II. THE MINING SECTOR

1. THE MEXICAN MINING INDUSTRY IN THE EIGHTEENTH CENTURY

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This paper describes trends in the growth of precious metals production in eighteenth century New Spain, assesses the relations between government and industry in the Bourbon era, analyzes the role of the mining sector in the colonial economy, and sketches the causes of the collapse of the mining industry after 1810. The principal focus of the paper is economic, rather than institutional. The approach is general, rather than detailed. The purpose is to present a somewhat different view of the Mexican mining industry in this period than that found in the historiography, and to indicate the research tasks that promise the most significant results in the future. A more general objective of the paper is to contribute to new currents of work on the late colonial economy at a moment when – as this timely volume demonstrates – research in this area is already transforming the field. It will become clear in the course of this paper, however, that the author owes a large debt to scholars who have published an indispensible series of monographic studies on the colonial mining industry over the course of the past decade, and especially to David Brading, whose work on *Miners and Merchants in Bourbon Mexico* set a standard for the field.[1] The story of the eighteenth – century mining industry that emerged from the new work of the past ten years did not always fundamentally alter received wisdom about the industry. Late colonial Mexico experienced an unprecedented mining "boom"; the task was to explain how this boom was achieved. Government promotion played an important role in the boom; the problem was to explain the origins of official activism and to distinguish its effects. The industry collapsed when the 1810 insurgents, in their zeal to destroy all things Spanish, laid waste to mine works and refineries; little research was required to document this conclusion.

For the most part, this story is false. Mexico did not experience an unprecedented mining boom at the end of the century, but at the beginning, as Garner has already shown.[2] In fact, the late colonial

mining industry was in such deep trouble that it survived by draining the public treasury and diverting resources from other sectors. Government promotion cannot explain a boom that did not occur; it can only explain an increase in physical output based on propping up marginal operations (some quite large). The insurgents did not cause the collapse through destruction of plant and equipment (which could have been repaired). They merely accelerated the fiscal crisis that would have ended public subsidies and produced the collapse of industry in a short time anyway. The mining industry was so sick by 1810 that it can be doubted whether the industry's decline had anything to do with the insurgency at all.

This rather different story emerges from a study of published data, rather than new research. It is thus based on the work of other scholars whose studies departed from a much different set of assumptions and embodied different research strategies. The data they report are therefore imperfect for testing the hypotheses sketched here. Nonetheless, they are sufficient to demonstrate the significance that new primary research in this area could have for understanding economic trends in the late colonial era. The first section below reviews descriptive accounts of trends in physical output, the second questions the significance of this raw data for analyzing the health of the industry and recomputes output to reflect the purchasing power of the gold and silver produced in market terms, the third addresses the related questions of industry productivity and profit trends, the fourth reviews government efforts to prop up the industry, the fifth discusses the role of the mining industry in the economy as a whole, the sixth takes a new look at the industry's decline after 1810, and the final section comments on the future of research in this area.

I.

Descriptive accounts of the growth of precious metals production in eighteenth – century New Spain can rely on reasonably accurate data.[3] Table I reproduces the well – known statistics, with the data grouped into five year periods. Table II presents the same data in index form, showing the output of each period as a percentage of the output of the period 1755 – 59. Measured from the endpoints of each quinquennium, output increased at an annual average rate of 1.7 percent from 1695/99 to 1805/09. This growth represents an impressive achievement, the more so when it is recalled that population grew in this period at only about 0.5 percent.[4]

TABLE I: *Production of Precious Metals, 1695 - 1814*
(Millions of pesos, by quinquennia)

1695/99	19.6	1755/59	65.7
1700/04	25.3	1760/64	58.5
1705/09	28.5	1765/69	60.9
1710/14	32.8	1770/74	80.8
1715/19	35.0	1775/79	91.0
1720/04	50.3	1780/84	100.3
1725/09	52.0	1785/89	93.2
1730/04	52.5	1790/94	109.7
1735/09	47.7	1795/99	121.2
1740/04	48.6	1800/04	104.6
1745/09	59.6	1805/09	122.0
1750/04	64.6	1810/14	47.1

Source: Manuel Orozco y Berra, "Informe sobre la acuñación en las Casas de Moneda de la República," Anexo to the *Memoria* of the Secretaría de Fomento (Mexico, 1857).

TABLE II: *Index of Physical Output, Mexican Mining, 1695 - 1814*
(1755 - 59 = 100)

1695/99	29	1755/59	100
1700/04	39	1760/64	89
1705/09	43	1765/69	93
1710/14	50	1770/74	123
1715/19	53	1775/79	139
1720/24	77	1780/84	153
1725/29	79	1785/89	142
1730/34	80	1790/94	167
1735/39	73	1795/99	185
1740/44	74	1800/04	159
1745/49	91	1805/09	186
1750/54	98	1810/14	72

Source: See Table I.

Rather than steady increases, decade by decade, New Spain's mining industry appears to have grown in sharp spurts, followed by prolonged periods of stagnation. In the first half of the 1720's, output reached an annual average of more than ten million pesos. Then, for the next two decades it stuck there. In the late 1740's, production leaped to twelve million a year and stuck again at the new level, this time for a quarter century, until a new spurt in the 1770's. In the 70's and 80's, output stuck again between sixteen and twenty million pesos per year. In the

final two decades of the period, annual production averaged between twenty – one and twenty – four million pesos per year. Historians of the eighteenth century mining industry have thus correctly searched for discrete events, local bonanzas, and policy initiatives to explain the achievement of each new plateau.

This pattern is also revealed in the data displayed in Table III. Here, the data have been grouped into irregular periods suggested by the plateau pattern. The growth rates displayed in the table represent the compound annual rate of increase (or decrease) for the five year average measured from the last year of one quinquennium to the last year of a subsequent quinquennium. The table shows that the most prolonged period of rapid growth in the entire century occurred in the first quarter when the output of precious metals advanced at an annual average rate of 3.2 percent. This is the only period which does not display the plateau pattern, although growth did slow somewhat in the late 1710's. From the 1720's to the 1740's, production declined at just under 0.1 percent per year. The spurt in the late 1740's reached a rate of 4.1 percent per year. From the 1740's to the 1760's growth declined to a mere 0.1 percent per annum. The spurt in the 1770's lasted most of the decade; annual growth averaged 2.7 percent. From the late 1770's to the late 1780's, growth fell to 0.2 percent per year. The spurt in the late 1780's

TABLE III: *Growth of Mining Output, 1695 – 1809*
(Average Annual Increase in Percent)

1695/99 – 1720/24	+ 3.2
1720/24 – 1740/44	– 0.1
1740/44 – 1745/49	+ 4.1
1745/49 – 1765/69	+ 0.1
1765/69 – 1775/79	+ 2.7
1775/79 – 1785/89	+ 0.2
1785/89 – 1790/94	+ 3.3
1790/94 – 1805/09	+ 0.1
1765/69 – 1805/09	+ 1.7
1775/09 – 1805/09	+ 0.7

Source: See Table I.

to early 1790's reached a rate of 3.3 percent, while the succeeding period saw stagnation at 0.1 percent per year. Measured without the brief spurt in the 1790's, the annual average rate of increase from the late 1770's to 1805/09 was 0.7 percent. This exercise suggests that historians of growth should focus on the first quarter of the eighteenth century, the

early 1740's, and the decades of the 1770's and the 1790's in looking for the causes of New Spain's mining "boom". Most of the growth in physical output of precious metals occurred in these brief periods.[5]

Although two decades of significant growth occurred during the Bourbon period, it is not clear from the data whether the historians are justified in referring to the period as a "boom". Measured from the beginning of the era in the late 1760's to its end in the quinquennium 1805/09, output grew at an annual average rate of 1.7 percent. This is certainly a respectable rate of growth, even if it was largely confined to two of the four decades in the period. It is more than twice the rate of population increase, and rapid even by the later standards of the industrial revolution. This conclusion stands, even if the data are adjusted to take into account the debasement of the coinage that occurred in small doses in 1732, 1772 and 1776.[6] By the latter date, the silver content of the coins minted in Mexico had fallen to just over 93 percent of the silver content of the pre – 1732 period. Adjusted for this debasement, the growth rate over the whole Bourbon period drops only slightly, to 1.4 percent per annum. Nonetheless, the growth of output at the beginning of the century over a period of equal length averaged 3.2 percent per year, a much more impressive achievement.

II.

Measuring the growth of the mining industry in terms of physical output gives only a partial and not altogether accurate picture of trends in the industry. Mining produced money. The law required that all metals produced be dispatched to the mint to be converted into bars of coin. The prices of the goods and services for which gold and silver were exchanged fluctuated constantly. To assess the productivity of the mining industry, it is necessary to take into account these fluctuations in the purchasing power of the industry's output.

To measure productivity, physical output is not always the appropriate measure, since it does not measure output growth in market terms. Economists define productivity as the return to scarce factors of production. When the commodity produced is money itself, its value must be expressed in terms of its capacity to command other resources. Only then can costs incurred in the marketplace to produce the output be measured against the market value of the product.

Unfortunately, no adequate measure of the purchasing power of gold and silver coins yet exists for eighteenth – century Mexico. To analyze

the health of the industry, metals production should be deflated by an index of the prices of the commodities purchased by metals producers. Although the history of prices is still in its infancy, two long price series do exist that provide a crude measure of the purchasing power of the peso. One is the study by Enrique Florescano of the price of maize in eighteenth – century Mexico City; the other is an index of the prices of seven agricultural and livestock commodities produced by Cecilia Rabell in her study of San Luis de la Paz, a small farming community near Guanajuato.[7]

TABLE IV: *Market Value of Precious Metals Production in Mexico, 1695 – 1814 (Millions of pesos of 1775/79)*

	Florescano index	Rabell index
1695/99	–	13.1
1700/04	–	18.6
1705/09	–	22.0
1710/14	–	32.1
1715/19	–	39.8
1720/24	52.2	58.1
1725/29	54.1	43.2
1730/34	52.2	42.1
1735/39	45.6	47.7
1740/44	40.8	43.7
1745/49	49.5	41.2
1750/54	50.1	64.9
1754/59	65.7	65.7
1760/64	57.2	70.0
1765/69	75.2	–
1770/74	62.5	110.7
1775/79	99.1	133.3
1780/84	78.3	–
1785/89	42.6	–
1790/94	93.6	–
1795/99	81.3	71.6
1800/04	67.5	51.7
1805/09	69.3	–
1810/14	18.1	–

Source: See text.

Table IV reestimates mining output by deflating data on physical output using the Florescano and Rabell price indices. The results of this exercise are striking. The three decades at the beginning of the eighteenth century stand out even more than before for sustained and rapid growth, reaching an average of 6.1 percent per year when deflated by

the Rabell index. At the same time, the Bourbon period looks much more anemic than before. Deflated by either index, the series reaches a peak in the five year period 1775/79. Measured from that point to any later point, the growth rate is negative. The market value of the precious metals produced between 1775/9 and 1805/9 declined at an annual average rate of 1.0 percent.

TABLE V: *Index of Market Value of Precious Metals Production in Mexico, 1695 – 1814 (1755 – 59 = 100)*

	Florescano	Rabell	(Physical Output)
1695/99	–	20.0	(29)
1700/04	–	28.3	(39)
1705/09	–	33.5	(43)
1710/14	–	48.9	(50)
1715/19	–	60.6	(53)
1720/24	79.5	88.4	(77)
1725/29	82.3	65.8	(79)
1730/34	79.4	64.1	(80)
1735/39	69.4	72.6	(73)
1740/44	62.1	65.5	(74)
1745/49	75.3	62.7	(91)
1750/54	76.3	98.8	(98)
1755/59	100.0	100.0	(100)
1760/64	87.1	106.5	(89)
1765/69	114.5	–	(93)
1770/74	95.1	168.5	(123)
1775/79	150.8	202.9	(139)
1780/84	119.2	–	(153)
1785/89	64.8	–	(142)
1790/94	142.5	–	(167)
1795/99	123.7	109.0	(185)
1800/04	102.7	78.7	(159)
1805/09	105.5	–	(186)
1810/14	27.5	–	(72)

Source: See Tables II and IV.

The plateau pattern observed in the physical output data can also be observed in the purchasing power of value series, and the timing is roughly the same. The value series reaches its first plateau in the first half of the 1720's, spurts again in the early 1750's (later than physical output), and reaches a new plateau in the 1770's. Only the low level of prices at the beginning of the century and the marked inflation at the end of the period produce noteworthy alternations in the trends, sharpening the expansion at the beginning and converting modest growth into depression at the end of the century. Table V displays the data in index

form, while Table VI recomputes industry growth rates.

Caution should be exercised in interpreting the market value series. The new figures represent the total value of mining production solely in terms of domestically produced agricultural commodities. In the absence of other price indices for eighteenth – century Mexico, however, the series can help to correct impressionistic accounts that have relied on measures of physical output alone. Moreover, the significance of agricultural prices for mining operations have never been doubted. As Brading observed, "any increase in the price of maize and hay could easily drive a miner close to bankruptcy."[8] For more precise analytical uses, however, the data are still far from satisfactory.

TABLE VI: *Growth Rate of Market Value, Precious Metals, 1695 – 1809 (Annual Average Percentage Change)*

	Florescano index	Rabell index
1695/99 – 1720/24	–	+ 6.1
1720/24 – 1740/44	– 0.1	– 1.1
1740/44 – 1765/69	+ 2.1	–
1765/69 – 1775/79	+ 2.8	–
1775/79 – 1785/89	– 8.8	–
1785/89 – 1790/94	+ 8.2	–
1790/94 – 1805/09	– 1.5	–
1775/79 – 1805/09	– 0.1	–
1765/69 – 1805/09	+ 0.2	–

Source: See text.

III.

Systematic data on factor and input costs facing the eighteenth-century mining industry have yet to be collected. It is therefore impossible to make precise estimates of trends in productivity. There are no reliable data with which to compare the market value series. An indirect and partial measure may be suggestive, nonetheless. If costs rose in proportion to the level of prices, then the ratio of market value to physical output can serve as an indicator of the productivity of the industry. (In this case, the ratio of market value to physical output would equal the ratio of total costs to physical output.) Alternatively, this ratio can be used as a rough index of changing profit levels. (In this case, profits would be assumed to depend on the "basket" of commodities that a given

level of output could command in the market.) Combining the two interpretations would make the series into a rough measure of the health of the industry. The data are presented in Table VII. The table shows the number of pesos of constant purchasing power of 1755/59 that mine owners earned for each 100 pesos of coin produced.

TABLE VII: *Ratio of Market Value to Physical Output, Precious Metals, 1695 – 1814*

	Florescano index	Rabell index
1695/99	–	57
1700/04	–	63
1705/09	–	66
1710/14	–	84
1715/19	–	97
1720/24	120	99
1725/29	120	71
1730/34	106	69
1735/39	110	79
1740/44	97	77
1745/49	96	59
1750/54	91	86
1755/59	115	86
1760/64	113	102
1765/69	143	–
1770/74	89	117
1775/79	126	126
1780/84	90	–
1785/89	53	–
1790/94	98	–
1795/99	77	51
1800/04	75	–
1805/09	66	–
1810/14	44	–

Source: See text.

The ratio series correlates roughly with the output and value series. The ratio increases by nearly 50 percent between 1695/99 and 1720/4, as the industry boomed. The period of highest index values occurs in the third quarter of the century, between 1750/4 and 1775/9. The decline after this point to the end of the century is quite marked.

Of course, this index measures productivity only if the unit cost of producing a mark of silver moved in concert with the price indices employed to construct it. If unit costs were rising more rapidly than prices, the ratio will overestimate productivity. If unit costs rose more

slowly, productivity will be underestimated by ratio. The question yet to be answered is whether the real cost of producing a unit of constant market value was rising or falling.

The evidence is mixed on this point, but it appears easier to interpret toward the end of the eighteenth century than at any point earlier. The hypothesis that best explains the evidence is that the industry faced rising marginal costs for at least the period 1780 to 1810. That is, the cost of producing a fixed quantity of metallic purchasing power was rising. The industry was in trouble.

The evidence on this point can be summarized briefly under three headings. First, there is abundant evidence that quality of the ores mined was declining. An increasing proportion of the output of Mexico's mines consisted of low grade ore for which the *patio* or amalgamation process (as opposed to cheaper and faster smelting) had to be employed to extract the metal. Brading presents very clear evidence of this. In Zacatecas, the proportion of low grade ore processed by amalgamation increased from 66 to 85 percent between 1763 and 1806. In Guanajuato, the entire increase in production between the 1760's and 1804 was due to amalgamation. The output of smelted ore actually decreased in this period.[9]

Second, the size and depth of mine shafts and their attendant drainage works was increasing. As shafts were driven deeper, drainage problems increased. The revival of Zacatecas (and its later decline), as well as the fortunes of all the other major mining centers, came to depend critically on reaching ever lower depths. Such excavations and drainage operations made it more costly both to reach the ore and to extract it.[10]

Third, labor costs appear to have been rising along with the cost of other inputs miners had to acquire in the market, mules, timber, tools, and the like. The evidence on labor costs is mixed, since efforts were made, quite logically, to reduce costs either by forcing down wages, eliminating or reducing the *partido* or resorting to government aid (exemption of the labor force from the tribute, forced labor drafts, and the like).[11]

The evidence on industry profits has not been systematically collected and analyzed. Two main sources of profit support have been identified in the literature. The first consisted of organizational and, though less likely, technological changes that could have offset rising factor and output costs. The second, discussed below, was government support for the industry.

One way to approach the issue of profit is to revise the market value series to reflect more closely the "basket" of commodities on which profit earners may have been spending their gains. The series in Table IV above provides a measure of the purchasing power of mining output in the market for maize (Florescano) or maize plus six other products (Rabell). The owners of New Spain's principal mines, however, built their reputations for opulence in conspicuous consumpton and for marshalling investment capital through their command over a far wider variety of products and services.

For both consumption and investment, it is safe enough to assume that these were highly labor intensive. Thus, actual profit depended on labor market conditions and social organization (in which conditions appear to have favored employers, at least from the 1750's to the 1810's).[12] Qualitative evidence also suggests that consumption, and possibly some investment activity, depended to an unmeasured degree on imports from abroad.[13] While there are no measures of elite propensities to consume imports, descriptive accounts suggest that they were high, especially in clothing, wine, consumer durables like pianos and furniture, and (possibly for investment) iron and steel products.

Price trends for commodities imported to New Spain have not yet been studied systematically. The data remain scattered through an immense *ramo* of the Archivo General de la Nación. Nonetheless, two observations can be made from the quantitative evidence available at present. First, as Brading has observed, the Bourbon liberalization of intra-imperial trade appears to have reduced the prices of imported products to consumers in the colony, in part through reducing the inconvenience and cost of shipping between New Spain and the rest of the empire and in part through abolishing (in 1778) the monopoly on foreign trading once held tightly by the Consulado de México.[14] Secondly, however, international trade prices in the late eighteenth century are known to have been rising, especially in periods of war (1756-63; 1778-83; 1796-1802; 1803-1812). For New Spain, the positive effects of liberalization were probably felt most strongly in the 1770's and 1780's (but offset in the 80's by the great famine of 1784-85), while the negative impact of international warfare was strongest later in the period. The Bourbon reforms may have produced a series of once-and-for-all decreases in the *level* of prices consumers would otherwise have paid for imports, while the sharply rising *trend* in international prices after 1796 clearly offset these earlier gains by the turn of the century.[15]

Thus, for mine owners and other consumers (and investors) of imported products the qualitative literature indicates that long – run international price trends were consistent whith those observed for domestic prices. In both cases, any gains made earlier in the century had disappeared by the war years that preceded the Hidalgo revolt. In terms of its purchasing power, the international market value of Mexico's silver output was probably declining at least as rapidly as it was on domestic markets.

However it is measured, the mining industry of New Spain entered into a crisis during the era of the Bourbon reforms, an economic crisis in which the declining market value of precious metals combined with rising costs of production. Each mark of silver produced bought less and cost more to produce.

IV.

Government policy towards the mining industry not only recognized this crisis, but in part created it. As Brading has clearly shown, government policy was directed towards maximizing output on the assumption that the output of the mining industry determined the level at which the colony could be taxed.[16] This assumption was based on experience. There was a close correlation in the eighteenth century between government revenue and mining output. This relationship is shown in Table VIII, where the production of precious metals is expressed as a percentage of government revenues. As the table indicates, this ratio was fairly stable throughout the first three quarters of the eighteenth century, varying around a mean of 225. The only exceptional period was the decade of the 1720's when mining output reached very high levels and the ratio leaped to more than 300. In the 1780's, the ratio declined to its lowest level in the century and dropped steadily thereafter. By 1805/09, the ratio reached 42, that is, mining output accounted for less than half of government revenue. The Bourbon reforms culminated in what even the Spanish rulers themselves must have recognized as a drastic decapitalization, or at least demonetization of the colony.

In any case, until this final period of desperate expediencies, the Crown found that the amount of gold and silver it could extract from the colony depended on the level of production of the two metals. When the Seven Years War pushed the Crown to "reforms" that could increase colonial revenues, it mixed new exactions and more effective adminis-

tration with measures to promote mining production. These measures included a series of steps to stimulate the revival and rehabilitation of marginal producers in the industry. With tax breaks, government aid in recruiting labor and generous credit to undertake the necessary excavation and construction, entrepreneurs found they could make a profit of mines long abandoned. For the existing mines, the government was somewhat less generous but equally concerned. The entire industry benefitted when the prices of *estanco* mercury and blasting powder were

TABLE VIII: *Precious Metals Production as a Percentage of Government Revenue in Mexico, 1695 - 1809*

1695/99	169	1755/59	211
1700/04	184	1760/64	259
1705/09	204	1765/69	173
1710/14	186	1770/74	199
1715/19	185	1775/79	203
1720/24	380	1780/84	153
1725/29	333	1785/89	129
1730/34	226	1790/94	135
1735/39	251	1795/99	70
1740/44	192	1800/04	44
1745/49	246	1805/09	42
1750/54	229		

Source: See Table I and John TePaske, *La Real Hacienda de Nueva Espãna: La Real Caja de México (1576 - 1816)* (Mexico: INAH, Colección Científica No.41, 1976).

reduced, when the crown created the Real Tribunal de Minería to service the industry, and when a range of services and protections (including special mining courts, a new mining code and technical assistance missions) were provided.[17] The result of these measures was to make production profitable despite higher costs. Physical output reached very high levels.

It is also possible that government aid to the industry made possible technological advances that would otherwise have been impossible to achieve. The extent and effect of technological advance has never been measured, however, and Brading was probably right in according it no more than a minor role, certainly too small to have arrested the rise in marginal costs.[18]

In short, the mining industry was already in decline by the time the independence movement erupted in 1810. That it did not collapse earlier

was due in large part to direct and indirect subsidies from government. The government taxed to stimulate more mining production to tax still more. When the combined forces of Napoleon Bonaparte and Padre Hidalgo destabilized the state, they doomed the mining industry at the same time.

V.

The role of the mining industry in the economy of New Spain has often inspired discussion. Two broad and somewhat contradictory notions may be found in the literature. One of these holds that the mining industry was overdeveloped to serve the interests of the Mother Country. Overdevelopment of mining distorted the colonial economy in both traditional and dependency school analysis.[19] The second broad interpretation suggests that the mining industry acted as a kind of "leading sector", promoting the growth of agriculture, commerce, and industry through backward linkages, dynamizing the economy of New Spain much in the manner of a modern export staple.[20] It may be noted in passing that these two views are not necessarily opposed to each other. They may be reconciled in various ways. For example, more sophisticated versions of the dependency argument no longer challenge the dynamic linkages created by export booms. The argument now turns on the long term as opposed to short – term benefits of such episodes.[21] Alternatively, it has been suggested that social, cultural or institutional constraints may dampen or thwart altogether the dynamism of the export sector.[22] Distortion occurs in this model as mining profits "sink" into a backward agricultural sector or are dissipated in conspicuous consumption.

The present state of research does not make it possible to reach firm conclusions, but the data do suggest a somewhat more complex picture than is usually drawn. The relations between agriculture and mining can serve to illustrate this point. Regional accounts of agricultural development in the first quarter of the eighteenth century provide evidence of trends in agricultural development that appear to have coincided roughly with the growth of mining. Areas close to mining centers, like the Bajío and portions of Michoacán and Jalisco, benefitted from the rapid increase in mining production in this period.[23] It is precisely in the 1700's to 1720's that many abandoned or rundown estates were purchased by new owners and refurbished. This trend appears to have continued during the 1730's and 1740's, but there is some evidence that agricultural investments were less successful in this period.[24] After

mid – century, a second trend emerged, that is, the movement of the livestock frontier towards the far north and the conversion of cattle and sheep haciendas in the central regions to the production of grain and *pulque*. The timing of this shift varied, but appears to have taken hold in the Bajío by the 1760's and in the Guadalajara region by the 1770's.[25] Population growth played a role in this shift. In part, however, it may be attributed to the growth of the mining industry, but the data are too fragmentary to permit a conclusive test.

One clue to the relationship between mining and agriculture may be found in the market value data in Table VI. This series may also be read as a rough index of the commodity terms of trade between mining and agriculture. For most of the century, terms of trade moved in favor of mining and against agriculture. The high point was reached in the 1770's. While mining growth may have stimulated production, this linkage cannot explain the downward trend in the terms of trade. The falling relative prices for agricultural commodities could be explained by increasing productivity. While conclusions must necessarily be tentative, it appears that the stimulus to increased agricultural output, particularly to the production of food and beverage crops, promoted increased productivity through greater regional specialization in production, at least through the 1770's.

It is possible that the growth of mining production inspired productivity gains in other sectors as well. Scattered evidence suggests that commerce, or the transactions sector as economists call it, became more efficient in part because markets expanded. Capital markets certainly became more fluid and better organized. The development of the mining regions attracted labor, especially to the Bajío, so the economy gained from the greater mobility of labor. Productivity gains in industrial activity – textiles, tanning and leather goods, soap and other "chemicals" – appear less likely, although processing industries like milling and sugar refining may be exceptions. In any case, the causes and the timing of these gains have yet to be investigated.[26] It is noteworthy that not a single study has yet been completed that addresses the question of productivity in this period. The single exception remains the necessarily partial analysis by Ward Barret in his monograph on the sugar haciendas of the Cortes family.[27] No one has challenged his conclusion that output per unit of labor on these sugar estates tripled between the late sixteenth and the mid – eighteenth centuries.

The data do make clear that the role of the mining industry had changed significantly by the 1780's. By this time, the dynamism of the

industry had disappeared. By the end of the eighteenth century, the mining sector had become a drag on the economy. It is an open question whether marginal product was declining faster in agriculture than in mining, but the shift of the terms of trade toward agriculture is suggestive. In Mexico, as in the rest of the world, precious metals were becoming less scarce and agricultural products more scarce in relation to demand. Resources that would otherwise have shifted from mining to agriculture responded to public policies designed to maintain the attractiveness of mining for investors. Wages in both sectors failed to keep up with inflation, not only because unemployment was higher as a result of the misallocation of capital to mining and away from agriculture.

While precious metals poured from the world's mines in immense quantities by the end of the eighteenth century, this commodity was always scarce from the point of view of the Spanish treasury. Hence the obsession with policies that could not have been better designed to weaken the Mexican economy, increase the world supply of silver, and thus increase still more the treasury's appetite for this effectively devalued commodity. More measures to stimulate mining production and tax revenues followed, with still greater distorting effects of the allocation of capital and labor in the Mexican economy.

It would be a mistake, however, to exaggerate the significance of this vicious circle for New Spain's economy as a whole. At the end of the eighteenth century, the mining industry accounted for no more than about 8 percent of the colony's gross domestic product of some 240 million pesos.[28] Even if the entire increase in mining output after the 1760's could be attributed to the distortion of investment induced by government subsidies, it is not clear that the capital involved, even if it equalled as much as an entire year's output of some 20 million pesos, could have reversed the decline in agricultural productivity or much improved the performance of other sectors of the economy. In any case, the data do not yet exist to make feasible a test of this counterfactual proposition. It is possible only to conclude that the mining industry contributed to the general economic crisis that occurred at the end of the colonial period, and that this contribution was actively promoted by government policy.

VI.

The collapse of the mining industry after 1810 occurred not because of the violence and predations of the independence movement, but

because the government, already under seige after Napoleon's invasion of the peninsula in 1808, was unable to continue supporting the industry. Between 1800 and 1809, Mexico's mines produced an annual average of 22.2 million pesos. Between 1810 and 1819, output dropped to an annual average of only 11.3 million, a decline of nearly 50 percent. A portion of this decline was due to the violence and destruction wrought by the Hidalgo movement and by the effort to suppress it, but only part. The records of the Tribunal de Minería are full of accounts by mine owners of the conflict and its effect on output. Many petitioned to be exempted from the provisions of the mining code that specified revocation of the mine owner's right to exploit a mineral deposit after four months without working it. Most of the petitions were granted.[29] By 1812, however, the mine owner's complaints had changed. From this point until Iturbide's coup, their letters and petitions, and the meetings of the mining deputies, are filled with other problems. High on the list of problems was the scarcity of mercury. In 1811, the Cortes had decreed an end to the *estanco* and declared mercury open for *comercio libre*. The mineowners were appalled. Private suppliers ran the price up from the monopoly's subsidized price of 41 pesos to as high as 200. Even then, supplies were often impossible to obtain.[30] In 1812, the Tribunal proposed to raise the funds necessary to outfit a naval expedition whose sole object would be to seize the mercury stored at Seville and Almaden in occupied Spain.[31] The project was set aside when Ferdinand recovered the throne, but mercury remained scarce and the price high even after restoration of the monopoly.

Most of the tax exemptions, official credit, and other privileges of the mining industry also came to end after 1810. Miners complained repeatedly about the tax surcharges imposed by royalist commanders throughout the decade.[32] The Tribunal defaulted on its loans after making extraordinary contributions to the war effort. Official credit to miners for the purchase of mercury ended.[33] Private capital dried up. To make matters worse, transport charges rose precipitously with brigandage and labor became scarce.[34] In short, Hidalgo and Napoleon, even though defeated militarily, made it impossible for the government to provide either the subsidies or the security the industry needed to restore production to its former levels. Mining collapsed when government disintegrated.

VII.

Much more research on the mining industry in pre – modern Mexico will be needed before the revisionist account presented here can be accepted, modified or cast aside. My purpose has been to show that the literary and quantitative data now available provide little support for the traditional view of boom and prosperity, benign government, and collapse by destruction. Instead, the evidence points to a sick industry, propped up by distorted public incentives, that collapsed of its own weight when the colonial government could no longer intervene to prevent it. Testing these opposing images systematically will no doubt help to produce a picture with more subtle shadings, but this is scarcely the point. Future research can now rely on a large number of recent monographs that have effectively illuminated the institutional history of the mining industry. Because of this, scholars are now in a better position to analyze the economic aspects of the silver legend directly.

Such an effort will require far more attention to the systematic collection of quantitative data that bear directly on the economic issues. The history of prices is crucial, as are more microeconomic (firm – level) data that can be manipulated to estimate the critical indicators of industrial health – costs, productivity, profit rates, the impact of subsidies – over time. The data do not have to be exhaustive, merely useful for analytical purposes.

At the aggregate level, progress in interpreting the articulation of the mining industry with the rest of the economy will remain dependent, to an extent, on the development of economic historical work on other sectors of New Spain's economy and on the international economy in the eighteenth century. Price history will be critical here, too, as will studies that address sectoral (or even micro – level) rates of output and productivity change, returns to capital and land, and the like. Much more is known already, however, than historians have put to use for analytical purposes. Long run price trends for agricultural commodities in diverse regions of Mexico have proved to be highly correlated with each other, and with international price movements, for example. Regional studies of agricultural development, though often lacking in economic analysis, have produced important and convergent findings on crop mix changes and investment patterns across wide areas of the colony. New studies of trade and public finance have added immense stores of data to be assimilated.[35]

In short, the economic history of the colonial mining industry in the eighteenth century can now be approached from a fresh perspective and with the support of a monographic literature that already provides the foundation for new discoveries. Some of them will be bonanzas.

NOTES

1. David A. Brading, *Miners and Merchants in Bourbon Mexico, 1763 - 1810* (Cambridge, 1971).
2. Richard L. Garner, "Silver Production and Entrepreneurial Structure in Eighteenth - Century Mexico," *JLA*, 17 (1980), 157 - 185.
3. The data cited below are taken from Manuel Orozco y Berra, "Informe sobre la acuñación en las Casas de Moneda de la República," printed as an unpaginated anexo to the *Memoria* of the Secretaría de Fomento in 1857.
4. For population data for the eigteenth century, see F. Navarro y Noriega, *Memoria sobre la Población del Reino de Nueva Espãna* (Mexico, 1820), p.30; Alexander von Humboldt, *Political Essay on the Kingdom of New Spain*, 4 vols. (London, 1811), vol. 1, bk. 2, chap.4; Peter Gerhard, *México en 1742* (Mexico, 1962), pp.17 - 18; Gonzálo Aguirre Beltrán, *La población negra de México, 1518 - 1810* (Mexico, 1946), pp.199 - 245.
5. Garner, "Silver Production," 159 - 167.
6. Brading, *Miners,* pp.43 - 44.
7. Enrique Florescano, *Precios de maíz y crisis agrícolas en México (1708 - 1810)* (Mexico, 1969); Cecilia Rabell, "San Luis de la Paz: estudio de economía y demografía histórica (1645 - 1810)" (Unpub. M.A. Thesis, U.N.A.M., 1975).
8. Brading, *Miners,* p.135.
9. Ibid., pp.139 - 142, pp.282 - 283.
10. Ibid., p.134; Garner, "Silver Production," 18 - 82.
11. Brading, *Miners,*, pp.133 - 136; Richard Garner, "Problèmes d'une ville minière mexicaine à la fin de l'époque coloniale: prix et salaires a Zacatecas (1760 - 1821)," *CAL*, 6 (1972), 75 - 111.
12. Garner, "Problèmes," p.109 - 111; Brading, *Miners,* pp.146 - 149.
13. Brading, *Miners,* p.95.
14. Ibid., pp.114 - 115.
15. Javier Cuenca Esteban, "Statistics of Spain's Colonial Trade, 1792 - 1820: Consular Duties, Cargo Inventories, and Balances of Trade," *HAHR*, 61 (1981), 381 - 428.
16. Brading, *Miners,* p.145.
17. Ibid., pp.140 - 146.
18. Ibid., p.139.
19. See the well - known works by André Gunder Frank *(Capitalism and Underdevelopment in Latin America)*; Fernando Henrique Cardoso and Enzo Faletto *(Dependence and Development in Latin America)*; and Celso Furtado *(The Economic Development of Latin America)*.

20. See Eric Wolf, "The Mexican Bajío in the Eighteenth Century: an Analysis of Cultural Integration," in M.S. Edmundson, ed., *Synoptic Studies of Mexican Culture* (New Orleans, 1975).
21. See, for example, John H. Coatsworth, *Growth Against Development: The Economic Impact of Railroads in Porfirian Mexico* (DeKalb, 1981).
22. See Brading, *Miners*, p.219; William P. Glade, *The Latin American Economies: Their Institutional Evolution* (New York, 1969), p.77.
23. Claude Morin, "Sentido y alcance del siglo XVIII en América Latina: el caso del centro - oeste mexicano," in Enrique Florescano, ed., *Ensayos sobre el desarrollo económico de México y América Latina (1500 - 1975)* (Mexico, 1979), 154 - 170; Rabell, "San Luis de la Paz," chap.3; David Brading, "La estructura de la producción agrícola en el Bajío de 1700 a 1850," *HM*, 33:2 (1973),197 - 237.
24. Brading, "La estructura de la producción," and *Miners*, chap.4.
25. Brading, "La estructura de la producción;" Eric Van Young, *Hacienda and Market in Eighteenth Century Mexico: The Rural Economy of the Guadalajara Region, 1675 - 1820* (Berkeley, 1981), chap.10.
26. These issues are addressed, in part, in the essays by Larson and Thomson in this volume.
27. Ward Barrett, *The Sugar Haciendas of the Marqueses del Valle*, (Minneapolis, 1970).
28. See John H. Coatsworth, "The Decline of the Mexican Economy, 1800 - 1860," Paper presented to Symposium on "The Economic History of Latin America, 1800 - 1850," Ibero - Amerikanisches Institut, Berlin, 1983.
29. See, for example, Don Pedro Perea presenta ocurso justificando el abandono de sus minas Sta. Rita y Espirito Santo, en el Real de Zimapan, AHPM, Exp.no. 11060 - 1811.
30. Contestaciones de las diputaciones territoriales a la circular de 24 de diciembre de 1816, Carta de la diputación de Guanajuato al Real Tribunal de Minería, 3 de marzo de 1817, AHPM, 1175 - 1817. See also the Carta de la diputación de Zacatecas, 4 de marzo de 1817, in the same file.
31. Sobre adoptar arbitrios del Real Tribunal de Minería para surtir el Reyno de Azogue, AHPM, 1053 - 1812.
32. All of the documents cited above raise complaints about new taxation; that of Guanajuato delegation in 1817 is especially poignant.
33. See, for example, La diputación de Zacatecas en Asuntos de Azogue, AHPM, 2454 - 1817.
34. On the matter of freight costs and the scarcity of transport, the Mining Tribunal repeatedly implored the Viceroy for aid. See, for example, the letter from the Real Tribunal de Minería al Virrey, dated 27 October, 1812, in "Azogues," AHPM, 1397 - 1812.
35. See the essays by TePaske and Barbier in this volume.