central Government, the 1996 Law on Minerals grants responsibilities to the provincial governments to manage and protect mineral resources as well as to supervise and inspect the implementation of the law on minerals in the localities. According to this, the Ministry of Natural Resources and Environment on the national level is responsible for the development and monitoring of the exploitation of large mineral deposits and the provincial governments are given the right to grant licenses to and control small mines, which are not included in national mineral plan. Due to this decentralization process, since 2005 the number of small-scale mining licenses granted by provincial authorities had increased rapidly. Provincial authorities granted over 3.495 licenses between 2005 and 2008 compared with a total of 926 licenses that the central government granted in the previous twelve years (World Bank, 2011). Additionally, the provincial policies on the strategy and vision for economic development can influence the operation of the extractive industries on the ground and its role for the future economic orientation of the regional economy.

Summing up, the 63 Vietnamese provinces are characterized by heterogenous institutions and a varying resource-dependence, thus providing distinct conditions for regional diversification. We will assess their influence for the diversification performance of Vietnamese provinces in the following section.

4 Extractive industries and diversification in Vietnamese provinces

In total, 2,323 non-extractive industry entries took place across Vietnamese provinces between 2006 and 2010. This accounts for 21 % of all 11,036 possible non-extractive industry entries (see table A1, Appendix). It reflects the dynamic industrial transformation the former socialist country has undergone during this period. However, as figure 1 reveals, these diversification dynamics did not occur uniformly across Vietnam. Especially, provinces around Vietnam's two economic centers HCMC and Hanoi record the highest numbers of non-extractive industry entries. Binh Phuoc and Ba Rịa/Vung Tau east of HCMC as well as the provinces Hoa Binh, Hung Yen, Ha Nam and Thai Binh south of Hanoi have broadened their industrial portfolio by around 50 new non-extractive industries. In contrast, Hanoi and HCMC record only low numbers of new entries. A central reason is that both provinces were the most diversified Vietnamese regions at the beginning of the period in 2006 with only few VSIC at the 4-digit level missing. Furthermore, it is noteworthy that the mountain provinces in the North of Vietnam tended to be characterized by a lower number of new non-extractive industry entries.

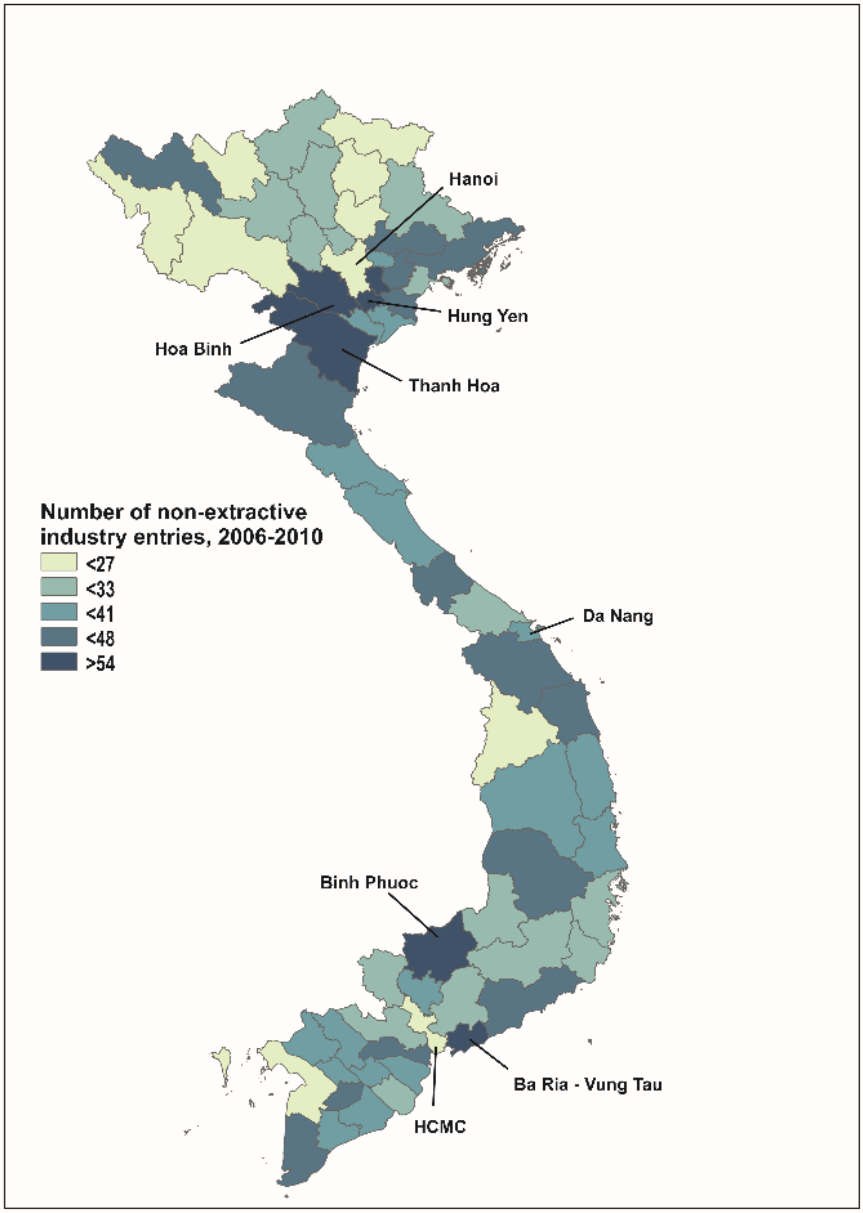

Figure 1: Number of non-extractive industry entries, 2006-2010 (Source: own illustration based on General Statistics Office of Vietnam, 2017)

While extractive industries have been a crucial component for Vietnam's economy on an aggregated national level in 2006 (see section 3.3), figure 2 underlines that this importance differs significantly across provinces. According to the map, in many provinces of the Southeast Asian country extractive industries are of no major importance. For instance, in the provinces of the Mekong River Delta in Southern Vietnam extractive industries contribute with less than one percent to the total provincial revenue. However, there exist some provinces such as Ba Ria/Vung Tau, Quang Ninh, Bac Kan or Lao Cai where extractive industries play a distinctly dominate role for the regional economy. For instance, in Ba Ria/Vung Tau, from where many of the offshore oil and gas fields are serviced, more than 70 % of the provincial revenues originated from extractive industries. In Quang Ninh, the largest coal mining area in Vietnam, 34 % of the provincial revenues was generated by extractive industries. The map also reveals that the Northern mountain provinces tend to be characterized by higher degrees of importance of extractive industries.

This last aspect overlaps with the lower diversification performance of the Northern mountain provinces. This is particularly apparent for Lao Cai and Bac Can – two mining provinces where about one fifth of the revenues is generated by extractive industries. It suggests a negative correlation

between the regional importance of extractive industries and the realized non-extractive industry entries. However, figure 1 and 2 also show that this relationship does not necessarily apply to all extractive regions. Ba Ria/Vung Tau and Quang Ninh are the provinces with the highest share of revenues from extractive industries and at the same time record a large number of new non-extractive industries between 2006 and 2010. These first descriptive insights suggest that even if resource-dependence could have the potential to impede the development of new non-extractive industries, there exist conditions that facilitate these developments in extractive regions.

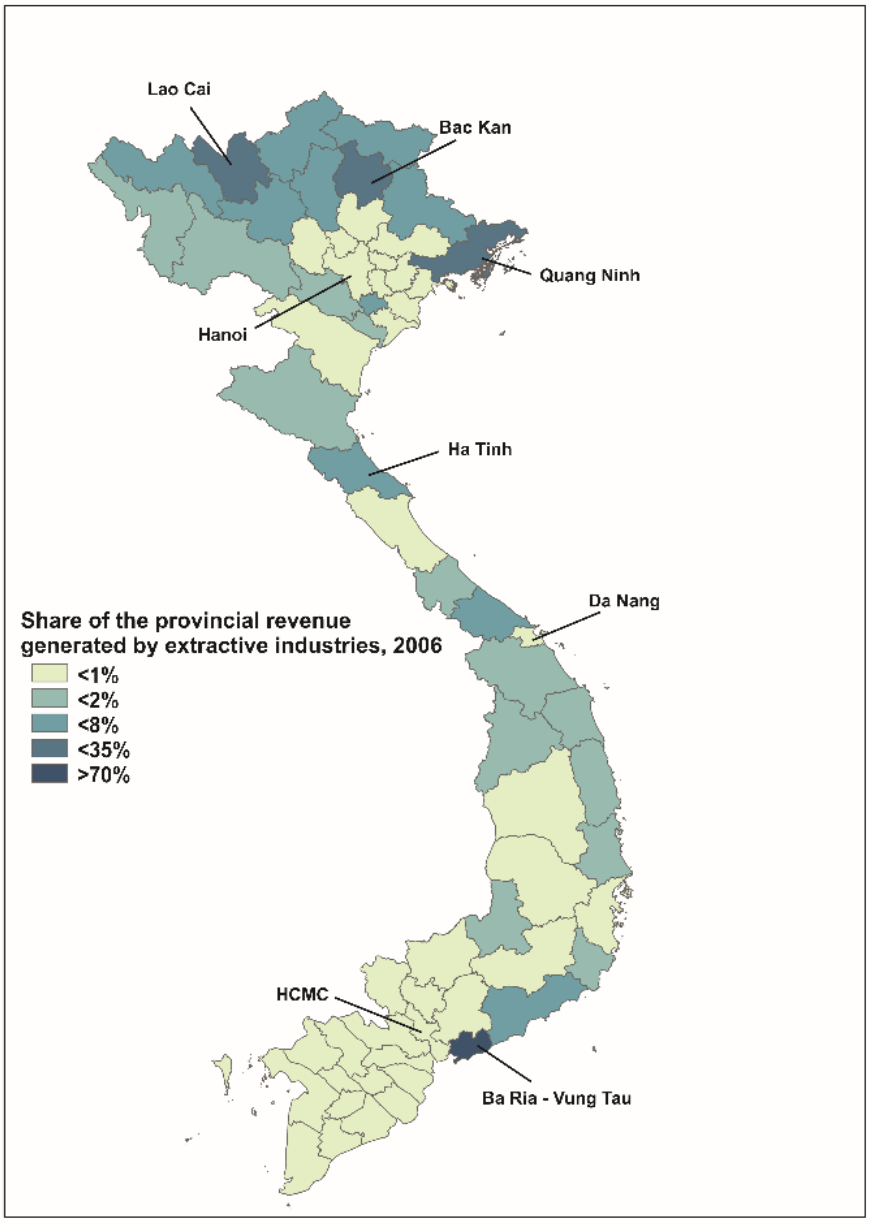

Figure 2: Share of provincial revenue by extractive industries, 2006 (Source: own illustration based on General Statistics Office of Vietnam, 2017)

We compute logit regressions in search of systematic evidence for the relationship. In total, three different models were calculated in which the different interaction terms were added gradually. The results of the regression analyses are reported in table 2.

In all models, the variable *ExtInd* is significantly negative (M1-3). It indicates that the regional importance of extractive industries negatively affects Vietnamese provinces' ability to develop new non-extractive industries. The direction of the effect corresponds with the existing empirical evidence on a country-level that resource-dependent economies tend to have struggles diversifying (Ross, 2019; Lashitew et al., 2020). However, in contrast to these existing insights, zooming in to the regional level

also shows that this effect has a regional dimension. In other words, the impact of resource extraction for economic diversification is felt differently across a country, among other things because extractive industries are spatially bound to particular regions. The finding suggests, that in addition to macroeconomic channels (which we do not consider in this single country case study), there exist channels that operate on a regional scale, as discussed for the resource movement effect as well as spillovers and linkage effects (Fleming et al., 2015; Fitjar and Timmermans, 2019). It is important to note, that due to data limitations we are not able to differentiate between the different channels. However, the overall negative effect implies that the resource movement effect overshadows possible positive effects from production linkages or spillovers emerging from extractive industries. In that sense, resource-dependent provinces such as Bac Can or Lao Cai tend to face more difficulties in developing new non-extractive industries compared to Vietnamese provinces without a strong extractive industrial profile.

Corresponding to the ample evidence in EEG studies (Neffke et al., 2011; Boschma et al., 2013; Essletzbichler, 2015), our industry- and region-specific control variable *RelDen* is significantly positive. Non-extractive new industries are more likely to enter into a region when they are related to the pre-existing regional industrial portfolio. It highlights the general importance of the region-specific environment for diversification processes. More directly related to the relationship between extractive industries and regional diversification is the interaction term *ExtInd x RelDen* which we find to be insignificant (M1). It means that the above negative effect of the regional importance of extractive industries on the diversification performance of regions does not differ between industry entries that are related or unrelated to the existing regional industrial portfolio. Thus, the regional importance of extractive industries influences the intensity of regional diversification, but it does not systematically affect the type (unrelated or related) of regional diversification.

Table 2: Regression results

	Dependent variable: Entry		
	(1)	(2)	(3)
ExtInd	-0.011**	-0.012**	-0.023***
	(0.005)	(0.005)	(0.006)
RelDen	0.014***	0.014***	0.014***
	(0.001)	(0.001)	(0.001)
ExtInd x RelDen	-0.00001		
	(0.0001)		
SOEbias		0.077*	
		(0.041)	
ExtInd x SOEbias		-0.003	
		(0.006)	
EntryCosts			-0.030
			(0.029)
ExtInd x EntryCosts			-0.046***
			(0.010)
GDP/capita	0.0001***	0.0001***	0.0002***
	(0.00003)	(0.00004)	(0.00003)
Population	0.00000***	0.00000***	0.00000***
	(0.00000)	(0.00000)	(0.00000)
Constant	-2.043***	-2.040***	-2.046***
	(0.051)	(0.056)	(0.051)
Observations	11,036	11,036	11,036
Log Likelihood	-5,513.683	-5,511.786	-5,499.415
Akaike Inf. Crit.	11,039.370	11,037.570	11,012.830
Note:	*p<0.1; **p<0.05; ***p<0.01		

In the models 2 and 3 institutional variables and interaction effects with the *ExtInd*-variable are included in order to test whether regional institutions condition the effect of extractive industries on Vietnamese provinces' diversification. We find the interaction term *ExtInd x SOEbias* to be insignificant (M2). According to this finding, the extent of SOE-biased regional institutions, as a proxy for political lock-ins, did not exacerbate the negative effect of the regional importance of extractive industries on diversification in Vietnamese provinces. Even when a bias exists, it does not seem to systematically constrain entrepreneurial activities in other new non-extractive industries.
Furthermore, we find a significantly negative interaction effect *ExtInd x EntryCosts*. According to this result, regional institutions that provide low entry costs for new economic activities moderated the

negative effect of extractive industries on a province's diversification performance. It suggests that the provision of facilitative conditions for creating new businesses can help provinces to reduce struggles imposed by the regional presence of extractive industries to develop new non-extractive industries. For instance, the extractive region Ba Ria/Vung Tau has been very proactive in creating a business-friendly environment, including one-stop-shops to facilitate administrative procedures or the establishment of industrial zones, in order to proactively attract investments from other industries (e.g. manufacturing, tourism) to the province (van Dong, 2021). During the period of analysis the province has experienced the fourth highest number of new non-extractive industries compared to all Vietnamese provinces despite the dominant presence of extractive industries.

The finding of the interaction effect provides the evidence to support our hypothesis that the quality of regional institutions can condition to what extent the effect of extractive industries on a region's diversification performance materializes. Moreover, this finding reveals an important factor that helps to explain why extractive regions in the same country can manage to develop new non-extractive industries with varying success. It, thereby, highlights the need to analyze the relationship between extractive industries and diversification also on a regional level, since region-specific context factors matter for whether resource-dependent regions fail or manage to develop non-extractive industries.

5 Conclusion

This study set out to refine the understanding of the relationship between extractive industries and the diversification towards new non-extractive industries by zooming in to the regional level. Our case study of Vietnamese provinces makes two important findings. First, the regional importance of extractive industries impeded the entry of non-extractive industries into the province in the observed period between 2006 and 2010. Second, appropriate regional institutions – more specifically, low entry costs for new firms – could moderate this negative effect of extractive industries on the diversification performance of Vietnamese provinces.

These insights help to refine the existing understanding of the impact of extractive industries on diversification in the following ways. The results confirm the hampering effect of natural resource extraction for diversifying into non-extractive industries, as also shown in country-level studies (Ross, 2019; Lashitew et al., 2020). However, the study also reveals the fact, that this impact is not felt uniformly across a country, but tends to differ across regions. The analysis suggests two reasons. First, extractive industries are bound to particular regions and their importance for regional economies varies considerably. While all regions in the same country will suffer from macroeconomic effects, such as currency appreciation, the results suggest that some effects of extractive industries on developing new non-extractive industries operate at a regional scale. In particular, the resource movement effect as revealed in other studies is expected to unfold on a regional level (Fleming et al., 2015; Fitjar and Timmermans, 2019; Xie et al., 2021) and could be responsible for the identified hampering effect of extractive industries on new non-extractive industry entries. Summing up, this means since extractive industries are spatially bound to particular regions, so are some of their effects for diversification. In other words, extractive regions tend to be more affected than non-extractive regions in the same country.

Second, the results point to the role of regional institutions for conditioning the impact of extractive industries on developing new non-extractive industries. Appropriate regional institutions, such as low entry barriers for establishing new firms, can reduce the hampering effect of extractive industries. Taking into account these region-specific context conditions provide explanations why extractive regions in the same national context can have mixed success in diversifying their regional industrial portfolios.

In sum, effects operating on a regional scale as well as the relevance of region-specific contexts highlight the regional dimension of the relationship between extractive industries and diversification. Thereby, the study shows that existing country-level explanations need to be complemented by a regional perspective in order to grasp the full effect. It also contributes to the nascent line of research

on the subnational or regional resource curse (Fleming et al., 2015; Manzano and Gutiérrez, 2019) by adding insights on a not yet considered regional economic consequence of resource-dependence – its consequence on diversification.

From a policy perspective, these insights emphasize that it requires region-specific policies for appropriately promoting economic diversification in resource-dependent economies. Even with the presence of national strategies for diversification, extractive regions could struggle to realize these objectives due to inappropriate regional institutions, constraining narrow industrial portfolios, as well as competition over factors of production. Considering these factors in the design of policies is important in order to create regional environments under which the diversification of extractive regions is likely to materialize.

Methodically, the study responds to recent claims for applying more disaggregated measures to study diversification (Lashitew et al., 2020) by introducing a common approach from EEG studies. The regional industry entry model allows to consider region- and industry-specific probabilities of diversifying away from the extractive sector.

Finally, more research is required to entirely uncover the regional dimension of the impact of extractive industries on diversification dynamics. Future studies could enrich these first insights by sectoral analyses that examine whether the influence of the regional presence of extractive industries differs across different economic sectors. But apart from additional quantitative studies, it requires qualitative research that complements these quantitative insights by exploring the exact channels through which extractive industries affect existing and potential new paths. This would provide an essential empirical foundation to avoid competitive and activate synergetic inter-industrial relations emerging from natural resource extraction. This research could benefit from recent conceptualizations of interpath relations (Frangenheim et al., 2020; Breul et al., 2021). Also, future research could apply a temporal perspective and analyze how the impact of extractive industries on regional diversification differs between boom and bust cycles. While the observed period has been part of the latest commodity super cycle, it is likely that in times of contraction influences such as the competition over production factors is less pronounced or, due to layoffs, not present and therefore alters the relationship between extractive industries and regional diversification significantly. Lastly, this analysis focused on the emergence stage of non-extractive industries. Future studies could complement these insights by exploring under which conditions newly emerging non-extractive industries grow over time, thereby reducing regional economy's dependence on natural resource extraction.

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Appendix

Table A1: Descriptives

	Entry	ExtInd	EntryCosts (centered)	SOEbias (centered)	RelDen	GDP/cap	Populaton
Mean	0.2104929	3.439389	0	0	16.07593	951.4466	1138144.8
Std.Dev	0.4076772	9.401511	0.8879665	0.6864626	20.62443	1533.1031	700187.5
Min	0	0	-2.435652	-1.909936	0	341.5369	290000
Median	0	0.8224936	0.1043485	-0.1099357	0	693.6503	1046400
Max	1	70.91710	1.774348	1.790064	94	13811.4411	6483100
N.Valid	11036	11036	11036	11036	11036	11036	11036