Urban Competitiveness in Brazil's State of Amazonas: A Green Growth Agenda

Companion report to "A Balancing Act for Brazil's Amazonian States: An Economic Memorandum"

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Contents

Acknowledgments

This report focuses on urban competitiveness in the Brazilian state of Amazonas as a companion report to the World Bank's "A Balancing Act for Brazil's Amazonian States: An Economic Memorandum." It was prepared by Marek Hanusch (Senior Economist and TTL), Jean François Arvis (Senior Economist), Claudia Tufani (Consultant), Fabio Artuso (Consultant), Gianluca Santoni (Consultant), Giulio Zanetti (Consultant), and João Maria de Oliveira (IPEA). The team is grateful for detailed comments provided by Amanda Schutze and Luiz Bines (Climate Policy Initiative) and comments and inputs on part of the report by colleagues from the state government of Amazonas and SUFRAMA, as well as from Manaus-based private sector representatives. The team is grateful for generous sharing of data by Marc Muendler (University of California, San Diego) and Christian de Cico and Matheus Nagliati (Arquivei).

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1 An Urban Forest

Amazonas is the most industrialized state among Brazil's nine states of the Legal Amazon (here called Amazônia). It is supported by a special economic zone (SEZ), the Zona Franca de Manaus (ZFM). More than 70 percent of its population (2.7 million) live in the Manaus Greater Area. Amazonas's industrialization is closely connected with the ZFM, introduced as an SEZ in 1967 by the Brazilian government in a geostrategic effort to settle and develop Amazonia.[1] Focused on industrial production, the ZFM has enabled Amazonas to leapfrog other states in the region through more rapid development of a sizable urban manufacturing sector. It has attracted multinational corporations[2] and made Amazonas one of the most affluent states in Amazônia, with Manaus roughly on par with Belém among Amazônia's largest cities. In 2021, companies located in ZFM produced over 184 million PC circuit boards, 14 million cellphones, 10-million LCD TVs, nearly 6-million AC units, almost 5-million microwave units, and over 1.2 million units of motorcycles (virtually all of Brazil's domestic production). In the same year, Amazonas had a positive trade balance with the rest of Brazil equivalent to R$146 billion, behind only São Paulo (R$253 billion) and Santa Catarina (R$182 billion) and ahead of the other 24 states.

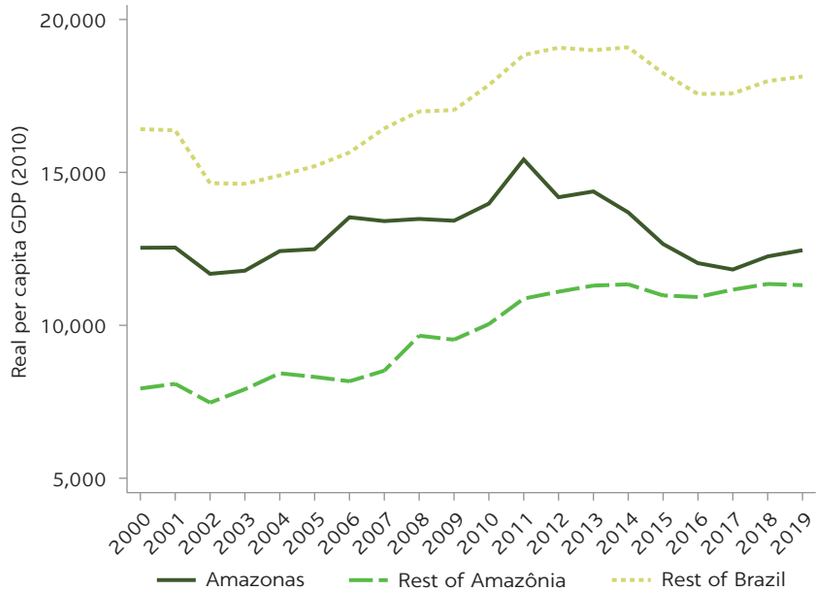
Amazonas's urban-focused growth model could be effective and sustainable but, in its current state, needs revision. In Amazonas, the industrial sector contributes to 28 percent of its GDP, the highest share in the country. Yet GDP per capita in Amazonas, after initially converging with Brazil's more advanced regions, has been regressing (figure 1), and the state has been experiencing premature deindustrialization.[3] This process is symptomatic of a loss of competitiveness of its ZFM manufacturing. Despite the potential for generating sustainable growth in the region, the ZFM in its current format falls short. It generates large economic and fiscal distortions while producing limited benefits. But an alternative, fiscally less costly, and more efficient model is possible.

Hanusch (2023), which this report accompanies, shows how urban productivity gains can generate prosperity and simultaneously help reduce deforestation pressures, making it a relevant model for Amazônia with its considerable social deprivations and its valuable yet threatened ecosystems.[4] But Amazonas's model has fallen short and received increased criticism over the years. The ZFM-based model and its potential for broader sustainable inclusive development in Amazonas and beyond deserve closer analysis. This report

FIGURE 1

Per capita GDP in Amazonas slipped after 2010

(R$)



Source: World Bank, using IBGE data.

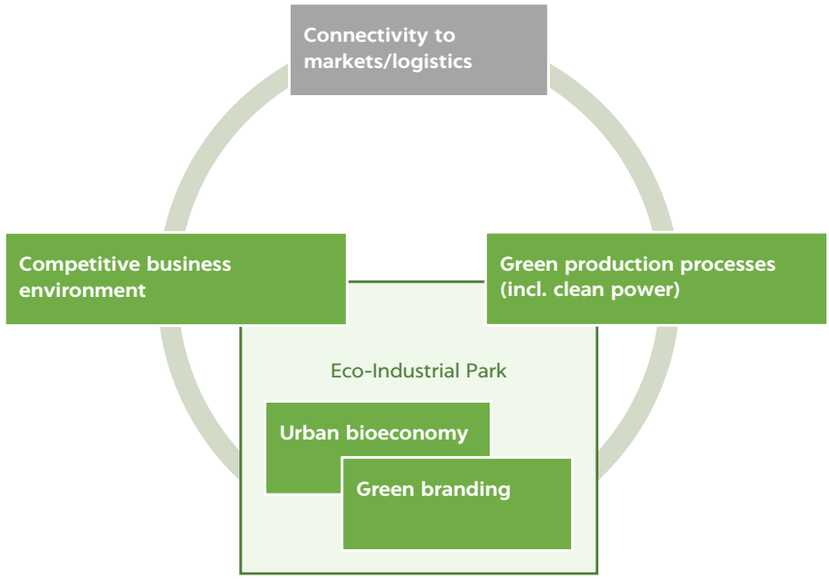
promotes urban competitiveness in Amazonas based not on fiscal incentives but on urban productivity. Amazonas may also serve as an illustrative case study with relevance for other Amazonian states that aim to foster their urban economies.

Leveraging the capabilities originally created by the ZFM requires investments in productivity, which can propel growth in Manaus and Amazonas more broadly. Lagging regions—especially those with manufacturing capabilities—have considerable potential to catch up with more advanced regions if distortions, such as trade costs or other costs to doing business, are removed. This report explores some policies that could help achieve this. Many of these policies, such as state-level regulatory changes, need not be constrained to Manaus or the ZFM. Others are more specific to the ZFM, with a suggestion to eventually transform it into an eco-industrial park. Such policies could enable Manaus to become an economic node in a network of productive Amazonian cities. A competitive and productive Manaus can thus play a positive role in Amazônia's—and Brazil's—economy, with beneficial externalities for natural forests at a lower cost to the public coffers. And a shift toward more competitive business climate could eventually reduce the fiscal liability associated with tax incentives of the ZFM.

The suggested reform priorities value all levels of government and require strong coordination across the municipal, state, and federal levels. Perhaps the key rationale for the ZFM as an SEZ is its geographic remoteness and associated high transport costs. But there is considerable policy space to reduce the costs of distance and to improve connectivity with markets in more sustainable and less fiscally costly ways than in the current model. Following a review of the current model, anchored in the ZFM, this report focuses on reform priorities to make urban Amazonas (essentially Manaus and its surrounding areas) more competitive.

FIGURE 2

Suggested reform priorities for a more competitive urban Amazonas



Source: World Bank.

Reforms could be structured around four focus areas (figure 2):

- Improved logistics.
- A competitive, productivity-promoting business environment.
- Clean production processes, including green power.
- Transitioning the ZFM to an eco-industrial park, supported by a competitive business environment and clean production, while fostering green products (the urban bioeconomy), and leveraging green branding. As productivity rises, tax incentives can be reduced or remodeled (into conservation finance).

The present report leverages a novel data source: Brazilian sales invoices from all transactions that took place in 2018. To examine subnational competitiveness, data are needed on international and interstate transactions. The report uses Brazilian firm-level tax data aggregated at state level for this purpose. Using firm-level tax data is relatively new in Brazil, offering great analytical potential (box 1).

BOX 1

Brazil's administrative data used to analyze competitiveness

Brazil has a rich and detailed set of subnational data. Spatially disaggregated data, ideally at the firm and sector levels, are needed to study the microeconomic issues associated with competitiveness in Amazonas. Brazil's electronic tax invoicing system provides this information, but access is restricted.

Through collaboration with Brazil's Instituto de Pesquisa Economica Aplicada (IPEA), the analysis for this report is based on the universe of firm-level interstate transactions from electronic tax receipts (*notas fiscais*) for 2018. The analysis used these data in a subnational gravity model,[a] supported by a trade cost matrix based on transport invoices (*conhecimento de transporte eletronico*, or CTEs) of a sample of firms for 2018. CTE data were obtained through a collaboration with the International Finance Corporation–supported Brazilian start-up, Arquivei. The subnational gravity model was complemented by external trade links based on tax data publicly available through Secretaria de Comércio Exterior (SECEX).

To study sector-state-level productivity, the analysis is based on firm-level data for 1994–2014 from Helpman et al. (2017). To strengthen the quantitative analysis, large amounts of qualitative data were also gathered through interviews and surveys with stakeholders.

As required by Brazilian law, and in line with good practice for this type of analysis, all tax data have been used guaranteeing the anonymity of companies. Some of the data, while novel, are somewhat dated. However, since the analysis focuses largely on structural issues, which tend to persist, the conclusions should still be valid today. There is scope to update the analysis if more recent data become available.

a. Redding and Rossi-Hansberg 2017.

2 An Overview of the ZFM

International experience shows that SEZs are not easy to get right. When successful, SEZs have promoted agglomeration, pooled labor, and supported technology spillovers. They can also pilot experimental policy reforms, particularly to promote innovation. They have the power to bring investment and new businesses to a region and to boost exports.[5] But while many countries have used SEZs as part of their strategy to develop manufacturing-oriented zones and advance development, success has been limited, often because of inadequate infrastructure and a lack of competitively priced labor. Even in countries that have had success with SEZs, the record is uneven. For example, while some Chinese SEZs have clearly been successful, others have done less well.[6] Despite the mixed record, governments around the world have used SEZs extensively to try to advance economic development. The number of SEZs grew sixfold over the 2000s, reaching 5,400 across 147 economies in 2018.[7] Getting the conditions right for success requires careful planning and implementation to ensure that the needed resources—labor, land, water, electricity, telecommunications—are available, that regulatory barriers are not excessive, and that connectivity is seamless. International experience suggests that infrastructure and trade facilitation promote investment and that without such interventions policies such as tax incentives have little impact.[8]

The ZFM, an older SEZ, was established in 1967 as an area for special tax incentives intended to create an engine of industrial, commercial, and agricultural development in Amazônia. Incentives and special conditions are given to compensate for local obstacles, especially the great distance to markets. The ZFM is administered by Superintendência da Zona Franca de Manaus (SUFRAMA). In the early 1990s, it was expanded to include the municipalities of Tabatinga (Amazonas), Guajará-Mirim (Rondônia), Boa Vista e Bonfim (Roraima), Macapá and Santana (Amapá), and Brasiléia and parts of Epitacolândia and Cruzeiro do Sul (Acre). These municipalities border neighboring countries and have the status of free trade areas (Areas de Livre Comércio). They are dwarfed by the ZFM.

The ZFM makes Amazonas the most important manufacturer in Amazônia, generating significant sales to other areas in Brazil. It occupies around 10,000 square kilometers across three municipalities in Amazonas: Manaus, Rio

Preto da Eva, and Presidente Figueiredo. Although it is structured around the three pillars of agribusiness, manufacturing, and services, the manufacturing pillar, Manaus Industrial Park (Polo Industrial de Manaus, PIM), is associated with the most revenue and jobs, with around 500 companies, 80,000 direct jobs, and turnover of R$82 billion in 2017.

2.1 ZFM INCENTIVES

The ZFM uses a variety of fiscal incentives to attract firms to the region (box 2). In 2018, ZFM tax subsidies (in the form of forgone tax revenues)

BOX 2

Incentives for companies investing in the Zona Franca de Manaus

Federal import tax (imposto de importação)

- Full tax exemption for goods intended for local consumption or value addition (including for manufacturing goods). Exemptions are also granted for agricultural and fishing goods that will be processed in the region and for goods related to the installation of new services.
- Partial exemption for goods produced in the zone but sold to other states in the country. A formula is applied to IT goods to calculate the exemption. The same formula is applied for cars, trucks, motorbikes, and bicycles, with an added 5 percent exemption possible. For all other goods, the tax exemption is 88 percent.

Federal tax on industrialized goods (imposto sobre produtos industrializados) related to imports

- Full tax exemption for imports intended for local consumption or for value-addition processing (including manufacturing goods).

Federal tax on industrialized goods (imposto sobre produtos industrializados) related to domestic transactions

- Full tax exemption for all goods produced in the ZFM that are produced for the local market or for sale in other Brazilian states.
- Goods produced for international markets follow the legislation for exports.

Employer contributions to national fund for workers (PIS-PASEP/COFINS)

There are three categories for PIS-PASEP contributions: on business revenues, on the value of imports, and on the payroll. In the ZFM:

- Businesses are exempted from PIS-PASEP related to imports when these goods are incorporated into business assets or when the imports are raw materials or intermediate goods used for processing by industrial plants based in the ZFM.
- Businesses producing for the local market are exempted from PIS-PASEP related to revenue on sales or on imports of raw materials or intermediate goods used for processing by industrial plants based in the ZFM.
- A series of special regimes are created for businesses that do not fit in the above categories, allowing them to request exemptions from PIS-PASEP contributions.

Incentives for IT companies

- The IT companies investing in the ZFM benefit from exemptions from the *imposto sobre produtos industrializados* and from reductions in the tax on imports (*imposto importação*).

State incentives (imposto sobre circulação de mercadorias e serviços, a state-level quasi-value-added tax)

- Exemptions between 55 percent and 100 percent.

Source: SUFRAMA, available at https://www.gov.br/suframa/pt-br/zfm/area-de-beneficios.

TABLE 1 **Fiscal incentives from the federal government in the form of forgone tax revenues, 2018**

TAX BASE	TAX/TARIFF/CONTRIBUTION	VALUE	%	
Transaction	**Imposto sobre Importação – II**	**2,750,934,049**	**10.52%**	
	Áreas de Livre Comércio	12,600,752	0.05%	
	Zona Franca de Manaus	2,738,333,297	10.47%	
	Imposto sobre Produtos Industrializados - Vinculado à Importação - IPI-Vinculado	**2,936,506,033**	**11.23%**	
	Áreas de Livre Comércio	11,486,448	0.04%	**82.88%**
	Zona Franca de Manaus	2,925,019,585	11.19%	
	Imposto sobre Produtos Industrializados - Operações-Internas - IPI Interno	**15,983,479,435**	**61.13%**	
	Áreas de Livre Comércio	**363,031,025**	**1.39%**	
	Zona Franca de Manaus	15,620,448,410	59.74%	
Revenue	**Contribuição Social para o PIS-PASEP**	**795,069,149**	**3.04%**	
	Zona Franca de Manaus - Importação de Matéria-Prima	149,979,328	0.57%	
	Zona Franca de Manaus - Importação de Bens de Capital	2,474,320	0.01%	
	Zona Franca de Manaus - Matéria-Prima Produzida na ZFM	35,121,596	0.13%	
	Zona Franca de Manaus e Área de Livre Comércio - Aliquotas Diferenciadas	216,202,788	0.83%	
	Zona Franca de Manaus e Área de Livre Comércio - Aquisição de Mercadorias	391,281,117	1.50%	
	Contribuição para o Financiamento da Seguridade Social - COFINS	**3,681,572,741**	**14.08%**	**17.12%**
	Zona Franca de Manaus - Importação de Matéria-Prima	716,629,626	2.74%	
	Zona Franca de Manaus - Importação de Bens de Capital	12,496,863	0.05%	
	Zona Franca de Manaus - Matéria-Prima Produzida na ZFM	161,826,109	0.62%	
	Zona Franca de Manaus e Área de Livre Comércio - Aliquotas Diferenciadas	988,355,603	3.78%	
	Zona Franca de Manaus e Área de Livre Comércio - Aquisição de Mercadorias	1.802.264 540	6.89%	
	Total	**26,147,551,407**	**100.00%**	

Source: Receita Federal.
Note: Does not include state-level incentives.

amounted to around R$26 billion from the federal government (table 1) and about R$6.2 billion from the state government—almost a third of Amazonas's GDP. Incentives were roughly equivalent to R$402,500 per worker (not taking into account potential job multipliers), which is about six times the average annual salary for ZFM workers (R$70,418).[9] High fiscal spending to generate jobs is not uncommon globally, yet it is usually highly inefficient.[10] Despite being thought of as a tool for job creation and economic growth, those incentives are likely to create distortions, limiting labor intensity. While the ZFM has struggled to innovate and generate exports, the incentive system was recently extended to 2073.

2.2 ZFM MAIN MARKETS

Unlike successful SEZs elsewhere, the ZFM sells mainly to the domestic market. Many SEZs worldwide benefit from duty exemptions to enhance their international export competitiveness. In 2020, Amazonas imported products valued at US$9.7 billion[11] and exported products valued at US$786 million, so imports accounted for 92.5 percent of Amazonas's total international trade (mainly by the ZFM). Domestically, Amazonas had a US$17.4 billion (R$87 billion)

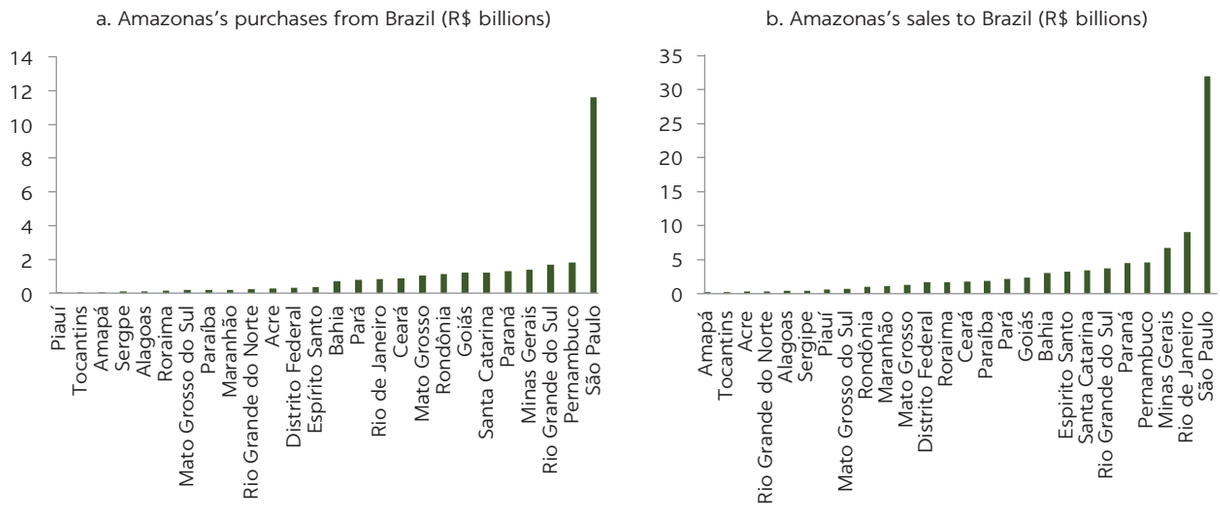
trade surplus with other Brazilian states in 2020.[12] Thus, the duty exemptions barely enhance the ZFM's integration into global value chains, a common objective for SEZs internationally. Instead, the duty exemptions essentially leverage the productivity of other countries (reflected in price-competitive imports) to compensate for the low competitiveness of remote Manaus, allowing the ZFM to compete in Brazil's otherwise highly protected market. In other words, ZFM incentives enable firms to circumvent the inefficiencies associated with Brazil's high tariffs and introduce new inefficiencies associated with remoteness—allowing Manaus to compete domestically but not globally.

São Paulo is Amazonas's main trading partner. In 2018, the value of Amazonas's purchases from São Paulo, its largest trading partner, was R$11.6 billion while the value of Amazonas's sales to São Paulo was R$ 32 billion (figure 3). To an extent, this reflects a degree of local value chain integration. For example, in the two-wheel vehicle sector, Honda sources many inputs from São Paulo and surrounding areas. São Paulo also sells consumer products (including food and hygiene articles) and other goods, including construction material, to Amazonas. And it is the main destination market for products made in Amazonas, mostly in the ZFM. Electronics (TVs, computers, radios, and smartphones), transport equipment (mostly motorcycles), and machinery and mechanical appliances (mostly air conditioners) account for nearly 60 percent of sales to other states, including São Paulo. For some products, including TVs, AC units, and motorcycles, the ZFM is the main producer in Brazil. Overall, more than 59 percent of local production in Amazonas goes to other Brazilian states. In contrast, local demand in other states absorbs far more than 50 percent of local production. This demonstrates the ZFM's role as a prominent—yet remote—part of the Brazilian production network.

The intensive trade between Amazonas and São Paulo belies the extreme challenges of supply chain connectivity between the two regions, and not

FIGURE 3

Amazonas's trade with the rest of Brazil



Source: World Bank and IPEA, using *notas fiscais* data for 2018.

just because of distance. While Manaus is 2,700 km from São Paulo as the crow flies, a typical multimodal route (river plus road) through Belém is more than 4,700 km, including more than 1,600 km by river, and takes 11 days. For comparison, container ships cross the Pacific from Shanghai to Los Angeles in about the same time. Thus, the cost and delay of logistics from Manaus to distribution centers in the southeast are comparable to or higher than those typically faced in international trade. The lack of connectivity and high transport costs highlight the challenging environment for industries in the region. But those challenges also reveal the scope for reducing transport times and costs and therefore the opportunities for businesses in the region to develop further if these barriers could be reduced.

The ZFM's foreign markets are mostly in the Mercosul customs union, where the ZFM has maintained and even grown its position. In 2019, the main destination markets for exports from Amazonas were Colombia (14.6 percent of total exports), Argentina (14.5 percent), Venezuela (11.3), and Bolivia (10.6). Among nonregional markets, China (7.9 percent) and the United States (7.2 percent) dominate. So, even for its few exports, the ZFM depends on high trade barriers to compete in most of its products. Despite the small size and limited geographic scope of the ZFM's exports, it has had some successes. The number of export products from Amazonas grew from 312 in 2005 to 972 in 2019 (covering around 21 percent of the portfolio of Brazilian export products; table 2). Amazonas is the main Brazilian exporter (has an absolute advantage) in about 50 products, a position that it broadly maintained over the period. The number of products in which Amazonas has a comparative advantage (exports more than the average Brazilian state)[13] even rose, from 72 in 2005 to 134 in 2019—though this partly reflects relative competitiveness losses in other Brazilian states rather than gains in Amazonas.[14]

Both export destinations and export capabilities remain concentrated. Amazonas has slightly diversified its export destinations (see table 2), but export concentration remains high, with 78 percent of its exports going to the top 10 destinations in 2019. Similarly, export capabilities are concentrated in a few sectors. Almost a third of the products in which Amazonas has a comparative advantage are concentrated in electrical machinery and mechanical appliances, miscellaneous manufacturing articles, and vehicles (motorcycles; table 3).

The ZFM is trying to focus on the bioeconomy and has been identifying resources from the surrounding Amazon biome as potential sources of natural competitiveness. In 2016, Brazil created the Zona Franca Verde,[15] providing fiscal incentives for free trade areas to source raw materials locally. Producers in free trade areas are eligible for exemption from the tax on

TABLE 2 **Amazonas's export diversification, 2005–19**

YEAR	# PRODUCTS	RELATIVE COMPARATIVE ADVANTAGE	ABSOLUTE COMPARATIVE ADVANTAGE	AVERAGE NUMBER OF DESTINATIONS (PER PRODUCT)	SHARE TOP 10 DESTINATIONS
2005	312	72	56	13.1	0.85
2012	327	82	51	8.3	0.84
2019	972	134	50	9.3	0.78

Source: World Bank, using SECEX data. All calculations were done using harmonized system 6 digits codes.

TABLE 3 **Amazonas's export diversification by Harmonized System six-digit codes, 2019**

DESCRIPTION	# EXPORTED PRODUCTS	RELATIVE COMPARATIVE ADVANTAGE	ABSOLUTE COMPARATIVE ADVANTAGE	EXPORT SHARE (TOTAL)
Miscellaneous edible preparations.	12	2	1	0.27
Vehicles o/t railw/tramw roll-stock, pts & accessories	13	5	4	0.12
Electrical mchy equip parts thereof; sound recorder etc	123	23	6	0.11
Tool, implement, cutlery, spoon & fork, of base mtl etc	26	3	3	0.06
Nuclear reactors, boilers, mchy & mech appliance; parts	95	10	2	0.05
Animal/veg fats & oils & their deavage products; etc	10	4	1	0.03
Prep. of cereal, flour, starch/milk; pastrycooks' prod	15	3	1	0.02
Miscellaneous manufactured alicies.	24	7	5	0.02
iron and steel.	14	3	0	0.10
Wood and articles of wood; wood charcoal.	14	2	1	0.03
Edible fruit and nuts; peel of citrus fruit or melons.	32	2	2	0.01
Soap, organic surface-active agents, washing prep, etc	12	3	0	0.01
Prod.mill.indust; malt; starches; inulin; wheat gluten	12	2	0	0.00
Articles of iron or steel.	39	2	0	0.00
Optical, photo, cine, meas, checking, precision, etc	39	3	2	0.01
Miscellaneous artides of base metal.	16	4	1	0.00
Tin and articles thereof.	4	4	1	0.00
Fish & crustacean, mollusc & other aquatic invertebrate	13	6	1	0.00
Toys, games & sports requisites; parts & access thereof	3	2	2	0.00
Paper &paperboard; art of paper pulp, paper/paperboard	25	1	0	0.00
Sum	541	91	33	0.85
Total	972	134	50	1.00

Source: World Bank, using SECEX data. Description refers to the harmonized system (HS) chapter description. All calculations were done using HS 6 digits codes.

industrialized goods (*imposto de produtos industrializados*) if they source more than half of a product's raw material regionally. The Amazon Biotechnology Center (CBA) was developed to house biotechnology companies that use local materials. Its 12,000 square meters are divided into more than 30 units, including laboratories and technology support units. It has experienced growing pains, however, and is still working well below capacity, reflecting the underdeveloped state of the bioeconomy in Amazonas. Some beverages manufactured in the ZFM, such as Guaraná, use forest inputs, but the sector has not necessarily been associated with sustainable production in the region. Animal products account for 1.5 percent, cereals and fruit preparations as well as rubber and rubber articles for 0.5 percent each, and pharmaceuticals, a higher value-added sector sometimes associated with the bioeconomy, for 0.3 percent.

3 A Model Under Pressure

Despite some success in specific industries, Amazonas has been losing attractiveness as a business destination, and companies there have been losing competitiveness in the domestic market. These failures lie behind the deteriorating economic performance and premature deindustrialization of Amazonas (see figure 1 and Hanusch 2023). Over 1994–2014, producers in Amazonas lost competitiveness relative to producers in other states in Brazil. Competitiveness across states and sectors in Brazil can be compared using a national index based on firm-level salary premia (as a proxy for enterprise competitiveness) and on employer–employee data using a Mincerian wage model.[16] The index shows that Amazonas lost several positions across multiple sectors and products between 1994 and 2014. In most of the macro-sector categories, Amazonas's competitiveness has been declining.

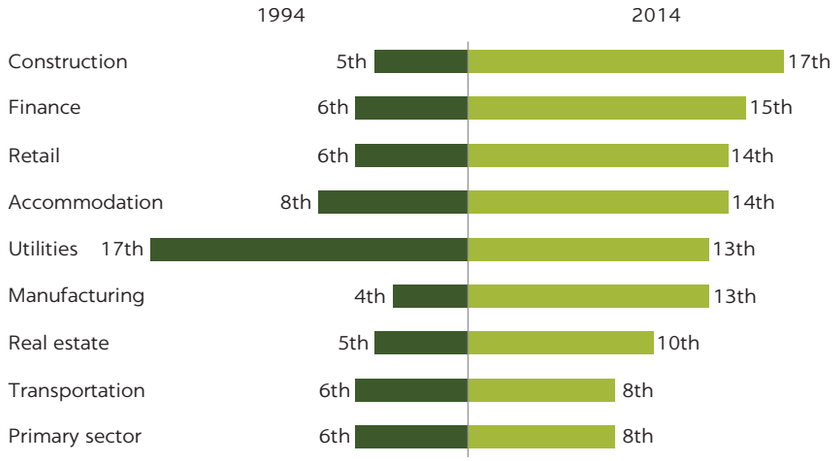
The current model is not conducive to private sector development. The ZFM mostly attract large businesses, which tend to integrate vertically rather than outsourcing to smaller businesses. Vertical integration can, for example, be seen among several producers of motorcycles, which are integrated with their own logistics companies. Leveling the playing field through horizontal interventions that improve the business climate for all companies, rather than targeting individual companies, will make it easier for smaller businesses to enter. This can raise productivity by improving market contestation and competition, while also creating jobs through small firms. And it can help generate a stronger ecosystem of smaller and larger businesses that support each other, further strengthening the foundations for competitive production.

3.1 LOSS OF COMPETITIVENESS

Amazonas's competitiveness has been declining in manufacturing industries since 1994, although at the product level, competitiveness has increased for few specific goods. From 1994 to 2004, Amazonas's manufacturing competitiveness fell from 4th to 13th place (figure 4). When broken down by sector, the competitiveness gap of firms in Amazonas widened between 1994 and 2014 for almost all manufacturing industries, including strategic industries such as machinery and motor vehicles. For example, Amazonas's electronics sector ranked the third

FIGURE 4

Amazonas's industry competitiveness dropped from 1994 to 2014
(competitiveness rank for Amazonas industries)

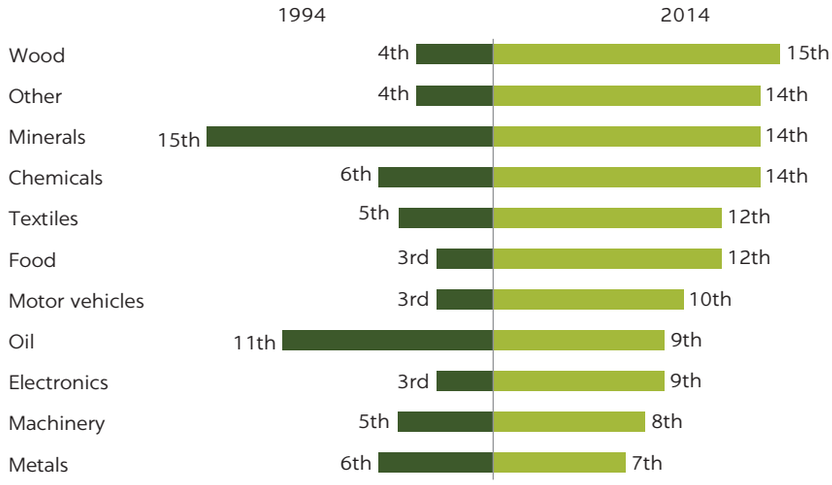


Source: World Bank, using Helpman et al. (2017) data.

most competitive in the country in 1994 but the ninth most competitive in 2014 (figure 5). In the early 1990s, most manufacturing industries in Amazonas were among the top five performers in the country, but 20 years later they had fallen several positions, many below the country median. Even so, Amazonas managed to maintain or even raise its competitiveness in a few specific products, notably in machinery, including transport equipment (trailers and reconditioned engines) and tools and appliances (machine tools and household appliances; figure 6).

FIGURE 5

So did its manufacturing sector competitiveness
(competitiveness rank for Amazonas manufacturing sectors)

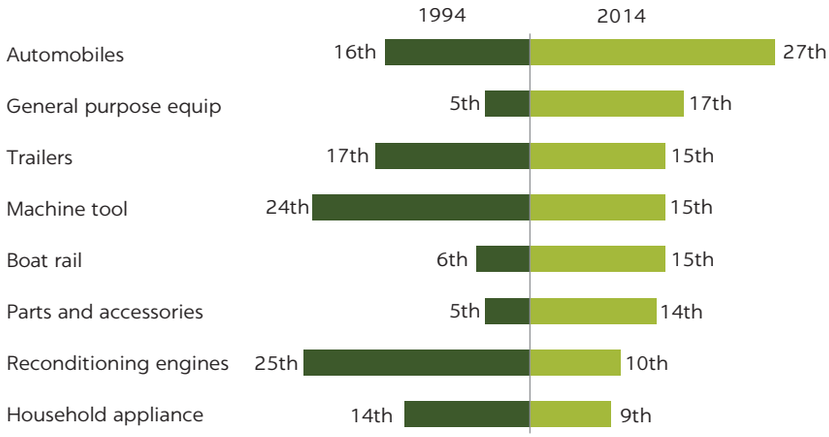


Source: World Bank, using Helpman et al. (2017) data.

FIGURE 6

And its manufacturing product competitiveness

(competitiveness rank for selected Amazonas manufacturing products)



Source: World Bank, using Helpman et al. (2017) data.

Amazonas's competitiveness relative not only to states in the south but also to other states in the region has declined. This change in relative competitiveness is consistent with the finding in Hanusch (2023) that the southeastern Amazonian states associated with the Arc of Deforestation have gone through a rapid, yet unbalanced, structural transformation, linked partly to improving market access (though at a very high cost to natural forests). As the competitiveness of Amazonas's manufacturing sector dropped nine positions between 1994 and 2014, Mato Grosso, Rondônia, and Tocantins pulled ahead of it to positions 5, 11, and 12, respectively (figure 7).

Among the challenges associated with strengthening and further developing the ZFM, in particular, and Amazonas, more broadly, is its remote location. A consistent finding in the literature is that location choice is critical to business success. The large tax incentives to firms operating in the region have aimed to overcome the ZFM's distance from the main urban centers of the country and its remote location in the world's largest rainforest. Like Brazil, many countries have used SEZs as regional development tools and have located them in lagging or remote regions. But research shows that SEZs are more likely to succeed when they are located near core areas and around gateway infrastructure, with connectivity to national and global markets.[17] To make remote SEZs more attractive, governments usually offer fiscal incentives, but these instruments have been largely ineffective or have created efficiency-sapping distortions.

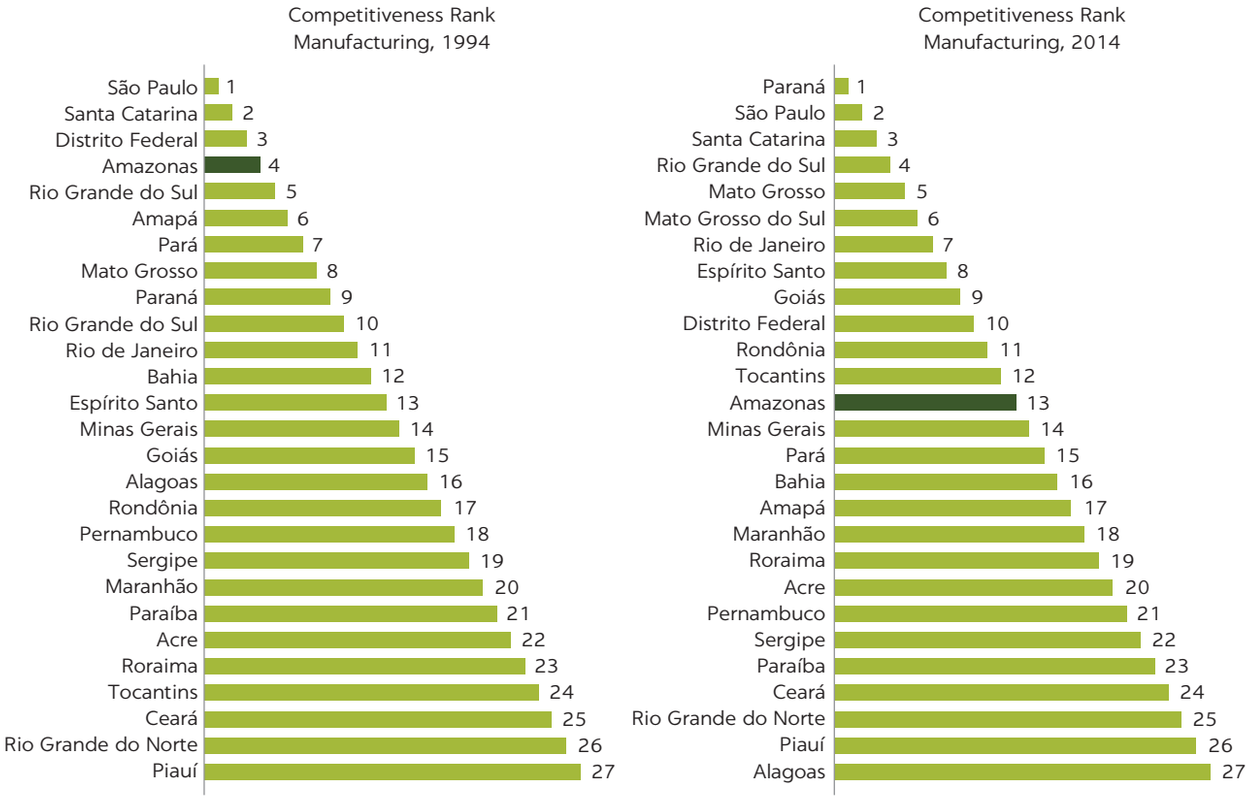
3.2 FISCAL INCENTIVES AND MARKET DISTORTIONS

While subsidies can help address market failures, such as catalyzing complementary investments in supply chains, ZFM fiscal incentives have introduced distortions into factor markets. By artificially lowering the cost of machinery relative to labor, fiscal incentives have made production in the ZFM

FIGURE 7

And its overall manufacturing competitiveness

(competitiveness rank for Amazonas manufacturing, by state)



Source: World Bank, using Helpman et al. (2017) data.

more capital intensive than in other areas of the country. In 2019, only 5 percent of ZFM firms' revenues were spent on salaries, while Brazil's average was around 11 percent. Moreover, 59 percent of workers employed in ZFM firms were low-skilled, earning up to twice the minimum wage.[18] Thus, fiscal incentives may have distorted the local job market by reducing the number of jobs that would otherwise have been created and by reducing the need for higher-skilled, higher-wage labor. Moreover, to the extent that the fiscal incentives lowered labor's share in income, wages will grow more slowly than average productivity. In addition, since capital ownership is typically concentrated among the top of the income distribution, a rise in the share of returns to capital increases income inequality. So, by creating a high capital-to-labor ratio, fiscal incentives hurt workers and increase inequality in the region.

Since the ZFM exports little to international markets, duty exemptions create an imbalance in trade flows and a vulnerability to future changes in trade agreements. By some estimates, 90 percent of imports to Manaus are inputs used in the ZFM.[19] And with more than half of containers (53 percent) leaving Manaus for long-haul navigation being empty,[20] transport costs for inbound (international) products are high because they also include the cost of shipping empty containers to other destinations abroad (mostly Jamaica). The efficiency losses associated with this distortion are reflected in the final price of

goods sold in the domestic market. If the ZFM were able to increase its exports, it would reap the efficiency gains from large-scale transportation. Further, the reliance on duty exemptions makes the ZFM highly vulnerable to future rounds of trade liberalization by the Mercosul customs union. The trade liberalizations of the 1990s hit the ZFM hard and are one possible explanation for the deterioration in its relative competitiveness since 1994.

Fiscal incentives can encourage vertical integration and reduce competition. The lack of investment in improvements to the business environment have kept the costs of doing business in the region extremely high. High transport costs and unreliable electricity service make business operations difficult, especially for small and medium enterprises. Large firms have more capacity and may be able to pursue a vertical integration strategy, developing their supply chain within the firm. Some large companies operating in the ZFM, such as Yamaha, have developed their own logistics subsidiaries to provide more efficient transportation. Other companies rent or own their own power supply. Thus, to be able to operate efficiently in ZFM, firms need to be large enough that the subsidies outweigh the high fixed costs of operating in the region. Overall, this means that the ZFM is attractive only to large firms (most of them multinationals). This model is not conducive to agglomeration or productivity growth, which are necessary for building up labor markets and other agglomeration economies.

Fiscal incentives are granted only if the firm complies with the Processo Produtivo Básico (PPB). The PPB sets minimum content policies and lays out the operations required for goods to be considered "industrialized" and therefore eligible for fiscal incentives. Since the early 1990s, firms have been using PPBs to apply for fiscal incentives in the ZFM and over the years, more than 1,000 bylaws have been issued to define PPBs for various products.[21] PPBs also makes it harder for smaller firms to benefit from subsidies since the process is long and expensive, which favors larger firms (the larger the firm, the smaller the per-employee cost for complying with the PPB).

PPBs place a large burden on the firms, by imposing high transaction costs to start a business in the ZFM and by disincentivizing innovation. On the content side, PPBs can turn the entire manufacturing process into a rigid set of operations. If firms change their production process, they have to reapply for the fiscal subsidies, which disincentivizes firms to innovate. Domestic content rules, which are part of PPBs, create market inefficiencies and may result in lower quality products since firms are forced to source inputs domestically even if better inputs are available internationally.[22] The domestic content rules can also increase logistics costs (and therefore production costs), since many parts and pieces are transported from São Paulo or other distant Brazilian cities instead of being imported.

A new strategy to support private sector growth in the region should focus on improving the business environment and revising the incentive structure. The ZFM model now relies too heavily on industrial policy approaches of the past, such as tax incentives and protectionist measures, that are clearly not enabling the ZFM to thrive and deliver the productivity gains necessary to remain competitive. With a clear understanding of investor needs, policymakers can design and deliver a ZFM model that can overcome current constraints to investment. For example, a survey of global SEZ investors found that infrastructure (especially reliable electricity) was among their top considerations in choosing an investment location; customs and trade issues were also a high priority. There is evidence that infrastructure and trade facilitation have a

significant positive impact on attracting business to a location and that tax and other financial incentives are much less important in their absence.[23]

Revising the fiscal incentives will also reduce labor market distortions and could reduce inequality in the region. Reducing fiscal incentives to recalibrate the capital-to-labor ratio to the national average would increase the share of income going to labor, which would likely benefit workers and reduce income inequality. Reducing or phasing out fiscal incentives can improve conditions in the local labor market, which will also benefit firms. Workers may invest more in their human capital, expecting higher wages, and firms will benefit from access to a more specialized labor pool.

Care is needed when revisiting fiscal incentives as they impact fiscal, social, and environmental sustainability. The fiscal cost of the ZFM, to Brazil and to Amazonas, is substantial. This cost would rise if production in the ZFM grew, as incentives are proportional to production. A better system is needed that continues to leverage the manufacturing capabilities of Manaus but with lower fiscal dependence. Although labor intensity is low in the ZFM, many jobs depend on it, directly and indirectly, requiring the careful design of a policy package that can generate more jobs at a lower cost. This is important for social sustainability, and social sustainability receives added urgency given the fragile ecosystem surrounding Manaus. Raising the competitiveness of the ZFM by improving the business environment can reduce the distortions generated by tax incentives, creating more jobs. Higher productivity associated with such reforms can also reduce deforestation pressures—especially since Amazonas manufacturing tends to have limited rural value chains.

4 Toward Green, Productivity-Led Growth in Urban Amazonas

A possible strategy for fostering urban economic development in Amazonas identifies four focus areas to support private sector growth and jobs in the region. First is overcoming the cost of remoteness by improving logistics. Second is improving the business environment. A more competitive business environment supports productivity gains and could also reduce Amazonian deforestation through general equilibrium impacts,[24] generating positive environmental externalities. Third is increasing green production to boost both productivity and environmental sustainability. Fourth is considering transitioning the ZFM toward an eco-industrial park, supported by a supportive regulatory environment, clean production processes, and green branding; reviewing the industrial policy for the region, considering a revision of fiscal incentives and investments can support a new growth model for the ZFM and beyond.

4.1 FOCUS AREA 1: IMPROVING LOGISTICS

Improving market connectivity, especially domestic shipping, and establishing a more productivity-enabling business climate could help Amazonas regain domestic and external competitiveness. That Amazonas broadly maintained its competitiveness and presence in regional markets but lost it in local markets suggests that its problems are primarily domestic. They could reflect either a deterioration in logistics links in Amazonas or improvements in competitiveness in some other states (including other Amazonian states), at least in domestic markets. In the longer term, the improvements suggested in this report will help Amazonas create jobs and greatly reduce dependence on fiscal incentives.

Connectivity challenges

Reducing bilateral trade frictions is essential to foster trade and is part of a successful industrial policy program. Examples of trade frictions include tariffs, transport gaps, administrative hurdles, contractual frictions, and corruption. The importance of reducing bilateral trade fictions should not be underestimated.

For instance, estimates show that improving supply chain–related trade costs associated with border administration and transport and communications infrastructure halfway to global best practice could produce global GDP gains up to six times larger than eliminating tariffs could.[25] These estimates are encouraging because they highlight areas for improvement under local authorities' control. Unlike tariffs, which are under federal control and are often influenced by political economy considerations that affect the whole country, improving administrative processes and investing in infrastructure are within the reach of local authorities, have little impact on other regions, and are more likely to find federal support.

Geographic remoteness is a high hurdle for Amazonas. A simple thought experiment is to ask what would happen to production in Manaus if it were placed in a less remote part of the country—say, in Espírito Santo, a southeastern state of similar population size as Amazonas but much closer to Brazil's economic center. Estimates based on assigning the geodesic distance[26] between Espírito Santo and other states to Amazonas suggest that Amazonas's GDP would rise by more than 27 percent (figure 8) if Amazonas faced the same distance to other states as Espírito Santo does. This result indicates that Amazonas would move up four positions in per capita GDP ranking in the country, from 13th place to 9th place (1st place being the highest per capita in the country) and surpassing states such as Minas Gerais, Goiás, and, indeed, Espírito Santo. Other Amazonian states, except Mato Grosso and Tocantins, would lose slightly from the associated increase in transport cost in this thought experiment since

FIGURE 8

If Amazonas were located where Espírito Santo is, Amazonas's GDP would be 27 percent higher

a) Hypothetically moving Amazonas into Espírito Santo's geographical location

b) Impact on Amazonian states' GDP from hypothetically moving Amazonas into Espírito Santo's geographical location

STATE	GDP CHANGE
Acre	−0.35
Amapá	−0.34
Amazonas	27.20
Maranhão	−0.02
Mato Grosso	0.02
Pará	−0.01
Rondônia	−0.61
Roraima	−1.37
Tocantins	0.09

Source: World Bank and IPEA, using a gravity trade model calibrated to tax data.

Source: World Bank and IPEA.

they are tightly integrated with Amazonas. Other states in Brazil, however, would benefit from Amazonas's reduced remoteness.

Given the current cost of logistics, fiscal incentives do compensate for Amazonas's remoteness. Amazonas's remarkable gain from a hypothetical geographic shift is consistent with the trade literature, which finds that trade declines with distance.[27] Thus, it is not surprising that high logistics and transport costs have been a major hindrance to private sector growth in Amazônia. The estimated geographic burden is roughly equivalent to the fiscal incentives that the region currently receives, showing how subsidization makes production in such a remote area commercially viable—albeit, at a high cost to the country.

Lowering transport costs can reduce the hurdle associated with geographic remoteness. Modeling also suggests that a 12.5 percent reduction in transport costs for Amazonas (a feasible amount for Brazil as a whole[28]) would lift Amazonas's GDP by 38 percent (table 4).[29] The GDP gains from this reduction in transport costs would even outweigh the gains from relieving the burden of unfavorable geography, which is around 27 percent. Because lowering transport costs would increase efficiency, most states in Amazônia, and indeed the whole country, would benefit from these cost savings in transport. In addition, Amazonian states would benefit from higher demand for their products from a more affluent Amazonas. Thus, while remoteness from major markets is an important challenge, a relatively small reduction in transport costs could lead to significant and positive impacts for the economy of both Amazonas and the broader region. In turn, it could also reduce pressure for fiscal support.

Reducing transport costs would have different effects across sectors, benefiting existing sectors and newer priority sectors such as the bioeconomy. Not least due to their large size the dominant sectors in Amazonas (supported by the ZFM), such as electronics, processed food and beverages, transport equipment, and mechanical appliances, would make the largest contribution to overall growth in Amazonas's GDP following a drop in transport costs (figure 9). Many smaller sectors would grow significantly faster in absolute terms, including some sectors associated with the bioeconomy (such as processed açai, beverages, soaps, cocoa, cosmetics, cereals, and pharmaceuticals). Consistent with the analysis in

TABLE 4 Reducing transport cost by 12.5 percent lifts Amazonas's GDP by 38 percent

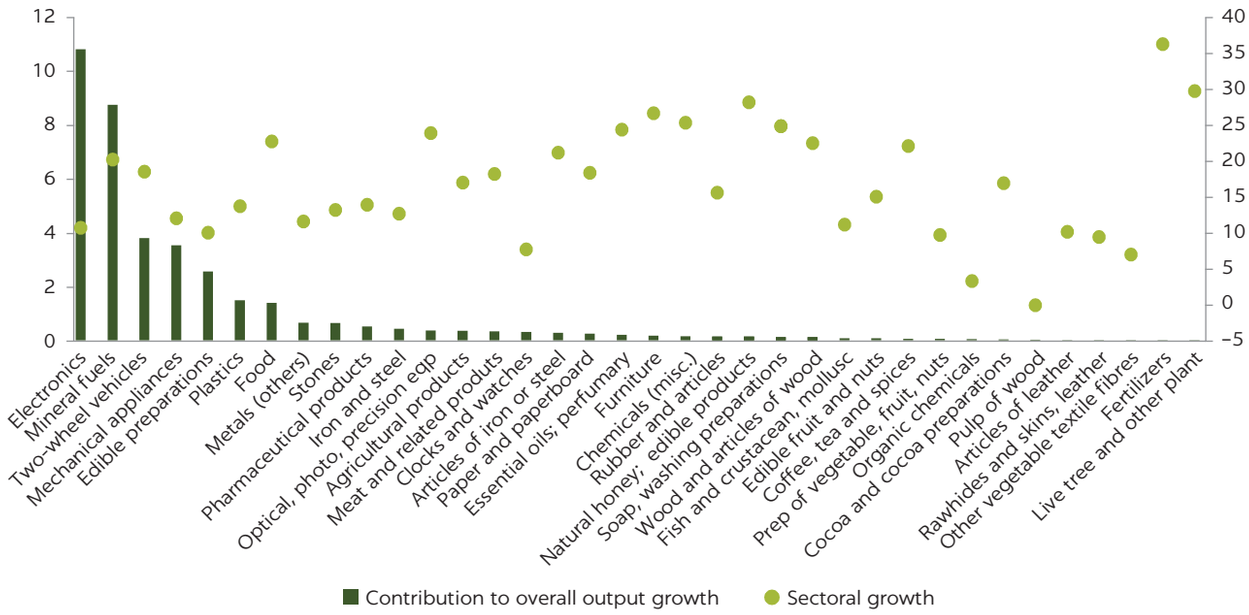
(impact of a 12.5 percent reduction in transport costs to and from Amazonas, by Amazonian state)

AMAZONIAN STATE	GDP CHANGE (PERCENT)
Acre	–.001
Amapá	–0.21
Amazonas	37.79
Maranhão	–0.02
Mato Grosso	0.03
Pará	1.36
Rondônia	–0.20
Roraima	0.67
Tocantins	5.19

Source: World Bank and IPEA, using a gravity trade model calibrated to tax data.

FIGURE 9

Estimated impacts of a 12.5 percent reduction in transport costs to and from Amazonas, by sector
(sectoral contributions to total value growth)



Source: World Bank and IPEA, using gravity trade model calibrated to tax data. Overall output growth takes into account interlinkages but sectoral effects do not.

Hanusch (2023), reducing transport costs in Amazonas also brings some sustainability risks by raising demand for products that could fuel deforestation, such as wood and wood products (including furniture) and animal products (including from cattle). Given the limited overall value of these sectors in Amazonas, however, their impact would be small. Nevertheless, such risks need to be mitigated, through complementary economic measures and effective forest governance, as discussed in Hanusch (2023).

In the long run, efficiency gains in transport and logistics could reduce the need for fiscal incentives, allowing Amazonas to compete domestically on its own merit. Since fiscal incentives are equivalent to almost a third of Amazonas's GDP, a back-of-the-envelope calculation shows that the simulated reduction in transport costs of 12.5 percent would eliminate the burden of geography altogether—and thus the need for any fiscal incentives. This analysis reveals an important pathway for Amazonas toward reducing market distortions and achieving competitiveness, at least in Brazil's domestic markets.

Reducing transportation costs without building new roads

There is an untapped potential for cabotage (or multimodal river and rail transportation) in Amazônia, especially the Amazon basin much of which is navigable by river. Over the years, the federal government has tried to improve connectivity between Amazônia and other markets, but success has been limited and often clashed with environmental concerns. Even though major cities in the region, such as Manaus and Belém, are connected to markets by rivers,

most efforts to connect Amazonas with other parts of the country have focused on road transport, which poses serious risks to the environment because of the strong correlation between roads and deforestation.[30] New roads—or even the improvement of roads—and their significant environmental damage, should as much as possible be avoided, especially if there are alternative options.

Cabotage holds great potential for reducing transportation costs to and from Manaus. Although cabotage loops link Manaus to major Brazilian ports and are potentially cheaper than the multimodal routes used by most ZFM businesses, few ZFM manufacturers use this mode. One reason is that cabotage is less flexible, resulting in potentially more delays than the established multimodal route through Belém, including long shipping times (two weeks to Santos), difficult port logistics, and inland trucking delays. This limited frequency and the need to coordinate with maritime shipping times mean that businesses cannot just rely on cabotage but must cobble together a mix of transport methods. Mixing is easier for businesses with large volumes than for shippers with small volumes. Several measures could make the cabotage system more competitive, including addressing port delays to make cabotage more relevant to time-sensitive manufacturers, improving the efficiency of offloading containers from ships to trucks and of offloading them from trucks to containers, reducing hurdles associated with bureaucratic requirements, and increasing competition in shipping sectors. While the cabotage sector has been slow to modernize, reforms such as the recently approved "BR do Mar" have been encouraging and could provide a valuable opportunity for the region to reduce transportation obstacles. Despite recent progress, some key challenges, such as introducing more competition into the deck and bridge operation sector (*pilotagem*), still have to be overcome. Significant opportunities also remain in streamlining documentary requirements, which are often unnecessarily complex and repetitive.

Reducing clearance times and introducing combined river-rail transportation could also lower trade costs. A combined river–rail system could make logistics more efficient, but Brazil would first have to develop intermodal facilities that accommodate the performance requirements of container/trailer shuttles. While such logistics are very different from bulk freight, as used in mining, and not common in Brazil, they can still be considered as a long-term strategy for improving connectivity in the country. Other measures that could be implemented in a relatively short time and that would not involve high fiscal costs include reducing administrative hurdles. For example, it takes on average 7.5 days for goods arriving in Brazil to leave a bonded warehouse (9.7 days for sea mode, 5.8 days for air mode, and 2.3 days for road mode), according to a 2020 time release study by the Brazilian Ministry of Economy.[31] Solutions to reduce clearance times include expanding the use of automation to increase efficiency (also for payment of taxes and fees), extending the Authorized Economic Operators program, and improving risk management and inspection procedures. Some companies in the ZFM already have a fast-track clearance procedure, but extending this option to more companies would be positive for business in the region.

The current dependence on trucking means that ZFM logistics are not only financially but also environmentally costly. Alternative routes through Santarem or Porto Velho (BR319) might reduce time to market but not the cost, and they might not bring long-term environmental relief. The carbon emissions of current ZFM export logistics are about 10 times those of rail or water transport. Global ZFM manufacturers are increasingly sensitive to their

carbon footprint. A gradual modal shift to maritime or river and rail logistics is thus the logical trend.

4.2 FOCUS AREA 2: A MORE COMPETITIVE REGULATORY ENVIRONMENT FOR BUSINESSES

Building a supportive environment for business to thrive is key to attracting more private sector investments and jobs. Such an improvement in the business environment would allow Amazonas and the ZFM to eventually become less dependent on tax incentives, which compensate for competitiveness disadvantages that businesses face in order to locate to a specific region. So, reducing costs associated with such barriers should be the first priority for raising productivity (box 3). Limited and targeted tax incentives could still provide the residual nudge to overcome remaining competitiveness gaps.

At the state level, Amazonas can improve the regulatory business environment in a wide range of policy areas, which will benefit the ZFM as well. By international standards, Brazil is a difficult country to do business in, and Amazonas performs below the national average, highlighting the need for reforms. Significant productivity and GDP gains for Amazonas are associated with the state implementing reforms that would make specific components of its business environment comparable to those in the best performing state in Brazil (figure 10). Large gains are associated with reducing the complexity and associated regulatory costs of constructing facilities (proxied here by warehouses), reducing the costs of contract enforcement, and reducing the costs of starting a business.

Building the skills foundation is critical. Human capital gaps in Amazonas remain significant, and available skills are limited. Skills hold the key to long-term development and to the transition to higher value-added manufacturing. They are also critical for high-skill sectors of the urban bioeconomy, from biotech to pharmaceuticals.

BOX 3

Both internal and external factors drive productivity

Productivity drivers can be classified as follows:

- *Internal factors* are production practices or levers over which producers have some direct control, such as managerial practices, input quality, firm-level IT and R&D, learning by doing, product innovation, and firm structure.
- *External factors* include external operating environments and interaction with markets, factors that influence both the within-component and the between-component aspects of aggregate productivity. The within-component aspect captures the fact that individual producers are becoming more productive, and the between-component aspect refers to the fact that more productive producers grow faster.

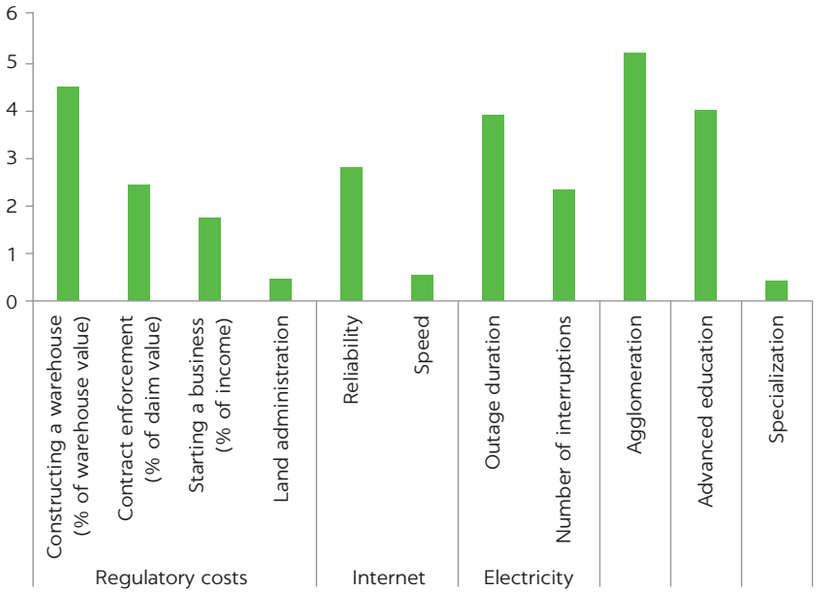
External factors are closely tied to government policy. Examples are spillovers (agglomeration), product and input market competition (trade and regulations in input markets), and utilities (including telecommunications, water, electricity, and others) and other services (including education). Internal factors are more within firm's internal purview and can be affected by actors such as firm management or equity investors and shareholders.

Source: Syverson (2011).

FIGURE 10

Productivity gains are large from improvements in the business climate in Amazonas…

(percent change associated with Amazonas closing gap with best performing state in Brazil)



Source: Regulatory costs: World Bank (2021b); Internet: Melhor Plano (2019); Electricity: ANEEL; Agglomeration (defined as number of workers in all sectors per square kilometer), advanced education (defined as share of adults with at least nine years of schooling), and specialization (defined as number of workers per square kilometer in the same sector). Derived from individual regressions using productivity measure based on Helpman et al. (2017).

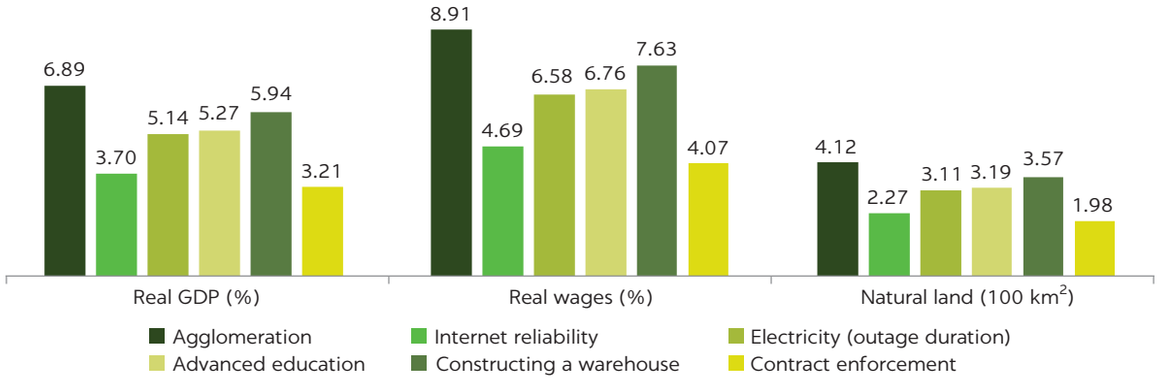
Better infrastructure is also needed, notably related to internet and power. While Amazonas has made significant progress in reducing the cost of internet use in recent years, internet reliability and speed are still a challenge. Improving them could have large economic payoffs and improving the reliability of electricity could also result in large gains (see figure 10).

Some reform priorities are more complex but will pay off in the longer term. Fostering agglomeration (linked to urbanization) and improving education, especially higher education, would have large economic impacts (see figure 10). The list of measures here is illustrative and not exhaustive (for example, improving access to financial instruments, though not included here, is also an important area for policy and the private sector). The reform scenarios would translate into large gains in GDP and real wages in Amazonas (figure 11). Since the effects are additive, making Amazonas the best performing state in Brazil through the selected reforms would have a minimum cumulative impact on productivity of 28 percent. General equilibrium simulations (focused on manufacturing as a proxy for urban productivity) suggest that, if phased in over 10 years, these reforms would raise Amazonas's GDP by more than 30 percent and average real wages by more than 38 percent, while attracting additional migration because the policies would create jobs in Amazonas. The simulations also suggest that these productivity gains combined would be associated with about 1,829 square kilometers of additional conserved natural forests in Amazonas alone.

FIGURE 11

. . . as are the associated cumulative GDP and real wage impacts if competitiveness gaps are closed by 2030

(cumulative change, percent and hundreds of square kilometers)



Source: Ferreira-Filho, J. B. and M. Hanusch. 2022. "A Macroeconomic Perspective of Structural Deforestation in Brazil's Legal Amazon." Policy Research Working Paper WPS10162, Washington, DC: World Bank.
Note: Focuses on the largest estimated impacts in figure 10 and assumes the impacts apply to manufacturing firms (as a proxy for the ZFM). Natural land (conservation of natural forests) for Amazonas state only. All numbers relative to the baseline.

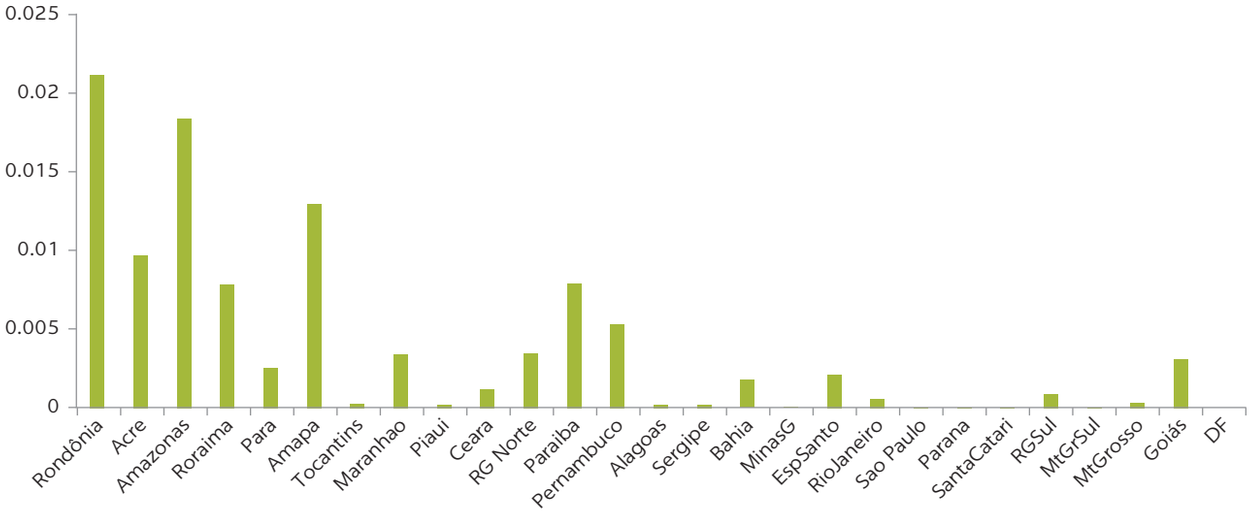
4.3 FOCUS AREA 3: GREEN PRODUCTION PROCESSES

Increasing the use of reliable and clean electricity is a steppingstone for revitalizing and improving the business environment in the region, making production both more productive and greener. Despite abundant solar exposure in a tropical latitude, local electricity generation in Amazonas is mostly thermal, coming largely from highly polluting fuel generators, including in Manaus (figure 12).[32] The rest of Brazil uses mainly hydropower-generated electricity,

FIGURE 12

Reliance on fossil fuels in Amazonas is among the highest in Brazil

(fossil fuels in electricity generation/value added)

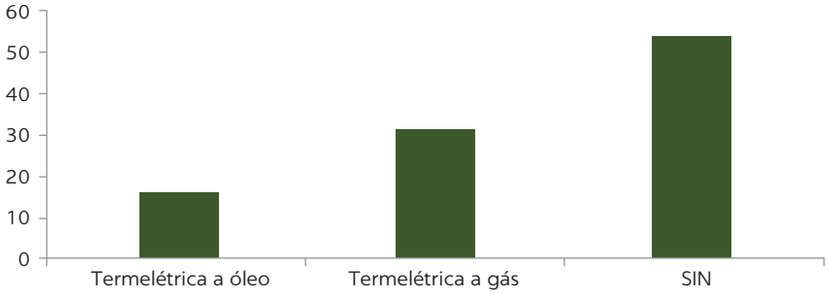


Source: World Bank, using Diniz 2019.

FIGURE 13

Only about half of the electricity in Manaus comes from the national grid

(power generation by source, percent)



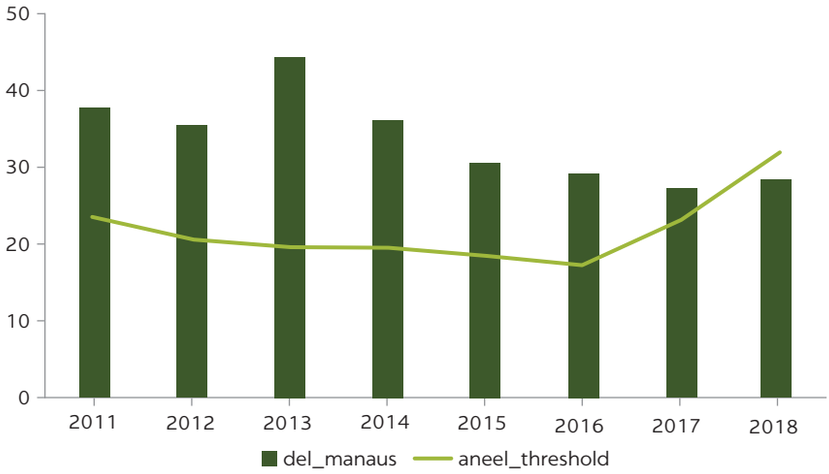
Source: World Bank, using Amazonas Energia, Relatório de Administração 2019 data.
Note: SIN is the national integrated network, which relies mostly on hydropower.

but most of Amazônia is not connected to the national electricity grid. In Manaus, only about 50 percent of electricity comes from the national grid (figure 13). Greater reliance on renewable resources would provide cheaper and more reliable electricity and would contribute significantly to increasing local productivity.

Amazonas should urgently address the high losses, poor management, and lack of commercial discipline in electricity services, while encouraging green power generation. Technical losses (from dissipation in the network) and non-technical losses (from fraudulent activity) are high and have been rising since 2014. As a result, quality has decreased in the system (figure 14). The failure to enforce payments for electricity, particularly from the public sector (especially public utilities and street lighting), and mismanagement have led to a downward spiral of underinvestment in basic maintenance, leading to poor quality services (figure 15) for which consumers do not want to pay.

FIGURE 14

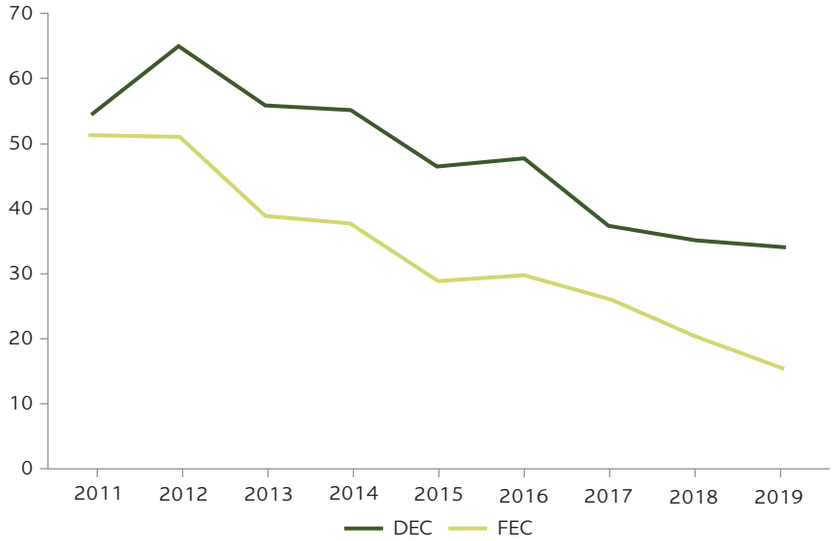
The number of hours of power supply interruption is high relative to ANEEL's acceptable threshold in Manaus, 2011–18



Source: World Bank, using Amazonas Energia, Relatório de Administração 2018 data.

FIGURE 15

The quality of electricity service is falling in Amazonas, 2011–19



Source: World Bank, using Amazonas Energia, Relatório de Administração 2018 data.
Note: DEC hours measure equivalent duration of interruption of internal origin per consumer unit, and FEC hours measure equivalent frequency of interruption of internal origin per consumer unit.

Against the national progress on promoting alternative sources of energy, such as solar photovoltaic, Amazonas is in the early stages of green energy adoption. Amazonas is taking promising steps toward establishing the legal and regulatory framework for renewable energy by implementing strategic guidelines for public policies expected to provide incentives for more sustainable electricity generation—and encourage investments that could double the share of renewable energy sources from today's 20 percent to 40 percent in 2030. As grid extension approaches its physical and economic limits, extending electricity to the remaining areas has become more difficult or even infeasible, making universalization increasingly difficult. However, the falling prices of renewables make distributed energy resources a viable alternative for universal access. Public policy should focus on these alternatives instead of costly investments in marginal extensions of the grid.

Progress in energy efficiency needs to be accelerated across Amazonas. There has been little improvement in energy efficiency. The main cause is widespread use of inefficient appliances and high demand for air conditioning in the hot and humid climate. Energy efficiency did not improve in the ZFM between 2003 and 2015.[33] The State Policy to Encourage the Use of Renewable Energy Sources and Energy Efficiency for the State (Law No. 5,350), which entered into force on December 22, 2020, is a milestone for Amazonas that could improve social, economic, and environmental sustainability, a triple win. It supports projects such as distributed generation connected to the public electricity network (on grid) and isolated systems (off grid) that use technologies from renewable energy sources and technologies that promote energy efficiency.

Green production also requires appropriate managing of water and waste. Hanusch (2023) draws attention to significant shortcoming in these areas across Amazônia, with considerable gaps in Amazonas, including Manaus. According to Centro de Liderança Publica (CLP) data, Manaus scores poorly on various

indicators, from sewage collection and treatment to water losses.[34] There are significant opportunities for private investment to improve service delivery, as in waste management.

4.4 FOCUS AREA 4: AN ECO-INDUSTRIAL PARK

The ZFM could transition toward a greener SEZ and leverage advantages from becoming an eco-industrial park. Such a strategy would align the ZFM with new, greener production technologies and give it an identity that sets it apart from other industrial locations. This could enable the ZFM to transition into an eco-industrial park focused on increasing the use of low-carbon green technologies in manufacturing. Key drivers for eco-industrial parks include reducing businesses' environmental footprints, promoting efficiency gains and cost-effectiveness, fostering community cohesion, increasing resilience to risk, providing better access to finance and technical support, and enhancing competitiveness.[35] Eco-industrial parks are becoming more common as global value chains increasingly demand more sustainable production methods that address global sustainability concerns.

Reforms to incentivize green production would also allow ZFM companies to tap into more developed markets. Around the world, SEZs are increasingly seeking a more sustainable and competitive operating environment that differentiates them from basic industrial parks. According to the World Economic Processing Zones Association, rising demand for green production facilities is an opportunity for SEZs—it could also be an opportunity for the ZFM. Developed markets are also looking for products that use green production methods. For example, there is potential to tap into the opportunities that could emerge from the EU-Mercosul trade agreement. Beyond green electricity, policies that would enable products to take advantage of the agreement include promoting recycling, provisioning green infrastructure, constructing environmentally friendly buildings, and reusing and commercializing waste products.

An eco-industrial park with better market access—especially through waterways—and a strong regulatory framework could further support production in Manaus. Most countries locate SEZs in lagging or remote regions, aiming to foster innovation, but only a few have adequately addressed the infrastructure, connectivity, labor skills, and supply access that these regions tend to lack. Locating SEZs in remote areas can render them less effective—yet proximity to a port can counter this effect.[36] The eco-industrial park would also benefit from national, state, and municipal-level reforms to improve the broader business climate, which could be further refined at the level of the eco-industrial park itself.

The urban bioeconomy

Beyond green inputs, such as energy, an eco-industrial park could also include the production of green products, such as those linked to the urban bioeconomy—if accompanied by strong environmental safeguards. Many state and federal governments have promoted and supported bioeconomy

sectors.[37] This report also draws attention to some of the limitations and risks of a growth model focused on the bioeconomy. In Amazonas, bioeconomy activities are mostly informal and lack comprehensive institutional support along the value chain. Capabilities still need to be built. Worker capabilities in Amazonas, as in most lagging regions, tend to be concentrated in mid-skill manufacturing and services. This is also the skill level at which the bioeconomy is most likely to succeed, in sectors such as beverages and food products (sectors that respond strongly to better market access, as shown in figure 9), as well as sustainable tourism.

The urban bioeconomy will also benefit from broad reforms linked to market access and competitiveness. As capabilities are built across the economy, the bioeconomy will benefit as well. In addition, targeted interventions can foster the bioeconomy, including reducing obstacles to financing the bioeconomy, such as the underpricing of biodiversity and the lack of data, measurement, and reporting.[38] The ZFM could play a catalytic role in this agenda, though strong coordination across the federal ZFM and state government initiatives would be critical. A more high-tech bioeconomy linked to sectors such as biotechnology and pharmaceutical development will become more feasible as Amazonas's economy matures, with better skills, infrastructure, and institutions required for advanced manufacturing and services. The development of a high-tech bioeconomy sector is a long-term strategy that needs to be thought out carefully. Given the current capabilities, this strategy is unlikely to succeed in the short term, as demonstrated by the lackluster experience of the CBA.

Green branding

A branding strategy is an important element of a broader strategy to increase productivity in Amazonas, starting with the ZFM and eventually expanding to all qualifying products and services originating in Amazônia.[39] It can be a tool to capture the value of products and services with unique characteristics linked to their origin, raw materials, intrinsic qualities, and history in Amazônia. Branding could help communicate the "green" contents of a product, linked to sustainable methods of manufacturing and production practices that have a positive impact on the Amazon biome. Minimum common characteristics should be developed and communicated through a label that would be a key part of the branding strategy. The technical standards underpinning certification and branding will have to be developed for each product and service. If properly designed and implemented, this branding strategy could help qualifying products capture a price premium in national and international markets based on their contribution to preserving Amazonian forests and on the sustainable, low-carbon practices used to produce branded products.[40]

The branding strategy could reduce the dependence on fiscal support by shifting a share of the economic burden of remoteness to customers. It would leverage Manaus's remote location in the Amazon as an advantage. It would have numerous benefits, including helping branded products or services stand out among consumers, establishing consumer bonds of loyalty and trust, and enhancing resilience during economic downturns or in the presence of new competitors.[41] Concerns about climate change are particularly pronounced in more developed countries, providing an export

opportunity for Amazonas under a sustainability label. Amazon sustainability labels have already been successful in Brazil, under the Mercados Verdes e Consumo Sustentavel project. For example, sustainable pirarucu from Amazônia under the Gosto da Amazônia label attracts a price premium of 300 percent in some high-end restaurants in southeast Brazil. Some attempts at branding have failed,[42] however, revealing the importance of careful design and implementation.

While the jury is still out on the effectiveness of sustainability labels, pride in a sustainable "Made in the Amazon" label could also strengthen incentives for environmental protection.[43] To give credibility to an Amazon label for ZFM products, Amazonas will need to demonstrate that it can control deforestation. This will be vital to overcome any adverse political economy factors that can weaken environmental enforcement and to generate additional incentives to invest in environmental protection systems. Hanusch (2023) argues that, given the positive externalities associated with a green ZFM, a case can be made for national and international compensation payments to support both productivity in the ZFM and broader environmental protection efforts.

The Processo Produtivo Básico

At the federal level, the Processo Produtivo Básico should be simplified, while at the agency level, application processing times could be handled more efficiently. Data suggest that applications at the ZFM take between 9 and 17 months to be analyzed, even though there is a commitment to review them in four months at most.[44] Making the rules for application approval more objective can shorten this process. Importantly, new regulations should not be a hindrance for firms' innovation but rather be designed in a way that supports it. To attract more firms, it is important that application processes are streamlined and simplified.

A new interpretation of business attraction

Under a new growth model for Amazonas, a paradigm shift is needed in the way policymakers and civil servants think about business attraction. The current definition focuses on specific firms by enticing them with tax incentives. The approach advocated here uses a more horizontal approach, focused on the broader business environment to which companies choose to migrate if it meets their needs and helps them produce more competitively.

Companies without forest value chains can still have positive climate benefits and will thus be assets for the ZFM as an eco-industrial park. What matters is to establish a business environment that fosters efficiency and environmental sustainability, whether companies have forest value chains or not. In fact, the bioeconomy is still largely an experimental sector, and proximity to primary inputs in the Amazon may not be sufficient to attract companies in the bioeconomy sector to the ZFM (box 4).[45] Urban bioeconomy sectors can exist outside Amazônia and may even be more competitive and climate-friendly in other parts of Brazil or in other countries. A focus on strengthening the eco-industrial park is likely to yield the highest payoffs. Fostering the bioeconomy is more of a strategic bet.

BOX 4

Attracting bioeconomy companies to the Amazon: Natura

Natura, a Brazilian company headquartered in São Paulo, operates in the bioeconomy, specializing in cosmetics products. It is one of the 10 largest direct sales companies in the world and operates 61 stores in Brazil and 7 in France, Argentina, and Chile, along with 474 franchise stores. The Body Shop, which also has a global presence, is a Natura subsidiary. The company is known for its sustainably sourced inputs from Amazonia, which made up 16.5 percent of its inputs in the fourth quarter of 2020. One of Natura's climate change key performance indicators under its Commitment to Life Vision for 2030 focuses on a 30 percent increase in the share of Amazonian inputs in total inputs.

Impacts on deforestation—and jobs?

Natura illustrates the potential of bioeconomy companies to advance sustainable, inclusive development in Amazônia. Applying the logic developed in this report, Natura can be expected to have ambiguous impacts on deforestation. Since Natura produces globally traded goods, productivity gains or rising external demand for its products can lead to reduced deforestation through general equilibrium impacts on extensive agriculture (Hanusch 2023). However, competition for land will intensify as commodities in Natura's supply chain compete with other commodities. The net impact on deforestation is thus, a priori, ambiguous. The social impact will depend on the ability to generate jobs and salaries. While Natura sources some of its inputs in Amazônia, most production occurs in southeast Brazil. Thus, attracting Natura's main production to the ZFM could generate further local jobs and social development in Amazônia.

Sustainable sourcing

For Natura to have a positive net impact on forest conservation, sustainable sourcing is key. Natura's sourcing is certified by the Union for Ethical Biotrade, which includes strong tracing mechanisms. This allows Natura to ensure that its sustainable sourcing market is not diluted by products that were produced using unsustainable methods that harm biodiversity in the forest. This is critical to ensure that even though Natura generates new demand for forest products—and thus land—its general equilibrium impact on land dynamics is benign, reducing deforestation in net terms.

Makers of productivity

To maximize the environmental and social benefits from companies like Natura, both the private and public sectors need to be involved. While companies should focus on applying strong sustainability standards and raising the efficiency of their production (internal markers of productivity), governments must establish an environment in which companies can compete successfully (external markers of productivity).

By focusing on productivity rather than just the share of Amazonian inputs in its products, Natura could increase its climate and biodiversity benefits. Natura's products are competitive in global markets. Boosting its productivity could thus be expected to have positive impacts on forest conservation, especially considering Natura's sustainable sourcing methods. In light of its commitment to reducing climate change, Natura could update its key performance indicators from the amount of inputs sourced from Amazônia to the amount of value added to those inputs. Separate from climate change benefits, inputs could still be a key performance indicator related to social development, supporting sustainable livelihoods.

Where to locate, given the transport costs

Even though Natura sources from Amazonia, it is not obvious that the company should relocate there. When choosing a production location, companies consider cost factors for their entire production chain, not just the sourcing of selected inputs (such as forest products). The methodological framework of this report shows that states like Amazonas struggle to compete with Brazil's southeastern states. In 2014, production plants with the highest capabilities in cosmetics manufacturing were located in São Paulo and Santa Catarina. In Amazonas, firms in chemicals production (which includes cosmetics) had a revealed production capability below the country average (set at 100) of 96.5 in 2014, down from 98 in 1994. In contrast, the best performing municipalities in Santa Caterina scored between 102.6 and 107.7, while those in São Paulo

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Box 4, *continued*

ranged from 103.1 to 111.4. This can help explain why the cosmetics sector is underdeveloped in Amazonas: it is not competitive there.

Transport costs can also work against moving production to Amazônia. Using the insights from the structural gravity model discussed earlier, it is possible to quantify the burden of geography that cosmetics producers currently operating in Santa Catarina would face if they relocated to Amazonas. Results indicate that if Santa Catarina-based cosmetic producers faced the same transport frictions as producers in Amazonas their production would shrink by about 15 percent. Overall, one-third of this effect is due to the fact that producers would be further away from their suppliers (noting that currently most inputs are not in fact forest inputs), and two-thirds is related to the fact that producers would be further away from consumers.

Bioeconomy companies like Natura can have positive environmental and social impacts even without relocating their main production operations to Amazônia. Natura makes positive social and environmental contributions by fostering sustainable livelihoods in Amazônia, while reducing pressures on natural forests in Brazil (including the Amazon biome) through general equilibrium effects. Could Natura make an even bigger contribution by relocating to Amazônia, say, to the ZFM? Not necessarily. Given current capabilities and transport costs in Amazonas, moving Natura there would lower its global competitiveness, with negative overall job impacts across its direct and indirect operations. It would also reduce Natura's productivity and the associated positive macroeconomic impacts on natural forests. In other words, it would reduce Natura's environmental and social benefits and likely require fiscal incentives, with the costs borne by Brazilian taxpayers.

To attract bioeconomy companies like Natura without creating negative social, environmental, and fiscal net impacts, Amazonas would need to improve its business climate, lower its transport costs—and, of course, assure effective forest governance.

Amazonas already exhibits some capabilities in many sectors, including green industries. Businesses in these sectors could be attracted by improving the business environment and reducing transport costs. Analysis based on a skill relatedness index shows that Amazonas has worker capabilities that could be used in manufacturing and services industries that are not yet established there (see tables A1 and A2 in the annex to this report). Relevant sectors include the medical supply industry (box 5), glass production, and chemical preparations. While there are many possible reasons for these industries to not be active in the state—especially industries linked to specific endowments (such as minerals or primary sectors)—high transport or other business costs are likely keeping businesses from locating in Amazonas, as with Natura (see box 4). Improving the business environment could make it beneficial for companies in these sectors to locate in Amazonas, where they could generate a considerable number

BOX 5

Potential opportunities for the ZFM in producing medical devices

The production of medical devices is one of the industries identified by the skill relatedness index as potentially relevant for the ZFM. The industry has a high degree of value addition and could bring significant gains to the region. The number of workers required to produce medical devices to standard specifications is unusually high compared with other manufacturing industries, in part because of the high potential for liability suits if products are defective. Direct labor for medical devices tends to be drawn from technical high school graduates, whereas the university system provides specialized workers such as material handlers, engineers, and microbiologists. The technology required to produce medical devices is proprietary. Similarly, the management experience required to secure regulatory approval for such devices in foreign markets is found mostly in firms with prior experience.

Since foreign firms bring with them "follow-on" suppliers in the medical devices industry, the industry is integrated in global value chains, with significant multipliers. Items such as elastic bandages, blood pressure cuffs, and X-ray film may be regulated lightly, whereas more stringent regulations are applied to devices implanted in the human body, such as pacemakers, artificial heart valves, and silicone breast implants.

As part of a focused strategy, Costa Rica was able to upgrade beyond light manufacturing exports (such as textiles) and integrate itself into more complex value chains, as in the medical devices industry. This was a long-term strategy, and it took almost 20 years to reap the fruits of the shift in its industrial policy. The ZFM already has a labor force that is more diversified and skilled than that of Costa Rica in the early 2000s, when the country decided to move away from light manufacturing. This can make building the industry somewhat easier in Amazonas, but commitment to a medium- to long-term strategy is the key to success.

Source: World Bank 2020a.

of green jobs in low-carbon industries (see tables A1 and A2). A competitive ZFM could be an attractive location for new productive, green industries and could help Amazonas catch up with more advanced economies, both domestically and internationally.

Reconsidering fiscal incentives

The policy options for revitalizing the ZFM and recalibrating its economic, social, environmental, and fiscal sustainability need to include a reconsideration of fiscal incentives. Many of the reforms in transport and in the business climate discussed in the present report are linked to regulatory constraints. Policy can address these at a relatively low fiscal cost. Such reforms can reduce the ZFM's dependence on fiscal incentives, freeing up fiscal resources for costlier investments, such as infrastructure. This would enable a shift away from less productive spending (implicit subsidies) to productive investment in future growth. Such a shift would support economic growth and job creation in the ZFM, protect the Amazon biome (since higher urban productivity reduces deforestation pressures), and limit fiscal liabilities and associated inefficiencies.

There may be additional opportunities to restructure the ZFM incentive regime. The duty exemptions generate significant trade distortions and reduce efficiency in the transportation sector. They also make Amazonas vulnerable to

Mercosul-wide trade liberalizations that could undermine this source of internal competitiveness. Both duty and tax exemptions favor capital-intensive production over labor-intensive production. The ZFM benefits are currently a sticking point in national efforts to reform the country's byzantine tax system, a key driver of Custo Brasil (a summary term for Brazil's high cost of doing business). The ZFM—and associated jobs—will continue to depend on fiscal support until reforms can improve the competitiveness of the ZFM and Amazonas. Yet as part of the broader discussion about tax reform in Brazil, there may be opportunities to reduce trade distortions and recalibrate incentives to favor labor intensity rather than capital intensity. Such an agenda goes beyond the scope of this report but is an important area for future research.

Savings from the reform of fiscal incentives could be availed for conservation finance (resources intended to promote sustainable development in Amazônia), further strengthening the positive links between development and forests. Public resources would then be explicitly justified by the public goods value of Amazonas's standing forest and could be availed both for protecting forests and fostering the urban development agenda. Hanusch (2023) discusses this further, including how conservation finance could be conditioned on verifiable results in controlling deforestation.

5 Conclusion and Policy Implications

This report has shown that there is considerable policy space to help leverage the existing capabilities generated by the ZFM to foster inclusive and sustainable growth in Amazonas. National efforts to raise productivity, including by reducing Custo Brasil, would also benefit firms in Amazonas, potentially enabling it to export beyond Brazil's and even Mercosul's borders. Reforming Brazil's logistics sector is critical to give remote areas such as Amazonas a fair chance to compete in domestic markets. Opportunities such as reforming the cabotage system would be the most environmentally sustainable way to improve market access for Amazonas.

Beyond connectivity, policy can augment the competitiveness of Amazonas. This includes some potential reforms for the ZFM and the broader business environment of the state. Regulatory changes could reduce the cost of doing business. In addition, reforming the energy sector is a priority for making production in Amazonas greener (by reducing emissions), more productive (by improving reliability), and more fiscally sustainable (by reducing losses and improving collections). The ZFM could transition toward an eco-industrial park, with potential gains in the international trading system and the possibility of benefiting from price premia in consumer markets. Manaus's traditional industries—which are currently almost entirely detached from the forest economy—have the potential to generate growth and help Amazonas catch up with more developed economies across Brazil and the world. But there may also be additional opportunities in fostering the development of the (currently very small) urban bioeconomy. While this may require some specific policy interventions, the present report has shown that many of the broad reforms that benefit traditional industries would also benefit the bioeconomy.

The urban bioeconomy could support Amazonas's development if the state provided a competitive environment and if sustainability risks are mitigated. Many Amazonian states have chosen the bioeconomy as a socioeconomic focus, including Amazonas for the ZFM. While Hanusch (2023) discusses the rural bioeconomy, this report has discussed the urban bioeconomy, generally associated with higher value-added activities beyond primary production. The bioeconomy, like other sectors, will benefit from many broader reforms advocated here, from skills to logistics. Existing industries in the ZFM, with very limited forest value chains, and new industries, based on the urban bioeconomy

and with sustainable rural value chains, can help propel socioeconomic development. As discussed in Hanusch (2023), risks for forests from rural value chains associated with the bioeconomy need to be carefully managed. This requires strong forest governance across Amazônia. A sustainability label could lend additional support.

Forest protection cannot be detached from economic development in the region. In the longer term, urban productivity gains in Amazonas will reduce economic deforestation pressures (Hanusch 2023). But reforms such as lowering transport costs pose some deforestation risks in the shorter term. So, it will be critical to accompany reforms with strong private sector environmental, safeguards and governance, or ESG, criteria and good forest governance, which can also be supported by conservation finance. Beyond deforestation, there are also risks associated with urban pollution that will need to be carefully managed. A strong environmental framework modeled on an eco-industrial park could help mitigate these risks.

Regulatory reforms require few fiscal resources, but financing will need to be available for investment. Hanusch (2023) highlights the need for subnational budgets to accommodate investment needs and discusses ways for both the private and public sectors to invest in Amazônia, including in infrastructure. Additional resources for these investments could come from conservation finance. Reforming the ZFM's current regime of tax incentives could be linked both to the broader national tax reform agenda and to conservation finance.

Annex

TABLE A1 **Worker capabilities in manufacturing in Amazonas**

(sectors not currently active in the Amazonas manufacturing sector for which worker capabilities exist)

CNAE	SECTOR NAME	ESTAB	WORKERS	SR	CHANGE IN EMISSION	CHANGE IN THE SHARE OF GREEN JOBS
AGRICULTURE						
321	Aqüicultura em água salgada e salobra	25	410	0,91	−678	2,8
153	Criação de caprinos e ovinos	154	963	0,88	0	−2,7
163	Atividades de pós-colheita	471	9754	0,87	−8292	−2
132	Cultivo de uva	42	317	0,85	−2320	3,4
990	Atividades de apoio à extração de minerais, exceto petróleo e gás natural	467	11178	0,84	26057	−4,7
112	Cultivo de algodão herbáceo e de outras fibras de lavoura temporária	205	2567	0,83	−30410	1,3
892	Extração e refino de sal marinho e sal-gema	15	92	0,81	−782	−35,3
135	Cultivo de cacau	164	1021	0,8	−101491	2,2
729	Extração de minerais metálicos não-ferrosos não especificados anteriormente	359	7236	0,79	1518	−11,2
891	Extração de minerais para fabricação de adubos, fertilizantes e outros produtos químicos	286	5266	0,79	9501	−7,6
134	Cultivo de café	308	2699	0,74	−77189	−0,1
710	Extração de minério de ferro	599	13233	0,69	−4697	−8,6
721	Extração de minério de alumínio	125	2131	0,68	3153	−9,6
500	Extração de carvão mineral	80	3490	0,64	−1488	−7,5
MANUFACTURING						
1532	Fabricação de tênis de qualquer material	7	135	0,9	−1022	−1,3
2072	Fabricação de tintas de impressão	44	2786	0,9	544	−11
2865	Fabricação de máquinas e equipamentos para as indústrias de celulose, papel e papelão e artefatos	110	8869	0,89	6	5,8
2866	Fabricação de máquinas e equipamentos para a indústria do plástico	41	8296	0,87	23	1,9
2660	Fabricação de aparelhos eletromédicos e eletroterapêuticos e equipamentos de irradiação	82	11272	0,86	−115	−1
1533	Fabricação de calçados de material sintético	32	372	0,86	−3675	0

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TABLE A1, *continued*

CNAE	SECTOR NAME	ESTAB	WORKERS	SR	CHANGE IN EMISSION	CHANGE IN THE SHARE OF GREEN JOBS
2122	Fabricação de medicamentos para uso veterinário	207	5443	0,85	−743	3,8
1051	Preparação do leite	19	463	0,84	−4018	−1,8
2522	Fabricação de caldeiras geradoras de vapor, exceto para aquecimento central e para veículos	183	3056	0,84	8827	−5,3
1043	Fabricação de margarina e outras gorduras vegetais e de óleos não-comestíveis de animais	227	11350	0,84	−3250	0
1353	Fabricação de artefatos de cordoaria	65	4911	0,84	−33728	−0,4
4291	Obras portuárias, marítimas e fluviais	819	17714	0,83	−5639	−8,3
1323	Tecelagem de fios de fibras artificiais e sintéticas	91	11161	0,83	−1045	−2,8
3512	Transmissão de energia elétrica	381	11031	0,83	63937	−1,4
2521	Fabricação de tanques, reservatórios metálicos e caldeiras para aquecimento central	642	20070	0,82	8037	−1,7
2312	Fabricação de embalagens de vidro	50	8253	0,81	4112	−0,8
2421	Produção de semi-acabados de aço	225	3725	0,81	−5202	3
1529	Fabricação de artefatos de couro não especificados anteriormente	764	5774	0,81	−3675	−3,2
2349	Fabricação de produtos cerâmicos não-refratários não especificados anteriormente	151	2104	0,81	796	8
2861	Fabricação de máquinas para a indústria metalúrgica, exceto máquinas-ferramenta	349	18299	0,8	−5040	3
2531	Produção de forjados de aço e de metais não-ferrosos e suas ligas	75	9576	0,8	6090	0,3
2411	Produção de ferro-gusa	38	598	0,79	7604	12,4
1330	Fabricação de tecidos de malha	95	9789	0,79	−1633	4,6
3212	Fabricação de bijuterias e artefatos semelhantes	447	3481	0,79	−8554	4,1
2431	Produção de tubos de aço com costura	133	1750	0,79	5958	−0,1
1220	Fabricação de produtos do fumo	103	11428	0,79	−6540	−2,6
4319	Serviços de preparação do terreno não especificados anteriormente	941	28492	0,79	−16506	−9,7
1414	Fabricação de acessórios do vestuário, exceto para segurança e proteção	1542	12005	0,79	−3850	−1,5
2854	Fabricação de máquinas e equipamentos para terraplenagem, pavimentação e construção, exceto tratores	196	13678	0,78	−14437	0,1
2029	Fabricação de produtos químicos orgânicos não especificados anteriormente	74	9681	0,78	211	0
3032	Fabricação de peças e acessórios para veículos ferroviários	41	8296	0,78	−99	2,8
4212	Construção de obras-de-arte especiais	1295	24808	0,78	−711	0,2
2862	Fabricação de máquinas e equipamentos para as indústrias de alimentos, bebidas e fumo	341	7152	0,78	−4914	−23,8
2051	Fabricação de defensivos agrícolas	70	8825	0,78	−650	−0,1
2851	Fabricação de máquinas e equipamentos para a prospecção e extração de petróleo	726	22519	0,77	−8422	−8,9
3041	Fabricação de aeronaves	5	105	0,76	−87	1,6
1321	Tecelagem de fios de algodão	46	582	0,76	−3241	−5,1
2412	Produção de ferroligas	50	8554	0,75	5229	−4,6
2812	Fabricação de equipamentos hidráulicos e pneumáticos, exceto válvulas	203	11785	0,75	−6241	6,5
2013	Fabricação de adubos e fertilizantes	386	16895	0,74	−12109	−3,4

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TABLE A1, *continued*

CNAE	SECTOR NAME	ESTAB	WORKERS	SR	CHANGE IN EMISSION	CHANGE IN THE SHARE OF GREEN JOBS
1351	Fabricação de artefatos têxteis para uso doméstico	420	5829	0,74	−3751	−40,5
2021	Fabricação de produtos petroquímicos básicos	258	4431	0,73	3257	−6,2
1072	Fabricação de açúcar refinado	84	3583	0,73	−4406	0
2831	Fabricação de tratores agrícolas	37	2684	0,73	−2670	−5,9
1071	Fabricação de açúcar em bruto	159	4997	0,72	−18761	3,7
2814	Fabricação de compressores	71	9906	0,71	−2737	−11,2
3042	Fabricação de turbinas, motores e outros componentes e peças para aeronaves	129	9336	0,71	−4285	−13,9
1931	Fabricação de álcool	709	13656	0,7	−16399	4,6
2853	Fabricação de tratores, exceto agrícolas	94	3194	0,7	−37392	−6,5
2833	Fabricação de máquinas e equipamentos para a agricultura e pecuária, exceto para irrigação	241	7329	0,7	−5327	−6,4
1313	Fiação de fibras artificiais e sintéticas	48	8412	0,7	−17	0,5
2423	Produção de laminados longos de aço	294	6090	0,7	247	9,1
1422	Fabricação de artigos do vestuário, produzidos em malharias e tricotagens, exceto meias	1411	9222	0,68	−5505	0,3
1314	Fabricação de linhas para costurar e bordar	72	8494	0,68	−27	−3,6
2852	Fabricação de outras máquinas e equipamentos para uso na extração mineral, exceto na extração de petróleo	124	10012	0,67	−199	−2,8
3031	Fabricação de locomotivas, vagões e outros materiais rodantes	181	3773	0,67	−2192	−1,8
1421	Fabricação de meias	27	267	0,65	0	−0,7
2451	Fundição de ferro e aço	201	8700	0,65	6823	10,8
2910	Fabricação de automóveis, camionetas e utilitários	606	22293	0,65	−10504	−1,1
2813	Fabricação de válvulas, registros e dispositivos semelhantes	271	11677	0,65	−11526	4,2
1311	Preparação e fiação de fibras de algodão	98	8871	0,65	−4565	−2,7
2944	Fabricação de peças e acessórios para o sistema de direção e suspensão de veículos automotores	202	16511	0,65	−2597	−4,6
2920	Fabricação de caminhões e ônibus	45	2163	0,64	2	−1
1061	Beneficiamento de arroz e fabricação de produtos do arroz	465	10854	0,63	−25034	−3,8
2040	Fabricação de fibras artificiais e sintéticas	40	8159	0,61	8869	−8
3315	Manutenção e reparação de veículos ferroviários	235	10548	0,61	62	4,7
2550	Fabricação de equipamento bélico pesado, armas de fogo e munições	47	8939	0,58	12630	0,5
2012	Fabricação de intermediários para fertilizantes	40	8159	0,52	123	−0,9

TABLE A2 **Worker capabilities in services in Amazonas**

(sectors not currently active in the Amazonas services sector for which worker capabilities exist)

CNAE	SECTOR NAME	ESTAB	WORKERS	SR	CHANGE IN EMISSION	CHANGE IN THE SHARE OF GREEN JOBS
SERVICES						
6492	Securitização de créditos	65	467	0,98	111	−2,3
4621	Comércio atacadista de café em grão	50	1112	0,9	−9067	−5,6
6630	Atividades de administração de fundos por contrato ou comissão	253	3489	0,89	7	0
6433	Bancos de desenvolvimento	3	306	0,88	−2395	0
4622	Comércio atacadista de soja	99	2203	0,85	−2272	−19
6621	Avaliação de riscos e perdas	437	5353	0,83	−4981	−2,6
5812	Edição de jornais	236	11829	0,82	1875	0
6611	Administração de bolsas e mercados de balcão organizados	172	2435	0,82	171	−7,5
6022	Programadoras e atividades relacionadas à televisão por assinatura	100	10277	0,8	−109	0
6143	Operadoras de televisão por assinatura por satélite	458	4588	0,8	−3328	0
8621	Serviços móveis de atendimento a urgências	1403	201043	0,79	−151	−0,7
5221	Concessionárias de rodovias, pontes, túneis e serviços relacionados	550	21269	0,78	65425	1,7
8542	Educação profissional de nível tecnológico	512	197808	0,77	−199	0
4685	Comércio atacadista de produtos siderúrgicos e metalúrgicos, exceto para construção	292	13733	0,73	497	−8,7
6432	Bancos de investimento	158	2263	0,73	0	−5,3
8720	Atividades de assistência psicossocial e à saúde a portadores de distúrbios psíquicos, deficiência mental e dependência química	286	13278	0,73	−13	0
6493	Administração de consórcios para aquisição de bens e direitos	3270	41201	0,69	−4445	−2
4911	Transporte ferroviário de carga	616	11455	0,66	71542	−4,6
7722	Aluguel de fitas de vídeo, DVDs e similares	1345	15667	0,57	−8444	0

Note: Green jobs follow the definition of the Bureau of Labor and Statistics. (Bureau of Labor and Statistics, U.S. Department of Labor, 2012, 2013). Sectors are mapped from NAICS to ISIC and mapped from ISIC to CNAE. BLS estimates the share of green jobs in each industry for the years 2010 and 2011. We use the average in our estimates. Columns (3) and (4) show the number of related establishments and workers, respectively. Column (5) shows the skill-relatedness index (SRI). We exclude sectors with less than 50 related workers or flows of workers. We restricted our analysis to SRI above a threshold of 0.5. Emission refers to the difference between estimated emission in the destination sector and the mean of emission in the origin sectors. Green jobs refer to the change in the share of green jobs.

Endnotes

1. During recent decades, a variety of zone setups have evolved. Special economic zones (SEZ) include free trade zones, export processing zones (EPZ), hybrid EPZs, enterprise zones, freeports, and single factory EPZs.
2. They include such companies as BMW, Coca-Cola, Harley Davidson, Honda, Kawasaki, LG, Philips, S.C. Johnson, Samsung, Solutions 2 GO (Sony), Technicolor, Whirlpool, and Yamaha.
3. Hanusch (2023).
4. Hanusch (2023). Also see Holland et al. (2019).
5. For a review of the literature, see World Bank (2017).
6. World Bank (2020a).
7. Grover et al. (2021).
8. Farole and Akinci (2011).
9. According to SUFRAMA (2020), the ZFM generated 80,000 jobs and companies' revenues was about R$ 105 billion, of which 5 percent is paid out to workers.
10. To put the fiscal cost per worker in perspective, future analysis should calculate the fiscal cost per job created (rather than the fiscal cost for the total number of jobs in the sector). For an overview of the international experience and costs associated with tax incentives and jobs, see IMF et al. (2015).
11. ComexStat, Secretaria de Comércio Exterior.
12. CONFAZ, Brazil Federal Ministry for Economy.
13. The Balassa Index is the most widely used measure of comparative advantage (captures differences in relative production costs) and is computed as the ratio of the share of product k in the total export of state I over the share of product k in the total exports of Brazil. After normalization, the index ranges from –1 to +1 or ($-1 \leq RSCA_{ik} \leq 1$), with values greater than 0 indicating a comparative advantage and those less than 0 a comparative disadvantage. As an example, Amazonas in 2019 was exporting more of 134 products than the country average.
14. The absolute advantage measures the number of products for which Amazonas is the main Brazilian exporter.
15. The Zona Franca Verde was created with Law 11.898/2009 and subsequently regulated with decree 8597/2015.
16. The competitiveness and more specifically the productivity of firms can be measured in several ways, depending on data availability. The analysis here relies on a firm-level salary premium as a proxy for enterprise competitiveness. Being based on employer-employee data and estimated from a Mincerian wage model, such a measure ensures broad coverage of sectors and time and has sound theoretical foundations. The analysis is based on data from Helpman et al. (2017). The authors thank Professor Muendler for sharing the data required for the analysis. The underlying model is estimated at the plant level using data from the RAIS database, where wages were deflated to Brazilian reais in August 1994. There are around 3 million plants per year on average in the raw data (3.8 million in 2014). The model

includes a plant fixed effect with an extensive specification for worker characteristics (including all education categories). The plant fixed effect, aggregated at the sector and state levels, conceptually combines both a pure plant effect, ascribable to plant capability, and an average worker ability effect per plant, derived from the mean ability of workers who are matched to the plant during the respective year. Coming from a cross-sectional regression by year, the plant fixed effect has been normalized by the average value in each sector-year cell, and thus it is indicative of cross-plant deviations.

17. Grover et al. (2021).
18. CPI (2021b).
19. According to the qualitative assessment by one of the interviewed port operators.
20. ANTAQ statistic panel.
21. Tavares de Araujo (2015).
22. Assunção et al. (2020).
23. Grover et al. (2021).
24. Hanusch (2023).
25. World Bank (2020a).
26. The geodesic distance is the linear distance between two coordinates on a map and therefore does not consider specific geographic characteristics, such as mountains, valleys, or rivers.
27. Yotov et al. (2016).
28. As identified in World Bank (2012).
29. Simulations show that reducing transport costs to and from Amazonas using the trade cost index as a proxy for bilateral trade frictions (rather than unrealistically switching places with Espirito Santo) would lead to a significant increase in GDP.
30. Hanusch (2023).
31. Secretaria Especial da Receita Federal do Brasil (2020).
32. This section draws on Vagliasindi (2022).
33. Assunção et al. (2020).
34. https://municipios.rankingdecompetitividade.org.br/.
35. World Bank (2021a).
36. ADB (2015); FIAS (2009); Madani (1999).
37. The bioeconomy features prominently in national government policy documents, including the Operational Plan 2020–23, published in March 2020 by the federal government to implement the National Plan for the Control of Illegal Deforestation and the Recovery of Native Vegetation. An Action Plan on Science, Technology and Innovation in Bioeconomy (PACTI Bioeconomy) was developed by the Ministry of Science, Technology, Innovations and Communications, covering the period 2018–22. Its objective is to promote development in science, technology, and innovation to overcome challenges and seize the opportunities presented by the national bioeconomy, focusing on sustainable development and the production of social, economic, and environmental benefits. The plan identifies three central thematic lines: biomass, processing and biorefineries, and bioproducts. It establishes the Brazilian Bioeconomy Observatory (expected to collect and disseminate information on current and future trends in the bioeconomy) and the Central Coordination Body for the Bioeconomy (expected to discuss, coordinate and implement policies, actions, programs and projects related to the development of the national bioeconomy).
38. World Bank (2020b).
39. Artuso and Zanetti (2022).
40. EU (2020); Miltenburg (2017).
41. Getachew Mengistie (2019).
42. High-end producers are able to export to more distant markets with a greater geographic diversification of international demand and thus are better able to benefit from growth in remote destinations. On the other hand, Sedjo and Swallow (2002) found that, under certain conditions, eco-labeling in wood products may result in lost profits. In an analysis of prices for eco-labeled salmon in the United Kingdom, Asche et al. (2015) show that there is substantial variation in the prices of different eco-labels and that eco-label premiums vary across retail chains. They also emphasize the importance of considering retailer heterogeneity to estimate more precisely a label's premium.
43. Currently, Zona Franca de Manaus has a label "Feito na Zona Franca de Manaus," but it is not a sustainability label.

44. Tavares de Araujo (2015).
45. There is an interesting parallel to mining products. Having mineral deposits does not necessarily mean that a country will also be a minerals processor. For example, some major steel producers (such as Japan and the Republic of Korea) have no iron ore resources, while many African countries export raw materials without conducting any significant beneficiation. A comparative advantage in processing primary products (including forest products) does not emerge simply from proximity of the natural resource.

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