

*The Bolivian Tin Mining Industry
in the
First Half of the Twentieth Century*

Manuel E Contreras

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The errors that persist are my exclusive responsibility.

The Bolivian Tin Mining Industry in the First Half of the 20th Century

Introduction

Tin was known since pre-colonial days and has been mined since about the beginning of the 17th century. In his *Relación de Oruro* (1608), Phelipe de Godoy comments on tin mining, and Alvaro Alonso Barba in *Arte de los Metales* (1640) reports that tin was worked in Carabuco, Chayanta, and Colquiri. According to the British envoy Joseph B. Pentland, there was a regular exploitation in Oruro in the early 19th century, and tin was exported to the United States, France and England. In that period the main use of tin was as an alloy for the manufacture of brass.

While Bolivia entered independence with a tin industry, it was not until the 20th century that tin ruled the economy. In the words of Sergio Almaraz: '[In Bolivia] the 20th century arrived on the shoulders of tin mining'.¹ The growth of the tin plate industry and the use of tin in wire coating for the expanding electrical industry, caused the demand for tin ores to increase significantly, and tin became the most precious and scarce of all common metals.

In this paper, I will outline the development of the Bolivian tin industry from the middle of the 19th century to the nationalisation of the main mines in 1952. I shall concentrate on the changes in the international and domestic economy that enabled this development, analysing the performance of the major mining companies and the impact of the tin mining industry on Bolivian economic development.

The whole issue of tin mining and the role it played in the social, political and economic development of Bolivia has been highly mythologised, in part as a result of the importance of tin mining in the country's history, and in part due to the incipient development of historiography in Bolivia. In this essay, I will review the current state of scholarship on the subject. Since there exists no serious study of the political influence of the mining industry, I will not address this important subject here. Instead, I will concentrate on the economic and technical aspects of the development of the tin mining industry, based on both the main secondary sources and archival material, particularly that derived from the Patiño Mines Archive in El Alto and the US National Archives in Washington, DC. At the same time, the sheer economic importance of tin requires an appraisal of the relationship between the state and the mining industry, undertaken here principally through an analysis of

fiscal policy implementation and of the contribution of resources from the tin mining industry to the state and to the economy at large.

From the mid-19th century to the First World War

Until 1850, Bolivian participation in the international market was limited by several factors. Internally, transportation difficulties were a major obstacle; externally, the quality of the Bolivian mineral ores imposed limits to its participation, and the structure of the market was by itself unfavourable.²

From the mid-1850s, increases in tin consumption associated with the growing use of tin plate, particularly in cans, caused long term price rises as production failed to respond with sufficient speed. As a result, during the second half of the 19th century, interest in Bolivian production increased. Furthermore, improvements in smelting technology enabled the refining of Bolivian ores in Great Britain, a country that increasingly depended on Bolivian production. German smelters also took an interest in Bolivian ore, and built a foundry in 1891 for its treatment. As a consequence of these changes in the international market the five-year average metallic tin export increased more than ten-fold between 1850-54 and 1895-99 (from 795 to 7,541 long tons) and the export of tin mineral ores (concentrates) rose by a factor of thirty-six (from 870 to 23,150 fine long tons).³

This response of the industry to the market stimulus relied largely on the material infrastructure and human resources developed during the silver mining period which preceded that of tin mining. Silver mining had trained technicians and qualified labour, and gave rise to a group of 'entrepreneurs' with mining, commercial and technical knowledge who performed as the pioneers of the tin mining industry. The transition from silver to tin, however, was not as easy or automatic as has been suggested. John Hillman has estimated that tin production was 9,000 fine long tons in 1899 and that only about 40 percent came from sources closely linked to the silver production. However, he points out that most of the remainder was being produced by people formerly associated with the silver mining industry.⁴

The last major obstacle to the expansion of the industry was cleared with the inauguration of the Oruro-Antofagasta railroad in 1892. Railroad transport eliminated the limitations imposed on exports by pack-animal transportation, reduced transportation costs (particularly improving traffic regularity and reducing travel time, more than in actual freight reductions), and expedited the import of machinery.

In the first decades of the 20th century, the growth of Bolivian production was spectacular. As a direct response to price and demand increases,⁵ production – measured by exports (no production figures are available) – more than doubled between 1900 and 1910 (from 9,740 fine MT to 22,885 fine MT); in the next decade it increased a further 30 percent, reaching 28,230 fine MT (see Graph 1). As a result Bolivian production rose from 12 percent of world supply in 1900 to 20 percent in 1910.⁶ Likewise, the importance of tin in the Bolivian economy increased significantly. Tin exports increased from 40 percent of the total value of exports in 1900 to 60 percent in 1905, and this level was maintained till the twenties when tin exports represented 70 percent of the total value of exports (see Graph 2).

This rapid expansion of production – at an annual growth rate of 5.9 percent (Table 1) – is only explained by developments in the tin mining industry in the 19th century and the richness of the deposits, which, at least in the first stage, could be readily exploited. Although Bolivian tin deposits were underground hard rock, high tin contents enabled certain ores to be hand-picked. This material, known as *guía*, was bagged in the mines and exported with assays of 60 percent fine tin content. The tin mining industry was not, however, exempt from problems, particularly inland transport difficulties, high fuel costs, and labour shortage.⁷

Transportation problems were partially solved by the Liberal Party's policy of railroad construction that speeded up transport from the mining areas to the Pacific Ocean. The completion of the Guaqui-La Paz railway in 1905, the Rio Mulatos-Potosí railway in 1912, the Oruro-Viacha line in 1913 (which reached La Paz in 1917), the Uyuni-Atocha railway in 1913, and, finally, the Arica-La Paz railway also in 1913, all increased the Bolivian economy's links with abroad.⁸ However, difficulties persisted with communications between the production centres and the railways, and often the costs incurred over this stretch were higher than the railway freight to the port. This transport (mine-railway) was irregular and subject both to the rainy season (which made crossing rivers difficult) and to the drought season (which reduced forage availability for the animals) so it became common to store ores in the mine. Transport from the mine to the mill also experienced the limitations and mishaps associated with the use of mules, donkeys and llamas. It is within this context that we must view the concern of the dynamic entrepreneur Simón Patiño to 'free himself' from transport by pack animal. In 1904, he installed an aerial rope way to move his mineral from the mine to the mill, and in 1911 he began a project to construct the Machacamarca-Uncía railroad to link his mines with the railroad trunk network. The railway was completed in 1921 at a cost of \$5 million.⁹

An inadequate supply of native fuel (in terms of both quantity and heating power) and the high cost of coal, were both partially accountable for the high railroad transportation costs. The scarcity of native coal and the high cost of

the imported product, were key elements in ending tin smelting in Bolivia. To smelt tin of adequate quality and at a competitive cost in the 20th century, reverberatory furnaces were required, something not feasible without a source of cheap power. In mines distant from the railway where the cost of coal was prohibitive, *yareta* (a local shrub) or dry llama dung were used as fuel, but their low caloric value limited their use to heating water for steam generation and calcination. Forging required coal. Diesel oil (also imported) was required to generate electric power for the mills, and it was not until 1916 that hydroelectric power was generated in Catavi.

Labour shortage was a problem of longer duration. The initial rapid growth of mining demanded a larger labour-force than was immediately available. Moreover, the expansion of tin mining had to compete for labour with railroad construction in Bolivia and the Chilean nitrate industry. The irregular provision of labour – which was also subject to the agricultural cycle – was undoubtedly an important element for the early mechanisation of many mines during the 1912-1915 period, when air drills were introduced, alongside machinery to replace the handling of the ore. The majority of mines were located at great altitudes and the very harsh working conditions in mines clearly acted as a disincentive for the potential labour force.¹⁰

There was also a notable shortage of technical and administrative personnel. This was initially resolved by bringing in foreigners, the training of mining engineers within the country only starting in 1917 in the Escuela Nacional de Ingeniería in Oruro, with expansion in 1937 to the University of Potosí. This enabled a gradual replacement of foreign engineers by Bolivian engineers trained locally and abroad throughout the first half of the century. In Patiño Mines, for example, Bolivian engineers increased from 16 percent of the total corps in 1937 to 48 percent in 1941. Nevertheless, the mining demand for engineers could not be entirely met by Bolivians and foreigners were employed even after nationalisation, especially in senior technical and administrative positions.¹¹

I estimate that the number of people employed in tin mining quadrupled from 1900 to 1907, increasing from 3,000 to 12,700 as a result of the boom in that period, when both the number of mines in production and employment in mines already producing increased. After 1907, the increase in labour employed was more gradual, reaching about 15,000 people in 1910 and 17,000 in 1925. It is exceptionally difficult to reach a reliable estimate of the total number of people employed by the tin mining industry thereafter, but an indirect indicator is the variation in employment in the whole mining industry (tin and other minerals) and in the major company, Patiño Mines (see table 2). When considering these figures, however, one should not lose sight of the seasonal character of most of this labour. This gave rise to a permanent and specialised labour force (drill hands and mechanics), and a temporary,

non-specialised one, employed in opening new galleries and in the portage of ore.

In this early period (1900-1915), production methods were primitive and not very different from those used in the 18th and 19th centuries. With very few exceptions, exploitation was unsystematic; there were no geological maps and production was undertaken without previous planning, exploiting only the richest and most accessible veins, with the least possible capital and until the mineral deposit deteriorated, before moving on to a new one. The very wealth of the tin deposits allowed this type of work. In sharp contrast, in the silver mining industry, where deposits were poorer, prices lower and companies established for longer, exploitation was carried out in a markedly more rational and scientific manner. In tin mining the use of machinery was minimal: in 1900 only Huanuni had steam machinery. The increase in prices, the arrival of railroads, and the greater availability of capital, expedited the large scale import of machinery and concentration mills starting in 1908.¹²

The main source of capital for the mining industry at the beginning was from traders in the form of advance payments on future production or credit on mining supplies. But these modest sums could only meet short term capital demand. Since the participation of local banking was marginal, investment capital was necessarily sought abroad. After 1906 (when the Peace Treaty with Chile was signed, fixing disputed national frontiers) there was significant inflow of Chilean capital as more companies were floated in the Santiago Stock Exchange. The principal Chilean purchase was that in 1906 of the Llallagua mine, the richest in Bolivia. In 1912 Chilean investment in Bolivian mines amounted to £2.6 million. By 1913, foreign capital investment exceeded £10 million and was mostly Chilean, British, and, to a lesser degree, US in origin.¹³

Capitalisation of the mining industry facilitated the emergence of production in a group of 'modern' companies characterised by their greater mechanisation of both mining and concentration, their more developed administrative organisation, their access to greater working capital, and by their direct marketing of ores. This group – comprised of the Aramayo Francke Mines Ltd (registered in London in 1906), the Compañía Estañífera de Llallagua (registered in Santiago, Chile, in 1906), the Patiño Group (Compañía Minera La Salvadora, Empresa Minera Huanuni, Compañía Uncía, and others), and the Compañía Minera y Agrícola Oploca de Bolivia (registered in Santiago, Chile, in 1906) – accounted for 55 percent of total national production in 1912 and by 1917 had exceeded 65 percent.¹⁴

Except during the 1907 crisis, which caused the closure of several small mines and provoked unemployment across the industry, the pre-war period was distinctly favourable for Bolivian tin mining: both prices and demand continued to increase. However, when the London Metal Exchange closed

(August, 1914) at the outbreak of World War One, the industry suffered the effects of the fall in prices and demand until mid-1915; many mines were closed and wages (hitherto in ascent) were depressed. Moreover, unemployment spread as the construction of railroads was paralysed and work in the Chilean nitrate mines decreased. The mining crisis rebounded on commercial activity, which was in turn affected by a severe credit restraint. The decrease in mining production and exports led to a shortage of drafts on London (foreign exchange in pounds sterling) and so caused a considerable drop in imports. This had a negative effect on fiscal income, since taxes on imports (as a percentage of total value) were five times higher than the tax rate on exports. To cover the deficits, in view of the impossibility of increasing the taxes on the mining industry, the Government requested advances from exporters in the form of *Vales de Aduana* for Bs.10,250,000. To overcome the shortage of foreign exchange, the government issued a law requiring exporters to deliver 10 percent of the value of their exports in drafts to the Banco de la Nación.¹⁵

The war-related depression affected the modern companies differently. These had already secured a financial stability that allowed them to stop their production – as in Aramayo Francke – or reduce it – as in Oploca – and concentrate their efforts in development operations, while processing their tailings to keep their mills running and their skilled labour employed (unskilled labour was made redundant). Once the market opened again, these companies resumed exporting, benefiting from the higher prices, and in addition selling both their accumulated stocks and new production.¹⁶

An important effect of the war was the change in the destination of Bolivian foreign trade. Before the war, most imports and exports had been to and from Europe, particularly Britain. The war made trading with Europe difficult and increased interest in the USA in establishing foundries of their own and buying tin mineral ores directly from Bolivia despite British opposition. Three foundries were built in the USA, the most important by American Smelting and Refining Co. (ASR) with 8,000 short ton capacity. ASR ensured the supply of Bolivian mineral ores by offering the mining companies attractive advance payments that helped to reactivate the mining industry in 1916. US interests also attempted to control ore production by offering to buy several established companies. Rubber, antimony, wolfram and other ores were now exported to the USA. By providing the local market with drafts on New York (foreign currency in dollars) rather than on London (because of restraints on trade with Europe), these exports enabled the importation of US products. Trade between the USA and Bolivia was consolidated to such an extent that when smelting of Bolivian ores in the USA was stopped in 1923, other commercial ties were not greatly affected.¹⁷

The war also had effects on the big mining companies. It forced Patiño to abandon his interests in Germany (where he sold his ores) and to develop

them in England, where he invested in the Williams Harvey foundry. On the other hand, Aramayo Francke Mines, originally registered in London in 1906, was forced to change residence and move to Switzerland under the name of Compagnie Aramayo des Mines en Bolivie, due to the high taxes in Great Britain.¹⁸

When the war ended, the over stock of mineral ores in the USA caused a ban on tin imports that lasted until early 1919. This had a particularly adverse effect on the Bolivian industry because 40 percent of total production was now traded in the USA. However, the problem was shortlived, and once overcome, Bolivian tin mining benefited from the brief post-war combination of rising prices and a strong demand.

The 1920s

Having reached an unprecedented level in 1920, tin prices dropped in line with the world economy's business recession, and stocks began to accumulate. This state of affairs caused the implementation of the first price control agreement by the governments of Dutch Indies and Malaya, which by 1922 had accumulated almost 15 percent of the world production in the notable 'Bandoeng Pool'.¹⁹

This was fully evident in Bolivia, particularly in 1921 when tin exports dropped to 19,086 fine MT, after having reached 29,280 fine MT in 1918 (Table 1). As to the effects of the crisis on different sectors of the Bolivian mining industry, the comment of the *Mining Journal* of January 1922, captured the situation succinctly:

Unlike Malaya, the bulk of the Bolivian production is by four large producers, who can afford to contract or expand their production at will, and are not obliged to work harder in bad times to make ends meet.

The publication added that large producers preferred not to deplete their reserves during periods of low prices, but rather take advantage of the occasion to reduce their labour force. It also noted, however, that the small mines were forced to close, while the medium ones increased their production (supposedly they now needed a larger production in order to pay back their advance payments). But 'the main cause of the reduction', the article concluded, 'is the voluntary curtailment of the rich concerns'.²⁰ This comment indicates the new structure of the Bolivian mining industry and of the capacity for survival of the big companies in a time of depression. In this production concentration process a dominant role was played by Simón

Patiño, who had bought the interests of the Irishman John Minchin (the *Compañía Minera de Uncía*) in 1910, those of the British Penny and Duncan, and the *Compañía Minera El Balcón* (also of British capital), to form the *Compañía Minera Huanuni* in 1911.²¹

Once the crisis was over, the period from 1924 to 1928 proved to be one of boom. Bolivian production increased throughout these years reaching an all-time high of 47,191 fine MT in 1929. During the 1920s, Bolivian production came to represent between 18 percent (1921) and 24 percent (1929) of total world production.²² Between 1920 and 1929, exports grew at an annual rate of 5.9 percent, a growth rate similar to that registered in the preceding period (1900-1919; Table 1). This rise is explained by the large investment flow during the first half of the decade. It has been estimated that between 1920 and 1926, investment in tin mining industry amounted to \$27.2 million including investments in both new operations and capitalisation of existing ones. Out of this total, \$12.1 million corresponds to the 1920 investments of the US Guggenheim Bros. in the Caracoles Tin Company of Bolivia.²³ Guggenheim Bros. was also interested in buying other companies, investing almost \$1 million in 70,000 shares of the Aramayo Company after several unsuccessful attempts to reach an agreement with Carlos Victor Aramayo to buy 50 percent of his shares.²⁴ In 1928, Guggenheim Bros. obtained an administration contract from Aramayo in exchange for a share in profits. However, this contract only lasted until 1933 when Aramayo took advantage of the tin crisis and the heavy losses in Caracoles to buy this mine from Guggenheim.²⁵

The continuous growth of tin mining increased the importance of the industry for the national economy. In the second half of the 1920s, the value of tin exports reached its highest level, surpassing 70 percent of the total value of exports (Graph 2). The primary measurement for quantifying the contribution of the mining industry to the economy has always been the taxes paid by the mining industry to the government. However, we should not lose sight of the significant regional impact exercised by mining activity by creating a demand for domestic consumer goods (promoting manufacturing and agriculture) as well as for imported goods that, when entering the country, paid import taxes and gave rise to a strong import sector. An example of this may be seen in the urban, commercial and financial development of Oruro, described in 1912 by a French observer as the 'home of industrial and commercial progress', with nine banks, two agencies and several factories and commercial premises.²⁶ The effect of the mining industry on the rural areas still remains to be studied, particularly in terms of its role in introducing a commercial/cash economy to the peasantry. There is no doubt, however, that the mining industry was not the great 'engine of growth' of Bolivian development that it could have been. The reason for this is beyond the purpose of this paper; but we should register two factors of clear relevance: (i) governmental incapability to extract higher taxes from the

mining industry, particularly during the first decades, together with the inefficient use of that income which was generated; and (ii) the factor that the major mining companies, after obtaining large profits, did not invest in the country.²⁷

The classic indicator for quantifying the contribution of the mining industry to the national economy has been the percentage obtained by dividing the overall amount the mining companies paid in export tax by the total value of mining exports. This percentage increased from a decennial average of 2.7 percent in the first decade up to 4 percent in the second one, reaching 9.2 percent in the 1920s.²⁸ However if we consider not only total taxes paid but also company profits, the figure rises appreciably, in the case of 1925, for example, from 9.1 to 17.7 percent.²⁹ Likewise, the value of export duties paid on tin as a percentage of total fiscal income increased from an average of 6 percent for the five-year period between 1901-04 up to 22 percent for the 1916-20 quinquennium (see Graph 2).

Until the early 1920s the main tax on mining was the export tax, with a sliding scale based on international prices. In 1920, general fiscal difficulties encouraged the government to introduce the first profit tax into the statute book. But it was not until 1923 that a serious profit tax was levied in practice, in order to cover the financial obligations of the 'Nicolaus' loan, contracted in 1922 to refinance the public debt (including the *Vales de Aduana* of 1915 and 1916) by the Bautista Saavedra administration (1921-1925). The new law of 1923 specified the amounts that could be deducted to establish the profit and so overcame one of the central shortcomings of the previous legislation. This improvement plus the existence of a suitable agency for collecting the taxes (the Comisión Fiscal Permanente, created to control the 1922 loan) were important elements in the significant increase in taxation on the mining industry (the percentage of total taxes on export and on profits relative to the value of exports rose from 7.4 percent in 1923 to 15.6 percent in 1924).³⁰ According to Gómez D' Angelo, this decade more than any other distinguishes itself precisely because the taxation system proved capable of extracting a significant portion of any increase in the value of mining production.³¹ However, from the 1920s the relative importance of tin export duties on total national income began to decrease (see Graph 2), as resources from the profit tax and foreign currency control (from the 1930s onwards) became the preferred mechanisms by which the government obtained resources from the tin mining industry.

The comparative importance of the different taxes paid by the mining industry and the greater absolute amount of resources 'extracted' from the industry by the state in the 1940s are well illustrated in Table 3. Based on Patiño Mines data, this shows that export taxes accounted for 50 percent of the total taxes paid in the 1920s and profit taxes 30 percent. The relative significance of both taxes dropped significantly in the second half of the

1930s when exchange difference taxes accounted for over 50 percent of total taxes. This reinforces my point that export taxes are but a poor proxy indicator of the mining industry's contribution to fiscal resources, whose significance drops significantly after the 1920s.

As might be expected, the mining industry opposed these measures. Precisely when a new tax increase was imminent, Patiño took advantage of the lack of state funds to complete the Sucre-Potosí railroad, the conclusion of which was the subject of much regional pressure. He extended a £600,000 loan to the Saavedra administration under the condition that taxes on the mining industry would not be further increased for five years.³²

Patiño had offered the loan to the government for the first time on 6 August, 1924, after buying the *Compañía Estañífera de Llallagua* from Chilean interests and registering Patiño Mines and Enterprises Consolidated, Inc. (formed by the merger of the *Compañía Estañífera de Llallagua*, *Compañía Minera La Salvadora* and the *Machacamarca-Uncía Railroad*) in Delaware, USA. This acquisition completed a share purchasing process in the *Compañía Estañífera de Llallagua* started in 1914 through the British firm Duncan Fox and afterwards through the Anglo-South American Bank. The purchase of the *Compañía Estañífera de Llallagua* – the main tin producer – and the further establishment of Patiño Mines in the USA are without doubt two landmarks in the development not only of the tin mining industry but also of Bolivian capitalism in general. Patiño has been the sole Bolivian capitalist (and one of the few from any peripheral country) who succeeded in forming an authentic transnational company (with interests in four continents and over five countries) from a base in his own country. It is, then, worth considering some of the factors in this accomplishment.

To understand the creation of the 'Empire', we must consider not only the characteristics of the environment in which Patiño developed his mining interests and those of the tin market, but also Patiño's skills as a businessman. The consolidation and initial expansion of Patiño's interests must be seen in the context of Bolivian political instability, economic underdevelopment and geographic isolation, all of which limited the influence of foreign investors and so gave his enterprise a valuable initial independence. This independence was reinforced by the extraordinary wealth of La Salvadora. The nature and condition of the market also provided two key advantages: (i) concentration of tin production and consumption in few countries, and a market centralised in London, making its control easier than that of other metals;³³ and (ii) the virtually constant rise in price and consumption during the first three decades of the century.³⁴ These are undeniably critical factors, but it would be hard to disagree with Herbert Klein when he states that without the 'extraordinary skill and administrative foresight', and the early and intensive investment in 'expert engineers and foreign administrators, in the best modern machinery, and in expensive

transportation systems... [Patiño] would never have come to create the wealth he created'.³⁵ Finally, the decision to establish Patiño Mines in the USA reflects Patiño's foresight that proximity to the main financial and stock-market centres was vital for the future of his empire. It is worth emphasising that, whilst the 'modernity' of Patiño's enterprise was in many aspects shared by the other two big groups, the companies of Aramayo and Hochschild – there were fundamental differences. Aramayo's origins dated to the silver mining industry of the 19th century, and he had immediate access to foreign capital by establishing Aramayo Francke Mines in London, in 1906. Hochschild, on the other hand – besides being a European Jewish immigrant – became involved in mining exploitation proper, through the commercial sector (trading minerals and financing existing companies and then administering others). Moreover, Hochschild had an important comparative advantage: he had close contacts with an influential German metal firm, Metallgesellschaft, and had extensive trading experience before coming to Bolivia.³⁶

Since 1925, the voice and the interests of the big mining industry was channeled through the Asociación de Industriales Mineros, which grouped the main mining companies and mineral traders and had as its main purpose the defence of the interests of the mining industry.³⁷ The Asociación was a constant opponent of the Comisión Fiscal Permanente because the latter exhaustively reviewed the books of mining companies and succeeded in collecting significant amounts from many of them in back taxes. To recover these taxes the Comisión went so far as to appeal to the Supreme Court in Sucre, where in 1926 it obtained favourable judgment on two debit notes drawn two years earlier against the Patiño interests and the Chilean Compañía Estañífera Llallagua, obliging both companies to pay Bs.1.4 million, equivalent to half a million dollars.³⁸

The formation of the Asociación was possibly also a response to growing labour organisation in the mines and the introduction in the country of the first labour laws. By 1925 there had been a series of strikes in the major mines and labour unions were established in most enterprises. The 8 hour work day had been legislated and there now existed quite extensive rules and regulations regarding working conditions including the provision of medical services, and initial steps had been taken ensuring mine safety.³⁹ In 1925 a new Mining Code was enacted that provided significant improvements in labour safety legislation, increased state control over mining concessions, and defined them in more detail in order to reduce one of the greatest causes for litigation in the industry.⁴⁰ The establishment of the Asociación reflects both the institutional development of the mining industry and its reaction to the progressive intervention of the government.

By 1929, the main mining companies accounted for 77 percent of total exports, and Patiño Mines alone was responsible for 46 percent of total

exports.⁴¹ Since the formation of Patiño Mines in 1924 there had been a significant increase in the combined production of Llallagua and La Salvadora (from 16,480 fine long tons in 1923 to 20,926 fine long tons in 1929) based on investment in new mining and milling machinery and the introduction of a new management.⁴² These improvements were to be tested in the depression that ensued in the thirties.

The Great Depression and Tin Control

The price of tin started to decline in 1928 due to an oversupply of ore, a situation that motivated producers to form the Association of Tin Producers in London, in July 1929, for the purpose of voluntarily restricting the 1930 production. The crash of the New York Stock Exchange in October 1929 and the beginning of the depression in the USA immediately affected tin, reducing its consumption by 11 percent in 1930. This fact, in addition to the ineffectiveness of the voluntary restriction of production, forced producers to search for a production quota regime at the country level with an inter-governmental agreement implementing the system of quotas. The scheme took shape in the First International Tin Agreement which lasted from 1931 to 1933. This was followed by the Second Agreement (1934-1936) and the Third Agreement (1937-1941), all of which were administered by the International Tin Council (ITC). The main objective of these agreements was to 'assure a fair and reasonable balance between production and consumption' and to prevent 'fast and severe oscillations in price...' This was to be achieved through the implementation of production quotas. Tin accumulation in a Buffer Stock designed to control price oscillations was begun in the Second Agreement. However, during the operation of these agreements some members, with the consent of the Council, carried out private stock accumulation operations.⁴³

Consumption continued to decrease in 1931 (by 13 percent), reaching its minimum level in 1932 with a contraction of 25 percent. Production also decreased: 9 percent in 1930, 20 percent in 1931, and almost 33 percent in 1932. From then on, a gradual recovery began to take place and in 1935 consumption increased by 19 percent, rising by 7 percent in 1936 and 21 percent in 1937. Controlled production grew even faster: 37 percent in 1934, 15 percent in 1935, 31 percent in 1936, and 14 percent in 1937. Finally, prices began their recovery in 1932, increasing, though in an irregular fashion, by 78 percent between 1932 and 1937.⁴⁴

On the domestic front, the depression caused the closing of many mines, unemployment and great difficulties for the government because the mining industry was the primary source of foreign exchange.⁴⁵ From 1930 to 1939,

tin exports decreased at an annual rate of 3.6 percent, reaching their lowest level in 1933 when 14,957 fine MT were exported (Table 1), a level similar to that of 1901-03. In 1937 Bolivian production dropped to 12 percent of world production (its lowest level since 1904), and ended the decade with 17 percent of world production in 1939.⁴⁶

By late 1929, mining interests had demanded a rebate in railroad freight and the liberty to readjust wages. In 1930 the Asociación de Industriales Mineros formally requested from the government: non-intervention of the state in setting wages; reduction in railroad freight for ore exports and imported materials (such as gasoline, petroleum and dynamite); the creation of a Caja de Seguros e Indemnizaciones to relieve the companies of social security obligations; and a devaluation of currency. The Asociación was fearful of the social consequences of worker lay-offs. President Hernando Siles (1926-1930) had committed his support for these measures, but could not meet his promises because he was overthrown in July 1930 by a Military Junta.⁴⁷

The Depression imposed changes in the country's fiscal and monetary policy. In 1931, after Britain abandoned the gold standard, Bolivia did likewise and stopped payments on its external debt. The government now had to set the rate of exchange and, being unable to resort to foreign credit, needed to find new ways of solving its constant budget deficits. In both cases the tin industry played a preeminent role and its behaviour became the subject of public scrutiny. In the setting of the exchange rate for the pound sterling, the mine-owners had to confront the interests of importers, who wanted to maintain the exchange rate and lobbied hard for an adequate supply of foreign exchange. The mining interests, on the other hand, urgently required a devaluation in order to lower their local costs and were obviously opposed to foreign exchange control. This confrontation alienated the big mining companies – Patiño, Hochschild and Aramayo – from the interests of the commercial import sector.⁴⁸

Perhaps one of the most important effects of the Depression was greater government participation in the mining industry in general, principally through the allocation and enforcement of export quotas. The distribution of these quotas, in turn, required the institutionalisation of the small mining industry in Cámaras Departamentales and, thereafter, of the medium mining industry in the Asociación Nacional de Mineros Medianos established in 1939.⁴⁹ Quota distribution caused tensions both among the big mining companies (Patiño, Hochschild and Aramayo) as well as between them and the medium and small mining enterprises. When the disputes were aired in the national press, the apparent cohesion of the mining sector broke down both before the government and public opinion. Moreover, these public controversies allowed the middle class to become more conscious of the

strategic importance of mining to the country and more sensitive to the confrontations between state and mining interests.

In 1909 a Department of Mining had been established in the Ministry of Industry. Its main responsibility was to gather information from the mining industry such as production statistics and costs, but most of its efforts were dedicated to surveying and establishing mining concessions. It was not until the administration of Colonel David Toro (1936-37) that a Ministry of Mining and Petroleum was set up, in 1937, and the main part of the export quota distribution, which was considered a financial matter, was handled through the Ministry of Finance.

The internal distribution of export quotas between 1931-35 was based on 1929 production capacity. That is, the tonnage exported in 1929 by each group or company was taken as base figure on which the percentage of restriction imposed by the ITC was calculated. During 1938-39, the government used 1937 production capacities as the base year. Export quotas were distributed by the government to each mining group within the large mining industry; to each company in the medium mining companies (producing more than 60 fine MT/year but less than Patiño, Hochschild and Aramayo), and to the departmental Chamber of Mining in the small mining industry.⁵⁰

After closing the high-cost Araca and Oploca mines, the Patiño Group only worked in Patiño Mines (Llallagua); the Aramayo Group paralysed workings in Animas, Tasna and Chocaya and only worked in Chorolque; and the Hochschild Group concentrated all their production in Unificada, Potosí. Despite these measures, production restrictions due to export quotas had severe consequences on the big mines. Production in Patiño Mines decreased from 20,800 fine MT in 1929 to 8,000 fine MT in 1932. The general manager reported that over half the mine was paralysed and miners worked only five days per week. They returned to hand-drilling to employ the most labour possible, and the lower levels of the mine were allowed to flood to eliminate pumping expenses. The mill only worked one 8 hour shift, five days a week. Wages were reduced in line with production cut-backs.⁵¹

Beginning in 1933, however, the government reserved its right on 50 percent of any increase in the Bolivian quota. This enabled it to distribute the quota between the different mining sectors in order to offset distortions due to the use of the base year (1929) in the distribution, and/or to export it directly to generate foreign currency.⁵² This latter measure was taken in view of the foreign exchange shortage and the need of covering the considerable expenses stemming from the Chaco War with Paraguay (1932-35). The quota distribution had also been subject to financing contracts entered into between the mining interests and the state. Between 1931 and 1935, financing from the mining industry to the state, in the form of

advances, amounted to £2,690,398, equivalent to 29.5 percent of the total income of the National Budget during that period.⁵³ This finance was distributed as follows:

Patiño Group	77.8%
Hochschild Group	11.7%
Aramayo Group	6.3%
Medium miners	4.2%
Total	100.0%

Often contracts stipulated that the export quota of the Group would be increased or maintained. These advances usually went to cover war expenses, but were also used to stem many economic and political crises.⁵⁴

The internal distribution of quotas was only necessary from 1931 to 1933. Between 1933 and 1937, Bolivia could not meet its export quota, so there was no need to restrict production through export quotas. In the first period (1931-1933), Bolivia exceeded her quota assigned by the ITC as a result of production increases in small and medium sized mines that had started in 1932, when the price began to improve. As a result, in April 1933, the Patiño and Aramayo groups voluntarily handed over part of their quotas to the small mining industry. Between 1934 and 1937, there was under-export because the quota assigned to Bolivia by the ITC was too high relative to her long-run production capacity. There was a labour shortage, and the large mining companies were particularly reluctant to export because of their opposition to the system of mandatory delivery of export drafts.⁵⁵ The share of total export receipts delivered by tin producers to the government increased from 43 percent in 1932 to 52.6 percent in 1934, and fell back somewhat to 47 percent after the Chaco War.⁵⁶ In order to encourage production, which remained the primary foreign exchange source for the state, the government was forced to negotiate contracts with the mining companies. These contracts tied reductions in the percentage of foreign exchange delivery to increases in production.

Production problems in mining were also due to the impoverishment of deposits and to the lack of investment in new concentration processes from the end of the 1920s. In the Llallagua mine (Patiño), the average grade of tin ore reserves (assays of the ore fed to the mill) dropped by 18 percent (from 4.11 to 3.35 percent tin in ore) between 1930 and 1939; and in the Animas mine (Aramayo) by 27 percent (from 6.0 to 4.4 percent) in the same period.⁵⁷ We must also not lose sight of the limitations imposed by an inadequate labour supply, specially the qualified labour that was conscripted into the Armed Forces for the Chaco War. In Patiño Mines, for example, during the first six months of the War, 1,000 workers were drafted, representing almost 50 percent of the labour force employed.⁵⁸ It was not

until 1933 that qualified personnel was exempted from military recruitment, and in 1934 exemption was extended to all personnel employed in the mining industry.⁵⁹ The labour shortage compelled the mining companies to bring miners from Chile and Peru, but these attempts did not produce the expected results: foreign workers did not prove to be efficient, and they caused problems with native miners over wage differentials. For the first time, women were employed inside the mines. At Patiño Mines, women worked inside the mine from 1935 to 1939, and in 1937 a maximum of 313 women were employed within the mine interior while 202 women worked outside the mine.⁶⁰ Labour shortage was also a reason for reducing development work (prospecting and preparation of the mine) because the scarce labour available was deployed in direct exploitation between 1932 and 1935. As a result, when the market improved and export restrictions were lifted, mines such as Llallagua underwent a reserve shortage.⁶¹

Labour scarcity lasted until well after the war. To promote employment in the mining industry, the companies obtained from the government exemption from military service for all those working in the industry and also negotiated an amnesty for those that had not served in the Chaco War and were willing to be employed in the mines. The post-war period was one of strong labour competition among mining companies as well as between these and the public works programmes (particularly on roads) undertaken by the different governments. Roads replaced railways as the main source of competition for labour for the mining industry in the mid-thirties and forties.⁶² This was a period when the industry was obliged to resort to recruitment methods such as *enganche* (conscription) in order to obtain labour. It even attempted to recruit Bolivian labourers in Northern Argentina through this system. *Enganche* labour accounted for over a third of the total labour force in Patiño Mines between 1934 and 1944, and reached its peak in 1938 and 1939 when it represented 58 and 59 percent, respectively.⁶³

The restrictions on production imposed by the quota system restrained new – and often necessary – investment in mining. The only major investments in this period were those by Mauricio Hochschild, who invested approximately two million dollars in the development of Colquiri, the construction of a modern mill and a 2,000 kw hydro-electric plant.⁶⁴ Between 1935 and 1940, annual production increased from 250 to 5,200 fine MT. In the Cerro de Potosí, Empresa Minera Unificada doubled its annual production between 1930 and 1939, reaching 3,288 fine MT, based on investments in new mining properties, mill machinery, and new water sources.⁶⁵ Other factors inhibiting new investment were the diminished availability of foreign exchange (caused by the increase in delivery to the state at the official rate), and the uncertainty provoked by the new post-war nationalism and policies, such as the nationalisation of Standard Oil in 1938, the decree of the German Busch administration (1937-1939) giving the state a 100 percent control of

foreign exchange, and the incursion of the state in ore trading with the creation of Banco Minero in 1936.

While the 1920s saw the development of an efficient taxation system for the mining industry, the 1930s was a decade in which the state succeeded in substantially diminishing the expatriation of mining profits through the mandatory delivery of foreign currency. Moreover, by exchanging the foreign currency delivered by the mining companies at the official (overvalued) rate, the state succeeded in further burdening the mining sector with an additional tax. This implicit tax increased from 12.07 percent of the value of mining exports in 1936 to 16.68 percent in 1938, falling to 13.49 percent in 1939. The effect of the measure was to increase the percentage of total taxes paid by the mining industry to 13.8 percent from an average of 9.2 percent for the previous decade.⁶⁶ In Patiño Mines, exchange difference tax in the second half of the 1930s exceeded both export and profit taxes and accounted for 59 percent of total taxes paid (Table 3). The mining industry also had to bear a loss in its accumulated balances from the devaluation of the boliviano, from Bs.19.55 per pound sterling in 1933 to Bs.141.40 in 1939.

The effect of these measures on the development of the national economy as a whole, however, was not as expected. Large amounts of bolivianos were accumulated in the country without finding any productive investments. The Banco Mercantil, for example, had accumulated £650,000 in current accounts in 1933 and was forced to suspend interest payments on these deposits 'whatever their term or conditions'.⁶⁷ The increase in foreign exchange delivery forced Patiño Mines to accumulate Bs.19 million in 1935 (equivalent to 34 percent of the effective National Budget income or 10 percent of effective expenditure) 'for which no use or safe investment [had] been found'.⁶⁸ Patiño Mines tried several investments with these accumulated balances: (1) investments in mining (2) diversification into other areas, and (3) loans. Mining investment was concentrated in exploration of new mining properties and new minerals, particularly gold, and buying shares in existing mining companies (such as Compañía Minera y Agrícola Oploca de Bolivia). The main diversification efforts consisted of investments in the Chapare region of Cochabamba to develop a timber industry and cattle rearing, to supply the mines with timber for struts and meat (this fell through because of bureaucratic obstacles), and the purchase of the Foundation Company's cement plant in Viacha (La Paz) which also did not materialise because Patiño Mines was unable to reach an agreement on how much of the final price would be paid in hard currency. Patiño Mines did invest in the Crédito Hipotecario and in the newly formed Banco Minero in 1938. The company also purchased a significant portion – Bs. 5.9 millions worth – of the Banco Minero's shares. Finally, loans were made to banks, and other mining companies (such as the Bolivian Tin Corporation) and agricultural enterprises (SAGIC) in which Patiño Mines had interests.⁶⁹

This exceptional 'capital saturation' of the local market clearly requires further study. It provides an idea of the very limited capacity for capital absorption in the Bolivian economy and the perceived 'country risk' by both foreign and local investors. It therefore raises doubts on the axiom – implicit in many studies on pre-nationalisation mining industry – that higher tax on mining industry would produce greater economic development.

The Second World War and nationalisation

The tin market operated under severely controlled conditions through most of the 1940s due to the Second World War. The London Metal Exchange ceased to quote tin in December 1941, when the Japanese entered the war. Until 1949 both the price and the buying and selling of tin were largely controlled by the British government. The market price was therefore not solely determined by demand and supply. The USA also intervened in the market in 1940 buying the ITC tin stocks, and the US government began to negotiate the provision of tin directly with Congo and Bolivia in the following year, playing an active and direct participation in the market.⁷⁰ In light of British and US intervention, there was no need for the ITC to limit the production and/or exercise control on the market. Although a fourth and last agreement (1942-1946) was formally signed under the sponsorship of the ITC, its real function was slight. In the post-war period a new group of countries was formed to control the market, on the expectation there could be a tin surplus. This time the group consisted of both producers and consumers – the ITC was an exclusively producers organisation – and was denominated the International Group for Tin Studies, which operated from 1948 to 1956.⁷¹

During the Second World War the governments of Great Britain and the United States had to compete for the provision of tin ores even more sharply than during World War One. Great Britain did not want to loose its hegemony on the market, and the USA wanted to reduce its dependence on metallic tin provision from Great Britain. Thus, on 4 November 1940, the principal Bolivian producers, with the important exception of Patiño, signed a contract for their total production with the Metal Reserve Company of the USA. This ore was processed in a new smelter that the US government installed in Texas; clearly with the political objective of reducing its dependence on foreign processing, because this foundry was uneconomical. The contract provided for the sale of all of the companies' production, approximately 18,000 fine long tons (about 50 percent of the Bolivian production), at a price of 48 1/2 US dollar cents per pound of contained tin FOB (free on board) US ports. This price was increased to 60 cents FOB Antofagasta and/or Mollendo in 1942; and to 62 and 63 1/2 cents in 1945.⁷² When the war ended,

however, prices were decreased from 63 1/2 cents in late 1945 to 58 1/2 in about the middle of 1946. The Patiño group did not participate in this contract because they already had a contractual agreement with the British smelter, Williams Harvey, to whom they kept selling during the war at prices and conditions similar to those applied to the rest of the Bolivian producers by Metals Reserve.

The similarity of both prices and conditions for the Bolivian ores between the British and US markets, despite the competition between both, reflects the slight probability of Bolivia having lost a major opportunity for obtaining better prices during the war – a view frequently to be found in the traditional historiography. The fact that tin was not a metal used *directly* by the armaments industry enabled the consumer countries to control its demand through prohibitions and substitution. Furthermore, the high level of inventories they managed to accumulate demonstrates that demand was not as essential for the war effort as has been believed.⁷³

Though there was no proper market price, the price negotiated between the producers and the British and US governments rose in the first half of the 1940s. This increase was accompanied by an increase in Bolivian production during the war period. In the second half of the decade, Bolivian production experienced a decline that continued until the 1950s (see Graph 1). Two distinct periods can be distinguished between the years 1940 and 1952: 1940-45, when exports grew at an annual rate of 2.3 percent, and 1946-1952 when they decreased at 2.7 percent (Table 1). During the first period, Bolivian production reached its highest level as a percentage of world production: 49 percent in 1945. In the second half of the forties, the fall in national production and the entrance to the world market of the production from the Asiatic territories (formerly occupied by Japan during the war), meant that Bolivian production returned to pre-war levels of world importance, ending the decade with 21 percent of world production.⁷⁴

Although the war meant that the restrictions on production (previously imposed by the ITC) were cancelled, with a rise in prices and in Bolivian production (see Graph 1), the industry was by no means free of problems. Amongst these were the difficulty in the provision of basic materials, and the increase in freight and insurance costs. However, because of the importance of Bolivian tin for the USA, Washington gave preference to the orders of the mining industry and even froze the prices of certain spare parts and machinery. The rise in freight and insurance costs was also regulated and later absorbed by the Metal Reserve Corporation when the delivery condition for the mineral ore was changed from CIF US ports to FOB Latin American ports. However, these measures only partially alleviated the difficulties which continued throughout the conflict.

The USA also dispatched technical missions during the war to evaluate reserves and improve tin production by introducing new methods and machinery, particularly in ore dressing. The purpose of the mission was to 'do all in its power to get the maximum of tin from Bolivian mines in the shortest possible time as a vitally necessary contribution to the winning of the war by the United States'.⁷⁵ While the effect of these missions on the productivity of the Bolivian mining industry as a whole is not clear, they certainly secured some improvements in concentration methods with the introduction of better machinery (Sullivan concentration tables) to recover tin from the tailings, which had previously been impossible.⁷⁶ The US government also provided capital in form of soft loans through the Metals Reserve Corporation to several medium-sized and small mining companies in order to increase production. A \$365,000 advance was made for the development and operation of the 'Santa Teresa Placer' which did not meet expectations. The Bolivian International Mining Corporation also received an advance of \$150,000 to rehabilitate its dredge in 1944.⁷⁷ A Mining Development Fund was established.⁷⁸ Independently of the US efforts, the tin mining industry successfully introduced new processes such as the sink and float preconcentration system and attempted, this time unsuccessfully, to introduce volatilisation for the treatment of low grade ore with Hochschild's Tainton plant.

The introduction of the sink and float preconcentration process enabled the grade of the ore fed to the mill to be improved and the process of manual selection, traditionally performed by *palliris* (women hand-sorters), was mechanised, in 1943 at Colquiri and in 1945 (with an investment of approximately \$600,000) in Catavi (the Llallagua mill).⁷⁹ Additionally, new mining methods were introduced for mass ore exploitation by block caving enabling the working on lower grade sectors. Sink and float was also adopted by Empresa Minera Unificada in 1948.⁸⁰ The attempt to volatilise low grade tin was a product of years of research by U.C. Tainton in Baltimore, financed by Hochschild. After satisfactory laboratory tests, Tainton proposed the installation of a pilot plant for 250 daily tons, which started operations in 1944. (It is estimated that the investment in the development of this project and the construction of the plant exceeded one million dollars). The causes for the failure of this plant are not fully evident but everything seems to show that the altitude was the cause of the failure to reproduce the US laboratory results in Potosí.⁸¹ In addition to their experiments with the sink and float plants and Tainton process the principal tin groups – Patiño and Hochschild – were also carrying out research on methods for improving concentration, in important laboratories (Batelle) and universities (Massachusetts Institute of Technology) in the USA.⁸² That is to say, they were still investing in new technologies and plants in the country, at least up to the first half of the 1940s. Indeed, investment in mining as a whole (measured by the yearly average value of mining capital goods imported) had been significant during the period 1940-44, equalling for the first time the level reached in the

five-year period preceding the Great Depression, which was identified as one of high investment in mining industry.⁸³

Once the war ended, Bolivian production began to fall. The inability of the tin mining industry to respond to the post-war price increase for the first time in fifty years (see Graph 1) was due to several factors. Among these the most important were the impoverishment of deposits, high tax rates, foreign exchange controls, and constant increase in cost. But while these were immediate causes, political instability, radicalisation of the labour movement and a growing nationalism (Gualberto Villarroel administration, 1943-46) dissuaded the main companies from making significant new investments. The annual average value of capital goods imported for the mining industry fell slightly (3 percent) between the first and second half of the forties. Further, the spectre of a possible nationalisation was already present in the minds of the companies.

The impoverishment of deposits was not a new phenomenon in tin mining industry, but rather a constant process. It has been noted above that the ore grades in Patiño Mines fell by 18 percent in the 1930s, and by 27 percent in the mines of Aramayo. In the 1940s there was an even greater decline: in Patiño Mines ore head grade dropped 26 percent (from 3.07 percent in 1940 to 2.27 in 1949); the drop was even more pronounced in the Aramayo mines where between 1944 and 1949 alone average ore grades decreased by a full 48 percent (from averages of 4.09 percent in 1944 to 1.95 percent in 1949).⁸⁴ Any notable decay in grade requires that the quantity of ore extracted from the mine must be increased in order to maintain the production level. The increase in the volume of extracted and treated material, however, required higher investments in machinery both within the mine itself and in the mill and, obviously, led to higher production costs per fine pound. In the existing climate of uncertainty – in terms of the tin market because of the end of the war and with respect to national politics for the reasons already mentioned – investments were not being made. Another reason for the lack of investment was the fall in profit margins, due in good measure to progressively rising production costs and taxes. In the forties Patiño Mines was paying over twice the amount of taxes than in the second half of the 1920s. Total annual taxes paid increased from an average of £415,100 for the period 1924-29 to an annual average of £1,116,500 in the first half of the 1940s and £1,231,300 in the second half (Table 3). There is a perceptible correspondence between these figures and the fact that the average annual profits for Patiño Mines decreased from \$4,082,000 in the six-year period between 1940-1945 to \$2,439,000 in the 1946-1951 period.⁸⁵

Impoverishment of deposits, increases in costs, and general political uncertainty of the mining industry's future, all caused reduction of personnel in companies such as Patiño Mines (Table 2) and retrenchment of operations in many mines (Huanuni in 1945, for example), whilst obliging others to

consider the total paralisation of their operations. This was the case of Compañía Minera Oruro in 1947. At the prospect of a monthly loss of \$50,000, the management notified the government that they would shut down operations leaving 2,500 miners unemployed. In view of the acute social problems this would have caused, the administration of Enrique Hertzog (1947-1949) took it upon itself to operate this mine through the Banco Minero. Initially, the Banco Minero succeeded in increasing production substantially. The financial results of this operation, however, are not clear. The primary objective of the state was to obtain foreign currency and improve the living status of the mining workers.⁸⁶

The high costs and heavy tax burden did not only affect the big mining industry, nor did they solely occur in the second half of the 1940s. All sectors of the Bolivian mining industry (large, medium and small) already knew and expressed complaint at these problems – aggravated after the war – in 1942, at the Second National Mining Congress. In this Congress, the companies stressed their disadvantageous situation compared with the Asiatic producers. Whilst in Malaya the tin mining industry paid a tax of \$120 per metric ton and daily wages of \$0.15, in Bolivia taxes were more than double this figure (\$300 per metric ton of tin) and daily wages were five times higher (\$0.80).⁸⁷ These differences are even more significant because production costs were considerably lower in Malaya on account of their alluvial tin deposits.

Labour cost increased considerably in the 1940s. The average wage in dollars (including social benefits) in the large companies increased 82 percent between 1940 and 1944, and 129 percent between 1944 and 1948. This increase was principally due to the many social law decrees and regulations issued during that decade. In the opinion of the United Nations' Technical Assistance Mission to Bolivia, headed by H.L. Keenleyside, which visited Bolivia in 1950, this legislation gave the appearance of having been prepared hastily, lacked suitable planning and offered distinctly dubious real benefits for either workers or employers. The proliferation of social legislation for the mining industry caused the cost of contributions to increase to almost 59 percent of the wage.⁸⁸

Besides this direct incidence on production cost, labour indiscipline also adversely affected production. Trade union politicisation and the frequent support given to labour claims by the Villarroel administration contributed to increasing polarisation between labour and capital in the industry. The Villarroel administration came to power precisely after the administration of Enrique Peñaranda (1940-1943) had been weakened by a violent confrontation between army troops and mining workers as consequence of a strike in Catavi in 1942. This event, which led to loss of life and became known as the Catavi Massacre, had a sharp impact on public opinion and was effectively denounced by the Movimiento Nacionalista Revolucionario

(MNR) which gained political preeminence through its campaign.⁸⁹ Once in power with Villarroel, the MNR registered appreciable success in organising the mining workers. Under its sponsorship, the Federación Sindical de Trabajadores Mineros de Bolivia was established in 1944. The events of Catavi encouraged both increased unionisation and radicalisation of the mining labour force, that took shape in the Trotskyist-oriented Tesis de Pulacayo, adopted by the FSTMB in 1946. This manifesto promoted union militancy and the seizure of the mines, subordinating 'the minimalist union demands to the fight for power'.⁹⁰ Both became prominent symbols of the pre-revolutionary period known as the '*sexenio*' of conservative government (21 July 1946 to 9 April 1952).

When the MNR assumed power for a second time in 1952, the issue of nationalisation was one of the major decisions the party leadership had to address.⁹¹ There was little consensus within the party on this issue. The decision to carry out this measure was undoubtedly made under pressure from the new union confederation, the Central Obrera Boliviana (COB). Union pressure and the fear that the big mining industry might overthrow the revolution (as it was believed happened with Villarroel in 1946) led first to the establishment of a monopoly of export and sale of mineral ores under the aegis of Banco Minero on 2 July 1952. The purpose of this measure was to gain full control of the foreign currency generated by the mining industry. This was not enough for many in the MNR or much of the labour movement and so the Corporación Minera de Bolivia (COMIBOL) was created on 2 October to administer the state mines. On the 7th, the government intervened the operations of Patiño, Hochschild and Aramayo (la Gran Minería) and, finally, on the 31st of the same month the nationalisation decree was signed at the Maria Barzola field – site of the Catavi massacre of 1942.

The MNR had formed a state commission for the legal, technical and economic analysis of the nationalisation in May 1952 the report of which was finally submitted on 9 October. Without any doubt the decision to carry out the nationalisation was political in character. The report of the committee contains proposals from the Hochschild and Patiño groups for establishing joint companies with the government for mining exploitation – ideas which were rejected. Furthermore, the nationalisation of other foreign companies was never considered. For example, the International Mining Co. (Mina Chojlla, tin and wolfram) of W.R. Grace (USA) or Fabulosa Mines (British) (Milluni, tin), both medium sized mining companies and yet neither was expropriated. The state only took over the three principal companies of the Gran Minería (responsible for 80 percent of Bolivian tin production) and it did so at a time when their deposits were becoming progressively poorer, and large investments were required for the development of mass exploitation methods. Investment in machinery and equipment had been on the decrease for seven years, and the tin market was entering a difficult stage after the short boom caused by the Korean War. Moreover, the state was clearly

inheriting a major labour problem and, in view of the shortage of senior Bolivian engineers and managers, it was predictable that subsequent difficulties in COMIBOL would confirm the conclusion anticipated by the Keenleyside Mission in 1951:

Even if the nationalisation of the mining industry would be theoretically convenient, it would be impossible under the present conditions of Bolivia. The government lacks financial resources, and technical and administrative competence indispensable to undertake such a task.⁹²

Conclusion

Forty years after halting Patiño, Hochschild and Aramayo participation in the exploitation of Bolivia's mineral wealth, and nationalising these companies, the Bolivian government is seeking private capitalists with whom to form joint ventures, and it has converted COMIBOL into a holding company. The reasons for this turnaround are exceptionally complex and far exceed the scope of this paper. Not unlike tin mining development before nationalisation, the full story of COMIBOL remains to be written. The enormous influence exercised by COMIBOL in Bolivia's social and economic development over the past four decades, on the one hand, and the underdeveloped stage of Bolivian historiography, on the other, provide major obstacles to a comprehensive appraisal of a very polemical subject. Yet there are some aspects of COMIBOL that bear on the analysis of tin mining before nationalisation.

The development of COMIBOL may be divided in at least two periods, the first covering 1952-1985, and the second from 1985 onwards. During the first period, the ideology of state capitalism was generally in vogue and the state owned and managed companies exploiting key natural resources, such as mining, in order to generate resources for industrialisation. After 1985, this development model was brought to an abrupt end when a free market regime was implanted by Supreme Decree 21060 that liberalised the economy. Almost simultaneously, COMIBOL suffered a severe – effectively fatal – blow as a result of the tin crash of 24 October 1985 when prices halved (from just over £8,000 to less than £4,000 per long ton).

It is in the first period (before 1985) that we can consider the recurring themes covered in this paper. The rapport between the state and COMIBOL, technological development and labour relationships were key elements in the operations and essential record of COMIBOL. Moreover, now that the state had full control of the principal mining companies, its ability to obtain sustained economic development with resources yielded by the mining sector

became a key question. Unfortunately, however, the results proved little different from those evident before nationalisation. Although comparisons in Gross Domestic Product growth are not possible because no figures exist before 1950, the only serious analysis of the benefits of nationalisation concludes that in *economic terms* it was not indispensable.⁹³ It must be admitted that the reasons for this are far from simple, and a lively, complex debate has centred mainly on the deficiencies of COMIBOL management, labour unrest and low productivity. But one must clearly also take into consideration the macro-economic conditions under which the corporation had to operate (hyperinflation and an undervalued exchange rate from 1952 to 1956) and the political constraints it faced.⁹⁴ For our present purposes it is sufficient to highlight the fact that successful natural resource exploitation in an underdeveloped economy is always very difficult and complex, and that making the mining sector an 'engine for growth' – despite its natural shortcomings: capital intensive exploitation, with few backward or forward linkages to the rest of the economy – cannot necessarily be resolved either by greater taxation or by outright nationalisation.

It is from this perspective that the development of the industry in the first half of the century should be assessed. The richness of the ores and the favourable market in the first third of the century greatly assisted the mining industry in overcoming very difficult physical conditions. It obtained the necessary technological base, capital inputs, and human resources to become competitive in world markets. Moreover, the structure that developed enabled the creation of a formidable empire in the form of Patiño Mines.

We have also seen that the state was capable of extracting a significant portion of the wealth generated through a variety of taxes on the industry. The relationship, however, was not well defined. Although a government agency was responsible for this relationship from the turn of the century, and a Ministry of Mines was set up in 1937, no government was able to develop a lasting technical relationship with the mining industry. Rather, the relations seem to have been driven predominantly by the different administrations' need to obtain fiscal resources. The interest of the state was almost exclusively fiscal and therefore short term. There was no explicit policy to provide the guidelines to develop a longer term and more comprehensive relationship between the major mining companies and the state. In contrast, the mining companies, although divided by competition, were well organised under their respective corporate associations.

Another key factor worth stressing is the ability of the mining industry to overcome different crises. In both World Wars and the Depression the companies accommodated to the changing circumstances and were largely able to overcome the major problems confronting them. Similarly, despite frequent assertion to the contrary, the main companies were able to keep abreast of technological developments, and they introduced both new mining

and ore dressing techniques to overcome the lowering grades of their deposits. Not surprisingly, these investments were threatened by growing nationalism and labour unrest, and so decreased in the second half of the 1940s.

Finally, it is our contention that, despite the tensions and the problems the mining industry faced, the main companies remained interested in working the Bolivian tin deposits (even with the state as a partner) in the early 1950s. Nationalisation determined otherwise.

Bibliographical Essay

Despite the importance of mining in Bolivian history, the industry in general, and tin mining in particular, have not been well served by historians. There are only a few academic studies on the development of the industry and the different companies. Interpretative essays concentrating more on the political impact of the mining industry are still prevalent. An excellent example is the suggestive analysis of Sergio Almaraz, *El poder y la caída. El estaño en la historia de Bolivia* (La Paz, 1976). There is no good comprehensive academic study on the development of the mining industry in Bolivia in the 20th century. However, there do exist good sources for this period, even if they have hitherto been little worked on.

The monographs of Manuel V. Ballivián, *El estaño en Bolivia* (La Paz, 1900) and Pedro Aniceto Blanco, *Monografía de la industria minera en Bolivia* (La Paz, 1910) are a good starting point. The former provides a balance of the state of the industry at the beginning of the century. The latter presents details of production and technical features of the major mining companies. Interesting descriptions of the state of the mining industry can also be found in the accounts of foreign travellers and engineers. Good examples of this genre are: Martin W. Conway, *The Bolivian Andes: A Record of Climbing and Exploration in the Cordillera Real in the years 1898 and 1900* (London and New York, 1901) and A.V.L. Guise, *Six Years in Bolivia: The Adventures of a Mining Engineer* (London, 1922).

An excellent source for the study of the mining industry in the first quarter century, likewise, is the British *Mining Journal*, which had a correspondent in Potosí at that time and also contains analytical articles. The US *Engineering and Mining Journal* includes good articles on different aspects of the mining industry and the different companies in Bolivia up to the middle of the century. A good bibliographical guide to the articles on Bolivian mining in these and other foreign and Bolivian magazines is Jorge Muñoz Reyes, Leonardo Branisa y Alfonso Freile, *Bibliografía geológica, mineralógica y paleontológica de Bolivia* (La Paz, 1962).

Without doubt the vast collection of pamphlets on mining issues and the mining companies' annual reports are a rich source for the study of mining. Unfortunately, these publications are dispersed in various libraries and repositories and no single institution possesses a complete – or even comprehensive – collection. However, part of this great bibliographical wealth is classified in Irma Lorini, *Catálogo de la folletería minera del Repositorio Nacional* (La Paz, 1979).

A good synthesis of the mining industry at the beginning of the century is given by a commissioner of the French Ministry of Trade, Paul Walle,

Bolivia: Its People and its Resources, its Railways, Mines and Rubber-Forests (London, 1914). Of still better quality, for the late 1910s, is the report from the agent of the US Department of Commerce, W.L. Schurz, *Bolivia: A Commercial and Industrial Handbook* (Washington, 1921). Additionally, the report *El estaño en Bolivia* (La Paz, 1935) provides extensive information on the state of the mining industry, especially of tin mining, and of the different companies, as a result of the crisis of 1929. For the forties and early fifties, the journal *Minería Boliviana* is a good source of statistical information and includes articles written by Bolivian and foreign engineers. Among the several analytical papers by writers of that time, those of Formerio González, 'Rasgos generales de la economía minera y sus problemas más urgentes en Bolivia' and 'Los grandes problemas de la economía minera en Bolivia', in *Boletín de la Dirección General de Minas y Petróleo*, Año 1, No. 1 (1939), pp. 48-62 and No. 2 (1940), pp. 46-79, stand out. For this period the book by Donanciano Ibáñez, *Historia Mineral de Bolivia* (Antofagasta, 1942) is also useful. It describes the main companies and miners. In addition, the still unpublished study by Mervin Bohan, 'Report of the U.S. Mission to Bolivia' (La Paz, 1942) contains a summary of the condition of mining and metallurgy in Bolivia in the early forties.

A good survey of mining industry at mid-century may be found in Naciones Unidas, *Informe de la Misión de Asistencia Técnica de las Naciones Unidas a Bolivia* (New York, 1951). However, the most detailed evaluation, with valuable primary information on each of the companies before the nationalisation is, beyond doubt, the 'Informe de la Comisión de Nacionalización de Minas' (La Paz, 1952). Unfortunately this report remains unpublished. Despite the time that has elapsed, there has been no serious analysis of the decision-making process for the nationalisation of the mines.

The article by John Hillman, 'The Emergence of the Tin Industry in Bolivia', *Journal of Latin American Studies*, vol. 16 (1984), pp. 403-37, is fundamental for a comprehensive understanding of the transition from silver to tin mining. A succinct synthesis and analysis of tin mining development in the first quarter of the century is found in Manuel E. Contreras, 'Tin Mining in Bolivia, 1900-25', unpublished MA thesis (University of London, 1980). Juan Albarracín Millán, *El poder minero en la administración Liberal* (La Paz, 1972), also presents an interesting and well documented focus on the beginnings of tin mining industry. A global and suggestive analysis of tin mining industry development can be found in Naciones Unidas, *Análisis y proyecciones del desarrollo económico*, vol. IV: *El desarrollo económico de Bolivia* (México, 1958). The major contribution towards an understanding of the impact of mining industry on Bolivian development, is Walter Gómez D'Angelo, *La minería en el desarrollo económico de Bolivia, 1900-1970* (La Paz, 1978), which additionally contains excellent statistical information. Manuel E. Contreras provides a revisionist and more detailed analysis of this

process for the 1920s and 1930s in 'Debt, Taxes and War: The Political Economy of Bolivia, c.1920-1935', *Journal of Latin American Studies*, vol. 22 (1990), pp. 265-287. A recent study with an interesting assessment on the first half century is the one by Mahmood Ali Ayub and Hideo Hashimoto, *The Economics of Tin Mining in Bolivia* (Washington, 1985). Other general commentary of a more traditional inspiration (descriptive, with little analysis, and hypercritical of mining development in Bolivia) may be found in Luis Peñaloza, *Nueva historia económica de Bolivia*, vol. VI: *El estaño* (Cochabamba, 1985) and vol. VII: *Bolivia: El estaño y los barones* (Cochabamba, 1987). Though disordered, these volumes contain much statistical information.

Despite the major role of foreign capital in the development of the tin mining industry, there are no systematic studies of this issue. The transition from Chilean and British to US and Bolivian capital has still to be explored and explained. Max Winkler, *Investments of United States Capital in Latin America* (Boston, 1929) contains some information. The best statistical series on foreign investment in Bolivia for the first third of this century is probably to be found in Norman T. Ness, 'The Movement of Capital into Bolivia: A Backward Country', unpublished doctoral dissertation (Harvard University, 1938). Another little studied issue is the relation of the mining industry to local banking.

The development of the major tin mining companies has received attention from several authors. For Patiño, the book by Roberto Querejazu Calvo, *Llallagua. Historia de una montaña* (La Paz-Cochabamba, 1978) and the biography of Charles Geddes, *Patiño. The Tin King* (London, 1976) are important. In a more analytical vein, the article by Herbert S. Klein, 'La formación del imperio del estaño de Patiño', *Historia Boliviana*, vol. III, no. 2 (1983), pp. 237-252, complemented by my own essay, 'En torno a "La formación del imperio del estaño de Patiño" de Herbert S. Klein', *Historia Boliviana*, vol. IV, no. 2 (1984), pp. 203-209, are key studies. For Aramayo, we only have the book by Alfonso Crespo, *Los Aramayo de Chichas. Tres generaciones de mineros bolivianos* (Barcelona, 1981), of biographic style. Unfortunately, nothing of significance is yet available on Mauricio Hochschild – although volume VII of Peñaloza provides some information.

The impact of world crises on the mining industry has been studied in my 'La minería estañífera boliviana en la Primera Guerra Mundial', en *Minería y economía en Bolivia* (La Paz, 1984), pp. 11-38; and in Burton C. Hallowell, 'Some Aspects of Tin Control as Applied to Bolivia', unpublished doctoral dissertation (Princeton University, 1948). The published chapters of Hallowell's thesis: 'Administration of Tin Control in Bolivia, 1931-1939', *Inter-American Economic Affairs*, vol. III, no. 2 (1949), pp. 3-24; 'Tin Control and Bolivia's Foreign Exchange Position, 1930-39', *Inter-American*

Economic Affairs, vol. III, no. 3 (1949), pp. 61-83; and 'Tin Control and Exchange Depreciation in Bolivia, 1931-1939', *Inter-American Economic Affairs*, vol. IV, no. 1 (1950), pp. 71-84, provide a guide to the multiple consequences of export control on the Bolivian economy. For the role of Bolivia in the tin cartel see John Hillman, 'Bolivia and the International Tin Cartel, 1931-1941', *Journal of Latin American Studies*, vol. 20 (1988), pp. 83-110. An excellent paper on the Depression in Bolivia is Laurence Whitehead, 'El impacto de la Gran Depresión en Bolivia', *Desarrollo Económico*, vol. 12, no. 45 (1972), pp. 49-80, highlighting its effect on the mining industry, especially on the alienation of industrialists and the import sector, struggling for foreign exchange delivery. Unfortunately, this paper has not been circulated widely in Bolivia. Napoleón Pacheco, 'Aproximación a una visión histórica de las crisis económicas en Bolivia', *Dinámica Económica*, vol. 10 (1990), pp. 114-220, offers a good synthesis of the effects the first years of the Depression had on mining industry. Furthermore, Contreras, in 'Debt, Taxes and War', analyses the results of fiscal policy on the mining sector during this period.

There is no global study on the consequences of World War II on the Bolivian mining industry. A good first approximation is provided by Kathryn A. Ross, 'Bolivia and the War Effort: An Economic History of 1939-45 in the Context of Allied Tin Procurement Policy', unpublished master's thesis (Oxford University, 1977). On the other hand, an excellent contribution to the understanding of the development of trade relations with Great Britain is John Hillman, 'Bolivia and British Tin Policy, 1939-1945', *Journal of Latin American Studies*, vol. 22 (1990), pp. 289-315. Hillman questions the existence of any 'subsidy' granted by the Bolivian mining industry (and the country) to the Allies by having entered into fixed price contracts with Great Britain and the USA during that period.

The labour situation in the tin mining industry, fundamentally from the supply and demand point of view, has been studied by Manuel E. Contreras, 'La mano de obra en la minería estañífera de principios de siglo, 1900-1925', *Historia y Cultura*, vol. 8 (1985), pp. 97-134. Gustavo Rodríguez Ostria, *El socavón y el sindicato. Ensayos históricos sobre los trabajadores mineros, siglos XIX-XX* (La Paz, 1991), presents an interesting analysis of the development of the mining proletariat from the 19th century to the establishment of the Federación Sindical de Trabajadores Mineros de Bolivia in the 1940s. The radicalism and political importance of the worker movement is analysed in Laurence Whitehead, 'Sobre el radicalismo de los trabajadores mineros en Bolivia', *Revista Mexicana de Sociología*, vol. 42, no. 4 (1980), pp. 1465-1496 and 'Miners as voters: The electoral process in Bolivia's mining camps', *Journal of Latin American Studies*, vol. 13 (1981), pp. 313-346.

The anthropological approach in the study of tin mining is well represented by the work of June Nash, *We Eat the Mines and the Mines Eat Us: Dependency and Exploitation in Bolivian Tin Mines* (New York, 1979) and 'Religión, rebelión y conciencia de clase en las comunidades mineras del estaño de Bolivia', *Allpanchis*, no. 26 (1985), pp. 115-135. Likewise, the piece by Tristan Platt, 'Conciencia andina y conciencia proletaria. Qhuyaruna y ayllu en el norte de Potosí', *Hisla*, no. 2 (1984), pp. 47-73, presents an interesting approach to the countryside-mine transition.

An area that is still under-researched is the technological evolution of Bolivian mining. The journal *Minería Boliviana* contains good articles on these issues. An effort to fill this gap, especially from the perspective of engineering training and the professional market in Bolivia, is the study by Manuel E. Contreras, 'The Formation of a Technical Elite in Latin America: Mining Engineering and the Engineering Profession in Bolivia, 1900-1954', unpublished doctoral dissertation (Columbia University, 1990). A good synthesis of the 'state of the art' in the geology, mining and ore dressing technology at a global level at the end of the forties is the study by C.L. Mantell, *Tin: Its Mining, Production, Technology, and applications* (New York, 1949). Bolivia figures prominently in this study and it is significant that the flow diagrams of the mills of Avicaya, Catavi and Socavón de Oruro are discussed. Likewise, there is an absence of good studies on the development of foundries in Bolivia. The studies of Almaraz, *El poder y la caída*, and Albarracín Millán, *El poder minero* (cited above), contain some information and much speculation on this issue.

The institutional and corporate development of mining companies has been studied by William Lofstrom, *Attitudes of an Industrial Pressure Group in Latin America, the Asociación de Industriales Mineros de Bolivia, 1925-1935* (Cornell, 1972). Despite the importance of the issue and the political influences of the big mining companies, serious scholarship has not addressed this issue for the 1935-52 period. For the medium mining industry, see: Manuel E. Contreras and Napoleón Pacheco, *Medio siglo de minería mediana en Bolivia, 1939-1989* (La Paz, 1989). The position of the large, medium and small mining companies regarding the tax system, mining legislation, development of the sector and international affairs at the beginning of the forties is reflected in Comité de Coordinación Minera, *Congreso Nacional de Minería de 1942* (La Paz, 1943?). The large mining companies' point of view is reflected in Carlos Víctor Aramayo, *Memorandum sobre los problemas de la industria minera en Bolivia* (La Paz, 1947), that contains good statistical information and an extensive analysis.

There still is a lack of studies on the small mining industry. An interesting methodological contribution on risk and the evolution of 'peasant mining' is

Ricardo A. Godoy, *Mining and Agriculture in Highland Bolivia* (Tucson, Arizona, 1990).

The complex development of mining legislation during this period, regarding taxation aspects, can be found in *Tasas e impuestos sobre la industria minera en Bolivia* (La Paz, 1941). A good compilation of mining legislation is Vicente Fernández, *Legislación minera, petrolera y social* (La Paz, 1928). We still lack analytical studies on the evolution of mining legislation, especially on mining property, concession possession and demarcation. This was a source of much litigation in this period and probably detrimental to attracting genuine (non-speculative) capital to the mining sector.

Finally, some studies (of many existing ones) on tin market in general should be highlighted as a key aspect to understand the development of Bolivian tin mining industry. William Fox, *Tin. The Working of a Commodity Agreement* (London, 1974) is a good synthesis of the development of the International Tin Council. John Ridge, et al., *Estudio sobre el estaño*, 2 vols., reproduced in *Dinámica Económica*, no. 5 (1962), continues to contribute a good introduction to the uses of tin, major producers and consumers, and has extensive statistical information on both production and prices.

Notes

1. *El poder y la caída. El estaño en la historia de Bolivia* (La Paz, 1976), p. 21.
2. John Hillman, 'The Emergence of the Tin Industry in Bolivia', *Journal of Latin American Studies*, vol. 16 (1984), p. 417.
3. *Ibid.*, p. 425. Export figures calculated from Table 1, p. 419.
4. *Ibid.*, p. 433.
5. World per capita tin consumption (in kg) increased from 0.04 in 1890 to 0.05 in 1900 and to 0.07 in 1910, Lotte Müller-Ohlsen, *Non-Ferrous Metals* (Cambridge, 1981), Table 16, p. 93.
6. Figures from Eduardo López Rivas, *Esquema de la historia económica de Bolivia* (Oruro, 1955), pp. 11, 23.
7. I follow Manuel E. Contreras, 'Tin Mining in Bolivia, 1900-25', unpublished MA thesis (University of London, 1980) on these points.
8. On the development and impact of railways in the first third of the century, see Manuel E. Contreras, 'Causas y consecuencias del desarrollo de los ferrocarriles en Bolivia, 1900-1930', forthcoming *Revista del MUSEF*.
9. Charles F. Geddes, *Patiño. The Tin King* (London, 1972), pp. 175-6.
10. Manuel E. Contreras, 'La mano de obra en la minería estañífera de principios de siglo, 1900-1925', *Historia y Cultura*, vol. 8 (1985), pp. 97-134.
11. Manuel E. Contreras, 'The Formation of a Technical Elite in Latin America: Mining Engineering and the Engineering Profession in Bolivia, 1900-1954', unpublished doctoral dissertation (Columbia University, 1990). Figures from Table 5.5, p. 259. See below for technical personnel and nationalisation.
12. Contreras, 'Tin Mining in Bolivia', pp. 27-9.
13. *Ibid.*, pp. 33-7.
14. Manuel E. Contreras, 'La minería estañífera boliviana en la Primera Guerra Mundial', *Minería y economía en Bolivia* (La Paz, 1984), p. 14.

15. *Ibid.*, p. 23.
16. *Ibid.*, pp. 24-31.
17. Indeed, '[t]he bringing of Bolivian ores to the United States not only [meant] cheaper tin and the employment of thousands of American workmen, it means also the creation of a market for American products which ... may approach \$50,000,000 annually', *Daily Commerce Reports*, vol. 1, no. 4 (January 6, 1916), p. 53, quoted in Contreras, 'La minería estañífera boliviana en la Primera Guerra', p. 34.
18. Contreras, 'Tin mining', p. 64.
19. William Fox, *Tin. The Working of a Commodity Agreement* (London, 1974), p. 115.
20. *Mining Journal*, 14 January 1922, p. 40.
21. See Geddes, *Patiño*, chapter 12.
22. López Rivas, *Esquema de la historia económica*, pp. 58, 66.
23. Norman T. Ness, 'The Movement of Capital into Bolivia: A Backward Country', unpublished doctoral dissertation (Harvard University, 1938), Table xiv, p. 130 and Appendix iv, p. 274.
24. See the correspondence in the Navarro Papers in the Archivo de La Paz which contains many letters between Carlos Víctor Aramayo and Carlos Navarro, spanning from 1919 to 1928, on this issue.
25. Alfonso Crespo, *Los Aramayo de Chichas* (Barcelona, 1981), pp. 247-8.
26. Paul Walle, *Bolivia: Its People and its Resources, its Railways, Mines and Rubber-Forests* (London, 1914), pp. 204-05.
27. See Walter Gómez-D'Angelo, *La minería en el desarrollo económico de Bolivia, 1900-1970* (La Paz, 1978), pp. 186-7 and Manuel E. Contreras, 'Debt, Taxes and War: The Political Economy of Bolivia, c.1920-1935', *Journal of Latin American Studies*, vol. 22 (1990), pp. 265-287. For the twenties and thirties, I stress that '[t]he real barriers to growth were the absence of investment opportunities for private capital in the thirties, and the squandering of public funds through corruption and investment in unproductive prestige projects in the twenties' (p. 287).

28. Calculated from Naciones Unidas, *Análisis y proyecciones del desarrollo económico*, vol. IV: *El desarrollo económico de Bolivia* (México, 1958), p. 10. Export value is an estimate of the Bolivian Customs and takes into account the value added by shipping and smelting. It is a proxy indicator.
29. Data from the Comisión Fiscal Permanente quoted in Mahmood Ali Ayub and Hideo Hashimoto, *The Economics of Tin Mining in Bolivia* (Washington, 1985), Table 3, p. 12.
30. On the 'Nicolaus' loan and the Comisión Fiscal Permanente, see Contreras, 'Debt, Taxes and War'. Figures from Gómez-D'Angelo, *La minería en el desarrollo económico*, Table 13, p. 204.
31. Gómez-D'Angelo, *La minería en el desarrollo económico*, pp. 142-46.
32. Contreras, 'Debt, Taxes, and War', pp. 270-2.
33. In 1910 *The Economist* commented: 'The tin market is a small one, it is centred in London, and it is therefore not difficult to manipulate'. Cited in Contreras, 'Tin Mining in Bolivia', p. 7.
34. Manuel E. Contreras, 'En torno a "La formación del imperio del estaño de Patiño" de Herbert S. Klein', *Historia Boliviana*, vol. IV, no. 2 (1984), pp. 203-209.
35. 'La formación del imperio del estaño de Patiño', *Historia Boliviana*, vol. III, no. 2 (1983), pp. 237-252.
36. I am indebted to John Hillman for this information on Hochschild.
37. William Lofstrom, *Attitudes of an Industrial Pressure Group in Latin America; the Asociación de Industriales Mineros de Bolivia, 1925-1935* (Cornell, 1972).
38. Contreras, 'Debt, Taxes and War', p. 269.
39. Contreras, 'Mano de obra', pp. 115-120.
40. I base these commentaries on a rapid comparison of the 1925 Mining Code with the Mining Law of 1880 and the Mining Code of 1852. There is clearly a need for a more detailed analysis of this legislation, particularly regarding the underlying State conceptions of mining development they encompass.
41. Calculated from *El estaño en Bolivia, 1935* (La Paz, 1936), Table 7.

42. See R.R. Beard, 'Property and Operations of Patiño Mines & Enterprises at Llallagua, Bolivia', reprinted from issues of the *Engineering and Mining Journal*, for a good technical review of developments in Patiño Mines' first years.
43. Fox, *Tin*, chapter 4.
44. *Ibid.* pp.
45. On the depression's effects on the Bolivian economy see: Laurence Whitehead, 'El impacto de la Gran Depresión en Bolivia', *Desarrollo Económico*, vol. 12, no. 45 (1972), pp. 49-80, Napoleón Pacheco, 'Aproximación a una visión histórica de las crisis económicas en Bolivia', *Dinámica Económica*, vol. 10 (1990), pp. 114-220, and Contreras, 'Debt, Taxes and War'.
46. López Rivas, *Esquema de la historia económica*, p. 107.
47. Lofstrom, 'Attitudes of an Industrial Pressure Group', pp. 63-4.
48. See Whitehead, 'La gran depresión', pp. 78-9.
49. On this point and on the development of this sector see Manuel E. Contreras and Napoleón Pacheco, *Medio siglo de minería mediana en Bolivia, 1939-1989* (La Paz, 1989).
50. Burton C. Hallowell, 'Some aspects of tin control as applied to Bolivia', unpublished doctoral dissertation (Princeton University, 1948), chapters I and II.
51. Quoted in Roberto Querejazu Calvo, *Llallagua. Historia de una montaña*, (La Paz-Cochabamba, 1978), p. 174.
52. Hallowell, 'Some Aspects of Tin Control', p. 55.
53. Calculated from National Budget figures in Banco Central de Bolivia, *Octava memoria anual ... 1936* (La Paz, 1937), p. 104.
54. Hallowell, 'Some Aspects of Tin Control', pp. 48-9.
55. *Ibid.*, chapter III.
56. Contreras, 'Debt, Taxes and War', p. 283.
57. Hallowell, 'Some Aspects of Tin Control', Table 8, p. 86.

58. Querejazu Calvo, *Llallagua*, p. 175.
59. Lofstrom, 'Attitudes of an Industrial Pressure Group', p. 71.
60. Patiño Mines Archive in El Alto under COMIBOL (hereafter PMA-COMIBOL), 'Turnover of labor'. On the role of women in Bolivian mining in the 19th and 20th centuries, see Gustavo Rodríguez Ostría, *El socavón y el sindicato. Ensayos históricos sobre los trabajadores mineros, siglos XIX-XX* (La Paz, 1991), chapter IV.
61. Hallowell, 'Some Aspects of Tin Control', p. 92.
62. See Comité de Coordinación Minera, *Congreso Nacional de Minería de 1942* (La Paz, 1943?), pp. 235-9.
63. PMA-COMIBOL, 'Turnover of labor', corresponding years.
64. Letter from the Vicepresident of Mauricio Hochschild S.A.M.I to the President of the Comisión de Nacionalización de Minas dated 8 August 1952, in 'Informe de la Comisión de Nacionalización de Minas'. Unpublished typescript (La Paz, 1952). For a technical description of the mine see, H.I. Altshuler, 'Compañía de Minas de Colquiri', Ministerio de Minas y Petróleo, *Boletín*, no. 1 (1939), pp. 41-7.
65. Fixed assets increased from £796,695 in 1930 to £1,489,075 in 1938. 'Informe sobre la Cia. Minera Unificada del Cerro de Potosí', in 'Informe de la Comisión de Nacionalización de Minas'.
66. Gómez D'Angelo, *La minería en el desarrollo económico de Bolivia*, implicit tax from table 18, p. 217, averages calculated from Table 13, p. 203.
67. Banco Mercantil, *Novena memoria* (La Paz, 1934), p. 2.
68. Patiño Mines and Enterprises Consolidated, *Annual Report ... 1935*. Budget data from Banco Central de Bolivia, *Octava memoria anual ... 1936* (La Paz, 1937), p. 104.
69. PMA-COMIBOL, see for example: 'Informes sobre propiedades mineras recibidas del Departamento de Exploraciones', 15 Dec. 1936, File 1052; Vice-President to Simón I. Patiño, 20 Jan. 1937, File 837; Vice-President to Patiño Mines (Llallagua), 29 Oct. 1937, File 912; 'Memorandum sobre la petición Santa Albina de tierras del Chapare', 10 Nov. 1937, File 1156; General Secretary to Patiño Mines (Oruro), 26 Jan. 1938, File 975; Vice-President to Patiño Mines (Llallagua), 17 June 1938, File 982; and General Manager to Patiño Mines (La Paz), 8 June 1943, File 1307.

70. By 1940 the USA accounted for 44.1 percent of total world consumption, Müller-Ohlsen, *Non-Ferrous Metals*, Table 20, p. 104.

71. Fox, *Tin*, pp. 185-6, 191-204.

72. United States National Archive, Washington, D.C. (hereafter USNA), 'Notes on Bolivian Tin Contract and Amendments', RG 234, Box 124.

73. This topic is well developed in John Hillman, 'Bolivia and British Tin Policy, 1939-1945', *Journal of Latin American Studies*, vol. 22 (1990), pp. 289-315, where he makes a careful and intelligent inspection of the evolution of British policy towards Bolivia and the role of Patiño in this process, with the argument that there was no such 'subsidy' from the Bolivian economy to the US economy arising from the negotiated tin prices.

74. López Rivas, *Esquema de la historia económica*, pp. 139, 165.

75. On US technical missions see USNA RG 234, 'Reconstruction Finance Corporation-US Comercial Company Commodity Program Development File: Tin', where a series of reports are contained. Quote from 'Tin Industry of Bolivia: Suggestions for a Program of Investigations by BEW Mission', Box 125.

76. For an assessment of Sullivan tables in Patiño, see 'Nuevas instalaciones en la Patiño Mines', *Minería Boliviana*, vol. I, no. 2 (1944), pp. 29-30.

77. USNA, 'Tin Contracts Involving Cash Advancements by U.S. Government', RG 234 Box 124.

78. USNA, RG 234, 'Progress of work of BEW Metals and Minerals Mission in Bolivia', 20 Mar. 1943, see also RG 59 Department of State, W. Thurston to State Dept. 16 Nov. 1945 doc. 824.63/11-1645 and G.S. Jewett to K. Anderson, 30 April 1948, doc. 824.6354/4-3048.

79. PMA-COMIBOL, General Manager to Vice-president (La Paz), 28 July 1945, File 1406.

80. 'Adelanto técnico de la minería boliviana', *Minería Boliviana*, vol. I, no. 2, (1944), pp. 25-27; 'Patiño Mines moderniza sus instalaciones', *Minería Boliviana*, vol. I, no. 10 (1944), p. 30; 'Patiño Mines & Ent. Cons. (Inc)', *Minería Boliviana*, vol. VI, no. 50 (1949), pp. 5, 8.

81. See: Raymond R. Beard, 'El proceso Tainton', *Minería Boliviana*, vol. I, no. 1 (1943), p. 21; 'Adelanto técnico de la minería boliviana'; José Bustamante Borda, 'Planta Tainton', *Minería Boliviana*, vol. II, no. 18 (1945), pp. 11-16.

82. See, for example, PMA-COMIBOL, General Manager to Vice-president (La Paz), 18 Sept. 1943, File 1312, where the General Manger indicates that research had just started with MIT, but had already been going on since 1942 with Batelle.

83. Naciones Unidas, *El desarrollo económico de Bolivia*, Table 1, p. 56. The development of the five-year averages (calculated by the author) in thousands of constant US dollars was as follows: 1925-29: 3,036; 1930-34: 1,561; 1935-39: 2,327; 1940-44: 3,050; 1945-49: 2,956.

84. Compagnie Aramayo de Mines en Bolivie, S.A., *Sinopsis de su economía en el último quinquenio, 1944-48* (La Paz, 1949), p. 16.

85. Calculated from figures in Geddes, *Patiño*, p. 356.

86. 'Informe sobre la Empresa Minera San José', *Minería Boliviana*, vol. VII, no. 51 (1950), pp. 12-15; no. 52 (1950), pp. 15-19.

87. Comité de Coordinación Minera, *Congreso Nacional de Minería*, p. 154. The Comité was composed by representatives of the Asociación de Industriales Mineros de Bolivia, the Asociación Nacional de Mineros Medianos and the Federación de Asociaciones Mineras de Empresarios Minoristas. It had been created in 1938 to carry out a detailed study of the multiple factors that affected the mining industry. PMA-COMIBOL, Vice-president to Patiño Mines (Oruro), 11 Dec. 1941, File 1179.

88. Naciones Unidas, *Informe de la Misión de Asistencia Técnica de las Naciones Unidas a Bolivia* (New York, 1951), pp. 438-9, salary increases calculated from appendix 6, p. 534.

89. On the effects of the Catavi incident in the press and therefore on urban public opinion see, Jerry Knudson, 'The impact of the Catavi mine massacre of 1942 on Bolivian politics and public opinion', *The Americas*, vol. 26, no. 3 (1970), pp. 138-158.

90. Rodríguez, *El socavón y el sindicato*, pp. 129-30.

91. I follow James Malloy, *Bolivia: The Uncompleted Revolution* (Pittsburgh, 1970), pp. 172-8.

92. Naciones Unidas, *Informe de la Misión de Asistencia Técnica*, p. 228.

93. Gómez-D'Angelo, *La minería en el desarrollo económico*, p. 167.

94. For an intelligent discussion of developments in COMIBOL up to 1970 see Melvin Burke, *The Corporación Minera de Bolivia (COMIBOL) and the Triangular Plan: A Case of Dependency* (Meadville, PA, 1987). A rigorous study of COMIBOL's management 'style' and its shortcomings is found in Centro de Estudios Minería y Desarrollo (CEMYD), *Desempeño y colapso de la minería nacionalizada en Bolivia* (La Paz, 1991).

Table 1
Tin Exports in five selected periods: annual averages, maximum, minimum and annual growth rates, 1900-1952

Period	Annual Average (fine MT)	Maximum		Minimum		Annual Growth Rate (%)
		MT	Year	MT	Year	
1900-19	19,810	29,280	1918	9,739	1900	+ 5.9
1920-29	33,216	47,191	1929	19,086	1921	+ 5.9
1930-39	25,864	38,723	1930	14,957	1933	- 3.6
1940-45	40,608	43,168	1945	38,531	1940	+ 2.3
1946-52	34,638	38,222	1946	31,714	1950	- 2.7

Sources: Calculated from export figures in Walter Gómez-D'Angelo, La minería en el desarrollo económico de Bolivia, 1900-1970 (La Paz, 1978), table 19, pp. 218-20

Table 2
Employment in mining in general and in Patiño Mines, 1925-1950

Year	Total in Mining	Patiño Mines	% Patino Mines
1925	n.d	3,300	-
1930	n.d	4,390	-
1935	20,229	3,169	15.7
1940	35,595	7,081	19.9
1945	43,466	8,532	19.6
1950	45,000	5,017	11.1

Sources:

Total in mining:

1935: *El estaño en Bolivia, 1935* (La Paz, 1936);

1940 and 1945: H. Senado Nacional, *Informe de la comisión investigadora de la industria del estaño* (La Paz, 1947), p. 45;

1950: *Informe de la misión de asistencia técnica de las Naciones Unidas a Bolivia* (New York, 1951), p. 425

Patiño Mines:

1925: Manuel E. Contreras, 'La mano de obra en la minería estañífera de principios de siglo, 1900-1925', *Historia y Cultura*, vol. 8 (1985), table 1;

1930: Patiño Mines & Enterprises Consolidated, *Memoria Anual*, 1931;

1935: 'Report on the turnover of labour', Patiño Mines Archive, COMIBOL;

1940: 'General Manager's Report on Operations During Year 1940', Patiño Mines Archive, COMIBOL;

1945: 'General Manager's Annual Report and Summary of Operations for 1945', Patiño Mines Archive, COMIBOL;

1950: Empresa Minera Catavi, 'Informe Anual 1956', Patiño Mines Archive, COMIBOL

Table 3
Average tax break-down for selected periods in Patiño Mines, 1924-1949
 (£ in thousands)

Period	Export Tax		Profit Tax		Exchange Diff. Tax		Import & Municipal (*)		Other Taxes (**)		Total	
	£	%	£	%	£	%	£	%	£	%	£	%
1924-29	205.1	50	119.8	30	-	-	73.5	16	16.8	4	415.1	100
1930-34	69.8	42	7.5	4	-	-	55.2	32	40.3	23	172.8	100
1935-39	74.6	19	19.3	5	216.4	54	38.5	10	46.0	12	394.8	100
1940-44	134.0	12	290.4	24	682.8	59	20.7	2	39.5	4	1,167.5	100
1945-49	137.6	11	120.8	9	808.1	66	36.6	3	128.2	10	1,231.3	100

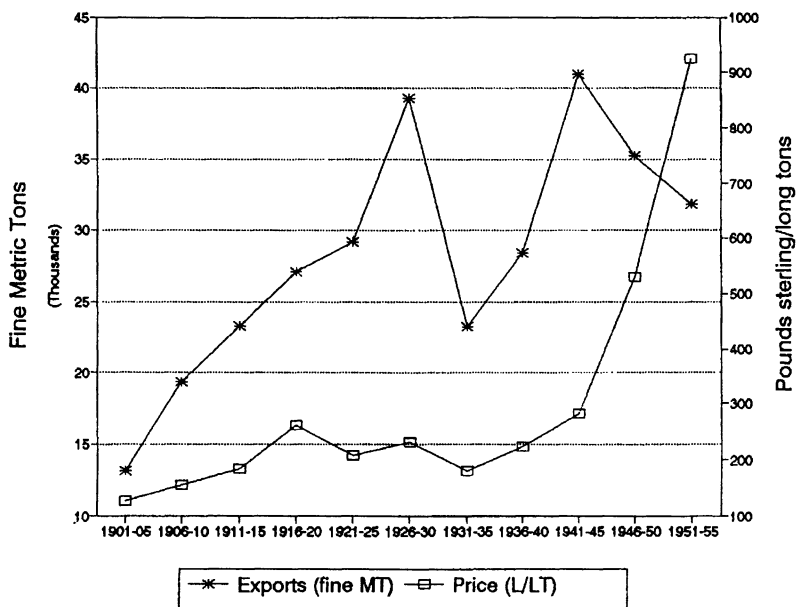
* Includes import tax on machinery and production materials as well as on food-stuffs, it also includes taxes on urban properties.

** All other taxes such as specific levies for Universities, Potosí's Centenary, and the Cochabamba-Santa Cruz road.

Sources: Calculated from information in the Patiño Mines Archive, COMIBOL.

1924-1943: 'Cuadro Demostrativo de Impuestos Fiscales', File 1323; 1944: Not available;

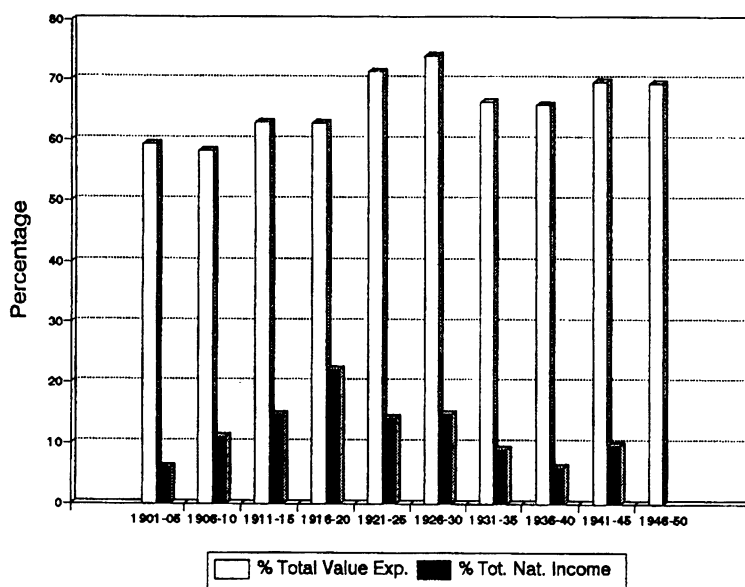
1945-1948: 'Impuestos Pagados al Estado' (corresponding years) Files 1493, 1554, 1641 and 1699.

Graph 1**Tin Exports and Prices: Five-year Averages, 1901-55**

Sources: Exports from Walter Gómez-D'Angelo, *La minería en el desarrollo económico de Bolivia, 1900-1970* (La Paz, 1978), pp. 218-20; prices from John Ridge, et al., *Estudio sobre el estaño* (La Paz, 1962), vol. 2, pp. 491a and b.

Graph 2

Tin Export Value and Tax Revenue as a Percentage of Total Export Value and National Income



Sources: Eduardo López Rivas, *Esquema de la historia económica de Bolivia* (Oruro, 1955), pp. 12-13, 24-25, 35-36, 49, 59, 68, 84-85, 115, 145; Walter Gómez-D'Angelo, *La minería en el desarrollo económico de Bolivia, 1900-1970* (La Paz, 1978), p. 208; Banco Central de Bolivia, *Suplemento estadístico*, no. 118 (Feb 1953), p. 16.

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