

**THE DEVELOPMENT OF STEEL PRODUCTION IN THE EASTERN AMAZON
AND THE DEBATE ON THE PROCESS OF TECHNOLOGICAL AND SOCIAL
UPGRADING**

***O DESENVOLVIMENTO DA PRODUÇÃO SIDERÚRGICA NA AMAZÔNIA
ORIENTAL E O DEBATE SOBRE O PROCESSO DE APRIMORAMENTO
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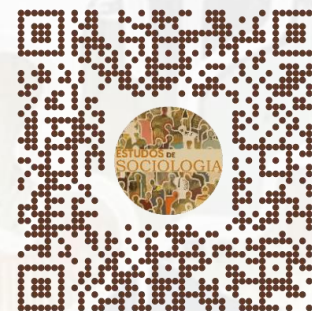
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How to reference this article:

CARNEIRO, M. S.; MANCINI, R. M. The development of steel production in the Eastern Amazon and the debate on the process of technological and social upgrading. **Estudos de Sociologia**, Araraquara, v. 28, n. esp. 2, e023015, 2023. e-ISSN: 1982-4718. DOI: <https://doi.org/10.52780/res.v28iesp.2.18871>



| Submitted: 15/08/2023
| Required revisions: 19/10/2023
| Approved: 05/11/2023
| Published em: 29/12/2023

Editor: Prof. Dr. Maria Chaves Jardim
Executive Deputy Editor: Prof. Dr. José Anderson Santos Cruz

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ABSTRACT: The article analyzes the development process of the steel industry in the Eastern Amazon, which, over the last thirty years (1990-2020), has been organized as part of a global commodity chain, seeking to identify the main transformations operated in this chain. Using the perspective of global value chain approaches and global production networks, we discuss the possibility that the ongoing technological upgrading process in this chain will produce benefits for workers and the territory in which these companies are located, highlighting, however, the role played by certain collective agents in modifying the performance of these steel companies.

KEYWORDS: Steel industry. Global value chain. Global production network. Amazon. Contestation.

RESUMO: O artigo analisa o processo de desenvolvimento da atividade siderúrgica na Amazônia Oriental, que, ao longo dos últimos trinta anos (1990-2020), se organizou como parte de uma cadeia global de mercadoria, procurando identificar as principais transformações operada nessa cadeia. Utilizando a perspectiva das abordagens das cadeias globais de valor e das redes de produção global, discutimos a possibilidade que o processo de aprimoramento tecnológico em curso nessa cadeia produza benefícios para os trabalhadores e o território no qual essas empresas se localizam, destacando, contudo, o papel desempenhado por determinados agentes coletivos na modificação da atuação dessas empresas siderúrgicas.

PALAVRAS-CHAVE: Siderurgia. Cadeia global de valor. Rede de produção Global. Amazônia. Contestação.

RESUMEN: El artículo analiza el proceso de desarrollo de la siderurgia en la Amazonía Oriental, que en los últimos treinta años (1990-2020) se ha organizado como parte de una cadena global de mercancías, buscando identificar las principales transformaciones operadas en esa cadena. Desde la perspectiva de los enfoques de cadenas globales de valor y redes globales de producción, discutimos la posibilidad de que el proceso de mejora tecnológica en curso en esta cadena produzca beneficios para los trabajadores y el territorio en el que se encuentran estas empresas, destacando, sin embargo, el papel que juegan ciertos agentes colectivos en la modificación del desempeño de estas empresas siderúrgicas.

PALABRAS CLAVE: Industria metalúrgica. Cadena de valor mundial. Red de Producción Global. Amazonas. Contestación social.

Introduction

In an article written in the 1980s about the major investment projects in the Amazon and the region's growing integration into the world market, Elmar Altvater (1989) argued that with the transformation of natural resources into commodities, the regional production centers were included in the process of international capital circulation, defending the need for the Brazilian state to introduce political restrictions on this transit of goods and capital, in order to try to guide the process of regional development.

Altvater's reflection (1989), based on an analysis of the implementation of the Carajás Iron Project, anticipated some issues that are central to the debate on development processes (CARNEIRO, 2012) and which concern the disputes that are established between private investors and state agencies, operating on different territorial scales, over the capture of the value generated in different types of economic activities.

However, despite the originality of this reflection, it did not give due prominence to the role played by non-state social agents in the implementation and development processes of the so-called large investment projects (HALL, 1991), which was done in a more recent period by an approach to the socioeconomics of development called the global production networks (GPN) model (HENDERSON *et al.*, 2011).

According to this perspective, which emerged as a critique of the global commodity chains approach (GEREFFI, 2007), when analyzing the globalized economy, it is necessary to consider not only the relationship established between the leading companies and their subcontractors, but also the role played by non-economic agents located at national and local level in the process of shaping the economic activities in question.

It is worth mentioning that this criticism from the advocates of the GPN approach has been validated by the authors of the global commodity chains perspective, who, in a recent assessment of their perspective of analysis (GEREFFI, 2018), recognized the need to observe processes of value disputes, incorporating the debate on the issue of social upgrading in commodity chains, based on the actions of trade unions and social movements (BARRIENTOS; GEREFFI; ROSSI, 2018).

In this sense, this article discusses the trajectory of an economic activity implemented in the Eastern Amazon, that of steel production, which has been organized as part of a global value chain (or network), seeking to identify the main transformations that have taken place in this chain over the last thirty years (1990-2020).

Started as a pig iron production activity and aimed at meeting the demand of steel mills located mainly in the United States, Amazonian steel production has recently undergone a process of technological upgrading, with the establishment of two steel mills, companies dedicated to the production of rebar, rolled and drawn steel (Sinobrás and Aço Verde Brasil), steel products with greater added value than the pig iron originally produced.

However, while from a technological point of view the improvement of steel production is an unquestionable fact, the question we seek to answer in this article concerns the results that this type of improvement has produced, that is, whether the move towards a nobler stage of steel production has generated improvements in terms of social benefits for the workers involved in the work process (industrial and forestry) and whether this steel production process, which involves the use of charcoal, has taken on a more sustainable profile.

The article begins with a brief discussion of the socio-economic perspectives on development mentioned above, seeking to identify their main contributions. It then presents the main elements of the process of structuring steel production in the Eastern Amazon, highlighting the role played by social protest in the process of developing this activity. The third section discusses the recent process of establishing a steel production sector in the region, based on the case of the companies Aço Verde Brasil and Sinobrás, seeking to identify the existence of social upgrading processes. Finally, in the conclusion, we discuss the challenges facing the companies that have carried out the upgrading process and analyze the significance of this process in terms of the relative disconnection from the global value chain (or network) that has structured steel production in the Amazon.

The debate on value capture and the question of technological and social improvement in global value chains (or networks)

The current discussion on development theories gives a central role to the so-called global commodity chains (GCC) in structuring international trade. According to Gereffi, Posthuma and Rossi (2021), based on data from the World Bank, close to 50% of the global movement of goods is currently organized by this type of inter-business relationship.

According to Bair (2009), the acceptance of this approach - which was born as an extension of Immanuel Wallerstein's world-system theory - was related to the success of export-oriented industrialization strategies in the 1980s, which gave great visibility to the production of goods by subcontracted companies, generally located in Southeast Asia, which had become the main suppliers of inputs to the central economies of capitalism.

According to the first version of this approach, the central question of analysis³ concerned the relationships of cooperation and conflict established by the different companies along a given production chain, a relationship conceptually understood as the governance structure of the respective chain (GEREFFI, 1994). Based on empirical analyses of certain economic sectors, GCC researchers have identified the existence of two basic governance structures in global chains. In the case of industries such as the automobile industry, the chain's governance would be directed by the producing companies (producer-driven); while in a sector such as the textile industry, the chain's direction would be located in the buying firms (buyer-driven). As Gereffi (1994, p. 99, our translation) points out: "If in production-driven industries the characteristics of demand are shaped by production patterns, in buyer-driven chains the organization of consumption is the major determinant of where and how global manufacturing is located".

Subsequently, the debate on global commodity chains was enriched by replacing the term commodity with value, to draw attention to the issue of the dispute over the wealth produced and to consider the analysis of non-standardized products, which are not commodities, but which make up an important part of international trade.

Gereffi's work has become the main point of reference in this literature, but his central concept of the 'global commodity chain' is misleading. The problem is that the term 'commodity' tends to be associated with standardized products made in large quantities, while much of the research focuses on the manufacture and marketing of differentiated products. The concept 'global value chain' has the advantage of drawing attention to where and by whom value is added along the chain (SCHMITZ, 2005, p. 328, our translation).

A more recent critique highlights a methodological weakness in the approach to global value (or commodity) chains⁴, due to the fact that it focuses almost exclusively on inter-company relations, neglecting the role played by non-economic social actors in the governance structure of the chains. For this perspective, called Global Production Networks, it is necessary to consider that inter-firm relations "are profoundly influenced by the socio-political contexts within which they are rooted" (HENDERSON *et al.*, 2011, p. 153, our translation), in other

³ The other conceptual elements of the approach concern the analysis of the input-output structure of the chain, the description of the territorial configuration of production and the institutional context in which it is inserted (BAIR, 2009).

⁴ The methodological discussion on research into value chains proposed by Fleury and Fleury (2005) is illustrative in this respect, since, when indicating the steps for developing the research, the authors present a list that includes companies (from the chemical and textile sectors) and business representation associations, but they do not mention the unions or other actors in the places where these companies are located.

words, they say that it is necessary to observe both the governance structure of the chain (inter-firm relations) and the way in which the chain is rooted in the territory.

To analyze this territorial rootedness⁵, the authors of the GPN perspective highlight the need to consider how "collective agents seeking to influence companies in specific GPN locations, their respective governments and sometimes international agencies" (HENDERSON *et al.*, 2011, p. 158, our translation). Among these collective agents, they cite, for example, trade unions, employers' associations and non-governmental organizations (NGOs), which take action against companies at different points in the global value chain (network).

Another important debate concerns the possibilities for companies located in countries on the periphery of the capitalist economy to upgrade from less valued activities to others that involve generating and capturing greater added value within the respective production chain (GEREFFI, 2018).

According to the typology established by global value chain studies, there are four basic types of improvement: i) **product improvement**: when the firm starts to manufacture a better quality or more sophisticated product; ii) **process improvement**: when the company reorganizes its production process, starting to produce more efficiently; iii) **functional advancement**: when the company moves to new stages in the value chain, starting to develop activities such as the design of the products manufactured and, iv) **intersectoral advancement**: the company uses skills acquired in a specific function to enter another activity (or sector) (SCHMITZ, 2005).

However, the most important aspect for understanding upgrading processes concerns the fact that changing position in a value chain, with the possibility of gains in terms of power and added value, involves disputes with other agents in the chain (SCHMITZ, 2005). According to Berthe, Grouiez and Dupuy (2018), most studies on upgrading processes are based on research in which change occurs as a result of movements by the leading company in the chain, however, as we have already seen, other social actors, rooted in the territories in which these firms are located, can also influence the upgrading process.

In this sense, when analyzing an economic structure in terms of commodity or value chains, we must consider that the activities studied are encapsulated within different territorial units (sub-national, national and global), depending, in this sense, on infrastructure actions and

⁵ De certa forma, a abordagem das RPGs retoma uma distinção que foi realizada por Altvater (1989) sobre processos de produção de valor do espaço e no espaço, no qual ele chama atenção para o fato de que a maior parte do valor gerado no território amazônico será apropriado em outros espaços, seguindo a lógica de valorização do capital.

public policies (industrial, foreign exchange, regional development etc.) developed within these units, as well as the mobilization of other social agents, impacted or interested by these public policies, which act to improve their situation.

Another aspect that should also be highlighted, and which relates to the discussion about the different types of industrial upgrading, concerns the nature of the upgrading in question and its possible impacts on the development of the local or regional economy, the quality of the jobs offered and the way in which this activity impacts the environment. In other words, it is necessary to consider not only the productive dimension of upgrading, but also to try to ascertain how this process affects the territory in which the activity is located, since there is a possibility that the company(ies) obtaining a better position in the commodity chain may be at the expense of reducing the quality of employment or the intensive exploitation of natural resources (RAWORTH; KIDDER, 2009).

The development of steel production in the eastern Amazon: a brief periodization

The national production of pig iron using charcoal as an energy input and reducer began in the 19th century and was consolidated in the 1930s (SUZIGAN, 1986). Even with the emergence and expansion of the metallurgical coke plant, charcoal-based pig iron production has continued to occupy an important place in the Brazilian steel industry, accounting for around 25 to 35% of total pig iron production in recent years.

The development of this production was based on the establishment of a production system marked by the coexistence of two types of pig iron producers: integrated producers and independent producers. The former manufacture pig iron within larger steel units, including the production of steel and other more elaborate products, while independent units are characterized by producing pig iron exclusively and then selling it to foundries and steelworks.

Until the end of the 1980s, the production of charcoal pig iron was concentrated almost exclusively in the state of Minas Gerais. However, from the end of that decade, the first steel plants were set up in the Eastern Amazon, located in the municipalities of Açailândia-MA and Marabá-PA. This shift in pig iron production to the Eastern Amazon was only made possible by the decisive action of the federal government, which, seeking to take advantage of the infrastructure (railroad and port) created to transport mineral production from Carajás, developed a set of financial incentives (tax exemptions and subsidies) to attract business groups with some experience in the steel industry (CARNEIRO, 1989; MONTEIRO, 1998).

In this sense, the implementation of iron and steel production in the Carajás region began with the relocation of steel groups from Minas Gerais (Itaminas) and the investment of companies that took part in the construction of the Carajás railroad (Queiroz Galvão, Camargo Corrêa), which, taking advantage of the incentives and tax exemptions offered by the federal government, became pig iron producers (Chart 1).

Chart 1 - First steel companies set up in the Eastern Amazon

Company name	Location	Start	Company Controller
Cia. Vale do Pindaré S.A.	Açailândia-MA	1988	Construtora Brasil (MG)
Viena Siderúrgica do Maranhão S.A.	Açailândia-MA	1988	Grupo Andrade Valadares (MG)
Cia Siderúrgica do Pará S.A.	Marabá-PA	1988	Grupo Itaminas (MG)
Siderúrgica Marabá S. A	Marabá-PA	1988	Grupo Belauto (PA)

Source: Carneiro (2021)

In addition to state support, the wide availability of charcoal was also a crucial factor in the regional establishment of this steel production. Despite the state's claim that charcoal would be produced from renewable sources (forest management or reforestation), the wood consumed by the Carajás steel mills in their early years came from three main sources: the opening up of native forests, the waste from the conversion of forests for the establishment of pastures and the waste from logging (MONTEIRO, 1998; ASSIS, CARNEIRO, 2015).

On the other hand, the low cost of the charcoal consumed by the Carajás steel mills also contributed to the amount paid for the labor used. As several studies have shown, the workers mobilized by the charcoal producers, usually contractors subcontracted by the steel mills, rarely had a signed work permit and worked in precarious conditions, with the occurrence of many situations classified as contemporary slave labor (SUTTON, 1994; MONTEIRO, 1998; CARNEIRO, 2008).

It was only through the work of social critics, especially the Human Rights Defense Centre in Açailândia, Maranhão, and the Pastoral Land Commission (CPT – Portuguese initials) in Pará, that working conditions in the Amazon's sawmill production chain came under more intense government scrutiny, with the mobilization of mobile inspection groups (PITOMBEIRA, 2011).

The boom in pig iron production in the Amazon (1998 to 2008)

While the companies located in the Amazon had a small presence in the national steel industry in the initial period of its implementation, this scenario changed in the second half of the 1990s, with Amazonian exports of the commodity surpassing 1.0 million tons (1998) and reaching 3.6 million tons before the economic crisis of 2008. On the other hand, when considering the share of total national exports, the Carajás steel mills went from 11.34% at the beginning of the decade to around 35% in 1997, reaching more than half of the pig iron exported in the following decade (CARNEIRO, 2021).

This expansion of Amazonian steel production is related to the entry of new business groups into the economic field and the expansion of the production capacity of companies that we could call "pioneers", such as Viena Siderúrgica and Cia Vale do Pindaré - which was acquired by the Queiroz Galvão group - in Açailândia-MA and Cia. Siderúrgica do Pará in Marabá-PA. In the following table (Chart 2), we present the companies that make up the Carajás steel production field in this second phase, sorting them by the year they started operating, and also highlighting the controlling business groups.

Chart 2 - Companies according to location, start of operation and controlling group

Company name	Location	Start	Company controller
Cia. Vale do Pindaré S.A.	Açailândia-MA	1988	Grupo Queiroz Galvão (PE)
Viena Siderúrgica do Maranhão S.A.	Açailândia-MA	1988	Grupo Andrade Valadares ((MG)
Cia Siderúrgica do Pará S.A.	Marabá-PA	1988	Grupo Costa Monteiro (MG)
Siderúrgica Marabá S. A.	Marabá-PA	1988	Grupo Aço Cearense (CE)
Siderúrgica do Maranhão S.A.	Açailândia-MA	1991	Grupo Queiroz Galvão (PE)
Cia. Siderúrgica do Maranhão S.A.	Santa Inês-MA	1991	Grupo Queiroz Galvão (PE)
Maranhão Gusa S.A.	Bacabeira-MA	1992	Grupo Calsete (MG)
Gusa Nordeste S.A.	Açailândia-MA	1993	Grupo Ferroeste (MG)
Ferro-gusa do Maranhão Ltda.	Açailândia-MA	1996	Grupo Aterpa (MG)
Siderúrgica Ibérica Pará S.A.	Marabá-PA	2002	Promotora Vascoasturiana (ESP)
Usina Siderúrgica de Marabá	Marabá-PA	2002	Demétrio Fernandes Ribeiro (PA)
Ferro-gusa Carajás S.A.	Marabá-PA	2005	Empresa Vale S.A.
Siderúrgica do Pará S.A.	Marabá-PA	2005	Grupo Valadares Gontijo (MG)
Sidenorte Siderurgia Ltda.	Marabá-PA	2006	Sem Identificação
Usina Siderúrgica do Pará S.A.	Barcarena-PA	2007	Grupo Costa Monteiro (MG)
Marabá Gusa Siderurgia Ltda.	Marabá-PA	2007	Grupo Leolar (PA)
Da Terra Siderúrgica Ltda.	Marabá-PA	2007	Grupo Revemar (PA)
Cikel Siderurgia S.A.	Marabá-PA	2008	Grupo Cikel Brasil Verde (PR)
Siderúrgica Norte Brasil S.A.	Marabá-PA	2008	Grupo Aço Cearense (CE)

Source: Carneiro (2021)

From a chronological point of view, the entry of these new business groups into Amazonian iron and steel production took place in two stages. In the first stage, between 1991

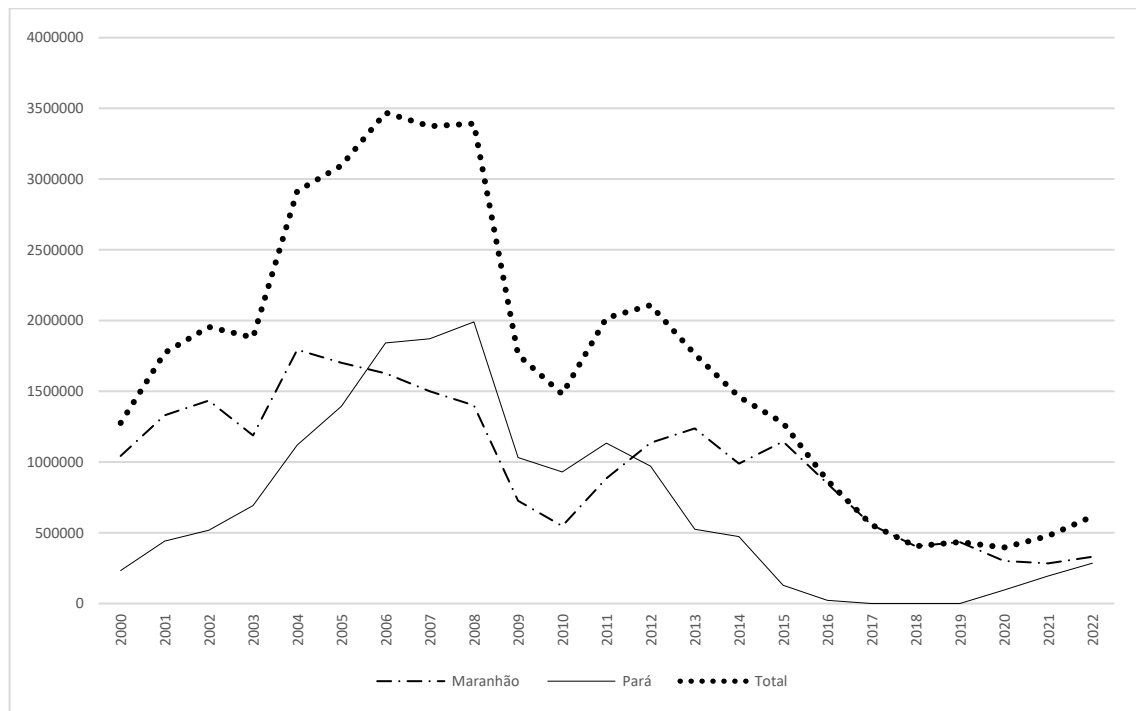
and 1996, there was an expansion of units in the state of Maranhão, with the establishment of *Simara*, *Gusa Nordeste* and *Fergumar* in Açailândia, *Cosima* in Santa Inês and *Margusa* in Bacabeira. In the second stage, which began at the start of the 21st century, the development of the iron and steel industry was concentrated in the state of Pará. Between 2002 and 2008, nine companies were set up in the Marabá Industrial District and one, the *Usina Siderúrgica do Pará*, in the port city of Barcarena-PA.

According to a report by the Social Observatory Institute (IOS, 2006), this expansion is related to the decision by the government of Pará to waive the payment of the Tax on the Circulation of Goods and Services (ICMS) on the iron ore bought by these steel mills, as well as the greater availability of charcoal from native forests. Therefore, we can say that this expansionist situation has opened up the possibility for 'neophyte' economic agents to move into steel production, such as the business groups operating in the retail sector in the state of Pará (Leolar, Revemar and Diferro), a company in the forestry sector (Cikel Brasil Verde) or Sidepar, a firm belonging to the Valadares Gontijo group, which operates in the civil construction sector.

The 2008 economic crisis and the response of steel companies

The 2008 economic crisis had its epicenter in the US economy and caused a sharp recession in global markets. As a result, Amazonian pig iron exports, which are geared towards the North American market, were heavily impacted. According to the data shown in Graph 1, regional pig iron exports fell from around 3.5 million tons in 2006 to 1.5 million in 2010, recovering somewhat in the years 2011-2012, falling again in the period 2015-2020, until starting a recovery process in 2021, but at a very low level of around 500-600 thousand tons/year. However, if the drop observed in this period was general, it affected the steel companies located in Maranhão and Pará differently, because, as the data below shows, in the years 2017-2019 there were no exports of pig iron from the state of Pará, while exports from Maranhão remained at an average level of around 450,000 tons/year.

Graph 1 - Evolution of pig iron exports (in tons) from PSC and companies in the states of Maranhão and Pará - 2000 to 2022



Source: Dados da CAMEX-MDIC

The explanation for the decline and almost total closure of the iron and steel industry located in Marabá-PA - with the exception of production for the company Sinobrás' own consumption - and the resistance of the activity in Açailândia-MA is related to two aspects: the political mobilization for a deferral in the price of iron ore sold by Vale S/A and the differentiated investments made by companies located in Maranhão to obtain charcoal from legal sources.

In the first case, it should be remembered that at the same time as the 2008 crisis caused a downturn in demand for pig iron and drove the price of the commodity down, Vale S/A decided, taking advantage of Chinese demand, to raise the price of iron ore from US\$ 48.00 to US\$ 137.00 a ton (RAMALHO; CARNEIRO, 2015). Faced with this situation, the companies located in Açailândia, with the strong support of the municipality's Metal Industry Workers' Union (STIMA), campaigned for Vale S/A to reduce the price of iron ore, arguing that the new price would make steelmaking in the region unfeasible. According to the president of STIMA, Jarlis Adelino, the mobilization had an effect and Vale S/A undertook to sell the ore at US\$93.00 a tonne (RAMALHO; CARNEIRO, 2015).

In Marabá-PA, despite the temporary closure of most of the companies in 2008 (SANTOS; ASSIS, 2015) and the bankruptcy of Cia. Siderúrgica do Pará (Cosipar) in 2012, there was no similar mobilization⁶. Speaking at a hearing to discuss the sector's crisis at the Marabá City Council on 16 October 2015, the president of the Marabá Metalworkers' Union (SIMETAL), Neiba Nunes, pointed out that "the formula adopted in Açailândia would have to be repeated in Marabá. We will learn how to make pig iron at a low price and still compete on the international market" (CARNEIRO, 2021, p. 184, our translation).

Another factor that has made it difficult for most of the companies in Marabá-PA to maintain their activities is the lack of investment in the supply of charcoal from legal sources and the heavy fines levied by the bodies responsible for environmental inspection. This was the case, for example, of the companies *Cosipar*, *Siderúrgica Ibérica* and *Siderúrgica do Pará S/A (Sidepar)*, which were subject to a heavy fine - around 284 million reais - during the "Black Balance" inspection operation carried out by the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) in 2011 (SANTOS; ASSIS, 2015).

In the case of the main companies located in Açailândia-MA, *Viena Siderúrgica*, *Gusa Nordeste* and *Queiroz Galvão Siderurgia*, the issue of social and environmental protest was tackled earlier, with the creation of the Citizen Coal Institute in 2004, and heavy investment in eucalyptus plantations for charcoal production (CARNEIRO, 2021), which led these companies to formalize labour relations and invest in technologies to mechanize charcoal production, in a pattern that is not at all reminiscent of the early days of charcoal production in the region (CARNEIRO, 1995; MONTEIRO, 1998).

Despite this investment, the differentiated treatment obtained in the purchase of ore from Vale S/A and despite the fact that the companies of the Queiroz Galvão Group (GQG) stood out among the firms with the best results in pig iron exports after the 2008 crisis, GQG decided to sell its forestry assets in the region to *Suzano de Papel e Celulose* (in 2016), abandoning its steelmaking activities in the region.

⁶ There were demonstrations by metalworkers in Marabá, following the dismissal of around 480 employees by the company Cosipar, however, this mobilization was motivated by the defense of the dismissed workers' labor rights and not by keeping the company in business (CARNEIRO, 2021).

The 2008 crisis and the question of improving steel production in the Eastern Amazon

As Gereffi, Posthuma and Rossi (2021) point out, external economic shocks, such as the one caused by the 2008-2009 economic crisis, have had important effects on global commodity chains, as they have demonstrated the fragility of the position of companies located in the initial positions of supply chains. In this sense, we can say that in the case of the Amazonian steel industry, this crisis acted as a catalyst for some transformations that were underway in this economic field (CARNEIRO, 2021; MANCINI, 2021).

As shown in Graph 1, the most recent data on pig iron exports from the Carajás Steel Complex show that regional pig iron production has never regained the level of the 2000s, standing at around 600,000 tons/year, when it reached 3.6 million tons.

This production has been maintained mainly by the steel mills that continue to operate in Açailândia-MA, *Viena Siderúrgica* and *Gusa Nordeste*, since *Aço Verde Brasil*, also located in this municipality, uses pig iron to produce steel. In the case of Marabá-PA, the company that continues to operate fully is Sinobrás, which also uses pig iron to produce steel. However, according to news published in January 2020, two pig iron production units have started operating again in Marabá-PA, *Siderúrgica Âncora* (formerly *Maragusa*) and *Gusa Brasil* (formerly *Sidepar*).

The following chart (Chart 3) shows the current shape of steel production in the Carajás Steel Complex, which, although quite small compared to the previous period, shows a positive change, with the establishment of two companies that produce steel and steel products, *Sinobrás* and *Aço Verde Brasil*.

Chart 3 - Information on companies operating in the PSC - 2022

Company	Location	Start	Controller	Manufactured Products
Viena Siderúrgica	Açailândia-MA	1988	Grupo Valadares	Pig iron
Gusa Nordeste	Açailândia-MA	1991	Grupo Ferroeste	Pig iron
Aço Verde Brasil	Açailândia-MA	2016		Steel, Billets, Rebar and Wire Rods
Siderúrgica Norte Brasil S/A	Marabá-PA	2006	Aço Cearense	Steel, Billets, Rebar and Wire Rods
Gusa Brasil	Marabá-PA	2020	Sem Informação	Pig iron
Siderurgia Âncora	Marabá-PA	2020	Sem Informação	Pig iron

Source: Carneiro (2021)

The development of the production of steel and steel products by *Siderúrgica Norte Brasil S/A* (Sinobrás) and *Aço Verde Brasil* (AVB) represents what in the discussion on value chains is defined as a functional improvement, a situation in which a certain company or

companies occupy new stages in the value chain, manufacturing more elaborate steel products and capturing a greater amount of value (SCHMITZ, 2005).

Siderúrgica Norte Brasil S/A (Sinobrás) is a company belonging to the *Aço Cearense* group and started producing steel in 2006 in Marabá-PA, while *Aço Verde Brasil S/A* (AVB), which belongs to the *Ferroeste* group, was inaugurated ten years later, in 2016, in the Pequiá Industrial District (Açailândia-MA). As well as being set up at different times, these two companies follow different technological routes to manufacture steel. Sinobrás uses a mix of 30% pig iron and 70% steel, while AVB uses 75% pig iron and 25% scrap in its production process. According to information from AVB's industrial director, this technological route was chosen because the *Ferroeste* group is a major producer of pig iron in the region and the use of charcoal-fired pig iron allows to produce diversified products, such as rebar and wire rod, which are commodities, but also high-quality wire rod (CARNEIRO, 2021).

When it started operating in Marabá-PA, Sinobrás acquired a company that produced and exported pig iron, *Siderúrgica Marabá S/A* (Simara), which operated two blast furnaces. The charcoal used by the company in the production of pig iron comes from thirteen farms located in the state of Tocantins - to escape the requirements of maintaining legal reserve areas, which are much larger in areas of the Amazon biome (ASSIS; CARNEIRO, 2015) - totaling 24,000 hectares, 14,000 of which are eucalyptus plantations (SINOBRAS, 2014).

According to information from the *Ferroeste* group, in its first stage AVB will be able to produce 600,000 tons of steel, mainly for the domestic market. On the other hand, it is worth mentioning that the plant's project includes the construction of a second stage, which will allow the company to double its production capacity. AVB began operating in 2016, producing 157,000 tons of steel. In the following years, the company continued to expand its production, reaching 338,000 tons of steel in 2019. In addition to steel, AVB also produces long rolled products (wire rod and rebar) and semi-finished products (billets) (AVB, 2020).

Sinobrás began operating in 2006, with an initial production forecast of 200,000 tons of steel per year. This capacity was expanded over time and allowed the company to reach 338,000 tons of production in 2019. According to information published in the *Valor Econômico* newspaper, Sinobrás produces rebar, wire rod and drawn steel destined entirely for the domestic market (CAMARGO, 2012).

Chart 4 shows the evolution of crude steel production by steel companies and/or groups in Brazil between 2017 and 2020. As can be seen, total production fluctuated between 31.4 and

37.1 million tons per year, with the *Arcelor Mittal*, *Gerdau Aço Longos* and *CSN* and *Ternium Brasil* groups standing out, accounting for around 74.0% of total production in 2020.

Chart 4 - Crude steel production by steel company or group (in thousand tons)

Steel company or group	2017	2018	2019	2020	2021
Aço Verde do Brasil (AVB)	144	279	338	321	345
Aperam Inox América do Sul	716	709	688	696	754
Grupo Arcelor Mittal*	11.121	11.188	9.858	8.717	11.161
Cia. Siderúrgica Nacional (CSN)	4.426	4.199	3.043	3.810	4.260
Companhia Siderúrgica do Pecém	2.455	2.978	2.866	2.743	2.811
Grupo Gerdau S/A	6.955	6.654	6.301	6.220	6.974
SIMEC	284	480	671	988	951
Siderúrgica Norte Brasil (SINOBRÁS)	389	345	345	330	367
Ternium Brasil	4.497	4.606	4.379	4.138	4.529
Usiminas S/A	3.012	3.086	3.264	2.760	3.178
Vallourec Tubos do Brasil S/A	671	769	705	588	710
Villares Metals S/A	108	114	111	104	134
TOTAL	34.778	35.407	32.569	31.415	37.174

* It involves the production of the Arcelor Mittal Aços Longos, Tubarão and Sul Fluminense units.
Source: Brasil (2022)

As can be seen in the chart above, while *Sinobrás* has maintained a constant steel production of around 350,000 tons, *Aço Brasil Verde's* production has been growing steadily, having reached its highest level in 2021, with 345,000 tons. In other words, although the steel production of the steel companies located in the Amazon has been growing, it represents a small proportion of national production, which means that from the point of view of field theory they act as dominated agents in the field of Brazilian steel production, and that their maintenance and/or expansion of participation in this new economic field depends on their ability to position themselves vis-à-vis the large groups in the sector (CARNEIRO, 2021).

The move made by these two companies seems to indicate that some players in Carajás steel production are betting on functional upgrading strategies (SCHMITZ, 2005), with the transition to more sophisticated and higher value-added product manufacturing processes, moving away from pig iron production to steel and derivatives and betting on the differential of steel that is produced on the basis of a low carbon economy (AVB, 2021). In this new context, an important question is whether these companies will be able to hold their own in this new market, which is dominated by larger economic groups (IAB, 2021).

Another important dimension of the discussion about upgrading processes concerns the possibilities that the change in position in the value chain will generate positive results in social terms for the workers and communities in the localities where these companies are located. The

expectation is that the process of technological change, which demands a more qualified workforce, will lead to an improvement in jobs and working conditions, with more protection and rights for workers (BARRIENTOS; GEREFFI; ROSSI, 2018).

In the case of steel production by the companies of the Carajás Steel Complex, the data already available points to the opening of jobs with a higher level of remuneration, so we can say that the switch to steel production has had positive effects on the local labor market (MANCINI, 2021), even though the number of workers currently hired is lower than that observed at the time of the highest level of steel production activity in the region, before the 2008 crisis (MANCINI; CARNEIRO, 2018a).

A final dimension of this process of improvement, which has not yet been addressed in the literature consulted, refers to the positive environmental effects of the technological transformation in steel production in the Amazon, since the transition from pig iron to steel production required the companies studied to acquire and implement their own forest areas, disconnecting them from deforestation processes and inserting them into the production movement of so-called "ecological or green steel", with a positive contribution to the process of capturing carbon dioxide in the atmosphere and, consequently, in the fight against global warming (ADEODATO, 2019).

This positive environmental dimension is reinforced by the sustainability report of the company Aço Verde Brasil, which points out that "in the steel industry, the Group seeks to verticalize the **production of green steel**, a concept created for steel produced 100% with renewable energy and a carbon footprint, without the use of fossil fuels" (AVB, 2021, p. 6, authors' emphasis, our translation)⁷. In this sense, the production of steel using charcoal as an input can be seen as a quality strategy (MANCINI, 2021) in the competition of an economic field dominated by companies with much larger production capacities (Gerdau, ArcelorMittal), which would allow AVB to enter, for example, the field of specialty steel production (CARVALHO; MESQUITA; CARDARELLI, 2017).

⁷ In the case of Sinobrás, the emphasis is on the use of scrap metal, which the company defends as a strategy to reduce the impact on natural resources (SINOBRÁS, 2014, p. 63).

Conclusion

The insertion of the steel industry in the Eastern Amazon, based on the construction of the first pig iron production unit, will be thirty-five years old in 2023. In these three decades, this industrial activity has experienced strong growth between the end of the 1990s and 2008, oscillating with periods of crisis, especially since 2008.

The crisis brought two sets of effects: those related to the economic efficiency and profit strategies of the companies, and others related to transformations in the institutional apparatus of the steel production field. Regarding these effects, previous studies have shown that steel companies or groups were shaken by the global crisis of 2008 and by the movement of social criticism formed by civil society actors. The result was a reduction in production capacity, job cuts and the closure of production units (CARNEIRO, 2008; MANCINI; CARNEIRO, 2018a).

From the late 2000s onwards, some of the groups mobilized strategies that resulted in significant transformations in the field: the Queiroz Galvão group pioneered the incorporation of charcoal production from its own company (MANCINI; CARNEIRO, 2018b); and the Aço Cearense and Ferroeste groups advanced in the steel value chain, building integrated mills that produce steel and long rolled products. This phase saw the implementation of new profit strategies, organized through a new production model, which enabled the productive and social improvement processes of recent years (MANCINI, 2021; CARNEIRO, 2021).

However, this process of production improvement meant that the companies (AVB and Sinobras) moved away from the global value chain or network that structured the formation of steel production in the Amazon (SANTOS, 2010), since by investing in steel production they stopped or reduced their participation in pig iron exports to the North American market, directing this input towards their own production of more elaborate goods. In this sense, we can say that these companies have carried out a kind of strategic improvement⁸ (BERTHE; GROUIEZ; DUPUY, 2018), which is characterized by the development of an autonomous movement in relation to the leading agent of a given global value chain or network, developing new activities or products.

The manufacture of products with higher added value has led the companies to more rewarding markets and raises the possibility of continued production diversification in the coming years, as can be seen in the implementation of wire drawing at both Sinobrás and AVB, whose production starts with finished products, such as wire rod. This progress, however, is

⁸ As opposed to constrained upgrading, which is carried out under the leadership of the leading firms in global value chains or networks (BERTHE; GROUIEZ; DUPUY, 2018, p. 193).

accompanied by the insertion into a new context of competition, now national, in which the success of the steel groups located in the eastern Amazon will depend on the strategies adopted to face players with a greater economic contribution and presence in the Brazilian market.

REFERENCES

AÇO VERDE BRASIL (AVB). **Relatório de Sustentabilidade AVB – 2019-2020**. Belo Horizonte: AVB, 2020.

AÇO VERDE BRASIL (AVB). **Relatório de Sustentabilidade AVB – 2020-2021**. Belo Horizonte: AVB, 2021.

ADEODATO, S. Carvão vegetal ajuda a reduzir a pegada de carbono. **Valor Econômico**, São Paulo, p. f-8, 21 ago. 2019.

ALTVATER, E. Consequências regionais da crise do endividamento externo: o caso do Pará. **Novos Cadernos do NAEA**, [S. l.], n. 10, p. 99-126, 1989.

ASSIS, W. S.; CARNEIRO, M. S. O uso de carvão vegetal como fonte de energia para o PSC: controversias ambientais, sociais e econômicas. *In*: RAMALHO, J. R.; CARNEIRO, M. S. (org.) **Ações coletivas em complexos minero-metalúrgicos na Amazônia e no Sudeste brasileiro**. São Luis: EDUFMA, 2015. p. 71-103.

BAIR, J. Global commodity chains: genealogy and review. *In*: BAIR, J. (ed.) **Frontiers of Commodity Chain Research**. Stanford, Califórnia: Stanford University Press, 2009. p. 1-34.

BARRIENTOS, S.; GEREFFI, G.; ROSSI, A. Economic and social upgrading in Global Production Networks. A new paradigm for a changing World. *In*: GEREFFI, G. **Global Value Chains and Development: redefining the contours of 21st Century Capitalism**. Cambridge, UK: University Press, 2018.

BERTHE, A.; GROUIEZ, P.; DUPUY, L. Les upgradings stratégiques des firmes subordonnées dans les CGV: le cas des éleveurs investissant dans unités de méthanisation. **Revue d'Économie Industrielle**, [S. l.], n. 163, p. 187-226, 2018.

BRASIL. Ministério de Minas e Energia/Secretaria de Geologia, Mineração e Transformação Mineral. **Anuário Estatístico do Setor Metalúrgico – 2020**. Brasília, DF: SGM/MME, 2022. Available: <https://www.gov.br/mme/pt-br/assuntos/secretarias/geologia-mineracao-e-transformacao-mineral/anuario-do-setor-metalurgico>. Access: 26 Apr. 2023.

CAMARGO, T. Situação internacional pesa nas projeções da Sinobrás para 2012. **Valor Econômico**, São Paulo, p. F-4, 2012.

CARNEIRO, M. S. Estado e empreendimentos guseiros no Programa Grande Carajás. *In*: CASTRO, E.; MARIN, R. E. A. (org.). **Amazônias em tempo de transição**. Belém: UFPA/NAEA/ARNI/CELA, 1989. p. 151-192.

CARNEIRO, M. S. O Programa Grande Carajás e a dinâmica política na área de influência da ferrovia: políticas públicas e poder local na Amazônia. *In*: CASTRO, E.; MOURA, E.; MAIA, M. L. S. (org.). **Industrialização e Grandes Projetos**: Desorganização e Reorganização do Espaço. Belém: Gráfica e Editora da UFPA, 1995.

CARNEIRO, M. S. Crítica social e responsabilização empresarial: Análise das estratégias para a legitimação da produção siderúrgica na Amazônia Oriental. **Cadernos do CRH**, [S. l.], v. 21, n. 53, p. 319-331, 2008.

CARNEIRO, M. S. Práticas, discursos e arenas: notas sobre a socioantropologia do desenvolvimento. **Sociologia e Antropologia**, [S. l.], v. 2, n. 4, p. 129-158, 2012.

CARNEIRO, M. S. As transformações do campo da produção siderúrgica na Amazônia (1988-2018): apogeu, declínio e o processo de aprimoramento na cadeia de valor. *In*: RAMALHO, J. R.; CARNEIRO, M. S.; OLIVEIRA R. V. de. (org.). **Configurações do desenvolvimento, trabalho e ações coletivas**. São Paulo: Annablume, 2021. p. 173-195.

CARVALHO, P. S. L.; MESQUITA, P. P. D.; CARDARELLI, N. A. Panoramas setoriais 2030: Mineração em Metalurgia. *In*: **Panoramas setoriais 2030**: desafios e oportunidades para o Brasil. Rio de Janeiro: BNDES, 2017. p. 43-58.

FLEURY, A.; FLEURY, M. T. Em busca de metodologia para o estudo das cadeias de valor. *In*: GITAHY, L.; LEITE, M. de P. (org.). **Novas tramas produtivas**: uma discussão teórico-metodológica. São Paulo: Editora do SENAC, 2005. p. 121-148.

GEREFFI, G. The organization of buyer-driven global commodity chains: how U.S. Retailers shape overseas production networks. *In*: GEREFFI, G.; KORZENIEWICZ, M. (ed.). **Comodity Chains and Global Capitalism**. Westport & London: Praeger, 1994. p. 95-122.

GEREFFI, G. Promessas e desafios do desenvolvimento. **Tempo Social**, [S. l.], v. 19, n. 1, p. 223-248, 2007.

GEREFFI, G. The emergence of global value chains. Ideas, institutions, and research communities. *In*: GEREFFI, G. **Global Value Chains and Development**: redefining the contours of 21st Century Capitalism. Cambridge, UK: University Press, 2018. p. 17-39.

GEREFFI, G.; POSTHUMA, A. C.; ROSSI, A. Introduction – Des chaînes de valeur sous pression: continuités ou rupture pour la gouvernance du travail? **Revue Internationale du Travail**, [S. l.], v. 160, n. 4, p. 1-21, 2021.

HALL, A. L. **Amazônia**: desenvolvimento para quem? Desmatamento e conflito social no Programa Grande Carajás. Rio de Janeiro: Jorge Zahar Ed., 1991.

HENDERSON, J. *et al.* Redes de Produção Globais e a análise do desenvolvimento econômico. **Revista Pós Ciências Sociais**, [S. l.], n. 15, p. 143-170, 2011.

INSTITUTO AÇO BRASIL (IAB). **Anuário Estatístico 2021**. Rio de Janeiro: IAB, 2021.

INSTITUTO OBSERVATÓRIO SOCIAL. Responsabilidade social das empresas siderúrgicas na cadeia produtiva do ferro-gusa na região de Carajás: os produtores de carvão vegetal - **Relatório Geral**. Rio de Janeiro: Instituto Observatório Social, março de 2006.

MANCINI, R. M. **Modelos produtivos, mudança institucional e mercado de trabalho na Amazônia maranhense**: estratégias de empresas e trajetórias de trabalhadores na indústria siderúrgica. 2021. Tese (Doutorado em Ciências Sociais) – Universidade Federal do Maranhão, São Luís, 2021.

MANCINI, R. M.; CARNEIRO, M. S. Desenvolvimento industrial e mercado de trabalho: contestação social e transformações recentes na produção siderúrgica na Amazônia Oriental. **Cadernos CRH**, [S. l.], v. 3, p. 373-387, 2018a.

MANCINI, R. M.; CARNEIRO, M. S. A construção do mercado de trabalho de carvão vegetal na Amazônia Oriental: estratégias corporativas e crítica social. **Estudos de Sociologia**, Araraquara, v. 23, n. 45, p. 175-196, jul./dez. 2018b.

MONTEIRO, M. de A. **Siderurgia e carvoejamento na Amazônia**: drenagem energético-material e pauperização regional. Belém: Ed. UFPA/ETFPA. 1998.

PITOMBEIRA, K. S. **A construção da responsabilidade social empresarial no Polo Siderúrgico de Carajás**: o caso do Instituto Carvão Cidadão. 2011. Dissertação (Mestrado em Ciências Sociais) – Universidade Federal do Maranhão, São Luís, 2011.

RAMALHO, J. R., CARNEIRO, M. S. Trabalho e siderurgia na Amazônia brasileira. *In*: RAMALHO, J. R., CARNEIRO, M. S. (org.). **Ações coletivas em complexos minero-metalúrgicos na Amazônia e no Sudeste brasileiro**. São Luis: EDUFMA, 2015. p. 15-43.

RAWORTH, K.; KIDDER, T. Mimicking “lean” in global value chains. *In*: BAIR, J. (ed.). **Frontiers of Commodity Chain Research**. Stanford, Califórnia: Stanford University Press, 2009. p. 165-206.

SANTOS, M. M.; ASSIS, W. S. de. Crise do Distrito Industrial de Marabá e as estratégias empresariais. *In*: RAMALHO, J. R.; CARNEIRO, M. S. (org.). **Ações coletivas em complexos minero-metalúrgicos na Amazônia e no Sudeste brasileiro**. São Luis: EDUFMA, 2015. p. 45-70

SANTOS, R. S. P. **A forja de Vulcano**: siderurgia e desenvolvimento na Amazônia oriental e no Rio de Janeiro. 2010. Tese (Doutorado em Sociologia e Antropologia), Universidade Federal do Rio de Janeiro, Rio de Janeiro, 2010.

SCHMITZ, H. Aglomerações produtivas locais e cadeias de valor: como a organização das relações entre empresas influencia o aprimoramento produtivo. *In*: LASTRES, H. M. M.; CASSIOLATO, J. E.; ARROIO, A. (org.). **Conhecimento, sistemas de inovação e desenvolvimento**. Rio de Janeiro: EDUFRRJ/Contraponto, 2005. p. 321-345.

SIDERÚRGICA NORTE BRASIL S/A (SINOBRAS). **Relatório de Sustentabilidade 2013**. Marabá: SINOBRAS, 2014.

SUTTON, A. **Trabalho escravo**: um elo na cadeia da modernização no Brasil de hoje. Edições Loyola, São Paulo, 1994.

SUZIGAN, W. **Indústria brasileira**: origens e desenvolvimento. São Paulo: Brasiliense, 1986.

Processing and editing: Editora Ibero-Americana de Educação.
Proofreading, formatting, normalization and translation.

