



# International tin agreements & the rise of Brazilian tin mining industry

by Ralf Larsson and Patrik Söderholm

**Brazil's share of the world tin cassiterite production increased from 3 per cent in 1980 to almost 22 per cent in 1989. Pitinga and Bom Futuro, two deposits discovered in 1979 and 1987 respectively, together increased the production capacity of Brazil by over 700 per cent. The superior geological conditions and the favorable economics of these deposits have been the dominant and necessary factors behind the soar in Brazilian tin cassiterite mining. However, the International Tin Council's market interventions from 1976 and onwards as well as domestic governmental support have also been crucial for the development described.**

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Brazil increased its production of tin cassiterite<sup>1</sup> from 7 kt in 1980 to 50 kt in 1989, also increasing her world market share from 3 per cent to 22 per cent during the same period (Table 1). Along with Brazil, China was the only country that consistently increased production during the 1980s. During the same period, old leading producers like Malaysia, Thailand and Bolivia lost in production. Hence, from being the eighth largest world tin cassiterite producer in 1980, Brazil became the number one contributor in 1989. The purpose of this paper is to briefly depict and explain this remarkable and unanticipated expansion.

The findings of two new deposits, Pitinga and Bom Futuro, are almost alone responsible for the tin cassiterite production increase in Brazil from 1982 and onwards (Figure 1). Pitinga started producing in 1982 after three years of exploration and development. Extraction at Bom Futuro was initiated in 1987 as small-scale local miners practically 'invaded' the mine. Both Pitinga and Bom Futuro were among the world's richest tin cassiterite deposits at the time when they were discovered. The biggest known deposit before Pitinga was located in Tasmania and had an annual production capacity of 5 kt.<sup>2</sup> This is in comparison to Pitinga's annual capacity of 20 kt in 1985 and Bom Futuro's of 33 kt in 1989.<sup>3</sup> Initially, the average ore grades at both Pitinga and Bom Futuro were around 10–20 kg per cu m, compared with the average ore grades of the old main producers operating with less than 0.5 kg per cu m.<sup>4</sup>

These geological advantages also meant that the two deposits were extremely profitable, with the lowest costs of production in the world.<sup>5</sup> Bom Futuro, in particular, had (and still has) exceptionally low extraction costs. Here the tin cassiterite could be found at a depth of only 2 meters.<sup>6</sup> During the 1980s the rival deposits in South East Asia were quite old and the easily exploited concentrations had already been exhausted. Furthermore, even if findings outside Brazil

have been plenty since 1980, the economic rent for these operations have been small.<sup>7</sup> Thus, in comparison with their competitors the geological and economical conditions of Pitinga and Bom Futuro were, and to some extent still are, extraordinary.

Figure 1 pictures the respective contributions of Pitinga and Bom Futuro to the soar in Brazilian tin cassiterite production during the 1980s. Even if their outstanding geological qualities and low costs of production alone can explain the increase in Brazilian tin production there are also other important circumstances that did speed up the findings and the developments of these deposits. The historical review that follows in the following sections will show that the interdependence between the rise of Brazilian tin mining in the 1980s and the actions of the international tin agreements, especially the International Tin Council (ITC), has been substantial. Not only did the ITC stimulate tin mining in the country but perhaps more importantly, this is also the story about how the production expansion from Brazil from the late 1970s and onwards put an end to the long lasting commodity agreement. Furthermore, governmental support and institutional changes have also played a crucial role in encouraging tin mining in the country.

## The Brazilian tin mining industry: the early days

Extensive tin cassiterite mining in Brazil began in the state of Rondônia. Here small-scale independent miners, so-called Garimpeiros, produced tin cassiterite in the late 1960s. The Garimpeiros are basically poor people mining to survive. The tin cassiterite was sold to domestic smelters, which otherwise had to import their raw material.<sup>8</sup> Established mining companies, often with tin smelting capacity, were also attracted to the fields and lobbied the government to get rid of the Garimpeiros.<sup>9</sup> With the federal mining act 195 in 1971 the Garimpeiros were prohibited to mine in Rondônia and

**Table 1. Tin output from the major tin mining countries (kt)**

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
<b>China</b>	na	15	16	17	18	20	25	28	38	41	42	42	44	49
<b>Brazil</b>	7	8	8	13	20	26	25	27	44	50	39	29	22	26
<b>Malaysia</b>	61	62	52	41	41	37	29	30	29	32	29	21	14	10
<b>Indonesia</b>	33	32	34	27	23	22	24	26	30	31	32	30	29	29
<b>USSR</b>	16	37	16	35	17	17	16	15	15	14	13	12	16	14
<b>Thailand</b>	34	35	26	20	22	17	17	15	14	15	15	11	8	5
<b>Australia</b>	12	12	13	11	9	6	7	9	7	8	7	6	7	8
<b>Bolivia</b>	27	27	24	25	20	16	11	8	11	16	17	17	17	19
<b>World total</b>	244	243	227	208	224	216	203	201	221	231	217	190	179	188

Source: United Nations (1991, 1993), DNPM (annual) and Metall Gesellschaft AG et al (1995).

only established companies were allowed to apply for mining or exploration rights in Rondônia. Establishment is done at the government agency DNPM (Departamento Nacional da Produção Mineral).<sup>10</sup>

With the development of Rondônia the federal government became aware of the tin cassiterite potential of Brazil. The mining laws in Brazil were relatively liberal and aimed at stimulating utilization of the country's resources by offering private companies financial and technical assistance.<sup>11</sup> Through the CPRM (Companhia de Pesquisa de Recursos Minerais, set up in 1969) the government undertook a large number of exploration

projects in the early 1970s. For tin mining purposes, the biggest success came with the radar project RADAM. It started out in 1971 with a purpose to evaluate the natural resources of the Amazon state. With the use of radar one could see the tin granites as dark spots and many potential tin deposits were found this way.<sup>12</sup> Thus, the government improved the potential for future tin cassiterite mining in Brazil not through tax/subsidy incentives but primarily through own exploration activities, which increased the knowledge about the huge country's tin reserves.<sup>13</sup>

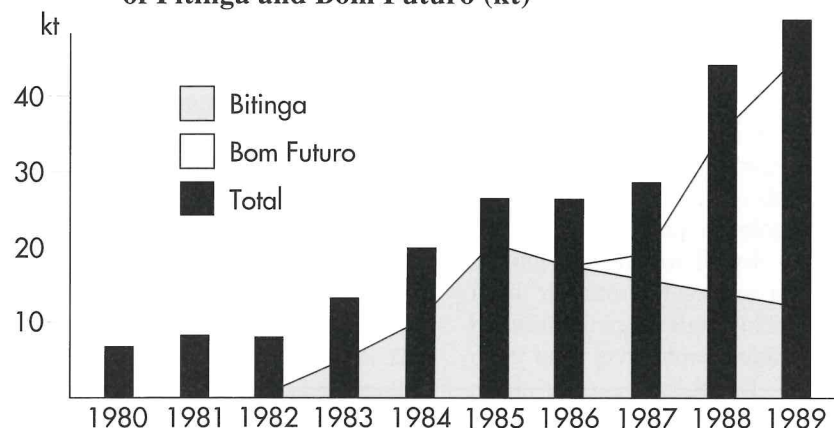
During the 1970s, the Brazilian tin mining industry was divided between

Paranapanema, Brumadinho and Cesbra. They each had a market share of roughly 30 per cent, leaving the rest of the market to established small-scale companies. These companies all benefited from the activities of the CPRM and as imports of tin cassiterite became uneconomical in the end of the 1970s their interest in tin mining increased even further.<sup>13</sup> Another major incentive, we argue, came with the market interventions of the ITC.

### The international tin council and Pitinga

The ITC was the international tin organization, supported by the United Nations, and with members from both the consumer and the producer side of the market. It was established in 1956 and operated on the international tin market until 1985. Malaysia, Indonesia, Thailand and Bolivia were the major producer members. Brazil and China, on the other hand, were never members of the ITC.<sup>15</sup> ITC's main objective was to stabilize world tin metal prices within a specified range.<sup>16</sup> In this way, consumer countries would not suffer from a high tin price and producer countries would be better off during recessions. The actions of the ITC normally involved buffer stock operations, with a buffer stock manager who was buying tin metal when necessary.<sup>17</sup>

**Figure 1. Brazilian tin output and the contributions of Pitinga and Bom Futuro (kt)**



Source: Pereira (1994) and PC H. Machado Coelho.

In spite of a weakening world demand from 1976 the ITC floor support price was raised by over 78 per cent from May 1976 to October 1981 by ITC operations.<sup>18</sup> The effect on the tin metal price of these operations is shown in Figure 2. The ITC wanted to secure future production in Bolivia, the country being recognized as the high cost member of the ITC.<sup>19</sup> It was also thought that a rising tin price was a reflection of the fact that tin reserves were low in relation to annual consumption. However, the tin price level probably had very little to do with economic fundamentals, i.e. it was basically a 'political' price.<sup>20</sup> No matter how, "there was virtually no hint of the expansion in output which was to come from Brazil in the 1980s."<sup>21</sup>

For the Brazilian tin mining companies, though, the tin metal price increase came very timely. Most companies were producing at the margin in the mid 1970s and in 1975 and 1976 some of the mines were close to closure.<sup>22</sup> The broken line in Figure 2, for example, shows the level of the Brazilian tin producers' marginal cost of production in 1976.<sup>23</sup> As the price was raised Brazilian producers were able to make a profit, something which encouraged continued tin mining. Bromadinho is one example of this. The company was able to proceed with its mining operations until the price collapsed in 1985, after which they only engaged in smelt-

ing activities.<sup>24</sup> For Paranapanema, on the other hand, the decision by the CPRM to give the company the mining rights to Pitinga was the most important factor for its long term survival (see below). It should be noted however that the financial performance of Paranapanema had probably deteriorated if it had not been for the increasing tin price in 1976.<sup>25</sup>

The most important effect of ITC's price raise was probably however the drastic increase in exploration and developments of new deposits in Brazil that it gave rise to.<sup>26</sup> Companies were eager to get mining rights to new deposits and the rising price was the major incentive.<sup>27</sup> In 1979 Pitinga was prospected by the CPRM and the mining rights were (as mentioned) given to Paranapanema. The deposit was first spotted through the RADAM project.<sup>28</sup> The investments at Pitinga were large, over 102 MUSD excluding exploration costs. The high and rising tin metal price together with the geological potential of Pitinga encouraged these investments.<sup>29</sup> The management at Paranapanema faced an uncertain future with regard to future tin price movements. However, it was unlikely that the ITC would have the strength to maintain the artificially high price level for much longer, it was argued. Also, fierce internal competition (often from illegal mining) had begun to increase. For these reasons, the company's strategy at

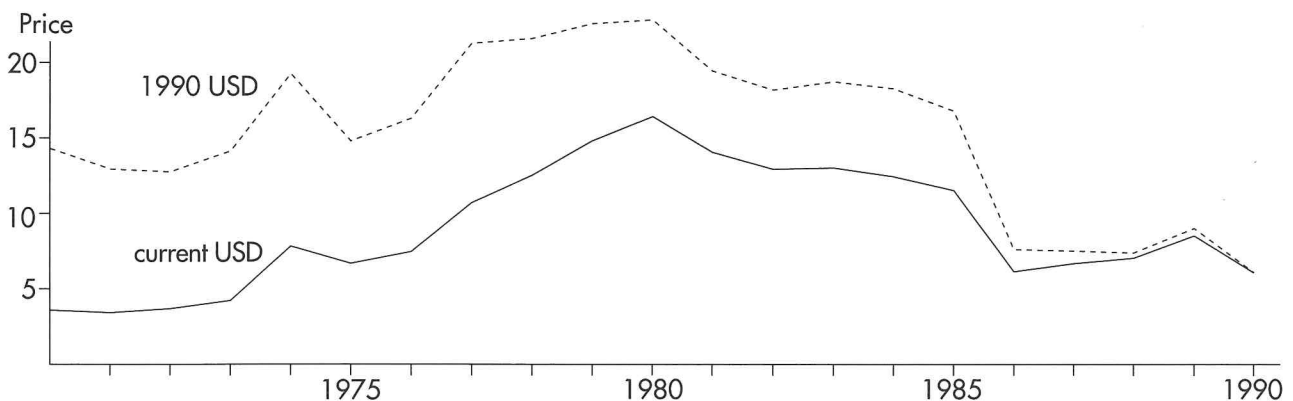
the time was to earn profits fast and maximize production.<sup>30</sup> Given this, it also made sense for the company to lobby the government not to join the ITC.<sup>31</sup>

In 1982, when Pitinga began producing, export controls for ITC's producer members were enforced but still stocks continued to increase. The ITC proved unable to hold off the huge stocks from the market, the stocks which accumulated as demand fell and sales from Brazil rose. From 1982 until 1985 the ITC defended a monopolistic price floor through continuous supporting purchases.<sup>32</sup> In October 1985, though, the buffer stock manager could no longer meet his obligations and the ITC collapsed, as did the tin metal price (see Figure 2).<sup>33</sup> Thus, Brazilian tin producers put an end to ITC's market operations, the same operations that earlier had encouraged tin mining activities in Brazil.

### The Association of Tin Producing Countries and Bom Futuro

After the downfall of the ITC another tin organization, the Association of Tin Producing Countries (ATPC), continued to operate on the weak tin market.<sup>34</sup> All major producer countries, except Brazil, were members of the ATPC.<sup>35</sup> With one of the major producers outside the organization the ATPC became a relatively

Figure 2. Average annual price of tin metal (USD/t, Kuala Lumpur Stock Exchange)



Source: The World Bank 1993.

toothless agreement. Brazil got an observer status in 1987, though, and began to restrict its tin metal exports in line with the ATPC supply rationalization schemes. These schemes aimed at reducing an alleged excess supply in the world tin market. However, with the discovery of Bom Futuro in Rondônia by the Garimpeiros in 1987 the Brazilian tin producers as an aggregate were not able to limit their production according to the schemes.

In practice Bom Futuro was an open access resource and the Garimpeiros together with small, already established, tin producers invaded the mine and extracted tin cassiterite in a manner impossible to control at the federal government level.<sup>36</sup> Also, fierce internal competition between Brazilian producers further increased the incentive to boost production at Bom Futuro. In 1988 Brazil officially exported 5 kt tin metal more than the agreed ATPC level. On top of this, illegal export activities (or smuggling) were substantial, especially between 1989 and 1991.<sup>37</sup> Thus, once again the Brazilian tin mining industry made the international tin agreements ineffective or to be more precise, in this case *even more* ineffective than before.

When mining began at Bom Futuro in 1988 the so-called article 225 was implemented. With the article the Garimpeiros were recognized as legal mining companies if they organized themselves into cooperatives, which they also have done.<sup>38</sup> This recognition was supported by the local government of Rondônia, the Garimpeiros being the greatest source of political support in the region. Here it is worth emphasizing that with the ruling military regime in the early 1970s, the federal government was much stronger than was the case in the late 1980s. However, with the democratization process in Brazil the local governments gained in power at the expense of the federal government. This shift in power over the years has, in other words, been crucial for the fortune of the Garimpeiros, being forbidden to mine in

Rondônia in the early 1970s and encouraged to do just that in the late 1980s.<sup>39</sup>

However, article 225 did not improve the control over tin cassiterite production at Bom Futuro. When the alternative is starvation, the Garimpeiros had all the incentives to maximize production, and often with very wasteful mining methods.<sup>40</sup> Anyhow, in their search for high value metals, like gold and tin, they were responsible for finding the richest tin cassiterite mine in the world.

### Conclusions

The surge in Brazilian tin cassiterite production during the 1980s was due to the findings of the Pitinga and the Bom Futuro deposits. The superior geological and economical conditions of these two deposits made Brazil the major tin cassiterite producer in the world. Government programs like RADAM provided information about the immense tin mining potential of the country and the price increase caused by the ITC sped up the development of new deposits, especially Pitinga. At Bom Futuro, on the other hand, article 225 legalized the mining activities of the Garimpeiros. Even if this led to a soar in production, it is not long-term sustainable mining that has been assured.

In the future, there are no reasons to believe that Brazil will surprise the world tin market in the way she did in the 1980s. Pitinga is today less profitable than in the early 1980s and if the tin price remains fairly stable it will produce tin cassiterite for another estimated 50 years. At Bom Futuro the most profitable areas have already been exploited by the Garimpeiros. Furthermore, the legal changes through article 225 have definitely not favored the long-run development of the mining industry in Brazil. On the one hand, the article legalizes more or less harmful mining in Rondônia while on the other hand prohibiting mining in Roraima in the north of Brazil. In the latter case, an international opinion, mainly through the World Bank and the United

States, has pushed for increasing environmental concern and protection of the local Indians. Article 225 has also made foreign investments in the tin industry less attractive by prohibiting foreign owned companies to mine for tin cassiterite.<sup>41</sup>

As a result, Brazil has lost market shares in the early 1990s, mainly to China and Indonesia (see Table 1). Thus, another production boom from the Brazilian tin mining industry is not to be expected in the near future. Of course, findings of huge deposits like Pitinga and Bom Futuro are (as we have seen) extremely difficult to anticipate but the probability of something similar happening again is lower than 15 years ago. It is also unlikely that the tin metal price will soar in the future, especially since the ATPC is much weaker than the ITC was in the late 1970s. In addition, the government's attitude towards exploration and development of new deposits is, with the article 225, much more prohibitive.

### Notes

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1. Practically all primary tin is produced from cassiterite. Throughout the article the term tin cassiterite is used synonymously with tin in cassiterite, excluding all secondary production.

2. Robertson, 1982.

3. Pereira, 1994; personal communication (Personal communication) with H. Machado Coelho. On average, tin deposits worldwide have an annual production capacity of 1–2 tt (Robertson, 1982).

4. Crowson, 1987; Cowhig, 1988; Personal communication J. Bettencourt. Personal communication N. Madhusudanan. In the 1990s, the average ore grade has been around 2.5 kg per cu m at Pitinga and 1.2 kg per cu m at

Bom Futuro (Personal communication N. Madhusudanan; Pereira 1994).

5. UNCTAD, 1990. In the tin metal market transportation costs only account for a fraction of the total production costs. Mining is by far the most costly procedure. See for example Thoburn (1981) and IAS (1991).

6. Kinch, 1988.

7. Personal communication J. Bettencourt.

8. Thoburn, 1994.

9. Personal communication F. Barboza.

10. UNCTAD, 1990.

11. Lloyd & Wheeler, 1977.

12. Ibid. Since the value of imported copper was high, the government most of all hoped to find copper deposits. The search for copper, though, often led to tin discoveries (Personal communication F. Barboza).

13. Personal communication F. Barboza; Bettencourt et al, 1981.

14. Bettencourt et al, 1981.

15. Carlin, 1992; Thoburn, 1994.

16. Radetzki, 1990.

17. Thoburn, 1994.

18. Ibid.

19. Thoburn, 1981.

20. Baldwin, 1983. We are indebted to our reviewer for this remark and reference.

21. Thoburn, 1994, pp. 143.

22. Personal communication J. Goncalves; Personal communication F. Barboza.

23. Ibid.

24. Personal communication A. Chaves.

25. Personal communication F. Barboza.

26. Bettencourt et al, 1981. Robertson (1982) compares the exploration activities in tin producing countries. These were more intense in Brazil and in the United Kingdom from the 1970s and onwards than in for example Malaysia, Indonesia, Thailand and Bolivia.

27. Personal communication J. Bettencourt.

28. Personal communication F. Barboza.

29. Personal communication N. Madhusudanan.

30. Personal communication H. Machado Coelho. It is only in the early 1990s the company decided not to produce at full capacity (Kinch, 1992).

31. Personal communication F. Barboza.

32. Anderson & Gilbert, 1988.

33. Kestenbaum, 1991; Thoburn, 1994. In 1982, the buffer stock manager ran out of financial resources, but still continued his operations until 1985 (Kestenbaum, 1991). This was made possible by borrowing cash from banks against the collateral of tin held in the buffer stock and by engaging in forward deals

that increased the Council's short-term liquidity.

34. The first agreement in the ATPersonal communication came into force already in 1983. Before the ITC collapsed in 1985 the ATPersonal communication was seen as a complement to the ITC (Carlin, 1992). In 1997 the ATPersonal communication still exists, but its influence on the tin price is insignificant.

35. Carlin, 1992.

36. Kinch, 1990, 1992; Thoburn, 1994.

37. Personal communication J. Bettencourt; Thoburn, 1994.

38. Kinch, 1988.

39. Personal communication F. Barboza.

40. UNCTAD, 1990.

41. Personal communication F. Barboza.

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