Empires of Grain: State Building and Market Integration in French West Africa, 1915-1950

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ABSTRACT

Markets for millet and rice in the Western Sudan became much more integrated over the course of the twentieth century. Drawing on a new dataset of prices from across French West African colonies, this paper documents that price dispersion as measured by the coefficient of variation roughly halved from 1915 to 1940. Estimates of route-specific freight prices suggest that much of the decline in price gaps can be attributed to falling transport costs due to the introduction of mechanised transport. A market-supportive legacy of precolonial state-building, and particularly the Islamist states of the Fulani jihads and the Wassulu Empire of Samory Touré is also evident in the price data.

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Keywords: market integration, West Africa, grain markets, grain prices

Empires of grain: market integration in West Africa under French rule

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> Then the Shaykh asked us, "Is there anyone among you who needs more millet?" The army told him that everyone was completely satisfied..."

—Muhammadu Aliu Tyam[1]

> *Coloniser, c'est transporter*

—Variously attributed to Henry Morton Stanley, King Leopold II and Maurice Lippens

IN THE NINETEENTH CENTURY, TWO VISIONS OF POLITICAL UNITY STROVE FOR supremacy in the Central and Western Sudan, the part of West Africa that lies between the forest belt and the Sahara desert. The first was the great Islamic state-building projects of the Fulɓe *jihāds* and then, as the century drew to a close, of the Malinké warrior Samory Touré.[2] The second was European colonial conquest, which aimed to unite the region under European law and with European means of transportation, and make its agricultural hinterlands safe for international commerce. The second won a bloody but comprehensive victory over the first, and while Britain claimed most of the territory of the former Sokoto Caliphate, the richest and most powerful of the *jihād* states, the bulk of the former Muslim empires in the West Africa savanna, Sahel and Sahara was taken by France. By 1912, the date of the final annexation of the Waday sultanate, a dusty tricolor hung on flagpoles from Saint Louis on the Atlantic coast to Adré in eastern Chad.

What were the economic impacts of these political projects? This paper offers, for the first time, quantitative evidence of market integration in colonial Africa between the Sahara and the Zambezi. More specifically, its purpose is to examine the economic legacy of the two main statebuilding projects of West Africa prior to political independence. It examines price dispersion and price comovement between different markets for three goods—millet, rice and salt—that were of primordial importance for the everyday economic life of Africans in the region but of much

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[1] *The Life of al-Hajj Umar: A Pulaar Qasida*, Translated and reproduced in Christopher Wise, *Archive of the Umarian Tijaniyya*

[2] Paul E Lovejoy, *Jihād in West Africa during the Age of Revolutions* (Ohio University Press, 2016); Yves Person, *Samori : une révolution dyula* ((Institut fondemental de l'Afrique noire, Dakar), 1968).

less interest to colonial rulers, who left little statistical evidence on which to make a rigorous statistical assessment of long-run developments.

While many aspects of the economies of colonial West Africa have been documented in African economic history's 'renaissance' in the past two decades,[3] quantitative work on market integration and particularly on staple grain markets has been conspicuous by its absence, largely due to a lack of adequate data. (A valuable exception has been work on integration of British West African *coastal markets* with world commodity markets, which, it has been shown, was much less comperehensive than one might expect due to trading monopolies[4]. See also recent work on maize markets in East Africa.[5]). Despite a large literature on the importance of markets in the *longue durée* of West African history, and the abundant contemporary evidence on the relatively disintegrated state of Western Sudanian grain markets, we know very little about how markets have become either more or less integrated prior to the advent of regular statistical monitoring in the 1980s. To date, only one paper has explicitly compared prices *within* colonial states in West Africa, and it documents a very large degree of price dispersion for a cross section of towns in French West Africa in 1948.[6] Was this simply a consequence of war-time disruption, or did it reflect a more permanent state of economic disintegration in the Western Sudan?

The absence of any quantitative estimates of domestic market integration in colonial West Africa is regrettable because well-developed markets have often been thought to be, if not a prerequisite for modern economic growth, then at the very least a handmaiden, in I.B. Kravis's sense of the word.[7] A long intellectual tradition, beginning with Adam Smith, holds that the integration of markets causes or at least facilitates economic growth. High transport costs prevent trade, hence impede economic specialization, hence slow productivity growth.[8] Connecting towns to roads can lower the cost of inputs, further enabling specialisation according to comparative advantage.[9] Market integration also sometimes had unforeseen, unintended effects

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[3]Gareth Austin and Stephen Broadberry, "Introduction: The Renaissance of African Economic History," *The Economic History Review* 67, no. 4 (2014): 893–906; Ewout Frankema and Marlous Van Waijenburg, "Bridging the Gap with the 'New' Economic History of Africa," *The Journal of African History* 64, no. 1 (2023): 38–61; Denis Cogneau and Cecilia Falgas-Ravry, "The Economic History of Africa: Renaissance or False Dawn?," *Annales. Histoire, Sciences Sociales* 71, no. 4 (2016): 879–96; Katharine Frederick, Dácil Juif, and Felix Meier zu Selhausen, "The Revival of African Economic History in the 21st Century: A Bibliometric Analysis," *Revista De Historia Industrial—Industrial History Review* 33, no. 92 (2024): 11–48.

[4]Federico Tadei, Nektarios Aslanidis, and Oscar Martinez, "Trade Costs and the Integration of British West Africa in the Global Economy, C. 1840–1940," *The Economic History Review*, 2024.

[5]Ewout Frankema et al., "The Political Economy of Maize in East Africa, 1900-2020: How Cheap Food Turned Expensive," 2025.

[6]Tom Westland, "Spatial Inequality in Living Standards and the Urban Premium in Late Colonial French West Africa," *Revista De Historia Industrial—Industrial History Review* 33, no. 92 (2024): 93–118.

[7]Irving B Kravis, "Trade as a Handmaiden of Growth: Similarities between the Nineteenth and Twentieth Centuries," *The Economic Journal* 80, no. 320 (1970): 850–72.

[8]Tasso Adamopoulos, "Transportation Costs, Agricultural Productivity, And Cross-Country Income Differences," *International Economic Review* 52, no. 2 (2011): 489–521; Hundanol A Kebede, "Gains from Market Integration: Welfare Effects of New Rural Roads in Ethiopia," *Journal of Development Economics* 168 (2024): 103252.

[9]Mesay Gebresilasse, "Rural Roads, Agricultural Extension, And Productivity," *Journal of Development Economics* 162 (2023): 103048.

on parts of the domestic economy that are perceived, particularly by colonial officials as backward, such as the survival of market-oriented handicraft textiles in the face of foreign competition.[10] In this respect, evidence on market integration would help to complete the quantitative picture of structural change in the colonial period in West Africa that has been painted in the last two decade or so.[11]

The paper makes three major arguments, each a new intervention in the literature. Firstly, I show that transport costs fell and markets for rice and millet—though not for salt—became more integrated in the Western sudan over the first half of the twentieth century. Secondly, I show that falling internal transport costs account for most but not all of the the considerable decline in price dispersion for millet, rice and salt. Thirdly, I show that the degree of market integration for grain (but not for salt) was higher in parts of the Western Sudan that were part of three of the most important 19th century Islamic states, the Sokoto Caliphate founded by Usman dan Fodio in 1804, the 'Tukolor' empire of El Hadj Umar Tall, founded around 1852, and the Wassulu Empire of Samory Touré, much more fleeting, having been established around 1880 and collapsing under intense French pressure at the turn of the twentieth century.

I argue, therefore, that these empires—which, at least in the case of the first two, led to the establishment of large-scale grain plantations exploiting slave labour and producing for the market rather than purely for subsistence consumption—helped to create regional markets in grain that preceded French rule and endured through it. The continuity of economic activity across the traditional historiographical divide —the onset of European territorial control—poses an interesting question about the extent to which Smithian dynamics were already present in West Africa prior to European conquest.[12] Did colonisation, in Olúfẹ́mi Táíwò's words, pre-empt economic modernity in the region?[13] A major literature spanning political science, development economics and economic history has tried to understand whether the existence (and form) of states that existed prior to colonial rule can still be detected in economic outcomes today.[14] The most common mechanism invoked is a story of state capacity: colonial rulers coopted state power where it existed, and were able to build on it, but were forced to start *ab initio* elsewhere, setting the stage for long-

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[10]Emiliano Travieso and Tom Westland, "What Happened to the Workshop of West Africa? Resilience and Decline of Handicraft Textiles in Colonial Northern Nigeria, 1911–52," *The Economic History Review* 77, no. 4 (2024).

[11]Ewout Frankema and Marlous Van Waijenburg, "Structural Impediments to African Growth? New Evidence from Real Wages in British Africa, 1880–1965," *The Journal of Economic History* 72, no. 4 (2012): 895–926; Stephen Broadberry and Leigh Gardner, "Economic Growth in Sub-Saharan Africa, 1885–2008: Evidence from Eight Countries," *Explorations in Economic History* 83 (2022): 101424.

[12]Gareth Austin, "Labour Intensity and Manufacturing in West Africa, C. 1450–C. 2000," ed. Gareth Austin and Kaoru Sugihara, *Labour-Intensive Industrialization in Global History* (Routledge, 2013).

[13]Olúfẹ́mi Táíwò, *How Colonialism Preempted Modernity in Africa* (Bloomington, Indiana: Indiana University Press, 2010).

[14]Noah L Nathan, *The Scarce State* (Cambridge University Press, 2023); Sanghamitra Bandyopadhyay and Elliott Green, "Precolonial Political Centralization and Contemporary Development in Uganda," *Economic Development and Cultural Change* 64, no. 3 (2016): 471–508; Martha Wilfahrt, "Precolonial Legacies and Institutional Congruence in Public Goods Delivery: Evidence from Decentralized West Africa," *World Politics* 70, no. 2 (2018): 239–74.

run path dependence mediated by initial state capacity. State capacity yesterday, in other words, means state capacity today, and state capacity today means economic development tomorrow. But another possible story is one in which precolonial states guaranteed the growth of domestic markets, and it is markets, rather than state capacity, that explains spatial inequality.

The process of grain market integration in the Western Sudan was not limited to the colonial period. There was almost certainly integration prior to colonial rule, and integration after it. In Figure 1, the coefficient of variation for millet prices across a consistent sample of nine towns in the Western Sudan is shown, drawing on the new data presented in this paper as well as from contemporary food price monitoring datasets. There is, more or less, a halving of price dispersion from the 1915 to 1940, followed by another rough halving from 1940 to 2010 or so. Unfortunately, we lack consistent series for the intervening period, but the long run trend suggests that market integration was over the whole twentieth century was substantial for staple grains in the West African savannah and Sahara.

The structure of the paper is as follows: in Section 2, I give a brief history of both the 19th century states and of the major investments in mechanised transport made by French colonial governments. I also survey the literature on grain and salt markets in 19th and 20th century Africa. In Section 3, I discuss two new datasets which I use to assess market integration in the region: the first, an entirely new dataset of grain and salt prices from locations across French West Africa; and a dataset of transport prices, gathered from both primary and secondary sources. In section 4, I examine the impact of falling transport costs on price dispersion for millet, rice and salt. In section 5, I consider price correlations between locations, showing that correlations were higher for town-pairs located *within* 19th century states than for town pairs that were partially or wholly outside them. Section 6 concludes.

FIGURE 1. Long-run millet market integration (coefficient of variation of annual average price) in the Western and Central Sudan across consistent set of towns (Bobo-Dioulasso, Dédougou, Gao, Bamako, Ouagadougou, Niamey, Ségou, Tombouctou and Zinder). Source: 1915-1940 as described in the paper; 2008-2025 from the FAO Food Price Monitoring and Analysis tool.

MARKETS, STATES AND TRANSPORT IN THE WESTERN SUDAN.   Prior to the coming of mechanised transportation to the Western and Central Sudan, high freight costs limited the trade in grain, but not everywhere. The most economically significant highways of medieval and early modern West Africa had been rivers, which, as Adam Smith famously noted, were too few and "at too great a distance from one another to give occasion to any considerable inland navigation".[15] There were essentially two main arteries: the Senegal and Niger rivers. Both were the sites of substantial long-distance trade in grain. The town of Timbuktu, a desert-facing commercial centre, relied for its grain supply on canoes that ferried millet some 800 kilometres from slave plantations in Sinsani;[16] according to the *Tārīkh as-Sūdān*, the city's grain stores would have allowed it to withstand a siege of seven years without starvation.[17] Lagoons, such as those on the coasts of what are now Côte d'Ivoire and Benin, allowed for extensive east-west trade in foodstuffs, such as maize.[18]

Millet trade was extensive where economic specialisation was the most developed: for example, the Senegalese 'bread basket' of Fuuta Toro exported grain both to

[15] Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations: In Three Volumes*, vol. 3 (Strahan, 1784).

[16] Richard Roberts, "Long Distance Trade and Production: Sinsani in the Nineteenth Century," *The Journal of African History* 21, no. 2 (April 1980): 169–88.

[17] By the 19th century, Timbuktu's reliance on grain imports was a source of weakness, exploited by Tijani Tall in 1885 in order to solicit Timbuktu's submission to the Umarian state: see Caron, "De Saint Louis au port du Tombouctou", 271.

[18] Patrick Manning, "Merchants, Porters and Canoemen in the Bight of Benin: Links in the West African Trade Network," ed. Catherine Coquery-Vidrovitch and Paul Lovejoy, *The Workers of African Trade*, 1985, : 59.

the French proto-urban centre of Saint Louis[19] as well as to the salt producers of Waalo on the lower Senegal and the Bîdân pastoralists of southern Mauritania.[20] The exchange of millet for meat and milk was widespread where pastoralists came to graze their herds.[21] The traditional sources for historians of pre-1900 Africa—traveller's accounts—certainly indicate that millet was widely available for purchase, even in the absence of formal markets: Caillé, for example, wrote that at the relatively minor village of Douasso "there is no daily market" but "some women came to sell us millet and peanuts for dinner".[22]

Outside the river basins and lagoons, trade was limited by the expense and speed of human porters in the tseste fly zone and pack animals beyond it. This severely circumscribed the possibilities for trade in grain, at least for millet. Rice, unlike millet, was occasionally traded long distances on foot: from the highlands of Fuuta Jalon over 300 kilometres to the Rio Nunez, and even from the Niger River town of Sansanding to the Saharan entrepôt of Araouane some 600 kilometres away.[23] Salt, of course, was traded at great distances due to the high value-weight ratio. It was produced both in the well-known Saharan mines like Idjil and Taoudeni,[24] as well as by earth salt producers, like those of the strategically important Waalo saltworks.[25] It was traded across West Africa by camel, donkey and on foot,[26] often in exchange for essentials like millet, which was then sent from productive areas along what Webb calls 'relays' deep into the desert.[27] The costs of trade were high; accordingly, even when it could be transported along rivers like the Niger, prices varied widely across space. According to French explorer and soldier Eugene Lenfant, "a bar of salt which costs 16 to 20 francs in Timbuktu is worth 25 to 28 francs in Djenné, 35 francs in

[19]Though even its supplies were fragile: in 1794, for example, the French governor expelled all non-citizens from Saint Louis in order to protect the town's dwindling millet supplies; he also forbade any millet exports: Alquier, 'Saint Louis du Sénégal.

[20]Oumar Kane, *La première hégémonie peule* (Paris: Karthala, 2004), : 318; Ibrahima Abou Sall, *Mauritanie du sud: conquêtes et administration coloniales françaises, 1890-1945* (Paris: Karthala, 2007), : 65.

[21]Oussouby Touré, *Peul du Ferlo* (Paris: L'Harmattan, 1986); Monique Chastanet, "Survival Strategies of a Sahelian Society: The Case of the Soninke in Senegal from the Middle of the Nineteenth Century to the Present," *Food and Foodways* 5, no. 2 (1992): 127–49.

[22]René Caillié, *Journal d'un voyage à Temboctou et à Jenné, dans l'Afrique centrale, précédé d'observations faites chez les Maures Braknas, les Naouls et d'autres peuples; pendant les années 1824, 1825, 1826, 1827, 1828*, vol. 1 (Romantique, 1830), : 111.

[23]Véronique Blanchard de la Brosse, "Riz des femmes, riz des hommes au Guidimaka (Mauritanie)," *Études rurales*, 1989, 37–58.

[24]E Ann McDougall, "Salts of the Western Sahara: Myths, Mysteries, And Historical Significance," *The International Journal of African Historical Studies* 23, no. 2 (1990): 231–57.

[25]Mamadou Diouf, *Le Kajoor au XIXe siècle: pouvoir ceddo et conquête coloniale* (Paris: Karthala Editions, 1990), : 30.

[26]Paul E Lovejoy, "Commercial Sectors in the Economy of the Nineteenth-Century Central Sudan: The Trans-Saharan Trade and the Desert-Side Salt Trade," *African Economic History*, no. 13 (1984): 85–116.

[27]Paul E Lovejoy and Stephen Baier, "The Desert-Side Economy of the Central Sudan," *The International Journal of African Historical Studies* 8, no. 4 (1975): 551–81; E Anne McDougall, "Camel Caravans of the Saharan Salt Trade: Traders and Transporters in the Nineteenth Century," ed. Catherine Coquery-Vidrovitch and Paul E Lovejoy, *The Workers of African Trade*, 1985; James LA Webb, *Desert Frontier: Ecological and Economic Change Along the Western Sahel, 1600-1850* (Univ of Wisconsin Press, 1995); Stephen Baier, "Trans-Saharan Trade and the Sahel: Damergu, 1870–1930," *The Journal of African History* 18, no. 1 (1977): 37–60.

Ségu, and 40 francs in Koulikoro".[28]

The fiscal weakness of states limited the construction of roads, a rule proved by the exception of Asante, by some distance the strongest state of the forest belt and the only state which devoted substantial resources to maintaining roads (the famous *nkwantempon*, or Great Roads).[29] Some other states built less comprehensive roads, though generally more for the projection of state power than for commerce, like Danhomè's Great Road.[30] However, if the great 19th century states of the Western Sudan did little to invest in transportation infrastructure, they nonetheless did sometimes promote the development of regional markets in grain.

In the Sokoto Caliphate, a high rate of urbanisation and the only comprehensive monetary land tax in pre-20th century Africa jointly produced a relatively well-developed market for millet.[31] What was most novel in Sokoto was the development of a plantation sector, with large estates belonging to (often) absentee landlords. The plantations of the Caliphate produced a variety of different crops, including cotton for the most important industrial venture of West Africa, the Northern Nigerian textile manufacturing sector. They also produced large quantities of grain for sale, particularly for urban centres and for the exchange with the 'desert-side' sector of the Sahelian economy.[32] Though the Fulani conquerors did in some instances impose state monopolies of trade in some goods, such as kola nuts in the southern emirate of Nupe,[33] the grain market appears to have been competitive and—to judge by the extensive urbanisation of the region—efficient.

The impact of Umarian rule is more complicated than that of Sokoto: Richard Roberts has argued that the violence of the *jihād* swept away the thriving commercial economy of the pagan Bambara state in Ségou which preceded Umarian rule in the Middle Niger, leaving a legacy of instability and economic retrenchment at least in that region. But the effect was not universally negative.[34] Hanson argues that as the *jihād* pushed further east, conquering Ségu and then Masina, the aristocracy it left

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[28]Eugène Lenfant, *Le Niger: voie ouverte à notre empire africain* (Paris: Hachette et cie, 1903).

[29]Ivor Wilks, "On Mentally Mapping Greater Asante: A Study of Time and Motion," *The Journal of African History* 33, no. 2 (1992): 175–90.

[30]Stanley B. Alpern, "Dahomey's Royal Road," *History in Africa* 26 (1999): 11–24; Robin Law, "Wheeled Transport in Pre-Colonial West Africa," *Africa* 50, no. 3 (1980): 249–62.

[31]Gareth Austin, "Markets with, Without, And in Spite of States: West Africa in the Pre-Colonial Nineteenth Century" (Department of Economic History, London School of Economics, Political Science, 2004).

[32]Paul E Lovejoy, "Plantations in the Economy of the Sokoto Caliphate," *The Journal of African History* 19, no. 3 (1978): 341–68; Paul E Lovejoy, "The Characteristics of Plantations in the Nineteenth-Century Sokoto Caliphate (Islamic West Africa)," *The American Historical Review* 84, no. 5 (1979): 1267–92; Mohammed Bashir Salau, "Ribats and the Development of Plantations in the Sokoto Caliphate: A Case Study of Fanisau," *African Economic History*, no. 34 (2006): 23–43; Polly Hill, "From Slavery to Freedom: The Case of Farm-Slavery in Nigerian Hausaland," *Comparative Studies in Society and History* 18, no. 3 (1976): . Though Hogendorn ('Economics of slave use') argues that 'little millet or guinea corn was sold' by the plantations he studied, he also acknowledges Polly Hill's intriguing argument that his oral informants may have seen such sales as immoral, and so underplayed their extent..

[33]See for example the tax assessment report of Labozhi district in Niger Province, Bida Division, of 1913: British Library EAP 535/2/5/1/2.

[34]Richard L Roberts, *Warriors, Merchants, And Slaves: The State and the Economy in the Middle Niger Valley, 1700-1914* (Stanford University Press, 1987).

behind in Karta turned to commercial grain agriculture, some of which supplied the markets of the French trading post at Médine.[35] The Umarian elite also reinvested some of its military capacity into securing trade routes, particularly the southeast-northwest route that led from Ségou through Nyamina and Banamba to Nioro.[36] The Umarian states—perhaps a more accurate term than 'state' or 'empire', given the fragmentation of political power—therefore present a complicated picture, both destabilising the regional economy but also, potentially, supporting the growth of trade and grain production in some areas.

The Wassulu empire of Samory Touré offers a similarly mixed picture. Samory himself was a trader, had extensive links to Malinké commercial network, and in its initial phases at least, his state-building project was modelled on the traditional Malinké states that obtained political legitimacy through their protection of long-distance trading routes.[37] Touré's success in limiting the fiscal extraction of local rulers accounts for his initial popularity among the commercial community of the Guinean highlands. As his ambitions expanded and collided with the French, though, Samorian rule became primarily extractive.[38] Samory's relationship with the Kooroko kola-nut merchants led him to institute a kind of state-directed commercial apparatus that allowed him to extract both profits and loyalty from his selected merchants, who in return received the Almami's favour, sometimes in material form[39] In addition, independent traders also existed, traded extensively with Samory's army, and according to early colonial reports, earned very considerable profits doing so. Samory also was adept at cutting off food supplies as a military strategy, for example during his siege of Kong in 1897:[40] it is possible that the experience of Samorian conquest may have led to a distrust of dependence on markets for urban provisioning.

French conquest of the Western Sudan upended some grain trades and supplied the demand for new ones. By 1903, the quantity of millet demanded by French troops and other officials in the new capital of the Soudan français, Bamako, was sufficiently large that a local grain futures market had sprung up to cater for the trade.[41] A 1904 report on the millet trade in Bamako described it as 'active, dealing in several tonnes per day', and heavily marked by the seasons: 'during the rainy season

[35] John H Hanson, "Generational Conflict in the Umarian Movement After the Jihād: Perspectives from the Futanke Grain Trade at Medine," *The Journal of African History* 31, no. 2 (1990): 199–215.

[36] Richard L Roberts, "Production and Reproduction of Warrior States: Segu Bambara and Segu Tokolor, C. 1712-1890," *The International Journal of African Historical Studies* 13, no. 3 (1980): 389–419.

[37] Victor Azarya, "Traders and the Center in Massina, Kong, And Samori's State," *The International Journal of African Historical Studies* 13, no. 3 (1980): 420–56.

[38] Akbar Muhammad, "The Samorian Occupation of Bondoukou: An Indigenous View," *The International Journal of African Historical Studies* 10, no. 2 (1977): 242–58.

[39] Jean-Loup Amselle, *Les négociants de la savane: histoire et organisation sociale des Kooroko, Mali* (Paris: Les Éditions Anthropos, 1977).

[40] Konan Jean-Marc Yobouet, "Affamer l'ennemi par le siège militaire : une stratégie de conquête coloniale en Côte d'Ivoire (1897-1915)," *Revue Della/Afrique* 6, no. 18 (2024).

[41] Richard Roberts, "The Emergence of a Grain Market in Bamako, 1883–1908," *Canadian Journal of African Studies/la Revue Canadienne Des études Africaines* 14, no. 1 (1980): 37–54.

there is scarcity, and any millet is quickly snapped up by buyers'.[42] In Kankan and Kouroussa, in Upper Guinea, 'millet is hardly purchased at all in normal times; the natives live on rice and fonio. Daily trade in millet does not exceed 300 kilograms. But in the rainy season, when all reserves are more or less exhausted, millet is sold regardless of how small the quantity. Africans come running from villages four or five days' walk away at the news of the arrival of a shipment.'[43]

The monthly prices (minima and maxima) given in the same reports for millet in Western Sudanian towns in the early twentieth century give us an insight into the nature of markets: heavy seasonality, with prices peaking in the rainy season for all towns and both crops. If we take the middle of the price ranges as an average, then the trough-to-peak increase (from January to August in each case) in rice prices was 75% for Bamako, 114% for Kouroussa, and 200% for Kankan. For millet, Bamako prices were roughly 500% higher in August as in January; Kouroussa/Kankan prices 175% higher across the same time period (see Figure 2). By way of comparison, according to official statistics, in 2024, the wholesale millet price in Bamako rose 95% from its January trough to its October peak, indicating a substantial decline in price seasonality over the course of the twentieth century.

French investments in infrastructure made some axes of existing grain trades cheaper, and therefore probably increased volumes. The most obvious example is the introduction of modern vessels on the Niger and Senegal. On the former, steam transport was possible from around July to December, and for the rest of the year smaller craft propelled by sail or punt, or pulled by ropes from the shore, could trade along the river. The bulk of the trade in millet and rice took place on the northern reach of the river, beween Koulikoro and Ansongo, rather than the southern section from Bamako to Kouroussa. In the dry season of 1923/1924, for example, it was reported that "a trading company had sent 600 tonnes of millet" from Niamey —equivalent to the annual consumption requirements of around 3000 people—to Timbuktu, where the previous harvest had been bad.[44]

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[42]'Culture du sorgho dans les vallées du Niger et du Haut Sénégal : suite', in *L'agriculture pratique des pays chauds : bulletin du Jardin colonial et des jardins d'essai des colonies françaises*, (Paris: Challamel, 1905): 17.

[43]Ibid: 18.

[44]'La situation économique en A.O.F', *Les annales coloniales*, 29 April 1924: 2
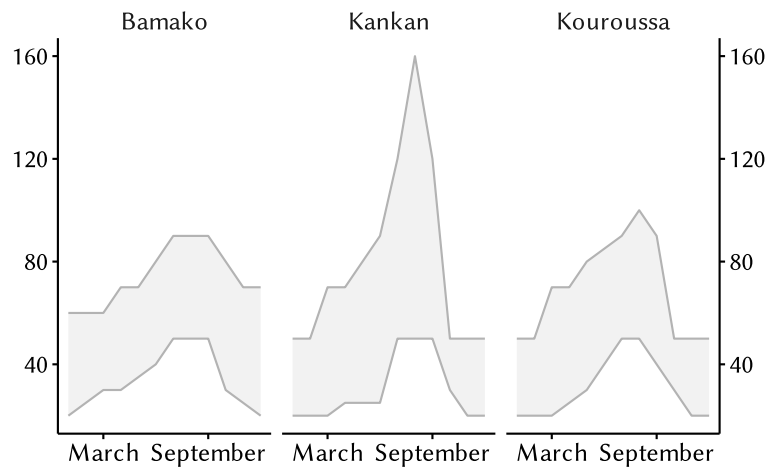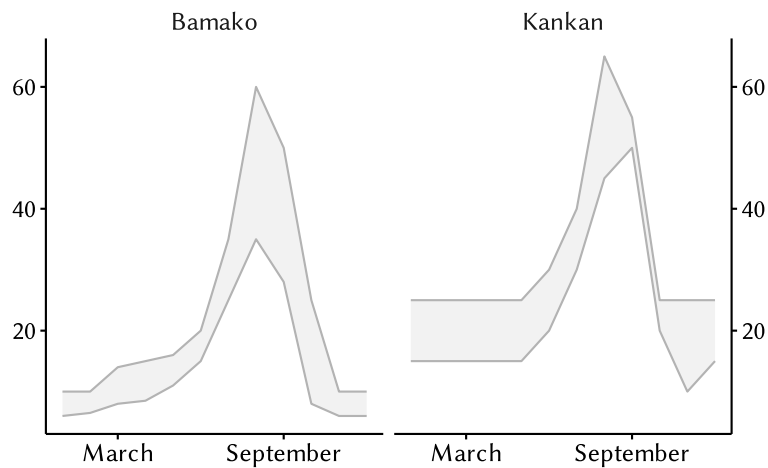
FIGURE 2a. Rice

FIGURE 2b. Millet

FIGURE 2. Monthly grain price movements (range) in the early 20th century Western Sudan. Expressed as francs per 100kg. For Bamako, the prices are from 1903; for Kankan and Kouroussa, they are from 1904. Source: Culture du sorgho dans les vallées du Niger et du Haut Sénégal : suite, in L'agriculture pratique des pays chauds : bulletin du Jardin colonial et des jardins d'essai des colonies françaises, (Paris: Challamel, 1905): 17.

Salt trades also underwent substantial transformation. French attempts to compete in the savanna and Sahel markets were not always successful,[45] though the saltworks located in the Senegalese town of Kaolack did end up supplying much of the hinter-

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[45]E Ann McDougall, "'Perfecting the Fertile Seed': The Compagnie du sel aggloméré and Colonial Capitalism, c. 1890-1905," *African Economic History*, 2002, 53–80.

land markets of French West Africa, drawing on a pool of convict labour that allowed it to compete with Saharan producers who also often relied on coerced labour.[46].

Two transport revolutions occurred under colonial rule, and produced quite different effects. The building of railroads required a very high capital investment, but resulted in very low freight costs, often on a par with or even lower than river transport. Railways were, however, limited in geographical range, and construction responded very slowly to the expansion of cash cropping to new frontiers. In constrast, motorable roads could be built at relatively low monetary cost—especially when unpaid, forced labour was used, as it was extensively in colonial Africa. But motor transport was much less economical than rail, and prices per tonne-kilometre were of a similar order of magnitude (if usually somewhat lower) to animal transport outside of the tseste zone.[47] In the forest zone, the structure of costs was somewhat different: head porterage was uneconomical compared to lorry transportation in the Gold Coast from very early on, which helps to explain why many farmers there found it so attractive to reinvest cash-crop profits in lorries.[48]

North of the forest zone, the transition from non-mechanical to mechanised transport was a much more uneven process: animal transport in particular, but even head porterage, survived in Africa long into the colonial period and after, and different modes of transport both complemented and competed with one another. The dominion of the lorry was greatly circumscribed by the quality of the roads. Where they were poor, oxen and camels remained in employment. Around Dakar in 1926, the roads were already largely dominated by lorries: according to the engineer Mahé, a census of the road from Dakar to Rufisque showed an average of 66 lorries per day and 114 touring cars; on the other hand, there were only 16 horse-drawn vehicles and 15 saddled animals on average on the same road.[49] Elsewhere, the condition of roads prevented it the use of lorries:

> The state of roads in Senegal is such that it is often more profitable to use the old means of transport, the only ones that can carry groundnuts to the trading posts: camels, donkeys and pack oxen.[50]

Both road quality and low agricultural productivity in vast streches of the territory of French West Africa produced a road network with a very heavily exploited core and enormous lengths of road that were only occasionally used: in the 1950s, only 78 kms of the network saw more than 2,000 vehicles a day and only 293 km had over 500

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[46]Laurence Marfaing and Mariam Sow, *Les opérateurs économiques au Sénégal: entre le formel et l'informel, 1930-1996* (Paris: Karthala Editions, 1999); Babacar Fall, *Le travail forcé en Afrique Occidentale française (1900-1946)* (Paris: Karthala Editions, 1993), 287.

[47]Our estimates here may be somewhat biased by the fact that we may only be observing prices for animal transport in times and places where it was competitive.

[48]Simon Heap, "The Development of Motor Transport in the Gold Coast, 1900–39," *The Journal of Transport History* 11, no. 2 (September 1, 1990): 19–37.

[49]Mahé, 'A report on the use of tars and bituments for the protection of roads in the region of Dakar (Senegal)'

[50]Giraud, *Arachide sénégalaise*, 146

vehicles a day; meanwhile roughly 40,000 km of roads saw fewer than 30 vehicles per day.[51] Nonetheless, the net effect of new investments in transport infrastructure was to lower the price of transport per kilometric tonne in real terms, allowing for a much greater volume of cash crop exports than would have been possible without mechanised transport, and — potentially — increasing the prospects of grain trade as well.

There were two other major impacts of French colonial rule, one operating on the demand side of the grain market and another on the supply side. The demand side impact was the purchases made by the French army to feed its employees, and especially its African soldiers—a factor I make use of in the quantitative analysis. The supply side factor was encouragement of a cash crop-oriented economy. The French —and their African partners[52] sometimes encouraged cash cropping at the expense of food crops, particularly in Senegal where Indochinese rice supplies could easily make good deficits; at other times and in other places, they discouraged diversification away from food crops, particularly in the more arid environments of the Western Sudan but also in regions like southern Côte d'Ivoire where the pressure of cash cropping on food security must presumably have been less acute. Cash crop special- isation did lead to interregional trade in foodstuffs: in early 20th century Guinea, for example, the rubber boom did apparently lead to some previously self-sufficient districts, like Kankan, importing staple grains like rice and millet from neighbours.[53]

Despite the fact that rail investments were directed more towards areas of greater cash crop potential than towards food-producing regions[54], the railways were used for the transport of grain, including by private individuals. The final budget accounts of the colonial railways often included information about payments for damages paid to merchants who had sent rice or millet on the railways: for example, in 1921 compensation was paid to Namory Keïta and Seni Camara, each of whom had lost a sack of rice on the Conakry-Niger railwauy. French trading houses meanwhile, like SCOA and Peyrissac et Cie, were engaged in the salt trade on the railway, with the houses being compensated for 134 and 460 kg of salt lost by the railway respec- tively. While we cannot entirely assume that damages and losses occured at random —perhaps it was possible to secure better-protected spots in the railway cars—the compensation claims do suggest a wide range of economic actors used the railway to transport basic foodstuffs.

Grain traders in the Western Sudan, like all traders, were looking to exploit the potential for price arbitrage: buying where and when prices were low and selling

[51]E. Crouzet, "Rentabilité des voies de communications dans l'Outre-Mer," *Revue d'économie politique* 64, no. 2 (1954): 307–28.

[52]Meghan O'Donoghue, "Amadou Cissé on the 'Dangers' of Millet: A Microhistory of Colonial Power, Colonized Agency, And Agricultural Knowledge in the Schools of Colonial Senegal, 1911–14," *Francosphères* 13, no. 1 (2024): 9–27.

[53]Emily Lynn Osborn, "'Rubber Fever', Commerce and French Colonial Rule in Upper Guinée, 1890–1913," *The Journal of African History* 45, no. 3 (2004): : 463.

[54]John Tosh, "The Cash-Crop Revolution in Tropical Africa: An Agricultural Reappraisal," *African Affairs* 79, no. 314 (1980): 79–94.

where and when they were high. Some indirect evidence of this comes from the Soudan-side railings data for the Dakar–Niger railway, published in the *Journal officiel du Soudan français* for a number of years in the 1930s and 1940s. The data only give the volume of goods traded by month, not the prices or the destinations. Though there is a great deal of annual variation, overall the suggests a marked seasonal pattern, with millet railings peaking not after the harvest (which was generally between September and December[55] but rather during the next year's planting season, around June and July, in the period known in French as the *soudure*, when reserves are low and caloric demand is high. In 1933, 1935, and 1938 the month with the highest volume of millet shipped on the Dakar-Niger was August; in 1934 it was May, in 1937 and 1939 June, and in 1936 July. This is also the period in which grain prices in the Western Sudan are typically at their highest during the year, as the price data depicted above in Figure 2 show quite starkly. It seems therefore safe to assume that grain trade was not simply a matter of disposing of surplus production at a low and relatively unremunerative price in years of good harvest, but rather that market-oriented behaviour was important and systematic among grain farmers, at least in those parts of Soudan français that were close to the railways.

However, we must assume that a large share, perhaps the largest, of West Africa's grain trade was carried by less capital-intensive methods. We know that at least some was still being transported on the Senegal and the Niger rivers, since scattered reports exist in French documents. Foodstuffs were also transported by lorry. A report on transportation in Haute-Volta in 1925 (well before it was connected to the railways) suggested that since the colony had been created in 1919, "human portage had declined by 65%, while the amount of tonnage transported had grown by 270%".[56] Yet on this question, the archives are in general much less helpful. Some that is available does point to relatively small amounts of grain being transported: for example, the records of the Benin-Niger's supplementary automobile service between the railway station Dassa-Zoumé and the northern town of Tanguiéta give monthly figures of goods transported, including, for example, 9 tonnes of millet in 1935, 10 tonnes of cassava flour and 35 tonnes of maize; however, these were dwarfed by cash crops: 824 tonnes of raw cotton, 727 tonnes of groundnuts, and 491 tonnes of shea kernels.[57] At least in terms of recorded trade, grain markets were secondary to cash crop markets, and it is likely that traditional forms of transportation — porters and pack animals — remained relatively important in the grain trade for a long time.

TWO NEW DATASETS.   Given this complicated picture, given the high cost of motor transport early on, and given that railways in particular were usually planned in order to transport cash crops towards ports rather than food crops from surplus to deficit regions, we cannot assume that the arrival of rail and roads in Africa under colonial rule led to grain market integration.

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[55]See e.g. the USDA crop calendar for Mali at https://voyager.fas.usda.gov/voyager/navigo/show?id=317e9f0b-fbf5-5421-827b-03efc05e3d4f&disp=default

[56]'Le courrier de l'Afrique occidentale : transport', in *Les Annales coloniales*, 8 September 1925, p.2.

[57]Archives nationales d'outre mer, Aix-en-Provence, fonds AGEFOM, dossier 375.

I introduce two major new datasets to analyse the role of mechanised transportation to market integration in colonial AOF. The first is a newly gathered set of prices for millet and rice prices in order to document the development of grain markets across the Western Sudan (additionally, I gather salt prices, which serves as a benchmark for price differentials). The second is a set of freight prices gathered from a vast range of primary and secondary sources. Adequately measuring transport costs has been a persistent difficulty with market integration studies. As Federico has argued, proxying for costs with as-the-crow-flies bilateral distances or with dummy variables for railway connections may give misleading results. Not only are transportation connections rarely constructed in straight lines across the Earth's surface, infrastructure like rail and roads must be used in order to bring down price dispersion, and this will depend on freight rates, technology, and, in the case of roads, the availability of lorries and other vehicles. Unlike other recent work on transport costs and market integration, the period I study saw considerable changes in the relative prices of transport modes in West Africa. I therefore consider it necessary to explicitly construct a set of time- and colony-varying transport costs for West Africa, which I assemble into the West Africa Transport Cost database. The data sources are varied, and include both primary and secondary literature. The database records prices on a francs-per-kilometric-tonne basis, thus allowing for easy comparison between modes and across time periods.

The price data I collect comes from the provisioning system of the French military, which was thinly spread in West Africa, and relied mainly on African soldiers. After a period in which Securing supplies for soldiers was largely the task of local commanders, who were required to either secure local food supplies themselves or provide a cash payment to African soldiers to allow them to purchase their own food. The value of the ration varied by town to reflect local price levels, and each year in the federal government gazette, the *Journal officiel de l'Afrique occidentale française,* the central administration published a table of cost prices for the rations that incorporates commodity-level estimates of local prices for foodstuffs, including millet, rice and meat, as well as for firewood. I give a summary visual representation of the data in Figure 3.

Certainly these prices are not retail prices, but rather *prix de revient*, or cost prices. Yet in theory they ought to track actual price developments in African markets reasonably closely As one textbook on colonial military administration put it[58]

African [soldiers] live, in general, on the land. Local resources will determine the composition of their ration and therefore the way in which they are fed will conform to local customs, habits and religion. They will buy their foodstuffs themselves with the daily allowance which will be determined and calculated *according to the market value of the foodstuffs* that make up the ration.

[58]Agostini, *Cours d'administration militaire dans les troupes coloniales* (Paris: Imprimerie sparnacienne, 1930): 324

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Moreover, retail price observations from colonial Africa are not infallible: seasonality and volatility mean that unless price statistics were recorded relatively frequently, annual averages were probably only approximations of the price level[59]. In Appendix 1, I take two (admittedly short) price series from the 1920s for Dakar and Bamako, taken from a cost of living inquiry French colonial officials conducted and found in the national archives of Senega, and I compare them to the ration cost price series for those two towns. In general, the ration cost prices seem to be concordant with price observations found in other sources. I therefore use the ration cost prices as is, though I acknowledge that they are far from perfect as a price series.

In this paper, I am mainly interested in the integration of grain markets, because staple grains like millet, rice and maize made up a very large share of the daily diet of Africans living north of the forest belt (below which roots, tubers and plantains became increasingly important), and hence a large share of their household budgets, whether produced on farm on purchased on the market.
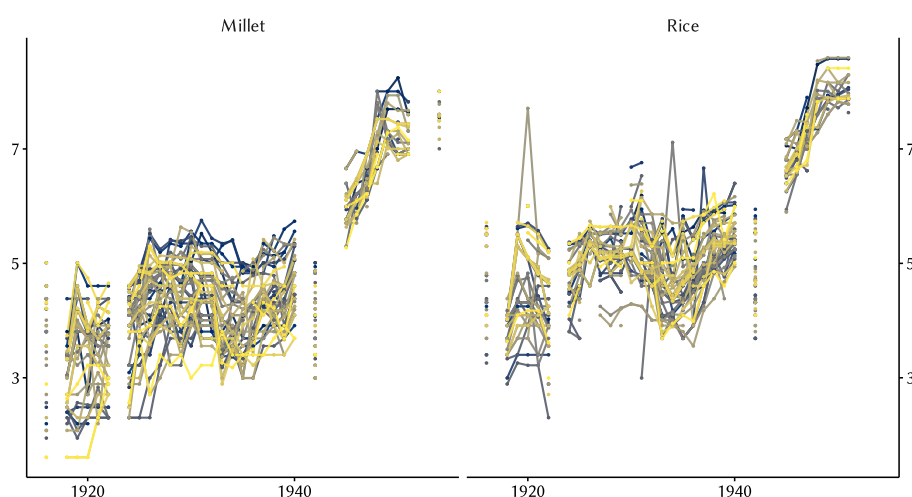

FIGURE 3. Representation of millet and rice prices (nominal, logged, per 100kg) in Afrique occidentale française, 1912-1952.

By offering new price series for around 70 locations across West Africa, this paper dramatically expands the number of locations with colonial-era price series: previously, the sample which had been limited to the colonial capitals of British Africa, for which prices are from the *Blue Books*,and Dakar, for which prices were assembled from a wide variety of archival and published sources.[60] The specific locations are plotted in Figure 4, along with the main precolonial states covered in the geographic areas covered by the price dataset, particularly the jihadist states and Wassulu. There is reasonably good coverage for the Tukolor/Umarian empire, and three locations

[59]Tom Westland, "How Accurate Are the Prices in the British Colonial Blue Books?," *Economic History of Developing Regions* 37, no. 1 (2022): 75–99.

[60]Frankema and Van Waijenburg, "Structural Impediments"; Tom Westland, "The Fruits of the Boom: Real Wages and Housing Costs in Dakar, Senegal (1914-1960)," 2021.

each within Wassulu and Sokoto, though in the case of the latter all of the points are in the northwestern fringes of the Caliphate.
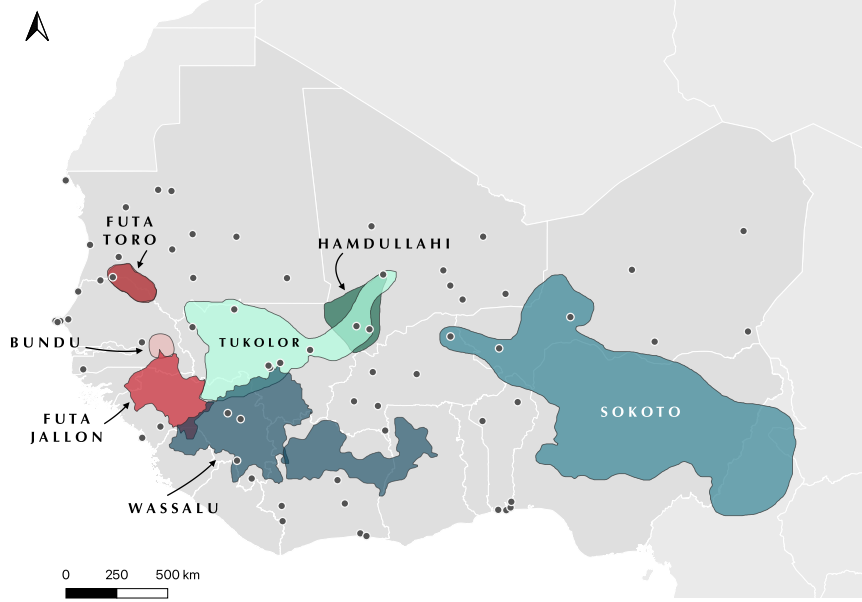

FIGURE 4. Precolonial states and location of price series in this paper's dataset. Author's elaboration based on maps in Ajayi and Crowder, 'Atlas'

PRICE CONVERGENCE.   A market, following Cournot, is a region in which prices tend to converge. The simplest test of market integration over time is therefore to test whether prices are converging: that is to say, whether the Law of One Price holds in the long run. Federico has argued that there are essentially *two* conditions that must hold if a process of market integration can be said to have occurred: first, prices must converge to a common equilibrium value, and secondly, prices must return to equilibrium after a shock.[61] A number of tests, many highly demanding in terms of data requirements, exist to econometrically test the second condition. The length of my dataset precludes using the most data-intensive tests: instead, I adopt the simple approach of calculating correlation coefficients for town pairs and examining their spatial distribution.

The simplest test of market integration is to look at the evolution of a measure of dispersion: in the case of prices, the most natural is the coefficient of variation (the annual standard deviation of prices divided by the annual mean). The concept of σ-convergence follows naturally from the coefficient of variation: regressing the coefficient of variation on a time trend

$$\log\left(\frac{\sigma}{y}\right) = \beta_0 + \beta_1 \log(t) + \epsilon \tag{1}$$

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[61]Giovanni Federico, "Market Integration," *Handbook of Cliometrics* (Springer, 2024).

and taking the estimated coefficient $\widehat{\beta_1}$ yields the estimated rate of σ-convergence. I estimate Equation 1 for both the full sample of towns as well as for the subsample of towns that were connected to one of two low-cost means of transport in the colonial period (one of the railways or one of the two navigable rivers, the Niger and the Senegal).

In Table 1, I give the estimates for $\widehat{\beta_1}$ separately for each product. The results tend to confirm what visual inspection of the data suggested: markets for staple foodstuffs became more integrated over the colonial period in French West Africa. There are statistically significant convergence trends for millet and (for a subset of towns) for rice. Conversely, I find no statistically significant trend of convergence for salt. The point estimates of the trend rates are higher for towns that were connected by the two particularly low-cost methods of transport, railroads and navigable rivers, but there was still significant price convergence, at least for millet, for towns that were not directly connected to these methods of transport. For rice, the trend is statistically significant only for towns connected to low-cost means of transport; the sign is negative for other towns, but the estimate is not precise.[62]

Sample	Millet	Rice	Salt
Full sample:	–0.166***	–0.188	0.004
River and rail connected only:	–0.241***	–0.230*	0.004
Not connected to river or rail:	–0.209***	–0.059	–0.059

TABLE 1. Speed of price convergence by product in the Western Sudan, 1914-1952

Within West Africa, salt was also produced domestically in places with very poor access to modern transportation: though the Kaolack saltworks were certainly connected to the railway-Niger river network, the Saharan mines that were the traditional sources of the long-distance salt trade were only connected by (poor quality) roads rather late in the colonial period, and so it is perhaps unsurprising that we would observe a price bifurcation in the salt market between towns that could obtain their salt from the coast or Kaolack by modern mechanised transport and those that still relied on the animal-borne trade from the Sahara.

How plausible is it that trade in grain was driving price dispersion lower? The lack of comprehensive data on internal trade makes it difficult to be precise. What scraps exist suggest that there was trade, but that it was relatively small compared

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[62]There are a number of factors that can help explain this result. The first is that 'salt' is not a homogenous good: Lovejoy (*Salt of the Desert Sun.*) and, as suggested above, the fact that there were multiple but geographically concentrated different sources of salt imports, the one penetrating the Western Sudan from the coast and the other from the Sahara, may have had uneven effects on the overall level of salt prices. The national accounts of Mali for 1959 estimate that 20% of total salt consumption in that country was domestic Saharan production, largely for use by pastoralists, while the rest was imported from the Kaolack saltworks in Senegal: République du Mali, *Comptes économiques de la République du Mali, 1959*, p.57. Moreover, we may be looking at the wrong time period: since we are looking at the period after the construction of most of the railways in French West Africa, we may miss the moment when salt price dispersion declined the most, even if price dispersion for salt was still quite high at the beginning of the period under study.

to overall production. The national accounts for Mali for 1959 suggest that 10% of millet production was marketed: 60,000 tonnes of a total of 800,000 tonnes of millet were sold within the country, and around 20,000 were exported to neighbouring countries. The rice harvest was somewhat more market-oriented, with 52,000 tonnes of paddy rice sent to market out of a total of 182,000 tonnes.[63] For Niger, which also published detailed national accounts for 1959, only 7% of the millet crop was marketed.[64] Yet even though proportionally this represented a relatively small amount, since millet was by far the most important crop grown in both countries, a relatively large quantity of the grain made its way through a marketplace before it reached a mortar for pounding.

THE IMPACT OF TRANSPORT COSTS.   If we had very long price series, spanning the opening of multiple railways or major roads, a difference-in-difference design could help to quantify the impact of transportation infrastructure on market integration. As it is, the main rail network was largely opened to revenue service prior to the first observations in my dataset. Moreover, price dispersion across a large geographical region is not simply a function of *one* piece of infrastructure: it is a result of a (usually) multimodal network of transportation options, making it difficult to cleanly identify an effect from a singular treatment.

However, some events give a relatively good test of the impact of transport infrastructure on market integrations: chiefly, the opening of the extension of the Abidjan–Niger railway from Bouaké, in central Côte d'Ivoire, to Bobo-Dioulasso from 1929 to 1934. In Figure 5, the evolution of the price of salt in three towns shows the extent to which transport costs determined prices. Prices in Abidjan and Bouaké —separated by around 300km of railway track—were roughly equal, whereas salt prices in Bobo-Dioulasso were well over double the levels in the two other towns prior to the opening of the railway. As the railway extension was opened, prices began to converge rapidly, such that the price of salt in Bobo-Dioulasso was even lower than in Abidjan by the time of the Second World War. The graph also gives the salt price series for Dori, separated from Bobo-Dioulasso by about 600km. Though there was a sharp drop in price at the beginning of the Great Depression, it did not follow the same trajectory as Bobo-Dioulasso, suggesting that the effect of the railway, and not just a Depression-era collapse in demand, explains the convergence in salt prices between Bouaké and Bobo-Dioulasso.

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[63] République du Mali, *Comptes économiques de la République du Mali, 1959*, p.57 p.32

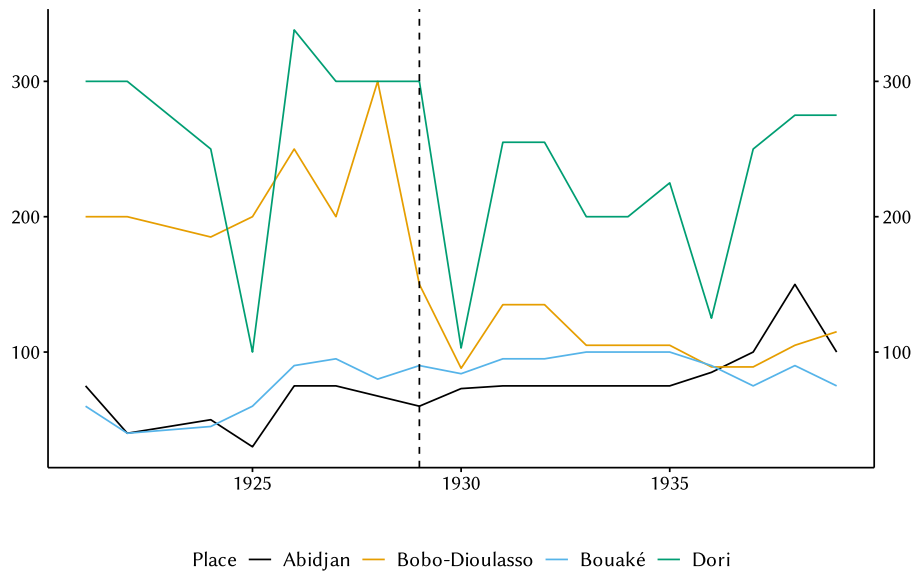[64] République du Niger, *Comptes économiques de le République du Niger, 1959*, p.8

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FIGURE 5. Price of salt per 100 kg in three towns in Côte d'Ivoire and Haute Volta, 1920-1940. A vertical dashed line marks the opening of revenue service to Bobo-Dioulasso

However, this is a relatively exceptional case. Mostly, changes in transport costs were gradual. How gradual and how important were these changes? Without new data, it would be difficult to make a thorough assessment of changing transport costs. While other scholars have used scattered data on transport costs[65] in colonial Africa there is no existing comprehensive dataset that documents changes over time and by mode of transportation for French West Africa. The closest dataset to my purposes is Whatley's constructed map of travel times by foot, but since I need the *price* of transportation, it is insufficient for my purposes[66]. While other studies of market integration have assumed constant relative prices between different transport modes,[67] I consider that this would be an overly strong assumption in the particularly context of French Africa. I therefore construct a new set of data for this purpose. It covers the major modes of transportation, both freight and for passengers in French colonies, and contains around 1000 observations. The dataset covers a wide variety of modes of transportation, including human porterage, pack animals like oxen and camels, river transportation, rail and road.

I estimate a central price (on the basis of the price of a kilometric tonne of transport) for each existing mode of transport within each colony for each year. The

[65]Federico Tadei, "Measuring Extractive Institutions: Colonial Trade and Price Gaps in French Africa," *European Review of Economic History* 24, no. 1 (February 1, 2020): 1–23; Remi Jedwab and Alexander Moradi, "The Permanent Effects of Transportation Revolutions in Poor Countries: Evidence from Africa," *The Review of Economics and Statistics* 98, no. 2 (May 1, 2016): 268–84.

[66]Warren Whatley, "How the International Slave Trades Underdeveloped Africa," *The Journal of Economic History* 82, no. 2 (June 2022): 403–41.

[67]David Chilosi and Stefan Nikolić, "Vanishing Borders: Ethnicity and Trade Costs at the Origin of the Yugoslav Market," 2021.

procedure I adopt to fill gaps in the series is detailed in Appendix 1. Having constructed a set of year-colony-mode-specific prices, I build a network representation of the transport infrastructure of French West Africa, drawing on a set of colonial-era maps. I calculate the least-cost path between each town in the price dataset using Dijkstra's algorithm. My estimates of transport costs therefore reflect changes in infrastructure connecting towns as well as colony-specific and mode-specific changes in costs over time.

In order to calculate the contribution of transport cost declines to market intergration during the colonial period, I regress the (logarithm) of the freight cost on the absolute value of the logarithm of the price ratio between two locations *i* and *j*, along with fixed effects for town-pairs and year. The estimated coefficient is essentially an elasticity: the responsiveness of price dispersion in salt, rice and millet markets to declines in transport costs.

More precisely, I estimate the following fixed effects regression for each product separately:

$$\left| \log \frac{P_{i,t}}{P_{j,t}} \right| = \beta_0 + \beta_1 \tau_{i,j} + \Gamma \Phi_{i,j,t} + \epsilon_{i,j,t} \tag{2}$$

where the $\Phi_{(i,j,t)}$ is a vector of town-pair fixed effects. $\tau_{i,j,t}$ is measured as the cost of transportation between the two towns for that product deflated by the price of the product (ie. it is equivalent to the share of the product's price that is swallowed up by transport costs). For this calculation, I take the lower of the two prices, on the logic that this was the 'source' destination and the higher price-location was the destination, if they happened to trade. The method follows closely that of Nikolić's recent investigation of spatial inequality in 19th century Serbia.[68]

The results of estimating Equation 2 are presented in Table 2. In the first panel, I simply estimate the equation over all observations in the price dataset. In the second panel, I limit the sample to only town pairs where trade was profitable, i.e., where the absolute gap in prices exceeded the cost of transport $P_i - P_j > \tau_{i,j}$. Failing to restrict the sample in this way could bias the coefficients on $\tau_{i,j}$, since even halving of the cost of transportation between (for example) Bilma in eastern Niger and Conakry in western Guinea would not usually lead to millet trade between the two locations, (transport costs would still dwarf any price distance). For town pairs like this, therefore, we might not expect to see the same impact of transport costs on price dispersion.

I find evidence of a considerable contribution of falling transport costs to the overall convergence in grain prices I document above. The effect of falling transport costs is substantively larger than it was in 19th century Serbia. Here the obvious explanation is because markets in the Western and Central Sudan were much less

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[68]Stefan Nikolić, "Spatial Inequality in Prices and Wages within a Late-Developing Economy: Serbia, 1863–1910," *The Economic History Review*, 2024.

integrated than those of 19th century Serbia, and even relatively small declines in transport costs could lead to large declines in price dispersion. For millet, I find that the trading-only restriction leads to the expected (modest) increase in the coefficient on transport costs: towns that were close enough to trade experienced market integration as a result of falling transport costs. For rice and salt, somewhat curiously, I find the opposite result, though this may be simply a function of the fact that unlike for millet, rice and salt were both imported from outside West Africa as well as produced within it, and the decline in price gaps may have more to do with proximity to sources of imports than to bilateral distances between towns.

	Millet	Rice	Salt
All town pairs			
$\log(\tau)$	0.415***	0.295***	0.472***
	(0.019)	(0.016)	(0.015)
Num.Obs.	13113	13469	19737
R2	0.601	0.421	0.620
Trading pairs only			
$\log(\tau)$	0.435***	0.238***	0.429***
	(0.030)	(0.026)	(0.029)
Num.Obs.	3307	3249	4683
R2	0.733	0.590	0.679

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

TABLE 2. Impact of trading costs (freight factor) on price dispersion (log absolute price gap). In the first panel, all town pairs are included; in the second panel, only town pairs for which the price gaps exceed transport costs are included.

THE IMPACT OF PRECOLONIAL STATES.   Strong states can provide the shelter for strong markets by establishing a monopoly of violence and extraction, thus ensuring the physical security of traders and other market participants; they can also levy taxes in cash that require the existence of markets to obtain specie, they can establish armies that require food, which might be obtained through markets as well as by requsition and — as the Sokoto Caliphate did — they encourage broad-based economic diversification and urbanisation that requires a functioning market sector to supply food to those that no longer produce any.

Largely following the empirical strategy of James Fenske and Namrata Kala,[69] I calculate correlation coefficients $\rho_{i,j}$ for each town pair and then regress them on dummies for location within empires, as well as town fixed effects and a battery of control variables:

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[69] James Fenske and Namrata Kala, "Linguistic Distance and Market Integration in India," *The Journal of Economic History* 81, no. 1 (2021): 1–39.

$$\rho_{i,j}^x = \beta_0 + \beta_1 \text{Transport costs}_{i,j} + \Gamma \text{Empire dummies}_{i,j} +$$
$$\Phi \text{Town}_i + \Psi \text{Town}_j + \Theta \text{Controls}_{i,j} + \epsilon_{i,j} \tag{3}$$

The value of the empire dummies will indicate whether or not price correlations were higher within empires than outside them, once controlling for a battery of other variables that might be driving price integration in millet, rice and salt markets.[70]

In the first set of regressions, I include neither town fixed effects nor any other controls. In the second set of regressions, I add town fixed effects, leading unsurprisingly to a large increase in the proportion of variation explained. In the third set of regressions, I add controls (Set I) for the absolute difference in FAO-GAEZ suitability of banana, cassava, cocoa, coffee, cotton, dryland rice, groundnuts, maize, millet, sorghum, sweet potato, yam, palm oil and rubber between locations i and j. In the fourth set of regressions, I add controls (Set II) for *absolute differences* in malaria prevalence, elevation, latitude, longitude, annual rainfall, annual mean temperature, and seven soil quality measures (nutrient availability, nutrient retention capacity, rooting conditions, oxygen availability to roots, excess salts, toxicity, and workability). Controls are added also for *pairwise correlations* in monthly rainfall and temperature between the two towns i and j. Finally, in the fifth set of regressions, I add controls (Set III) for characteristics of the correlations: year of first joint observation and last joint observation, as well as number of years of observations over which correlation is computed. Standard errors are clustered by town i and town j. I estimate the model for all three products separately and report the results in Table 3 for millet, Table 4 for rice and Table 5 for salt.

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[70]One possible source of bias is that in the *Journaux*, prices are often reported for multiple towns at once (i.e., there may be a single price report for Bamako and Koulikoro in a given year.) Unless prices were in fact identical between these locations in all years of shared reporting, this will naturally bias the correlation coefficients upwards, which would be problematic for an analysis of the impact of belonging to precolonial states, since the doubled-up observations tend to be for locations that are relatively close together, and hence more likely to belong to the same precolonial state than a randomly-selected town-pair. I account for this in two ways: firstly, I use only price series which have a minimum number of observations (15 years), which eliminates many of the doubled-up observations. In addition, I calculate correlation coefficients only for years in which prices were *not* reported together: i.e., for the case of Bamako and Kati, which are only around 20km from one another, I exclude all years prior to 1926 from the calculation of the correlation coefficient, since in these years prices were not reported separately for both towns.

	(1)	(2)	(3)	(4)	(5)
(Intercept)	1.091***	1.300***	1.347***	1.618***	3.609
	(0.101)	(0.196)	(0.198)	(0.299)	(27.123)
log(τ)	-0.079***	-0.086***	-0.096***	-0.059*	-0.049*
	(0.013)	(0.016)	(0.017)	(0.026)	(0.025)
Umarian	0.023	0.154**	0.150**	0.175***	0.178***
	(0.034)	(0.052)	(0.052)	(0.052)	(0.052)
Sokoto	0.052	0.148	0.169	0.125	0.121
	(0.223)	(0.140)	(0.141)	(0.136)	(0.136)
Wassoulou	-0.013	0.401*	0.390*	0.379*	0.390*
	(0.341)	(0.170)	(0.170)	(0.162)	(0.163)
Set I	Yes	Yes	Yes	Yes	Yes
Set II	No	Yes	Yes	Yes	Yes
Set III	No	No	Yes	Yes	Yes
Set IV	No	No	No	Yes	Yes
Set V	No	No	No	No	Yes
Num.Obs.	655	655	655	655	655
R2	0.051	0.553	0.566	0.627	0.628

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

TABLE 3. Market integration for millet and precolonial jihād states: regression of correlation coefficient of millet prices in town pairs on bilateral transport costs (logged) and dummies for joint membership in precolonial states.

Millet price correlations were higher for town pairs located within the three major states, controlling for relevant variables, but only significantly so for the Umarian and Wassoulou town pairs. In the preferred specification (regression V), millet price correlation coefficients between towns locating in the Umarian sphere were 0.178 points higher than other town pairs, even when controlling for bilateral transport costs and a battery of other variables. This points towards an economic legacy of grain market integration within the Tukulor empire. I also find evidence of higher price integration within the Wassulu empire, though with higher variability.

	(1)	(2)	(3)	(4)	(5)
(Intercept)	0.763***	1.571***	1.516***	0.813**	-103.213
	(0.129)	(0.142)	(0.232)	(0.274)	(75.988)
log(τ)	-0.031*	-0.103***	-0.099***	-0.003	-0.019
	(0.016)	(0.013)	(0.016)	(0.021)	(0.019)
Umarian	0.215***	0.014	0.013	0.085+	0.079+
	(0.034)	(0.044)	(0.044)	(0.044)	(0.044)
Sokoto	-0.075	0.730***	0.723***	0.627***	0.644***
	(0.149)	(0.120)	(0.121)	(0.119)	(0.118)
Wassoulou	0.263***	0.038	0.041	0.009	-0.003
	(0.015)	(0.120)	(0.121)	(0.118)	(0.117)
Set I	Yes	Yes	Yes	Yes	Yes
Set II	No	Yes	Yes	Yes	Yes
Set III	No	No	Yes	Yes	Yes
Set IV	No	No	No	Yes	Yes
Set V	No	No	No	No	Yes
Num.Obs.	842	842	842	842	842
R2	0.038	0.666	0.673	0.702	0.706

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

TABLE 4. Market integration for rice and precolonial jihād states: regression of correlation coefficient of rice prices in town pairs on bilateral transport costs (logged) and dummies for joint membership in precolonial states.

For rice, I only find robust evidence for a state-building effect on markets for the relatively few towns within the Sokoto Caliphate (though there is also an effect for the Umarian empire once I add all of the control variables into model 5.) The effect is reasonably large— a correlation coefficient somewhere between 0.311 points and 0.73 points higher. However, the fact that this is based on only three towns within that were ever part of the territory of the Sokoto Caliphate (Dori, Naimey and Tahoua) should lead us to be a little circumspect about this. Nonetheless, the

When it comes to salt markets, I find no evidence of any long-run legacy of integration from the 19th century statebuilding projects of the Fulɓe jihāds or of Samory Touré. On average, a lower cost of transport between a pair of towns led to higher correlation of prices, but the only significant result is in the first regression, for the Umarian state, and its significance does not survive the addition of controls.[71] If there was a long-run impact of 19th century statebuilding on salt market integration, it is not possible to detect it in the colonial-era price data. Again, the particularity of salt when compared to grain is a question of the value-to-weight ratio. Salt was

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[71]One could make the argument that many of the controls — such as those measuring soil quality and crop suitability — are not relevant to salt production, but it is not a strong case.

so valuable that it was traded quite profitably across space prior to the colonial transport revolutions despite high transportation costs.

Grain prices in the Western and Central Sudan were determined not only by the considerable shifts in transport costs that colonial-era investments in railways and roads, but also by the growth of market behaviour during the major African statebuilding projects of the nineteenth century. One limitation of this paper is that it cannot cover one of the most important states in the region prior to colonial rule — Asante — and it covers only the northwestern periphery of the Sokoto Caliphate. Further research in the British archives may allow us to extend this analysis to more fully cover markets that fell within the boundaries of these polities. Nonetheless, the results here do suggest that the other major states did play a role in knitting together savanna grain markets in West Africa—a process that would be deepened with that arrival of trains and lorries, but which was by no means complete by the time Europeans relinquished political control over their colonies.

	(1)	(2)	(3)	(4)	(5)
(Intercept)	0.616***	1.098***	1.086**	1.127**	-8.094
	(0.149)	(0.212)	(0.348)	(0.416)	(125.265)
$\log(\tau)$	-0.051**	-0.081***	-0.100***	-0.094**	-0.099***
	(0.018)	(0.019)	(0.024)	(0.032)	(0.029)
Umarian	0.132*	0.079	0.066	0.075	0.096
	(0.064)	(0.065)	(0.065)	(0.068)	(0.067)
Sokoto	0.111	0.051	0.092	0.088	0.103
	(0.282)	(0.180)	(0.181)	(0.185)	(0.181)
Wassoulou	-0.023	-0.102	-0.094	-0.072	-0.094
	(0.131)	(0.180)	(0.181)	(0.183)	(0.181)
Set I	Yes	Yes	Yes	Yes	Yes
Set II	No	Yes	Yes	Yes	Yes
Set III	No	No	Yes	Yes	Yes
Set IV	No	No	No	Yes	Yes
Set V	No	No	No	No	Yes
Num.Obs.	904	904	904	904	904
R2	0.028	0.388	0.403	0.413	0.433

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 5. Market integration for salt and precolonial jihād states: regression of correlation coefficient of rice prices in town pairs on bilateral transport costs (logged) and dummies for joint membership in precolonial states.

CONCLUSION.   Grain markets in the Western Sudan became more integrated over the course of the colonial period, but one ought not exaggerate the extent. By the end of colonial rule, price dispersion for staple grains was still high. We do

not (yet) have a comprehensive dataset of prices to understand the development of grain markets in the Western and Central Sudan during the crucial decades following political independence from France in 1960. [^20]

Yet in the very long-run, there has been substantial convergence of prices in the region. In Figure 1, I trace compare the degree of grain market integration in the Western and Central Sudan in the middle of the colonial period with contemporary grain markets by plotting the coefficient of variation for millet prices in a consistent set of towns across two periods, one from 1915-1940 using the grain price data introduced in this paper, and the other from 2010 and 2025, taking wholesale millet price data from the FAO'S Food Price Monitoring and Analysis tool. This analysis shows that price dispersion has declined remarkably for millet, even when compared to the later colonial period. Millet markets in contemporary West Africa have been found to be relatively efficient *within* countries, though evidence on the efficiency cross-border markets is mixed.[72] Though the coefficient of variation is still somewhat larger than one might find for a comparable set of locations in Southeast Asia, it is clear that markets, even for staple grains like millet that are not really widely traded internationally, have become more integrated since colonial rule.

This paper has set out the first quantitative evidence on market integration for basic foodstuffs in colonial West Africa. Using newly assembled data on grain and salt prices across nearly seventy locations in French West Africa, and a new dataset of transport costs by mode and year, I have shown that markets for millet and rice became more integrated over the first half of the twentieth century. Transport costs fell considerably, and these declines account for a substantial share of the fall in price dispersion. The shadow of the nineteenth-century state-building projects is also visible in the data. A pair of towns located within the former territories of the Sokoto Caliphate, the Umarian states, or the Wassulu empire will tend to be more integrated with one another than town pairs that lay outside their boundaries or were separated by them. In this sense, the paper suggests that a sharp divide between 'precolonial' and 'colonial' may, in the case of grain markets, be less useful than a historical narrative that begins with the Fulɓe jihads, was profoundly shaped by colonial investments in mechanised transport, and was completed by postcolonial economic development.

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[72]Vincent Caupin and Bertrand Laporte, "L'intégration régionale des marchés céréaliers: une approche économétrique," *Autrepart*, 1998, 145–62.

The accuracy of the price series I use in this article can fairly be questioned: the prices are taken from an official set of sources documenting cost prices (*prix de revient*) and are not retail prices—which were not published in the form required. These prices may, and almost certainly did, diverge from market prices to some extent.

One initial concern may be that the cost prices are calculated on the basis of transport costs themselves, and therefore in including a transport cost variable in the regressions in this paper we are regressing a price on a constituent part of itself. Some kinds of prices in French Africa were indeed calculated on a theoretical basis that took into account the cost of transport from a port: for example, the official price used for trade statistics for some export goods were calculated in this way.[73] The three items selected for study in this paper — millet, rice and salt — were on the other hand all classified as items 'achetés sur place', purchased on location. Therefore we can be reasonably confident that transport costs did not figure directly into the *prix de revient* for these prices.

I compare the ration cost prices for millet with annual average millet prices from Bamako and Dakar from a colonial report into the cost of living in French West Africa, in which several relatively short price series are given for the 1920s.[74] Though the archival source does give prices for other goods, for other colonies it seems that prices were an undocumented average of prices taken at various places within the colony rather than a location-specific price series, making comparison with the ration cost series inadvisable. (For example, the letter attached to the Haute Volta series states that 'the instructions sent to the administrators of districts prescrtibed the establishing of averages taken from the prices that obtained not in urban centres but rather in the whole territory of districts.'[75] Unsurprisingly, the prices are somewhat lower than in the ration price series for, say, Ouagadougou.) The series for Bamako and Dakar are in relatively strong agreement with the ration cost prices. The agreement is not perfect, but given that there was no regular statistical collection of prices in French West Africa in this period, it is not clear that the archival prices are more accurate than the ration cost prices.

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[73]Tadei, "Measuring Extractive Institutions".

[74]As in the main text, I assume that the price reported in the *Journaux officiels* in, say, 1925 is in fact the price for 1924, since the purpose of the publication of the table was to define the amount to pay soldiers for goods in the year following the publication of the table, and therefore the figures published in, say, January 1925 cannot relate to the actual prevailing prices throughout 1925.

[75]'Lieutenant Gouverneur de la Haute Volta à Monsieur le Gouverneur Général de l'Afrique occidentale française, a/s des variation du coût de la vie pour les indigènes de 1920 à 1926′, ANS 6G 39.
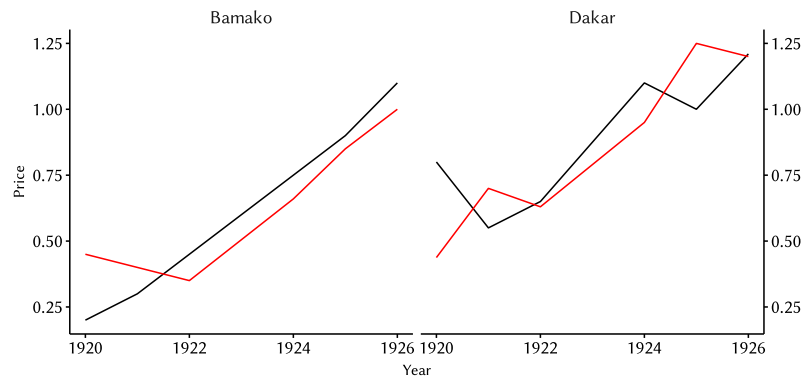
FIGURE 6. Price of millet in Dakar and Bamako, 1920-1926. Black line is the price given in the ration cost estimates in the Journal officiaux. Red line represents prices given in archival sources (see text for details)

In this appendix, I detail the construction of the West Africa Transport Cost Database and its application to the calculation of transport costs between bilateral town pairs in the main part of the paper. The database at the moment documents the cost of transportation across modes and years for the French colonies in West Africa: Senegal, Mauritania, Soudan français, Guinea, Côte d'Ivoire, Dahomey, Haute-Volta, Niger, and the protectorate of Togo. I consider the following modes of transportation: human porterage, animal porterage (including the use of oxen, camels and horses), water-based transport (canoes, boats and steamers), rail transport, and automotive transport.

The sources I have drawn on are extremely varied. They include official government gazettes, publications in the 'colonial periodical' genre, government budgets (particularly for government-run services like trains, ferries and fixed-route automobile services), archival reports on transport, and so on.

As an example of the kind of information that is available in the original primary sources, consider the article "Automobilisme - tourisme - chasse - à la Côte d'Ivoire", published in the colonial newspaper *Les annales coloniales* in June 1922:

> *Les méfaits du portage, pour être moins graves à la Côte d'Ivoire qu'au Gabon et au Moyen-Congo, sont nombreux. D'abord le portage ne peut s'exercer pratiquement dans une limite très étroite. Le transport à tête d'homme d'une tonne de produits sur 100 kilometres représente 250 journées de portage et une dépense minimum de 200 à 300 francs.*

This gives a direct estimate of the cost of transport by human portage in Côte d'Ivoire. Taking the average of 200 and 300 francs, it suggests that the kilometric-tonne price of human portage in Côte d'Ivoire was 2.5 francs, which was in the range of other estimates in the same time period. The basis of the database is to record prices on the basis of French francs per tonne-kilometre, which facilitates easy comparison. In the main body of the paper, I use the nominal price divided by the location-specific price of the good being transported, i.e., a freight factor. I also here plot the transport cost series.

In order to give an idea of the coverage of the price series, in the following table, I give the percentage of each colony-mode-year combinations for which I have a price data. The best coverage is for the colony of Soudan français, for which every second year, more or less, has an estimate of the cost of water-borne transport and automotive transport. In general, animal and human transport costs are less well documented, and my estimates are more dependent on the interpolations. Broadly speaking, however, the coverage across time is good enough to be relatively confident in the relative price of different modes within each colony, particularly given the magnitude of those differences.

Colony	Human	Rail	Road	Water	Animal
Cote d'ivoire	24%	36%	42%	4%	NA
Dahomey	6%	44%	60%	4%	NA
Guinea	24%	22%	38%	14%	4%
Haute-volta	20%	NA	24%	NA	8%
Mauritania	2%	NA	6%	NA	8%
Niger	2%	NA	40%	26%	16%
Senegal	4%	22%	22%	24%	4%
Soudan	26%	34%	44%	46%	10%
Togo	2%	4%	2%	NA	NA

The total dataset from 1910 to 1959 (which covers roughly the same period as the price data in the main paper) includes 792 observations. Though this is a much larger dataset than any gathered to date, I clearly do not have one observation per mode per colony per year, so interpolation is required. To do this, I adopt the following procedure:

- observations are interpolated using linear interpolation between observations.

- for missing observations prior to the first observation in each colony-mode series, and for missing observations after the last observation in each mode series, I estimate a loess regression based on all observations for that mode of transport, and call this a price index. I project backwards and and forwards from the first and last observations in each colony-mode series by the respective mode price index.

I assume that prior to the construction of a road for cars, the same route was used by animal or human transport (and afterwards, if human/animal transport was cheaper than by animals). The effect of the construction of motorable roads is therefore modelled essentially as a switch from animal/human freight to motor vehicle freight along the same routes.

Once these colony-mode-specific prices are calculated, I apply them to a network representation of the transportation network of French West Africa. An example of this network, for 1925, is show below in Figure 7. Least cost paths are calculated for each pair or towns by selecting the lowest cost method of transport for each edge in the network (which contains considerably more nodes than the towns in the price dataset) and Dijkstra's algorithm is used to determine the least cost path between town i and town j.
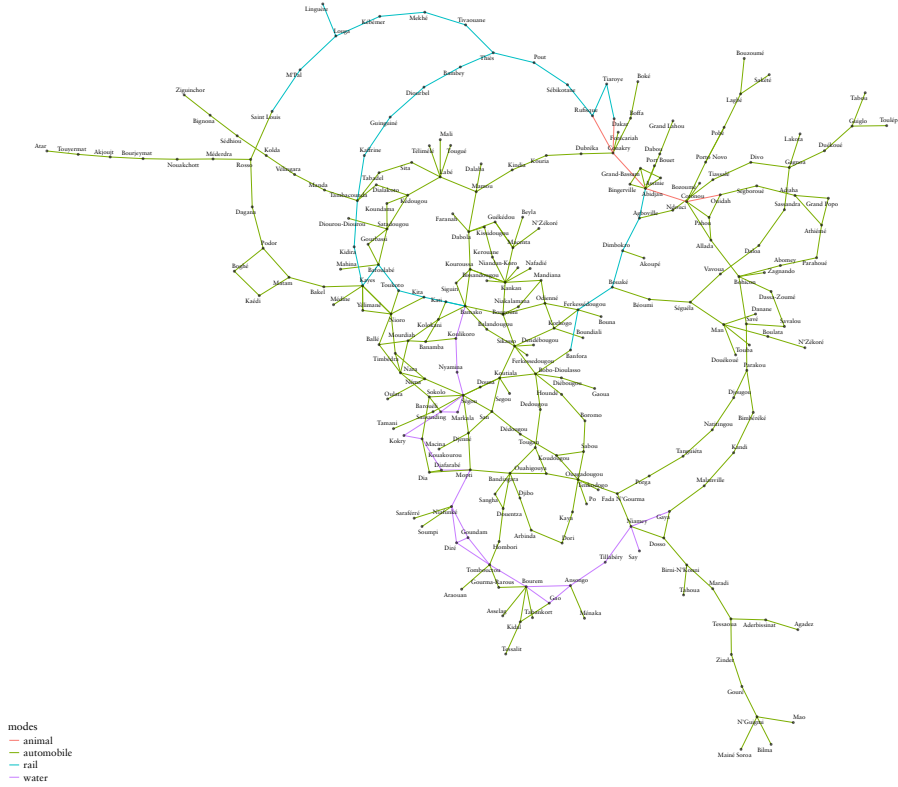
FIGURE 7. Network representation of transport possibilities between locations in French West Africa, with edges coloured by the cheapest mode of transport between nodes in 1925.

In Figure 8, I calculate take the index of all transport cost estimates for each possible town-pair combinations in my dataset, and deflate it with the price for millet in the cheaper of the two towns. I then calculate the index for each route, setting 1916 to 100, and present the median index value for each year. There is a clear overall negative trend in real transport costs over time, though with particularly clear declines in the late 1920s, a large upward spike in the 1930s as millet prices fell much faster than transport costs, and a continuing downward trend from the late 1930s to the 1950s. Across the period, we see that transport costs roughly halved in nominal terms.
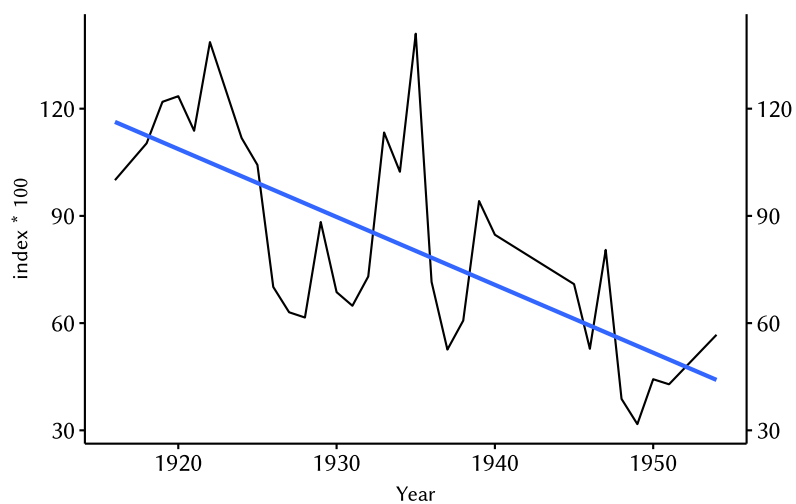
FIGURE 8. Index of transport costs in French West Africa, 1916-1952

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