African Slavery and the Reckoning of Brazil

Guilherme Lambais and Nuno Palma*

October 17, 2025

Abstract

More enslaved Africans disembarked in Brazil than in any other country in the New World. Using new archival data, we build real wage and slave price series for Brazil covering 1574–1920. Wages initially matched those in Europe but fell as the slave trade expanded, only recovering when the trade ended and slave prices rose. We develop a directed technical change model with slave tasks to explain this finding. We also estimate a large, positive causal effect of slave trade prohibition on wages, consistent with our model. Post-prohibition, there was technological change towards free labor and concentration of slave labor in high-disamenity occupations.

JEL Classifications: N36, N96, J31, J47.

Keywords: comparative development, slave trade, colonial Brazil, frontier settlement.

*Lambais: Center for Research in Economics and Comparative Development (CIEDEC), Lusíada University of Lisbon. Palma: University of Manchester. We are grateful to Leticia Arroyo Abad, Bob Allen, Juan Martirén, Tommy Murphy, Klas Rönnbäck, Eric Schneider, Israel Solares, and Pim de Zwart for kindly sharing data. We also thank Guido Alfani, Luciano Amaral, Gareth Austin, Tim Besley, Ana Rute Cardoso, John Devereux, Rui Pedro Esteves, Giovanni Federico, Rachel Griffith, Anne Hanley, Ellen Hillbom, Yuzuru Kumon, Remy Levin, Peter Lindert, Suresh Naidu, Sheilagh Ogilvie, Eustáquio Reis, Henrik Sigstad, Daniela Vidart, Chris Wallace, Leonard Wantchekon, and participants at several seminars and conferences, for useful comments. Vinicius Alves, Camila Amaral, Joakim Book, Hélder Carvalhal, Eduardo Cavalcante, André Lanza, Gustavo Acioli Lopes, and Maria Ferraz Santos provided excellent research assistance. Special thanks go to Urano Andrade and João Fialho for outstanding help with constructing our dataset. We also thank Rosana Souza at the *Santa Casa* archive in Salvador, William Abitbol at Sorbonne's *Bibliothèque Serpente*, and staff at other archives for support with the data collection. The data corresponding to this paper will be made publicly available upon publication. We thank funding from the European Union's Horizon 2020 research and innovation programme, under the Marie Sklodowska-Curie grant agreement 101031282, and from the Haddad Foundation.

1 Introduction

Over twelve million people were forcibly taken from Africa to the Americas over the four centuries of the Atlantic slave trade. More enslaved Africans disembarked in Brazil than in any other country in the New World.[1] How did the slave trade shape Brazil's long-run development? In this paper, we offer evidence and a novel interpretation of how the slave trade created a slavery economy that underdeveloped Brazil, leading to an economy characterized by a low level of wages and technology for free workers. Only with the end of the slave trade did Brazil begin altering its development path.

We assemble new, hand-collected archival data, with over 17,000 observations for Salvador and Rio de Janeiro extending more than three centuries since the sixteenth century (1574–1920), and leverage the sequence of slave-trade prohibitions as plausibly exogenous shocks to coerced-labor supply. We document a previously unknown fact. Real wages for unskilled workers in Brazil were initially high by global standards, comparable to the European average. Then they declined sharply as the slave trade expanded, reaching some of the lowest levels in the world, and then recovered as the trade contracted during the nineteenth century.[2]

To interpret these findings, we develop a model of directed technical change with slave tasks. Tasks differ by disamenities, and firms assign each task to enslaved or free labor by comparing unit costs. Learning-by-doing generates factor-specific productivity gains in the tasks performed by each type of labor. The model yields multiple steady states, with a high-slavery and a low-slavery equilibrium. A slave trade prohibition that raises the price of enslaved labor can eliminate the high-slavery equilibrium, reallocating tasks toward free labor and directing subsequent technical change to complement free workers.[3] We can then map three of the model's predictions to the

[1] Estimates point to 12.5 million embarkations in Africa and 10.6 million disembarkations in the Americas. Considering only documented voyages, there were approximately 8.4 million slaves taken from Africa to the Americas: Brazil received 3.2 million, compared with 520,000 to the Spanish America mainland, 4.4 million to the Caribbean, and 300,000 to mainland North America (Slave Voyages, 2023b). The intra-American slave trade increases the disparity: From this trade, 850,000 slaves were disembarked in Brazil, 172,000 in the Spanish America mainland, 205,000 in the Caribbean, and 130,000 in mainland North America (Slave Voyages, 2023a).

[2] Long-run real wages have been used to study the Industrial Revolution (Clark, 2005; Acemoglu & Johnson, 2024), the income divergence in historical Europe (Allen, 2001), income divergence in the Americas (Allen et al., 2012; Abad et al., 2012), and contemporary topics (Ashenfelter, 2012).

[3] Labor scarcity spurs innovation and adoption when technology replaces labor, as firms innovate to substitute capital for scarce labor, accelerating mechanization and growth. Technologies that

data: (a) unskilled free wages should rise after prohibition shocks and the rise in slave prices; (b) adoption/organization should move toward free-labor-complementary technologies; (c) enslaved workers should become concentrated in high-disamenity tasks.[4]

We test the first prediction using a synthetic difference-in-differences design (SDID) with a broad international donor pool, estimating large, positive causal effects of the prohibition on unskilled wages for free workers, who were in direct competition with the slaves.[5] There is an effect ranging from a 28% increase in wages in the first shock to around a 40% increase in each of the later two shocks. We explore as treatments the 1807 Slave Trade Acts of the British Empire and the United States. These acts were followed by the 1831 and 1850 slave trade prohibition laws in Brazil, which were enacted under British pressure and threats from the Royal Navy (Bethell, 1970).[6]

We then show suggestive historical evidence for the other two predictions. First, we present cases of technological change after the prohibition, where technology evolved towards the more productive use of free labor (*e.g.*, mechanization of urban transport and port handling). Second, we use the first nationwide census in 1872 to demonstrate that enslaved workers were disproportionately concentrated in occupations with high-disamenity tasks. All together, the evidence shows that Brazil was only able to escape underdevelopment after a large enough shock to the prevalent "high-slave equilibrium," which then unshackled wages and technological change for free workers, putting the economy on a path with increasing real wage levels.[7]

Our paper contributes to several literatures. We complement the "colonial origins with reversal of fortune" and "factor endowments" perspectives by "decompressing history" (Engerman & Sokoloff, 1997; Acemoglu et al., 2001, 2002; Austin, 2008; Engerman & Sokoloff, 2012), through offering a new dataset and a concrete labor-market mechanism connecting coerced-labor supply to *measured* real wages and the

create new tasks for free workers raise their marginal productivity and share, supporting higher wages (Acemoglu, 2010; Acemoglu & Johnson, 2024).

[4]On the information content of slave prices for political shocks, see Calomiris and Pritchett (2016).

[5]SDID combines unit and time fixed effects with unit and time weights in a doubly-robust estimator (Arkhangelsky et al., 2021). We show that other potential idiosyncratic drivers of wages were uncorrelated with the slave trade prohibition shocks.

[6]For all prohibition dates, we find a sizable negative immediate shock to the number of enslaved Africans arriving at the Salvador and Rio de Janeiro ports, suggesting these were unanticipated. The prohibitions were being pushed by the British due to exogenous factors relative to Brazil, and hence were plausibly uncorrelated to other factors also driving wages in Salvador and Rio de Janeiro.

[7]On the matter of Brazil failing to develop because it specialized for centuries in producing cheap people see also Leff (1972b, 1982), and Allen et al. (2012) for Spanish America.

direction of technical change in a major New World economy which was the leading importer of slaves. We also provide an explanation for the causes of Brazil's initial development path, aligning with the timing and magnitude of the changes in income levels observed over time. In doing so, our results have broad implications for the literature that explains the differential development of New World economies.[8]

Our results support work which suggests that market wages were suppressed in societies that relied heavily on unfree labor (Naidu & Yuchtman, 2013; Dippel et al., 2020; Korchmina, 2024). In addition, we add causal evidence to debates on slavery and modern economic growth, suggesting the reliance on slavery was not an appropriate foundation for the emergence of modern economic growth (Acemoglu et al., 2012; Olmstead & Rhode, 2018; Wright, 2020; Palma et al., 2021; Wright, 2022; Gardner, 2023; Carvalhal & Palma, 2024; Jung & Yoon, 2025). Slavery certainly enriched a limited number of merchants. Still, it led to a society that was not conducive to broad economic development, even if changing the associated political equilibrium was difficult (Acemoglu, 2003; Ogilvie, 2007).

By providing evidence on Brazil, we additionally cover the case of a country which, despite its large size and historical importance, is usually left out of international comparisons.[9] Prior to our study, no comparative or systematic data existed for Brazil before the nineteenth century, and for that century, some partial and indirect evidence suggested slow or negative income growth.[10] We find that during most of the nineteenth century, real wages for unskilled workers increased.

Our findings, however, have broader implications beyond understanding the case study of Brazil's historical underdevelopment. In Figure 1, we pool our real wage data with a cross-section of studies with comparable real wages for the Americas and compare the wages with how many enslaved Africans disembarked in each of the locations. There is a strong, negative correlation between the number of slaves disembarked and real wages across all locations, which suggests that the same type of mechanisms discussed in this paper were likely at play in other New World regions.

[8]Evidence from multiple contexts shows the negative effects of coerced labor in the Americas (Acemoglu & Wolitzky, 2011; Burnard et al., 2019; Geloso et al., 2023; Abad & Maurer, 2024; Abad & Maurer, 2025).

[9]Studies of historical wages or living standards in the American continent include Haber (1997), Lindert and Williamson (2013, 2016a, 2016b), and Devereux (2019), among others.

[10]Leff (1973), Engerman and Sokoloff (1997), and Maddison (2006). By contrast, Summerhill (2003, 2005) argues that slow or negative growth during the nineteenth century was unlikely given the development of railroads.

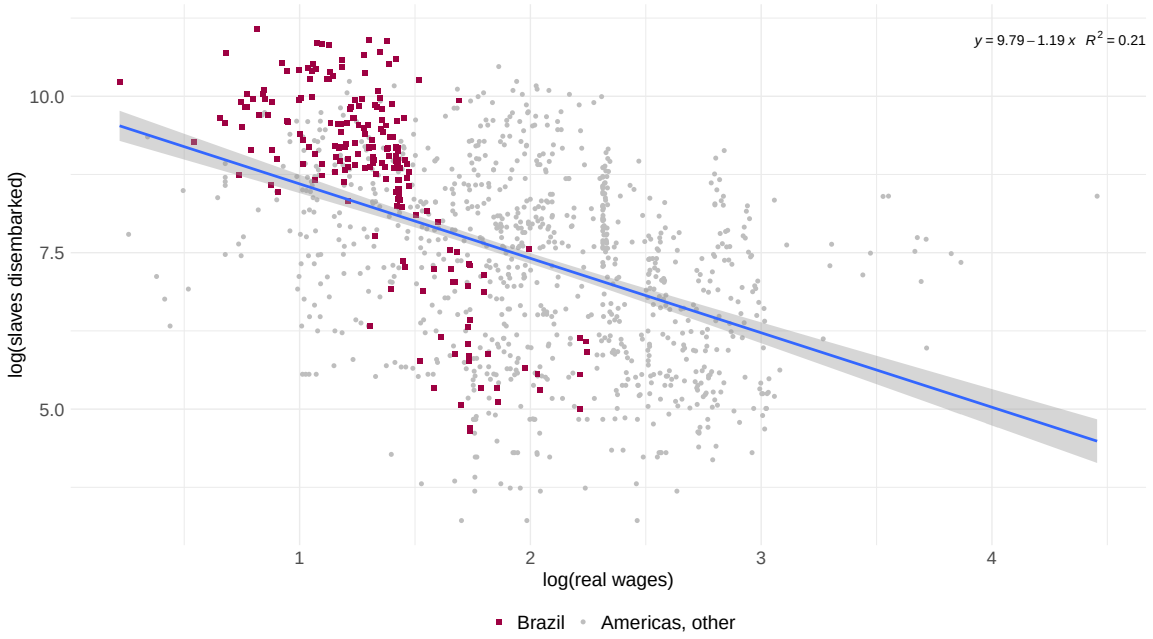


Figure 1: Slaves disembarked and real wages in the Americas

Sources: See Section 2 for real wages in Brazil, Section 3 for real wages in the other locations, and Slave Voyages (2023b) for disembarked slaves.
Notes: Each observation corresponds to a location-year with an annual real wage matched to the total number of slave disembarkations in that year, adjusted for the intra-American slave trade. We aggregate locations for which we have real wages to match them to corresponding specific regions of disembarkation in the Slave Voyages (2023b) database. "Americas, other" does not include observations from any other regions of Brazil. For clarity, we only include observations that had one or more disembarked slaves in that year; however, the correlation remains robust when including locations with zero disembarked slaves.

The remainder of the paper is organized as follows. Section 2 describes the data and the construction of globally comparable real wages and presents our timeseries results. Section 3 situates Brazil's wages globally. Section 4 presents the model and its economic implications. Section 5 estimates the causal effects of prohibition shocks on wages. Section 6 shows historical evidence for other mechanisms of the model. Section 7 concludes.

2 Labor markets and wages in Brazil, 1574–1920

In Section 2.1 we summarize the labor markets, with emphasis on the relationship between free labor and slavery. In Section 2.2, we explain how to build price and wage series to arrive at internationally comparable real wages for unskilled workers, including a detailed description of the primary sources and how we constructed our final dataset. In Section 2.3, we conclude with the series for unskilled workers, combining new hand-collected archival data with information available in secondary sources to build the first-ever three-and-a-half-century price, wage, and slave price series for Brazil.

Our dataset includes around 17,000 observations pertaining to the cities of Salvador and Rio de Janeiro. The former was the heart of Brazil's early settlement and sugar production, the first national capital (from 1549 to 1763), a major slaving port, and is still one of Brazil's most important states today. The capital moved to Rio in 1763, which then became the largest slaving port in the world, and remained there until 1960. Rio de Janeiro was the first region of coffee production, later becoming one of the main industrial and financial centers in Brazil.[11] Our data covers the period which goes from first Portuguese settlement until the twentieth century (1574 to 1920).[12]

2.1 The labor market for unskilled workers

Before the effective abolition of the Atlantic slave trade in 1850, Brazil's labor markets were dominated by systems of coerced labor, reflecting both the colony's plantation and mining-based economy and Portuguese imperial policies.[13] Enslaved Africans formed the core workforce in sugar production, mining, cattle ranching, and urban trades, with the trans-Atlantic slave trade supplying the majority of the enslaved labor, while high rates of manumission ensured a large proportion of free blacks and

[11] Note that in both cases, the state includes its namesake city (as with New York in the USA). We provide additional historical background about Salvador and Rio de Janeiro in Appendix A of the Appendix. The data for Salvador includes information from the *São Francisco do Conde* sugar mill in the outskirts of Salvador.

[12] The first year we were able to get reliable information on market-set prices and wages was 1574, and we stopped in 1920 because it was the year of Brazil's first census that reported income levels (there was an earlier demographic census in 1872 that did not report income). From the early twentieth century, there exist credible national accounting studies, for example Haddad (1974).

[13] Slavery itself would end only in 1888, but its importance was by then much reduced.

mulattoes coexisting with free whites.[14] Unskilled tasks in small-scale agriculture, artisanal trades, and port work, for example, could be carried out both by enslaved Africans and free workers, which were constituted by poor whites, poor mixed-race individuals, and liberated blacks and mulattoes, though opportunities were constrained by the dominance of slavery in both rural and urban economies (Klein & Luna, 2009).

2.2 Building internationally comparable real wages

Price and wage data collection in new world economies is a major challenge because there are not many century-old institutions with record keeping like in Europe, such as universities, monasteries, hospitals, charities, and royal administrations, which can also provide market values of goods and services. One of the oldest institutions in Brazil is the Holy House of Mercy of Bahia (*Santa Casa de Misericórdia da Bahia*), established in Salvador in 1549, which functioned as a church, charity, orphanage, and hospital.[15] The Holy House is the only institution still in existence in Bahia that can provide continuous information since the seventeenth century. We use account and receipts books from the Holy House since the first book we were able to find (1647) up to 1920. In the Franciscan archive in Recife, we were also able to find the account books of the *São Francisco* Convent and Hospital of Salvador, which is a novel addition to the literature. The account book covers 1790 to 1820.

For the earlier periods we take advantage of documentation available at the *Torre do Tombo* National Archive in Lisbon. There we find the probate records of Mem de Sá (c. 1504–1572), third Governor-General of Brazil, which was the first owner of the sugar mill *Sergipe do Conde* in *São Francisco do Conde*.[16] In the Torre do Tombo we also find account records spanning the years 1611 to 1742 that have survived from the Sergipe do Conde sugar mill, largely recognized in the literature as the most complete

[14]For example, Alden (1984) documents that whites were only 20% of the population in Salvador around 1810, while free blacks and mulattoes amounted to 32%, and enslaved blacks and mulattoes were the largest group with 47%. Klein (1969) documents the general patterns of the free black and mulatto population in various parts of Brazil, finding that free blacks and mulattoes accounted for 47% of the craft artisans, for instance. In contrast, indigenous labor, initially important to the colonial economy, declined quickly over the seventeenth century due to disease, displacement, and the expansion of African slavery, even though some frontier settlements could still rely on coerced native work.

[15]The Holy House in Salvador is almost as old as the first Holy House created in Lisbon in 1498, which was the model that was followed by those who created it in Brazil.

[16]He was also involved with the founding of the city of Rio de Janeiro in 1565. Some documents related to Mem de Sá were transcribed in Instituto do Açúcar e do Álcool (1963).

sugar mill account documentation from Brazil.[17] We complete this data with probate records in the State Public Archive of Bahia.[18]

For Rio de Janeiro, we used account books of similar kind, from the Archive of the Holy House of Rio de Janeiro, the National Archive, and the Archive of the City of Rio de Janeiro. All the archival sources we relied on for data collection are detailed in Appendix B and in Appendix C, where we also show some sample images of manuscripts from the archives. We then combine our archival data with various printed sources, described in Appendix D. Finally, to arrive at real wages series we follow Allen (2001) and build an internationally comparable "bare-bones" representative price basket for Brazil. We then divide the nominal wage series by the price series. See Appendix D for details.

2.3 Results

We now describe our main results for real wages in Salvador and Rio. Figure 2 shows real wages for unskilled workers.[19] We find that real wages were well above subsistence from first settlement until the beginning of the eighteenth century.[20]

Real wages in Brazil then trended down over time, even reaching subsistence for brief periods in the early nineteenth century. After the gold boom peak (with further encouraged import of slaves to parts of Brazil), real wages temporarily plateaued and then began to quickly fall again, similar to the macroeconomic performance of European Portugal (Palma & Reis, 2019; Kedrosky & Palma, 2025).[21] This fall

[17] This is also the difference of our dataset from earlier works that used the São Francisco do Conde account books such as Schwartz (1985). We use the complete set of manuscripts, combining the account book already transcribed in Instituto do Açúcar e do Álcool (1956) with newly transcribed manuscripts, making this also a novel addition to the literature, so it is not necessary to use these authors as secondary sources.

[18] We restricted our selection to records from the eighteenth century because that is the earliest period available at the archive, while data for the nineteenth century was already available from other sources. We selected the records based on a mix of early availability at the archives and a random 10% sample. In all, we were able to find some data points between 1700 and 1793. Note that the probate records that we reference in Appendix B are the ones that we found these data points, but that we have read many more.

[19] In Figure G.1 we measure the real wage in working days instead, following Allen and Weisdorf (2011).

[20] Research for other frontier societies also suggests that early settlers chose the most productive locations to initially settle (Cilliers et al., 2023). Schwartz (1973) classifies the Brazilian sugar mill (*engenho*) as a "frontier institution."

[21] Large quantities of gold were found in Minas Gerais, far away from Salvador or Rio; but as they generated much internal and external migration in the context of the ensuring gold rush, this

continued into the early decades of the nineteenth century, before a period of slow but sustained improvement began.

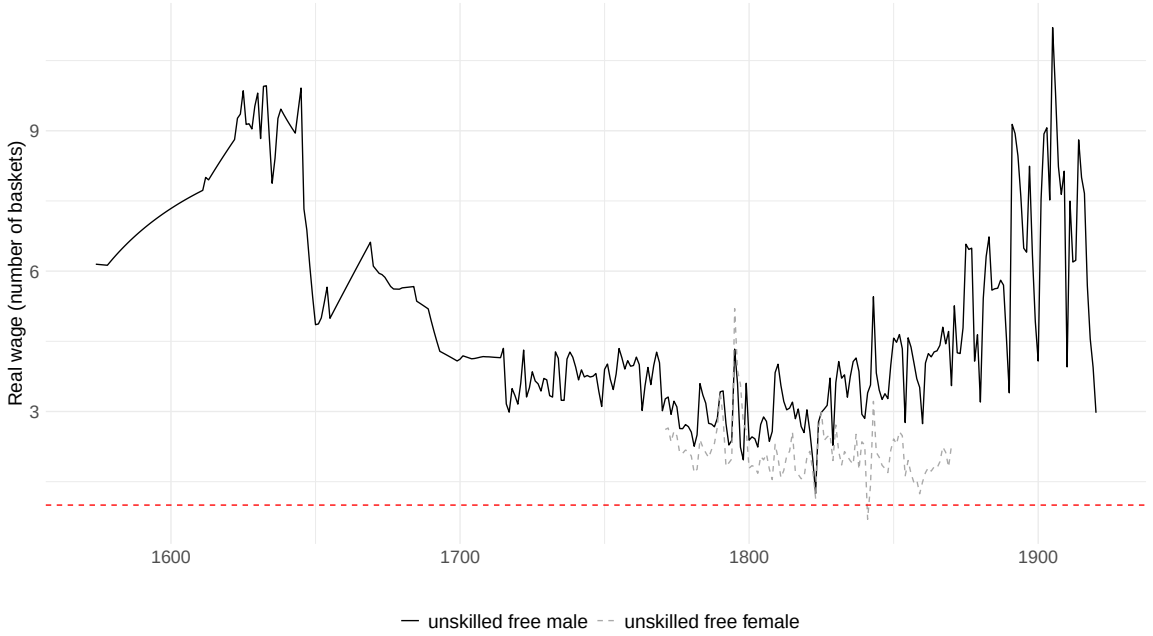


Figure 2: Real wages, 1574–1920

Sources: See Section 2.2 and Appendix B for details on the sources.
Notes: Real wages are measured in annual subsistence baskets. The horizontal dashed line is equal to one basket. A real wage equal to one or more means an individual worker can provide at least bare-bones subsistence.

The high real wages observed for wage-earners in the first few decades of our period are surely related to the scarcity of labor, which was a recurring complaint and concern of colonists.[22] This also resulted from the Crown's efforts, in alliance with the Jesuits, to prevent natives from being enslaved in order to reduce the risk of revolts (Mauro, 1997, pp. 203–4). Boxer (1952, p. 26) points out that in addition to not taking kindly to routine labor, Brazilian natives died in great numbers due the unsanitary conditions combined with low resistance to the epidemics introduced

affected the labor market back in Salvador and Rio. As elsewhere in Latin America, precious mineral resources enabled the geographic expansion of the empire and shaped political institutions, labor regimes, the fiscal apparatus, economic activity, and population density (Abad & Palma, 2021; Baerlocher et al., 2023).

[22]Some of the earliest published works about Brazil were motivated to encourage immigration there, for example Gândavo (2004) published in 1574.

by Europeans. As a result, bringing enslaved Africans was seen as fundamental and would fundamentally change the long-run development path.

3 Brazil's wages and slavery in global perspective

We now compare Brazil's real wages with several locations across the globe. The baskets are comparable across regions, as they correspond to similar quantities of goods and foodstuffs which match protein and caloric content, as shown in Table D.1 of the Appendix. In Figure 3, we show Brazil compared with various locations in almost all continents.[23] The important general trend to highlight is that, with the exception of Europe, Brazil tends to be the location with the highest real wages until the middle of the seventeenth century, even in comparison with North America. In the same period, Brazil is comparable to the European average, with real wages higher than many locations, including Lisbon, Strasbourg, and Valencia, but lower than Amsterdam and London, for example. After the second half of the seventeenth century, real wages in Brazil entered a long period of decline, becoming one of the world's lowest in the eighteenth century. Brazil's real wage then partially recovers in the nineteenth century, ending the period still as one of the lowest but higher than in some places in Latin America and Asia.

[23] In Appendix H, we breakdown this figure and show Brazil's annual series compared with each location individually.

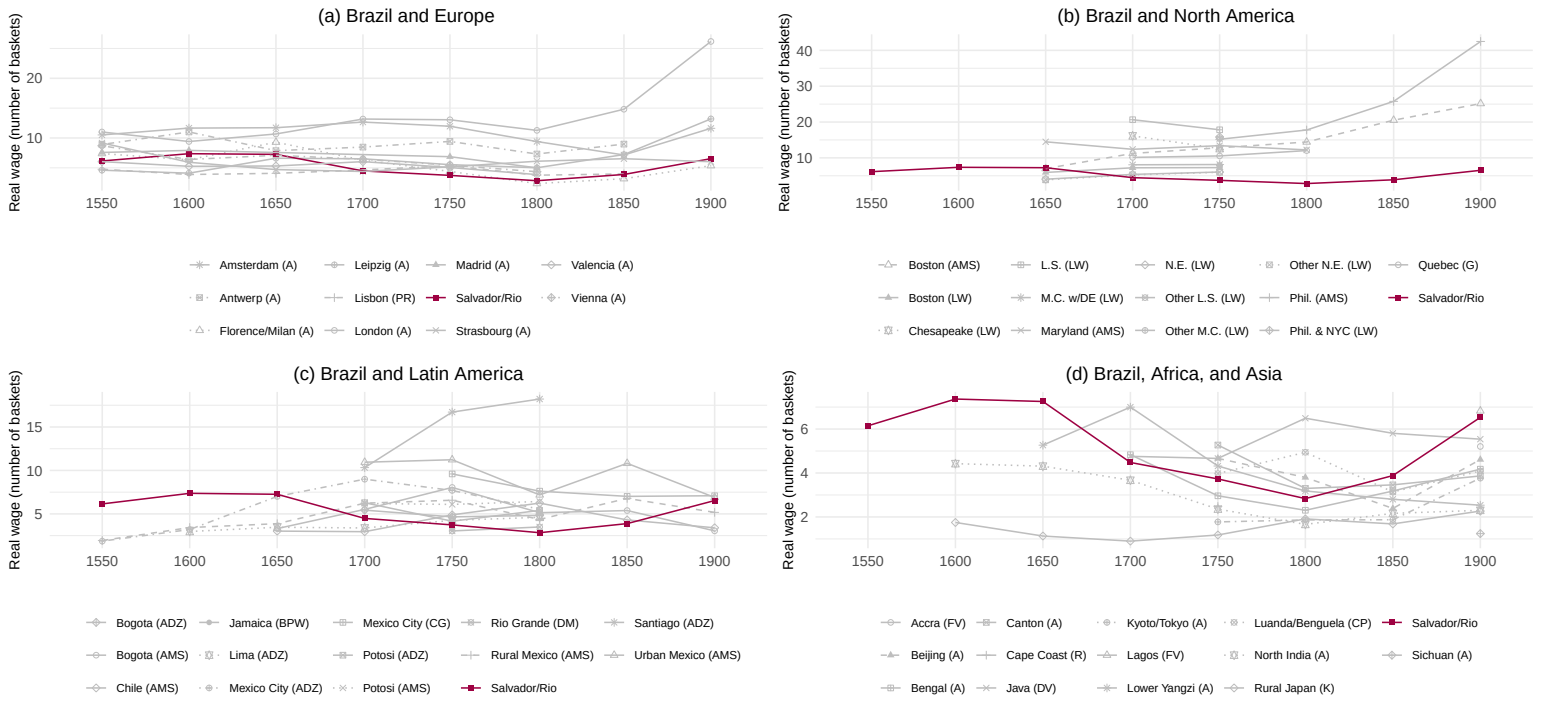


Figure 3: Unskilled real wages for Brazil compared with locations in Europe, North America, Latin America, Africa, and Asia

Sources: Brazil: see Section 2.2 and Appendix B for details on the sources. For the others: (A): Allen (2001) and Allen et al. (2011); (ADZ): Abad et al. (2012); (AMS): Allen et al. (2012); (BPW): Burnard et al. (2019); (CG): Challú and Gómez-Galvarriato (2015); (CP): Carvalhal and Palma (2024); (DM): Djenderedjian and Martirén (2020); (DV): de Zwart and van Zanden (2015); (FV): Frankema and van Waijenburg (2012); (G): Geloso (2019); (K): Kumon (2022); (LW): Lindert and Williamson (2013, 2016a); (PR): Palma and Reis (2019); (R): Rönnbäck (2014). (A) and (AMS) have been updated in Allen (2023).

Notes: The observations correspond to fifty-year averages around the dates shown in the figure. Real wages are measured in annual subsistence baskets and are for comparable unskilled workers. L.S.: Lower South; M.C.: Middle Colonies; N.E.: New England.

What could explain these trends in real wages? In Figure 4, we plot in panel (a) the number of slaves disembarked in various regions of the Americas for which we have shown real wages.[24] Brazil was by far the region where most slaves disembarked, only comparable to Jamaica.[25] In panel (b), we overlay Brazil's slave trade series and real wage series for unskilled workers, which were in competition with the enslaved and newly freed populations. The inverse correlation is visible. As soon as the slave trade increases, the real wage starts to fall. In fact, the height of the slave trade coincides with period with the lowest real wages. Real wages only start to improve when the slave trade dies down. In the next section we build a model of directed technical change with slave tasks to explain this finding.

[24]While it would be interesting to include Cuba, which is also known to have participated heavily in the slave trade, we are not aware of real wage data for it in the nineteenth century or before. But the information that exists for the twentieth century suggests that Cuba became a prosperous middle-income economy after the end of slavery, and by the 1920s had an income per capita level which approached that of Western Europe and the US South (Ward & Devereux, 2012).

[25]It is interesting to note that for the only year that we have a real wage observation for Jamaica it is at the same level as in Brazil (see Figure H.6 in the Appendix H).

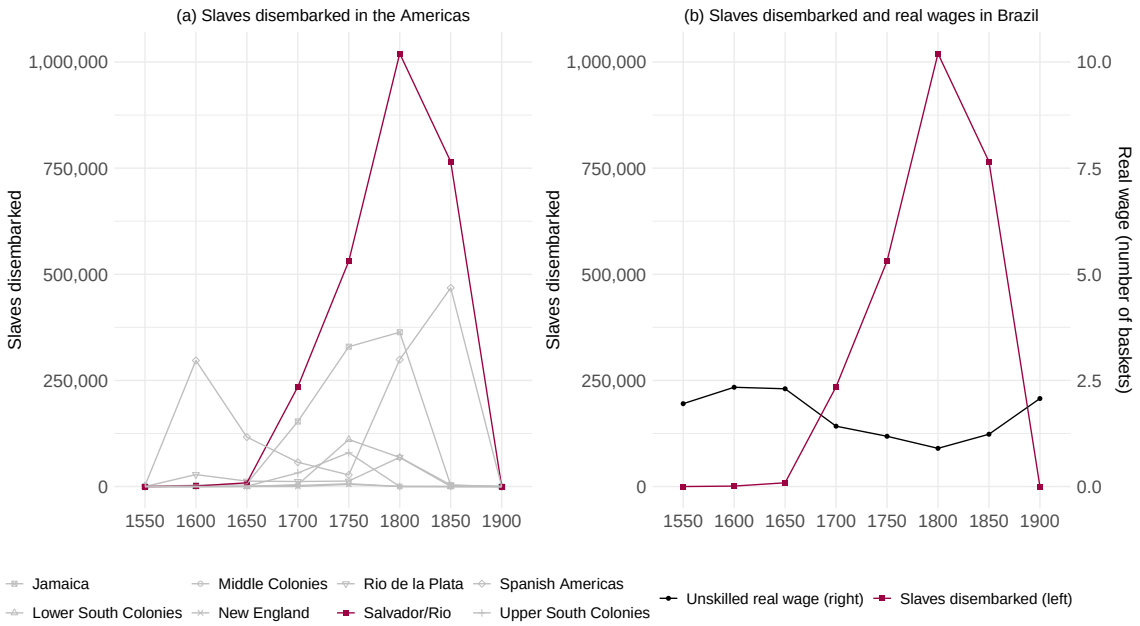


Figure 4: The slave trade and real wages

Sources: Slaves disembarked: Slave Voyages (2023b). Real wages in Brazil: see Section 2.2 and Appendix B for details on the sources.

Notes: The observations correspond to fifty-year averages around the dates shown in the figure. In the left panel, we aggregate locations for which we have real wages to match them to corresponding specific regions of disembarkation in the Slave Voyages (2023b) database. In the right panel, real wages are measured in annual subsistence baskets.

4 Directed technical change with slave tasks

In this section we provide a model based on Acemoglu and Autor (2011) that formalizes what we argue are the key long-run mechanisms at play in Brazil's development path. The model shows that ending the slave trade shifted Brazil's development path towards a equilibrium with less enslaved workers and technical progress towards complementing free workers.

4.1 Assumptions

Slave supply. We start with the assumption of mildly upward or flat function for slave supply (that is, we do not need to assume strong scale effects):

$$p(L_s;\tau) \;=\; p_0 \;+\; \eta\, L_s \;+\; \phi(\tau), \qquad \eta \geq 0,\;\; \phi'(\tau) > 0, \tag{1}$$

where L_s is slave labor supply and τ capture slave trade frictions, including a potential blockages and prohibitions of the trade. When $\eta = 0$, the supply curve is perfectly flat; if $0 < \eta \ll 1$, even large demand shifts p only slightly. Historical contexts can justify this if foreign supply lines or shipping logistics keep marginal costs roughly stable or gently rising with volume.[26]

Coercion costs. Following Acemoglu and Wolitzky (2011) and Naidu and Yuchtman (2013), the cost of enforcing enslaved labor rises when the outside option (the free wage) improves. This is because enslaved workers become more resistant to forced labor as their outside option rises. In addition, similar to Fenoaltea (1984), higher slave prices induce greater monitoring expenditures. Let $d(s)$ denote a task disamenity (arduousness) index, increasing in s (defined below). We can model both channels of coercion as

$$\kappa \;=\; \kappa\big(p(L_s;\tau),\, w,\, d(s)\big), \qquad \kappa_p > 0,\;\; \kappa_w > 0,$$

without imposing a sign on κ_d we only require below a single-crossing condition in relative unit costs. The per-period cost of enslaved labor in task s is thus

$$c_s(s) \;=\; p(L_s;\tau) \;+\; \kappa\big(p(L_s;\tau),\, w,\, d(s)\big).$$

Task heterogeneity and directed technical change. Tasks are indexed by $s \in [0,1]$. Let $d(s)$ be a strictly increasing disamenity (arduousness) index. Free workers

[26] Improvements in ocean shipping and slaving logistics during the Age of Sail—documented for the slave trade (Eltis, 1995) and for shipping more generally (Bogart et al., 2021)—reduced travel times, raised capacities, and lowered mortality. We model these as a decline in trade frictions (τ), shifting $p(L_s;\tau)$ downward for any L_s. Conversely, blockades and prohibitions raise τ and shift p upward.

require a compensating differential that increases with disamenity:

$$w_f(s) \;=\; w \times \varphi\big(d(s)\big), \qquad \varphi(0) = 1,\ \varphi'(\cdot) > 0,$$

where w is a base wage and $\varphi(\cdot)$ is a reduced-form schedule capturing equalizing differences across tasks.

Factor-specific productivities evolve via learning-by-doing/adoption:

$$\dot{A}_f(s) \;=\; \alpha_f\, \mathbb{1}\{\text{task } s \text{ uses free labor}\}, \qquad \dot{A}_s(s) \;=\; \alpha_s\, \mathbb{1}\{\text{task } s \text{ uses enslaved labor}\}.$$

When a free or enslaved labor captures a segment of tasks, $A_f(s)$ or $A_s(s)$ for those tasks grow, effectively lowering future private costs of using that type of labor. Every additional unit of free or enslaved labor used invests in factor-specific knowledge, technology, and routines—not necessarily frontier innovation—that permanently lowers the future cost of free or enslaved labor in those tasks, which α_s and α_f summarize, and creates demand-side self-reinforcement.

4.2 Production and task allocation

We now consider production and task allocation, using a continuum-of-tasks model. A final good Y aggregates tasks outputs with elasticity of substitution $\rho > 1$:

$$Y \;=\; \Big(\int_0^1 y(s)^{\frac{\rho-1}{\rho}}\, ds\Big)^{\frac{\rho}{\rho-1}}, \quad y(s) \;=\; A_f(s)\, l_f(s) \;+\; A_s(s)\, l_s(s). \tag{2}$$

For each task s, a representative firm chooses inputs to minimize cost subject to producing the task output $y(s)$:

$$\min_{l_f(s), l_s(s)} \Big\{ w_f(s)\, l_f(s) \;+\; c_s(s)\, l_s(s) \Big\} \quad \text{subject to } y(s),$$

where $w_f(s)$ is the compensating-differential wage for free labor and $c_s(s)$ is the per-period cost of enslaved labor in task s. Because technologies are linear in inputs within each task, the optimal choice for the firm is a corner solution based on unit costs. The firm compares:

$$\frac{w_f(s)}{A_f(s)} \quad \textit{vs.} \quad \frac{c_s(s)}{A_s(s)},$$

if and only if $\frac{w_f(s)}{A_f(s)} \leq \frac{c_s(s)}{A_s(s)}$, then task s uses free labor; otherwise it uses enslaved labor. Summing enslaved-labor usage across tasks yields:

$$L_s \;=\; \int_{\bar{s}}^{1} \frac{y(s)}{A_s(s)}\, ds,$$

where $\bar{s}$ solves for the unique task threshold. The strength of *across-task* substitution, however, is governed by the elasticity ρ: When $c_s(s)$ rises (for example, with the slave trade prohibition), tasks that rely on enslaved labor lose weight and the aggregate response is stronger the larger ρ is. Our results require only ρ moderately above one so that costs differentials trigger reallocation across tasks, which is supported by the historical evidence in the case of unskilled workers (see Section 2.1). Higher ρ amplifies the demand-side feedback, while ρ closer to one leads to a gradual reallocation away from slave labor.

4.3 Multiple equilibria and the slave trade ban

Because the unit cost of enslaved labor depends on the endogenous price $p(L_s;\tau)$ and on the base wage w through coercion $\kappa(\cdot)$, and because $A_s(s)$ rises with past use through learning-by-doing and adoption, the economy induces a law of motion for enslaved labor:

$$L_{s,t+1} \;=\; \Gamma\big(L_{s,t};\, \tau\big),$$

where $\Gamma(\cdot;\tau)$ combines (i) the within-task technology choice via the cutoff $\bar{s}_{t+1}$ and (ii) the across-task CES reallocation that shifts demand towards relatively cheaper tasks. When enslaved labor is widely used at t, $A_{s,t+1}(\cdot)$ becomes large in those tasks, which lowers future private costs there; this demand-side feedback can make $\Gamma(\cdot;\tau)$ S-shaped. Pre-slave trade ban, such non-monotonicity can generate multiple steady states:

- *Slave economy equilibrium*: high slave usage (L_s^H), strong $A_s(\cdot)$, and an enslaved-labor-friendly production pattern.
- *Free(er) economy equilibrium*: low slave usage (L_s^L) and low $A_s(\cdot)$.

Under standard local stability, these steady states are separated by an unstable threshold that divides the basins of attraction.

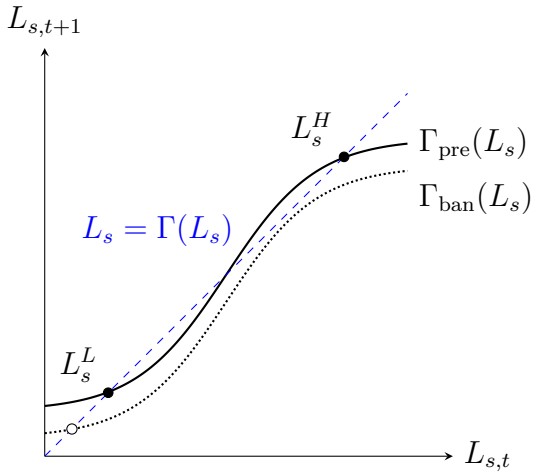


Figure 5: Slave economy *vs.* free(er) economy.

Notes: The solid curve $\Gamma_{\text{pre}}(L_s)$ intersects the 45° line at two stable equilibria, L_s^L and L_s^H. A ban shifts the schedule down to the dotted $\Gamma_{\text{ban}}(L_s)$, eliminating the high-slavery crossing while preserving a single low-slavery intersection.

A slave-trade ban increases τ, shifting $p(L_s;\tau)$ upward and (through higher risks) raising κ; this shifts the entire map downward. If the shift is large enough, it eliminates the high-slavery fixed point, leaving only the low-slavery steady state. Figure 5 illustrates this argument: The solid pre-ban curve crosses the 45° line at low and high L_s, while the dotted post-ban curve, of the same shape but slightly lower, preserves only the low crossing.

In general, any prohibition or blockade raises trade frictions τ, shifting up the effective use cost of enslaved labor $p(L_s;\tau)$ for any given L_s. An increase in τ raises the cutoff $\bar{s}$, thus fewer tasks employ enslaved labor and L_s falls.[27] This static task reallocation triggers a dynamic feedback: As tasks switch away from enslaved labor, demand for free labor rises, which bids up the base wage w under an upward-sloping free-labor supply. A higher w increases coercion costs $\kappa(\cdot)$ (outside options improve and monitoring costs increase), which further raises the unit cost of enslaved labor and deepens the contraction in L_s. Over time, directed technical change raise $A_f(s)$

[27] Our slave price series are *sale* prices (see Section 2.2 and Appendix B). Our model uses the *per-period* effective price (a rental/user cost). One can write the rental price as the sales price multiplied by $u = r + \delta - \pi_p + m$, where r is the interest rate, δ captures losses (mortality and escape, for example), π_p is the expected price appreciation, and m other holding risks. For exposition we absorb u into $p(\cdot)$ and work directly with $p(L_s;\tau)$. Under prohibition in Brazil, both the salve price (scarcer imports) and u (higher holding costs) plausibly rose, so the effective unit price relevant for allocation increased even more. The economic implications of our model therefore carry over when using sale-price evidence.

in the tasks that switch, reinforcing the move toward free labor.

The Brazilian slave price data in Figure 6 is consistent with the first step in this chain: Prices of enslaved men rose sharply, more than ever before, following waves of prohibition and intensified enforcement. Indeed, this is exactly what one would expect in an economy dependent on the trans-Atlantic slave trade to maintain the stock of enslaved workers due to high rates of manumission and the absence of positive natural rate of increase, in contrast to the United States, for example. In such a setting, cutting off imports markedly raises slave prices. Because the effective per-period price p co-moves with the sales price (and with higher holding risks), the ban makes enslaved tasks more expensive right away, initiating the reallocation toward free labor that, in turn, increases w and $\kappa(\cdot)$.

Figure 6 shows that the wage of unskilled free males also rose following the prohibition shocks and that the wage of unskilled enslaved workers co-moved with those of free workers, until enslaved workers disappear from these tasks. In Section 5 we provide *causal evidence* that these prohibition shocks increase the wages of unskilled free men, as reallocation tightened the free-labor market. In Section 6, we first we show that enslaved labor became increasing concentrated in *high-disamenity tasks*—consistent with the cutoff mechanism—and, second, we document historical cases where technology, organization, and adoption shifted to make *free* labor more productive—consistent with the model's directed technical change channel.[28]

[28]Formally, Appendix I shows how an increase in slave trade frictions lead to increasing wages. Our SDID estimates in Section 5 identify this w response. The appendix further shows how our static allocation rules lead to a law of motion that delivers the other results.

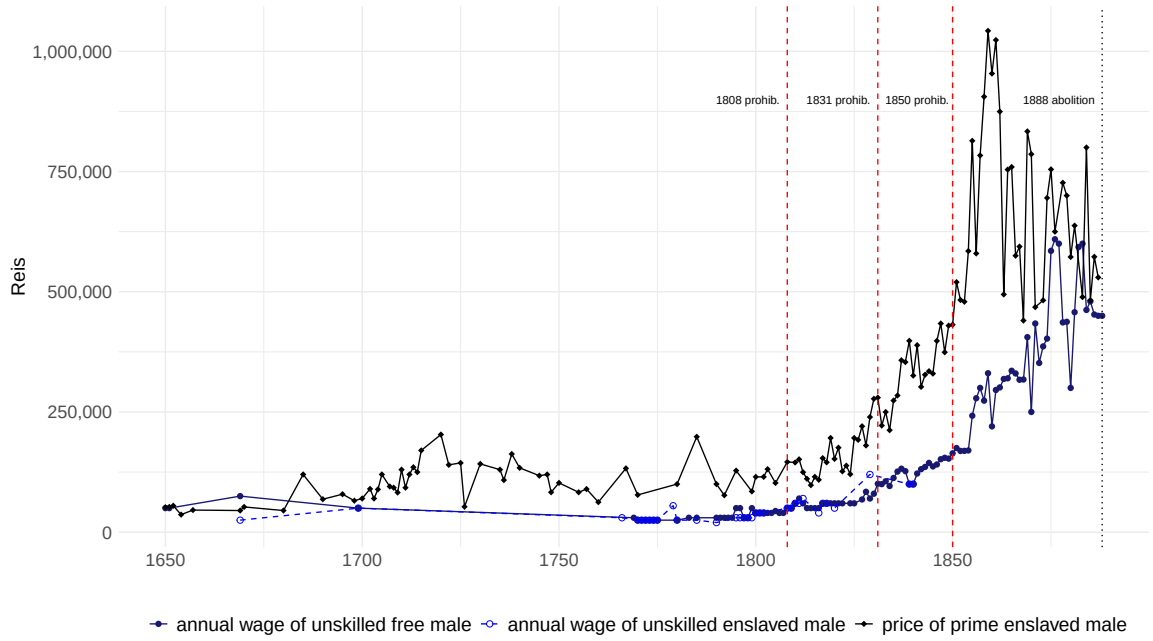


Figure 6: Male unskilled slave prices and free wages and slave trade prohibition shocks in Brazil

Source: See Section 2.2 and Appendix B for details on the sources.
Notes: The vertical lines represent the date of the prohibition shocks. The first shock represents the 1808 British and American prohibition laws and beginning of the blockades, the second shock is the 1831 prohibition law in Brazil largely influenced by British diplomatic pressure and naval blockade actions, and the third shock is the final 1850 prohibition law enacted in Brazil under substantial British pressure, including an ultimatum threat posed by the British Royal Navy (see, e.g., Bethell (1970)).

5 The effects of slave trade prohibition shocks on wages

In this section, we present estimates of the causal effect of slave trade prohibition shocks on wages. In Section 5.1, we document the institutional and legal background of the slave trade prohibition laws. In Section 5.2, we discuss our empirical strategy and the estimation sample. In Sections 5.4 and 5.5, we present the main results, placebo tests, and various robustness checks.

5.1 The slave trade prohibition laws

In 1807 the British prohibited the slave trade in all of the empire. Following the British empire, the United States declared the prohibition of all slave imports in its territories. The enforcement of such acts entered in effect in 1808. The British Royal Navy established the West Africa Squadron and between 1808 and 1860 seized approximately 1,600 slave ships (Sullivan, 2020). As West Africa was one of Brazil's main slave trade partner, the British enforcement resulted in the capture of 17 of 32 slave ships in activity in 1810, resulting in the closure of five of the main commercial houses in Salvador (Manchester, 1933). Thus, even as Brazil was not part of the British empire, the British enforcement of the slave trade prohibition dealt a blow to the trade. Enforcement was, however, weak and indirect.

The slave trade recovered in Brazil, as slavers were able to reorganize to evade the British prohibition. After much British pressure, Brazil's government passed into law the first slave trade prohibition in 1831 (*Lei Feijó*), which established that all slaves brought into Brazil would be free, a fine to slave traffickers, and a cash reward to anyone that reported trafficking. The law was enforced for a few years but it soon became known only "for the English to see."[29] Finally, with concrete threats by the British that included invading Brazilian ports and seizing any suspect ship in the Atlantic, the slave trade finally ended in 1850 (Bethell, 1970). The 1850 law (*Lei Eusébio de Queirós*) was more incisive than the 1831 law and prohibited any disembarkation of slaves in Brazil, criminalizing anyone who violated the order.

In Table 1, we summarize the enforcement across regions. The history of the slave trade shows that the enforcement of the prohibitions were external to the Brazilian economy, and exogenous to the prior wage dynamics in Brazil. Figure 7 shows quantitatively the effects of these prohibitions in the number of slaves disembarked in the Americas. The 1807 prohibitions were enforced in 1808 in all regions except for Brazil, so we treat it as a "1808 shock." There was a fall in slave trade in the year of the shock but the trade recovered, only to be hit again in 1831, from which it recovered once more, before it finally stopped in 1850.

[29]The expression *para inglês ver* is still commonly used today in Brazil to mean some rule that is not enforced.

Table 1: Enforcement of slave trade prohibitions

	1807 prohibition	1831 prohibition	1850 prohibition
Brazil			
	WEAK	TEMPORARY	YES
Elsewhere			
	YES	YES	YES

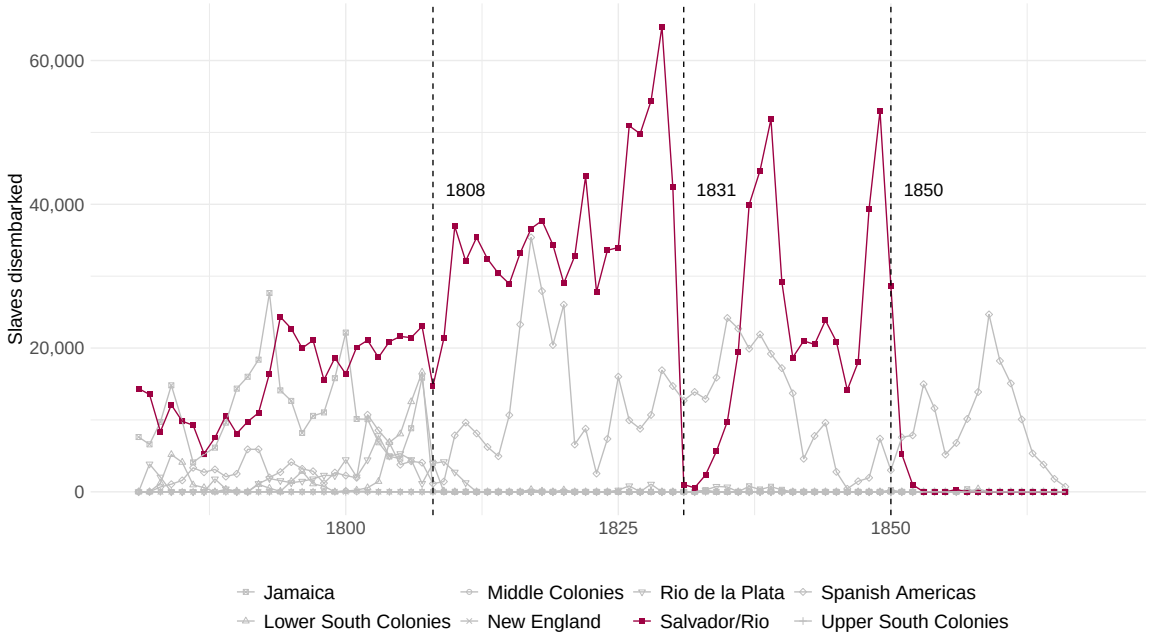


Figure 7: Slave trade prohibition shocks

Source: Slave Voyages (2023b).

Notes: We only consider locations for where we have wage data. The vertical lines represent the date of the prohibition shocks. The first shock represents the 1808 British and American prohibition laws and beginning of the blockades, the second shock is the 1831 prohibition law in Brazil largely influenced by British diplomatic pressure and naval blockade actions, and the third shock is the final 1850 prohibition law enacted in Brazil under substantial British pressure, including an ultimatum threat posed by the British Royal Navy (see, e.g., Bethell (1970)).

5.2 Empirical strategy

In this section, we present the synthetic difference-in-differences (SDID) method used to estimate the treatment effect of the slave trade prohibition shock on wages. We begin by presenting the assumed data generating process, which is useful for us to discuss the identifying assumptions. Then we present the estimator in its weighted regression form. This facilitates understanding the mapping of the model to the data and how the estimator works in practice, so that the advantages of the double-weighting process become clear.[30] We finish the section with a brief summary of the estimation sample.

The method by Arkhangelsky et al. (2021) assumes the following data generating process:

$$\mathbf{Y} = \mathbf{L} + \theta\ \mathbf{W} + \mathbf{E}, \tag{3}$$

where, in our setup, $\mathbf{Y}$ is wages, $\mathbf{W}\theta = W_{it}\theta_{it}$ follows a block treatment assignment of the slave trade prohibition shocks in W_{it}, $\mathbf{L}$ is the systematic component or factor matrix, and $\mathbf{E}$ represents the idiosyncratic component or error matrix. It is not required to estimate the true factor matrix $\mathbf{L}$, which can include two-way fixed effects α_i and β_t. The treatment assignment matrix $\mathbf{W}$ is allowed to depend on the systematic component $\mathbf{L}$ but not on the idiosyncratic component $\mathbf{E}$. It is assumed that $\mathbf{E_i}$ is independent of $\mathbf{E'_i}$ for each pair of units $\mathbf{i}, \mathbf{i'}$ but it is allowed to be correlated across time periods within an unit.

We want to estimate the average treatment effect for the treated unit θ, thus a first crucial assumption is that the treatment assignment is not correlated with the idiosyncratic component. Even as we established in Section 5.1 that the slave trade prohibition shocks were likely exogenous and unanticipated, there could be idiosyncratic drivers of wages that are correlated with the slave trade prohibition laws. There were mainly two important events happening around the prohibition dates that could be driving wages in Brazil. First, the slave imports were directed to areas of increasing agricultural exports, but it was the increase in slave prices that pushed slaves to the crop that used them most efficiently and that high work disamenities (see the evidence in Section 6), which was coffee throughout the nineteenth century,

[30] The SDID weighted double-differencing estimator is similar to certain specifications of the "augmented synthetic control" in Ben-Michael et al. (2021).

and not the other way around (Eltis, 1988).

As this shift in the economy took place, the second important event was factor reallocation from the Northeast to the Southeast that led to the emergence of regional inequality (Leff, 1972a). The rise of the Southeast in the international coffee market could have led to increasing domestic trade between regions, which could then have been related to increasing demand for labor, benefiting both Salvador and Rio, leading to a correlation with the slave trade prohibition shocks. It is unlikely that this was the case. Until at least well into the twentieth century, the only reasonable trade route of physical goods between the southeast and northeast regions was by sea through cabotage navigation, and while there was some reallocation of slaves from the Northeast to the Southeast, this reallocation was in relative, not absolute terms.[31] In addition, Marcondes (2012) shows that the share of domestic trade imports by coastal shipping for both Bahia and Rio de Janeiro are unrelated to the slave trade prohibition.[32]

We can now interpret Equation (3) as a weighted regression to facilitate our understanding of how the SDID estimator works in practice. Consider a balanced panel with N units, T time periods, and a block assignment treatment W_{it}:

$$(\hat{\theta}, \hat{\mu}, \hat{\alpha}, \hat{\beta}) = \underset{\theta,\mu,\alpha,\beta}{\arg\min} \left\{ \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{it} - \mu - \alpha_i - \beta_t - W_{it}\theta)^2 \hat{\omega}_i \hat{\lambda}_t \right\} \tag{4}$$

where, in our preferred specification, the outcome Y_{it} takes the form of an index of the unskilled wage, with the index equal to 100 set to the shock date. The α_i are unit fixed effects, β_t are time fixed effects, and μ is the error. The SDID estimator finds unit weights $\hat{\omega}$ to make the average outcome for Brazil approximately parallel to the weighted average outcome for the control units. Analogous time weights $\hat{\lambda}$ are found to balance a weighted average of pre-treatment periods outcomes for the control units

[31] By the early 1870s Bahia still had one of the largest provincial slave populations in the country, more than the province of São Paulo, which was by then booming with coffee exports (Leff, 1972a). In fact, due to labor shortages internal migration was discouraged by those in power, and slaves had to be issued passports to cross provincial lines. It was only with the rubber boom in Amazon in the late-nineteenth century that the country experienced the first massive internal labor reallocation, and moreover after the 1930s with structural transformation (Wagner & Ward, 1980; Baerlocher et al., 2023).

[32] Bahia's share was relatively low and decreasing, from around 10% to 5% of the total toward the end of the nineteenth century. While Rio de Janeiro's share of domestic trade imports was larger, at 15% to 20% around the prohibition, it decreases to 10% towards the end of the 1850s, only recovering in the 1860s.

that predict treatment-period outcomes for the same control units. Since the SDID method takes a data-driven approach to selecting the time weights, it does not need to rely on arbitrary covariates and time periods to adjust the data to support the parallel trends assumption, as is often the case when using difference-in-differences. It also not necessary to perfectly match the pre-treatment outcome of the control group and the treatment, as in the synthetic control method. They only need to be approximately parallel, because the unit fixed effects will absorb any constant differences between units.[33] Finally, standard errors are constructed by a placebo method where placebo evaluations are conducted replacing the treatment unit with each of the control units.[34]

5.3 Data

The data for the estimation samples are as follows. For Brazil, we use our wage series for unskilled workers. For the other locations across the globe, the sources are multiple and described in Section 3 and the Appendix H. We use all available locations that have wage series for the whole period around the prohibition shocks, excluding locations directly affected by the shocks. Thus, we only have to actively exclude Lisbon and London from the control donor pool.[35] We use as controls Amsterdam, Antwerp, Beijing, Bengal, Bogota, Canton, Chile, Florence/Milan, Kyoto/Tokyo, Java, Leipzig, Lower Yangzi, Madrid, Mexico City, North India, Paris, Rural Mexico, Strasbourg, Urban Mexico, Vienna, and Warsaw.

We restrict the sample from 1800 to 1860. We start in 1800 because that gives a reasonable pre-treatment period for the first shock in 1808 and that we have consistent data for almost all years; going back even further would include the revolutions of the 1790s as relevant shocks in the period, which is not recommended. We stop in 1860 because that gives ten years of post-treatment period for the last shock, so we do not risk to confound other shocks in our treatment period. For each prohibition shock we have the similar number of pre- and post-treatment periods.[36]

[33] Including unit fixed effects is equivalent to the synthetic control practice of centering the data by subtracting each unit's trajectory from its pre-treatment mean as in Ferman and Pinto (2021).

[34] The algorithm is described in Arkhangelsky et al. (2021). This is somewhat equivalent to the placebo evaluations used in the synthetic control method.

[35] Other locations directly affected such as Jamaica and North America do not have comparable wage series for the period.

[36] Abadie et al. (2010) argues that a decade-long period is a reasonable limit of time that we can attribute variation in the outcome to a past treatment.

5.4 Main results

Figure 8 and Table 2 show the results for the three slave trade prohibition shocks of estimating Equation (4) with unskilled wages as the outcome. In Figure 8, in the top panel we plot the trends over time for Brazil and the control-weighted average, with triangles indicating time weights, and the arrows indicating the size of the treatment effect. We can see that approximate parallel trends hold very well for all prohibition shocks. In the below panel, we show the location-by-location differences in adjusted outcomes with the corresponding control weight. We can see that the algorithm rarely excludes a location and does not give too much weight on any one location, varying the locations with more weights depending on the prohibition period. In Table 2 Panel A, we show the coefficients and placebo standard errors. The estimates are economically large and statistically significant at the 5% level. The increase in unskilled wages was, on average, on the order of 28% following the 1807 prohibitions, 45% after the 1831 prohibition, and 42% after the 1850 final prohibition. Panel B shows a placebo test randomly backdating each prohibition shocks. Reassuringly, all the placebo results are economically and statistically insignificant.

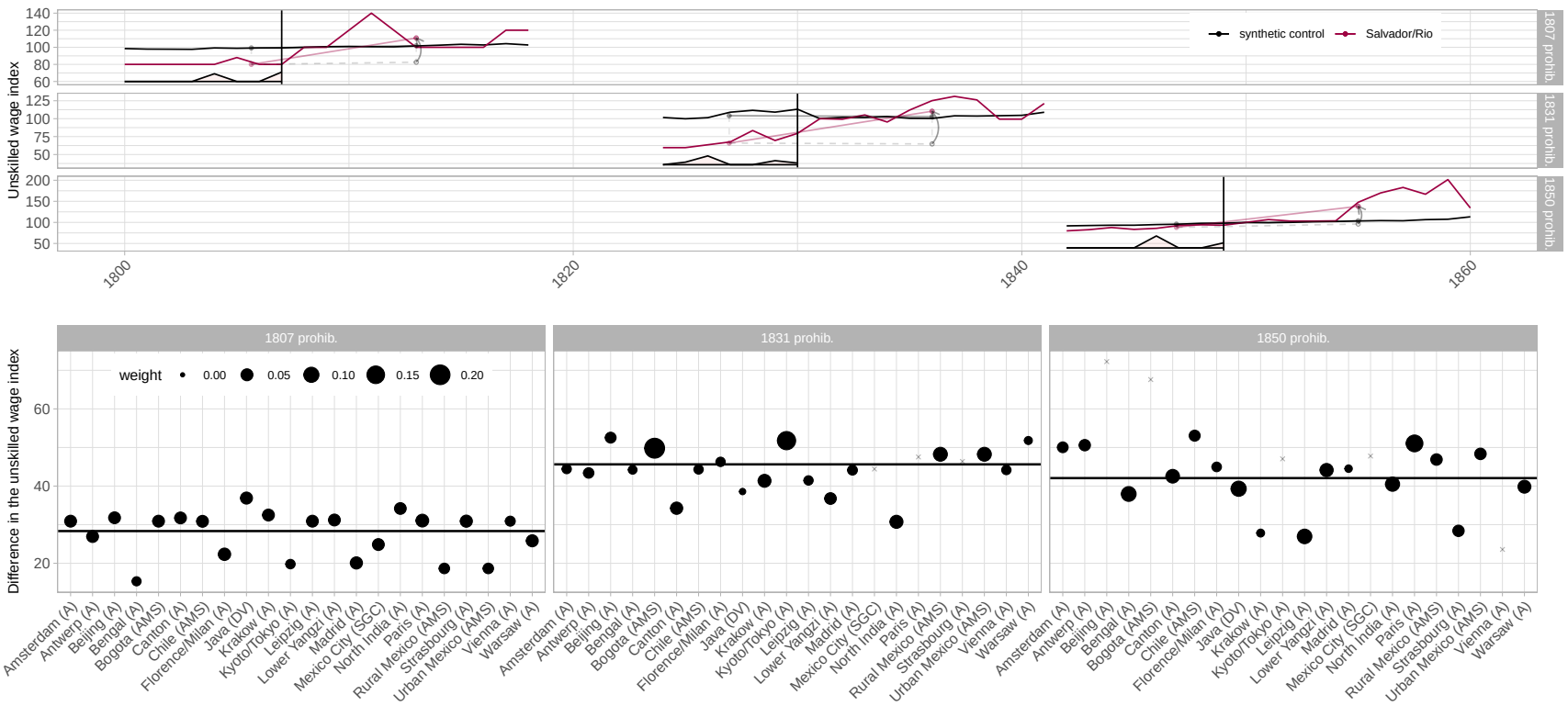


Figure 8: The effects of slave trade prohibition shocks on unskilled wages using synthetic difference-in-differences

Notes: The panel above shows trends in the unskilled wage index over time for Salvador/Rio (BR) and the weighted average for the controls, with the time weights $\hat{\lambda}_t$ used to average the pre-treatment time periods as triangles. The vertical lines represent the prohibition shocks. The arrows indicate the size of the estimated effect. The panel below shows unit-by-unit differences in adjusted outcomes ($\hat{\theta}_{BR} - \hat{\theta}_i$). The treatment effect is represented by a horizontal line. Control weights $\hat{\omega}_i$ indicated by dot size. Units with zero weight are denoted by an $\times$ symbol.

5.5 Robustness

In Appendix J we present the results for a series of robustness exercises. We apply three exercises: 1) change how we measure the outcome, 2) change the donor pool in many ways, 3) include the price index as a control. To check for robustness in the way we measure our outcomes, we re-estimate our main results with unskilled wages as log wages. The results remain very similar. In our main analysis, to choose the donor pool we do not actively pre-screen or engage in any type of selection; we are only constrained by the data availability in the literature. We included all studies we could find that have comparable wages in the period of the prohibition shocks. Still, one could argue we do not have an appropriate donor pool because the control locations are too different from Brazil. In addition, one could argue that some locations in the donor pool are indirectly affected by the slave trade prohibition shocks, such as Antwerp and Amsterdam that were relevant trading ports in the nineteenth century. We address these issues by changing the control groups in many ways for the main estimates: 1) keeping only locations in Latin America and Java, which can be considered more similar in the experience of commodity booms in the nineteenth century; 2) keeping only locations in Latin America and Asia, which effectively excludes places in Europe that could be importing Brazilian commodities; 3) keeping only locations with similar levels of real wages during the period of the shocks independent of the continent; 4) a "leave-one-out" approach with all available locations. Our results are robust to all donor pool changes. At last, we show that coefficients are practically unchanged with the inclusion of the price index in each location as a control.

Table 2: The effect of slave trade prohibition shocks on unskilled wages

	1807 prohibition	1831 prohibition	1850 prohibition
Panel A: Effect of the prohibitions			
SDID coefficient	28.343**	45.628***	42.064**
s.e.	(11.354)	(10.681)	(16.379)
Panel B: Placebo			
SDID coefficient	0.74	11.47	2.46
s.e.	(5.05)	(7.31)	(9.82)
p-value	0.88	0.12	0.8
Time FE:	Yes	Yes	Yes
Unit FE:	Yes	Yes	Yes
N units:	23	23	23
N years:	19	18	19

Notes: Panel A presents estimates of the average treatment effect of slave trade prohibition shocks on unskilled wages in Salvador/Rio using the synthetic differences-in-differences (SDID) method. Panel B presents the estimates of a placebo effect for each prohibition shock. Only Salvador/Rio is treated in each prohibition period. The placebo test randomly backdates the shock date in each prohibition. The dependent variable is the annual average of the daily wage transformed to an index equal to 100 in the year of each prohibition. All estimates include time and unit fixed effects. The control unit and time weights for the Panel A estimations are shown in the accompanying figure. The number of units and time periods in each estimation is shown in the table. Standard errors are constructed using the placebo method detailed in Arkhangelsky et al. (2021), where placebo evaluations are conducted replacing the treatment unit with each of the control units. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$

6 Post-prohibition labor reallocation and directed technical change

The Atlantic slave trade effectively ended around 1850, but slavery itself continued to be legal in Brazil. In 1871, children of enslaved women were determined to be free, making the beginning of the progressive emancipation phase. Brazil was the last country in the Americas to abolish slavery, finally doing so in 1888. Between the prohibition and abolition those still enslaved ended up concentrated in the occupations that were composed of tasks that were arduous and unpleasant and were more difficult to substitute for free workers. In these occupations, there were many tasks where the per-period unit cost of enslaved labor still surpassed that of employing free workers: The necessity of coercion in high-disamenity tasks was greater; while, at the same time, the outside option for these black and mulatto enslaved workers were curtailed by the new wave of white European immigrants (Klein, 1969). Figure 9 illustrates this argument using the 1872 census for all municipalities.[37]

In addition to reallocation of labor between tasks, technology began to evolve towards complementing free workers. Two historical case studies of post-prohibition labor-saving technical change are illustrated in Appendix L. The first interesting case pertains to Salvador. Prior to the end of slavery, transportation between the lower part and the higher part of the city of Salvador was done by enslaved workers carrying people in chairs. After the slave trade prohibition, a public elevator was built to connect the two parts of the city, largely increasing the productivity of free workers in general. The second case illustrated is that of how the port in Rio de Janeiro operated at the height of the slave trade, where enslaved workers manually carried all the cargo on and off ships. After the prohibition, between 1850 and 1860 the port adopted steam cranes. These examples are evidence that higher wages for free workers and labor scarcity induced innovation via adoption, mechanization, and growth, in line with the mechanism emphasized by Acemoglu (2010). More generally, in both Salvador and Rio, once the slave trade was over, there was a shift of merchant activity towards other activities including banking and industry (Palma et al., 2021;

[37] Figure K.1 in the Appendix shows that the same pattern is found if we include only Salvador and Rio. From the 1870s, Brazilian elites became gradually convinced that abolition was an obstacle to modernization. Earlier efforts to bring Europeans to work in Brazil had failed due to the impossibility of maintaining appropriate conditions in a shareholding environment, and several German states had even outlawed Brazilian recruitment of immigrants in their territory (Skidmore, 2009, p.74).

Clarence-Smith, 1985, p. 6).

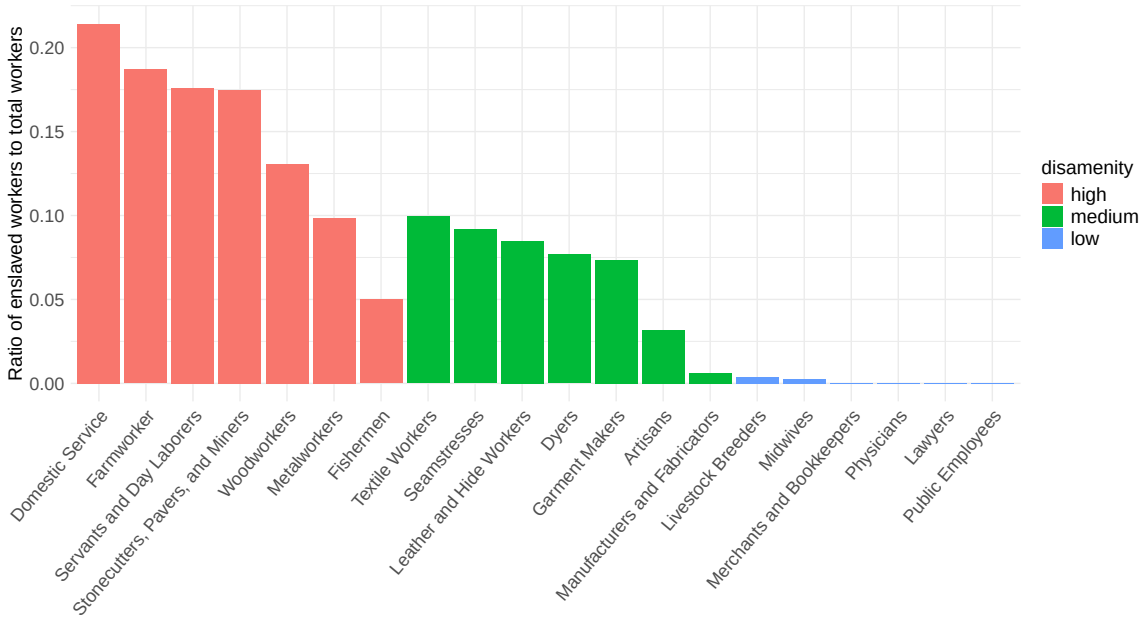


Figure 9: Share of enslaved labor by occupation and task-level disamenities in the 1872 census

Notes: For each occupation we divide the number of enslaved workers by the number of total workers and average across all 642 municipalities in 1872. We use 20 occupations out of 30 available. We remove some redundant occupations, such as hat and shoe makers, and exclude occupations that do not have enslaved workers, such as judges, justice officials, capitalists, priests, teachers, and military personnel. We classify the occupations in high, medium, and low disamenity based on the variety of tasks that are more arduous or unpleasant in each occupation.

7 Conclusion

In this paper, we explore the consequences of the slave trade for unskilled wages and technical change in Brazil. To do so, we built real wage series for various occupations, male and female, free and enslaved, that extend more than three centuries (1574–1920) for Brazil. We documented an association between the import of enslaved Africans and the level of real wages. Unskilled real wages in Brazil start relatively high, but as soon as the slave trade increased, real wages decreased. Unskilled real wages only recovered following the progressive end of the slave trade. Using synthetic difference-in-differences, we show that this relationship was plausibly causal; slave

trade prohibition shocks led to an increase in unskilled wages. Brazil's reckoning with the slave trade served to improve living standards in the nineteenth century, but came too late to recover lost ground compared with other countries in the Americas and Europe. Our results suggest that free workers benefited from slavery's disappearance, which despite being profitable for a small elite, was overall was making Brazil poorer by preventing other development opportunities.

References

Abad, L., & Maurer, N. (2025). The long shadow of history? the impact of colonial labor institutions on economic development in peru. *Journal of Economic Growth*.

Abad, L. A., Davies, E., & Van Zanden, J. L. (2012). Between conquest and independence: Real wages and demographic change in Spanish America, 1530–1820. *Explorations in Economic History*, *49*(2), 149–166.

Abad, L. A., & Maurer, N. (2024). Does time heal all wounds? The rise, decline, and long-term impact of forced labor in Spanish America. *Explorations in Economic History*, *93*, 101580.

Abad, L. A., & Palma, N. (2021). The fruits of El Dorado: The global impact of American precious metals. In *The fruits of the early globalization: An Iberian perspective* (pp. 95–131). Springer.

Abadie, A., Diamond, A., & Hainmueller, J. (2010). Synthetic control methods for comparative case studies: Estimating the effect of california's tobacco control program. *Journal of the American Statistical Association*, *105*(490), 493–505.

Acemoglu, D. (2003). Why not a political Coase theorem? Social conflict, commitment, and politics. *Journal of comparative economics*, *31*(4), 620–652.

Acemoglu, D. (2010). When does labor scarcity encourage innovation? *Journal of Political Economy*, *118*(6), 1037–1078.

Acemoglu, D., & Autor, D. (2011). Skills, Tasks and Technologies: Implications for Employment and Earnings. In D. Card & O. Ashenfelter (Eds.). Elsevier.

Acemoglu, D., García-Jimeno, C., & Robinson, J. A. (2012). Finding Eldorado: Slavery and long-run development in Colombia. *Journal of Comparative Economics*, *40*(4), 534–564.

Acemoglu, D., & Johnson, S. (2024). Learning From Ricardo and Thompson: Machinery and Labor in the Early Industrial Revolution and in the Age of Artificial Intelligence. *Annual Review of Economics*, *16*(1), 597–621.

Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The colonial origins of comparative development: An empirical investigation. *American Economic Review*, *91*(5), 1369–1401.

Acemoglu, D., Johnson, S., & Robinson, J. A. (2002). Reversal of fortune: Geography and institutions in the making of the modern world income distribution. *Quarterly Journal of Economics*, *117*(4), 1231–1294.

Acemoglu, D., & Wolitzky, A. (2011). The economics of labor coercion. *Econometrica*, *79*(2), 555–600.

Alden, D. (1984). Late colonial Brazil, 1750–1808. In L. Bethell (Ed.), *The Cambridge History of Latin America* (pp. 601–660, Vol. 2). Cambridge University Press.

Allen, R. C. (2001). The great divergence in European wages and prices from the Middle Ages to the First World War. *Explorations in Economic History*, *38*(4), 411–447.

Allen, R. C. (2023). *Building labourers' wages, living costs, and welfare ratios. Database.*

Allen, R. C., Bassino, J.-P., Ma, D., Moll-Murata, C., & Van Zanden, J. L. (2011). Wages, prices, and living standards in China, 1738–1925: in comparison with Europe, Japan, and India. *The Economic History Review*, *64*, 8–38.

Allen, R. C., Murphy, T. E., & Schneider, E. B. (2012). The colonial origins of the divergence in the Americas: A labor market approach. *The Journal of Economic History*, *72*(4), 863–894.

Allen, R. C., & Weisdorf, J. L. (2011). Was there an 'industrious revolution' before the industrial revolution? An empirical exercise for England, c. 1300–1830. *The Economic History Review*, *64*(3), 715–729.

Arkhangelsky, D., Athey, S., Hirshberg, D. A., Imbens, G. W., & Wager, S. (2021). Synthetic difference-in-differences. *American Economic Review*, *111*(12), 4088–4118.

Ashenfelter, O. (2012). Comparing real wage rates. *American Economic Review*, *102*(2), 617–642.

Austin, G. (2008). The 'reversal of fortune' thesis and the compression of history: Perspectives from African and comparative economic history. *Journal of International Development*, *20*(8), 996–1027.

Baerlocher, D., Firmino, D., Lambais, G., Reis, E., & Veras, H. (2023). *Old but gold: Historical pathways and path dependence.*

Ben-Michael, E., Feller, A., & Rothstein, J. (2021). The Augmented Synthetic Control Method. *Journal of the American Statistical Association*, *116*(536), 1789–1803.

Bethell, L. (1970). *The Abolition of the Brazilian Slave Trade: Britain, Brazil and the Slave Trade Question, 1807–1869*. Cambridge University Press.

Bogart, D., Dunn, O., Alvarez-Palau, E. J., & Shaw-Taylor, L. (2021). Speedier delivery: coastal shipping times and speeds during the Age of Sail. *The Economic History Review*, *74*(1), 87–114.

Boxer, C. R. (1952). *Salvador de Sá and the Struggle for Brazil and Angola, 1602-1686*. London: The University of London, Athlone Press.

Burnard, T., Panza, L., & Williamson, J. (2019). Living costs, real incomes and inequality in colonial Jamaica. *Explorations in Economic History*, *71*, 55–71.

Calomiris, C. W., & Pritchett, J. (2016). Betting on secession: Quantifying political events surrounding slavery and the Civil War. *American Economic Review*, *106*(01), 1–23.

Carvalhal, H., & Palma, N. (2024). *Living standards in Angola, 1760-1975*. African Economic History Working Paper Series.

Challú, A. E., & Gómez-Galvarriato, A. (2015). Mexicos's real wages in the age of the Great Divergence, 1730–1930. *Revista de Historia Economica - Journal of Iberian and Latin American Economic History*, *33*(1), 83–122.

Cilliers, J., Green, E., & Ross, R. (2023). Did it pay to be a pioneer? wealth accumulation in a newly settled frontier society. *The Economic History Review*, *76*(1), 257–282.

Clarence-Smith, W. G. (1985). *The Third Portuguese Empire, 1825-1975: a study in economic imperialism*. Manchester University Press.

Clark, G. (2005). The condition of the working class in England, 1209–2004. *Journal of Political Economy*, *113*(6), 1307–1340.

de Zwart, P., & van Zanden, J. L. (2015). Labor, wages, and living standards in Java, 1680–1914. *European Review of Economic History*, *19*(3), 215–234.

Devereux, J. (2019). Arrested development? Puerto Rico in an American century. *The Journal of Economic History*, *79*(3), 708–735.

Dippel, C., Greif, A., & Trefler, D. (2020). Outside options, coercion, and wages: Removing the sugar coating. *The Economic Journal*, *130*(630), 1678–1714.

Djenderedjian, J., & Martirén, J. L. (2020). Consumption baskets and cost of living in southern late colonial Brazil: Rio Grande, 1772–1823. *Revista de Historia Económica - Journal of Iberian and Latin American Economic History*, *38*(2), 279–309.

Eltis, D. (1988). The Economic Impact of the Ending of the African Slave Trade to the Americas. *Social and Economic Studies*, *37*(1/2), 143–172.

Eltis, D. (1995). Productivity in the transatlantic slave trade. *Explorations in Economic History*, *32*(4), 465–492.

Engerman, S., & Sokoloff, K. (1997). Factor endowments, institutions, and differential paths of gowth among New World economies. In S. Haber (Ed.), *How Latin America fell behind: Essays on the economic histories of Brazil and Mexico, 1800–1914*. Stanford Univ. Press.

Engerman, S., & Sokoloff, K. (2012). *Economic Development in the Americas since 1500: Endowments and Institutions*. Cambridge University Press.

Fenoaltea, S. (1984). Slavery and Supervision in Comparative Perspective: A Model. *The Journal of Economic History*, *44*(3), 635–668.

Ferman, B., & Pinto, C. (2021). Synthetic controls with imperfect pretreatment fit. *Quantitative Economics*, *12*(4), 1197–1221.

Frankema, E., & van Waijenburg, M. (2012). Structural impediments to African growth? New evidence from real wages in British Africa, 1880–1965. *The Journal of Economic History*, *72*(4), 895–926.

Gândavo, P. d. M. (2004). *História da província santa cruz a que vulgarmente chamamos brasil.* Lisboa: Assírio e Alvim. Originally published in 1574.

Gardner, L. (2023). Slavery, coercion, and economic development in sub-Saharan Africa. *Business History Review*, *97*(2), 199–223.

Geloso, V., Kufenko, V., & Arsenault-Morin, A. P. (2023). The lesser shades of labor coercion: The impact of seigneurial tenure in nineteenth-century Quebec. *Journal of Development Economics*, *163*, 103091.

Geloso, V. J. (2019). Distinct within North America: Living standards in French Canada, 1688–1775. *Cliometrica*, *13*, 277–321.

Haber, S. H. (1997). *How latin america fell behind: Essays on the economic histories of brazil and mexico*. Stanford University Press.

Haddad, C. (1974). *Growth of brazilian real output, 1900–1947*. [Doctoral dissertation, The University of Chicago].

Instituto do Açúcar e do Álcool. (1956). *Documentos para a História do Açúcar. Vol. II. Engenho Sergipe do Conde. Livro de Contas (1622–1653)* (Vols. 3, Vol. 2). Serviço Especial de Documentação Histórica.

Instituto do Açúcar e do Álcool. (1963). *Documentos para a História do Açúcar. Vol. III. Engenho Sergipe do Conde. Espólio de Mem de Sá (1569–1579)* (Vols. 3, Vol. 3). Serviço Especial de Documentação Histórica.

Jung, Y., & Yoon, C. (2025). The shadow of slavery on industrial innovation: Evidence from the US South. *Journal of Comparative Economics*.

Kedrosky, D., & Palma, N. (2025). The Cross of Gold: Brazilian treasure and the decline of Portugal. *Journal of Economic History*.

Klein, H. (1969). The Colored Freedmen in Brazilian Slave Society. *Journal of Social History*, *3*(1), 30–52.

Klein, H., & Luna, F. V. (2009). *Slavery in Brazil*. Cambridge University Press.

Korchmina, E. (2024). Should I stay or should I go? Living standards of serfs and peasants in 18th century Moscow. *Rivista di storia economica*, *40*(3).

Kumon, Y. (2022). The Labor-Intensive Path: Wages, Incomes, and the Work Year in Japan, 1610–1890. *The Journal of Economic History*, *82*(2), 368–402.

Leff, N. H. (1972a). Economic Development and Regional Inequality: Origins of the Brazilian Case. *The Quarterly Journal of Economics*, *86*(2), 243–262.

Leff, N. H. (1972b). Economic retardation in nineteenth-century Brazil. *The Economic History Review*, *25*(3), 489–507.

Leff, N. H. (1973). Tropical Trade and Development in the Nineteenth Century: The Brazilian Experience. *Journal of Political Economy*, *81*(3), 678–696.

Leff, N. H. (1982). *Underdevelopment and development in Brazil: Volume I – Economic Structure and Change, 1822–1947* (Vol. 1). London. Allen & Unwin London.

Lindert, P. H., & Williamson, J. G. (2013). American incomes before and after the Revolution. *The Journal of Economic History*, *73*(3), 725–765.

Lindert, P. H., & Williamson, J. G. (2016a). American colonial incomes, 1650–1774. *The Economic History Review*, *69*(1), 54–77.

Lindert, P. H., & Williamson, J. G. (2016b). *Unequal gains: American growth and inequality since 1700*. Princeton.

Maddison, A. (2006). *The world economy*. OECD publishing.

Manchester, A. (1933). *British Preëminence in Brazil, Its Rise and Decline: A Study in European Expansion*. University of North Carolina Press.

Marcondes, R. L. (2012). O mercado brasileiro do século XIX: uma visão por meio do comércio de cabotagem. *Brazilian Journal of Political Economy*, *32*(1), 142–166.

Mauro, F. (1997). *Portugal, o Brasil e o Atlântico, 1570-1670* (Vol. 1). Lisboa: Editorial Estampa.

Naidu, S., & Yuchtman, N. (2013). Coercive contract enforcement: Law and the labor market in nineteenth century industrial britain. *American Economic Review*, *103*(1), 107–44.

Ogilvie, S. (2007). 'Whatever is, is right'? Economic institutions in pre-industrial Europe. *The Economic History Review*, *60*(4), 649–684.

Olmstead, A. L., & Rhode, P. W. (2018). Cotton, slavery, and the new history of capitalism. *Explorations in Economic History*, *67*, 1–17.

Palma, N., & Reis, J. (2019). From Convergence to Divergence: Portuguese economic growth, 1527–1850. *The Journal of Economic History*, *79*(2), 477–506.

Palma, N., Papadia, A., Pereira, T., & Weller, L. (2021). Slavery and development in nineteenth century Brazil. *Capitalism: A Journal of History and Economics*, *2*(2), 372–426.

Rönnbäck, K. (2014). Living standards on the pre-colonial Gold Coast: a quantitative estimate of African laborers' welfare ratios. *European Review of Economic History*, *18*(2), 185–202.

Schwartz, S. (1973). Free labor in a slave economy: The lavradores de cana of colonial Bahia. In D. Alden (Ed.), *Colonial Roots of Modern Brazil: Papers of the Newberry Library Conference* (pp. 147–197). University of California Press.

Schwartz, S. (1985). *Sugar plantations in the formation of brazilian society: Bahia, 1550-1835*. Cambridge University Press.

Skidmore, T. E. (2009). *Brazil: Five centuries of change*. Oxford University Press.

Slave Voyages. (2023a). *Intra-American Slave Trade Database* (V2). https://doi.org/10.7910/DVN/QD3JSH

Slave Voyages. (2023b). *Transatlantic Slave Trade Database* (V1). https://doi.org/10.7910/DVN/DGIHX9

Sullivan, A. (2020). *Britain's War against the Slave Trade: The Operations of the Royal Navy's West Africa Squadron, 1807–1867*. Frontline Books.

Summerhill, W. R. (2003). *Order against progress: Government, foreign investment, and railroads in Brazil, 1854-1913*. Stanford University Press.

Summerhill, W. R. (2005). Big Social Savings in a Small Laggard Economy: Railroad-Led Growth in Brazil. *The Journal of Economic History*, *65*(1), 72–102.

Wagner, F. E., & Ward, J. O. (1980). Urbanization and Migration in Brazil. *American Journal of Economics and Sociology*, *39*(3), 249–259.

Ward, M., & Devereux, J. (2012). The road not taken: Pre-revolutionary Cuban living standards in comparative perspective. *The Journal of Economic History*, *72*(1), 104–132.

Wright, G. (2020). Slavery and Anglo-American capitalism revisited. *The Economic History Review*, *73*(2), 353–383.

Wright, G. (2022). Slavery and the Rise of the Nineteenth-Century American Economy. *Journal of Economic Perspectives*, *36*(2), 123–148.

Online Appendix for "African Slavery and the Reckoning of Brazil" by Lambais and Palma

A Historical background

Bahia was the region where the Portuguese first settled and made contact with natives in 1500. At the entrance of a large bay lays the city of *São Salvador da Bahia de Todos os Santos*, today simply known as Salvador. It was Brazil's first capital, founded in 1549. Further inward is the city of *São Francisco do Conde*, home to some of the leading earliest sugar mills in Brazil. The city of Salvador was Brazil's most populous until the nineteenth century, with an estimated 51,000 people in 1807 (Morse, 1974; Alden, 1984).[1] It was the seat of the colonial government since 1549, and in addition to the governor-general, by the early seventeenth century the city had a bishop and a high court (Boxer, 1952, p. 18). Following around two decades of conflict with the indigenous population, the settlement gradually expanded around the bay, with many sugar mills by the 1570s (Schwartz, 1985).[2] In 1614, the settled area still did not extend for more than 30 kilometers, but it gradually expanded over the following decades (Boxer, 1952, p. 18). Salvador remained Brazil's capital until 1763, when it was replaced by Rio de Janeiro. By contrast, nearby São Francisco do Conde was a smaller city. In 1659, it had a population of more than 2,700 and 14 sugar mills (Mattoso, 1992, p. 73).

Rio de Janeiro was founded in 1565 to expel French interlopers from Guanabara Bay, but over the early modern period transformed from a small colonial settlement on Brazil's southeastern coast into one of the Portuguese Empire's most important Atlantic ports. The turning point came in the 1690s, when gold was discovered in Minas Gerais. The city's deep, sheltered harbor made it the natural funnel for the mineral wealth of the interior — and for the enslaved Africans who mined it. By the mid-18th century, Rio's docks teemed with ships carrying bullion to Lisbon and returning laden with European goods. Slavery underpinned every aspect of the economy; Africans and their descendants formed a majority of the city's population, laboring in portage, crafts, and domestic service (Góes, 1997). In 1763, as mentioned, the Portuguese crown moved Brazil's capital from Salvador to Rio, cementing its political and economic ascendancy. The number of churches and government buildings in its streets grew considerably. By the eve of the nineteenth century, Rio was both a

[1] This was the case even though narrative sources suggest that Olinda, the former capital of the Captaincy of Pernambuco during the colonial era (but now part of Recife), was richer (Mauro, 1997).

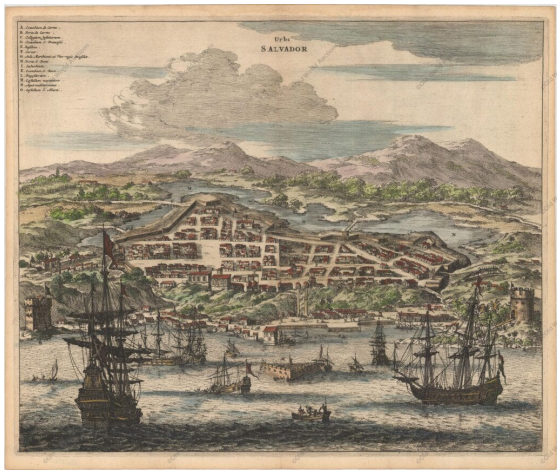
[2] Schwartz (1985) examines in detail the history of the sugar-based economy and plantation society in Bahia over three centuries.

symbol of imperial power and a frontier of opportunity, poised to play an even greater role in the Atlantic world when the royal court arrived in 1808, fleeing Napoleon's invasion of Portugal. This, in turn, transformed the city from a colonial port into the political and cultural capital of the Portuguese Empire. The court's presence spurred rapid urban expansion, the opening of ports to friendly nations, and the creation of new institutions such as the National Library, Botanical Garden, and Royal Press (Schultz, 2013). When Brazil declared independence in 1822, Rio remained the imperial capital, serving as the political center of the new Empire of Brazil under Dom Pedro I and later Dom Pedro II. Throughout the nineteenth century, the city grew in population and infrastructure, fueled by coffee exports from the Paraíba Valley and the continuing influx of enslaved Africans until the gradual abolition process, culminating in 1888. By the time the monarchy fell a year later, Rio had become a bustling, if socially unequal, metropolis. It remained Brazil's capital until 1960.

According to one contemporary estimate, there were 180 sugar mills in Brazil in 1584, producing around 1,000 metric tonnes per year; 36 of these mills were located in Bahia (Boxer, 1952, p. 179). These figures grew considerably over the following decades, and there were 40 mills in Bahia by 1628, along with technical improvements in the method of grinding the cane (Boxer, 1952, p. 180). As late as the mid-seventeenth century, sugar produced in Brazil was the world's best in quality and quantity (Boxer, 1952, p. 179). In addition to sugar, Bahia was a great producer of tobacco, cassava, and cattle (Barickman, 2003). Tobacco in particular was central to the slave trade, Bahia was responsible for over 90% of the country's production and much of it was traded for slaves in West Africa's "Mina Coast," which is from where the majority of the enslaved population was taken to Bahia (Alden, 1984; Schwartz, 1985).[3] Bahia was not central to the gold rush, which mainly took place in neighboring Minas Gerais, but it did also have some gold production and had pathways that connected the Salvador port to the mines and to other cattle regions of the Northeast (Baerlocher et al., 2023).[4]

[3]The Mina Coast was the combination of the Gold Coast and the Slave Coast (or Bight of Benin), corresponding to present-day Ghana, Togo, Benin, and Nigeria. After the Mina Coast, Angola was the region that sent the most number of slaves to Bahia; see, for example, Miller (1996) for the history of the trade with Angola.

[4]For more detailed reviews of Brazil during the colonial and post-independence periods, see Alden (1984), Russell-Wood (1984), and Bértola and Ocampo (2012).



(a) Salvador in 1671, M. Arnold.

(b) Rio de Janeiro, c. 1825, M. Rugendas.

Figure A.1: Seventeenth- and nineteenth-century views of Salvador and Rio de Janeiro.

B Archival sources

Arquivo Nacional da Torre do Tombo (Lisbon)

- Maço 13: n. 19 (PT/TT/AJCJ/CJ013/00019);
- Maço 14: n. 4 (PT/TT/AJCJ/CJ014/00004);
- Maço 17: n. 4, 19, 22, 24, 25, 27, 28, 29, 31, 32, 33 (PT/TT/AJCJ/CJ017/00004 to 00033);
- Maço 30 (PT/TT/AJCJ/CJ030).

Arquivo Distrital de Braga (Portugal)

- Mosteiro de São Bento, Rio de Janeiro, Estados, Livro 1 (1623–1748).

Arquivo da Santa Casa de Misericórdia da Bahia (Salvador)

- Account books (1648–1709): F843; F845; F848; F849; F850; G1017; G1019.
- Receipt folders, various years (1770–1920).

Arquivo Público do Estado da Bahia (Salvador)

- Tribunal da Relação da Bahia, Série Inventários: 01/232/351/02; 03/1309/17778/03; 03/1416/1885/02; 04/1572/2041/02; 04/1596/2065/03; 04/1614/2083/08; 04/1766/2236/08; 07/3148/05; 08/3473/09.

Arquivo Provincial Franciscano (Recife)

- Convento de São Francisco, Rio de Janeiro, Account book (1790–1820).

Arquivo Provincial Franciscano (São Paulo)

- Convento Santo Antônio, Rio de Janeiro, Accounts (1854–75).
- Convento Santo Antônio, Rio de Janeiro, Receipts (1867).

Arquivo da Ordem Jesuíta (São Paulo)

- Accounts, Rio de Janeiro, 1835

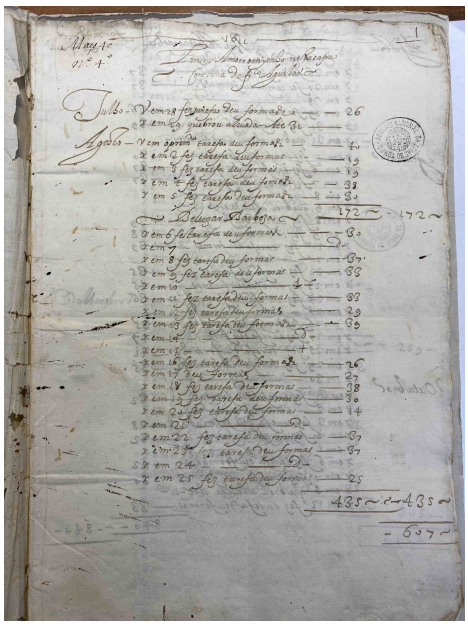
Arquivo da Santa Casa de Misericórdia do Rio de Janeiro (Rio de Janeiro)

- Recolhimento, Account book (1768–1780).
- Account book (1795–1802).

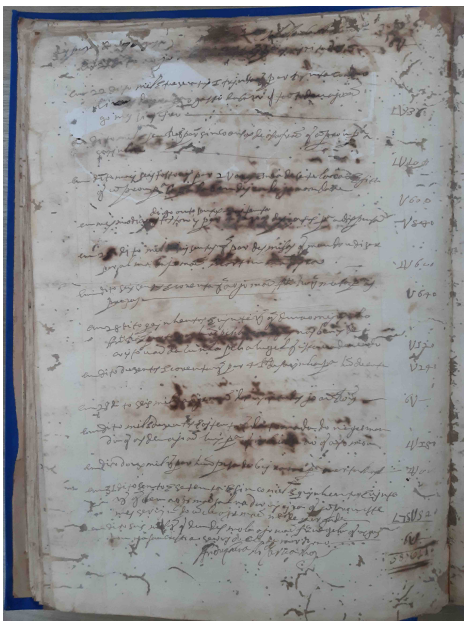
Arquivo Nacional (Rio de Janeiro)

- Diversos códices da antiga SDH, Códice 513, Vol. 1 e Vol. 2, Hospital dos Lázaros, Account book (1763–1795).
- Vice-Reinado, Caixa 499, Pacotes 1 e 2 (1790–1808).
- Polícia da Corte, Códice 362, Vol. 1 (1808–1812).
- Série Justiça
  - Prisões e Casas de Correções, Accounting, various (1834–1860).
  - Secretaria de Polícia da Corte, Accounting, various (1831–1871).
- Junta do Comércio, Agricultura, Fábricas e Navegação
  - Caixa 360, Pacotes 2 e 3, Administração da pesca da baleia (1816–1840).
  - Caixa 367, Pacote 1, Generalidades (1809–1850).
  - Caixa 399 e 400, Pacotes 1 a 3, Junta, Account book (1809–1849).
  - Caixa 423, Pacote 2, Fábricas (1808–1850).
  - Caixa 458, Pacote 1, Avulsos (1810–1849).
  - Códice 176, Vol. 1, Accounts (1814–1821).

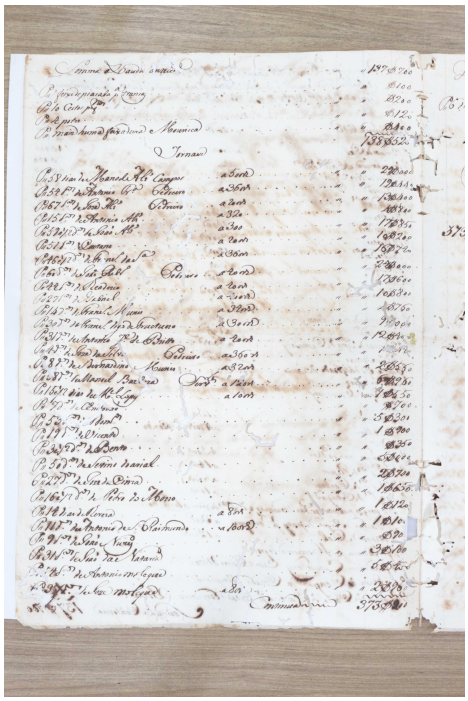
C Sample images from the archives



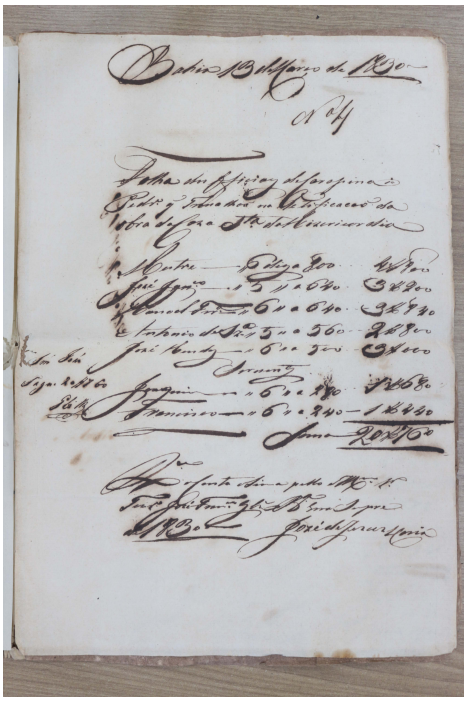
(a) Sugar mill account book, 1611.



(b) Holy House account book, 1647.



(c) Holy House account book, 1790.



(d) Holy House receipts, 1830.

Figure C.1: Samples of historical sources

D The final dataset

The subsistence bare-bones price basket To construct the price series, we gather annual information on a "bare-bones" basket of goods. The bare-bones basket was first proposed in Allen et al. (2011) as a practical solution to the "index number problem." We want to compare the change in aggregate welfare of a representative family between two points in time and between two places in relation to a basket of goods. In our period, many transactions with different prices are taking place, changing the aggregate basket price. In theory, comparing the income in the two periods to the price index should show the change in welfare. There are then two problems, however. One is choosing whether we are fixing the basket in the initial or the final period, and the other which actual goods we are including in the basket, if we want to compare two different places.

We want to compare workers in Brazil to workers in Europe, for example, but the food available in each place was widely different. While people in Brazil consumed manioc flour and beans, those in Europe consumed oats, wheat bread, butter, cheese, beer, and wine. To build the index, in theory, the same products should be available in both places so the worker can choose to consume the first bundle when presented with Brazilian prices and the second bundle when presented with European prices. People in Brazil, however, did not have access to the European basket at local prices, so comparing living standards in both continents is not trivial. One solution is to use the most basic substitutes in the basket. In Brazil, for example, the most basic substitute for oats is cassava flour. We use the most basic food items in quantities with the amount of calories and proteins necessary for daily survival and also add a necessary bundle of non-foodstuffs that is approximately the same everywhere: cloth, soap, fuel (firewood), candles, and lamp oil.[5]

The bare-bones solution represents an empirical approach to the theoretical ideal because we are choosing the most basic items that are necessary for subsistence, thus the worker's choice is already tangential to the indifference curve. The Brazilian bare-bones basket can then be considered the Laspeyres index and the European basket the Paasche index. Allen et al. (2011) compare Chinese and European baskets (and also China and Japan) in local prices and an average of the two, which gives the

[5]The bare-bones basket contrasts with a basket with more variety known as the "respectability basket" (Allen, 2001; Allen et al., 2011, 2012).

Fisher index, and find there is not much of a difference between the three indexes. This result, they argue, gives us the confidence to work just with an equivalent of the Laspeyres index, since a fixed subsistence basket of goods gives many intuitive interpretations. The bare-bones approach has since been adopted in the literature.[6]

We adapt the bare-bones foodstuffs to Brazilian standards following Mattoso (1986, 1992), who documents in detail the historical consumption patterns in Bahia.[7] Mattoso (1992) finds that a family of five had an annual consumption of 870 kilos of cassava flour, 156 kilos of beans, and 156 kilos of meat.[8] We re-balance these amounts and set the annual consumption of one adult to 120 kilos of cassava flour, 70 kilos of beans, and 70 kilos of meat.[9] This translates to approximately the same amount of daily calories and proteins as the standard in the Europe, United States, Mexico, Peru, Bolivia, and Colombia, with proteins slightly below Argentina and Chile and above West Africa. Table D.1 shows a summary of the bare-bones basket for Bahia in comparative perspective. Appendix E shows the conversion weights and measures.

[6]See, for example, a review in Abad and Gary (2020).

[7]The need to adapt baskets to local consumption patterns is well established in the literature (Allen, 2017, 2020).

[8]The earliest histories of Brazil mention cassava (also known as manioc) as the main staple which substituted for bread, e.g. Gândavo (2004, p. 63).

[9]Remarkably, in Brazil slaves commonly received three daily meals which included meat. See Soares (1958, p. 74).

Table D.1: Bahia's bare-bones baskets in global perspective

Good (per person per year)	Brazil	Europe	USA	Mexico, Peru Bolivia, Colombia	Argentina Chile	South China, Japan	North China	West Africa
Cassava flour (kg)	120	-	-	-	-	-	-	-
Meat (kg)	70	5	5	35	105	3	3	3
Beans/peas (kg)	70		20	45		20	20	-
Wheat/oats (kg)	-	155	-	-	132	-	-	-
Maize (kg)	-	-	165	165	-	-	-	185
Sorghum (kg)	-	-	-	-	-	-	179	-
Butter (kg)	-	3	3	-	-	-	-	-
Rice (kg)	-	-	-	-	-	171	-	-
Oil (kg)	-	-	-	-	-	3	-	3
Soap (kg)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Linen/cotton (m)	3	3	3	3	3	3	3	0
Candles (kg)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Lamp oil (l)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Fuel (MBTU)	3	3	2	3	3	3	3	2
Total daily calories	1926	1936	1936	1943	1938	1939	1942	1939
Total daily protein	58	60	60	60	89	63	71	43

Sources: For Brazil, foodstuffs based on Mattoso (1992); for Europe, Allen et al. (2011); for South America Abad et al. (2012); for the United States Allen et al. (2012); for Asia Allen et al. (2011); and for Africa Frankema and van Waijenburg (2012). See Appendix E for conversion metrics and further details.

Occupations and wages We collect daily wages free and enslaved unskilled workers. The unskilled workers were called *serventes* which we translate to "helpers." The choice of these construction sector occupations is typical in this literature because it is a type of work that change little between countries, enabling a comparative analysis. These occupations are also the most largely available for extended periods of time, since first settlement as is the case of Bahia and Rio de Janeiro. They also represent a large share of the urban labor market: artisans made up on average 28% of the workers in Salvador around the middle of the nineteenth century (Nascimento, 2021).[10]

The daily wages are always market wages and do not include in-kind transfers. To build annual series we assume a labor year with 250 working days, as it is standard in the literature.[11] We use annual wages only in the comparative analysis in Section 3, where for all the other places we are also assuming 250 working days, so none of

[10]Depending on the parish and census year, the share of artisans varied from 18% to 36%.

[11]Mattoso (1992) shows that discounting holidays and one resting day per week, the 250-day assumption is realistic for the Brazilian case.

the results depend on this assumption. In the analysis of the slave trade prohibition shocks, in Section 5, we use daily wages for all places including Salvador and Rio.

Real wages Using the price of the annual bare-bones basket for an adult individual, we deflate the nominal annual wage series to arrive at the real wage series.

Prices and wages dataset To build the final dataset for wages and foodstuffs and non-foodstuffs prices we combine the primary sources with data from Johnson Jr. (1973), Lobo (1978), Mattoso (1986), and Alden (1990).[12] Their source is market data mainly from the Holy Houses in Rio de Janeiro and Salvador, in addition to religious hospitals and private firms. All authors explain they have arrived at annual series taken averages of the available observations, except for Alden (1990) who does not mention anything in the text, but we suspect that he also calculates the average for each year because that was the most common method at the time. With the exception of Lobo (1978), the authors do not disclose how many observations they have per year and we suspect that they have used some type of sampling. In contrast, our dataset builds on all manuscripts available for each year sourced at the Holy House.

To build our annual series we take the median of the price and wage observations in each year. We use the median because it is more representative of the price on might encounter in the market and less prone to outliers influencing the annual series than the average. Our results are robust to taking the average of the observations. The only imputation for wages we add is for 1574 based on the ratio of carpenters and unskilled workers in 1611/12. For prices, we apply the ratio of cassava to beans and meat in 1625/26 for 1574 and the ratio of tallow to firewood (1611/12), lamp oil (1622/24), and soap (1643/44). For both wages and prices, the nominal prices and thus the ratios are stable around this period. After we have an observation for each product-year and occupation-year we interpolate the missing years. See Tables D.2 and D.3 for coverage rates by product and occupation. Since we are effectively combining two cities, in Appendix F we show that the prices and wages of the both cities are on a comparable level when they overlap or even when there is a time gap between the

[12]From Lobo (1978) we use data on free unskilled workers (helpers of carpenter and masons as in our archival data) for Rio de Janeiro. From Johnson Jr. (1973) we use data on cassava, beans, and lamp oil for Rio de Janeiro. From Mattoso (1986) we use data on cassava flour, beans, meat, lamp oil, and free unskilled workers, also like in our archival data, for Salvador. From Alden (1990) we use data on cassava flour and meat for Salvador.

Table D.2: Frequency of observations by product. Percent of the period covered and in parentheses the number of prices in each period.

Period	Cassava	Beans	Meat	Nonfood stuffs
1574–1599	19% (6)	19% (5)	19% (5)	19% (13)
1600–1699	34% (262)	13% (27)	9% (40)	42% (403)
1700–1799	90% (982)	51% (520)	85% (519)	65% (717)
1800–1899	91% (833)	90% (568)	90% (875)	53% (523)
1900–1920	100% (21)	100% (29)	100% (70)	10% (4)

Table D.3: Frequency of observations by gender and legal status. Percent of the period covered and in parentheses the number of wages in each period.

Period	Unskilled free male	Unskilled enslaved male	Unskilled free female	Unskilled enslaved female
1574–1599	19% (5)	0% (0)	0% (0)	0% (0)
1600–1699	10% (12)	2% (3)	0% (0)	1% (1)
1700–1799	20% (1187)	16% (929)	10% (108)	8% (49)
1800–1899	98% (2746)	15% (3960)	34% (597)	5% (893)
1900–1920	90% (117)	0% (0)	0% (0)	0% (0)

series.

Slave price dataset Expenditure with slaves was often recorded in account books and probate records, thus we collect slave prices from the same primary sources that we use for prices and wages. In addition, we compile various printed sources on the sale price of slaves mainly from probate records and manumission bills summarized in Soares (1958), Schwartz (1974), de Mello (1977), de Queirós Mattoso et al. (1986), Miller (1986), de Souza Andrade (1988), and Nishida (1992). We categorize the slaves by sex and age, thus we are able to build a final series of male slaves of prime working age to be better comparable with our unskilled workers series (we discard children and old people—usually the literature classifies over 65 as old and around 14 or under as children). As with prices and wages, we take the annual average of the observations and interpolate missing years.

E Weights and measures

For the firewood energy conversions, based on Miller (1995) we find the conversion of "carro" and "tarefa" to cubic meters, then based on Reyes et al. (1992) we set medium hardwood as 600 kilograms per cubic meter, finally to convert firewood kilograms to M BTU we follow Allen et al. (2012). For measures that we found two indications in the literature, marked with (1) and (2) in the table, we take the average of the two conversion factors.

Table E.4: Conversions to the metric system

unit	conversion factor	to	source
alqueire	36.27	litro	Mattoso (1992, p. 503)
alqueire beans	29.02	kg	Mattoso (1973, p. 170)
litro beans	0.8	kg	Mattoso (1973, p. 170)
litro cassava (1)	0.65	kg	Canabrava (1972, p. 116)
litro cassava (2)	0.69	kg	Barickman (2003, p. 214)
alqueire cassava (1)	23.5	kg	Canabrava (1972, p. 116)
alqueire cassava (2)	24.99	kg	Barickman (2003, p. 214)
sirio cassava (1)	44.06	kg	Canabrava (1972, p. 116)
sirio cassava (2)	46.86	kg	Barickman (2003, p. 214)
arroba	14.75	kg	Schwartz (1985, p. xxiii)
quintal	58.98	kg	Schwartz (1985, p. xxiii)
moio	2178	litro	Schwartz (1985, p. xxiii)
sirio	1.87	alqueire	Schwartz (1985, p. xxiii)
libra	0.46	kg	Mattoso (1973, p. 170)
pipa	424	litro	Simonsen (1977)
canada Bahia	6.85	litro	Mattoso (1973, p. 170)
canada Rio de Janeiro	2.66	litro	Johnson Jr. (1973, p. 238)
vara	1.1	m	Schwartz (1985, p. xxiii)
covado	0.66	m	Mattoso (1992, p. 503)
acha firewood kg	0.026	M BTU	conversion (see text)
feixe firewood kg	0.15	M BTU	conversion (see text)
tarefa firewood kg	75.4	M BTU	conversion (see text)
carro firewood kg	9.43	M BTU	conversion (see text)

F Price and wage comparisons between cities

We compare prices and wages in Salvador and Rio de Janeiro. All figures document that observations either show overlap or continuity at the same level.

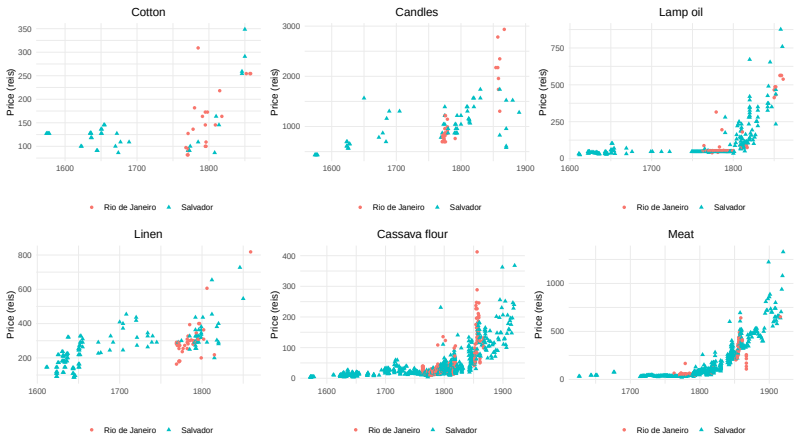


Figure F.1: Prices in Salvador and Rio de Janeiro

Sources: See Section 2.2 and Appendices B and D for details on the sources and construction.
Notes: Includes only primary source observations at the micro level.

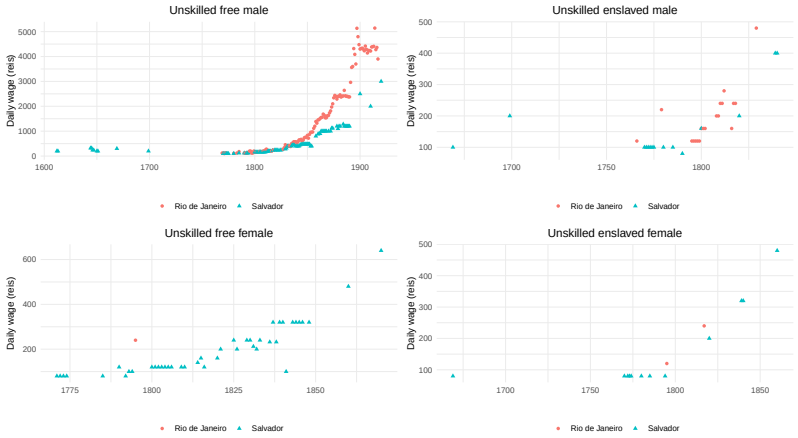


Figure F.2: Wages in Salvador and Rio de Janeiro

Sources: See Section 2.2 and Appendices B and D for details on the sources and construction.
Notes: Includes only observations at the micro level.

G Additional real wages

In Figure G.1, we show our main real wages series measured in working days necessary to purchase an annual subsistence basket. This might be useful for comparison of our series to other studies that use this type of real wage measure.

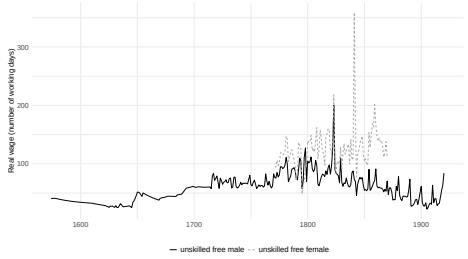


Figure G.1: Real wages in working days for unskilled workers

Sources: See Section 2.2 and Appendices B and D for details on the sources and construction.
Notes: Real wages are measured in number of working days necessary to purchase an annual subsistence basket.

H International comparisons by location

In this section, we show all places of Figure 3 in the main text separately by location.

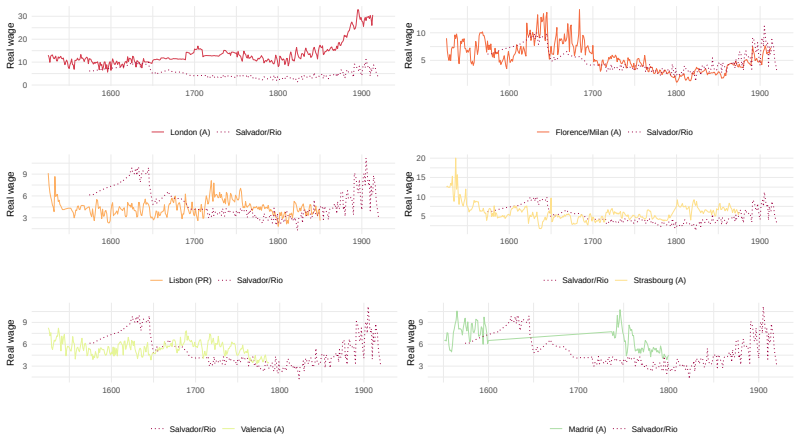


Figure H.1: Unskilled real wages for Brazil and London, Florence/Milan, Lisbon, Strasbourg, Valencia, and Madrid

Sources: (A): Allen (2001) and Allen et al. (2011) updated in Allen (2023).
Notes: Real wages are measured in annual subsistence baskets.

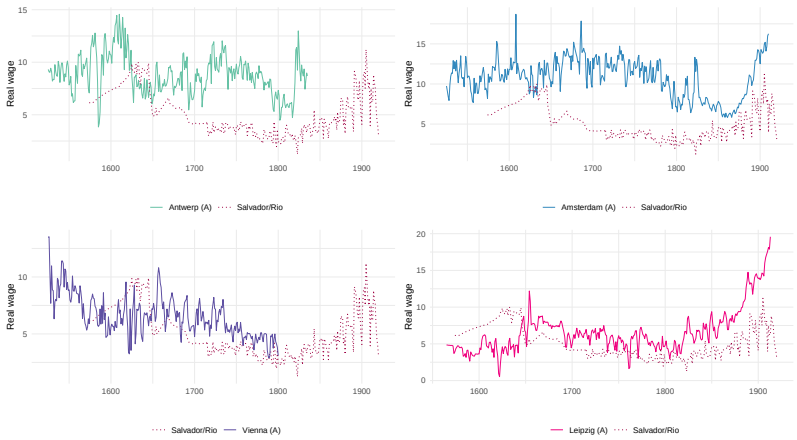


Figure H.2: Unskilled real wages for Brazil and Antwerp, Amsterdam, Vienna, and Leipzig

Sources: (A): Allen (2001) and Allen et al. (2011) updated in Allen (2023).
Notes: Real wages are measured in annual subsistence baskets.

Figure H.3: Unskilled real wages for Brazil and Quebec, Boston, Philadelphia, Maryland, and New England

Sources: (AMS): Allen et al. (2012) updated in Allen (2023); (G): Geloso (2019); (LW): Lindert and Williamson (2013, 2016).
Notes: Real wages are measured in annual subsistence baskets.

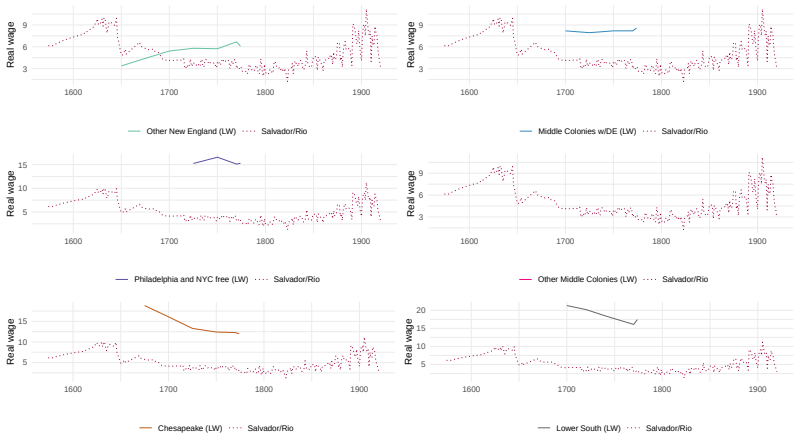


Figure H.4: Unskilled real wages for Brazil and Other New England, Middle Colonies with Delaware, Philadelphia and New York City, Other Middle Colonies, Chesapeake, and Lower South

Sources: (LW): Lindert and Williamson (2013, 2016).

Notes: Real wages are measured in annual subsistence baskets.

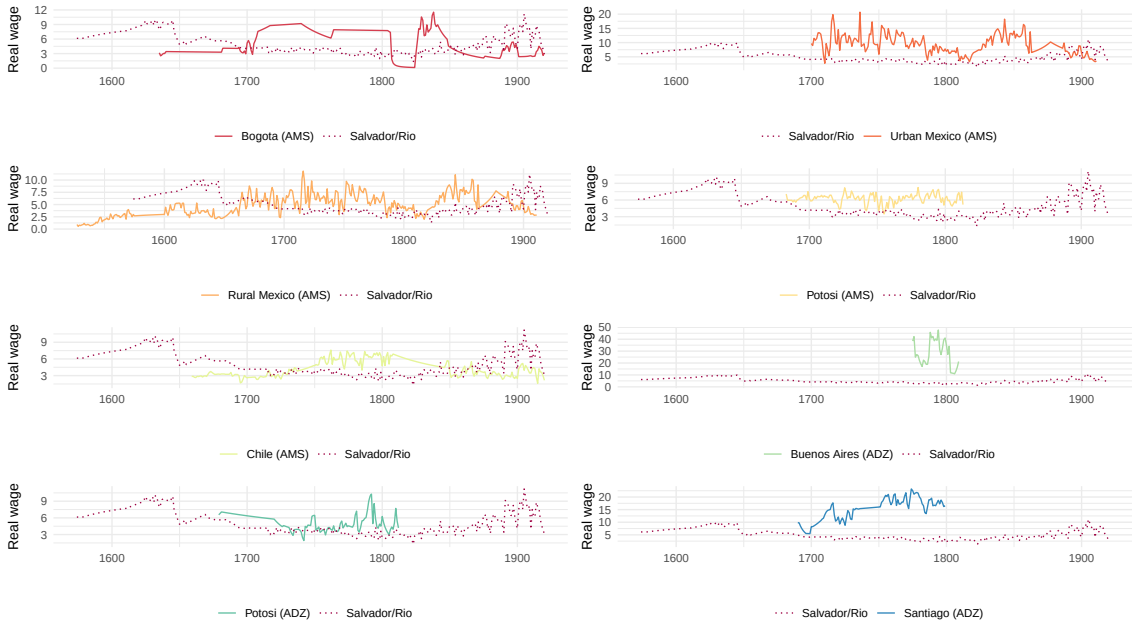


Figure H.5: Unskilled real wages for Brazil and Bogota, Urban Mexico, Rural Mexico, Potosi, Chile, Buenos Aires, and Santiago

Sources: (ADZ): Abad et al. (2012); (AMS): Allen et al. (2012) updated in Allen (2023).

Notes: Real wages are measured in annual subsistence baskets.

Figure H.6: Unskilled real wages for Brazil and Bogota, Mexico City, Lima, Rio Grande, and Jamaica

Sources: (ADZ): Abad et al. (2012); (BPW): Burnard et al. (2019); (CG): Challú and Gómez-Galvarriato (2015); (DM): Djenderedjian and Martirén (2020).
Notes: Real wages are measured in annual subsistence baskets.

Figure H.7: Unskilled real wages for Brazil and Accra, Lagos, Cape Coast, Japan, Beijing, and Canton

Sources: (A): Allen (2001) and Allen et al. (2011) updated in Allen (2023); (FV): Frankema and van Waijenburg (2012); (K): Kumon (2022); (R): Rönnbäck (2014).
Notes: Real wages are measured in annual subsistence baskets.

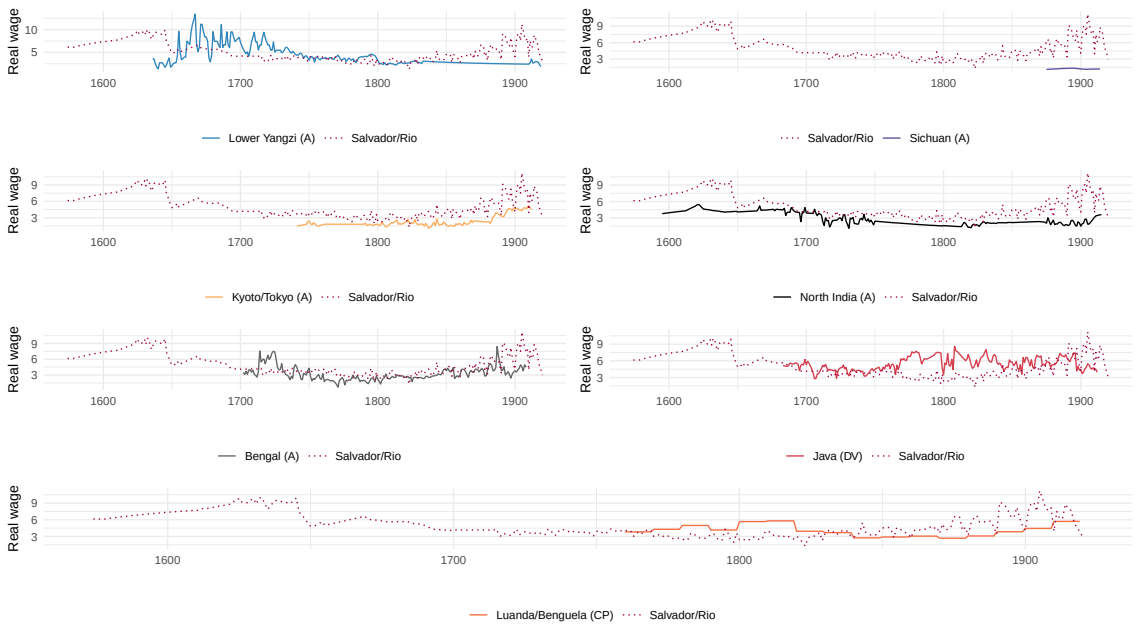


Figure H.8: Unskilled real wages for Brazil and Lower Yangzi, Sichuan, Japan, North India, Bengal, and Java

Sources: (A): Allen (2001) and Allen et al. (2011) updated in Allen (2023); (DV): de Zwart and van Zanden (2015).
Notes: Real wages are measured in annual subsistence baskets.

I From static allocation to the law of motion

Assumptions. We have three modeling choices, relative to canonical DTC models, that drive the dynamics:

1. **Two-sided endogeneity of the enslaved user cost.** The per worker-period user cost $c_t(s) = p(L_{s,t}; \tau) + \kappa(p_t, w_t, d(s))$ moves with an almost flat external slave supply and with coercion that rises in both the slave price and the free wage.

2. **Disamenity-ordered tasks and compensating differentials.** Tasks are ordered by a disamenity index $d(s)$. Free labor requires equalizing differences $w_{f,t}(s) = w_t \, \varphi(d(s))$ with $\varphi' > 0$. Together with single crossing, this delivers a sharp cutoff $\bar{s}_t$ separating free from enslaved tasks.

3. **Task-capture learning.** Productivity gains are binary: using a factor on a task raises that factor's $A(\cdot)$ on that task next period. This creates history dependence even when static price effects are small.

Timing. At the start of t, the state is $\{A_{f,t}(\cdot), A_{s,t}(\cdot), L_{s,t}\}$ and the trade friction is τ. The external supply pins down $p_t = p(L_{s,t}; \tau)$. Firms allocate tasks at date t; then learning updates to $\{A_{f,t+1}(\cdot), A_{s,t+1}(\cdot)\}$. The base wage w_t is determined by an upward-sloping supply $w_t = W(L_{f,t})$ (per worker-period).

Static allocation. Free vs. enslaved unit costs on task s are

$$P_f(s,t) = \frac{w_t\,\varphi(d(s))}{A_{f,t}(s)}, \qquad P_s(s,t) = \frac{c_t(s)}{A_{s,t}(s)}, \qquad c_t(s) = p_t + \kappa\big(p_t, w_t, d(s)\big). \tag{5}$$

Single crossing of $P_s - P_f$ in s implies a unique cutoff $\bar{s}_t$ with

$$s < \bar{s}_t \Rightarrow \text{free labor}, \qquad s > \bar{s}_t \Rightarrow \text{enslaved labor}.$$

Intuitively, disamenities makes free labor expensive (compensating differential), so enslaved labor concentrates in high-$d(s)$ tasks when it is relatively cheaper.

Law of motion. Learning is task-capture:

$$A_{s,t+1}(s) = A_{s,t}(s) + \alpha_s\,\mathbb{1}\{s > \bar{s}_t\}, \qquad A_{f,t+1}(s) = A_{f,t}(s) + \alpha_f\,\mathbb{1}\{s < \bar{s}_t\}.$$

Next period's user cost embeds the external supply evaluated at last period's enslaved use and the new wage:

$$c_{t+1}(s) = p(L_{s,t}; \tau) + \kappa\big(p(L_{s,t}; \tau),\, w_{t+1},\, d(s)\big), \tag{6}$$

with $w_{t+1} = W(L_{f,t+1})$. Given the CES aggregator across tasks (see Equation (2)), next period's enslaved employment is

$$L_{s,t+1} = \Gamma(L_{s,t}; \tau) \equiv Y_{t+1} P_{t+1}^{\rho} \int_{s:\, P_s(\cdot,t+1) \le P_f(\cdot,t+1)} c_{t+1}(s)^{-\rho}\, A_{s,t+1}(s)^{\rho-1}\, ds, \tag{7}$$

where P_{t+1} is the CES price index implied by Equation (2). Thus, changes in relative unit costs affect both the *set* of enslaved tasks and their *weights* in aggregation.

Immediate comparative statics corollary. A higher τ raises $p(\cdot;\tau)$ and, via $\kappa_p > 0$, the enslaved user cost on every task. The crossing shifts so that $\bar{s}$ rises: the enslaved domain $[\bar{s}, 1]$ shrinks and the free-task domain $[0, \bar{s})$ expands. Free-labor demand increases, and with $W' > 0$ the base wage w rises, which can be seen also by a regular free worker supply closure and applying the Implicit Function Theorem. In short,

$$\uparrow \tau \;\Rightarrow \uparrow \bar{s}, \quad \downarrow L_s, \quad \uparrow w,$$

which is the mechanism we take to the data.

S-Shape of Γ. Three forces determine the slope of $\Gamma(\cdot;\tau)$:

1. **Task capture (upward).** Using enslaved labor today raises $A_{s,t+1}$ exactly where it is used, cutting future unit costs on those tasks and expanding the enslaved set.

2. **Price/coercion (downward).** Higher $L_{s,t}$ raises $p(L_{s,t};\tau)$ (external supply) and, because $\kappa_p > 0$, it shrinks the enslaved set and its weight.

3. **Wage–coercion feedback (downward near low L_s).** When more tasks are done by free workers, with $W' > 0$ this bids up w, and $\kappa_w > 0$ then further raises user costs for enslaved labor.

With $\rho > 1$, the CES aggregator amplifies these forces by tilting demand toward cheaper tasks. For moderate supply slopes (η small) and sizable task-capture (α_s not tiny), the upward effect can dominate in the middle but not at the tails—producing the S-shape and allowing multiple steady states before a ban. A slave trade ban ($\uparrow \tau$) shifts the whole Γ schedule down, typically eliminating the high-slavery fixed point and selecting the low-slavery equilibrium.

J Robustness checks for the main results

In this section, we show robustness tests for the main result changing the transformation of the outcome, controlling for a price index, and changing the donor pool in many ways. Our main regressions are robust to all these tests. Table J.1 estimates our main regressions changing the outcome for logs, instead of an index. Table J.2

controls for the bare-bones price index in each location included in the main regressions. Table J.3 estimates our main regressions changing the donor pool to keep only places in the Americas and Java, which can be considered more similar in the experience of commodity booms in the nineteenth century, Table J.4 keeps only places in the Americas and Asia, thus excluding places in Europe that might be importing Brazil's commodities, Table J.5 keeps only places with around the same level of real wages, and Table J.6 implements the "leave-one-out" approach.

Table J.1: The effect of slave trade prohibition shocks on unskilled wages – Outcome in logs

	1807 prohibition	1831 prohibition	1850 prohibition
SDID coefficient	0.294**	0.519***	0.33**
s.e.	(0.117)	(0.084)	(0.146)
Time FE:	Yes	Yes	Yes
Unit FE:	Yes	Yes	Yes
N units:	23	23	23
N years:	19	18	19

Notes: Estimates of the average treatment effect of slave trade prohibition shocks on unskilled wages in Salvador/Rio using the synthetic differences-in-differences (SDID) method. Only Salvador/Rio is treated in each prohibition period. The control unit and time weights are shown in the accompanying figure. The dependent variable is the log of the annual average of the daily wage. All estimates include time and unit fixed effects. The number of units and time periods in each estimation is shown in the table. Standard errors are constructed using the placebo method detailed in Arkhangelsky et al. (2021), where placebo evaluations are conducted replacing the treatment unit with each of the control units. $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

Table J.2: The effect of slave trade prohibition shocks on unskilled wages – Controlling for a price index

	1807 prohibition	1831 prohibition	1850 prohibition
SDID coefficient	25.683**	43.745**	41.448***
s.e.	(11.75)	(20.916)	(15.448)
Time FE:	Yes	Yes	Yes
Unit FE:	Yes	Yes	Yes
N units:	17	16	16
N years:	19	18	19

Notes: Estimates of the average treatment effect of slave trade prohibition shocks on unskilled wages in Salvador/Rio using the synthetic differences-in-differences (SDID) method. Only Salvador/Rio is treated in each prohibition period. The control unit and time weights are shown in the accompanying figure. The dependent variable is the annual average of the daily wage transformed to an index equal to 100 in the year of each prohibition. All estimates include time and unit fixed effects. The number of units and time periods in each estimation is shown in the table. Standard errors are constructed using the placebo method detailed in Arkhangelsky et al. (2021), where placebo evaluations are conducted replacing the treatment unit with each of the control units. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$

Table J.3: The effect of slave trade prohibition shocks on unskilled wages – Only Latin America and Java

	1807 prohibition	1831 prohibition	1850 prohibition
SDID coefficient	30.644***	45.183***	41.952***
s.e.	(5.149)	(12.057)	(3.848)
Time FE:	Yes	Yes	Yes
Unit FE:	Yes	Yes	Yes
N units:	7	7	7
N years:	19	18	19

Notes: Estimates of the average treatment effect of slave trade prohibition shocks on unskilled wages in Salvador/Rio using the synthetic differences-in-differences (SDID) method. Only Salvador/Rio is treated in each prohibition period. The control unit and time weights are shown in the accompanying figure. The dependent variable is the annual average of the daily wage transformed to an index equal to 100 in the year of each prohibition. All estimates include time and unit fixed effects. The number of units and time periods in each estimation is shown in the table. Standard errors are constructed using the placebo method detailed in Arkhangelsky et al. (2021), where placebo evaluations are conducted replacing the treatment unit with each of the control units. The donor pool includes Bogota, Urban Mexico, Rural Mexico, Chile, Mexico City, and Java. $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$

Table J.4: The effect of slave trade prohibition shocks on unskilled wages – Only Latin America and Asia in the donor pool

	1807 prohibition	1831 prohibition	1850 prohibition
SDID coefficient	27.454**	45.987***	39.647***
s.e.	(13.905)	(13.597)	(4.367)
Time FE:	Yes	Yes	Yes
Unit FE:	Yes	Yes	Yes
N units:	12	12	12
N years:	19	18	19

Notes: Estimates of the average treatment effect of slave trade prohibition shocks on unskilled wages in Salvador/Rio using the synthetic differences-in-differences (SDID) method. Only Salvador/Rio is treated in each prohibition period. The control unit and time weights are shown in the accompanying figure. The dependent variable is the annual average of the daily wage transformed to an index equal to 100 in the year of each prohibition. All estimates include time and unit fixed effects. The number of units and time periods in each estimation is shown in the table. Standard errors are constructed using the placebo method detailed in Arkhangelsky et al. (2021), where placebo evaluations are conducted replacing the treatment unit with each of the control units. The donor pool includes Bogota, Urban Mexico, Rural Mexico, Chile, Mexico City, Java, Canton, Lower Yangzi, Kyoto/Tokyo, North India, and Bengal. $^{*}p < 0.1$,$^{**}p < 0.05$,$^{***}p < 0.01$

Table J.5: The effect of slave trade prohibition shocks on unskilled wages – Only around the same level of real wages in the donor pool

	1807 prohibition	1831 prohibition	1850 prohibition
SDID coefficient	28.538***	24.169***	36.201***
s.e.	(3.954)	(1.791)	(5.815)
Time FE:	Yes	Yes	Yes
Unit FE:	Yes	Yes	Yes
N units:	6	6	6
N years:	19	18	19

Notes: Estimates of the average treatment effect of slave trade prohibition shocks on unskilled wages in Salvador/Rio using the synthetic differences-in-differences (SDID) method. Only Salvador/Rio is treated in each prohibition period. The control unit and time weights are shown in the accompanying figure. The dependent variable is the annual average of the daily wage transformed to an index equal to 100 in the year of each prohibition. All estimates include time and unit fixed effects. The number of units and time periods in each estimation is shown in the table. Standard errors are constructed using the placebo method detailed in Arkhangelsky et al. (2021), where placebo evaluations are conducted replacing the treatment unit with each of the control units. The donor pool includes Florence/Milan, Canton, Lower Yangzi, Bengal, and Chile. $^{*}p < 0.1$,$^{**}p < 0.05$,$^{***}p < 0.01$

Table J.6: The effect of slave trade prohibition shocks on unskilled wages — Leave one out of the donor pool

	1807 prohibition	1831 prohibition	1850 prohibition
SDID coef. [1]	28.388**	45.595***	41.765***
s.e. [1]	(12.208)	(11.057)	(13.56)
SDID coef. [2]	28.184**	45.569***	41.853***
s.e. [2]	(12.625)	(9.426)	(14.684)
SDID coef. [3]	28.093**	45.748***	40.601**
s.e. [3]	(11.384)	(11.429)	(17.274)
SDID coef. [4]	28.179***	46.972***	42.891***
s.e. [4]	(10.5)	(9.477)	(13.767)
SDID coef. [5]	28.683**	45.541***	42.088***
s.e. [5]	(11.646)	(9.453)	(15.415)
SDID coef. [6]	28.746***	45.565***	42.064***
s.e. [6]	(10.83)	(10.398)	(15.207)
SDID coef. [7]	28.184***	45.615***	43.834***
s.e. [7]	(10.677)	(9.599)	(15.687)
SDID coef. [8]	28.24***	45.573***	41.839***
s.e. [8]	(9.751)	(9.409)	(15.086)
SDID coef. [9]	28.096**	46.058***	38.811***
s.e. [9]	(11.457)	(10.048)	(12.526)
SDID coef. [10]	28.43**	45.46***	42.367***
s.e. [10]	(11.865)	(11.393)	(16.025)
SDID coef. [11]	28.144***	45.637***	42.394***
s.e. [11]	(10.322)	(10.397)	(14.962)
SDID coef. [12]	28.146***	46.229***	42.124**
s.e. [12]	(10.15)	(10.17)	(16.445)
SDID coef. [13]	28.17**	45.967***	42.017***
s.e. [13]	(11.206)	(9.291)	(15.142)
SDID coef. [14]	29.7***	41.573***	42.005***
s.e. [14]	(4.802)	(8.86)	(14.505)
SDID coef. [15]	28.04**	47.103***	42.296***
s.e. [15]	(12.046)	(7.91)	(15.971)
SDID coef. [16]	28.773***	45.574***	42.563***
s.e. [16]	(9.883)	(10.542)	(16.502)
SDID coef. [17]	28.184***	38.737***	41.631***
s.e. [17]	(9.608)	(6.124)	(11.569)
SDID coef. [18]	28.653**	44.732***	41.858***
s.e. [18]	(11.698)	(10.178)	(14.833)
SDID coef. [19]	28.653**	44.732***	41.937***
s.e. [19]	(11.227)	(11.252)	(15.532)
SDID coef. [20]	28.186***	45.571***	41.689***
s.e. [20]	(9.446)	(9.874)	(15.589)
SDID coef. [21]	27.825**	45.564***	42.429***
s.e. [21]	(10.831)	(9.78)	(16.224)
SDID coef. [22]	28.495**	45.643***	42.054**
s.e. [22]	(11.441)	(9.644)	(17.304)
Time FE:	Yes	Yes	Yes
Unit FE:	Yes	Yes	Yes

Continued on next page

Table J.6 — *Continued from previous page*

	1807 prohibition	1831 prohibition	1850 prohibition
N units:	22	22	22
N years:	19	18	19

Notes: Estimates of the average treatment effect of slave trade prohibition shocks on unskilled wages in Salvador/Rio using the synthetic differences-in-differences (SDID) method. Only Salvador/Rio is treated in each prohibition period. The control unit and time weights are shown in the accompanying figure. The dependent variable is the annual average of the daily wage transformed to an index equal to 100 in the year of each prohibition. All estimates include time and unit fixed effects. The number of units and time periods in each estimation is shown in the table. Standard errors are constructed using the placebo method detailed in Arkhangelsky et al. (2021), where placebo evaluations are conducted replacing the treatment unit with each of the control units. $^{*}p < 0.1, ^{**}p < 0.05, ^{***}p < 0.01$

K Reallocation in Salvador and Rio

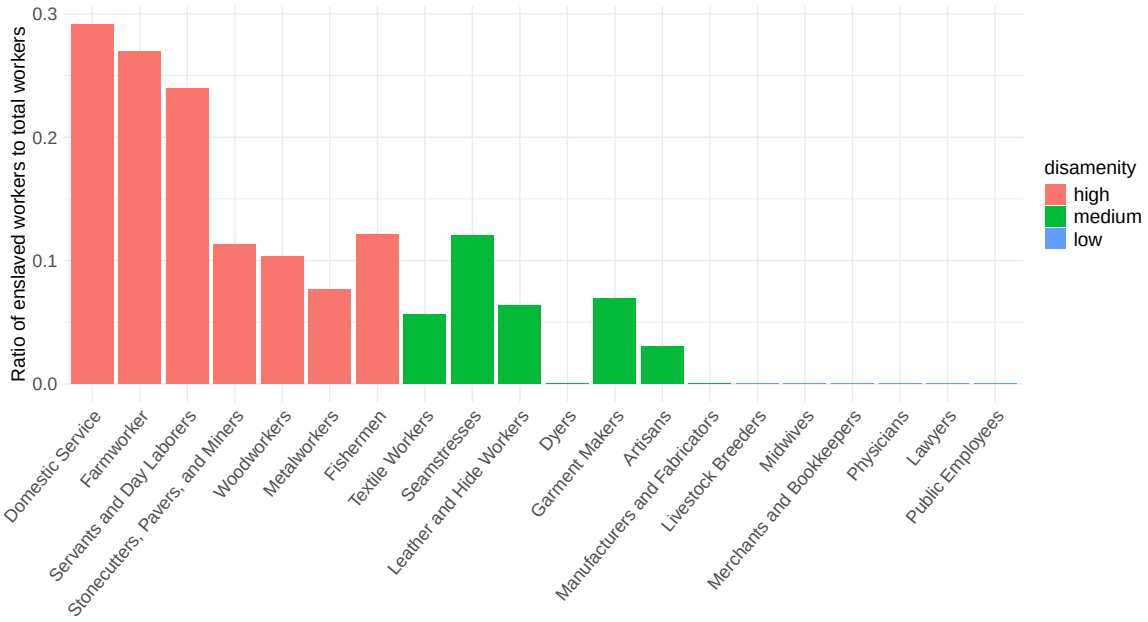
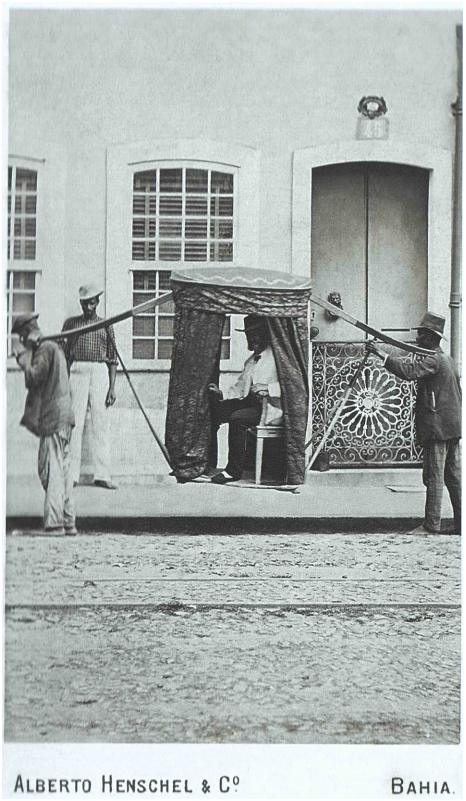


Figure K.1: Share of enslaved labor by occupation and task-level disamenity in the 1872 census for Salvador and Rio only

L Illustrations of technical change



(a) Alberto Henschel, *Escravos transportando um homem*, 1869. Public domain.

(b) Elevador Lacerda, built 1869–1873, then the world's highest elevator. Public domain.

(c) Jean Baptiste Debret, *Negros de Carro*, 1834. Public domain.

(d) Old steam crane at the docks, introduced between 1850 and 1870. Public domain.

Figure L.1: Nineteenth-century urban labor and mechanization in Salvador and Rio

Appendix References

Abad, L. A., Davies, E., & Van Zanden, J. L. (2012). Between conquest and independence: Real wages and demographic change in Spanish America, 1530–1820. *Explorations in Economic History*, *49*(2), 149–166.

Abad, L. A., & Gary, K. (2020). A window to the past: Living standards in historical perspective. In C. Diebolt & M. Haupert (Eds.), *Handbook of cliometrics* (pp. 1–25). Springer Berlin Heidelberg.

Alden, D. (1984). Late colonial Brazil, 1750–1808. In L. Bethell (Ed.), *The Cambridge History of Latin America* (pp. 601–660, Vol. 2). Cambridge University Press.

Alden, D. (1990). Price Movements in Brazil before, during, and after the Gold Boom, with Special Reference to the Salvador Market, 1670–1769. In *Essays on the Price History of Eighteenth-Century Latin America*. University of New Mexico Press.

Allen, R. C. (2001). The great divergence in European wages and prices from the Middle Ages to the First World War. *Explorations in Economic History*, *38*(4), 411–447.

Allen, R. C. (2017). Absolute poverty: When necessity displaces desire. *American Economic Review*, *107*(12), 3690–3721.

Allen, R. C. (2020). Poverty and the labor market: Today and yesterday. *Annual Review of Economics*, *12*, 107–134.

Allen, R. C. (2023). *Building labourers' wages, living costs, and welfare ratios. Database.*

Allen, R. C., Bassino, J.-P., Ma, D., Moll-Murata, C., & Van Zanden, J. L. (2011). Wages, prices, and living standards in China, 1738–1925: in comparison with Europe, Japan, and India. *The Economic History Review*, *64*, 8–38.

Allen, R. C., Murphy, T. E., & Schneider, E. B. (2012). The colonial origins of the divergence in the Americas: A labor market approach. *The Journal of Economic History*, *72*(4), 863–894.

Arkhangelsky, D., Athey, S., Hirshberg, D. A., Imbens, G. W., & Wager, S. (2021). Synthetic difference-in-differences. *American Economic Review*, *111*(12), 4088–4118.

Baerlocher, D., Firmino, D., Lambais, G., Reis, E., & Veras, H. (2023). *Old but gold: Historical pathways and path dependence.*

Barickman, B. J. (2003). *Um contraponto baiano: açúcar, fumo, mandioca e escravidão no Recôncavo, 1780–1860*. Civilização Brasileira.

Bértola, L., & Ocampo, J. A. (2012). *The economic development of Latin America since independence*. Oxford: Oxford University Press.

Boxer, C. R. (1952). *Salvador de Sá and the Struggle for Brazil and Angola, 1602-1686*. London: The University of London, Athlone Press.

Burnard, T., Panza, L., & Williamson, J. (2019). Living costs, real incomes and inequality in colonial Jamaica. *Explorations in Economic History*, *71*, 55–71.

Canabrava, A. (1972). Uma economia da decadência: os níveis de riqueza na Capitania de São Paulo, 1765/67. *Revista Brasileira de Economia*, *26*(4), 95–123.

Challú, A. E., & Gómez-Galvarriato, A. (2015). Mexicos's real wages in the age of the Great Divergence, 1730–1930. *Revista de Historia Economica - Journal of Iberian and Latin American Economic History*, *33*(1), 83–122.

de Mello, P. C. (1977). *The Economics of Labor in Brazilian Coffee Plantations, 1850–1888* [Ph.D. dissertation]. The University of Chicago.

de Queirós Mattoso, K. M., Klein, H. S., & Engerman, S. L. (1986). Trends and Patterns in the Prices of Manumitted Slaves: Bahia, 1819–1888. *Slavery & Abolition: A Journal of Slave and Post-Slave Studies*, *7*(1), 59–67.

de Souza Andrade, M. J. (1988). *A mão de obra escrava em Salvador, 1811–1860*. São Paulo: Corrupio.

de Zwart, P., & van Zanden, J. L. (2015). Labor, wages, and living standards in Java, 1680–1914. *European Review of Economic History*, *19*(3), 215–234.

Djenderedjian, J., & Martirén, J. L. (2020). Consumption baskets and cost of living in southern late colonial Brazil: Rio Grande, 1772–1823. *Revista de Historia Económica - Journal of Iberian and Latin American Economic History*, *38*(2), 279–309.

Frankema, E., & van Waijenburg, M. (2012). Structural impediments to African growth? New evidence from real wages in British Africa, 1880–1965. *The Journal of Economic History*, *72*(4), 895–926.

Gândavo, P. d. M. (2004). *História da província santa cruz a que vulgarmente chamamos brasil*. Lisboa: Assírio e Alvim. Originally published in 1574.

Geloso, V. J. (2019). Distinct within North America: Living standards in French Canada, 1688–1775. *Cliometrica*, *13*, 277–321.

Góes, J. R. (1997). *A paz das senzalas: famílias escravas e tráfico atlântico, Rio de Janeiro, c. 1790-c. 1850*. Civilização Brasileira.

Johnson Jr., H. (1973). A preliminary inquiry into money, prices, and wages in rio de janeiro, 1763–1823. In D. Alden (Ed.), *Colonial Roots of Modern Brazil: Papers of the Newberry Library Conference* (pp. 231–283). University of California Press.

Kumon, Y. (2022). The Labor-Intensive Path: Wages, Incomes, and the Work Year in Japan, 1610–1890. *The Journal of Economic History*, *82*(2), 368–402.

Lindert, P. H., & Williamson, J. G. (2013). American incomes before and after the Revolution. *The Journal of Economic History*, *73*(3), 725–765.

Lindert, P. H., & Williamson, J. G. (2016). American colonial incomes, 1650–1774. *The Economic History Review*, *69*(1), 54–77.

Lobo, E. M. L. (1978). *História do rio de janeiro: Do capital comercial ao capital industrial e financeiro*. Rio de Janeiro: IBMEC.

Mattoso, K. (1973). Os preços na Bahia de 1750 a 1930. In *L'Histoire Quantitative du Brésil de 1800 à 1930*. Paris: Editions du Centre National de la Recherche Scientifique.

Mattoso, K. (1986). *Au Nouveau Monde, une Province, d'un Nouvel Empire: Bahia au Dix-Neuviéme Siécle* [Doctoral dissertation, University of Paris-Sorbonne].

Mattoso, K. (1992). *Bahia, Século XIX: Uma Província no Império*. Editora Nova Fronteira.

Mauro, F. (1997). *Portugal, o Brasil e o Atlântico, 1570-1670* (Vol. 1). Lisboa: Editorial Estampa.

Miller, J. C. (1986). Slave Prices in the Portuguese Southern Atlantic, 1600–1830. In P. E. Lovejoy (Ed.), *Africans in bondage: Studies in slavery and the slave trade* (pp. 43–77). Madison: University of Wisconsin Press.

Miller, J. C. (1996). *Way of death: Merchant capitalism and the Angolan slave trade, 1730–1830*. University of Wisconsin Press.

Miller, S. (1995). A madeira combustível na Bahia colonial: consequências sociais e econômicas da escassez de combustível, 1549–1820. *Estudos Econômicos*, *25*(1), 115–145.

Morse, R. M. (1974). Brazil's Urban Development: Colony and Empire. *Journal of Urban History*, *1*(1), 39–72.

Nascimento, A. A. V. (2021). *Dez freguesias da cidade do salvador: Aspectos sociais e urbanos do século XIX*. Edufba.

Nishida, M. (1992). *Gender, Ethnicity, and Kinship in the Urban African Diaspora: Salvador, Brazil, 1808–1888* [Ph.D. dissertation]. The Johns Hopkins University.

Reyes, G., Brown, S., Chapman, J., & Lugo, A. E. (1992). *Wood Densities of Tropical Tree Species* (tech. rep.). U.S. Department of Agriculture, Forest Service. New Orleans, LA.

Rönnbäck, K. (2014). Living standards on the pre-colonial Gold Coast: a quantitative estimate of African laborers' welfare ratios. *European Review of Economic History*, *18*(2), 185–202.

Russell-Wood, A. J. R. (1984). Colonial Brazil: The gold cycle, c. 1690–1750. In L. Bethell (Ed.), *The cambridge history of latin america* (pp. 547–600, Vol. 2). Cambridge University Press.

Schultz, K. (2013). *Tropical Versailles: empire, monarchy, and the Portuguese royal court in Rio de Janeiro, 1808-1821*. Routledge.

Schwartz, S. (1985). *Sugar plantations in the formation of brazilian society: Bahia, 1550-1835*. Cambridge University Press.

Schwartz, S. B. (1974). The Manumission of Slaves in Colonial Brazil: Bahia, 1684–1745. *The Hispanic American Historical Review*, *54*(4), 603–635.

Simonsen, R. C. (1977). *História Econômica do Brasil: 1500–1820* (7th ed.). São Paulo: Companhia Editora Nacional.

Soares, U. (1958). *Escravatura na Misericórdia*. Rio de Janeiro: Fundação Romão de Matos Duarte.