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INTERNALIZATION IN PRACTICE: EARLY FOREIGN DIRECT INVESTMENTS IN MALAYSIAN TIN MINING

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Abstract. This paper looks at the historical record of early foreign direct investment in Malaysian tin mining and draws its implications for the theory of the MNE.

In the last ten years the theory of the multinational enterprise (MNE) has made giant strides with the development of transaction costs/internalization models (Buckley and Casson, 1976; Casson, 1979; Rugman, 1981; Hennart, 1982). These models fit comfortably within the larger framework provided by Dunning's eclectic theory (Dunning, 1981). The emergence of these new theories has stimulated a lively debate. Recently, Peter Buckley (1983) has expressed some doubts on the ability of existing internalization models to explain and predict the behavior of MNEs. Buckley argues that a number of assumptions on which internalization rests are basically untested and should be subjected to closer empirical scrutiny. He questions the models' assumption of widespread imperfections in the market for knowledge, of an inherent advantage of the local firm over the foreign entrant because of the former's greater familiarity with local conditions, and of the ability of innovating firms to continually improve on their initial advantages.

This paper looks at one particular foreign direct investment episode, that of British, French, Australian and American firms in Malaysian tin mining between 1860 and 1920. The goal is to ascertain whether the historical record is broadly consistent with that predicted by the new theories of the MNE. As we will see, the experience of Western investors in Malaya generally fits the model, but also suggests a number of additions and modifications which serve to deepen our understanding of the foreign direct investment phenomenon.¹

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FOREIGN DIRECT INVESTMENT IN MALAYSIAN TIN MINING

The Origins

Up until the end of the 19th century, Cornwall mined and smelted almost all of the world's tin. World production grew very rapidly after 1850, increasing from a yearly average of 17,000 tons in the 1840s to 39,000 tons in the 1870s and to 80,000 at the turn of the century. This expansion was fueled by a rapidly rising demand for tinplate (Economist Intelligence Unit, 1958, p. 8). Cornish mines expanded significantly their output to meet the growing demand for tin. But diminishing returns soon set in and Cornish output reached its peak in 1871.

Tin had been mined in Malaya for many centuries. It was smelted by the Malays and refined in Singapore by Chinese merchants. Up until 1850, the greater part of what was called "Straits tin" was exported to China and India. By 1865 the expansion of the U.K. tinplate industry led to a major increase in British imports of Straits tin (Won, 1965, pp. 15-17). This persuaded the Malay chieftains to increase their revenues by developing their tin resources. To expand production, they invited Chinese miners into Malaya and borrowed from the Western and Chinese merchants of Singapore to which they sold their output. In 1848, rich tin ore was discovered in the Larut tin fields of Perak and Chinese immigrants poured in.

As early as 1861 some Western merchants based in Singapore sought to benefit from the opportunities offered by tin mining in the Malay states. All investments failed, however, due to the general climate of insecurity as the Malay chiefs waged continuous wars with one another (Wong, 1965, pp. 33-41). Chinese miners were better able than Westerners to withstand these unsettled political conditions because they operated with negligible fixed capital. They also organized secret societies to protect themselves against the exactions of Malay rulers.

At the end of the 18th century the British had established themselves in the "Straits Settlements" of Penang, Malacca, Singapore and the Dingdings. In 1873 they intervened to restore order in the Malay Peninsula, and appointed a British resident in the three independent Malay states of Perak, Selangor and Sungai Ujong. Similar treaties were signed with Negri Sembilan and Pahang in 1885 and 1887, and with the other Malay states in 1909-1919. The establishment of the Pax Britannica provided a strong impetus for the development of tin mining, but its main beneficiaries were the Chinese miners.

Chinese mining techniques were labor intensive.² The overburden was excavated by hand and carried by bucket out of the mine. The tin ore was concentrated in wooden sluice boxes. Water was drained from the opencast mines by wooden chain pumps, operated by an overshot water wheel or by a treadmill. This primitive method of drainage made it impossible to operate deep mines (Wong, 1965, pp. 48-50).

Nearly all of a mine's numerous workers were imported from China as indentured laborers (*singkehs*), who mortgaged their labor to their

employer who had advanced the cost of their passage. Because the laborers had to buy their necessities from the advancer, they were charged considerably above market prices and had to borrow at usurious rates. The major advancers also had the farm of gambling and opium, and this was an important source of additional gains.³ Because of this system, *singkehs* were continuously in debt to their advancers, and the Chinese capitalists were able to prolong their indenture. In this way they had control over a docile and low-paid labor force.

Early Western Foreign Direct Investments

One of the first acts taken by the British administrators in the protected states of Malaya was to encourage Western firms to enter tin mining by offering them leases on advantageous terms, provided the companies used Western techniques and machinery to work the mines. Few firms took up the offer.

Between 1882 and 1897, thirty-five companies were registered in the United Kingdom to mine tin in Malaya. There were also an unknown number of French and Australian ventures. Almost all of these firms were unsuccessful. By 1897 only three foreign mining companies were still active in Perak and Selangor, while the only remaining foreign concern in Pahang was the Pahang Corporation, Ltd, floated in 1887 in London to mine the largest of Malaysia's rare tin lodes (Yip, 1969, pp. 97-99; Wong, 1964, p. 143).⁴

There were many reasons for the inability of these early Western firms to successfully compete with Chinese entrepreneurs. First, tin deposits in Malaysia are alluvial, not lode deposits as in Cornwall. As a result, many of the techniques with which foreigners were familiar were not suited to Malaysian conditions. Test boring, which was necessary and reliable for hard-rock mining, often gave misleading results in Malaya, as the boring tools often carried down with them particles of tin ore, erroneously suggesting that the deposits were much deeper than was actually the case (Swettenham, 1893, p. 32). Often the laborers, insufficiently supervised, doctored the samples with tin ore to avoid further boring (Wong, 1965, p. 148).

Because tin deposits were usually close to the surface, there was no need for elaborate machinery to pump water and to raise the paydirt out of the mine. In contrast with lode ores, which must be crushed before the metal can be separated from the gangue, most Malayan ores can be concentrated by a simple washing. The Westerners did not, therefore, have a technological edge over their Chinese counterparts.⁵

Indeed, given the problems of faulty prospecting, the negligible fixed investment in Chinese mines was a great advantage. If the deposit was not profitable, it could easily be abandoned for a more promising one. Foreign companies, on the other hand, used heavy and expensive machinery. Once mining had begun it could not be discontinued without significant capital loss (Yip, 1969, pp. 102-3). The relative inferiority of

European mining methods is confirmed by the fact that in many cases the land abandoned by bankrupt Western companies was successfully mined by the Chinese.

European companies were, moreover, at a disadvantage relative to the Chinese in hiring labor. The best mine workers were Chinese, and they tended to prefer working under someone of their own race. European managers had to hire Chinese interpreters or overseers to supervise mine labor. In those circumstances the European staff hired by Western mining companies was both more expensive and less efficient (Wong, 1964, p. 138). Because of serious problems in managing Chinese workers, European companies found it necessary in order to survive, to turn to a modified tribute system by which they let the Chinese work the company concessions in their own ways in exchange for a fixed share of the output (Wong, 1964, p. 139).

The system of importation of Chinese labor also gave the Chinese mine-owners control over the supply of skilled Chinese tin miners, whereas the truck system, by which these miners had to purchase their provisions from a mine advancer, often allowed the latter to prolong their indenture. Chinese laborers were also attracted to Chinese mines by the availability of opium and the facilities for gambling, which were not supplied by European mines (Yip, 1969, pp. 103-4). Furthermore, the Chinese capitalists successfully used the secret societies of which they were the leaders to dissuade Chinese coolies from working for Europeans (Wong, 1965, p. 149). Finally, Western companies also experienced difficulties in obtaining land, as all the best ground was already held by numerous Chinese and Malay smallholders (Wong, 1964, p. 149).

All the British companies floated to mine tin in this period also suffered from high monitoring costs. Frank Swettenham, who was then British Resident of Perak, gives this contemporary account of the main cause of their lack of success:

European mining is done by companies, and company's money is almost like government money. It is not of too much account because it seems to belong to no one in particular and is given by Providence for the support of deserving expert and often travelled individuals. Several of these are necessary to start an European mining venture and they are mostly engaged long before they are wanted. There is the manager and the submanager, the accountant, the engineer, the smelter. . . Machinery is bought, houses are built, in fact the capital of the company is spent. . . And then—if ever things get so far—some Chinese are employed in wages or contract—the former for choice, to remove the overburden. After possibly a series of great hardships to the staff and disaster to the company, it is found that the tin raised is infinitesimal in value when compared to the rate of expenditure, and that the longer the work goes on the larger will be the losses. This is usually discovered when the paid up capital is all but exhausted. The company is wound up. . . and the only people who really enjoy themselves are the neighboring Chinese miners who buy the mine and plant for an old song and make several large fortunes out of working on their own ridiculous and primitive methods (Swettenham, 1893, p. 341).

Western companies were thus generally unsuccessful in the 1880s and 1890s, and by 1900 European mines only accounted for about ten per cent of Malayan tin output (Yip, 1969), p. 149).

The Emergence of Western Enterprise

The inability of European firms to compete with the Chinese forced them to look for opportunities to utilize Western technology. Both private and government prospectors searched in vain for tin lodes, in the mining of which the Westerners enjoyed clear technical superiority. European miners also sought to develop new ways to mine alluvial tin so as to reduce their dependence on Chinese labor.

One of the techniques that was tried was hydraulic mining. That method had been used to recover gold in California. There the auriferous sands were broken up by jets of water at high pressure. The liquid ore and mud was then fed into a line of sluice boxes where gold was caught by riffles placed at the bottom. The first attempt at hydraulic mining was made with American equipment in 1891 by F.D. Osborne, a Cornish mining engineer. He was unsuccessful, but continued his experiment the following year in the mine of the Gopeng Tin Mining Co., a company floated in Cornwall in 1892 by major investors in Cornish tin mining and smelting concerns.⁶ Further experiments were made at Gopeng and at other companies, and by the turn of the century the basic techniques of hydraulic mining had been perfected (Wong, 1965, pp. 150-52).

Hydraulic mining had many advantages. First, it reduced considerably the need for Chinese labor. The process, besides being labor-saving, made it possible to use Indian or Malay laborers, for the work demanded of the labor force was less arduous (Wong, 1964, p. 140). The Gopeng mine, for example, employed 22 Chinese to operate the monitors and wash the tin-bearing mud into the ditch, and 40 Malay and Tamil women to pan for the ore. They did the work of 200 Chinese coolies (Thoburn, 1977, p. 127). Hydraulic mining also allowed Western companies to treat profitably ground that the Chinese with the labor-intensive techniques would have found uneconomical to mine. This gave Europeans the possibility to enter the industry without competing head-to-head with the Chinese.

The new technique rapidly took hold in the industry and by 1905 there were nine hydraulic mines in the Federated Malay states, including one Chinese-owned (Thoburn, 1977, p. 85; Wong, 1965, p. 210). A major improvement introduced around 1910 was the use of pumps to operate the monitor and elevate the slurry, a technique known as "gravel pumping." This made hydraulic mining possible in areas which did not have a natural head of water.

Dredging

Dredging was the major innovation that established European dominance in the industry. The first efficient bucket dredges were developed to mine

gold in New Zealand in the early 1880s. The use of dredges spread to gold and tin mining in Australia (Blainey, 1978, p. 254). In 1907 an Australian company introduced in Phuket Bay, off the west coast of Thailand, the first bucket dredge to mine for tin in Southeast Asia. By 1910 there were five dredges working in Phuket Bay and at the eve of WWI dredging had spread to Malaysia (Sinlapajan, 1969).

Dredges allowed Europeans to enter tin mining without having to compete for land with the Chinese. Dredges could operate in swampy wet land where drainage would have presented insurmountable problems. They could also work economically very low grade deposits previously considered too poor to be worth mining, and ground that had been already worked out by the Chinese using opencast methods (Yip, 1969, p. 133).

Dredging had also the advantage of being capital-intensive, thus saving on the use of Chinese labor. By World War I a typical dredge, costing 12,000 British pounds, could dig and treat in one day, with the help of 90 Chinese under European supervision, as much tin-bearing ore as 2,000 Chinese coolies in a traditional mine (Yip, 1969, p. 134). Table 3 shows that the development of dredging was very rapid. Because of its technical limitations, dredging did not, however, totally displace other mining methods (Table 2).

The Diffusion of Western Techniques

Chinese entrepreneurs had two main advantages over their European competitors: they enjoyed cheaper labor costs and held most of the best tin grounds. In the last decade of the century, a number of events reduced these advantages. First, a growing demand for Chinese labor in other sectors of the Malayan economy raised miner's wages. Increased opportunities on the outside, and the weakening of the Chinese secret societies by British authorities, made the truck system more risky for the advancers, since the workers could abscond without paying back their debts. The abolition of the opium and gambling farms between 1895 and 1912 also took a source of substantial profit away from the Chinese advancers (Wong, 1964, p. 148). Second, the exhaustion of high-grade surface deposits forced the Chinese to turn to more sophisticated mining methods.

The fortunes of the Western companies thus clearly hinged on the Chinese miners' ability to adopt the new techniques of hydraulic mining and dredging. These techniques could be purchased from a number of European mining engineering firms based in Malaya, and gravel pumping was in fact quickly taken up by the Chinese.⁷ Their craftsmen soon learned how to make pumps and monitors, so that by 1925 nearly all Chinese mines used gravel pumps (Wong, 1965, pp. 210-11; Allen and Donni-thorne, 1957, p. 153).

Chinese capitalists did not, however, take up dredging, and, consequently, the major segment of the industry was captured by European foreign

direct investors. Why didn't the Chinese enter dredging in competition with Europeans? There is little evidence that technology was the main barrier. Western mining companies subcontracted the design of dredges to independent mining consultants (such as F. W. Payne and Co.) and their construction to independent shipyards. The technology was therefore available on the market. The Chinese seem also to have become rapidly skilled in operating dredges, for, as early as 1917, they were employed as winchmen on European-owned dredges "with great satisfaction" (Griffiths, 1917, p. 79).

The major factor preventing Chinese entrepreneurs from adopting dredging seems to have been their limited access to capital. The Western banks who had offices in Malaya followed the British banking tradition of specializing in short-term credit to finance foreign trade and other commercial activities, leaving the provision of long-term financing to the London stock exchange (Drake, 1980, p. 156; Mackenzie, 1954, p. 285).⁸ Domestic sources of finance were limited, as the Malayan Chinese remitted a large part of their savings to their relatives in China, or invested them in mortgages and real estate (Song Ong Siang, 1923, p. 116). After 1906, the development of rubber planting increased the competition for local capital, and Chinese mining companies found it more and more difficult to borrow from the Western banks of Singapore. European entrepreneurs, on the other hand, were not constrained by the lack of local credit since they could tap overseas capital markets. This advantage was especially significant for such a capital-intensive process as dredging. Dredging required a large capital outlay which could be most efficiently obtained by floating joint-stock companies abroad. Chinese entrepreneurs were not able to tap these sources of finance. Their business was organized in single proprietorships or partnerships. They were unfamiliar with formal Western practices, including joint-stock companies, and unwilling to change their traditional forms of organization (Stahl, 1951, p. 113). In spite of the efforts made by the Perak Mines Department to persuade them to form such companies, there was not a single Chinese limited liability company in Malaya in 1914 (Wong, 1964, pp. 146-7).⁹ Finally, Chinese entrepreneurs lacked the business connections with the European investing public that would have made a London flotation possible.

Between 1920 and 1927 Malaya's tin production more than doubled. The overwhelming share of that increase was due to new dredging companies floated in London. A look at Tables 1, 2, and 3 shows that by 1937 dredges, all European controlled, accounted for half of Malaya's output, while the Chinese produced one third of that output in numerous small gravel pump operations. European enterprise was by then in solid control of the industry.

IMPLICATIONS FOR THE THEORY OF THE MNE

The history of early foreign investments in Malaysian tin mining is broadly consistent with the new theories of the MNE. As predicted by

TABLE 1

**European and Chinese-Controlled Production
of Tin in Malaysia, 1900-1940**
(thousand metric tons of tin-in-concentrates)

Year	Total output (tons)	European production		Chinese production	
		(tons)	(%)	(tons)	(%)
1900	43.7	4.4	10	39.3	90
1910	46.6	9.8	22	34.8	78
1915	47.7	13.4	28	34.3	72
1920	35.6	12.8	36	22.7	64
1925	46.7	20.5	44	26.2	56
1930	66.0	41.5	63	24.5	37
1935	41.4	27.1	65	14.3	35
1940	82.0	58.6	71	23.4	29

Source: Calculated from Yip, 1969, pp. 149, 161, 164, 347, 402. 1900 figures are estimates.

TABLE 2

**Percentage of Total Output of Tin by Mining Method
Federated Malay States (1928-37)**

	1928	1937
dredging	30.2	48.2
gravel pump	45.1	38.2
hydraulic mining	8.4	4.3
open-cast	6.4	4.0
underground	5.6	3.8
dulang washing	1.8	1.3
other methods	2.5	0.2

Source: Fermor, 1940, p. 112-113.

TABLE 3

Dredging Output of Malaysia 1880-1940
(thousand metric tons of tin-in-concentrates)

	Total output	Number of dredges	Dredging output
1880	11.9	0	0
1890	27.6	0	0
1900	43.7	0	0
1910	46.6	1	0
1915	47.7	11	2.2
1920	37.2	20	4.7
1925	46.7	40	12.7
1929	74.7	105	37.0
1935	41.4	70	18.6
1940	82.0	104	42.9

Source: calculated from Wong, 1965, p. 246; Yip, 1969, pp. 149, 161, 163, 375, 392, 400-401.

Dunning's OLI framework, FDI in Malaysian tin mining took place because three conditions were simultaneously realized. First, there was a shift in the location of tin mining: the exhaustion of Cornish mines coupled with a growing demand for tin stimulated efforts to find new orebodies in other locations. But why was the increase in tin production achieved through FDI by Westerners, and not by an increase in the output of local (Chinese) firms? Here the question centers on the advantages that Europeans had over the Chinese (Dunning's O) and on the method they chose to exploit them (the internalization issue).

The first point which appears clearly from the record is that foreign investors had substantial *disadvantages* vis-a-vis local firms. The conditions of general insecurity which prevailed in Malaya before the British took control made it impossible for Western firms to operate. Our story underlines another type of disadvantage which has not been discussed in the FDI literature. Foreign investors go abroad to combine local resources with their firm-specific advantage. Investors in Malaya were interested in exploiting indigenous tin deposits with new mining techniques. Yet, because of their ignorance of the local economy, these investors incurred higher cost than locals in contracting with complementary inputs, i.e., with the factors of production which had to be purchased locally and combined with those internalized by the MNE. In our case, Western firms experienced very high costs in managing local labor and were often unsuccessful in negotiating leases with landowners.¹⁰ They had the handicap of having come last. Their Chinese competitors held the best tin ground and had tied up the only source of qualified labor through their control of Chinese immigration. This situation is not dissimilar to that encountered today by many MNEs which seek to exploit their advantages in foreign markets, and find that the control of key resources is often monopolized by indigenous entrepreneurs or host governments.

One necessary condition to overcome these handicaps was the possession of some significant advantage over local entrepreneurs. That advantage was, in our case, privileged access to information, technology, and financial capital. As our story clearly shows, as long as Europeans did not have a clear technological advantage, the high management and information costs they experienced made them non-competitive.

Western dominance was achieved through the introduction of two new mining techniques, gravel pumping and dredging, which were borrowed from the practices that another mineral industry (gold mining) had developed in far-flung places (California and New Zealand). One important characteristic of these techniques was that they allowed the newcomers to bypass the barriers to entry set up by their Chinese rivals. Hydraulic mining and dredging both saved on Chinese labor and allowed for the profitable mining of low-grade or swampy deposits which their competitors were unable to exploit.

Why did this transfer of new techniques take place through foreign direct investment? Why didn't the Chinese, who benefitted from an initial

advantage, and who had control of the best mining land, successfully acquire or imitate European techniques, and shut off foreign firms from the industry?

Our findings, while supporting a transaction-cost explanation of the MNE, underline the danger of generalizing from a few examples. In our case, while superior technology was a necessary condition for the establishment of European firms, their long-term advantage over their Chinese rivals came from their ability to internalize inefficient international markets for long-term capital, as the less capital-intensive technique, hydraulic mining, was quickly adopted by their competitors.

The relative ease with which the Chinese were able to acquire this new technology is due to the particular way technical progress takes place in most mining industries. The traditional internalization model implicitly assumes that firms control the know-how used in their production process. Foreign direct investment allows the innovating firm to efficiently incorporate this know-how into the manufacture of the final good in the foreign country. This view may be too simplistic. In some industries, as in our case, the technology is not held by the producers, but is developed by specialist firms, and is consequently widely available.

The difference in the speed of adoption between hydraulic mining and dredging shows that the crucial advantage which allowed Western investors to survive and prosper was their privileged access to long-term capital. Most proponents of internalization theory have seen failures in the market for knowledge as the principal cause of foreign direct investments. The internalization literature has paid little attention to the existence of high transaction costs for other factors of production. Thus neither Buckley and Casson (1976) nor Rugman (1981) have explicitly considered the fact that international capital markets are often highly imperfect, and that the internalization of capital might be one motive for FDI.

It is easy to see why international credit markets might experience substantial transaction costs. Lending involves making funds available to the debtor, to be paid later with interest. The risk is that the borrower might be unable to meet his obligations, either because he has willfully spent the funds with no intention to repay, or because he has been unsuccessful in his investments. The easiest way for the lender to protect himself is to obtain some collateral, whose value to the borrower is higher than the value of the loan. Another tactic is to lend only to borrowers who are personally known to the lender as having both the intention and the ability to honor their obligations. Thus an established reputation and personal contacts are likely to be important factors in obtaining finance.

The Chinese were quick to adopt hydraulic mining because the capital cost of this technique was relatively modest. Dredging, on the other hand, required a larger initial investment, which was difficult to amass within the traditional Chinese forms of business organization. The Malaysian banking system being unwilling to provide long-term finance, the only avenue left open was to float Chinese limited-liability companies on

European stock exchanges. The Chinese were reluctant to shift to joint-stock forms of organization. Their lack of business connections in Europe would have put them, in any case, at a great disadvantage.

The advantages that personal contacts gave in raising capital is demonstrated by the fact that the British entrepreneurs who floated the companies investing in Malaysian tin mining were either personally involved with the tin industry, or were well acquainted with major stockholders in tin mining, smelting, or trading concerns. Many of the pioneer companies active in Malaya were organized in Redruth, the seat of the Cornish tin mining industry. Given the risk of applying untried techniques in a distant and little-known country, the personal reputation of the promoter was the key factor which made the mobilization of the required capital possible.¹¹

CONCLUSIONS

The paper shows the record of early European investments in Malayan tin mining to be consistent with the predictions of the new theories of the MNE. It also indicates that those models are susceptible of much broader applications than has been the case so far, provided that some of the models' assumptions are subjected to careful scrutiny. In our case, the crucial advantage that established the continued dominance of Europeans was not their possession of proprietary know-how, as a naive application of the theory would lead us to expect, but their privileged access to capital. This suggests that the contribution that those models can make to our understanding of the MNE depends crucially on their careful applications: specifically, as the efficiency of markets for know-how, capital, and other factors is likely to vary across time, countries, and industries, the reasons for FDI will vary accordingly.

Naturally, the FDI environment before WWI differs significantly from that of today. With the explosion of worldwide communication, MNEs have better information on foreign markets than their 19th century predecessors. On the other hand, the cost of contracting with local holders of complementary resources (including host governments) is probably as high today as it was before WWI. Similarly, one can argue that international capital markets are more efficient today than they were in the period under study, although the recent debacle of international lending shows that they still suffer from many imperfections.

Clearly, case studies like this one cannot provide rigorous tests of the new theories. They are, however, useful at this stage to determine which of their very assumptions are consistent with the facts and to flesh out these rather abstract models. As such, they are an important building block in the construction of more sophisticated models of the multinational enterprise.

NOTES

1. "European" or "Western" here means non-Malay and non-Chinese. Most of the Europeans were British, but there were also Australian, French and American-owned companies.

2. In 1880, the capital cost of opening a Chinese mine worked by 600 laborers with no Western machinery was estimated at 4,272 Malayan dollars, or about the price of a centrifugal steam pump. Forty-three percent of that cost was for collecting and importing the labor force. This was an unusually large mine by contemporary standards (Wong, 1965, p. 63).
3. Under the farm system, the tax authorities sold to tax-farmers the exclusive privilege of collecting certain taxes for a given period. The difference between the taxes collected and the cost of buying and running the farm was the farmer's profit (Wong, 1965, pp. 76-77).
4. Tin deposits are of two types: lode or hard rock deposits, as in Cornwall, or alluvial deposits, as in Malaysia, Thailand, and Indonesia.
5. The only exception was in the case of lode mining, where Chinese methods were inadequate. Hence the success of Pahang Corporation.
6. This was not, however, a vertical investment. The tin concentrates from the mine were sold at arm's length to independent smelters, and the tin metal sold to independent users.
7. One of the most famous of those mining consulting firms, Osborne and Chappell, was founded in Ipoh, Malaysia, by F. D. Osborne in 1890.
8. Even the provision of short-term credit to Chinese entrepreneurs was characterized by high transaction costs. Because of language and cultural barriers, British colonial banks dealt with Chettiars (South Indian money lenders), who enjoyed a high reputation among Western bankers. The Chettiars re-lent to Chinese businessmen at twice the bank rate (Chai Hon-Chan, 1964, p. 168).
9. By 1938, only 4 percent of the issued capital of companies engaged in Malayan tin mining was held by Chinese registered companies (Fermor, 1940, pp. 69-70). The first Chinese dredging company started operations in 1965.
10. McKay (1970, pp. 176, 193) also found these to be the two major problems encountered by French and Belgian investors in Russia at the turn of the century.
11. A better knowledge of downstream markets for tin was probably another European advantage, but not too much should be made of this. Since the industry was vertically disintegrated, the future demand for tin should have been reflected in the prices that smelters were willing to pay Chinese miners for their tin concentrates.

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