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Resource abundance and public finances in five peripheral economies, 1850s–1930s☆

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ABSTRACT

The resource curse literature has established that 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.

1. Introduction

The economic effects of natural resource abundance are among the most debated issues in economics.[1] Consequently, the effects of natural resources on government revenues are also under scrutiny. For instance, scholars within the developmental state tradition have highlighted that natural resources can provide states with abundant revenues with which to foster economic and social progress (Hujo and McClanahan, 2009; Karimu et al., 2017; Mosley, 2017). More skepticism 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 risks. 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

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[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 and Poelhekke (2017); Venables (2016). In a recent article, Atienza et al. (2021) propose to go beyond the national level and look at the economic effects of mining at the local level.

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other hand, the availability of natural resource 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, greater fiscal dependence on natural resource revenues has been associated with authoritarianism (Ross, 2001) and reduced quality of government (Anthonsen et al., 2012), although the first nexus was challenged by Haber and 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, 2005, 2015; Berg et al., 2013; Bhattacharyya and Collier, 2013; Collier and Hoeffler, 2005; Oyarzo and Paredes, 2018; Paredes and Rivera, 2017). On the revenue side, several studies have proposed the existence of a negative correlation between the expansion of natural resource revenues and the expansion of other revenues. This "fiscal resource curse" has been detected in Latin America (Ossowski and Gonzales, 2012), Africa (Bornhorst et al., 2009) and mineral and oil-rich economies (Crivelli and Gupta, 2014; Chachu, 2020).[2] It has also been identified at the local level, both in US states (James, 2015) and in Chilean regions (Oyarzo and Paredes, 2019, 2021).

However, most of the afore-mentioned studies cover the post- 1970s period. This is not irrelevant given that the resource curse can vary in its extent and impact over time (Auty, 2015). Moreover, recent research has suggested that the negative relationship between natural resource revenues and other revenues depends on institutional quality (Masi et al., 2020).[3] In this context, in this paper we evaluate fiscal dependence on natural resources from a different perspective than the previous literature: we compare three Andean (Bolivia, Chile and Peru) and two Nordic (Norway and Sweden) countries during the 1850–1939 period. The importance of natural resources in both regions and the stark differences across several other economic determinants[4] allows us to study why natural resource abundance can have opposing effects on the formation of modern tax systems. Likewise, our incorporation of a longer time span than previous studies offers the opportunity to test the effect of changes in resource cycles and other contextual factors.[5]

Our comparison of two regions that could be considered to have been peripheral during the nineteenth century shows that natural resource abundance does not automatically lead to fiscal dependence on natural resource revenues. Indeed, our estimations show that while the relative share of natural resources revenues fluctuated greatly in the case of Andean countries (between 10% and 70% of total current revenues), it barely exceeded 10% of total current revenues in the Nordic countries throughout the 1850–1939 period.[6]

These opposing trajectories can be explained by economic and political factors. With regard to the former, although both regions were abundant in natural resources, economic dependence on these resources (and particularly on mineral resources) was higher in the Andean countries. This is evidenced by looking at either the composition of the aggregate economy or that of total exports. As for politics, our work shows that the critical role of institutions in overcoming the "fiscal resource curse" is not limited to control of the executive by a strong parliament (Masi et al., 2020). In fact, our detailed historical analysis shows that greater power-sharing between the executive and other key political forces can increase rapacious attitudes over natural resource revenues, which is in line with the theoretical proposal of Tornell and Lane (1999). Therefore, the institutional challenge in natural resource abundant countries lies in the creation of economic and institutional restrictions to reduce the incentives for *any* powerful political group to foster an abrupt change of tax pressure on natural resource exploitation.[7]

The rest of the paper is organized as follows. In Section 2, we describe the centrality of natural resources in the two groups of countries during the period under scrutiny. In Section 3, we measure the dependence on natural resource revenues in Andean and Nordic countries from 1850 to 1939. In Section 4, we discuss the results of a structural break analysis and those of a fiscal identity in Section 5. In Section 6, we conclude.

2. Natural resource exploitation in Andean and Nordic countries

Much of the literature shows that the negative economic effects of natural resources can vary substantially depending on the specific product that is exploited (Isham et al., 2005). Making reference to this literature, Auty (2015) has stressed that the resource curse is stronger in small and mineral-driven economies. He proposed 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 mining is critical in taxation terms. Mining and oil are associated with windfall and concentrated resource rents. Moreover, these are non–renewable natural resources whose stocks are determined by previous and significant investments. In this context, the higher capital intensity and large operations of mining and oil ensure their rent is large relative to GDP (Auty, 2015). These features underline the attractiveness of these specific natural resources for testing the "fiscal resource curse" in a historical setting: sudden changes (a shock) in mining and oil production could have had sizeable fiscal effects that hampered the long-term

[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.

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

[4] Both group of countries were natural resource abundant and were embracing state-building efforts during the late nineteenth century (Blomström & Meller, 1991; De Ferranti, Perry, Lederman and Maloney, 2002; Ducoing and Peres-Cajías, 2021; Ranestad, 2018). However, there were striking differences between Andean and Nordic countries in several critical determinants of economic development, such as human capital (Peres-Cajías and Ranestad, 2021) and distance to major world markets (Ducoing et al., 2018). There were also important differences in their ability to transit from natural resource-dependent to more complex economies during the First Globalization (Peres-Cajías et al., 2021; Ville and Wicken, 2013).

[5] The "fiscal resource curse" has been evaluated through cross-country econometric exercises and in-depth case studies. However, to the best of our knowledge, there are very few long-term case studies. For instance, Rubio-Varas (2015) and Van der Eng (2015) offer fiscal dependence series for Venezuela, Mexico, and Indonesia. They do not analyze these series from the point of view of the rentier state theory, as Peres-Cajías (2015) does for the Bolivian case.

[6] It could be argued that the fluctuations we find are time and space specific, leaving little room for further generalizations that could help re-think the "fiscal resource curse". On the one hand, we focus on peripheral countries from Latin America and Europe since most African and Asian countries that are natural resource abundant were not sovereign states in the nineteenth century. On the other hand, significant variations in the relative size of natural resource revenues are also seen in the twentieth-century experience of Ecuador and Mexico (see Haber and Menaldo, 2011) as well as Colombia (see Hernández Rodríguez, 2015). Taxation cycles in natural resource abundant countries throughout the world and during the twentieth century have been also highlighted by Jaakkola et al. (2019).

[7] Masi et al. (2020) also propose that restrictions on the executive are critical to overcoming the "fiscal resource curse" insofar as it can assure the impartiality and transparency of the tax system.

consolidation of modern tax systems.[8]

Along with mining and oil production, we also analyze the fiscal effects of forestry and fishing exploitation in Nordic countries. While these sectors are not point-source natural resources, their exploitation during the nineteenth century was *extractive* in nature and, therefore, could be seen as a windfall source of public revenues. Indeed, 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 senses. 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 and Grytten, 2000: 273). Similarly, fishing resources were seen as a natural gift by nineteenth century Norwegians (which is not the case of aquaculture), and was considered alongside logging, mining and other extractive activities in early literature on resource economics (e.g. Scott, 1962).[9]

Taking into account these considerations, our goal in this section is to explore the centrality that *extractive* natural resources had in the five countries from the 1850s to the 1930s. To this end, we analyze the relative importance of mineral, forestry and fishing production as a proportion of GDP and the relative importance of these sectors as a proportion of total exports (Table 1). The former indicator shows the importance of the sector in the economy, whereas the latter highlights each country's degree of dependence (Badeeb et al., 2017). In the case of Norway, we estimated the relative importance of the natural resource sectors as a proportion of GDP for this article.[10]

The extractive sector was central to all these economies, albeit with varying intensity. Extractive natural resources were often between 10 and 20% of GDP, in both the Andean and the Nordic countries. The average over the whole period can be calculated for Chile, Peru and Sweden as 14.9%, 9.2% and 15.2%, respectively.[11] In terms of exports, dependence is even more clear: natural resource products represented more than half of the total in most years, with an average of 77.6% in Chile, 50.7% in Peru, and 52.2% in Sweden.

We can discern three groups in terms of the trajectories followed by the economic centrality of natural resources: first, Bolivia and Chile; second, Peru; and finally, the Nordic countries. In Bolivia and Chile, not only was the extractive sector of primary importance, but it also increased almost monotonically over time. Bolivian was an economy of very low complexity: the agrarian sector still represented 56% of GDP in the 1910s and 45% in the 1930s, and manufacturing only passed the 10% mark in the late 1930s. The relative share of mining jumped from 1% of GDP in 1846 to 6% in the 1890s, and to well over 10% in the last two decades shown (Herranz-Loncán and Peres-Cajías, 2016). This increase is explained by the recovery of silver exports during the early 1870s, the transition from silver to tin exports on the cusp 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 significant, 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 share of the mining sector of GDP jumped from 7% in the 1850s to between 15 and 20% after the 1890s. Here as well manufacturing was negligible in this period, at around 10% of GDP (Díaz et al., 2016). The mining sector in Chile underwent two pronounced natural resource cycles: the copper cycle and the nitrate cycle. The former started early in the nineteenth century with the growing demand for sheathing for ships (De Rosa, Ciarlo, Pichipil and Castelli, 2015), while the latter was a result of the annexation of former Bolivian and Peruvian territories after the War of the Pacific (1879–1883) and the expansion of international demand for this product as an agrarian fertilizer (Miller and Greenhill, 2006). Even though the nitrate cycle was shorter (1880–1930), it still had an impressive effect on the economy (Badia-Miró and Ducoing, 2015; Badia-Miró and 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).

In the case of Peru, the trajectory of the natural resource sector presents a U-shape, with maximum export dependence at the beginning of the period (around and above 80% of total exports in the 1850s to the 1870s), a fall that came as a consequence of the War of the Pacific, and another gradual increase starting in the 1890s. The extractive sector's share of GDP shows similar trends, albeit in this case the higher levels were reached at the end, at nearly 20% (Seminario, 2015).[13] The first natural resource cycle ended abruptly during the War of the Pacific (1879–1883), when nitrate-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 by way of a more diversified basket: copper, gold, silver, sugar, cotton, wool and rubber. In the early 1910s mining recovered some of its previous importance, a process driven by copper initially and by oil thereafter; the remaining exports were composed of agrarian products.

The third group includes Norway and Sweden, where the share of the natural resource sector, of both GDP (20–10% approximately) and exports (ca. 80 to 30% in Norway, 70 to 45% in Sweden), decreased over time. The new evidence gathered for Norway suggests that while mining production was marginal (see Table A1), forestry and fishing remained central until the early twentieth century. The main mining products

[8] The focus in mining and oil explains why we do not include Ecuador and Venezuela in our sample of Andean countries: both countries were agrarian economies during the nineteenth century, and oil exploitation only became important later on (the early 1920s in the former case, and the early 1970s in the latter). Likewise, we do not take into account Colombia (another Andean country) 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 decades 1830–1870 (Hernández Rodríguez, 2015). As stated previously, the study of these other Andean cases (and other worldwide examples) during the twentieth century offers similar paths of unstable taxation on natural resources.

[9] In any case, the inclusion of forestry and fishing does not alter our conclusions on the opposing effects that natural resource exploitation had on the tax system of Andean and Nordic countries.

[10] We estimated the weight of the natural resources sector by way of a two-stage process. First, we conducted a detailed analysis of the foreign sector 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).

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

[12] Note that data on the composition of Bolivian exports during the nineteenth century is scarce and dispersed. However, qualitative evidence and contemporaneous reports stress that, despite the increase in quinine exports during the mid-nineteenth century, silver exports represented the bulk of Bolivian exports. Copper exports were also of similar or greater significance than quinine exports. There is even less uncertainty on the centrality of silver exports from the 1870s to the early 1890s.

[13] The relative importance of the sector early on 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 nitrate production increased markedly: the former represented 50% of total exports and the latter jumped from 10% to 25%.

Table 1
Relative importance of extractive natural resources in GDP and total exports (percentage), 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

Notes: Extractive Natural Resources include 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).
Sources: For Bolivia, Herranz-Loncán and 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 et al. (2012).

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 peaked 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 and Grytten, 2000).[15]

In Sweden, the relative importance of *extractive* natural resources was notable throughout the period under analysis, both with and without forest production. Certainly, as has been described elsewhere (Lobell et al., 2008), the Swedish economy underwent considerable structural change from the late nineteenth century, with the agrarian sector decreasing in importance (from 44% in the 1850s to 16% in the 1930s) and considerable growth in manufacturing (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 forest products, iron ores, and sulfide ores. This is why the relative importance of natural resource 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 from the 1870s to the 1930s.

These differing trajectories of extractive natural resources in relation to GDP indicate that the size of natural resource shocks relative to the entire economy could be increasingly large in Andean countries. This, in turn, could generate larger tax effects through changes in the tax base alone and not necessarily through a political decision to tax the natural resource sector more. We consider this later in the paper.

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

All in all, however, *extractive* natural resources were important in these five economies throughout the First Globalization. Focusing solely on mining, its relative weight in total GDP was higher in Sweden than in Bolivia during the nineteenth century and similar to that of Chile before the nitrate boom (see table A1). Furthermore, these countries would all fall into the current IMF definition of a *resource intensive* country (natural resources accounting for a share of more than 25% of total exports; Thomas and Treviño, 2013) throughout the entire period (Fig. 1).

It is also important to consider the relative size of total public revenues in our sample (Fig. 2).[16] The clear distinction between the Andean and Nordic countries that we witness today was 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% of GDP), and converged somewhat again in the 1930s (now around 12%). Peru displayed the highest public revenue in the early 1870s, but also the greatest fluctuations. It experienced a very substantial drop after the War of the Pacific, and joined Bolivia in the lower ranks in the 1880s.

The centrality of natural resources and the similar size of the public sector in the two groups of countries represent an opportunity to analyze the relationship between natural resources and public revenues.

3. Fiscal dependence on natural resources in Andean and Nordic countries

3.1. The estimation of natural resource revenues

We provide a new database on the evolution of natural resource revenues from 1850 to 1939 in the countries under scrutiny.[17] The data was constructed using homogeneous definitions (following modern

[14] Iron production underwent difficulties in the second half of the nineteenth century, having been outperformed by Swedish and British competitors (Lieberman, 1970). Norwegian iron ore was found in hard-to-reach locations and was generally of poorer quality. A lack of coal in the country has also been cited as a reason for this decline. 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 and Grytten, 2000: 79). However, iron and copper mining were revived around 1900 thanks to the rise in electrification and the influx 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 up to a low level of processing, we only take into account timber exports and not exports from timber-related industries. This explains why our estimation of the relative importance of *extractive* natural resources in Norway are lower than those of Hveem (1991: 134) from 1900 to 1939.

[16] For 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 institutions.

[17] Note the recent flourishing of tax databases focused on natural resource revenues (ECLAC, OECD, & IDB, 2017; Laporte et al., 2017; Smith, 2012). As far as we are aware, only Haber and Menaldo (2011) offer comparative analysis of long historical series of tax natural resources dependence, starting in 1800 or the country's year of independence.

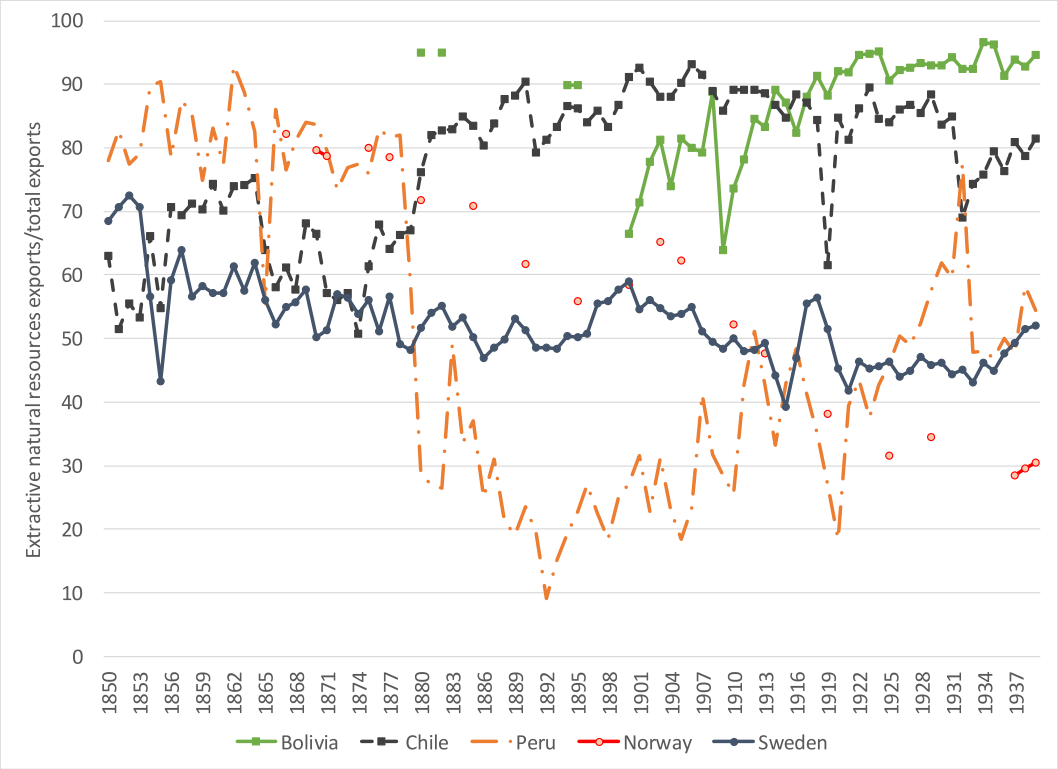

Fig. 1. Extractive natural resources exports (percentage of total exports), 1850–1939
Sources: See Table 1. **Notes**: Extractive Natural Resources include Mining in the case of Andean countries; Mining and Forestry in Sweden; Mining, Forestry and Fishing in Norway.

standards set by the International Monetary Fund), and is comprehensive in terms of types of revenue and based on actual budget figures.[18] As is common practice, we define natural resource revenues as those public revenues derived from mining and oil production. This means that we include those products obtained from extraction up to a low level of processing (e.g. copper and iron bars are included but cables and steel are excluded) and exclude agriculture. However, as previously stated, we also provide evidence on government revenues from forestry and fishing in the Nordic countries. This inclusion does not affect our conclusions.

Our estimation of natural resource revenues takes into accounts 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 made to the government by state-owned firms operating in these sectors (Haber and Menaldo, 2011). We define fiscal dependence as the relative importance of tax and non-tax revenues in *total current* public revenues. According to recent works by the International Monetary Fund's Fiscal Affairs Department, a country is fiscally dependent on natural resource revenues when it accounts for more than 20–25% of total current revenues (Pessino and Fenochietto, 2010; Thomas and Treviño, 2013).

These revenues are organized into four different categories that we constructed following the IMF *Government Statistics* guidelines: non-tax revenues, direct taxes, indirect internal taxes and export taxes.[19] Non-tax revenues arise from the public ownership 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 specific taxation of the natural resource sector or to their share of 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 to most of the prior literature (e.g., Anthonsen et al., 2012 or Collier and Hoeffler, 2005), our series of natural resource revenues include different fiscal instruments. When only non-tax revenues are included, it is under the rationale that these are derived from state property, and are received with administrative ease and without the need to generate stable relations with taxpayers -that is, a fiscal contract. Some tax revenues might share these features to some extent. For example, export taxes are collected at international trade centers, 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, despite the administrative advantages generated by the concentration of mining in very specific places (point sources), the collection of direct taxes in this sector demands broader administrative capabilities and higher taxpayer compliance.

We have estimated natural resource revenues 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 official fiscal statistics. To estimate the Peruvian case we used the statistical appendix in Contreras (2012a,b) for the 1850–1879 period, and primary sources thereafter. We processed the Peruvian calculations in the same way as the Bolivian case, which is explained in Peres-Cajías (2015), given the similarities between the primary sources of these two countries (*Cuentas Generales* and *Anuarios Administrativos*,

[18] In many cases, the earlier literature resorted to proxies such as a combination of world prices and estimates of production costs. Similarly, previous works tended to be limited to the analysis of non-tax revenues. Our database takes into account different tax categories given the range of tools that governments have to tax natural resources (Gómez Sabaini, Jiménez and Morán, 2015) and the disparate economic and political effects that these tools can have.
[19] In the case of Bolivia, we also take into account revenues derived from the use of multiple exchange rates imposed in a very specific period (1936–1939).

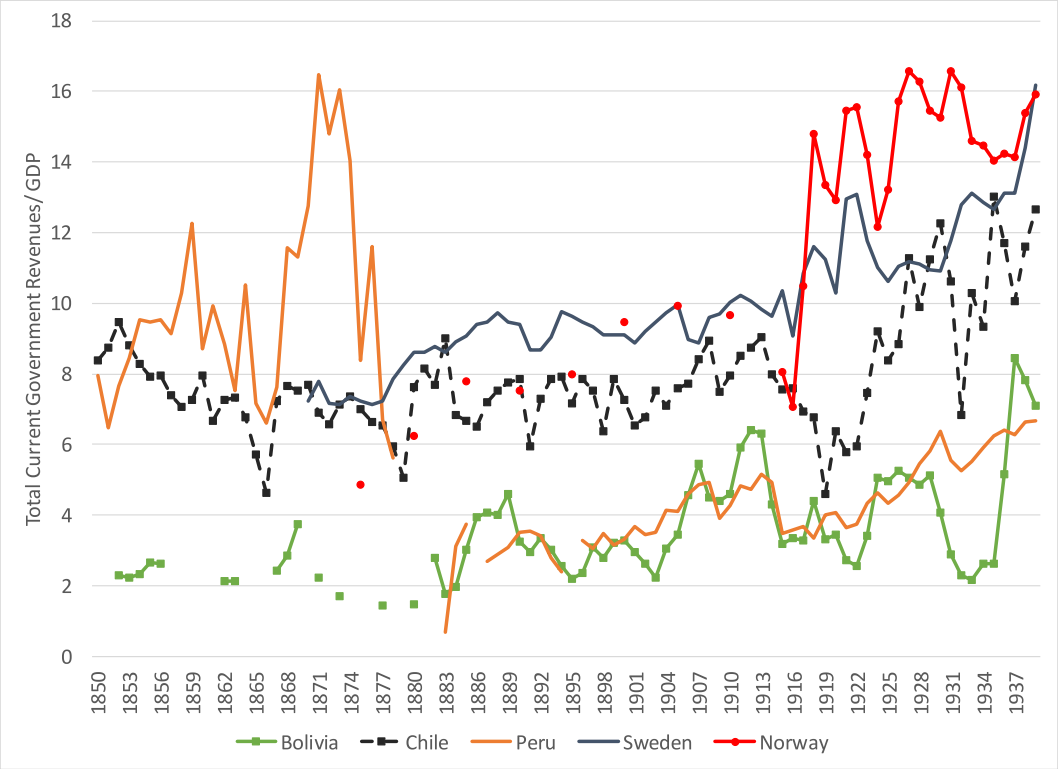

Fig. 2. Government Revenues (percentage of GDP), 1850–1939
Sources: For Bolivia, Peres-Cajías (2014); for Chile, Díaz et al. (2016); for Peru, Contreras (1997); Portocarrero S. et al. (1992) and Seminario (2015); for Norway, Eitrheim and Fevolden (2019) and authors' compilation from official historical statistics; for Sweden, Henrekson and Stenkula (2015) and authors' compilation from official historical statistics and Statistical Yearbooks. **Notes**: General Government statistics are presented in the case of Nordic countries and Central Government statistics in the case of Andean countries. Section 3.2 offers more information on the implications of both administrative units in the two group of countries.

respectively). The use and combination of these series allows us to analyze the composition of natural resource 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 resource revenues in Peru after the War of the Pacific.[20]

We have constructed the databases for Norway and Sweden specifically for this article. To this end, we have collected information on all natural resource revenues that fit our categorization for both countries, using statistical yearbooks, tax statistics, and previous scholarly publications such as Gårestad (1985) and Häggqvist (2018). The corporate income tax payments of natural resource companies are only known for certain years (statistics exist for the Swedish case for several years between 1909 and 1921); for the years for which they are not available, we have used the available data for our estimations.[21] We then express our natural resource revenues 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*

In this subsection we present our results on the evolution of natural resource revenues. To begin with, Fig. 3 shows our fiscal dependence series for the three Andean countries. Fiscal dependence in Bolivia started at 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 resource revenues until the late 1910s. Afterwards, the relative size of natural resources revenues as a proportion of total revenues surpassed 20% and went beyond 50% during the 1930s.

Fiscal dependence on natural resources also varied greatly in Chile and Peru. In the former, it started at levels below 10% of total revenues during the mid-nineteenth century to beyond 50% during most of the nitrate cycle (1880–1930). The proportion began to decrease during the 1920s, dipping below 20% after the Great Depression, but increased again in the late 1930s. In Peru, the proportion jumped from 20% in the mid-nineteenth century to 70% during the 1860s and 1870s. Thereafter, it remained close to zero and, despite an increasing trend from the First World War, it remained below 20%. Thus, the substantial retreat of *fiscal* dependence after the guano–nitrate peak was maintained, despite the strong recovery in the relative importance of *extractive* natural resources in GDP or total exports (see Table 1 and Fig. 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 (Fig. 4). Norway stands out for its downward trend, from levels around 10% to below 5%, with only a temporary (and slight) reversal during the first two decades of the twentieth century. In Sweden, despite the increasing trend in the early twentieth century, the proportion remained below 10% and reversed quickly after the First World War.

[20] Paredes (2010) provided an estimation that took into account tax revenues from agriculture products.

[21] Our estimation departs from aggregate income tax revenue, adjusts first for the share of corporate taxation therein, and then attributes to the natural resource sector its share corresponding of GDP. In Norway, data on the share of income taxes paid by non-personal taxpayers was not published until the taxation year 1954, but we have found approximate estimates for 1911 and 1937. With regard to Sweden, this information exists for 1912–13, 1917, and since 1920; we approximate the rest through interpolation. We estimated the natural resource shares in Norwegian GDP specifically for this article (see above), and take them 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.

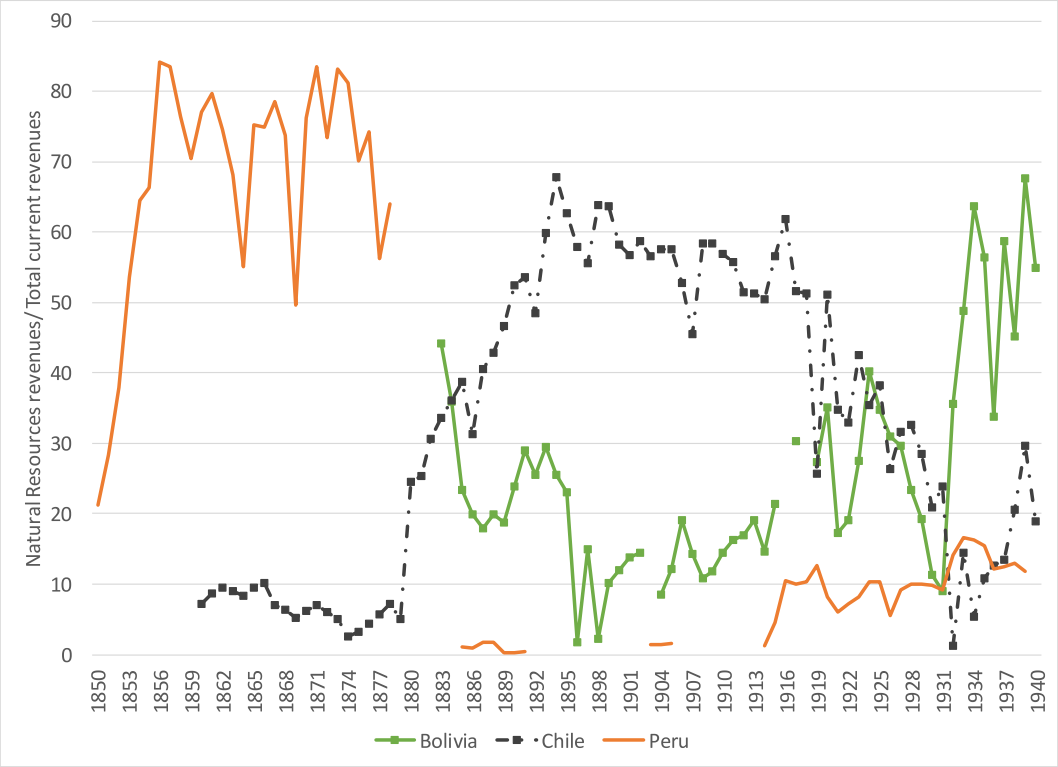

Fig. 3. Fiscal dependence in Bolivia, Chile and Peru (percentage of total revenues), 1850–1939
Sources: See subsection 3.1.

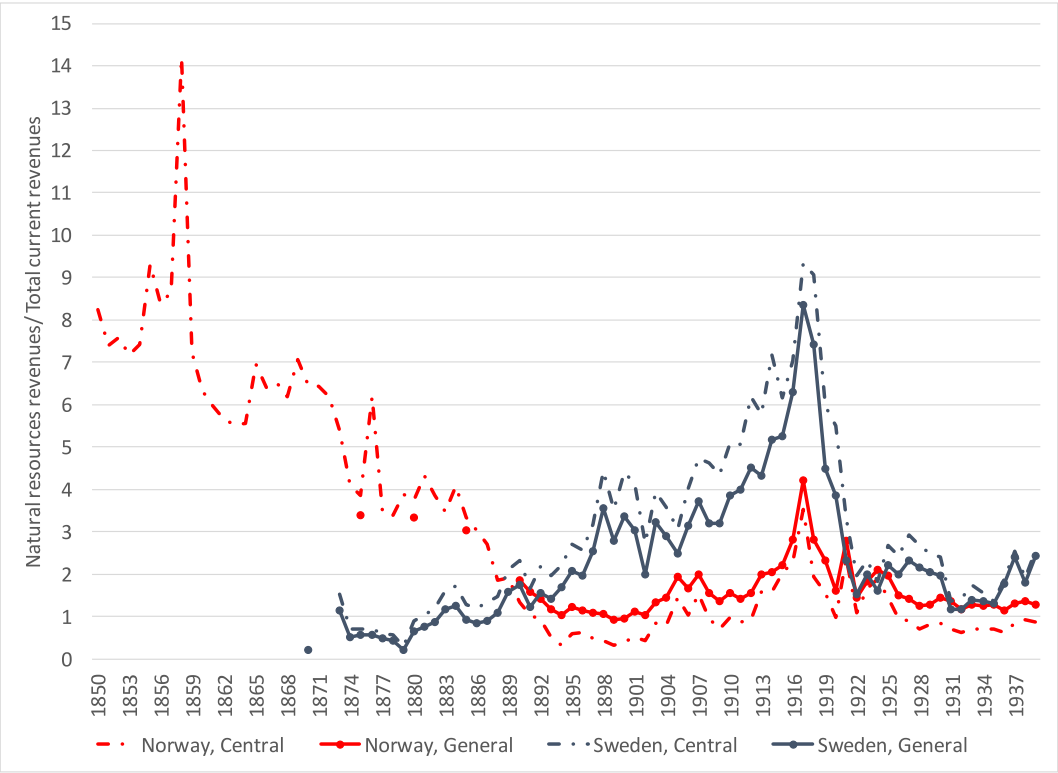

Fig. 4. Fiscal dependence in Norway and Sweden (percentage of total revenues), 1850–1939
Sources: See subsection 3.1.

For the Nordic countries, Fig. 4 presents series for both central and general government. Dependence on general government is the most relevant measure here, since local revenues were important in both countries throughout the period, and some taxes on natural resource exploitation were even collected at the municipal level. In any case, the series that takes into account central government displays the same trends and they allow us to go further back in time for Norway.[22]

Secondary sources and a range of official information indicate that fiscal dependence could have been higher in Norway before the period of analysis. Indeed, the Norwegian geologist and geographer Johan Herman Lie Vogt described, in several studies, the critical role 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 favored 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 various taxes between 1644 and 1814 (Vogt, 1895). The literature has also made reference to the significant role of natural resources in the funding of the Norwegian state during the period from 1814 to the 1840s. According to Hodne and Grytten (2000), export taxes on forestry totaled 16% of exported value in 1816–1830, which represented around 10% of all customs revenues; this amounts to between 4.5 and 6.5% of total central government revenue for these years.[23] The silver mine *Kongsberg Sölvverk* ran 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). The mine's contribution to state finances in this extraordinary period was 15% in 1833 and 8% in the five-year period from 1836 to 1840 (data from Beretning, 1843: 22). Iron and copper taxes were relatively unimportant, at an average of 0.7% for 1815–1848 -the years for which we have data.[24] Thus, despite its greater significance in this earlier period, the share of natural resource revenues did not surpass the 20–25% threshold and did not reach the levels presented in Andean countries.[25]

We could also ask 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 and 1820s, rising again to between 2 and 3% in 1828–1840.[26] We also have some incomplete estimates for the period 1850–1870, which show a low and declining level of fiscal dependence -always below 1% of central government 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 was of low profitability (this changed drastically after the reorganization of the sector in 1870). This and the data in Fig. 4 suggests that modern Sweden has undergone two cycles of higher fiscal dependence on natural resources: one in the late eighteenth century and another during World War I. However, because the proportion has been 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

In this section we present the composition of natural resource 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 significance. 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 the formulation of exchange rate controls.

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

By contrast, the early expansion of natural resource revenues in Peru relied on non-tax revenues (see Table 4). Natural resource revenues regained their significance during the First World War thanks to the reintroduction of export taxes. Interestingly, direct taxes were also significant during this period. In the 1930s, export taxes were consolidated as the main natural resource revenue mainly because of the oil export tax.

In Norway, there was a gradual substitution of export taxes with direct taxes (Table 5). The former was most important during the second half of the nineteenth century, while direct taxes on corporations predominated from 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 based on protectionist reasoning.[27] 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 from 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

[22] In terms of comparability, recall that central government is the administrative unit used in the Andean cases shown above. Although there are no 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 important in Bolivia during the last third of the nineteenth century, accounting for up to 40% of central revenues. In the early 1910s their relative share 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 means that our series of fiscal dependence on natural resources would move by around 5% to reach 30% of Bolivian general government revenues; still a significant figure. Asfor Peru, dependence on natural resources would in reality be close to 0% of general government revenues during the last decades of the nineteenth century. In the case of Chile, although several direct and indirect taxes were decentralized during the 1890s, most scholars argue that effective collection of taxes was highly restricted at the local level (Bernedo et al., 2014). Furthermore, most of these taxes were recentralized in the early 1920s.

[23] This and the following percentages in the paragraph are the authors' own calculations based on the totals from Eitrheim and Fevolden (2019).

[24] Source: 1815-20, *Stortingsproposisjon Nr.1, 1915, Statsfinansielle Opgaver 1815–1914, bilag 2*. From 1820, various documents in *Stortingets arkiv* (website) corresponding to budget estimations (except for 1835–1837 which are actual revenues).

[25] Fiscal dependence on 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).

[26] Export taxes from Hä;ggqvist (2018) and central government revenue from Fregert and Gustafsson (2007).

[27] "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: 166).

Table 2
Fiscal dependence in Bolivia (percentages, decennial averages), 1880s–1930s.

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

Notes: The first column shows the ratio of natural resources revenues to total current revenues. The remaining columns show the relative importance of each resource revenue source on total natural resources revenues.
Sources: See subsection 3.1.

Table 3
Fiscal dependence in Chile (percentages, decennial averages), 1860s–1930s.

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

Notes: The first column shows the ratio of natural resources revenues to total current revenues. The remaining columns show the relative importance of each resource revenue source on total natural resources revenues.
Sources: See subsection 3.1.

Table 4
Fiscal dependence in Peru (percentages, decennial averages), 1850s–1930s.

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

Notes: The first column shows the ratio of natural resources revenues to total current revenues. The remaining columns show the relative importance of each resource revenue source on total natural resources revenues.
Sources: See subsection 3.1.

Table 5
Fiscal dependence in Norway (percentages, decennial averages), 1850s–1930s.

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

Notes: The first column shows the ratio of natural resources revenues to total current revenues. The remaining columns show the relative importance of each resource revenue source on total natural resources revenues. Central Government statistics were used until 1880 and those of General Government thereafter.
Sources: See subsection 3.1.

mineral royalties (*malmavgift*).[28] The contribution of non-tax revenues was between 20 and 30% in the period 1860–1919 and reduced drastically in the 1930s.

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 ground to both direct and indirect taxation. The former corresponds to the modern tax on the income of corporations, which gathered force in Sweden during the interwar period, after its rather modest origins in 1902. During this latter period, various indirect taxes were also paid to the state and municipalities on the exploitation of forests.[29]

To sum up, both non-tax revenues and export taxes could drive higher levels of fiscal dependence in Andean countries. This shows that higher tax pressure on natural resource exploitation could be the result of direct negotiations between private companies and the executive (as in Peru during the Guano Era), sudden changes in executive policy (as in Bolivia during the 1935–1938 period), or the result of a broader political agreement between the main political forces represented in the parliament (as in Chile during the nitrate era or Bolivia during the nineteenth century and the 1920s). The information on the composition of natural resources revenues also shows that the role of direct taxation was marginal in this region. The opposite was the case in the Nordic countries: export taxes were eliminated early on and direct taxes gradually consolidated themselves as the most significant, which points to the

Table 6
Fiscal dependence in Sweden (percentages, decennial averages), 1850s–1930s.

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	

Notes: The first column shows the ratio of natural resources revenues to total current revenues. The remaining columns show the relative importance of each resource revenue source on total natural resources revenues. Data refers to Central Government statistics.
Sources: See subsection 3.1.

[28] Mineral royalties were introduced in the early twentieth century, on the *konsesjonslovene*. Before this, the exploitation of mineral resources only needed a permit from local authorities (Hodne, 1981). Our series of *malmavgift* starts in 1913.

[29] These were the *Skogvårdsavgift* (after 1911) and the *skogsaccis*, both paid on exploitation of forests. The *skogvårdsavgift* was raised by the state and distributed for the administration and care of forests, while the *skogsaccis* was a local tax.

greater complexity of tax administrations in this region.

4. Structural breaks analysis

In this section we aim to identify structural breaks in the fiscal dependence series presented in the last section.[30] Our analysis does not take into account the Peruvian case given the existence of several missing observations whose interpolation could create artificial results in the analysis. The study by Bai and Perron (1998) and its practical application for economic history by Ben-David and Papell (2000) offer the tools required to estimate more than one break in an endogenous way. Further improvements to the test were later incorporated by Bai and Perron (2003).[31]

Although we focus on levels (we are interested in identifying when the nature of natural resource revenues changed), the timing of breaks in both trends and levels tend to coincide.[32] This confirms that the periodization we propose is consistent. We have applied the maximum number of breaks (four) to all countries, taking into account a minimum of eight observations between breaks to avoid periods of extreme volatility caused by exogenous factors -such as wars-that are not related directly to natural resource policy. The results of the structural break analysis using the Bai & Perron test are presented in Table 7.

We complement the Bai & Perron test with the "outlier methodology" (Chen and Liu, 1993; Gómez and Maravall, 1997). This methodology is based on real shocks, which renders it suitable for historical analysis.[33] Under 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), which temporarily affect the time series (more similarly to an error); *c)* level shifts (LS), which increase or decrease all the observations by a constant amount; and *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 to exogenous and endogenous changes in the time series, while the latter two concern the nature of structural changes (Darné and Diebolt, 2004; Diebolt, 2007).

We used the TRAMO[34] program to detect outliers in the fiscal dependence of four of the five countries under scrutiny.[35] Table 8 shows the nature of the identified outliers, as well as their significance and the size of the coefficient. As for the Bolivian case, we identified two outliers in the nature of the structural breaks. The first is a temporary 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 to the decrease in tax pressure on silver exports and the latter to higher tax pressure on tin exports (see the next section). We identify two additive outliers (a temporal change) in 1936 and 1938, when the so-called "Military Socialists" increased their political and economic pressure on the main mining producers through the use of multiple exchange rates -an instrument whose usage increased the volatility of Bolivian public revenues.

With regard to the Chilean case, there are two level shifts (changes in line with structural breaks) that can be linked to nitrate exploitation. The first occurred in 1880, and is explained by the introduction of the nitrate export tax in November 1879. The second was in 1921, during the post-world war commodity crisis, once it became clear that Chilean nitrate exports would lose their previous prominence in international markets. Both fall within the confidence interval of the structural shocks identified through the Bai & Perron test (see Table 7). Besides that, TRAMO identified two additive outliers: in 1919 and 1932.

As for the Swedish case, with the exception of an additive outlier in 1902, we identified the remaining outliers *during* or *immediately after* the First World War. In relation to this, the Bai & Perron test suggested a break in 1918. This confirms that the only period when natural resource revenues could have had a more important (but still small) role in Swedish public finances was during the Great War (see Section 3.2). In contrast, TRAMO does not suggest that any outlier is in line with structural changes in the Norwegian case. We identified an innovative outlier 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 resource dependence whose landmarks are based on the Bai-Perron test. As previously seen, the confidence intervals 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, we identify four periods in each of the previously analyzed cases.[36] Finally, given the impossibility of running structural break analysis in the case of Peru,

Table 7
Structural breaks in the fiscal dependence series, 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' own estimation.

Table 8
Outliers in the fiscal dependence series, 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

Notes: AO refers to Additive Outlier; IO refers to Innovative Outlier; LS refers to Level Shift; TC refers to Temporary Change.
Sources: Authors' estimations using TRAMO.

[30] See Mills (2019) for a survey of recent developments in time series analysis suitable for economic history studies. There are several other structural break tests proposed for historical research besides that chosen in this article. See, for instance, Lee and Strazicich (2001, 2003).

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

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

[33] Real or permanent shock are defined as structural changes in time series that lead to noticeable shifts in levels (Lee and Brorsen, 2017).

[34] TRAMO stands for "Time Series regression with ARIMA Noise, Missing Observations and Outliers". It was developed by Gómez and Maravall (1997) at the Bank of Spain to estimate monthly or lower-frequency series.

[35] We used a critical value of 3.3.

[36] 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.

we offer periodization for this country based on critical historical facts: the beginning of the War of the Pacific and the consequent loss of nitrate reserves, and the beginning of the First World War and the reintroduction of export taxes.[37]

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

The goal of this section is to identify whether changes in the relative importance of natural resource revenues were driven by economic, political or both forces. To answer this question we start with Jensen (2011) who, based on Besley and Persson (2009, 2010), offers a model that links resource dependence and incentives to investing *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.[38] The author calibrates his model using data from 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).

Based on Jensen's (2011) contribution, we construct a simple accounting identity that allows us to measure how changes in fiscal dependence are linked to 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 a given sector); the identity takes into account both the natural resource sector and the rest of the economy. Thus, we begin with the following equation:

$$\frac{T}{GDP}=\frac{T_r+T_o}{GDP} \tag{1}$$

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:

$$\frac{T}{GDP}=\frac{(t_r{*}GDP_r)+(t_o{*}GDP_o)}{GDP} \tag{2}$$

$$\frac{T}{GDP}=\frac{t_r{*}GDP_r}{GDP}+\frac{t_o{*}GDP_o}{GDP} \tag{3}$$

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

$$\frac{T}{GDP}=t_r{*}\frac{GDP_r}{GDP}+t_o{*}\left(1-\frac{GDP_r}{GDP}\right) \tag{4}$$

The identity in Equation (4) allows us to determine whether higher dependence on natural resource revenues was driven mostly by significant economic shocks (i.e., an increase in the natural resource GDP) or by the tax imbalance (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 these is the "fiscal resource curse" scenario: a positive shock on natural resource GDP that coincides with an increase in the effective tax rate on this sector and a decrease in the effective tax rate on the rest of the economy. In other words, this is a substitution process in public finances, apparently guided by the ease of obtaining revenue from the natural resource sector, which would ultimately lead to a lack of development in general tax capacity.

In Table 9, we 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 in 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 (1932–1935), while in Chile it was a consequence of the huge shock caused by the acquisition of nitrate-rich territories from Peru during the War of the Pacific. These features can also be 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 1904–1931, Peru after 1914, or Sweden in 1906–1918.[39] In these cases, however, fiscal dependence on natural resources was in fact below the 20% threshold, or just at 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 in GDP growing from 5 to 15%) that was not accompanied by tax dependence, precisely because of the expansion of general taxation.

Table 9
Accounting identity: variation from 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	–	–	–	+

Notes: The table shows the direction of change in natural resource dependence (Tr/T) and the three variables identified in Equation (4) (Natural Resources GDP, GDP_r; Tax rate on the natural resources sector, t_r; Tax rate on the non-natural resources sector, t_o) with respect to previous period. "=" if variation is less than 5%. Periods of analysis in each country were identified through structural break analysis (see Section 4).
Sources: Authors' own estimations.

[37] So, there are the following three periods: 1850–1879, 1880-1813, 1914–1939.

[38] 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.

[39] 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.

In effect, when fiscal dependence was on the retreat, effective taxation of the "other" sector was always growing more (or decreasing less) than that of natural resources. Interestingly, this coexists with both expansions and reductions in the share of natural resources in GDP (examples of the first would be Bolivia in 1896–1903 and Chile in 1922–1928; of the latter, Peru in 1880–1913 or Sweden in 1919–1939). 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 imbalance 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 the 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 income tax at both the local level (where it was made compulsory in 1882) and 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 expanded throughout these periods as well.

So, our last general observation relates to the tax imbalance 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, and in Peru before the War of the Pacific. Conversely, in Norway and Sweden natural resources appear 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 to go 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 context of stagnation, de-urbanization and de-monetization (Prados de la Escosura, 2009). Similarly, after some initial experiments, tax reform failed and the old colonial tax system was reinstated (Irigoin, 2016). Therefore, during the first post-independence decades, the most important taxes were the capitation tax on the indigenous population and *ancien régime* taxes (such as the tithe) on agrarian production. This occurred in a context of poor investments in tax capacity. For instance, it was not until the mid-1840s that Peru had its first budget law.

The situation changed once economic growth resumed thanks to the expansion of trade, the engine driving the growth of Latin American economies during the First Globalization (Kuntz-Ficker, 2017). As Jensen's model (2011) suggests, it makes sense that the expansion of trade created strong incentives to invest in tax capacity in this sector. Trade also offered critical administrative and political advantages: collection occurs at point sources and requires bargaining with very specific economic elites. Therefore, the expansion of trade allowed the colonial tax system to be overcome and consolidated trade taxes as the most important (Coatsworth and Williamson, 2004).

The importance of natural resource 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 Fig. 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 Fig. 5, which 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 resource revenues represented up to 80% of total revenues. These were non-tax revenues that were obtained through individual contracts related to the different export concessions signed between the Peruvian government and both national and foreign capitalists. With the exception of exports to the United States, concessions on

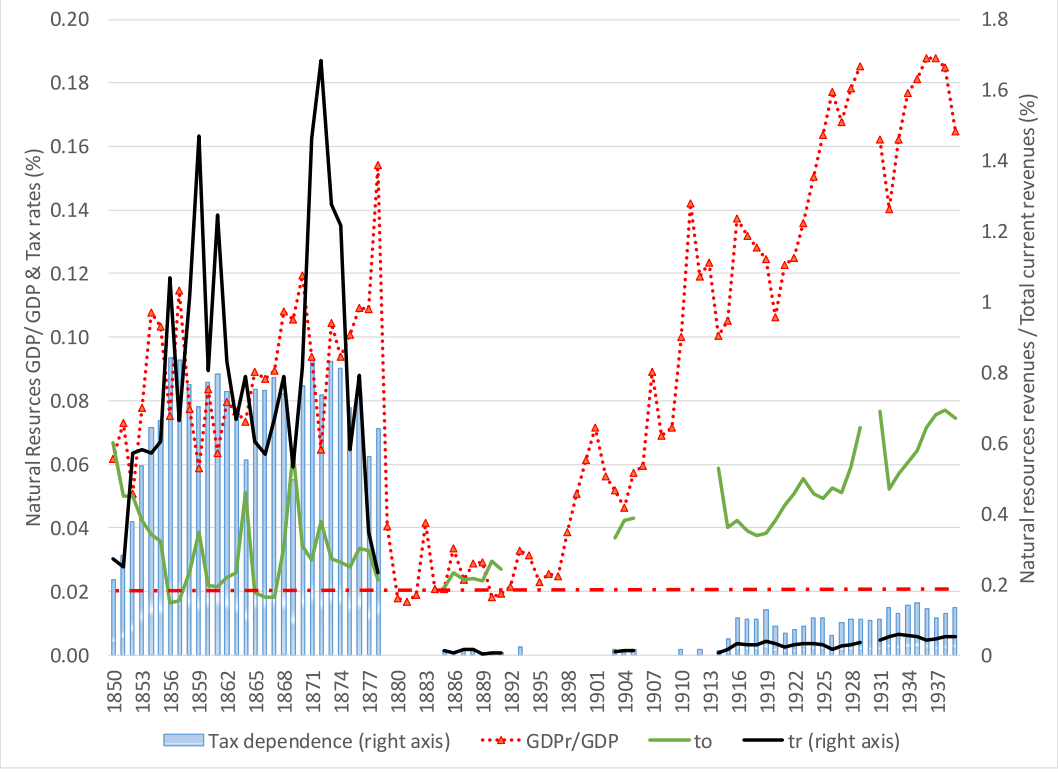

Fig. 5. Share of natural resource GDP in total GDP and effective tax rates in the natural and non-natural sectors in Peru, 1850-1939
Sources: Authors' own calculations.

guano exports were concentrated on one single producer during the late 1860s; this explains the increase in tax pressure on the natural resource sector. The guano monopoly was eliminated in 1874 and both guano and nitrate exports came to be overseen by the Peruvian government until the war.

Notes: The graph shows the annual evolution of each variable studied in Table 9. Fiscal dependence on natural resources revenues is presented in columns and measured in the right axis. The dotted horizontal line indicates the threshold when fiscal dependence on natural resources becomes significant. In order to assure a good visualization, the evolution of the tax rate on the natural resource sector in Peru is measured in the right axis.

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 of solving this crisis, the state and export producers signed an agreement in 1890 that eliminated all export taxes (Contreras, 2012a). This agreement is critical to understanding why the recovery of the natural resource GDP from 1895 to the First World War (Fig. 5) did not generate an increase in fiscal pressure on the natural resource sector (see Table A5). During the First World War, the Peruvian government reinstated export taxes (both for mining and agriculture products), pointing to the existence of higher international prices and higher potential profits. After the war, most export taxes came from copper 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 in the natural resource GDP, Peruvian public finances did not return their focus to natural resource revenues. Moreover, during the first third of the twentieth century, tax pressure on the non-natural resource sector increased and remained higher than that on the natural resource sector.

The transition from the colonial tax system to a modern one took place in Bolivia in the early 1870s, when the importance of the capitation tax on the indigenous population was replaced by custom duties and an export tax on silver. This was the result of an agreement between the executive and mining producers whereby the state ended the coinage of debased silver and allowed the free export of silver in exchange for an export tax on this product (Huber Abendroth, 1991; Sabaté-Domingo and Peres-Cajías, 2020).[40] Because of this transition, tax pressure on the natural resource sector was several times higher than tax pressure on the rest of the economy in the 1880s, a feature that persisted during most of the period under analysis (Fig. 6).

The fiscal dependence of the Bolivian central government on natural resource revenues decreased significantly during the last decades of the nineteenth century (see also Table A3). This decrease was driven by constant reductions in the tax pressure on the natural resource sector rather than by a notable negative shock in the sectorial GDP. The process is explained by the agreement between the government (which was controlled by some of the most important representatives of the silver elite) and parliament (where agrarian interests were prominent), to reduce the rate of the silver export tax in response to the impact that the severe fall of the international price of silver had on the sector's competitiveness (Peres-Cajías, 2015).

Mining production then turned quickly to tin, which became the most important export from 1904 (Peres-Cajías and Carreras-Marín, 2017). This explains the steady increase in natural resource GDP. However, it was not until the early 1920s that the fiscal pressure on the natural resource sector increased, 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), but not during the 1930s.

There are various explanations for the higher tax pressure on the mining sector during this decade. The first increase is explained by the higher bargaining power acquired by the Bolivian government due to the formation of the International Tin Cartel and the Chaco War against Paraguay (Contreras, 1990). Once the war ended (in 1935), the higher tax pressure on the sector was an indirect consequence of the conflict on Bolivian politics. Indeed, whereas *de jure* political participation remained very restricted, the war increased the *de facto* political significance of very different political actors. Despite their diversity, these actors shared an important commonality: they claimed that big mining producers (who were Bolivians) sucked up Bolivian mining wealth and neither reinvested their earnings in the country nor paid a significant amount of taxes that could be used to foster economic development. Therefore, the higher tax pressure on the sector during the second half of the 1930s (and to some extent during the 1940s) are explained by the fact that big mining producers constituted a political scapegoat in a context of greater political pluralism (Gallo, 1991).

Unlike Bolivia and Peru, Chile was one of the few Latin American countries that recovered from the post-independence crisis relatively quickly. The country experienced rare stability (by regional standards) when it came to the duration of presidential terms from the 1830s. In addition, 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. According to Jensen's model (2011), 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. Indeed, in contrast to other Latin American countries, Chile produced regular and complete official publications containing various statistics from this period. Our results show that tax pressure on the natural resource sector was similar to that on the rest of the economy during the 1860s; then, the former fell during the 1870s because of the export crisis that began in 1873 (Fig. 7).

However, a great reversal took place during the War of the Pacific (Sabaté-Domingo and Peres-Cajías, 2020). The seizure of nitrate-rich areas by the Chilean army increased the relative importance of natural resource GDP and sharply increased tax pressure on the sector. After the war, other taxes were progressively eliminated or decentralized, which was reflected in decreasing tax pressure on the rest of the economy (Fig. 7).

The greater fiscal dependence on natural resource revenues came from a single source: export taxes on nitrates.[41] This tax was introduced during the war and, among other justifications, it was stated that the war was caused by the interests of nitrate companies so these companies had to pay for it (Sater, 1986). The use of an export tax on nitrate production (and not other instruments such as non-tax revenues as in the Peruvian case) was justified as a way to make it easier for companies to transfer the tax burden to foreign consumers (Bernedo et al., 2014), which was possible given the high market share of Chilean nitrate exports.

This increase in importance of natural resource revenues occurred in the context not of a less constrained executive but of a stronger parliament. Indeed, traditional Chilean historiography defines the 1891–1925 period as the "Parliamentary Republic". This is explained by the victory of the parliamentary forces over the executive forces during the Civil War of 1891. In this context, the use of an export tax not only allowed the transfer of the tax burden to foreign consumers but also gave the parliament critical taxation power over the natural resource sector. In fact, a great deal of the Chilean tax policy during the last decades of the nineteenth century was related to the monthly update of the tax rate on nitrate exports (Sabaté-Domingo and Peres-Cajías, 2020). Furthermore, although the central authorities protested about the extreme dependence of Chilean public revenues on natural resources (there are plenty

[40] During the 1870s, highly volatile non-tax revenues from guano and saltpetre were also important.

[41] Mining patents were reinstated 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-nitrate export taxes in 1897, new export taxes on mining were created sporadically: on silver in 1906, borax in 1915 and iron in 1925.

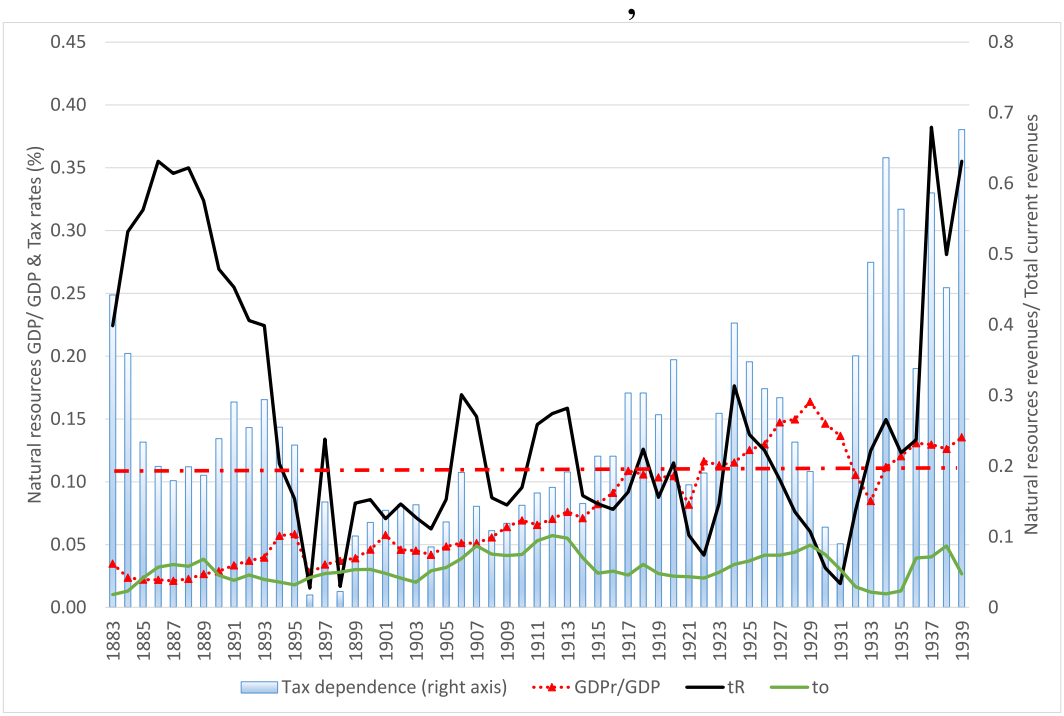

Fig. 6. Share of natural resource GDP in total GDP and effective tax rates in the natural and non-natural sectors in Bolivia, 1883-1939
Sources: Authors' own calculations. **Notes:** The graph shows the annual evolution of each variable studied in Table 9. Fiscal dependence on natural resources revenues is presented in columns and measured in the right axis. The dotted horizontal line indicates the threshold when fiscal dependence on natural resources becomes significant.

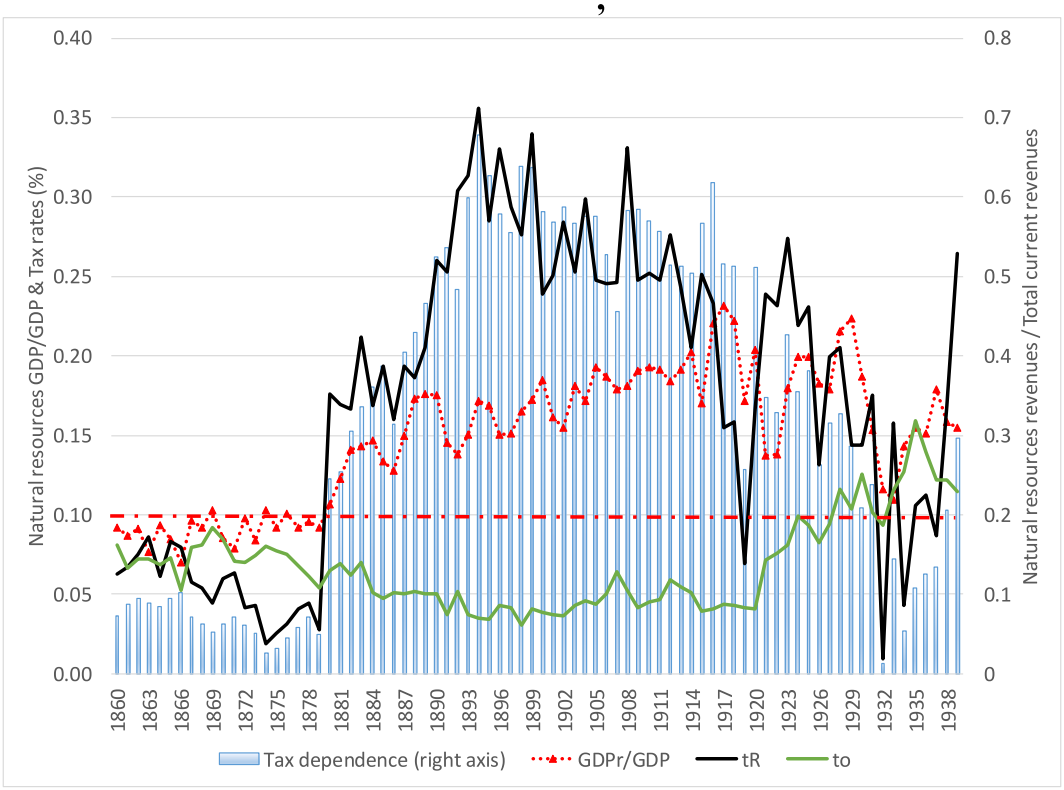

Fig. 7. Share of natural resource GDP in total GDP and effective tax rates in the natural and non-natural sectors in Chile, 1860-1939
Sources: Authors' own calculations. **Notes:** The graph shows the annual evolution of each variable studied in Table 9. Fiscal dependence on natural resources revenues is presented in columns and measured in the right axis. The dotted horizontal line indicates the threshold when fiscal dependence on natural resources becomes significant.

of examples in Chilean primary sources), Chilean parliamentarians used different strategies to boycott any attempt at tax reform (Bernedo et al., 2014). The pressure on the major political forces when it came to fiscal issues was so intense that of the 90 ministers of finance who occupied the post from 1891 to 1926, only six stayed for more than a year divided into different periods, and only one remained for more than a year continuously. One factor that is critical to understanding this political resistance to tax reform is the importance that foreign producers had on nitrate production (particularly during the last decades of the nineteenth century) and their natural absence from tax discussions in the parliament. Thus, the Chilean case shows how a strong parliament allowed the tax burden to be transferred to foreign producers and consumers of natural resources.

So, it was not until the early 1920s that tax reforms took place. The reform was an answer to the great crisis of the nitrate industry in the aftermath of the First World War (see Table A4). Among other measures, direct taxes were reintroduced after their decentralization during the early 1890s. This increased 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 latter tax was marginal during the 1920s but increased afterwards because of the generalization of direct taxes on big and small mining companies as well as the collection of taxes that were both budgeted and extra-budgetary (Humud, 1969). The Great Depression consolidated the nitrate crisis (note the big fall in the natural resource GDP) and natural resource revenues lost significance, although some would be recovered to some extent once copper exports increased.

The Nordic countries did not suffer the kind of economic crisis witnessed in the 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, due to both the extraction of natural resources and industrialization (Ville and Wicken, 2013). Partly because of economic diversification, no sudden and sustained increases in the share of natural resource GDP are evident; the First Word War being the only major exception (Figs. 8 and 9). Moreover, the available evidence indicates that, in contrast to the Andean countries, the relative importance of natural resource GDP was already high at the beginning of the period under study and tended to decrease over time. According to Jensen's model (2011), this has critical implications for a possible "fiscal resource curse": given the relatively high growth of the non-natural resource sector, it was rational to invest in tax capacity in this sector. This may be one of the possible explanations for the higher tax pressure on the non-natural resource sector than on the resource sector in Norway and Sweden throughout the entire period (Figs. 8 and 9 and Tables A6 and A7).

Another key factor may be the effect of long-term institutional determinants on previous investments in tax capacity. Indeed, unlike Andean countries, public revenues in the Nordic countries were more diversified and local taxation played a critical role during the nineteenth century (Schön, 2010). Also interesting is that the transition away from the *ancien régime* tax system was accompanied by the substitution of the old capitation with a modern income tax. The importance of this was felt keenly during and after the First World War, a period when tax pressure on the non-natural resource sector increased in both countries (Figs. 8 and 9).

Despite this tax diversification, trade taxes were still important in the Nordic countries during the second half of the nineteenth century, accounting for 30–50% of the 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 were finally eliminated in 1894 (Hodne, 1981: 53). Export taxes on fishing also persisted until this latter year, although they were less important quantitatively.

On the other hand, with the exception of a tax on forest products in 1903–1911, 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) but 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). Interestingly, there were various attempts at reintroducing export taxes during the second half of the nineteenth century. However, in contrast to the Bolivian and Chilean experiences, local producers who stood to lose out because of these reforms were able to push against them in parliament and convinced their counterparts that those changes would negatively affect the competitiveness of natural resource exports (Dugstad Sanders, 2018).[42] In relation to this, another particular feature of Nordic economies is 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).

6. Conclusions

In this paper we make three main contributions to the literature on natural resources and taxation. First, we provide new fiscal dependence series for five natural resource-abundant countries: three in the Andes and two in Scandinavia. Our series take into account 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 along ninety years of economic history (1850–1939), as well as with present day data.

Using 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, and Bolivia in 1870s–1895 and again increasingly after 1913. Conversely, 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 during the First World War in Sweden. The composition of natural resource revenues also differed in Andean and Nordic countries: in the latter, modern income taxation originated and had already attained importance during this period, while export taxes remained central in the former.

Finally, our accounting identity allows us to discern when situations 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 sector or another). In this context, we show that the greater importance of natural resource revenues in the Andean countries was sometimes the result of great shocks in the economy coming from the expansion of the natural resource sector. In other, it was also because of a higher political desire to tax more on the natural resource sector than in the rest of the economy.

We show that these preferences are not *inherent* to natural resource abundance or to Latin American countries. For instance, before the War of the Pacific, Chile's tax rates were higher in the rest of the economy than in the natural resource sector and not so different to those applied in the Nordic countries. Likewise, despite 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 along with those applied in the natural resource sector.

So, why did fiscal dependence on natural resources and *rentier*

[42] 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 presented extensively in Montgomery (1921).

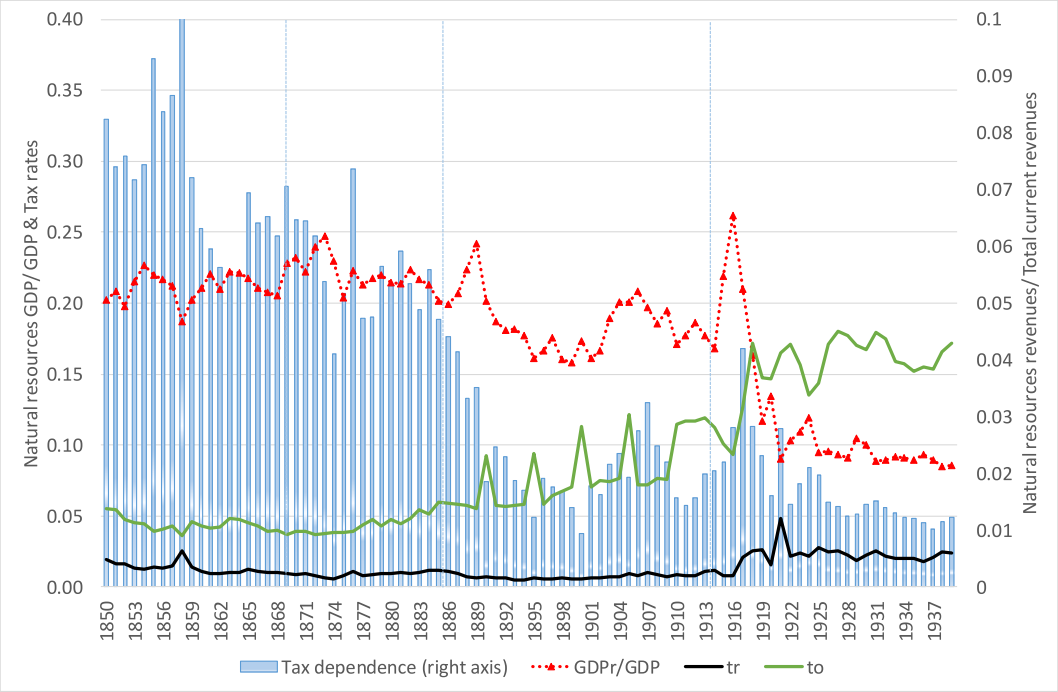

Fig. 8. Share of natural resource GDP in total GDP and effective tax rates in the natural and non-natural sectors in Norway, 1850-1939.
Sources: Authors' own calculations. **Notes:** The graph shows the annual evolution of each variable studied in Table 9. Fiscal dependence on natural resources revenues is presented in columns and measured in the right axis.

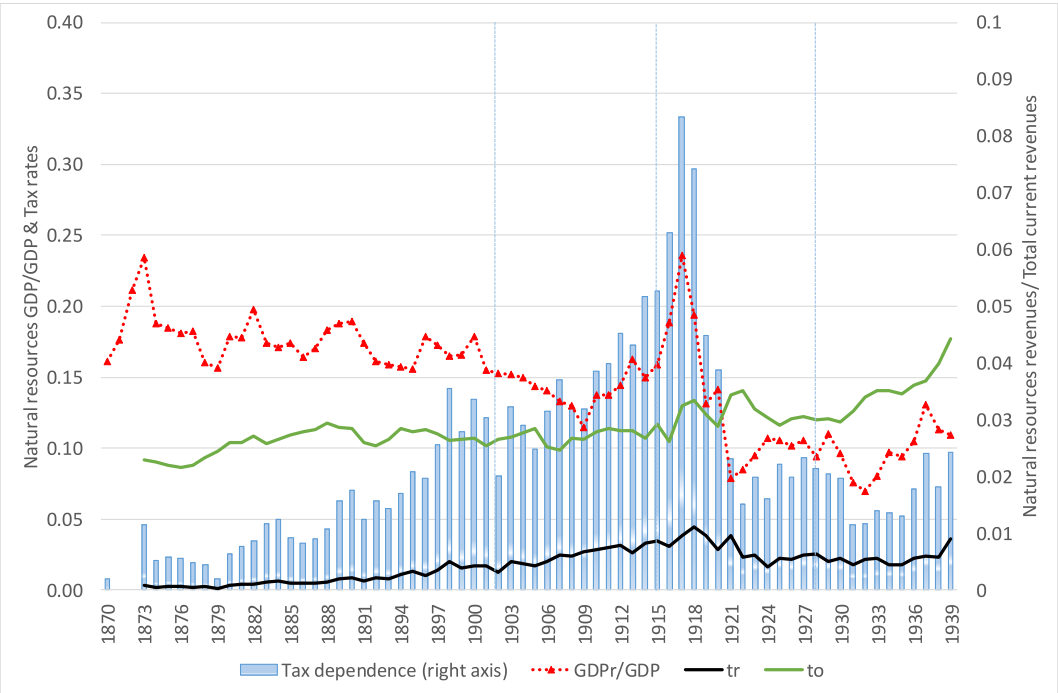

Fig. 9. Share of natural resource GDP in total GDP and effective tax rates in the natural and non-natural sectors in Sweden, 1870-1939.
Sources: Authors' own calculations. **Notes:** The graph shows the annual evolution of each variable studied in Table 9. Fiscal dependence on natural resources revenues is presented in columns and measured in the right axis.

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 for the fiscal resource curse: these specific natural resources generate significant windfall and concentrated rents that have particular economic (sudden changes in the GDP composition) and taxation (point sources) implications.

However, the link between mining and rentier states should not be taken for granted. Our work suggests that the fiscal resource curse is more likely in an economic scenario of low diversification, either in the export sector or in the overall economy. As Jensen (2011) has noted, greater 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 of the natural resource sector is also dependent on how the major 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). Therefore, sudden changes in tax pressure on the natural resource sector are more likely in countries that are *dependent* on mining production and in contexts in which natural resource producers have limited ability to interfere in the political debate (either in parliamentary or non-parliamentary regimes) in order to assure a relatively neutral tax treatment between the natural and non-natural resource sectors.

Author statement

Peres-Cajías, José: Conceptualization, Methodology, Validation, Formal Analysis, Data Curation, Writing, Supervision, Funding Acquisition.

Torregrosa-Hetland, Sara: Conceptualization, Methodology, Validation, Formal Analysis, Data Curation, Writing, Funding Acquisition.

Ducoing, Cristián: Conceptualization, Methodology, Validation, Formal Analysis, Data Curation, Writing, Funding Acquisition.

Data availability

Data will be made available on request.

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: Compiled by authors.

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' own elaboration based on Equation (4).

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' own elaboration based on Equation (4).

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' own elaboration based on Equation (4).

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' own elaboration based on Equation (4).

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' own elaboration based on Equation (4).

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