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The role of the Spanish imperial state in the mining-led growth of Bourbon Mexico's economy[1]

By RAFAEL DOBADO and GUSTAVO A. MARRERO

Colonial Mexico's economy experienced a long phase of growth during the eighteenth century. Around 1800, silver exports and fiscal surplus remittances from the colony rose to unprecedented levels. We study the contribution of the Spanish imperial state's policy to the expansion of silver production and the leading role of mining in economic growth and its fiscal implications. We find evidence to support a more favourable view of both the mining sector and the imperial state than that commonly presented in the literature. The interruption of colonial 'mining-led growth' helps to explain the 'lost decades' for the economic development of Mexico after independence.

Many specialists share the idea that the main economic problems in contemporary Latin America—slow growth and uneven distribution of wealth and income—are deep-rooted in its 'colonial legacy'. A sort of Weberian-style approach is particularly critical of the Catholic and Iberian components of Hispanic American culture.[2] North's views on this issue suggest familiarity with this approach.[3] Either through inefficient[4] or extractive institutions[5] or extreme inequality,[6] that 'colonial legacy' is causally related to some form of economic underperformance in Latin America, especially when compared with the US. Central to this opinion is the view that the imperial state was a key factor in the economic backwardness of its colonies. Its adverse influence on the economic and political development of the Spanish colonies in America persisted after independence.[7]

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[2] Harrison, *Underdevelopment*; Landes, *Wealth and poverty*; idem, 'Culture'.

[3] North, *Instituciones*; idem, *Understanding the process*.

[4] Coatsworth, *Los orígenes*.

[5] Acemoglu, Johnson, and Robinson, 'Reversal of fortune'.

[6] Engerman and Sokoloff, 'Factor endowments, institutions'; S. L. Engerman and K. L. Sokoloff, 'Factor endowments, inequality, and paths of development among new world economics', NBER working paper, 9259 (2002); S. L. Engerman and K. L. Sokoloff, 'Colonialism, inequality, and long-run paths of development', NBER working paper, 11057 (2005).

[7] North, Summerhill, and Weingast, 'Order'.

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In this article we do not examine the general implications of Spanish colonialism for Latin America economic development. Instead, we confine our analysis to the case of the Viceroyalty of New Spain during the eighteenth and early nineteenth centuries (Bourbon Mexico). Departing from the literature mentioned above, our research offers a favourable view of the contribution of the imperial state to economic growth in Bourbon Mexico. More specifically, we deal with two interconnected issues: firstly, the active role of the imperial state in the secular expansion of the mining sector; and secondly, the peculiar process of resource-based, pre-industrial growth that we term 'mining-led growth' and its fiscal implications for the imperial state. From our results it may be suggested that the sudden interruption of colonial mining-led growth imposed a high economic cost on independent Mexico.

Data availability allows us to complement the discussion of abundant historical evidence with an empirical analysis based on long time series. We also consider the century-long Bourbon period as a whole instead of just focusing on the reformism that started with the official visitation of Inspector General Gálvez (1765–71) to New Spain for implementing a new colonial policy.

The article is organized as follows. First, we introduce some evidence and arguments supporting a rather optimistic view of Bourbon Mexico's economic performance. Second, there follows a short informative section on mining institutions and labour conditions which paints a different picture from that recently popularized by Acemoglu, Johnson, and Robinson, and by Engerman and Sokoloff.[8] On the basis of data taken from previous archival research by Dobado, in the third section we analyse the role of the imperial state in promoting the secular expansion of the mining sector.[9] We emphasize the influence of supply-side mining policy variables, in particular those related to mercury, on silver production. Mining-led growth is discussed in the fourth section. In order to overcome the objections raised by pessimistic or sceptical views about Bourbon Mexico's economy, we estimate co-integration models to find statistical evidence in favour of the mining-led growth hypothesis. As direct continuous estimates of GDP are not available, we are forced to use an indirect approach. GDP trend is proxied by the trend of net ordinary income of the imperial state. This variable has been laboriously calculated from the enormous database produced by the extensive research of TePaske and Klein.[10] We are aware of the shortcomings of the fiscal approach to GDP estimation when applied without proper precautions. That is not the case here since the fiscal system in New Spain had a particularity: its responsiveness to long-term changes in economic activity and in population. Therefore, using net ordinary income—as opposed to total gross income—of the colonial state to determine the secular trend of GDP does not rely on heroic assumptions. Our dataset covers 1714–1805. In the fifth section, we suggest that the interruption of colonial mining-led growth caused by independence might partially explain Mexico's economic backwardness—'the lost decades'—in the nineteenth century. We end with some final remarks.

[8] Acemoglu et al., 'Reversal of fortune'; Engerman and Sokoloff, 'Factor endowments'; idem, 'Colonialism, inequality'.

[9] Dobado, 'El trabajo'; idem, 'Las minas de Almadén'; idem, 'El monopolio estatal'.

[10] TePaske and Klein, *Ingresos y egresos*.

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I

The meagre extant dataset on Bourbon Mexico's macromagnitudes includes estimations of nominal and per capita GDP by Coatsworth[11] for 1700, 1800, and 1820, and Maddison[12] for 1700 and 1820. Basically, both authors agree on nominal GDP estimates, but differ in per capita measures. Whereas Coatsworth does not see any growth, Maddison finds a significant increase in per capita GDP: an average yearly rate of 0.24 per cent—higher than his estimates for Western Europe (0.16 per cent).[13]

Based on the diverse, albeit not always aggregate or continuous data available, our view of colonial Mexico's economy is that GDP, population, urbanization, foreign trade, interregional commercial flows, and silver production experienced significant growth by pre-industrial standards in the eighteenth century.[14] While the increase in some of these variables (GDP or population) might have been purely extensive, that of the others would have required some form, even if minimal, of intensive growth. Therefore, we also conclude that productivity and per capita GDP necessarily had to grow as well, although at a slow, pre-modern pace. Thus, in spite of 'pessimistic' or 'sceptical' views about the economic performance of Bourbon Mexico,[15] we advocate an 'optimistic', although 'moderate', view, which is consistent with that of all qualified contemporary observers[16] and with that of two nineteenth-century classics of Mexican historiography.[17]

Mexico's resource endowment for pre-industrial, Smithian growth of the type experienced by most dynamic regions of western Europe was rather poor. Geography 'conspires against the economy' because of the serious obstacles to transportation (mountainous terrain, unnavigable rivers or canals, lack of natural ports, and so on).[18] In addition, low agricultural yields and the scarcity of energy were also important obstacles. Natural conditions required by an 'advanced organic economy' were far from being present in Bourbon Mexico.[19] Therefore, population density was very low. In spite of this, urban population—19 towns with 10,000 inhabitants or more are mentioned by Humboldt—was at least 9.1 per cent of the total *c.* 1800.[20] This percentage means that the urbanization rate was higher than the European average if Britain and the Netherlands are excluded.[21] Between 1700 and 1800 the number of cities with populations of 20,000 or more inhabitants doubled.[22]

[11] Coatsworth, 'Structures'.
[12] Maddison, *World economy*.
[13] Coatsworth, *Mexico*; Maddison, *World economy*, p. 114.
[14] Klein, *American finances*; Miño Grijalva, *Obrajes y tejedores*; idem, *El mundo novohispano*; idem, 'La ciudad de México'; Dobado and Marrero, 'Minería'; Ponzio, 'Interpretación económica'; idem, 'Globalisation'; Sanchez Santiró, 'El legado económico'.
[15] Coatsworth, *Los orígenes*; idem, 'Economic and institutional trajectories'; idem, 'Mexico'; idem, 'Structures'; Pérez Herrero, 'Los beneficiarios'; idem, 'Reformismo borbónico'; Garner, *Economic growth*; Cárdenas, *Cuándo se originó*.
[16] Humboldt, *Political essay*; Ortiz de Ayala, *Resumen de la estadística*; Elhuyar, *Memoria sobre*.
[17] Alamán, *Recuadro de Nueva España*; Lerdo de Tejada, *Comercio exterior*.
[18] Coatsworth, *Growth against development*.
[19] Wrigley, *Continuity*.
[20] Humboldt, *Political essay*.
[21] de Vries, *European urbanization*.
[22] Bairoch, *Cities*.

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Mining—the most important factor in the rising urbanization of northern regions of Bourbon Mexico—manufactures, and services were the leading economic activities in most towns. Growing towns implied falling production by and for the domestic economy and expanding markets across the whole economy. This picture of economic modernization—unevenly distributed at the regional level and probably unspectacular—in which towns play an important role is depicted by Miño.[23]

In the decades prior to the *Insurgencia*,[24] foreign trade showed the positive effects of the partial liberalization undertaken by Bourbon economic reformism in the second half of the eighteenth century and of the unprecedentedly high levels of silver production and exports.[25] Increasing commerce between New Spain and the Peninsula and other Spanish possessions in America brought about the opening of the economy. By 1804–10 the ratio of foreign trade to GDP was 11–15 per cent: less open than Britain but more than France. Certainly, in spite of a certain diversification of exports in the last decades of the eighteenth century (cochineal and sugar, among others), silver accounted for the lion's share (75 per cent in 1796–1820). By 1800, after decades of growth, New Spain's silver production represented almost two-thirds of the world output.[26] Figure 1 shows the evolution of registered silver production from 1700 to 1809.

The long-lasting growth of silver production is impressive by pre-industrial standards: an average annual growth rate of 1.8 per cent between 1700 and 1809. This rate is 64 per cent higher than that of British industry.[27] The growth rate is certainly high considering it is based on the exploitation of an exhaustible natural resource, probably surpassed only by British production of coal in the second half of the eighteenth century.[28]

A 'great shift' caused New Spain to replace Peru as the jewel of the Spanish Crown in America.[29] While the total revenue collected by the imperial state in 'the two Perus' barely tripled between 1700–9 and 1800–9, in the Viceroyalty of New Spain it grew between almost sixfold and sixteenfold, depending on whether or not loans and miscellaneous receipts are included. According to Klein, such an enormous increase in income was made possible by the 'extraordinary growth of the economy' and the resulting 'population expansion'.[30] After sustained growth, the population grew to at least six million. Mining was behind this economic and demographic dynamism: 'The growth in silver output was accompanied by a generalized expansion in all sectors of the economy'.[31] This statement precisely describes the core of the mining-led growth hypothesis. It is not the only

[23] Miño Grijalva, *Obrajes y tejedores*; idem, *El mundo novohispano*.

[24] By the term *Insurgencia* we refer to the social movement—which brought about some forms of extreme violence—against New Spain's acting authorities (but not clearly opposed to the Spanish colonial rule, as the reference to Ferdinand VII in some early slogans suggests) which started in 1810. In our view, its immediate historical context is determined by the vacuum of power and legitimacy resulting from the Napoleonic invasion of the Peninsula and the increase in the price of main staples caused by harvest failures. The literature offers very different interpretations regarding its real—political, economic, or social—motivations.

[25] Lerdo de Tejada, *Comercio exterior*; Fisher, *El comercio*.

[26] Schmitz, *World non-ferrous metal production*.

[27] Crafts, 'Industrial revolution'.

[28] Pollard, 'New estimate'.

[29] Klein, 'Great shift'.

[30] Klein, *American finances*, pp. 73–4.

[31] Ibid., p. 73.

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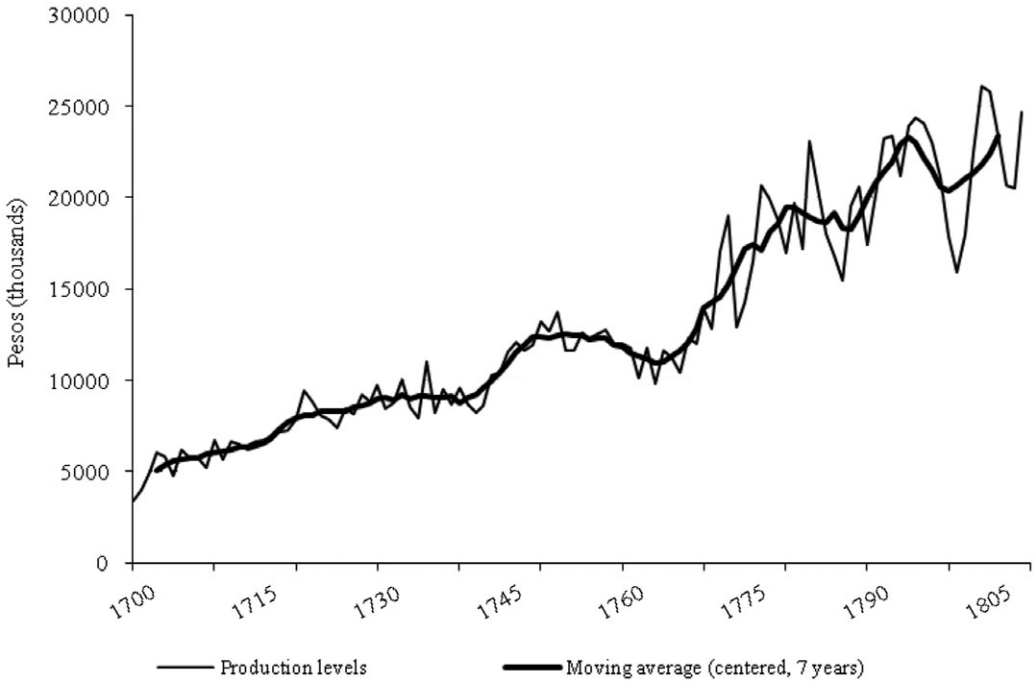

Figure 1. *Silver production in Bourbon Mexico, 1700–1809*
Source: Lerdo de Tejada, *Comercio exterior*, document no. 52; Dobado, 'Las minas de Almadén'.

description given by twentieth-century authors that may be found.[32] More baroque descriptions given by contemporary observers and specialists originate from a wide diversity of sources that include, but are not limited to, some representatives of the mining interests: Fray Arlegui, author of the *Crónica de Zacatecas*, published in 1737 and quoted by Lira and Muro;[33] the instructions of the Viceroy Revillagigedo to his successor;[34] Humboldt, an enlightened visitor to Mexico in 1803–4;[35] Fausto de Elhuyar, Director-General of Mining in New Spain;[36] the

[32] 'Mining production was the driving force in the expansion of the rest of economic activities as trade, agriculture, stockbreeding, manufactures and craftworks were developed thanks to the markets and the commercial flows that it created and stimulated'; Florescano, *Atlas histórico*, p. 82 (our translation).

[33] '. . . as the places where the minerals are discovered are unproductive of the necessary means of subsistence, the farmers and stockbreeders of the surrounding area sell their seeds and grains and, as they alone cannot supply the needs of the crowds that converge on those sites, there appear other people who, out of necessity or greed, are compelled to start up new farms and to populate new ranches even in lands with a greater danger of the barbaric Indians, this being the means whereby God provides for an eventual decline of the mines in which case there would still remain the neighbouring lands with new farms and well populated ranches and with sufficient trade among their residents'; Lira and Muro, 'El siglo', p. 315 (our translation).

[34] 'From the state of the mining centres depend the vigour and volume of [non-mining] taxes collected, because, the trades and fortunes of the vassals being proportional to the silver, everything grows if the silver grows'; *Instrucciones que los virreyes*, pp. 346–7 (our translation).

[35] 'In Mexico the best cultivated fields, those which recall to the mind of the traveller the plains of France, are those which extend from Salamanca towards Silao, Guanaxuato, and the Villa de Leon, and which surround the richest mines of the known world'; Humboldt, *Political essay*, vol. II, p. 359.

[36] '. . . as the manifestations of silver and gold grew, manoeuvres and operations in mines multiplied, and with them new and wider employment for people, and more consumption of all sorts. With this immediate increase in

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Deputies of the Mining Guild of Zacatecas;[37] and Lucas Alamán, one of the main characters in the history of early independent Mexico.[38]

Moreover, mining was also the driving force behind the physical and ethnic constitution of the vast northern areas that make up most of modern Mexico.[39] Mining centres spread throughout the majority of regions, especially those in central and northern New Spain: from Oaxaca to Chihuahua, from Sonora to San Luis Potosí. A dense network of about 500 mining centres covered most of the territory.[40]

The extended idea among the Dependency School of mining centres as enclave economies is simply wrong in this case. Mining was closely integrated into the domestic economy. Mining centres satisfied their demand for agrarian foods from distant and even remote producing areas.[41] The expansion of mining centres was accompanied by that of the agrarian activities 'in a more or less extended circle' around it, as a qualified contemporary observer put it.[42] Thus, mining activities contributed to the spatial division of labour and the integration of markets associated with Smithian growth. Coatsworth acknowledges that mining expansion 'possibly' resulted in higher productivity in other sectors and effectively in a better functioning of the markets for factors of production (capital and labour).[43]

The imperial state played an important role in the development of the mining industry. Starting in the 1720s, it began to pursue an active, reformist, supply-side economic policy four decades earlier than is commonly recognized in the literature (see section III). Efficient governmental actions were in the final analysis prompted by the open political and military conflict existing between Spain and Great Britain in the international arena throughout the eighteenth century. As the British case clearly shows, it was necessary to increase government revenue in order to secure financial support for increasingly costly war efforts. In an attempt to achieve this goal, the Spanish Crown's policy systematically favoured the growth of mining production, which in turn triggered the expansion of the economy, in particular

employment and in consumption, and the one [increase] that motivated in the rest of the industries . . . it resulted in a rise in agriculture and livestock . . . in the exercise of all sorts of arts and trades, and in population'; Elhuyar, *Memoria sobre*, p. 37 (our translation).

[37] 'Mining, Sir, is, so to say, a lever with an incalculable power which operates equally in all parts of the known world, which develops some industry, and in this America is the force that sets everything in motion, either by giving occupation to innumerable hands in its immediate works or by causing prodigious consumptions of goods and implements. Thus these effects are, certainly, incomparably superior with respect to the Population . . . if there were no mining, America would as if by magic be reduced to abject misery. So much timber, so much cordage, so much leatherwork, so much tallow, so many pack horses and mules, so much corn as required for feeding them, where would these be consumed or could they be consumed without the mining works? And without consumption, what would become of so many muleteers, so many carters, so many shepherds, so many farmers, who strive night and day to grow and transport these lines of goods? and where would the Treasury's revenues be generated?'; Archivo general de Indias, Seville, Sección México, File 2115 (our translation).

[38] '. . . without mining, neither the agriculture, nor the domestic commerce, nor any other industry, may prosper'; quoted by Brading, *Mineros y comerciantes*, p. 179 (our translation).

[39] 'Mining was also the engine of the territorial expansion and the regional formation of Northern Mexico, as the discovery of new silver deposits drove those missionaries, soldiers, farmers, shepherds, merchants and adventurers that, by the late seventeenth century, had established in this region, one of the most economically dynamic areas of the Viceroyalty, and a new social structure, more Creole and Mestizo than white or indigenous'; Florescano, *Atlas histórico*, p. 82 (our translation).

[40] Ward, *Mexico*, vol. I, p. 397.

[41] See map in Florescano and Gil, 'La época', p. 556.

[42] Ward, *Mexico*, vol. I, p. 33.

[43] Coatsworth, 'Mexican mining', p. 40.

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that of market-oriented economic activities, and therefore increased the fiscal base of the Viceroyalty. The 'sophistication of their bureaucracy and organization' allowed the Crown to collect growing taxes from an expanding economy throughout its dense and efficient network of Royal Treasuries.[44] A substantial, and increasing portion of the taxes collected in New Spain—not far from one-third *c.* 1800—was remitted to the metropolis, or to other colonies in the Caribbean.[45] In pre-*Insurgencia* years those transfers of fiscal surplus were probably equivalent to 4 per cent of New Spain's GDP. This ability of the Crown to extract fiscal remittances has already been emphasized by Smith and Humboldt.[46] A stagnant economy would have made it very difficult to effect such intense extraction of resources.

Hence, as a result of the rational pursuit of its self-interest, the Crown promoted a peculiar model of pre-industrial growth, where a relatively large and growing mining sector played a leading role: in other words, mining-led growth. This model was certainly consistent with the Crown's political and economic goals, but also with the colony's factor endowment. Silver production was not a colonial imposition, but a well-founded economic choice that did not result in any of the evils currently associated with the 'resource curse'.[47] A close look at the essence and effects of mining gives a general picture that, mutatis mutandis, resembles the much more optimistic and well-founded view of resource-based development proposed by David and Wright, and by Wright and Czelusta.[48]

In any case, according to Coatsworth and Maddison's estimates, by the early nineteenth century, New Spain's per capita GDP was closer to that of western Europe than it would be any time after independence.[49] In fact, its per capita GDP was similar to that of many countries in the European periphery, and was well above that of many other regions (eastern Europe, Africa, and Asia). As to the customary comparison with the US, we think that the criticism of its relevance by Prados de la Escosura for the nineteenth century is also applicable, by the same token, to the eighteenth: neither Britain nor any other country grew at the same rate.[50] Thus Bourbon Mexico's economy did not lag especially far behind that of the leader in growth.

II

Our view on mining in colonial Mexico is in marked contrast with that of some influential scholars. In the terminology of Acemoglu, Johnson, and Robinson, colonial mining would be a conspicuous example of 'extractive' institutions, as opposed to those 'of private property', which favour economic development.[51] To Engerman and Sokoloff, mining institutions were based on extreme inequality between the elite and the natives.[52] These two interpretations do not seem to be

[44] Klein, *American finances*, p. 3.
[45] Marichal and Souto, 'Silver and situados'.
[46] Marichal, 'Bankruptcy', pp. 16–17.
[47] Sachs and Warner, 'Natural resources', p. 827.
[48] David and Wright, 'Increasing returns'; Wright and Czelusta, 'Resource-based growth'.
[49] Coatsworth, 'Structures'; Maddison, *World economy*.
[50] Prados de la Escosura, 'Economic consequences'.
[51] Acemoglu et al., 'Reversal of fortune', p. 1235.
[52] Engerman and Sokoloff, 'Factor endowments, inequality' (see above, n. 6).

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consistent with abundant evidence that gives a picture of mining where neither extreme inequality nor 'extractive' institutions at the micro, sectorial level are found.[53]

In Bourbon Mexico's mining sector, property rights were secure and made accessible to a wide segment of society by a rather liberal legal framework, as may be concluded from the mining laws of 1584 (*Ordenanzas del Nuevo Cuaderno*) and of 1783 (*Reales Ordenanzas*), from the general legal code of Spanish America (*Recopilación de leyes de los reynos de Indias*) and from its qualified commentators.[54] The imperial state did not confiscate income or assets that belonged to individuals who were exploiting mineral deposits.[55] The pro-business institutional framework in the mining industry was openly acknowledged by Humboldt as well.[56] Quoting this author, Klein claims that the fiscal burden on mining was about 15 per cent, allegedly lower than in European countries.[57] Instead of a predator state, what may be seen is a state that conscientiously and efficiently promoted long-lasting and intense mining growth by means of a sound policy. Thus, the institutional framework of the mining industry was very close to, or even more liberal than, those that coexisted in western Europe.

According to Humboldt, *c.* 1800 some 3,000 mines were in operation, while Ward estimates that they numbered between 3,000 and 5,000[58] None of them was owned or managed by the state. All mines, then, were in private hands. Obtaining the legal right to exploit silver deposits was easy and inexpensive. Only a minority of mines were large-scale mines owned by those that might be termed 'a privileged few' by Engerman and Sokoloff.[59] In spite of the enormous riches of a handful of tycoons, most mine owners (*mineros*) belonged to the middle class. Indians were legally allowed to own mines, and seem effectively to have done so, and to have legally defended their property rights.[60] As late as in the 1770s representatives of the *mineros* still complained about the lack of social respect towards the business.[61] Many *mineros* behaved as conspicuous entrepreneurs whose benefits did not depend on any form of state capture. The large size of some mining firms—including agricultural estates in some cases—was a consequence of scale economies and of the

[53] The interesting idea of distinguishing between macro and micro levels was suggested by one the referees. See the final paragraph in section III.

[54] de Gamboa, *Comentarios a las Ordenanzas*; J. L. de Lassaga and J. Velázquez, 'Representación que a nombre de la minería de esta Nueva España hacen al Rey nuestro señor', Archivo General de Indias, Sección México, Legajo 2240 (1774); Humboldt, *Political essay*; Ward, *Mexico*.

[55] '. . . nor is there one instance, since the Conquest, of an attempt having been made by the Government to interfere with the mode of working adopted by individuals, or to diminish the profits of the successful adventurer, by exacting, under any plea, or pretence, from the more fortunate, a higher rate of duties than that which was payable by the poorest miner to the Royal Treasury'; Ward, *Mexico*, p. 395.

[56] 'All the metallic wealth is in the hands of individuals. The government possesses no other mine . . . The individuals receive from the king a grant of a certain number of measures on the direction of a vein or a bed; and they are only held to pay very moderate duties on the ores extracted from the mines . . .'; Humboldt, *Political essay*, vol. I, pp. 327–8.

[57] See Klein, 'Great shift', p. 42. By 1800, according to our calculations based on Treasuries records of TePaske and Klein, *Ingresos y egresos*, and on data on precious metals minted in Lerdo de Tejada, *Comercio exterior*, we estimate that the registered direct fiscal burden on gold and silver production and minting was 12 to 14.6% between 1797 and 1805.

[58] Ward, *Mexico*, p. 397.

[59] Engerman and Sokoloff, 'Factor endowments', p. 58.

[60] Archivo general de la Nación, Mexico City, Sección Minas, Files 18 and 74.

[61] J. L. de Lassaga and J. Velázquez, 'Representación que a nombre de la minería de esta Nueva España hacen al Rey nuestro señor', Archivo General de Indias, Sección México, Legajo 2240 (1774).

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advantages of vertical integration.[62] However, 'petty mining' was very common in many districts. Lack of capital was the rule among most of the *mineros*. Thus, with the aim of improving the supply of credit to mining firms, the Mining Code permitted the creation of a semi-public mining bank (Fondo y Banco de Avíos de Minas) in 1783. It was managed by officers appointed by the Mining Guild.[63]

In addition, mining in Bourbon Mexico was not based on the 'extraction' of labour from the indigenous population. Contrary to the assumption made by Acemoglu et al., there did not exist any abundant indigenous population that might explain the existence of 'extractive' institutions, for the reason that many of the original inhabitants of colonial Mexico, along with their descendants, had already disappeared a few decades after the Conquest.[64] Irrespective of whether colonial institutions at the macro level were extractive or not, it is quite clear that mining institutions at the micro level could not be so, if only for demographic reasons. Early colonial Mexico, in fact, experienced a dramatic fall in population. One of the main characteristics of the 'economic reorganization' of Latin America during the last third of the sixteenth century and the first half of the seventeenth century following such an intense decrease in indigenous populations was a persistent shortage of labour.[65] This was especially true as far as mining in Mexico was concerned. The discovery of mineral deposits in almost deserted northern areas created the conditions for a free labour market. By the late colonial period most mining districts were still located in regions where the indigenous population had always been very scarce or non-existent. In marked contrast to the south, by 1810, *españoles* (whites) and *castas* (mestizos) outnumbered Indians in the northern regions.[66]

Generally speaking, forced labour was of minor importance *c*. 1700. It was even less important in silver production since it had been increasingly replaced by free immigrants coming from other regions who were attracted by the higher living standards in northern mining centres.[67] Thus, mining was based on the existence of a free labour market with a high mobility of well-paid miners. Brading confirms this anti-conventional view: 'Mining workers in Mexico, far from being the oppressed peons that the legend presents, constituted a free, well-paid, geographically mobile, labour force that in many regions were practically partners of their patrons'.[68]

By the nineteenth century, Humboldt observed that miners were absolutely free and that no Indian or Mestizo could be forced to work in mines. He was emphatic on this point: 'Nowhere do the commoners more perfectly enjoy the fruits of their labour than in the mines of Mexico'.[69] Although the persistence of some forms of

[62] Brading, *Mineros y comerciantes*; Florescano and Gil, 'La época'.
[63] Albeit clearly mismanaged, as its early bankruptcy (1786) demonstrates, Flores, *El Banco de Avío*, p. 15, claims that 'it is the pioneer of the industrial banks in Mexico'. Ludlow and Marichal, *La banca en Mexico*, p. 11, considered it a precursor of the modern financial sector in Mexico.
[64] Acemoglu et al., 'Reversal of fortune', p. 1265.
[65] Carmagnani, *El otro Occidente*.
[66] Sanchez Santiró, 'El legado económico'.
[67] Swann, 'Migration'.
[68] Brading, *Mineros y comerciantes*, p. 201 (our translation).
[69] Humboldt, *Ensayo político*, pp. 136–7 (our translation).

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coercion in certain central mining centres might have been overlooked,[70] the fact still remains that in the course of the eighteenth century forced participation of Indians in the mining labour force became insignificant.[71]

Moreover, Humboldt claimed that the miners in colonial Mexico earned higher wages than their counterparts in western Europe: 'The Mexican miner is the best paid of all miners'.[72] He was right. Nominal wages—grams of silver per day—of miners in La Valenciana (Guanajauto) in 1803 were substantially higher than those of most building labourers, either unskilled or skilled, in Europe.[73] The comparatively high level of nominal wages was not due to the abundance of silver since most of it was exported. Real (grain and, especially, meat) wages of miners were also higher than in Europe and the average height in northern, mining regions was similar to the European average.[74] In sum, it does not seem that miners in late colonial Mexico endured poor living conditions; rather, the contrary is true.

Moreover, wages were traditionally complemented by non-registered payments in silver ore called *partidos*. Brading claims that the more or less formal negotiation about the size of *partidos* was at the heart of many labour conflicts, and that *partidos* tended to decrease over the last decades of the eighteenth century as a result of joint pressure from the government and employers.[75] According to Brading, *partidos* were a way by which workers became, so to say, partners, or even rivals, of mine owners. The miners' bargaining power might also have been weakened by population growth. However, especially in most northern mining centres, workers managed to keep substantial payments in silver ore whose sale to refiners was an additional source of income.

In sum, institutions ruling Bourbon Mexico's mining sector were 'institutions of private property', to use the terminology of Acemoglu et al., while mine workers' living standards did not reflect the extreme inequality posited by Engerman and Sokoloff.[76]

The extent to which the comparatively high living standards enjoyed by miners may be assumed for the rest of the working population is uncertain. There is almost no quantitative evidence regarding peasants. Urban building labourers were better off than in many parts of Europe, especially in terms of meat—a superior good—wages.[77] Dobado and García also find that the evolution of their real wages in the second half of the period under analysis was basically similar to that in Europe: the increase in the prices of grain and other staples contrasted with the stability of nominal wages and resulted in a falling trend of real wages

[70] von Mentz, 'Coyuntura minera'.

[71] Brading, *Mineros y comerciantes*; Velasco, Flores, Parra, and Gutiérrez, *Estado y Minería*; Ladd, *Génesis y desarrollo*.

[72] Humboldt, *Ensayo político*, p. 370 (our translation).

[73] The sources for New Spain are Brading, *Mineros y comerciantes*, for miners' nominal wages, and Garner, *Economic growth*, and Quiroz, *Entre el lujo*, for grain and meat prices in Mexico, respectively. Allen, http://www.iisg.nl/hpw/data.php is the source for wages and prices in Europe.

[74] R. Dobado and H. García, 'Neither so low nor so short! Wages and heights in eighteenth and early nineteenth century colonial Latin America from an international comparative perspective', paper presented at 'A Comparative Approach to Inequality and Development: Latin America and Europe Mini-Conference', Madrid (2009) http://eprints.ucm.es/9762/.

[75] Brading, *Mineros y comerciantes*; Ladd, *Génesis y desarrollo*.

[76] Acemoglu et al., 'Reversal of fortune'; Engerman and Sokoloff, 'Factor endowments, institutions'; idem, 'Factor endowments, inequality' (see above, n. 6); idem, 'Colonialism' (see above, n. 6).

[77] Dobado, 'Prices and wages'; Dobado and García, 'Neither so low' (see above, n. 68).

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throughout the late eighteenth and the early nineteenth centuries. In any case, the effects of Bourbon Mexico's economic growth on population welfare are beyond the limits of this research. However, incidentally, evidence on real (grain and meat) wages suggests an optimistic reconsideration of Bourbon Mexico's economy.[78]

III

In this section we deal with the role of the imperial state in the expansion of mining, and with the rationale underlying its policies. We argue that the imperial state made a significant contribution by encouraging the flow of growing quantities of capital and labour into silver mining. Behind the said policies, a fiscal goal was pursued: to obtain resources in order to compete better on the contested international arena of the eighteenth and early nineteenth centuries. Special attention is paid to the royal monopoly on mercury as it played a leading role in the silver production process and in its fiscal implications.

New Spain had become the main world producer of silver by 1800. Mexico's share in total world silver production was 64.4 per cent in 1781–1800 and 62.4 per cent in 1801–10.[79] Mexico continued to be a major producer during most of the nineteenth and twentieth centuries. However, it never recovered the share in world production it had had in colonial times. Mutatis mutandis, the imperial state's contribution included, but was not limited to, very close versions of two of the elements that David and Wright identify in the rise of US mineral production between 1870 and 1910:[80] firstly, the appropriate legal environment; and secondly, technical education.[81] Besides some measures of economic policy that affected the whole economy positively, a third element to be taken into account is the substantial improvement in the conditions of the supply of mercury, an input indispensable to silver production. While the improvements in technical education were not negligible at the end of the period under consideration, it is very likely that technological change would have only marginally fostered intensive mining growth. Therefore, the expansion of silver production seems to have followed a basically extensive model.

The contribution made by the imperial state through the establishment of a legal and institutional framework promoting mining growth was decisive. Some of its main features were: starting in the 1710s and 1720s, low and decreasing fiscal pressure on silver and on mining inputs, including total tax exemptions for some mining firms and centres under certain conditions; several temporary exemptions from indirect taxes on mine workers' consumption goods in important mining

[78] From Dobado and García, 'Neither so low' (see above, n. 68), it is possible to infer that Mexican GDP per capita by the early nineteenth century might be underestimated, as the ratio of GDP per capita to grain wages of unskilled urban labourers is significantly lower than in most European and Asian countries in the available sample.

[79] Schmitz, *World non-ferrous metal production*.

[80] David and Wright, 'Increasing returns'.

[81] Humboldt, *Political essay*, emphatically described the advance of modern scientific and technical knowledge in Mexico City and attributed a significant role to the state in such development through the School of Mines (1792) and other previous initiatives. According to Howe, *Mining guild*, p. viii, the School 'was the first serious engineering or technical school in the Western Hemisphere'. Comments on the School of Mines by Flores, *Minería*, are very favourable, much more than those by Velasco et al., *Estado y Minería*.

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centres; maintenance of law and order; enforcement of contracts; creation in 1776 of a specific body (*Cuerpo de Minería*—the Mining Guild—and its *Tribunal General*) for the purpose of defending and promoting mining interests, a body which was even granted judicial powers; and the promulgation in 1783 of a liberal mining code that reinforced property rights. Important as these things were, however, the substantial improvement in the conditions of the supply of mercury probably was the most important single measure adopted by the imperial state.

New Spain's mining sector basically consisted of extracting and refining silver ore.[82] During the eighteenth century, using coining as a proxy, there was a greater than fivefold increase in silver production (see figure 1). Even if we accept Pérez Herrero's criticism of using official coining figures as a proxy for silver production,[83] the expansion of mining is confirmed through an alternative, more reliable source: the *correspondido* (an official ratio reflecting the estimated average richness of silver mineral deposits in every mining centre) registered on the books of the Royal Treasuries. Two silver-producing methods were known: amalgamation with mercury (a rare and expensive metal) and smelting.[84] The former was especially well adapted to New Spain's mining conditions; namely, vast deposits of low-grade ore and costly fuel. In accordance with the specific *correspondido* officially in force in a given mining centre, *mineros* producing silver by amalgamation were compelled to *manifestar* (present) to the Royal Treasuries a certain amount of silver proportional to the mercury they had previously bought from the royal monopoly. From the mid-eighteenth century, Bourbon mining policy focused on overcoming the traditional limitations to long-lasting increases in the supply of mercury to the Viceroyalty. The Crown owned Mines of Almadén, in central Spain, the richest mercury deposit ever exploited. Commercialization of mercury was a royal monopoly. Mercury was sold to *mineros* exclusively for amalgamation purposes through the network of Royal Treasuries in New Spain. Thus, the Crown controlled the supply of an input in the silver production process that was indispensable to *mineros* in most mining centres. This control provided not only a mechanism for securing the 'devotion' of the *mineros* to the imperial state but also an instrument for reducing tax evasion as *manifestaciones* established at least a minimum of efficiency in the collection of mining taxes.[85] Thus, it was in the interest of the Crown that amalgamation should be the preferred technique for silver refining.

However, between the early 1720s and 1740s the mercury supply was not sufficient to allow for the growth of silver production. By the early 1740s, the Crown implemented a new policy at the very first stage of the process in Spain. Mines of Almadén were not producing more mercury by the late 1730s than at the beginning of the century, when the discovery and exploitation of a new deposit and

[82] Gold production was significant but much lower: 4.27% in 1763–1809, calculated from Romero, *Minería y guerra*. Production of other minerals (quarries excluded) and metals was almost negligible in comparison with silver, as is shown in Humboldt, *Political essay*, and as commented on in Elhuyar, *Memoria sobre*.

[83] Pérez Herrero, *Plata y libranzas*.

[84] A description of the amalgamation process may be found in Bakewell, 'Las condiciones'; Brading, *Mineros y comerciantes*.

[85] *Manifestaciones* were the quantities of silver presented for tax payment at the Royal Treasuries by the *mineros* of a given district. It was meant to be at least equal to their consumption of mercury multiplied by the *correspondido*.

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the technical change associated with the introduction of the use of explosive powder in mine works permitted a substantial increase in the level of production. Until 1739 mercury transportation was not exempt from the general, overly restrictive rules governing commerce between the Peninsula and Spanish America. Thus, in response to the constraints imposed by adverse maritime transportation conditions, mercury production in Almadén shows an intense variability.

Several factors are proximate explanations for the long-term improvement of the mercury supply, starting *c*. 1740: firstly, the change in the regulation of maritime transportation of mercury after 1739, and secondly, the process of sustained growth in mercury production in Almadén. In turn, the long-term upward trend in mercury production was made possible by some measures which were adopted in the metropolis but had important consequences for the colony. Firstly, there was a series of notorious increases in the budget annually transferred from the Spanish government to Mines of Almadén to finance its operations. Secondly, there was a better, more professional selection of managers and technicians—hired abroad in some cases—whose decisions were actively supported by the government. Thirdly, first steps were taken along a path of technological innovations, which culminated in the introduction of steam power in the late 1780s—for the first time in Spain in civilian applications—and in an original system for mining vertical deposits of minerals at the end of the century. Fourthly, a unique micro welfare state (pensions, hospital, tax and military-service exemptions, education, subsidized bread, and so on) was established at the local—Almadén—level in order to overcome the 'lack of arms' that had historically been a powerful constraint on mercury production.[86]

As expected, from the early 1740s to the mid-1750s consumption of mercury in New Spain increased and so did silver production. Figure 2 depicts the positive co-evolution of silver production and mercury consumption in New Spain along with the budget transferred from the Spanish government to Mines of Almadén from 1714 to 1805. There can be seen the notorious growth in the budget allotted to the Mines of Almadén from 1740 on, which was paralleled by the sustained increase in mercury consumption and in silver production in the eighteen century.

In 1720, mercury consumption in New Spain was below the level of 4,000 Castilian quintals.[87] Twenty years later it reached 5,000 Castilian quintals (an increase of 25 per cent) and by the mid-1750s it almost doubled its 1720 level. After a short stagnation from the mid-1750s to the late 1760s, consumption of mercury and silver production resumed almost uninterrupted growth, to which only the *Insurgencia* would be able to put an abrupt end.

The growth rate of mercury consumption experienced a further rise by the late 1760s in response to the first, substantial decrease in mercury price introduced by the royal monopoly in 1767 (25 per cent). However, in spite of the insistent complaints voiced by *mineros* about the high price of mercury—and high profits to the Crown—the royal monopoly had previously fixed a price that, more often than not, was rather low by international standards. In other words, the imperial state frequently set political prices for mercury in New Spain. From 1767 and especially after 1776, when the price of mercury was reduced again (33.3 per cent), the

[86] Dobado, *El trabajo en las minas*.
[87] A Castilian quintal is a traditional, pre-metric Spanish weight unit of 100 pounds.

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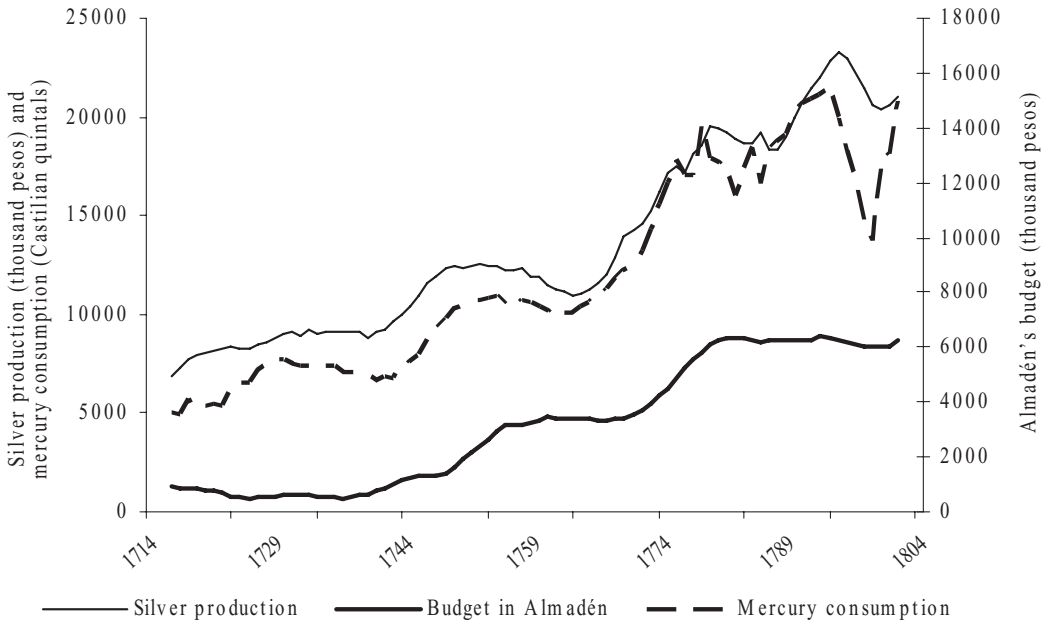

Figure 2. *Budget of Mines of Almadén, mercury consumption, and silver production in Mexico, 1714–1805 (centred seven-year moving average)*

Sources: Lerdo de Tejada, *Comercio exterior*, document no. 52; Dobado, 'Las minas de Almadén', pp. 481–2; Dobado, 'El monopolio', pp. 716–18.

political character of the pricing policy became even more obvious (for example, it frequently was at least one-third lower than in Amsterdam).[88]

Moreover, *mineros* facing especially adverse circumstances might have been granted free mercury, price reductions, or credit sales. In the years preceding the *Insurgencia*, despite the problems caused by maritime warfare, mercury consumption reached a yearly average of 16,000 Castilian quintals. Figure 3 shows the evolution of mercury consumption and silver production along with the price of mercury from 1714 to 1805. The co-evolution between mercury consumption and silver production and the positive influence of the falling price of mercury in the slope of both variables are clear in this figure.

The facilitation of the consumption of mercury in New Spain afforded new opportunities to those numberless *mineros* extracting low-grade silver ore or exploiting costly deposits. More generally, the improvement in mercury supply, together with the rest of the measures making up the reformist mining policy, reduced production costs and created better expectations for investors and thus favoured capital flows into the sector. Therefore, the long-lasting expansion of silver production was caused not only by the new conditions in mercury supply but also by the increasing role of amalgamation as the technical choice made by the *mineros* in silver production. In the 1710s only 40–50 per cent of silver was produced by amalgamation compared with almost 75 per cent in the 1800–5

[88] Our estimations are based on data from Posthumus, *Inquiry* (kindly provided by Javier Cuenca), and from Attman, *American bullion*.

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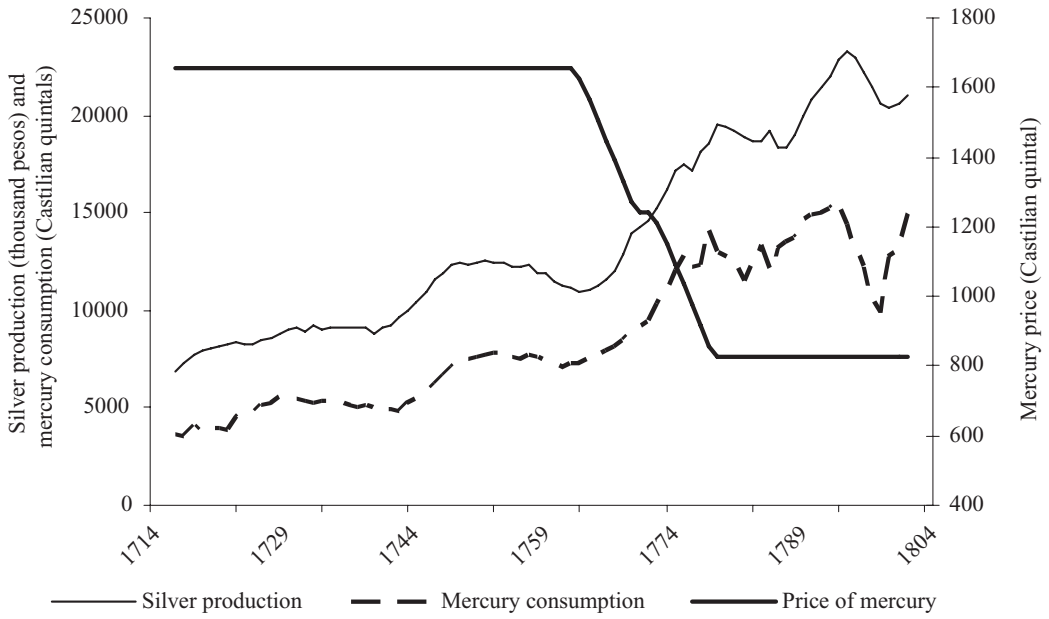

Figure 3. *Price of Spanish mercury and mercury consumption and silver production in Mexico, 1714–1805 (centred seven-year moving average)*

Source: Lerdo de Tejada, Comercio exterior, document no. 52 ; Dobado, 'El monopolio', pp. 716–18.

period, which explains the especially rapid growth rate of amalgamated silver produced after 1767 (2.8 per cent yearly). However, this phase of expansion of the mining sector was negatively affected by two exogenous shocks: the agricultural crisis of 1785–6 and naval warfare between Great Britain and Spain in the late eighteenth and early nineteenth centuries.

The ultimate explanation for the successful policy on mercury was a fundamental change in the goals pursued by the royal monopoly. This official and important institution ceased to be considered a source of direct revenue for the Crown. In contrast with the traditional, mercantilist role assigned to mercury in royal finances, early Bourbon reformism gradually came to the conclusion that mercury might be converted into a key to fostering mining growth. Thus, the behaviour of the royal monopoly towards mercury differed from the one that might be expected from a rational monopolist with absolute market power in that it simultaneously promoted, on the one hand, mercury production increases, and, on the other hand, mercury price decreases. As a result, its income from expanding mercury sales was substantially reduced, either in absolute or relative terms. On the contrary, and consistent with the general goals of Bourbon reformism, what the state tried to maximize with its mercury policy was mining growth and its spillovers in New Spain's economy as a whole.

In short, reducing mercury prices and increasing the mercury supply entailed a reduction in income from the mercury monopoly, which was more than counterbalanced by an increase in the revenue from taxation on silver extraction, since more silver was thus produced and fiscally controlled. Moreover, the positive backward linkages that mining had with other economic sectors, as discussed in

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the next section, also had a positive impact on aggregate demand, on the level of general economic activity and consequently on non-mining tax receipts. Receipts from mercury sales represented almost 45 per cent of the Crown's revenue derived from mining and coining in the late 1710s, whereas they fell to roughly 20 per cent by 1800. In 1760–6, yearly average sales of less than 7,000 Castilian quintals of mercury amounted to some 600,000 current pesos. The proceeds of mercury sales of more than twice that quantity in 1800–5 added only 50,000 more current pesos to the said amount. Rough estimates of the total gross profits of the monopoly and of profits per unit of mercury sold yield the following results: the former were 25 per cent higher in 1760–6 than in 1800–5, while the latter decreased from 60 current pesos per Castilian quintal in 1760–7 to 0.5 in 1800–5. However, total receipts from taxation of the mining industry and mercury sales rose from less than 1.5 million pesos in 1714–15 to almost six million in the early 1790s. Thus, the royal monopoly's calculated restraint, by abstaining from exploiting its full market power, proved to be good business for the Crown. Incidentally, it proved to be very positive for New Spain's economy as well (see the next section). To some extent, it seems as if the Spanish Crown adopted policies regarding taxes and mercury prices based on an early understanding of the Laffer curve.[89] Moreover, an extensive literature on optimal taxation theory points out the positive effect that changing the taxation mix from production factors towards consumption has on economic growth.[90] This policy was basically what the Spanish Crown followed in the Bourbon Mexican economy, which is consistent with the mining-led growth hypothesis. In Garner's words: 'To preserve and expand mining was in the interest not only of the State but also of the economy'.[91]

Efficient governmental action regarding New Spain's mining sector was encouraged by the open political and military conflict between Spain and Great Britain throughout the eighteenth century. In spite of being finally lost by Spain, this conflict may be interpreted as a sort of selective pressure on the efficiency of the imperial state. In other words, the imperial rivalry—various costly wars in different settings, including several oceans, islands, and continents—between both monarchies would have finished earlier and with bigger loses to the Spanish Crown if reforms—limited as they were—in the imperial state had not been introduced. The renovation of political and bureaucratic elites resulting from the change of dynasty also had favourable consequences for the management of economic affairs by the imperial state. Increasing the tax revenue was necessary to sustain the war effort. Economic prosperity appeared as a less provocative way to broaden the fiscal base of the empire than its alternative: increasing the tax burden. Coherent with the political and military goals of the Bourbon state, economic policy experienced a gradual change from interventionist mercantilism towards some form of limited proto-liberalism with a greater potential to promote pre-industrial growth.

In this context, probably by the late 1730s, the 'pre-enlightened' imperial state came to realize the existence of a fundamental economic relationship in New Spain of the following type:

[89] We appreciate this comment by one of the referees.
[90] Chamley, 'Optimal taxation'; Lucas, 'Supply-side economics'; Rebelo, 'Long-run policy'.
[91] Garner, *Economic growth*, p. 109.

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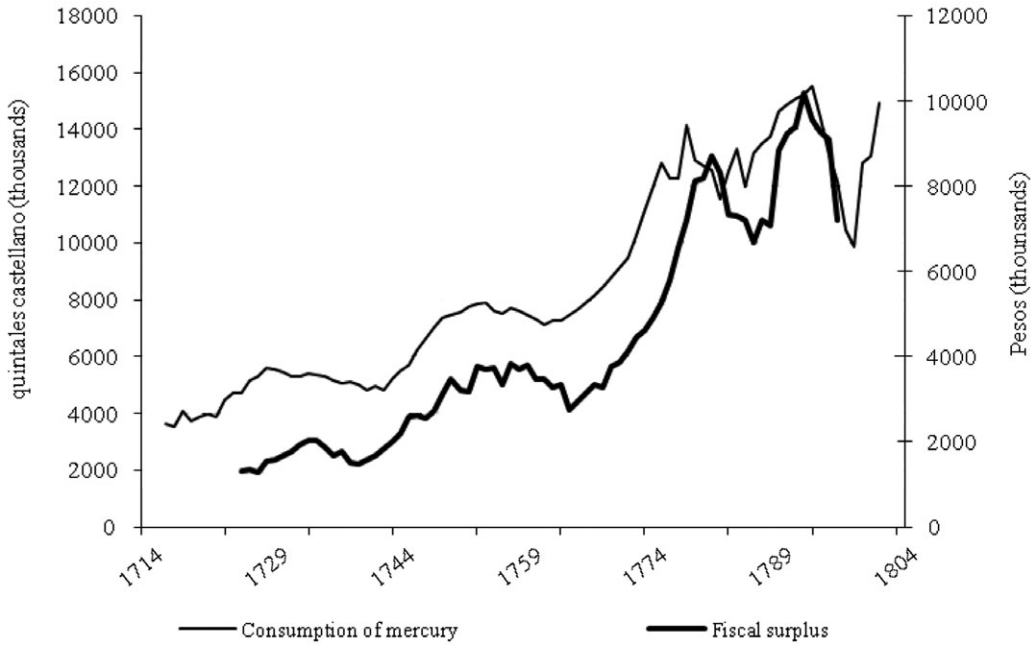

Figure 4. *Consumption of mercury and fiscal surplus remittances in New Spain, 1720–1800 (centred seven-year moving average)*

Source: Marichal and Souto, 'Silver and situados', pp. 612–13; Dobado, 'Las minas de Almadén', pp. 716–18.

ΔMERCURY CONSUMPTION IN NEW SPAIN → ΔSILVER PRODUCTION IN NEW SPAIN → ΔECONOMIC ACTIVITY IN NEW SPAIN → ΔTAX COLLECTION IN NEW SPAIN → ΔFISCAL SURPLUS REMITTANCES TO THE METROPOLIS AND OTHER COLONIES

Figure 4 shows the trend of the two variables (mercury consumption and fiscal surplus remittances) at either end of this chain of implications between 1720 and 1800. The extent to which they co-evolve is surprising. Some common response to exogenous shocks (such as maritime warfare *c*. 1800) was to be expected, but such long-term parallelism is unlikely to be superficial or casual instead of rooted in the causality suggested above.

An empirical analysis has been conducted in order to reinforce the arguments made in this section. This analysis is based on the one conducted by Dobado and Marrero. Naturally, its scope has been limited by the availability of data on explanatory variables of silver production.[92] The empirical analysis consists of long- and short-run studies and comprises the estimation of cointegration and the

[92] Dobado and Marrero, 'Minería'. In our model the endogenous variable is total silver production in New Spain at year *t* ($AGPROD_t$) between 1714 and 1805. As exogenous variables in the model, we use: the price of mercury in year *t* ($HGPRICE_t$), Mines of Almadén's budget in year *t* ($BUDGET_t$), and the mercury stocked by the royal monopoly in New Spain at the end of year *t*-1 and available for consumption by *mineros* in year *t* ($HGSTOCK_t$). By using these three variables we attempt to capture the individual effects of the main measures among those making up the imperial state's policy on the mining sector through their respective influence on the conditions of the mercury supply faced by *mineros*.

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associated error correction models.[93] Our results are consistent with our hypothesis about the positive effects that innovative mercury policies, adopted successively by the imperial state throughout the eighteenth century, had on the almost century-long expansion of the mining sector. Increasing the mercury stocked by the royal monopoly in New Spain and the financial resources available to Mines of Almadén to expand its operations had a positive effect on silver production. At the same time, reducing the price of mercury also had a positive and considerable impact on silver production. Thus, we share Coatsworth's view on the decisive role played by direct and indirect subsidies from the government to *mineros*.[94]

The apparent contrast between the final extractive goal of reformist colonial policies at a macro level and the 'non-extractive' character of some decisive, pre-industrial growth-favouring policies and institutions at the micro level—that is, mining—has great analytic potential for a proper characterization of Spanish colonialism in Bourbon Mexico and for a better understanding of its effects on economic development after independence. Exploring further the distinction between macro and micro level colonial policies and institutions constitutes a clear avenue for future research.

IV

In this section we attempt to complete our argument by offering insights on and empirical evidence in favour of one of the main themes of this research: the important role played by the long-term expansion of silver production in promoting mining-led growth. The empirical analysis used in this section is based on one of our earlier articles, but we use an augmented database on fiscal revenue that includes all Royal Treasuries receipts from 1714 to 1805.[95] Therefore the new database is a novelty that provides more solid grounds than our previous results. Additionally, more emphasis is given to showing the reliability of taking the long-term path of ordinary income of the imperial state in Bourbon Mexico as a reliable proxy for studying the secular trend of the colony's GDP.

Mining-led growth can be defined as a particular model of pre-industrial growth where mining acts as the main driving force of economic dynamism. It was compatible with other sources of growth (foreign trade, urbanization, regional specialization, and so on) and reinforced their effects. Mining-led growth was

[93] The standard Augmented Dickey-Fuller test shows that all series in this analysis are integrated of order one. The Johansen test (Johansen, 'Estimation and hypothesis testing') indicates the existence of one cointegration equation that is significant at the 5% level. The Engle-Granger test (Engle and Granger, 'Co-integration and error correction') shows that residuals of the cointegration equation are stationary at the 1% significance level. Hence the existence of cointegration at this level of significance cannot be rejected. As our variables prove to be cointegrated, we have also estimated an error-correction model in order to characterize short-term relationships. The short-run elasticity associated with *HGSTOCK* is about 0.06, similar to that found in the cointegration equation (a long-run elasticity). As it might be expected, estimated short-run elasticities of the two other variables are smaller (in absolute terms) than long-run elasticities. The short-run elasticity estimated for the *HGPRICE* is about –0.35, almost half of that estimated in the cointegration model. The short-run elasticity associated with *BUDGET* is equal to 0.09, while that estimated in the cointegration equation is about 0.17. Finally, the error correction term is strongly significant, with an adjustment coefficient of –0.38. This negative coefficient implies that when silver production deviates from its long-run path, approximately 40% of the adjustment towards its long-run level takes place within the first year. Detailed analysis results are available from the authors on request.

[94] Coatsworth, *Los orígenes*. However, we do not accept his defence of a pre-1810 decline of the mining industry (see section V).

[95] Dobado and Marrero, 'Minería'.

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made possible by the abundance of mineral resources in the form of enormous deposits of silver. Mining expansion was a rational economic alternative rather than a colonial imposition. Given New Spain's factor endowments, the existence of geographical obstacles to internal transportation,[96] and its distant location from significant foreign markets in Europe or Asia, productive specialization could only be led by a sector producing a good with high price/volume or high price/weight ratios, such as silver. Besides, silver was in great demand in the expanding international economy from the sixteenth to the eighteenth century.[97] Apart from some other raw products, what else could colonial Mexico export profitably to Europe or Asia? In Bulmer-Thomas's terminology, mining expansion in Bourbon Mexico may be considered an early, pre-industrial version of the 'transformative model' in export-led growth economies of nineteenth-century Latin America.[98]

Therefore, in contrast with the 'resource curse' hypothesis,[99] we believe that the abundance of natural resources does not necessarily have adverse consequences on economic growth, be it pre-modern or modern.[100] Thus, we share the same positive view of the role of mining in economic growth expressed by other authors.[101] Indeed, the very long-term sustainability of resource-based economic growth, either in colonial and post-colonial Mexico or elsewhere, is arguable. In Porfirian Mexico (1877–1910), mining reappeared as an important contributor to the development of the Mexican economy. Something similar can be predicated for several more or less early comers to industrialization (such as Britain, Belgium, Germany, the US, Sweden, and Spain). Curiously enough, some mineral-exporting countries are nowadays placed at the very top of the Human Development Index (that is, Australia and Canada). Thus, there does not seem to be any reason why the growth of the mining sector by itself should inevitably damage economic development.

In any case, mining made a significant contribution to Bourbon Mexico's economy. According to Romero and Jáuregui, mining represented 12 per cent of GDP *c*. 1810, and, calculating from Ibarra and Romano's estimates, its share in the market-oriented sector would have been 25–40 per cent.[102] It is likely that no other pre-industrial economy has ever had such an economically influential mining sector.[103] Even at the regional level, as van Young and Ibarra have shown for the Guadalajara region—where mining was not especially significant in terms of its contribution to GDP—the role of silver production was decisive in the articulation of its dynamic market-oriented economy.[104] It is small wonder that Pérez Herrero claims that mining was the main force behind the process of market integration

[96] Coatsworth, *Growth against development*.
[97] Flynn and Giráldez, 'Cycles of silver'.
[98] Bulmer-Thomas, *Economic history*, pp. 82–3.
[99] Sachs and Warner, 'Natural resources'.
[100] As the cases of Britain, Belgium, Germany, the US, Sweden, Norway, Australia, Canada, and others show.
[101] David and Wright, 'Increasing returns'; Wright and Czelusta, 'Resource-based growth'.
[102] Romero and Jáuregui, 'Comentarios sobre el cálculo'; Romano, *Moneda*; Ibarra, 'Mercado colonial', pp. 285–90.
[103] During the export-led mining boom of the late nineteenth and early twentieth centuries in Spain and Mexico, the size of the respective sectors was substantially smaller: less than 2% of GDP in Spain if we only consider extractive activities and no more than 6% in Mexico, as shown in Dobado and Silva, 'El crecimiento minero', pp. 498–500.
[104] van Young, *La crisis*; Ibarra, *La organización regional*.

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that took place in Bourbon Mexico.[105] Apart from mercury, iron, and some luxury items, the rather unsophisticated goods and services demanded by mining firms and workers were produced domestically. The secular expansion of silver production, especially in the most remote northern areas, would have been impossible without some form, even if not particularly impressive, of Smithian growth. Mining in colonial Mexico should not, then, be identified with an outward-looking economic enclave.

A direct quantitative test of the mining-led growth hypothesis is impossible to conduct, given the lack of a sufficient number of observations of GDP. Therefore, we are compelled to test our hypothesis indirectly by using fiscal data. Our approach implies that the trend of fiscal revenue proxies for that of GDP. We believe that this is the best practical way to assess economic growth in Bourbon Mexico given the present state of the historiography, in particular of that especially concerned with quantitative data and long-term perspectives.

This strategy is favoured by the fact that the particular characteristics of the tax system prevailing in the Viceroyalty made it possible for the tax receipts to have been traditionally considered a reliable proxy of New Spain's aggregate output as, from the beginning of the colonial period, it was substantially more efficient and flexible than its Peninsular antecedent.[106] Humboldt and Elhuyar regarded increases in revenue as indisputable evidence of economic growth.[107] Klein, taking into account criticism made by scholars who raised objections to the classical view,[108] as well as his own previous reflections,[109] put up a convincing defence of the fiscal approach as an adequate means to determine the general trend of economic activity in the Spanish colonies in America.[110] Dobado and Marrero, and Ponzio, have also adopted a fiscal approach to studying the evolution of Bourbon Mexico's GDP.[111] Marichal argues that taxes may be considered a reliable proxy for New Spain's GDP.[112]

In order to test the mining-led growth hypothesis, we explore, through cointegration analysis, the existence of a positive long-term relationship between silver production and the ordinary revenue of the imperial state in Bourbon Mexico. As the mining-led growth hypothesis is most economically meaningful in the long run, we are solely interested in cointegration analysis.[113]

Based on the myriad of raw data published by TePaske and Klein, we have produced annual time series (1714–1805) of total gross income for all treasuries in colonial Mexico.[114] After that, we have excluded from total gross income all receipts that do not fulfil the criteria of flexibility (close connection with economic activity) and realism (equivalence of book entries to effective income). After

[105] Pérez Herrero, *Comercio y mercados*.
[106] Klein, *American finances*.
[107] Humboldt, *Political essay*; Elhuyar, *Memoria sobre*.
[108] Brading, 'Facts and figments', pp. 61–4; Coatsworth, *Los orígenes*; Pérez Herrero, *Comercio y mercados*; idem, 'Reformismo borbónico'.
[109] TePaske and Klein, *Ingresos y egresos*.
[110] Klein, *American finances*.
[111] Dobado and Marrero, 'Minería'; Ponzio, 'Globalisation'.
[112] Marichal, 'El sistema fiscal', p. 55.
[113] ECM results are available on request.
[114] TePaske and Klein, *Ingresos y egresos*. We are very grateful to Herbert Klein for providing us with this data set.

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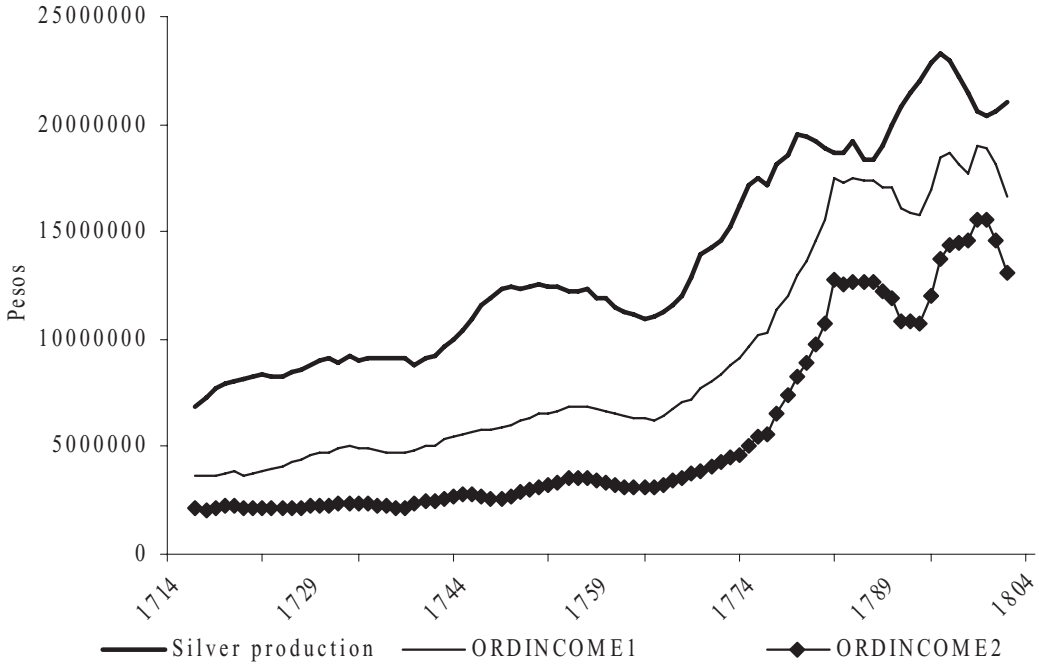

Figure 5. *Silver production and ordinary fiscal receipts in Mexico, 1714–1805 (centred seven-year moving average)*

Source: Lerdo de Tejada, *Comercio exterior*, document no. 52; TePaske and Klein, *Ingresos y egresos*.

deducting hundreds of different types of entries, such as loans, temporary deposits made by individuals, double accounts, and extraordinary and miscellaneous receipts, a series of total net ordinary income of the imperial state in the whole colony was obtained (*ORDINCOME1*). It might be argued that this series is biased by mining revenues and that this bias could affect results when *ORDINCOME1* is used for testing the mining-led growth hypothesis. In order to avoid this possible shortcoming, we have constructed an additional variable measuring non-mining ordinary fiscal receipts, *ORDINCOME2*, which results from subtracting mining revenue, including mercury sales, from *ORDINCOME1*.[115] These revenue series are shown the appendix. The positive co-evolution between silver production and these two fiscal revenue time series is perceptible from figure 5.

We do not disregard the possibility that higher revenues might also be caused by higher tax burdens or more efficient tax collection.[116] Generally speaking, increases in revenues might also be due to increases in the tax base (with a constant level of GDP), but, as far as Bourbon Mexico is considered, it is unlikely that the tax base behind our estimated revenue is uncorrelated with GDP. The reason is that our series of revenues, by construction, reflects the main trends in basic GDP

[115] Checking for robustness, we have also constructed another variable: *ORDINCOME3*, which results from substracting '*tributo indígena*' (a capitation tax collected for all aboriginal male adults). Any possible influence of aboriginal population growth is excluded by construction from *ORDINCOME3*. As cointegration results obtained with *ORDINCOME3* are almost the same as using *ORDINCOME2*, we do not show them.

[116] Pérez Herrero, *Comercio y mercados*; idem, 'Reformismo borbónico'.

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Table 1. *Cointegration analysis between silver production and ordinary fiscal receipts, 1714–1805*

	Cointegration tests			*Cointegration equation*			
		Johansen [a]		$RECEIPTS_t = \alpha + \beta AGPROD_t + \varepsilon_t$			
	Engle and Granger	*No cointegration*	*At most 1 cointegration*	α	β	*Std* (β)	R^2
ORDINCOME1 vs. silver production (1714–1805)	–4.236 *	26.47 *	6.01	–6.44	1.36	0.057	0.862
ORDINCOME1 vs. silver production (1714–65)	–3.599 *	23.93 *	8.27	–0.37	0.98	0.086	0.724
ORDINCOME2 vs. silver production (1714–1805)	–3.467 *	21.26 *	5.46	–11.91	1.66	0.091	0.786
ORDINCOME2 vs. silver production (1714–65)	–4.002 *	24.10 *	7.56	3.59	0.69	0.121	0.395

Notes: All variables are in natural logs.
* Rejected at 1% level of significance.
a Likelihood ratio test, not including linear trend, including intercept and two lags in dynamics.

components (mining production and inputs, other state monopolies, domestic consumption of a wide range of goods, imports, aboriginal population, and so on).

It is also interesting to consider whether the alleged increase in tax burden or tax collection efficiency resulting from reformist fiscal policies initiated by the late 1760s affects the cointegration between silver production and the three definitions of ordinary fiscal revenue. To do that, in our quantitative analysis we date the start of the reformist period in 1766, the year after the arrival of Inspector General Gálvez to New Spain to implement the reforms of the existing colonial policy.[117] The second step consists of comparing the results of the cointegration analysis for the whole period under consideration (1714–1805) with those for the pre-reformist one (1714–65), for which there is not substantial evidence showing significant changes in tax burden or tax collection efficiency. Results from the cointegration analysis are shown in table 1.

Engle-Granger and Johansen tests reveal that silver production is cointegrated with *ORDINCOME1* and *ORDINCOME2* at the 1 per cent level of significance for the two time samples considered. It is worth emphasizing that, during the pre-reformist period, increases in ordinary income may not be attributed to substantial increases in tax burden or in tax collection efficiency as they are not documented before the late 1760s. Thus, as cointegration for 1714–65 cannot be rejected, it is reasonable to think that the long-term relationship between silver production and ordinary revenue may be interpreted as evidence in favour of the mining-led growth hypothesis instead of responding to fiscal changes. Moreover, increases in the tax burden or tax collection efficiency after 1765 do not seem to be intense enough to have brought about any substantial change in terms of cointegration between the two periods considered (1714–65 and 1714–1805), as might otherwise be expected. In other words, accepting that the imperial state was capable of collecting more revenue in the reformist period is not necessarily at

[117] Our results are robust to small changes in the year chosen to conduct the exercise.

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odds with the mining-led hypothesis. It is also worth considering the fact that cointegration also exists between silver production and non-mining ordinary income, which captures taxes on other economic activities, and that cointegration also exists before and after 1766.

The estimated β coefficients in the cointegration equations can be taken as an estimation of the long-run elasticity between ordinary income and silver production along the long-term equilibrium path. In table 1 it can be seen that those coefficients are lower for 1714–65 than for 1714–1805. The explanation for these differences is that fiscal reform resulted in an increase in the elasticities between ordinary income and silver production. However, fiscal reform cannot be considered the only factor behind cointegration, as it is also found when looking only at the pre-1766 period.

The mining-led growth hypothesis turns out to be the least implausible explanation for the abundant and diverse historical and empirical evidence supporting the notion that silver production was a genuine driving force of pre-industrial economic growth in Bourbon Mexico.

V

This section briefly discusses the consequences for long-term economic growth of the sudden interruption of colonial mining-led growth caused by the *Insurgencia* and independence.

The decades after independence are generally considered to be a period of economic decline.[118] The divergence of Mexico's economy from the Atlantic ones was especially marked in this period. By 1870, Mexico had even fallen behind relatively slow-growing Spain as well. In addition to other, widely accepted factors behind Mexican economic decline—such as wars and subsequent destruction of human and physical capital, political instability—our findings also suggest that Mexico might well have paid a huge price for the sudden interruption of colonial mining-led growth from 1810 onwards.

Based on Maddison's estimates, by the early nineteenth century, Bourbon Mexico's per capita GDP was closer to that of western European countries than ever before.[119] The ratio between those two magnitudes has not yet recovered the level reached at the end of the colonial period (60 per cent).

Silver production reached a record level in 1804 and 1805: 26.1 and 25.8 million pesos, respectively. Between 1778 and 1809, silver production had been growing at a yearly average of 1.2 per cent. We agree with Ponzio that there is not enough evidence to support Coatsworth's pessimistic view of late colonial Mexican mining.[120] Despite the agrarian crisis of the late 1800s, the invasion of Spain by Napoleon, and the hypothetical negative effects of the forced loans imposed by the colonial government on the financial system of the colony, silver production in 1809 almost reached a new historical record: 24.7 million pesos. Moreover, in 1810, 18 million pesos were produced in spite of the early fall of

[118] Salvucci, 'Mexican national income'; Coatsworth, *Los orígenes*; idem, 'Structures'; Cárdenas, *Cuándo se originó*; Dobado and Marrero, 'Minería'; Maddison, *World economy*.

[119] Maddison, *World economy*, p. 262.

[120] Ponzio, 'Interpretación económica'; Coatsworth, *Los orígenes*.

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Guanajuato, by far the main mining centre, into the hands of the *insurgentes*. It was only after the *Insurgencia* that mining production collapsed. Therefore we depart from Ponzio's claim that 'Mining output ceased to be the source of economic growth at the end of the eighteenth century'.[121]

A dramatic fall in silver production occurred in 1811–12 as a consequence of the *Insurgencia*: four million pesos were officially minted in 1812. After a far from complete recovery in subsequent years, a new and important decrease was caused by independence: in 1821 production was 5.6 million. The intensity of the two shocks was certainly extraordinary. But what happened afterwards? Silver deposits were still there, as the expansion of mining in Porfirian Mexico demonstrated. Although, within a new, more favourable, international economic context (augmented technical progress, increasing integration of capital markets, and so on), the growth rate of mining production in 1823–65 (roughly 1.5 per cent) was close to that of the late colonial period, the level of production would never again be the same in the decades to come. By 1865 silver production had not even reached the lower band level of the predicted trend. It was not until 1871–5, 50 years after independence, that the early nineteenth-century levels were surpassed.

Curiously enough, according to Coatsworth and Maddison, Mexican per capita GDP in 1870 was still lower than in 1800 or 1820.[122] It is generally accepted in the literature that the *Insurgencia* caused a profound and lasting economic disruption which did not come to an end with independence. Mexico was not an exception among Spanish ex-colonies in America. To Bulmer-Thomas, the 'privileged' economic position reached by Latin America by 1800 with respect to other non-core countries 'was undermined by the upheavals associated with the struggle for independence'.[123] Generally speaking, the aftermath of the first two decades of the nineteenth century was characterized by a decrease in real per capita income. The main factors explaining this adverse economic evolution were the decline of external trade, the drain of capital away from the region, the collapse of the fiscal system, and in particular the serious decrease in the productivity of mines. Referring to the second quarter of the nineteenth century, Coatsworth termed it 'catastrophic'.[124] These problems, to which territorial conflict and political instability must be added, arose in Mexico with particular intensity. Cárdenas also emphasizes the negative influence of extreme political instability and subsequent financial astringency during the first decades of independence.[125]

Did the coincidence between economic stagnation in independent Mexico and the slow and incomplete recovery of late colonial mining output levels happen purely by chance? The absence of causality between these two important facts in Mexican economic history is most unlikely.

Successive independent governments were unable—or unwilling—to implement mining policies as effective as those adopted by the imperial state. In spite of the great expectations of a bright future for mining in independent Mexico which arose from the diffusion throughout western Europe of Humboldt's enlightened account of his travel to the colony in the early nineteenth century, the reality

[121] Ponzio, 'Globalisation', p. 462.
[122] Coatsworth, 'Structures'; Maddison, *World economy*.
[123] Bulmer-Thomas, *Economic history*, p. 27.
[124] Coatsworth, 'Structures', p. 137.
[125] Cárdenas, *Cuándo se originó*.

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proved to be much more sombre. Ward still expresses an optimistic view of post-colonial prospective developments in the mining sector in early post-independent Mexico.[126] In fact, these optimistic expectations help to explain the flows of foreign capital, technology, and entrepreneurial skills into the Mexican mining industry from Britain in most cases, but also from Germany and the US, from 1824 onwards. Seven mining companies were created in London to operate in Mexico. In general, their operations took place in mining centres that had been especially successful during the late colonial period. Initial financial exuberance soon changed into disappointment. None of these ventures was especially successful and some of them became outright failures.[127]

The obstacles to profitable investment resulting from the new circumstances in which mining was operating seem to have been insurmountable: losses of physical and human capital;[128] erratic economic policies;[129] inefficiencies of an underdeveloped capital market and crowding-out effects from excessive borrowing by the Mexican government;[130] huge increases in mercury prices in the 1830s and 1840s;[131] and attacks on northern mining centres by previously pacified 'wild Indians'.[132]

Thus, the disruption of colonial mining-led growth had a harmful effect on the Mexican economy. No other sector proved capable of replacing the dynamic role formerly played by mining in the Bourbon period.[133] The enormous contraction in mining output and exports with respect to pre-*Insurgencia* levels might help to explain the 'lost decades' in terms of growth and convergence with the Atlantic economies after independence that are pointed out by most authors.[134]

VI

In this article we attempt to make the case for a reconsideration of certain aspects of the late colonial period in Mexico and its long-term economic consequences. Thus, we argue against an important literature that finds in colonial institutions the key to explaining contemporary problems of development in Latin America. Our revisionism is only conditional, albeit not irrelevant, as the evidence shown relates exclusively to mining—supposedly the epitome of colonial exploitation—in New Spain, the jewel of the Spanish imperial Crown in America. From an institutional perspective, some possible implications of our conditional revision of mainstream perceptions might be as follows: although colonial institutions damaged economic growth in post-1810 Mexico, they did not do so before; the 'extractive' character of some important colonial institutions at the micro level should not be assumed

[126] Ward, *Mexico*.

[127] Velasco et al., *Estado y Minería*; Randall, *Real del Monte*.

[128] Resulting from both the violence associated with the *Insurgencia* and the migration or the expulsion of Spaniards. See Romero, *Minería y guerra*; Velasco et al., *Estado y Minería*.

[129] Paradoxically, the tax burden on mining was heavier after independence. See Velasco et al., *Estado y Minería*; Urrutia de Stebelski and Nava, 'La minería'; Contreras, 'La minería hispanoamericana'.

[130] Marichal, 'Obstacles'; idem, 'Introducción'.

[131] Randall, *Real del Monte*; Dobado, 'El trabajo'.

[132] Velasco et al., *Estado y Minería*, pp. 234–44.

[133] The emergence, although not before the 1840s, of a small modern textile sector is probably the only exception. See Dobado, Gómez, and Williamson, 'Mexican exceptionalism'.

[134] Cárdenas, *Cuándo se originó*; Coatsworth, *Los orígenes*; idem, 'Structures'; Maddison, *World economy*; Salvucci, 'Mexican national income'.

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without closer scrutiny; and extraction—at the macro level—of fiscal surplus by the imperial state does not seem to have been an insurmountable obstacle for long-term pre-industrial economic growth in New Spain.

Our research suggests that Bourbon Mexico's economic history might be interpreted in terms of a positive, if not impressive, sum game with which the imperial state managed to trigger mining-led growth in order to increase the extraction of tax surplus from the Viceroyalty. First, the *Insurgencia*, and finally, independence disrupted mining-led growth, as mining output stayed for decades well below late colonial levels. In independent Mexico no other engine of growth could be found. The political instability of the postcolonial period is probably the main explanation for this. Thus, contrary to Coatsworth, we claim that independence itself turned out to be costly from the economic viewpoint in spite of its potential or effective benefits.

From our work, it is possible to infer that modern Mexican comparative economic backwardness is not rooted in the last century of Spanish rule but in the 'lost decades' after the *Insurgencia* and independence. Besides, as has been pointed out by Bulmer-Thomas, independence, in spite of the benefits that it rendered, brought about specific, significant costs as well.[135] This conclusion is consistent with that of Prados de la Escosura, in whose opinion independence brought about costs as well as benefits, since the imperial state provided law and order and defence at a lower cost.[136] This is not surprising. Prados de la Escosura and Bates, Coatsworth, and Williamson show that independence from colonial rule in Latin America in the nineteenth century and in Africa, more than a hundred years later, was a costly business in economic terms, at least for several decades.[137]

Universidad Complutense de Madrid; Universidad de la Laguna

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[135] Bulmer-Thomas, *Economic history*.
[136] Prados de la Escosura, 'Economic consequences'.
[137] Ibid.; Bates, Coatsworth, and Williamson, 'Lost decades'.

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APPENDIX: ORDINARY INCOME OF THE CROWN IN NEW SPAIN, 1714–1805 (CURRENT PESOS)

Year	*Ordincome1*	*Ordincome2*	*Year*	*Ordincome1*	*Ordincome2*
1714	3,703,452	2,292,831	1760	6,819,070	3,339,099
1715	2,856,978	1,421,595	1761	6,968,832	3,293,051
1716	3,105,563	1,757,123	1762	6,162,782	3,222,923
1717	3,409,220	1,692,327	1763	5,721,540	2,707,264
1718	4,446,605	2,876,615	1764	5,829,995	2,691,032
1719	4,098,596	2,471,700	1765	6,186,336	2,977,277
1720	3,676,122	2,241,961	1766	6,466,673	3,448,302
1721	3,722,895	2,125,847	1767	6,862,163	3,355,824
1722	3,445,552	2,057,878	1768	6,615,656	3,506,718
1723	3,777,977	2,026,177	1769	7,327,307	3,893,292
1724	3,798,890	2,117,128	1770	8,103,132	4,267,544
1725	3,072,171	1,716,844	1771	7,727,851	3,696,789
1726	5,004,201	2,777,136	1772	7,338,095	3,877,220
1727	4,365,972	2,292,261	1773	10,170,287	4,706,341
1728	4,457,877	1,977,541	1774	8,808,780	4,678,566
1729	4,040,165	1,804,261	1775	9,468,590	5,062,455
1730	5,006,300	2,329,690	1776	10,097,034	4,923,392
1731	4,843,047	2,304,322	1777	10,569,824	5,547,570
1732	4,488,476	2,495,771	1778	11,427,756	6,675,715
1733	5,614,717	2,374,629	1779	10,445,447	6,517,270
1734	4,923,519	2,426,310	1780	11,434,007	5,618,745
1735	5,305,722	2,852,301	1781	15,970,785	11,542,664

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APPENDIX: *Continued*

Year	*Ordincome1*	*Ordincome2*	*Year*	*Ordincome1*	*Ordincome2*
1736	4,980,212	2,019,881	1782	14,517,418	11,038,554
1737	4,645,812	2,227,240	1783	16,860,552	10,672,144
1738	4,679,803	1,949,095	1784	14,505,921	9,923,288
1739	3,920,664	1,929,225	1785	18,460,515	13,107,643
1740	4,598,539	2,154,333	1786	17,277,339	13,476,625
1741	4,914,055	2,172,530	1787	24,660,262	19,316,774
1742	4,970,155	2,417,165	1788	14,516,671	10,124,004
1743	6,007,859	3,491,725	1789	16,195,470	11,714,951
1744	5,844,793	2,998,850	1790	15,959,770	11,030,151
1745	5,402,020	2,293,603	1791	14,830,905	9,576,560
1746	5,892,724	2,766,413	1792	16,182,845	10,352,537
1747	5,443,578	2,637,504	1793	16,959,301	11,153,376
1748	5,788,017	2,738,702	1794	17,645,888	12,239,238
1749	5,738,532	2,483,098	1795	13,238,552	9,703,031
1750	6,544,787	3,027,957	1796	15,608,810	11,353,827
1751	5,978,714	2,979,844	1797	24,030,568	19,632,464
1752	5,941,823	2,449,661	1798	25,301,900	22,054,698
1753	6,701,299	3,390,907	1799	17,655,743	14,561,609
1754	6,821,470	3,822,957	1800	13,765,623	11,745,608
1755	6,935,702	3,803,276	1801	14,530,702	12,955,224
1756	6,805,008	3,467,388	1802	21,888,864	16,314,214
1757	6,396,426	3,102,062	1803	14,805,536	11,695,165
1758	7,002,236	3,687,895	1804	18,934,199	12,799,268
1759	7,325,600	3,771,919	1805	15,026,654	11,717,580

Notes: ORDINCOME1 = Total income—loans—temporary deposits—double accounting between Treasuries—extraordinary and miscellaneous receipts.
ORDINCOM2 = *ORDINCOME1*—taxes on mining production and minting—mercury sales.
Source: TePaske and Klein, *Ingresos y egresos*.

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