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Resource abundance and public finances in five peripheral economies, 1850-1939

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Abstract

The resource curse literature has established that the taxation of natural resources might limit the long-term development of fiscal capacity in resource-rich countries. This article explores if, and how, natural resource abundance generates fiscal dependence on natural resource revenues. We compare five peripheral economies of Latin America (Bolivia, Chile, Peru) and Scandinavia (Norway, Sweden) over a period of 90 years, between 1850 and 1939. Both groups were natural resource abundant, but in the latter natural resource dependence decreased over time.

By using a novel database, we find that fiscal dependence was low in Norway and Sweden, while high and unstable in Bolivia, Chile and Peru. This suggests that natural resource abundance should not be mechanically linked to fiscal dependence. An accounting identity shows that sudden increases in fiscal dependence were related to both economic and political factors: countries' economic diversification, and attitudes of the relevant political forces about how taxation affects the companies operating in the natural resource sector.

JEL codes: H20, N40, N50, O13, Q32

Keywords: resource curse; taxation; Latin America; Scandinavia; rentier state; fiscal contract

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1. Introduction

The economic effects of natural resource abundance are one of the most debated issues in economics.[1] Consequently, the effects of natural resources on government revenues are also at scrutiny. For instance, scholars in the developmental state tradition highlight that natural resources can provide states with abundant revenue that can foster economic and social progress (Hujo & McClanahan, 2009; Karimu, Adu, Marbuah, Mensah, & Amuakwa-Mensah, 2017; Mosley, 2017). More scepticism is derived from the "rentier state" (Ross, 1999) hypothesis. A rentier state obtains a significant share of its revenues from resource rents (i.e. it is *fiscally dependent* on natural resources) which, according to the literature, might generate two different challenges. On the one hand, public revenues derived from natural resources hinder the expansion of fiscal capacity in the long term since these are easy to collect revenues that reduce the need to obtain other more politically and administratively complex revenues. On the other hand, the availability of natural resources revenues reduces the government's incentives to build a solid fiscal contract with society, which might foster sub-optimal spending decisions.

Several studies have identified these negative effects. For instance, a higher fiscal dependence on natural resources revenues has been related with authoritarianism (Ross, 2001) and reduced quality of government (Anthonsen, Löfgren, Nilsson, & Westerlund, 2012), although the first nexus was challenged by Haber & Menaldo (2011). Rentier states are also associated with low long-term economic growth because of suboptimal investment decisions or the effects of higher volatility (Auty, 2015; Auty, 2005; Berg et al., 2013; Bhattacharyya & Collier, 2013; Collier & Hoeffler, 2005). On the revenue side, different studies claim the existence of a negative correlation between the expansion of natural resources revenues and the expansion of the rest of revenues. Interestingly, this "fiscal resource curse" has been identified in both Latin America (Ossowski & Gonzales, 2012), Africa (Bornhorst, Gupta, & Thorton, 2009), mineral and oil rich economies (Crivelli & Gupta, 2014) and even US states (James, 2015).[2]

However, recent research suggests that the negative relationship between natural resources revenues and the rest of revenues depends on the quality of institutions (Masi,

[1] For excellent surveys and early evaluations of the recent commodity boom, see Badeeb et al., 2017; Corden, 1984; Frankel, 2012; Papyrakis, 2017; Van Der Ploeg & Poelhekke, 2017; Venables, 2016.

[2] See also Morrison (2009) who finds a negative relationship between all types of non-tax revenues and taxation of elites in democratic settings, among other results.

Savoia, & Sen, 2018).[3] Notice also that whereas the "fiscal resource curse" has been identified in different geographical settings, most studies cover the period post 1970s. This is not irrelevant given that the resource curse can have a varied incidence over time (Auty, 2015). Furthermore, we do not know so much about what contributes to the formation of rentier states in historical terms, and how some countries could have escaped from these dynamics. In other words, are countries rich in natural resources doomed to fail in constructing a fiscal contract? What is the role of political and economic factors in defining the path taken in different cases?

To answer these questions we depart from Jensen (2011) who, based on Besley & Persson (2009, 2010), offers a model that links resource dependence and incentives to invest *ex ante* in fiscal capacity. The model analyses how a shock can increase or reduce the incentives to invest in fiscal capacity, which is defined as the potential to collect taxes beyond the natural resource sector. As an example, the author shows how a sudden higher interest in the provision of public goods (i.e. higher interest in the existence of a common state) acts as a shock that increases the incentives to invest in fiscal capacity. The author calibrates his model using data of 30 hydrocarbon countries between 1992 and 2005. Among different econometric techniques, he uses the price and/or volume of oil and natural gas as instruments and proves that sudden increases in these variables led to lower incentives to invest in fiscal capacity. Furthermore, he stresses that "autocracies produce the highest offset in fiscal capacity following an increase in resource dependence" (Jensen, 2011: 190).

Starting from this link between natural resource dependence and state building, we assess the "fiscal resource curse" from a different standpoint than the previous literature. We cover the 1850-1939 period, which implies a larger time span and the opportunity to test the effect of changes in resources cycles and other contextual factors.[4] Furthermore, our sample comprises Andean (Bolivia, Chile and Peru) and Nordic (Norway and Sweden) countries. Both groups of countries were natural resource abundant and were embracing state-building efforts during the late nineteenth century (Blomström & Meller, 1991; de Ferranti, Perry, Lederman, & Maloney, 2002; Ranestad, 2017).[5] True, there were striking differences between Andean and

[3] Similarly, Morrissey, Von Haldenwang, Von Schiller, Ivanyna, & Bordon (2016) focus on government's revenues resilience or vulnerability to different shocks. They find that the effect of these shocks can vary importantly depending on economic endowments and political regime.

[4] To the best of our knowledge, there are very few country-case studies which evaluate fiscal dependence in the long term; for example, Peres-Cajías (2015) on Bolivia. Rubio-Varas (2015) and van der Eng (2015) offer fiscal dependence series for Venezuela, Mexico, and Indonesia but do not analyse them from the point of view of the rentier state theory.

[5] Whereas several African or Asian countries are natural resource abundant, most of them were not sovereign states during the nineteenth century.

Nordic countries in several critical determinants of economic development, such as human capital (Peres-Cajías & Ranestad, 2020) or distance to main world markets (Ducoing et al., 2018). There were also important differences in their ability to transit from natural resource dependent countries to more complex economies during the First Globalization (Badia-Miró, Carreras-Marín, Navarro, & Peres-Cajías, 2020; Simon Ville & Wicken, 2013). However, the relevance of natural resources in both regions and the stark differences between both regions in several other economic determinants, allows studying why natural resource abundance can have opposing effects on the formation of modern tax systems.

In this context, the paper offers three different contributions. First, it provides a new database on the evolution of natural resources revenues in the countries under scrutiny from 1850 to 1939.[6] The data has been constructed using homogeneous definitions (following modern standards set by the International Monetary Fund), and is comprehensive in terms of types of revenue and based on actual budget figures.[7] As is usually done, we define natural resources revenues as those public revenues derived from mining and oil production -*extractive* natural resources. Nevertheless, given the centrality of forestry and fishing activities in Nordic countries and the similarities in the economic rationality of these sectors during the nineteenth century with that of *extractive* industries today (see Section 2), we also provide evidence on government's revenues from forestry and fishing in Nordic countries. This inclusion does not affect our conclusions.

Secondly, we measure fiscal dependence on these revenues and how it evolved. Our estimations show that the relative importance of natural resources revenues was hardly higher than 10% of total current revenues in the Nordic countries and that it greatly fluctuated (from 10% to 70% of total current revenues) in the Andean countries.

Thirdly, the paper seeks to understand the opposing effect that extractive natural resources endowments had in both regions and the oscillations that took place in Andean countries.[8]

[6] Notice the recent flourishing of tax databases focused on natural resources revenues (ECLAC, OECD, & IDB, 2017; Laporte et al., 2017; Smith, 2012). To the extent of our knowledge, only Haber & Menaldo (2011) offers comparative analysis of long historical series of tax natural resources dependence, starting in 1800 or year of independence

[7] Very often, the earlier literature has resorted to proxies such as a combination of world prices and estimates of production costs. Similarly, previous work tends to be limited to the analysis of non-tax revenues. By contrast, given the diversity of tools that governments have in order to tax natural resources (Gómez Sabaini, Jiménez, & Morán, 2015) and the disparate economic and political effects that these tools can have, our database considers different tax categories.

[8] It could be argued that the oscillations the we find are time and space specific, leaving little room to further generalizations that could help re-think the "fiscal resource curse". However, important variations in the relative size of natural resources revenues are also seen in the twentieth-century experience of Ecuador or Mexico (see Haber & Menaldo, 2011) as well as Colombia (see Hernández Rodríguez, 2015). Taxation cycles in natural resources

Based on Jensen's (2011), we construct a simple accounting identity that allows measuring how changes in fiscal dependence are linked with changes in the potential tax base (i.e. exogenous shocks) and changes in the effective tax rates (i.e. the political predisposition and ability of the state to tax on a given sector); the identity considers both the natural resource sector and the rest of the economy.

The new quantitative evidence and the accounting identity allows identifying when a higher fiscal dependence on natural resources was the result of economic or political factors, or both. In this context, we can identify periods of strict "rentier dependence", defined as periods when an economic shock in the natural resource sector was accompanied by a higher tax pressure in the natural resource sector and a simultaneous lower tax pressure in the rest of the economy. These rentier scenarios took place in Peru from 1850 to 1878, Chile from 1879 to 1919 and Bolivia during the 1930s. In all of them, export concentration in *one* single natural resource was particularly high. From an institutional point of view, the rentier scenario in Peru can also be linked with poor previous investments in fiscal capacity. As for Chile, beyond export concentration, the rentier scenario was the result of a strong parliament (not the lack thereof). In the case of Bolivia, the higher tax pressure on the natural resource sector during the 1930s was the consequence of resource nationalism and the consolidation of big mining producers as a political scapegoat.

These different *rentier* scenarios in the three Andean countries and the lower fiscal resource dependence in Nordic countries, suggest that the critical role of institutions in overcoming the "resource fiscal curse" is not limited to the control of a rapacious executive by a strong parliament (Masi et al., 2018). Instead, the institutional setting should care about the existence (or generation) of the kind of economic incentives and institutional restrictions, that reduces the likelihood of voracity attitudes of all powerful political groups (Tornell & Lane, 1999).

The rest of the paper is organized as follows. Section 2 proves the centrality of natural resources in the two groups of countries during the period under scrutiny. Section 3 measures the dependence on natural resources revenues in Andean and Nordic countries from 1850 to 1939. Section 4 discuss the results on a structural breaks analysis and Section 5 on the fiscal identity. Section 6 concludes.

abundant countries throughout the world and during the twentieth century have been also highlighted by Jaakkola, Spiro, & van Benthem (2019).

2. Natural resource exploitation in Andean and Nordic countries

A vast literature suggests that the negative economic effects of natural resources can vary substantially depending on the specific product that is exploited (Isham, Woolcock, Pritchett, & Busby, 2005). Making reference to this literature, Auty (2015) stresses that the resource curse is stronger in small economies and mineral driven – particularly oil – economies. He proposes that "the dispersed (diffuse) resource rent associated with peasant farming is potentially more beneficial for economic development than the concentrated (point) rent associated with modern mining" (Auty, 2015: 32).

This differentiation between agriculture and *extractive* natural resources (mining and oil) is critical in taxation terms. Mining and oil are associated with windfall and concentrated resource rents. Moreover, these are non–renewable natural resources, the stocks of which are determined by previous and significant investments. In this context, the higher capital intensity and large operation of *extractive* natural resources ensure its rent is large relative to GDP (Auty, 2015). These features stress the attractiveness of mining and oil production to test the "fiscal resource curse" in a historical setting: sudden changes (a shock) in these sectors could have had sizeable fiscal effects that hampered the long-term consolidation of modern tax systems.[9]

As was mentioned in the introduction, in this study we adopt a wider definition of *extractive* natural resources. Indeed, in the late nineteenth century, the forestry and fishing sectors in Nordic countries shared several significant features with mining activities, which make them essentially comparable for our purposes. Timber felling consisted basically of extracting trees from native forest (Glete, 1987). Forestry did not follow a criterion of sustainability, which would have made it closer to agriculture in some sense. On the contrary, the rate of timber extraction created environmental losses, which even caused the prices of the Norwegian product to fall after 1873 (Hodne & Grytten, 2000: 273). Similarly, fishing resources were seen as a natural gift by nineteenth century Norwegians (which would not be the case of aquaculture), and is considered alongside logging, mining and other extractive activities in early literature on resource economics (e.g. Scott, 1962).

[9] The focus in *extractive* natural resources explains why we do not analyse Ecuador and Venezuela (which are Andean countries). During the nineteenth century, they were agrarian economies and oil exploitation became relevant later on (early 1920s in the first case and early 1970s in the latter). Likewise, we do not consider Colombia, given its singular reluctance to impose export taxes on natural resources throughout the nineteenth century and the earlier transition from mining exports (basically gold) to different agricultural products during the 1830-1870 decades (Hernández Rodríguez, 2015). As previously stated, the study of these other Andean cases (and other worldwide examples) during the twentieth century offers similar paths of unstable taxation on natural resources.

Taking into account these considerations, the goal of this section is to explore the centrality that *extractive* natural resources had in the five countries under study from the 1850s to the 1930s. For this, we analyse the relative importance of mineral, forestry and fishing production over GDP and the relative importance of these sectors on total exports (Table 1). The first indicator shows the relevance of the sector in the economy, whereas the second one highlights the countries' degree of dependence (Badeeb, Lean, & Clark, 2017). In the case of Norway, the relative importance of the natural resources sectors over GDP has been estimated for this article.[10]

Table 1. Relative importance of Extractive Natural Resources over GDP and total exports, 1850-1939 (%)

	Bolivia		Chile		Peru		Norway		Sweden	
	Share in GDP	Share in Exports	Share in GDP	Share in Exports	Share in GDP	Share in Exports	Share in GDP	Share in Exports	Share in GDP	Share in Exports
1850	1.0	n.d.	n.d.	63.0	6.2	78.0	n.d.	n.d.	16.9	68.4
1870	n.d.	n.d.	8.5	66.5	12.0	83.6	23.2	79.7	16.1	50.2
1880	2.7	95.0	10.6	76.1	1.8	28.6	21.4	71.7	17.8	51.7
1895	5.8	89.8	16.8	86.2	2.3	22.7	16.1	55.8	15.6	50.2
1913	7.6	83.3	19.1	88.5	12.3	42.7	17.7	47.7	16.3	49.3
1925	12.5	90.7	20.0	83.9	16.4	46.1	9.5	31.5	10.5	46.3
1938	12.6	92.7	15.8	78.8	18.5	58.2	8.5	29.5	11.3	51.5

Sources: For Bolivia, Herranz-Loncán & Peres-Cajías (2016); for Chile, Díaz, Lüders. R., & Wagner, (2016), for Peru, Portocarrero S., Beltrán B., & Romero P. (1992), Seminario (2015) and Zegarra (2018); for Norway, Norges Handel, several years; for Sweden, Lobell, Schön, & Krantz (2008) and Edvinsson, Jacobson, & Waldenström (2012).
Notes: Extractive Natural Resources includes Mining in the Andean countries, Mining and Forestry in Sweden, and Mining, Forestry and Fishing in Norway. See explanations in the text. GDP data in Bolivia for 1850 refers to 1846. Export data for Bolivia in 1880 refers to data in 1882; export data in 1895 refers to data in 1894. For Norway, data on the relative importance of the natural resources sectors over GDP has been estimated (see text).

The extractive sector was central in all these economies, albeit with varying intensity. Extractive natural resources were often between 10 and 20% of GDP, both in the Andean and Nordic countries. The average over the whole period can be calculated for Chile, Peru and

[10] The weight of the natural resources sector has been estimated in a two-stage process. First, a detailed analysis of the foreign sector was done to estimate the share of natural resources exports (fisheries, metals and forest) in total exports; we took into account just raw materials and therefore eliminated processed products. Secondly, we obtained the share in total production by dividing the export series over GDP in nominal terms from Grytten (2004, 2015). Therefore, our estimation should be considered a lower bound since it is based on natural resources exports (except for the case of forestry, where we considered a share going to national consumption according to secondary sources).

Sweden as 14.9, 9.2 and 15.2% respectively.[11] In terms of exports, dependence is even more clear: natural resource products represented in most years more than half of the total, with an average of 77.6% in Chile, 50.7% in Peru, and 52.2% in Sweden.

We can distinguish three groups in terms of the trajectories followed by natural resource economic centrality: first Bolivia and Chile, secondly Peru, and finally the Nordic countries. In Bolivia and Chile, the extractive sector was not only of primary importance but also increased through time almost monotonically. These were economies with very low complexity, especially Bolivia, where the agrarian sector still represented 56% of GDP in the 1910s and 45% in the 1930s, and manufacture production surpassed 10% just in the late 1930s. The relative importance of mining jumped from 1% of GDP in 1846 to 6% in the 1890s, and well over 10% in the last two decades shown (Herranz-Loncán & Peres-Cajías, 2016). This increase is explained by the recovery of silver exports during the early 1870s, the transition from silver to tin exports at the eve of the twentieth century and the consolidation of tin as the main Bolivian export since the First World War. With the exception of the 1890-1910 period, when rubber exports were relevant, mineral exports represented more than 90% of Bolivian exports from the mid-19th century to the Second World War (Table 1).[12]

As for Chile, the relative importance of the mining sector over GDP jumped from 7% in the 1850s to between 15 and 20% after the 1890s. Here as well, manufacture production was negligible in this period, with around 10% of GDP (Díaz et al., 2016). The mining sector in Chile underwent two pronounced natural resources cycles: the copper cycle and the nitrate cycle. The first started early in the nineteenth century with the growing demand for ships sheathing (De Rosa, Ciarlo, Pichipil, & Castelli, 2015), while the second was a result of the annexation of former Bolivian and Peruvian territories after the War of the Pacific (1879-1883) and the expansion of the international demand of this product as an agrarian fertilizer (Miller & Greenhill, 2006). Although the nitrate cycle was shorter (1880-1930), it had an impressive effect on the economy (Badia-Miró & Ducoing, 2015; Badia-Miró & Yáñez, 2015). Thus, with the exception of the 1850-1870 period, when wheat exports were significant, mining products constituted at least three quarters of Chilean exports during the 1850-1939 period (see Table 1).

[11] For the rest of the countries, yearly data is not available.

[12] Notice that data on the composition of Bolivian exports during the nineteenth century is scarce and disperse. However, qualitative evidence or reports by contemporaneous stresses that, despite the increase of quinine exports at the mid-nineteenth century, silver exports represented the bulk of Bolivian exports. Copper exports were also of similar or higher relevance than quinine exports. There is even less uncertainty on the centrality of silver exports from the 1870s to the early 1890s.

Regarding Peru, the trajectory of the natural resource sector presents a U-shape, with maximum export dependence at the beginning of the period (over and around 80% of total exports in 1850s-1870s), followed by a fall as a consequence of the War of the Pacific, and a new gradual increase starting in the 1890s. The share of the extractive sector on GDP shows the same trends, albeit in this case the higher levels were reached at the end, with near 20% (Seminario, 2015).[13] The first natural resource cycle ended abruptly during the War of the Pacific (1879-1883), when nitrates-rich territories were transferred to Chile, guano production became marginal and the Peruvian economy entered a long-lasting crisis. This crisis persisted until the mid-1890s when exports recovered through a more diversified basket: copper, gold, silver, sugar, cotton, wool and rubber. In the early 1910s, mining recovered some of its previous relevance, a process driven by copper initially and by oil thereafter.

The third group includes Norway and Sweden, where the share of the natural resource sector decreased through time, both in GDP (20 to 10% approximately) and in exports (ca. 80 to 30% in Norway, 70 to 45% in Sweden). The new evidence gathered here for Norway suggests that whereas mining production was marginal (see Table A1), forestry and fishing remained central until the early twentieth century. The main mining products were copper and iron.[14] Together with fishing and shipping, timber was one of the most important sectors in Norway during the nineteenth century. Its exports attained maximum levels around the 1870s and stagnated thereafter, one of the reasons being the fall in prices, given that Norwegian timber was of lower quality than that of Sweden or Finland because of over-exploitation of forest resources (Hodne & Grytten, 2000).[15]

In Sweden, the relative importance of *extractive* natural resources was noticeable throughout the period under analysis either with or without forest production. Certainly, as has been described elsewhere (Lobell et al., 2008), the Swedish economy experienced considerable

[13] The early high relative importance of the sector and its shrinkage during the last quarter of the nineteenth century is explained by the boom and bust of guano exports. Indeed, from the early 1850s to the early 1870s, guano represented two thirds of total Peruvian exports (Zegarra, 2018). During the 1870s, guano production started to decrease but nitrates production increased importantly: the former represented 50% of total exports and the latter jumped from 10% to 25%.

[14] Iron production underwent difficulties in the second half of the nineteenth century, since it was outperformed by Swedish and British competitors (Lieberman, 1970). Norwegian iron ore was found in extreme locations and generally had poorer quality. Lack of coal in the country has also been named as a reason for this decadence. Furthermore, Hodne and Grytten have argued that the political union with Sweden in 1814 and the subsequent free trade agreements were not beneficial for the sector (Hodne & Grytten, 2000: 79). However, iron and copper mining were reactivated around 1900 thanks to the diffusion of electrification and the entry of foreign capital.

[15] Timber-related industries, however, took off strongly in the early twentieth century. Given our interest in the analysis of natural resources until a low level of processing, we just considered timber exports and not exports of timber-related industries. This explains why our estimation on the relative importance of *extractive* natural resources in Norway are lower than those of Hveem (1991: 134) from 1900 to 1939.

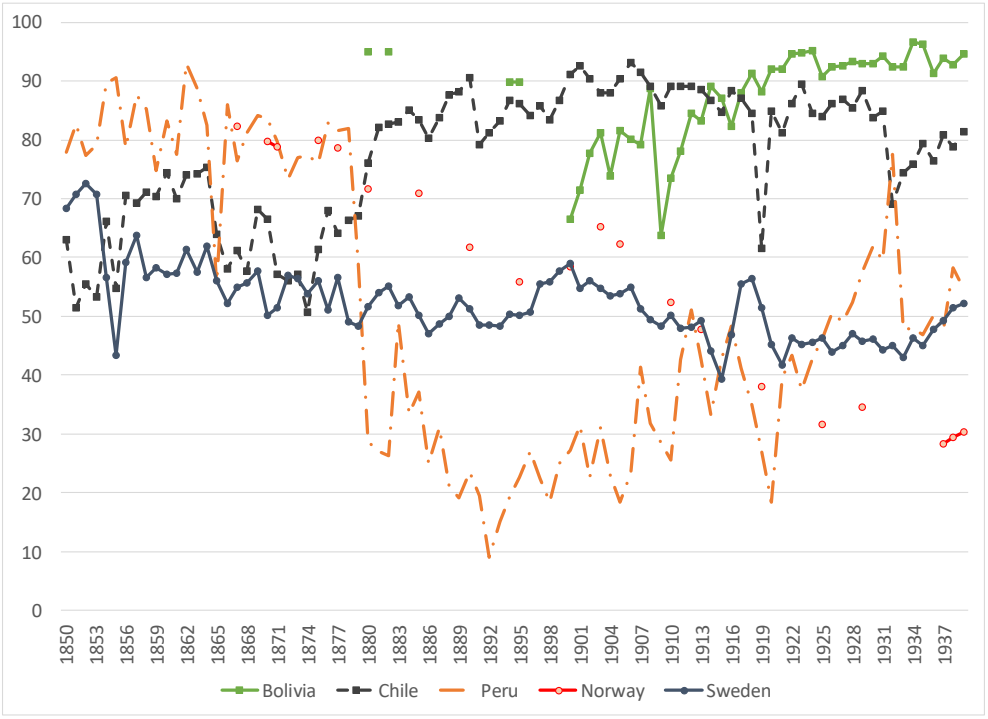
structural change since the late nineteenth century, with decreasing relative importance of the agrarian sector (from 44% in the 1850s to 16% in the 1930s) and considerable growth of manufacture production (from 15% of GDP in the mid-nineteenth century to 25% from the 1920s onwards (Edvinsson et al., 2012). However, Swedish industrial growth was based on domestic natural resources such as forests, iron ores, sulphide ores and rivers for hydropower. This is why the relative importance of natural resources production remained around 15% of GDP from the mid-nineteenth century to the 1910s and around 10% thereafter. Furthermore, exports from these sectors accounted for 50% of total exports since the 1870s to the 1930s.

These different trajectories in the shares of extractive natural resources to GDP indicate that the size of natural resources shocks relative to the entire economy could be increasingly larger in Andean countries. This, in turn, could generate larger tax effects by mere changes in the tax base and not necessarily by a political decision to tax more on the natural resource sector. Something that we consider later in the paper.

We highlight one additional difference, namely in the concentration of the export basket, which presents dissimilarities between countries (not only regions), both in levels and trends. Peru started off with very high levels of concentration in guano and diversified thereafter between agrarian and *extractive* natural resources. By contrast, there was extreme high concentration in *one* product in Bolivia (silver or tin) and Chile (nitrates or copper) from 1880 onwards. As for the Nordic countries, the export basket was more diversified since the mid-nineteenth century and included progressively both natural resources and manufacture products.

All in all, however, *extractive* natural resources were critical in these five economies at least throughout the First Globalization. It should be noted that if we were to focus solely on mining, its relative weight over total GDP was higher in Sweden than in Bolivia during the nineteenth century and similar to that Chile before the nitrates boom (see table A1). Furthermore, these countries would all fall in the current IMF definition of a *resource intensive* country (an exports share of natural resources above 25% of total exports, Thomas & Treviño, 2013) throughout the entire period (Figure 1).

Figure 1. Extractive Natural Resources exports over total exports, 1850-1939 (%)

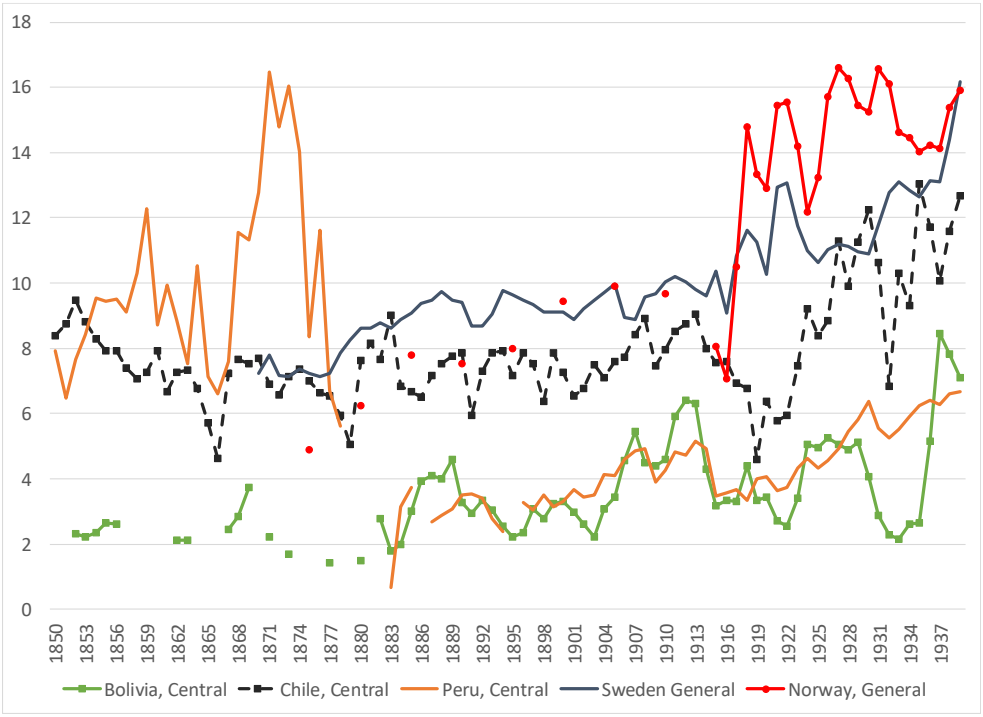


Sources: See Table 1.
Notes: Extractive natural resources reference to mining in the case of Andean countries; mining and forestry in Sweden; mining, forestry and fishing in Norway.

It is important to consider as well the relative size of total public revenues in our sample (Figure 2).[16] The clear distinction between the Andean and Nordic countries that we know of today is not perceivable in the early part of our period of analysis, but started to emerge around the First World War. Indeed, public revenues in Chile, Norway and Sweden were at very similar levels until around 1910 (between 6 and 10 percent of GDP), and became quite close again in the 1930s (now around 12 percent). Peru displayed the highest public revenue in the early 1870s, but also the highest oscillations. It experienced a very substantial drop after the War of the Pacific and joined Bolivia in the lower ranks since the 1880s.

[16] During a considerable part of the period we study, Norway was in a union with Sweden (1814-1905). This was, however, a *personal* union: both territories shared the same monarch but Norway had its own Constitution (1814), central bank (1816), and fiscal autonomy, among other national institutions

Figure 2. Central and General Government current revenues over GDP, 1850-1939 (%)



Sources: For Bolivia, Peres-Cajías (2014); for Chile, Díaz et al. (2016); for Peru, Contreras (1997); Portocarrero S. et al. (1992) and Seminario (2016); for Norway, Eitrheim & Fevolden (2019) and authors' elaboration from *Statistiske översikter 1948*; for Sweden, Henrekson & Stenkula (2015) and authors' elaboration from *Historisk statistik för Sverige* (1960) and Statistical Yearbooks.

The centrality of natural resources and the relatively similar size of the public sector in the two group of countries, represent an opportunity to analyse the relationship between natural resources and public revenues.

3. Natural resource fiscal dependence in Andean and Nordic countries

3.1. The estimation of natural resource revenues

As previously stressed, we consider *extractive* natural resources: we include those products obtained from extraction until a low level of processing (e.g. copper and iron bars are considered but cables and steel are excluded) and we exclude agriculture. Therefore, the estimation of natural resources revenues considers all taxes and royalties paid by either privately-owned or state-owned *mining*, *hydrocarbon*, *forestry* and *fishing* firms, and the dividend payments or direct transfers paid to the government by state-owned firms operating in these sectors (Haber and Menaldo, 2011). We define fiscal dependence as the relative importance that tax and non-tax revenues had in *total current* public revenues. According to recent works at the Fiscal Division of the International Monetary Fund, a country is fiscally

dependent on natural resources revenues when their relative importance is above 20%-25% of total current revenues (Pessino & Fenochietto, 2010; Thomas & Treviño, 2013).

These revenues are organized in four different categories that were constructed following the IMF *Government Statistics* guidelines: non-tax revenues, direct taxes, indirect internal taxes and export taxes.[17] Non-tax revenues arise from the public property of natural resources, and appear as dividends of public firms or royalties paid by businesses (related to the quantity, volume, or value of the asset extracted). Direct taxes refer to taxes on the income of corporations and other enterprises; these can correspond to particular taxation of the natural resource sector or to their share in general corporate taxes. Indirect internal taxes are taxes imposed on goods and services consumed in the country. Export taxes are levied upon overseas shipping.

Thus, in contrast with most of prior literature (e.g., Anthonsen et al., 2012 or Collier & Hoeffler, 2005), our series of natural resources revenues include different fiscal instruments. When only non-tax revenues are included, it is under the rationale that these derive from state property, and are received with administrative easiness and without the need to generate stable relations with taxpayers – i.e., a fiscal contract. Some tax revenues might share these features to some extent. For example, export taxes are collected at international trade centres, together with import duties, and both represented significant shares of revenue in early modern states precisely because of this administrative simplicity. However, export taxes may sometimes require broader political support than non-tax revenues, with greater control by national parliaments. Similarly, in spite of the administrative advantages generated by mining physical concentration, the collection of direct taxes in this sector demands broader administrative capabilities and higher taxpayer compliance.

Natural resources revenues have been estimated using both primary and secondary sources. In the case of Bolivia we relied on Peres-Cajías (2015) and in the Chilean case we used Díaz et al. (2016), Humud (1969) and Cuentas Fiscales de Chile (1959). The estimation of the Peruvian case used the statistical appendix in Contreras (2012) for the 1850-1879 period and primary sources thereafter. The latter have been processed as in the Bolivian case, which is explained in Peres-Cajías (2015), given the similarities in the nature of primary sources (*Cuentas Generales* and *Anuarios Administrativos*).

[17] In the case of Bolivia, we also consider revenues derived by the use of multiple exchange rates that were imposed in a very specific period (1936-1939).

The use and combination of these series allows analysing of, for the first time, the composition of natural resources revenues in Chile. Indeed, the specific weight of direct taxes obtained from the natural resource sector was not previously known. Likewise, we offer a new estimation of the relative importance of natural resources revenues in Peru after the War of the Pacific.[18]

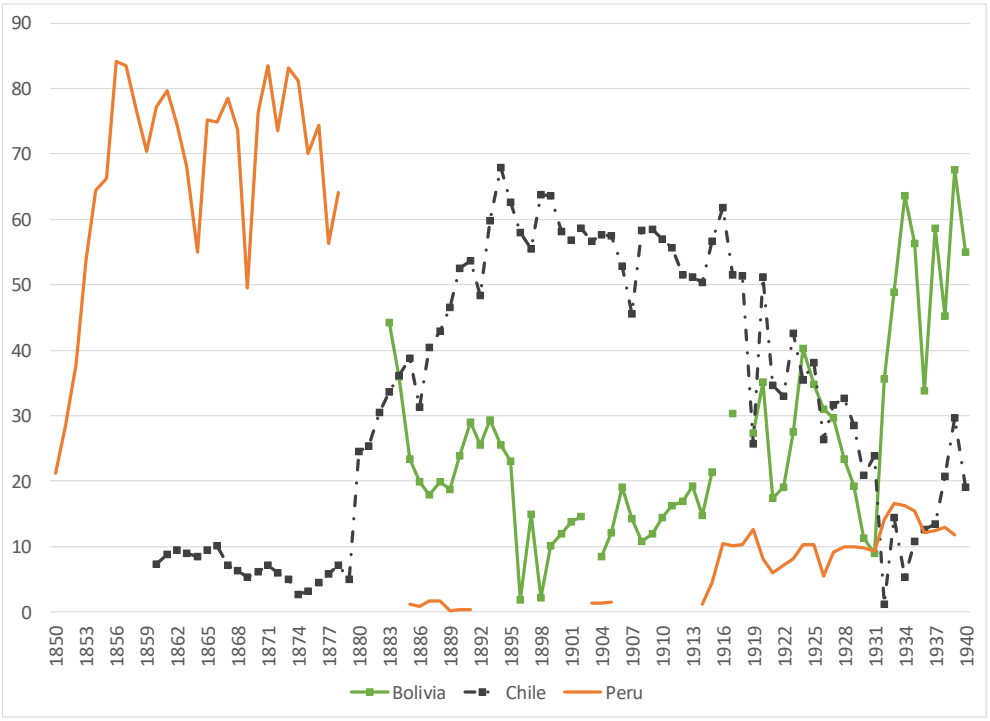
The databases for Norway and Sweden have been constructed specifically for this article. We have collected information on all natural resources revenues that fit our categorization in both countries, using statistical yearbooks, tax statistics, and previous scholarly publications such as Gårestad (1985) or Häggqvist (2018). Corporate income tax payments of natural resources companies are known only for some given years (statistics exist for the Swedish case for several years between 1909 and 1921); when not available, they have been estimated from available data.[19] Our natural resources revenues have then been expressed as a share of existent long-term series of total public revenue from Eitrheim and Fevolden (2019) in the case of Norway and Henrekson and Stenkula (2015) for Sweden.

3.2. Fiscal dependence: volatile in the Andean, low in the Nordic

This subsection presents our results on the evolution of natural resources revenues. To begin with, Figure 3 shows our fiscal dependence series for the three Andean countries. Fiscal dependence in Bolivia started from a relatively high level during the last quarter of the nineteenth century (around 40%) but decreased rapidly at the end of the century. The country remained quite fiscally independent from natural resources revenues until the late 1910s. Afterwards, the relative size of natural resources revenues to total revenues surpassed 20% and went beyond 50% during the 1930s.

[18] Paredes (2010) provides an estimation that, however, takes into account tax revenues from agriculture products.
[19] Our estimation departs from aggregate income tax revenue, adjusts first for the share in it of corporate taxation, and then attributes to the natural resource sector a share corresponding to its participation in GDP. In Norway, data on the share of income taxes paid by non-personal taxpayers was not published until the taxation year 1954 (see the explanation in *Historical Statistics 1968*), but we have found approximate estimates for 1911 and 1937. Regarding Sweden, this information exists for 1912-13, 1917, and since 1920; the rest have been approximated by interpolation. The shares of natural resources in Norwegian GDP were estimated for this article (see above), while they are taken from Edvinsson et al. (2012) in the case of Sweden. They lie between 9 and 23% in Norway, and between 11 and 24% in Sweden.

Figure 3. Natural resources revenues over total current revenues in Bolivia, Chile and Peru, 1850-1939 (%)

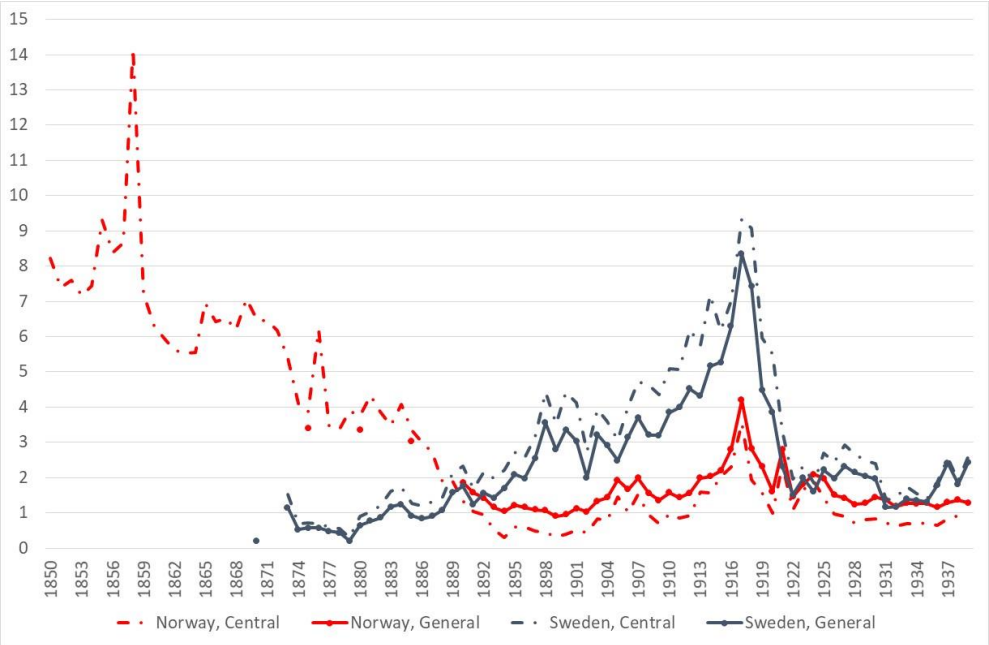


Sources: See subsection 3.1.

Fiscal dependence on natural resources also varied greatly in Chile and Peru. In the former, it started from levels below 10% of total revenues during the mid-nineteenth century to more than 50% during most of the nitrate cycle (1880-1930). The ratio started to decrease during the 1920s, reaching levels below 20% after the Great Depression, whereas it increased again in the late 1930s. In Peru, the ratio jumped from 20% at the mid-nineteenth century to 70% during the 1860s and 1870s. Thereafter, it remained close to zero and despite an increasing trend since the First World War, it remained below 20%. Thus, the substantial retreat in the *fiscal* dependence experienced after the guano-nitrates peak was maintained, in spite of the strong recovery in the relative importance of *extractive* natural resources over GDP or total exports (see Table 1 and Figure 1).

By contrast, given that the ratio of natural resources revenues to total revenues remained well below the 20-25% threshold, our estimations suggest the lack of fiscal dependence in the Nordic countries (Figure 4). In Norway, a downward trend stands out, from levels around 10% to below 5%, with only a temporary (and mild) reversal during the first two decades of the twentieth century. In Sweden, despite the existence of an increasing trend in the early twentieth century, the ratio remained below 10% and reversed quickly after World War I.

Figure 4. Natural resources revenues over total current revenues in Norway and Sweden, 1850-1939 (%)



Sources: See subsection 3.1.

For the Nordic countries, Figure 4 presents series both of central and general government. Dependence over general government is the most relevant measure here, since local revenues were important in both countries throughout the period, and even some taxes on natural resource exploitation were collected at the municipal level. The series considering central government, in any case, show the same trends – and they allow us to go further back in time for Norway.[20]

Secondary sources and disperse official information suggests that fiscal dependence could have been higher in Norway before the period we are analysing. Indeed, the Norwegian geologist and geographer Johan Herman Lie Vogt described in several studies the critical role

[20] In terms of comparability, remember that Central Government is the administrative unit used in the Andean cases shown above. Whereas there are not continuous series of General Government revenues, there is evidence that Central Government was the most important administrative unit in the three Andean countries. Department and local taxes were relevant in Bolivia during the last third of the nineteenth century, accounting for up to 40% of central revenues. In the early 1910s their relative importance fell to 10% of central revenues (Peres-Cajías, 2014). In Peru, the most important decentralization effort took place between 1886 and 1895, when departmental revenues accounted for around 20% of central revenues; this share fell to 4% in 1920 (Contreras, 2012a: 236-251, 413). In both cases, taxation of natural resources remained a prerogative of the central government. This implies that our series of fiscal dependence on natural resources would move around 5 to 30% of Bolivian General Government revenues; still a significant figure. As for Peru, dependence on natural resources would be really close to 0% of General Government revenues during the last decades of the nineteenth century. In the case of Chile, whereas several direct and indirect taxes were decentralized during the 1890s, most scholars argue that effective collection of taxes was very restricted at the local level (Bernedo et al., 2014). Furthermore, most of these taxes were recentralized in the early 1920s.

of taxation of the iron and copper sectors under the union with Denmark (i.e., up to 1814). He shows iron to have been relatively favoured, with lower export taxes and a special rate in the *tiende* (1.5% of the value of production instead of 10%; Vogt, 1908). According to Vogt's estimation, the Røros copper mine paid 17% of the gross value of its production in diverse taxes between 1644 and 1814 (Vogt, 1895). The literature also makes reference to a significant role of natural resources in the funding of the Norwegian state in the period from 1814 to the 1840s. According to Hodne & Grytten (2000), export taxes on forestry totalled 16% of the exported value in 1816-30, which represented around 10% of all customs revenues; this means between 4.5 and 6.5% of total central government revenue for these years.[21] The silver mine *Kongsberg Sölvverk* run on a deficit for several years, but became the second biggest source of income for the state in the early 1830s (when silver prices were high). Its contribution to state finances in this extraordinary period was 15% in 1833 and 8% in the five years 1836 to 1840 (data from *Beretning*, 1843, p. 22). Iron and copper taxes were relatively unimportant, with an average of 0.7% for the years where we have data between 1815-48.[22] Thus, in spite of its higher relevance in this earlier period, the share of natural resources revenues did not surpass the 20-25% threshold and did not reach the levels presented in Andean countries.[23]

We could also ask ourselves whether Sweden had higher fiscal dependence before the start of our series. This does not seem to be the case. Our calculations show that export taxes from natural resources reached 4-5% of central government revenues in the 1780s, from where they fell to below 1% in the 1810s-20s, rising again to between 2 and 3% in 1828-40.[24] We also have some incomplete estimates for the period 1850-70, which show a low and declining level of fiscal dependence, always below 1% of central government's revenues. In this period, the Swedish tax system was dominated by import duties and traditional taxes on land (Gårestad, 1985). Furthermore, the exploitation of public forests showed low profitability (which would change strongly after its reorganization in 1870; see *Skogsväsendet 1870*). This information and the data in Figure 4 suggests that modern Sweden has undergone two cycles of higher fiscal dependence from natural resources, one in the late eighteenth century and another

[21] This and the following percentages in the paragraph are authors' calculations with the totals from Eirthem and Fevolden (2019).
[21] Source: 1815-20, *Stortingsproposisjon Nr.1, 1915, Statsfinansielle Opgaver 1815-1914, bilag 2*. Since 1820, various documents in *Stortingets arkiv* (website), corresponding to budget estimations (except for 1835-37 which are actual revenues).
[23] Fiscal dependence from natural resources only seems to have attained high levels in Norway in the age of oil, which provided an average of 27% of Central government's revenues and 16% percent of General Government's revenues since the early 1970s (data from www.norskpetroleum.no combined with our total revenue series).
[24] Export taxes from Häggqvist (2015, 2018) and central government revenue from Fregert & Gustafsson (2007).

one during World War I. However, as the ratio has been always below 10% it can be concluded, as in the Norwegian case, that none of these cycles attained levels that could be considered high by comparative standards.

3.3. The composition of natural resource revenues

This section presents the composition of natural resources revenues in the five countries under study. To begin with, Table 2 shows that export taxes were the only source of mining revenues in Bolivia from 1880 to the first decade of the twentieth century, when the payment of mining patents achieved some importance. During the 1920s, the Bolivian government was able to impose and enforce a new tax on mining profits. As a consequence, the relative importance of direct taxes increased sharply, but decreased again in the 1930s. During this decade, the main fiscal innovation was related to the formulation of exchange rate controls.

Table 2. Natural resource dependence levels and composition in Bolivia, 1880-1930 (decennial averages, %)

Decades	% Natural Resources	Non Tax Revenues	Direct Taxes	Indirect Internal	Export taxes	Exchange rate
1880	26			1	99	
1890	19			1	99	
1900	13			9	91	
1910	20		1	8	91	
1920	28		29	6	65	
1930	44		6	4	33	57

Sources: See subsection 3.1.

The Chilean experience shows a similar pattern: the sharp increase of natural resources revenues since 1880 was driven by the export tax on nitrates and it was not until the early 1920s that direct taxes became relevant. During the 1930s, the relative upsurge of direct taxes is related with higher tax pressure (see below) but also with the elimination of the export tax on nitrates.

Table 3. Natural resource dependence levels and composition in Chile, 1860-1930 (decennial averages, %)

Decades	% Natural Resources	Non Tax Revenues	Direct Taxes	Indirect Internal	Export taxes
1860	8			20	80
1870	5			51	49
1880	35			6	94
1890	59			0	100
1900	56			0	100
1910	51			0	100
1920	35		5	0	95
1930	16	16	58	0	26

Sources: See subsection 3.1.

By contrast, the early expansion of natural resources revenues in Peru relied on non-tax revenues. Natural resources revenues regained relevance during the First World War thanks to the reintroduction of exports taxes. Interestingly, direct taxes were also relevant during this period. In the 1930s, export taxes consolidated as the main natural resource revenue mainly because of the oil export tax.

Table 4. Natural resource dependence levels and composition in Peru, 1850-1930 (decennial averages, %)

Decades	% Natural Resources	Non Tax Revenues	Direct Taxes	Indirect Internal	Export taxes
1850	59	100			
1860	71	100			
1870	74	100			
1880	1	0	79		21
1890	1	1	98		1
1900	1	10	90		0
1910	7	24	41	1	34
1920	8	34	17	1	48
1930	13	28	8	0	64

Sources: See subsection 3.1.

In Norway, there was a gradual substitution between export taxes and direct taxes (Table 5). The first were most important during the second half of the nineteenth century, while direct taxes on corporations predominated since the 1890s, when taxes on international trade lost ground and then disappeared. In fact, Norwegian foreign trade policy was remarkably liberal

during this period, with tariffs mainly used as a source for state finances but not with a protectionist reasoning.[25] Direct taxes emerged as the main component of natural resource revenue soon after their introduction, which was early by international standards: a local income tax existed since 1875, and the state income tax appeared in 1892. Non-tax revenues originated from the exploitation of public forests and a silver mine (*Kongsberg Sølvverk*), as well as from mineral royalties (*malmavgift*).[26] Non-tax revenues contribution was between 20 and 30% in the period 1860-1919 and was reduced drastically in the 1930s.

Table 5. Natural resource dependence levels and composition in Norway, 1850-1930 (decennial averages, %)

Decades	% Natural Resources	Non Tax Revenues	Direct Taxes	Indirect Internal	Export taxes
1850	9	41			59
1860	6	24			76
1870	5	27	13		60
1880	3	28	32		39
1890	1	8	82		10
1900	1	20	80		0
1910	2	23	76	1	0
1920	2	9	91	0	0
1930	1	0	99	0	0

Sources: See subsection 3.1.
Note: Until 1880s fiscal dependence is measured against central revenue only; since then, local plus central.

Non-tax revenues were the main component of Swedish fiscal dependence throughout the period, including mainly profits from the exploitation of large public forests (Table 6). Since 1900 these revenues ceded considerable space to both direct and indirect taxation. The first corresponds to the modern tax on income of corporations, which consolidated in Sweden in the interwar period, from its rather modest origin in 1902. During this latter period, various indirect taxes were also paid on the exploitation of forests to the state and municipalities.[27]

[25] "*The welfare of the three [Scandinavian] countries depended heavily on the export of a few commodities and the profitability of their export industries depended more on tariff reductions abroad than on a protected domestic market*" (Lieberman, 1970, p.166).
[26] Mineral royalties were introduced in the early twentieth century, in relation to the *konsesjonslovene*. Before this, the exploitation of mineral resources only needed a permission from local authorities (Hodne, 1981). Our series of *malmavgift* starts in 1913.
[27] These were the *Skogvårdsavgift* (after 1911) and the *skogsaccis*, both paid according to exploitation of forests. See the explanations in *Skattetaxeringarna… 1946*, p. 21*. The *skogvårdsavgift* was raised by the state and distributed for the administration and care of forests (Axelsson, 2018, p. 16), while the *skogsaccis* was a local tax.

Table 6. Natural resource dependence levels and composition in Sweden, 1850-1930 (decennial averages, %)

Decades	% Natural Resources	Non Tax Revenues	Direct Taxes	Indirect Internal	Export taxes
1870	1	73	27		
1880	1	89	11		
1890	2	94	6		
1900	3	79	12		9
1910	5	58	23	14	5
1920	2	44	30	26	
1930	2	50	26	24	

Sources: See subsection 3.1.

Therefore, both non-tax revenues or export taxes could drove higher levels of fiscal dependence in Andean countries. By contrast, the role of direct taxation was marginal. The opposite took place in Nordic countries: export taxes were early eliminated in Nordic countries and direct taxes consolidated progressively as the most relevant. These differences are important to understand the political economy of the "fiscal resource curse".

4. Structural breaks analysis

This section aims at identifying structural breaks in the series of fiscal dependence presented in the last section.[28] The analysis does not consider the Peruvian case given the existence of several missing observations whose interpolation can create artificial results in the analysis. The research by Bai & Perron (1998) and its practical application in economic history by Ben-David & Papell (2000) offer the tools to estimate more than one break in an endogenous way. Further improvements of the test were later incorporated by Bai & Perron (2003).[29]

Whereas we focus on levels (we are interested in identifying when the nature of natural resource revenues has changed), the timing of breaks in both trends and levels tend to coincide.[30] This assures us that the periodization we propose is consistent. The maximum number of breaks has been applied (4) to all countries, taking into account a minimum of 8

[28] See Mills (2019) for a survey of recent developments on series times analysis suitable for economic history studies. There are several other structural breaks tests proposed for historical research besides the chosen in this article. See, for instance, Lee & Strazicich (2001, 2003).

[29] We are aware of the multiple criticisms to these kinds of tests. For instance, the concluding remarks by Lee & Strazicich (2001) pointed out how different parameters could lead to spurious rejections regarding the magnitude of the break.

[30] Depending on the number of breaks chosen, the changes in trends and levels coincide if the number of breaks is less than five.

observations between breaks to avoid periods of extreme volatility caused by exogenous factors, such as wars, that are not related directly with natural resources policy. Results of the structural break analysis using the Bai & Perron test are presented in Table 7.

Table 7. Structural breaks in the series of fiscal dependence, 1850-1939

Country	Period	1st Break	2nd Break	3rd Break
Bolivia	1883-1940, 58 observations	1895	1904	1931
Chile	1860-1940, 81 observations	1879	1918	1928
Norway	1850-1940, 91 observations	1858	1876	1884
Sweden	1870-1940, 71 observations	1897	1906	1918

Sources: Authors' estimation.

We complement the Bai & Perron test with the "outlier methodology" (Chen & Liu, 1993; Gómez, & Maravall, 1997). This methodology is based on real shocks, which renders suitable for historical analysis.[31] According to this methodology, four different outliers can be identified: *a)* additive outliers (AO), which affect a single observation and not its future values; *b)* innovational outliers (IO) that affect temporarily the time series (more similar to an error); *c)* level shifts (LS) that increase or decrease all the observations by a constant amount; *d)* temporary changes (TC), which generates an abrupt increase or decrease that tends to return to its previous level. The former two kind of outliers are related with exogenous and endogenous changes in the time series, while the latter two are in the nature of structural changes (Darné & Diebolt, 2004; Diebolt, 2007).

We used the TRAMO[32] program to detect outliers in the fiscal dependence of four of the five countries under scrutiny.[33] Table 8 shows the nature of the identified outliers, their significance and the size of the coefficient. As for the Bolivian case, two outliers in the nature of structural breaks are identified. The first is a temporally fall in 1896 and the second a constant increase in 1932, both in line with two of the structural breaks identified through the Bai & Perron test. The former is related with the decrease of tax pressure in silver exports and

[31] Real or permanent shock are defined as structural changes in time series that lead to noticeable shifts in levels (Lee & Brorsen, 2017).
[32] TRAMO stands for "Time Series regression with ARIMA Noise, Missing Observations and Outliers". It was developed by Gomez and Maravall (1997) at the Bank of Spain to estimate at monthly or lower frequency series.
[33] We used a critical value of 3,3.

the latter with a higher tax pressure on tin exports (see the next section). Two additive outliers (a temporarily change) are identified in 1936 and 1938, when the so-called "Militaries Socialists" increased their political and economic pressure on the main mining producers through the use of multiple exchange rates, an instrument whose use increased the volatility of Bolivian public revenues.

Table 8. Outliers in the series of fiscal dependence, 1850-1939

Country	Date	Outlier	Value	T-stat
Bolivia	1896	TC	-0.21291	-3.30
	1932	LS	0.31008	5.65
	1936	AO	-0.23597	-4.56
	1938	AO	-0.17525	-3.39
Chile	1880	LS	0.19480	4.01
	1919	AO	-0.25604	-6.92
	1921	LS	-0.16553	-3.39
	1932	AO	-0.17201	-4.67
Norway	1855	IO	0.01957	3.55
	1858	AO	0.06452	14.81
	1876	AO	0.02596	5.96
	1917	AO	0.01580	3.63
Sweden	1902	AO	-0.02486	-5.56
	1917	TC	0.02327	5.54
	1919	IO	0.02486	-5.56
	1921	LS	-0.01422	-3.27

Sources: Authors' estimations using TRAMO.

Regarding the Chilean case, there are two levels shifts (changes in line with structural breaks) that can be linked with nitrates exploitation. The first one is in 1880, which is explained by the introduction of the nitrates export tax in November 1879. The second one is identified in 1921, during the post-world war commodity crisis, once it became clear that Chilean nitrates exports would lost the prominence that previously had in international markets. Both fall in the interval of confidence of the structural shocks identified through the Bai & Perron test (see Table 7). Besides that, TRAMO identifies two additive outliers in in 1919 and 1932.

As for the Swedish case, with the exception of an additive outlier in 1902, the rest of outliers in Sweden are identified *during* or *immediately after* the First World War in Sweden. In relation to this, the Bai & Perron test suggested a break in 1918. This confirms the idea that the only period when natural resources revenues could have a more relevant role in Swedish public

finances (although small) was during the Great War (see Section 3.2). In contrast, TRAMO does not suggest any outlier in line with structural changes in the Norwegian case. There is an innovative outlier identified in 1855 and three additive outliers in 1858, 1876 and 1917. In any case, the former two are similar to two of the structural breaks identified through the Bai Perron test.

We propose a periodification of natural resources dependence whose landmarks are based on the Bai-Perron test. As previously seen, the intervals of confidence obtained through this methodology incorporate most of the breaks identified through the outliers methodology, particularly those in line with structural breaks (LS and TC). Thus, four periods are identified in each case previously analysed.[34] Finally, given the impossibility to run structural breaks analysis in the case of Peru, we offer a periodization for this country based on critical historical facts: the beginning of the War of the Pacific and the loss of nitrates reserves and the beginning of the First World War and the reintroduction of export taxes.[35]

5. Understanding fiscal dependence: was it the economy or politics?

The goal of this section is to identify if changes in the relative importance of natural resources revenues were driven by economic, political or both kind of factors. For this, we develop a simple accounting identity. We start from the following equation:

$$\frac{T}{GDP} = \frac{T_r + T_o}{GDP}$$

where the sub-index *r* refers to the natural resource sector, the sub-index *o* refers to others (the non-natural resource sector) and T refers to total current revenues (tax and non-tax revenues).

Given that total collection (T_i) is equal to the tax rate (t_i) times the potential tax base (GDP_i), we can rewrite the equation as:

$$\frac{T}{GDP} = \frac{(t_r * GDP_r) + (t_o * GDP_o)}{GDP}$$

$$\frac{T}{GDP} = \frac{t_r * GDP_r}{GDP} + \frac{t_o * GDP_o}{GDP}$$

[34] For Bolivia: 1883-1895, 1896-1903, 1904-1931 and 1932-1939; for Chile: 1860-1879, 1880-1921, 1922-1928 and 1929-1939; for Sweden: 1870-1897, 1898-1906, 1907-1918, 1919-1939; and, for Norway: 1850-1858, 1859-1876, 1877-1884 and 1885-1939.

[35] So, there are three periods as follows: 1850-1879, 1880-1813, 1914-1939.

So, total tax collection is expressed as the aggregation of the effective tax rate on $sector_i$ times the participation of $sector_i$ in total GDP. However, given that $GDP_o = GDP - GDP_r$, we can concentrate the analysis in three variables:

$$\frac{T}{GDP} = t_r * \frac{GDP_r}{GDP} + t_o * (1 - \frac{GDP_r}{GDP})$$

The identity allows identifying whether higher dependence on natural resources revenues was driven mostly by significant economic shocks (i.e., an increase in the natural resource GDP) or by the tax disequilibrium (i.e., changes in the tax rates t_r and/or t_o). Given that these three variables can increase or decrease between two different periods, we can identify eight different possible scenarios (see Table A2). One of which is the "fiscal resource curse" scenario: a positive shock on natural resource GDP which coincides with an increase in the effective tax rate over this sector and a decrease of the effective tax rate on the rest of the economy. That is, a process of substitution in public finances, apparently guided by the ease to obtain revenue from the natural resource sector, which would ultimately lead to a lack of development in general tax capacity.

In Table 9 we can identify two instances of this "fiscal resource curse": Bolivia in the 1930s and Chile in 1880-1921. Here, significant expansions of the natural resource sector were accompanied by an intensification of the taxation of extractive activities and a decrease of the effective tax rate on the rest of the economy (that is, the combination + + - in the last three columns of the table). In the Bolivian case, this was associated with a political reaction to the Great Depression, the creation of the Tin Cartel and the Chaco War against Paraguay (1932-35), while in Chile it was a consequence of the huge shock caused by the acquisition of nitrates-rich territories from Peru in the War of the Pacific. These features are also identified in Peru during the Guano Era (1850-1879), which is not shown in Table 9 given that it is the first period of analysis in this country. Other episodes of increasing fiscal dependence were not characterized by this type of dynamics, since they did not entail significant decreases in t_o: for example, Bolivia in 1904-31, Peru after 1914, or Sweden in 1906-18.[36] In these cases, however, fiscal dependence from natural resources was in fact under the 20% threshold, or just on it in the Bolivian case. The case of Peru stands out as an instance of significant resource intensification in economic terms (with the share of extractive activities over GDP growing from 5 to 15%), which was not accompanied by tax dependence, precisely because of the

[36] It should be noted, however, that these are just factual developments and we cannot say anything at this point about what the counterfactual in t_o would have been.

expansion of general taxation and probably linked to diversification within the natural resource sector.

Table 9. Accounting identity: variation with respect to previous period

Bolivia				
Period	Tr/T	GDPr	tr	to
1896-1903	-	+	-	+
1904-1931	+	+	+	+
1932-1939	+	+	+	-
Chile				
Period	Tr/T	GDPr	tr	to
1880-1921	+	+	+	-
1922-1928	-	+	-	+
1929-1939	-	-	-	+
Peru				
Period	Tr/T	GDPr	tr	to
1880-1913	-	-	-	=
1914-1939	+	+	+	+
Norway				
Period	Tr/T	GDPr	tr	to
1859-1876	-	=	-	-
1877-1884	-	=	=	+
1885-1939	-	-	+	+
Sweden				
Period	Tr/T	GDPr	tr	to
1898-1906	+	-	+	=
1906-1918	+	=	+	+
1919-1939	-	-	-	+

Sources: Authors' own estimation. **Note:** = if variation is less than 5%.

When fiscal dependence was on the retreat, effective taxation on the "other" sector was always growing more than that on natural resources (or decreasing less). Interestingly, this coexists with both expansions and reductions in the share of natural resources over GDP (examples of the first would be Bolivia in 1896-03 and Chile in 1922-28; of the latter, Peru in 1880-1913 or Sweden in 1919-39). That is, avoiding fiscal dependence *was not* an automatic result of economic dependence fading away with diversification. It seems more appropriate to say that it was driven by the tax rate disequilibrium, and thus by efforts to build fiscal capacity.

The Nordic experience exemplifies these dynamics. In Norway, the almost unbroken trend of decrease in fiscal dependence was mostly driven by a sustained development of tax pressure on "the rest of the economy". This was particularly strong after 1876, a period that coincides with the expansion of the income tax both at the local level (where it was made compulsory in 1882) and at the central level (where it was introduced in 1892); see Hodne (1981). The effective tax rate on the extractive natural resource sector experienced very weak variations. In Sweden, even if we identify two periods with increases in tax dependence (at low levels), general taxation was expanding through these as well.

Indeed, our last general observation relates to the "tax disequilibrium" in Andean and Nordic countries. In the first, effective tax rates on the natural resource sector were often above those imposed on the rest of the economy. This was the case almost throughout our period of study in Bolivia and Chile; in Peru only before the War of the Pacific when they even attained the extreme level of 79%. Conversely, in Norway and Sweden natural resources look even under-taxed if compared with "the rest". In order to understand these differences, it is necessary to understand how state investment in tax capacity evolved *before* the period covered by our series in each country under consideration.

As for the Andean countries, it is necessary going back to independence wars (1810s-1820s). On the one hand, Bolivia and Peru were among the last countries to gain independence from Spain and among the countries that suffered the most from the direct and indirect costs of independence. This was reflected in an economic scenario of stagnation, de-urbanization and de-monetization (Prados de la Escosura, 2009). Similarly, after some initial essays, tax reform failed and the old colonial tax system was reinstalled (Irigoin, 2016). Therefore, during the first post-independence decades, the most important taxes were the capitation tax on the indigenous population and ancient regime taxes (such as the tithe) on agrarian production. This was done in a scenario of poor investments in tax capacity. For instance, it was not until the mid-1840s that Peru had its first budget law.

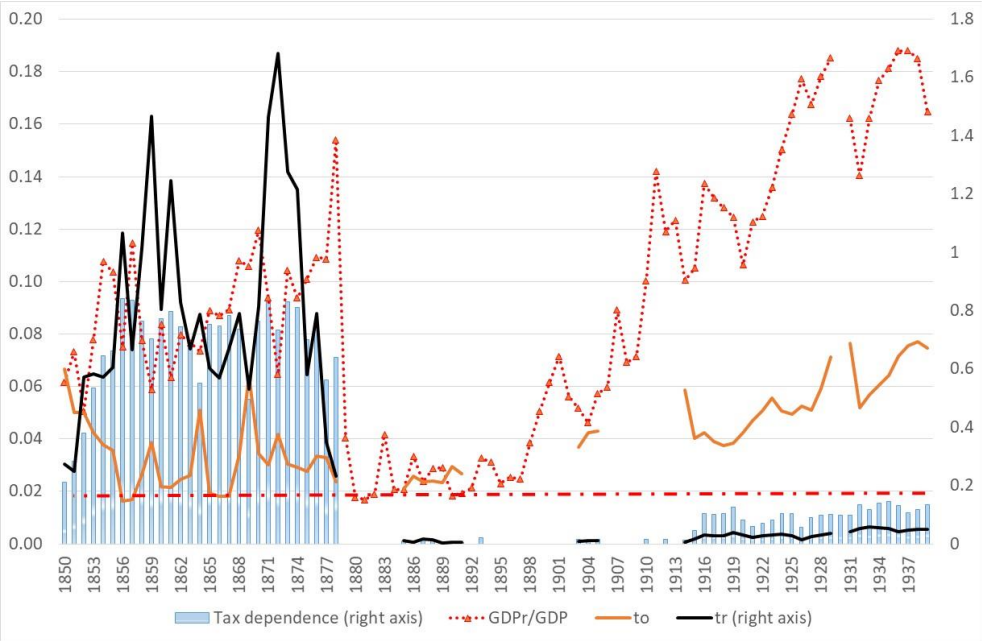
This would change once economic growth resumed thanks to the expansion of trade, the growth engine of Latin American economies during the First Globalization (Kuntz-Ficker, 2017). Following Jensen (2011), it makes sense that the expansion of trade created strong incentives to invest in tax capacity in this sector. Trade offered also critical administrative and political advantages: collection is obtained in point sources and does not need further bargaining with regional political powers. Therefore, the expansion of trade allowed

overcoming the colonial tax system and consolidated trade taxes as the most relevant (Coatsworth & Williamson, 2004).

The relevance of natural resources revenues in Andean countries are linked to this transition process from the colonial tax system to a modern one. Indeed, in the case of Peru, the consolidation of guano exports (which is reflected in Figure 5 in a significant increase of the natural resources GDP in the early 1850s), allowed the elimination of the indigenous capitation tax and other colonial taxes in the early 1850s. These changes are also reflected in Figure 5 that shows both an increase in tax pressure on the natural resource sector and a decrease in tax pressure on the rest of the economy. From these years up to the War of the Pacific (1879-1883), natural resources revenues represented up 80% of total revenues. These were non-tax revenues that were obtained through individual contracts on the different export concessions that were signed between the Peruvian government and both national and foreign capitalists. With the exception of exports to the United States, concessions on guano exports were concentrated in one single producer during the late 1860s; this explain the increase of the tax pressure on the natural resource sector. This monopoly was eliminated in 1874 and both guano and nitrates exports became administrated by the Peruvian government until the war.

The relative importance of the extractive natural resource sector plummeted after the war and the Peruvian economy entered into a deep crisis. As a way to solve this crisis, the state and export producers signed in 1890 an agreement that eliminated all export taxes (Contreras, 2012a). This agreement is critical to understand why the recovery of the natural resource GDP from 1895 to the First World War (Figure 5) did not generate an increasing fiscal pressure on the natural resource sector (see Table A5). During the First World War, the Peruvian government reinstalled export taxes (both for mining and agriculture products) while pointing out the existence of higher international prices and higher potential profits. After the war, most of export taxes came from cooper and oil exploitation, two *extractive* natural resource sectors that were progressively dominated by foreign investors. In any case, after the "fiscal resource curse" of the guano era and despite the increase of the natural resource sector, Peruvian public finances did not re-concentrate on natural resources revenues. Even more, during the first third of the twentieth century, tax pressure on the non-natural resource sector increased and remained always higher to that on the natural resource sector.

Figure 5. Evolution of the Natural Resources GDP over total GDP and effective tax rates on the Natural and Non-natural sectors in Peru, 1850-1939

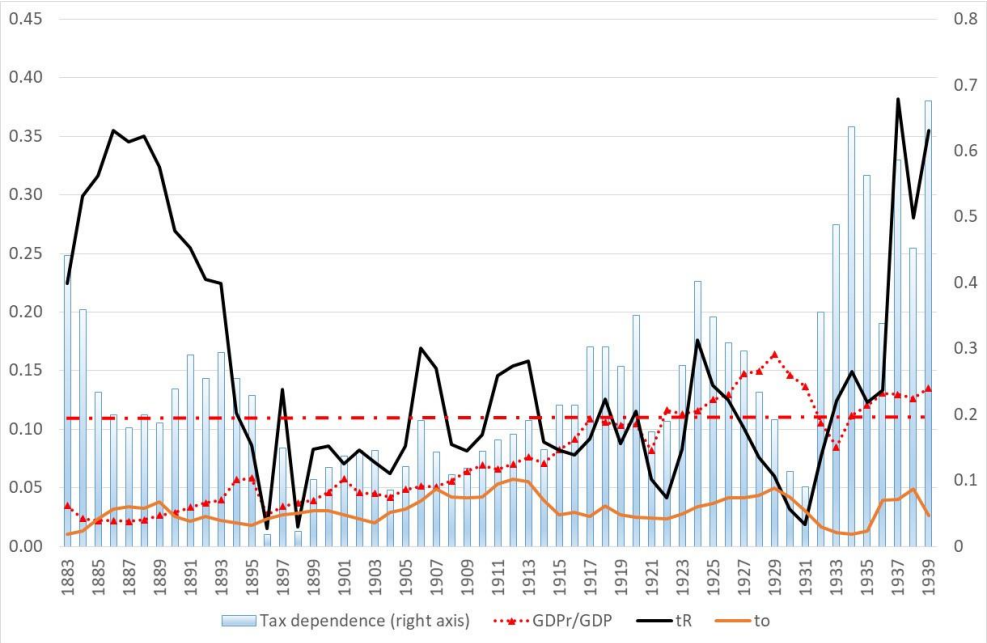


Sources: Authors' own calculations.

The transition from the colonial tax system to a modern one took place in Bolivia in the early 1870s, when the relevance of the capitation tax on the indigenous population was replaced by an export tax on silver and custom duties (Huber Abendroth, 1991; Sabaté-Domingo & Peres-Cajías, 2020).[37] This transition explains why tax pressure on the natural resource sector was several times higher than tax pressure in the rest of the economy in the early 1880s, a feature that persisted during most of the period under analysis (Figure 6). However, it also stands out the reduction in the fiscal dependence of the Bolivian central government on natural resources revenues during the last decades of the nineteenth century (see Table A3). This decrease was driven by constant reductions in the tax pressure on the natural resource sector and not by a noticeable negative shock in the sectorial GDP. This process is explained by the response of the government (which was administered by some of the most important representatives of the silver elite) to the impact that the severe fall of the international price of silver had on the sector's competitiveness (Peres-Cajías, 2015).

[37] During the 1870s, very volatile non-tax revenues from guano and saltpetre were also relevant.

Figure 6. Evolution of the Natural Resources GDP over total GDP and effective tax rates on the Natural and Non-natural sectors in Bolivia, 1883-1939



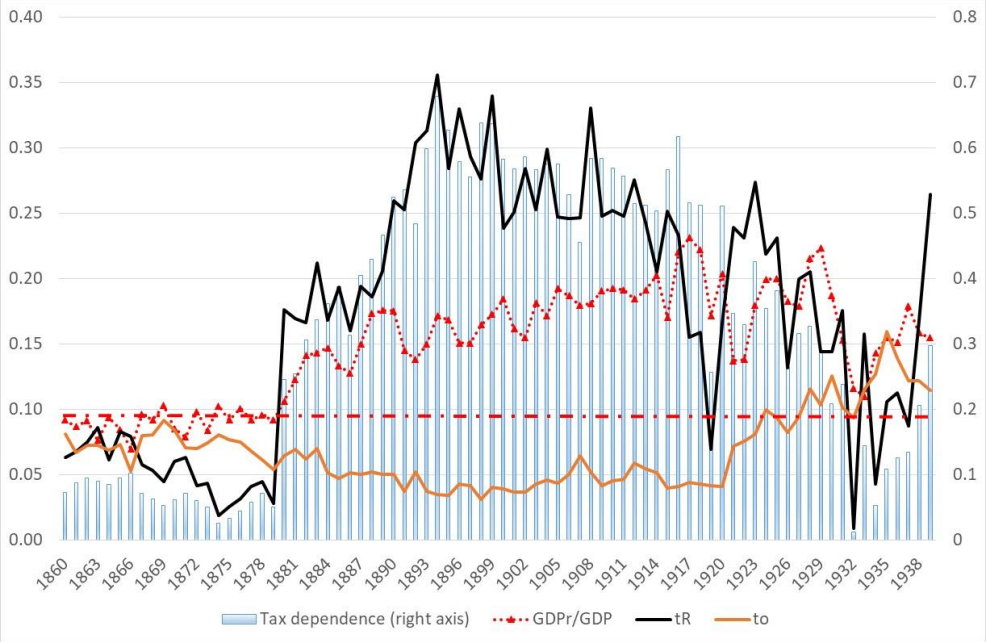
Sources: Authors' own calculations

Mining production presented a quick transition to tin, which became the most important export since 1904 (Peres-Cajías & Carreras-Marín, 2017). This explains the steady increase of the natural resources GDP. However, it was not until the early 1920s that the fiscal pressure on the natural resource sector would increase, once higher export taxes and a new direct tax on mining were implemented. The mining elites were able to reverse some of these tax prerogatives during the second half of the 1920s (Peres-Cajías, 2015). However, they were not successful in doing so during the 1930s, when higher tax pressure on the sector became persistent (Contreras, 1990). Indeed, once the Chaco war (1932-1935) was over, most of Bolivian political forces argued that the most relevant mining producers (which were nationals) were taking advantage of Bolivian natural wealth without reinvesting their profits in Bolivia. This fact justified a higher tax pressure on the sector, a process that did not take place on the rest of the economy.

Contrary to Bolivia and Peru, Chile was one of the few Latin American countries that recovered relatively quickly from the post-independence crisis. The country featured by a rare stability (by regional standards) in the duration of presidency terms since the 1830s. Also, economic growth resumed thanks to trade expansion and the relative strength of the internal economy – for instance, urbanization rates were around 30% in the mid-nineteenth century. Following Jensen (2011), once more, political stability and the expansion of both the natural resource sector and the rest of the economy, created incentives to invest in tax and

administrative capacity. In fact, in contrast to other Latin American countries, there are regular and complete Chilean official publications with different statistics from this period. Our results show that tax pressure on the natural resource sector was similar to that of the rest of the economy during the 1860s; the former became lower during the 1870s because of the export crisis that started in 1873 (Figure 7).

Figure 7. Evolution of the Natural Resources GDP over total GDP and effective tax rates on the Natural and Non Natural sectors in Chile, 1860-1939



Sources: Authors' own calculations.

However, a great reversal took place during the War of the Pacific (Sabaté-Domingo & Peres-Cajías, 2020). The seizure of nitrate-rich areas by the Chilean army increased the relative importance of the natural resource GDP and sharply increased tax pressure on the sector. During and particularly after the war, there was also a progressive elimination of other taxes, which is reflected in a decreasing tax pressure on the rest of the economy (Figure 7). The higher fiscal dependence on natural resource revenues came from a single source: export taxes on nitrates.[38] This tax was introduced during the war and, among other justifications, it was stated that the war begun because of the interest of nitrates companies so they had to pay for it (Sater, 1986). The use of an export tax (and not other instruments such as non-tax revenues as

[38] Mining patents were reinstalled during the early twentieth century but their relative importance was minimal, which explains the zero figures in Table 3. After the elimination of other non-nitrates export taxes in 1897, new export taxes on mining were created sporadically: on silver in 1906, borax in 1915 and iron in 1925.

in the Peruvian case) was justified as a way to make it easier for companies to translate the tax burden on foreign consumers (Bernedo, Camus, & Couyoumdjian, 2014). This was possible given the high market share of Chilean nitrates exports.

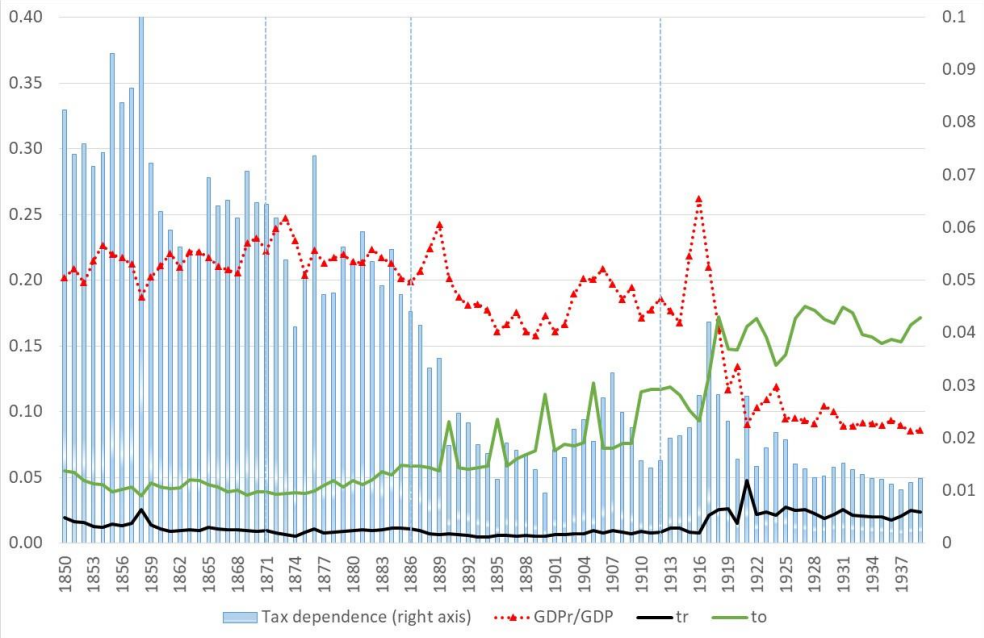
In any case, nitrates exploitation was dominated by foreign capitalists (particularly during the last decades of the nineteenth century), which had no direct access to tax discussions in the parliament. This institution played a critical role in the consolidation of such high fiscal dependence on natural resources. Indeed, whereas central authorities were aware of the extreme dependence (there are plenty of examples in Chilean primary sources), Chilean MPs used different strategies to boycott any attempt of tax reform (Bernedo et al., 2014). The pressure of the relevant political forces on fiscal issues was so vivid that among the 90 Ministers of Finances that occupied the post from 1891 to 1926, only six stayed for more than a year in different periods, and only one remained continuously for more than a year.

Tax reforms took place in the early 1920s, after the great crisis that the nitrates sector felt in the aftermath of the First World War (see Table A4). Among different measures, direct taxes were reintroduced after its decentralization during the early 1890s. This increased both the tax pressure on the rest of the economy and on the natural resource sector, with a new tax on mining profits. The relative importance of this last tax was marginal during the 1920s but increased afterwards because of the generalization of direct taxes on big and small mining companies and the collection of taxes that were both budgeted and extra-budgeted (Humud, 1969). The Great Depression consolidated the nitrates crisis (see the big fall of the natural resource GDP) and natural resources revenues lost significance, some of which would be recovered somehow once copper exports increased afterwards.

Nordic countries did not suffer the kind of economic crisis that was present in Andean countries in the decades following the Napoleonic Wars. However, economic growth rates were rather low. It was only during the second half of the nineteenth century that economic growth took off, both by the extraction of natural resources and industrialization (Ville & Wicken, 2013). Partly because of economic diversification, it is not possible to identify sudden and sustained increases in the participation of the natural resources GDP; with the First Word War the only major exception (Figures 8 and 9). Moreover, the available evidence suggests that, in contrast to Andean countries, the relative importance of the natural resource GDP was high already at the beginning of the period under study and tended to decrease over time. Following Jensen (2011), once more, this can have critical implications in a possible “resource fiscal curse”: given the relatively higher growth of the non-natural resource sector, it was rational to

invest in tax capacity in this sector. This can be one of the possible explanations of the higher tax pressure on the non-natural resource sector than in the resource sector throughout the entire period in Norway and Sweden (Figures 8 and 9 and Tables A6 and A7).

Figure 8. Evolution of the Natural Resources GDP over total GDP and effective tax rates on the Natural and Non-natural sectors in Norway, 1850-1939



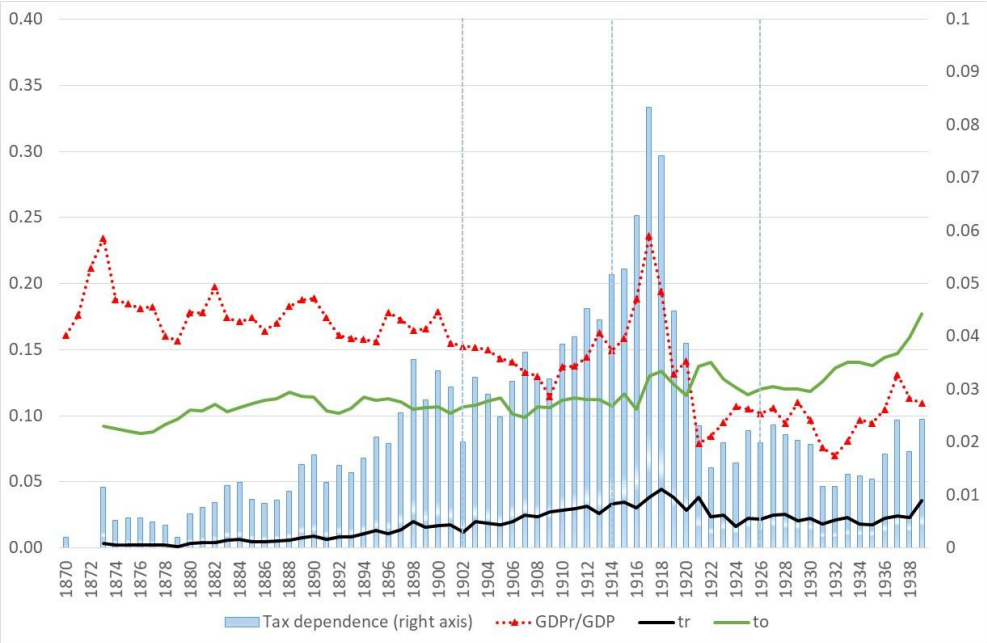
Sources: Authors' own calculations.

Another relevant factor could be related with the effect of long-term institutional determinants on previous investments on tax capacity. Indeed, contrary to Andean countries, public revenues in Nordic countries were more diversified and local taxation played a critical role during the nineteenth century (Schön, 2010). Also interesting, the transition away from the ancient regime tax system was accompanied by the substitution of the old capitation by a modern income tax. The relevance of this was felt vividly during and after the First World War, a period when tax pressure on the non-natural resource sector increased in both countries (Figures 8 and 9).

In spite of this tax diversification, trade taxes were still relevant in Nordic countries during the second half of the nineteenth century, accounting for 30-50% of Central government's revenues. So, it is still necessary to clarify why Nordic countries did not rely on export taxes. On the one hand, Norway abolished export taxes on iron and copper in the 1840s (Hodne and Grytten, 2000: 58), when the mining and metal sector was going through a deep crisis. Timber export taxes had also been reduced during 1814-30s, but they kept being an important revenue source given the strong increase in activity during the second half of the

century. They were finally eliminated in 1894 (Hodne, 1981: 53). Export taxes on fishing also persisted until this year, although they were less important quantitatively.

Figure 9. Evolution of the Natural Resources GDP over total GDP and effective tax rates on the Natural and Non-natural sectors in Sweden, 1870-1939



Sources: Authors' own calculations.

On the other hand, with the exception of a tax on forest products in 1903-11, export taxes in Sweden were marginal or inexistent. Export duties had been a significant component of revenue earlier on, especially in the case of bar iron. However, export taxes on forest products had disappeared by the mid-1840s and those on iron and copper were kept until the early 1860s (Häggqvist, 2018).[39]Also important, whereas there were some attempts to re-introduce export taxes in Sweden, the feasibility of these projects should carefully consider two elements: the negative effects that taxes could have on the competitiveness of natural resources exports and the need to balance the different economic interests of local producers (Dugstad Sanders, 2018). In relation to this, another particular feature of Nordic economies is related with the early consolidation of a cooperative relationship between the State and local capitalists, initially, and between the State, local capitalists and workers, thereafter (Hveem, 1991; Schön, 2010: 181; Södersten, 1991: 40).

[39] In the words of Häggqvist (2018), *"The move away from taxing exports to taxing only imports, and mainly imports whose growth were not hurt by the existence of tariffs, was instrumental in securing a steady flow of customs revenue"* and was also *"likely a move that promoted export growth"* (p. 16). The debates around the reforms in export taxation are extensively presented in Montgomery (1921).

6. Conclusions

This paper makes three main contributions to the literature on natural resources and taxation. First, we provide new series of fiscal dependence for five natural resource abundant countries, three in the Andes and two in Scandinavia. Our series consider all tax and non-tax revenues from *extractive* natural resources (mining, forestry, and fishing where relevant), and are constructed following the IMF definitions. This offers a comparison through ninety years of economic history (1850-1939), and also with present day data.

With our database we can describe the relative importance of natural resource revenues in both groups of countries. We provide evidence of high fiscal dependence in the three Latin American countries during different periods of their history: Peru in 1850s-1870s, Chile in 1880s-1920s, Bolivia in 1870s-1895 and again increasingly after 1913. On the contrary, according to our estimates, these revenues never crossed the 20-25% threshold in Norway and Sweden: maximum levels of near 10% were attained in the 1850s in the case of Norway and around World War I in Sweden. The composition of natural resources revenues was also different in Andean and Nordic countries: in the latter, modern income taxation originated and already attained importance during this period, while export taxes remained central in the former.

Finally, our accounting identity allows differentiating when scenarios of high fiscal dependence occurred because of economic or political factors (i.e., an increase in the share of the natural resource sector in the economy, or the state's intention and ability to extract more revenues from one or another sector). In this context, we show that the higher relevance of natural resource revenues in Andean countries was sometimes the result of great shocks on the economy coming from the expansion of the natural resource sector. In other, it was also because of a higher desire to tax more on the natural resource sector than in the rest of the economy. However, we show that these preferences are not *inherent* to natural resource abundance or to Latin American countries. For instance, tax rates applied to the rest of the economy in Chile before the War of the Pacific were higher than in the natural resource sector and not so different to those applied in Nordic countries. Likewise, in spite of the strong recovery of the natural resource sector in Peru during the first decades of the twentieth century, tax rates on the rest of the economy increased as those applied in the natural resource sector.

So, it is necessary to understand why fiscal dependence on natural resources and *rentier* attitudes arise in very specific periods in resource rich economies. Our findings on the experience of guano in Peru, nitrates in Chile and tin in Bolivia, are in line with the idea that

mining and oil exploitation are great candidates when looking for "resource fiscal curse": these activities generate significant windfall and concentrated rents which have particular economic (sudden changes in the GDP composition) and taxation (point sources) implications.

However, our findings also highlight that the link between mining and rentier states should not be taken for granted. Our work suggests that the "resource fiscal curse" is more probable in an economic scenario of low diversification, either in the export sector or in the overall economy. Following Jensen (2011), higher diversification would offer higher incentives to invest in tax capacity beyond the *extractive* natural resource sector. On the other hand, our work also shows that taxation on the natural resource sector is also dependent on how the relevant political forces think about the effects of taxes on companies' profits, and how the bargaining process takes place between the State and private companies (either collaborative or confrontational). In our sample, this awareness could be analysed by looking at ownership composition (national and foreign) or the market share and competitiveness in international markets. In Jaakkola, Spiro, & van Benthem (2019), available reserves and investments patterns are critical to understand tax cycles.

The relevance of politics underscores the critical role of institutions in evading the "fiscal resource curse". However, as previously highlighted by Tornell & Lane (1999) or as vividly showed by the Chilean experience during the nitrates era, democracy or a higher control over the executive can increase redistributive disputes, sometimes with unwanted long-term consequences. This suggests that the institutional challenge is far away from a "one fits all size" solution: it is related with how the state and private companies can solve the commitment problem (Jaakkola et al., 2019) and how the relevant political forces can cooperate and design a credible set of incentives that reduce voracity attitudes in the long-term.

Appendix

Table A1. Relative importance of Mining and Forest Extraction over GDP and total exports in Norway and Sweden, 1850-1939 (%)

	Norway				Sweden	
	Mining GDP/ GDP	Mining & Forest GDP/ GDP	Mining Exports/ Total Exports	Mining & Forest Exports/ Total Exports	Mining GDP/ GDP	Mining Exports/ Total Exports
1850	n.d.	n.d.	n.d.	n.d.	7.5	49.1
1870	0.8	11.7	2.6	40.2	6.6	23.7
1880	1.7	13.0	5.5	43.4	6.3	19.8
1895	0.9	6.4	2.9	22.2	6.0	20.3
1913	2.0	5.2	5.4	14.1	8.7	28.6
1925	1.2	3.3	4.0	11.0	4.6	28.1
1938	2.3	2.9	8.1	10.2	7.5	42.4

Sources: See Table 1.

Table A2. Fiscal scenarios using the accounting identity

Fiscal scenarios	Variables of interest and direction of change between two periods "+" (increase) and "-" (decrease)		
	GDPr	tr	to
1	+	+	-
2	+	-	-
3	+	-	+
4	-	+	-
5	-	+	+
6	+	+	+
7	-	-	-
8	-	-	+

Sources: Authors' elaboration.

Table A3. Fiscal dependence on extractive natural resources and Accounting Identity in Bolivia, 1880s-1930s (%, averages)

	Tr/T	T/GDP	GDPr	GDPo	tr	to
1883-1895	25.87	3.13	3.29	96.71	26.09	2.44
1896-1903	10.48	2.81	4.15	95.85	6.99	2.62
1904-1931	20.95	4.28	9.60	90.40	9.90	3.73
1932-1939	51.22	4.78	11.80	88.20	20.33	2.59

Sources: Authors' elaboration.

Table A4. Fiscal dependence on extractive natural resources and Accounting Identity in Chile, 1860s-1930s (%, averages)

	Tr/T	T/GDP	GDPr	GDPo	tr	to
1860-1879	6.69	7.07	9.02	90.98	5.33	7.26
1880-1921	49.89	7.98	16.93	83.07	23.76	4.76
1922-1928	34.25	11.37	18.48	81.52	21.30	9.16
1929-1939	16.50	12.19	15.73	84.27	12.82	12.02

Sources: Authors' elaboration.

Table A5. Fiscal dependence on extractive natural resources and Accounting Identity in Peru, 1850s-1930s (%, averages)

	Tr/T	T/GDP	GDPr	GDPo	tr	to
1850-1879	67.40	9.89	8.82	91.18	79.22	3.32
1880-1913	1.22	3.17	4.87	95.13	0.96	3.31
1914-1939	9.86	5.26	15.15	84.85	3.51	5.58

Sources: Authors' elaboration.

Table A6. Fiscal dependence on extractive natural resources and Accounting Identity in Norway, 1850s-1930s (%, averages)

	Tr/T	T/GDP	GDPr	GDPo	tr	to
1850-1858	8.71	3.90	20.96	79.04	1.61	4.51
1859-1876	6.14	3.42	21.96	78.04	0.96	4.11
1877-1884	5.27	3.93	21.64	78.36	0.96	4.76
1885-1939	2.04	9.99	15.43	84.57	1.42	11.39

Sources: Authors' elaboration.

Table A7. Fiscal dependence on extractive natural resources and Accounting Identity in Sweden, 1870s-1930s (%, averages)

	Tr/T	T/GDP	GDPr	GDPo	tr	to
1870-1897	1.09	8.53	17.72	82.28	0.56	10.33
1898-1906	2.94	9.28	15.58	84.42	1.75	10.67
1907-1918	4.94	9.98	15.71	84.29	3.10	11.27
1919-1939	2.06	12.19	10.12	89.88	2.42	13.29

Sources: Authors' elaboration

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