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10

Reinventing the Wheel: The Economic Benefits of Wheeled Transportation in Early Colonial British West Africa

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10.1 INTRODUCTION

Today sub-Saharan Africa is the poorest part of the planet. Though scholars and researchers debate just when the gap between Africa and the rest of the world developed, it is clear that Africa lagged behind Eurasia in terms of many of the key building blocks of economic growth. One can see this in the factors that go to determine income, for example literacy and human capital, but it is perhaps most evident in technology. The basis of the modern economic growth that emerged in Britain in the late eighteenth century was technological innovation, and the Industrial Revolution had itself built on a long incremental series of innovations in agriculture, transportation, and elsewhere in the economy. Many of these innovations did not take place in Africa. For example, outside of Ethiopia, no African country innovated the plow. Similarly, systems of writing were largely restricted to the same region, though also encompassing the Sudan and Somalia. Also absent was the wheel.

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The fact that wheeled transportation was not used in sub-Saharan Africa until the early colonial period is paradoxical because it is well established that African societies knew about the wheel from the early modern period onward.[1] They did not have to reinvent the wheel, only adopt it. Law (1980) documents many cases where Europeans gave gifts of wheeled transportation to different African kings. Wheeled carriages were in use in Dahomey from at least the eighteenth century and were even produced there. Nevertheless, wheeled vehicles did not spread out of ceremonial uses with the exception of a small amount of military use.

Why did African societies not adopt a technology that seemed to promise huge economic benefits in terms of reduced costs of transportation?[2] That such cost savings existed was certainly believed by early colonial officials and Europeans of the nineteenth century who noted this failure to adopt the wheel. In the absence of wheeled transportation, the majority of goods were transported by head porterage. British colonial diplomat Sir Gerald Portal noted in 1903:

> As an animal of burden man is out and out the worst. He eats more, carries less, is more liable to sickness, gets over less ground, is more expensive, more troublesome, and in every way less satisfactory than the meanest four-footed creature that can be trained, induced, or forced to carry a load. (Quoted in Clifford 1920, 151)

The consensus view about the absence of wheeled transportation on the development of West Africa is well summed up by the 1926 report that Secretary of State for the Colonies William Ormsby-Gore made to Parliament. Commenting on transportation difficulties in various parts of Nigeria where he visited, Ormsby-Gore wrote:

> The Province of Ogoja contains an estimated population of between 600,000 and 700,000 people who are producing little or nothing for export, and a low standard of life obtains. Until Ogoja is opened up by a network of roads ... there can be little trade with its consequent stimulus to production, and the real development of the Province has not yet begun. (Ormsby-Gore 1926, 24–5)

[1] See Piggott (1983) for a history of the use of wheeled transportation and Bulliet (1975) for how the introduction of the camel into the trans-Saharan trade led to the abandonment of the use of wheeled transportation on that route.

[2] As Goody (1971) and Austen and Headrick (1983) point out, this does not exhaust the puzzles surrounding the non-adoption of the wheel in Africa because neither potters' wheels nor spinning wheels were adopted either.

Later he noted:

> In British West Africa there is still too much of the most obsolete and expensive form of transport. I refer to the wide use of head porterage. (Ormsby-Gore 1926, 29)

Indeed, as recently as 1980 one could read in a textbook treatment:

> At first, head porterage had to be used for carrying imports; and palm oil was sent to the coast by the curious and expensive method of barrel-rolling. Porterage was a social evil, a political danger and an economic waste. (Church 1980, 152)

The use of such an incredibly labor-intensive system of transportation seems all the more puzzling when one considers that Africa has historically been very labor scarce (Austin 2008; Herbst 2000). Portal's view was widely shared by early colonial officials, who not only took it for granted that the absence of wheeled transportation was disastrously inefficient, but also routinely produced numbers to prove it.

Most of these officials gave no explanation for why Africans chose not to adopt a technology that they regarded as massively superior to the alternatives in use. The first attempt to provide such an explanation appears to be McPhee (1926). Though Portal noted how unhealthy human porters were, McPhee in essence argued that, at least in the forest zone of Africa, draught animals could not be used because of the presence of the tsetse fly. This, he claimed, made wheeled transportation, which would normally have depended on draught animals, uneconomical. His argument is rather equivocal, however, because the relevant chapter of his book attempts to show in some detail that road and rail transportation were far superior to head porterage. He seemed to take it for granted that Africans could not have built motorable roads or railways. He also explicitly pointed out, on the basis of Lugard's 1919 report on the amalgamation of northern and southern Nigeria for northern Nigeria, that:

> Strangely enough, although there are over 3,000,000 cattle, 176,000 donkeys, 113,000 horses and 4,000 camels, yet such a thing as a cart may be said to be unknown. (McPhee 1926, 121)

Therefore, though the argument about the tsetse fly is obviously relevant, it can at best only be a very partial solution to the puzzle. McPhee's discussion was augmented by Hopkins (1973), who argued that the cost of building roads through the forest zones was so high that this also made wheeled transportation uneconomical. Ogunremi (1975) also claims that head porterage was economically efficient because labor was not really scarce, and he claims that the calculations made by Lugard and others are misleading

because they ignore the huge capital costs involved in constructing railways. In essence, McPhee to an extent, but certainly Hopkins and Ogunremi, respond to the puzzle of the non-adoption of wheeled transportation by asserting that it is not a puzzle and that in fact it was an economically rational decision given the circumstances.[3]

These existing explanations present obvious problems. First, none of them is based on any real calculation or what was or was not economically rational. Second, while it is clearly correct that the impact of the tsetse fly made it difficult to use draught animals in large parts of central Africa,[4] wheeled transportation was not used in areas where there was no tsetse either. This is true not just in southern Africa, but also in the Sahel or northern Nigeria. Third, as Portal's remark notes, humans were very unhealthy as well, so what is relevant is the health of animals compared to humans, not the absolute health of animals in the tsetse zone. Finally, Hopkins's claim that wheeled transportation was not adopted in the forest zone because roads were uneconomical to build runs into the problem that African polities in the forest zone did indeed build such roads. Most notably, Wilks (1989) discusses in detail the great roads of the Asante Empire in the Gold Coast in the first half of the nineteenth century,[5] and Reid (2002) does the same for the roads built by the Buganda state. Yet neither the Asante nor the Buganda states used wheeled transportation.

In this chapter, we conduct the first attempt, to our knowledge, at bringing systematic evidence to bear on the question of whether wheeled transportation was economically rational in sub-Saharan Africa. We focus on the three British West Africa colonies of the Gold Coast, Nigeria, and Sierra Leone, largely because the British colonial state recorded in great detail the costs of constructing and maintaining different transportation systems in these colonies. Though we examine the efficiency of various types of wheeled transportation, including carts and motor vehicles, the bulk of our analysis focuses on railways. Railways of course embody not just wheels, but also

[3] See Basu and Weil (1998) and Acemoglu and Zilibotti (2001) for formalizations of the idea of appropriate technology.

[4] Witness, for instance, the enormous and costly lengths to which the Oyo Empire had to go to keep its cavalry safe from the ravages of tsetse (see Law 1977).

[5] The early colonial officials who deplored the backward state of transportation in Africa seem not to have been aware of these roads. In his discussion, McPhee, for example, notes: "At the beginning of the last century no proper roads existed anywhere in West Africa.... The earliest roads, not much better than rough tracks which were liable to be obliterated within a year by forest growths, were military roads. Thus Sir Garnet ... Wolsley constructed a road into the heart of Ashanti during the War of 1873–1874. Throughout the whole century very little progress was made" (1926, 106–7).

other technologies, such as iron smelting and casting and steam engines. Our focus is motivated by the fact that we have from colonial records very comprehensive information on the amount of goods and passengers that the railways carried, which we do not have for any other method of transportation. We also know a great deal about the capital expenditures associated with railway building, the neglect of which has been used as a critique of earlier estimates that head porterage was inefficient. In addition, this focus allows us to make comparisons with the rich literature in economic history that has examined the economic impact of railways. Our methodology is the canonical one based on that of Fogel (1964).[6]

Our basic findings are very contrary to the conventional wisdom. First, all forms of wheeled transportation were economically rational in the sense that they generated positive social savings, that is, that their adoption would have increased national income. In the case of railways, the social savings for goods traffic as a percentage of GDP range from a low of 0.8 percent in the Gold Coast in 1909 to a high of 7.8 percent for the same colony in 1934–5. For passenger traffic, the numbers are smaller, basically zero. Second, and more important, the social rate of return on railway construction was incredibly high, a calculation that explicitly takes into account the capital expenditures. This rate of return was around 100 percent in Nigeria, implying that the social savings in any year were equivalent to the entire capital outlays until then. Elsewhere they were lower, but were close to 50 percent for both the Gold Coast and Sierra Leone for much of the period. Our estimates therefore contradict the idea that wheeled transportation was not adopted in sub-Saharan Africa because it was an inappropriate technology.[7] Indeed, quite contrary to the conventional wisdom that railways were not appropriate because they were too expensive to build in African conditions, we find that they were cheap to build – their cheapness, in fact, causes the astonishing social rates of return calculations we present. This is consistent with the recent findings of Jedwab and Moradi (2011), who find that colonial railway construction in the Gold Coast had a powerful effect on exports and development.[8]

[6] Tsey (1986), in his analysis of the expansion of railways in the colonial Gold Coast, observed that one could undertake such an exercise but he chose not to do so.

[7] At some level this is not very surprising. Technological differences today, as captured by total factor productivity, are at the heart of differences in income per capita between Africa and the rest of the world (Acemoglu, Johnson, and Robinson 2001; Hsieh and Klenow 2010; Hall and Jones 1999), but few believe that such differences are efficient.

[8] See also the innovative work by Donaldson (2010), who finds large positive effects of colonial railroads in India using a general equilibrium model.

If wheeled transportation was economically efficient and generated very high social rates of return, why did Africans not adopt it? For the case of railways, we can identify three types of explanations. The first is the obvious point that it was very difficult to construct such large public works as railways without sufficient political centralization. We illustrate this argument in Sierra Leone. The second comes from thwarted attempts by a mission from the Asante state in Ghana to contract British engineers in London to build a railway in 1895: European powers had an interest in restricting technology adoption by African polities. Asante's attempt to build a railway, part of a larger program of modernization embarked on after 1874, was blocked by British colonial secretary Joseph Chamberlain. The likely explanation is that Britain did not want autonomous modernization of African polities. African states considering adopting railways invariably needed to rely on foreign capital, engineers, and expertise. This was normal during the nineteenth century: railways in Latin America and the Middle East were built with foreign capital and expertise. But at the time of the Scramble for Africa, European powers wished to control this type of technology adoption by African polities because it made them harder to control, a kind of incentive that was absent in Latin America and the Middle East. The third explanation comes from the rich evidence on the one independent African polity that actually built a railway, Ethiopia. Namely, African polities that could have profitably adopted railway technology had a political incentive not to because doing so might hasten the loss of sovereignty to Europeans. Here the evidence clearly shows that the Ethiopians were very concerned that constructing a railway from Djibouti up to Addis Ababa would precipitate a process of colonial domination and conquest. Similar mechanisms were at work elsewhere, for example in the Sultanate of Zanzibar.

This chapter proceeds as follows. In the next section, we discuss some of the estimates of the costs of transportation that colonial officials and administrators made during the early twentieth century. This evidence, which certainly suggests that head porterage was inefficient, is typically very incomplete, because it is not clear exactly what is involved in the calculations or how representative any of the information is. In Section 10.3, we discuss the data that are available to undertake cost and benefit calculations in the British colonies of the Gold Coast, Nigeria, and Sierra Leone. Section 10.4 then uses this data to provide estimates of the social savings from the introduction of the railways in these three colonies, and it also provides more speculative estimates of the social savings associated with simpler forms of wheeled transportation. Section 10.5 then focuses on the social rate of return of the railways. Section 10.6 discusses in more detail, and presents evidence for, our explanation for why African states did not adopt economically superior transportation technology during the nineteenth century. Section 10.7 concludes.

10.2 CONTEMPORARY DISCUSSION AND EXISTING EVIDENCE

British colonial officials did not doubt that the lack of wheeled transportation was a major impediment to economic progress in West Africa. To demonstrate this, they produced a whole range of different numbers, which were then constantly repeated over the years. Some of these are summarized in Table 10.1.

Unfortunately, in all the cases we have found, it is never clear exactly how these estimates were constructed or what considerations went into them. Ormsby-Gore's numbers, for example, were introduced by noting that:

> At Zaria, in Northern Nigeria, I was provided with some carefully compiled figures regarding the cost of different forms of transportation per ton-mile. Head porterage in an area where labour is plentiful and cheap works out at 2/6 per ton-mile; motor transport at 1/- per ton-mile; donkey transport at 11d; camel transport at between 9d and 10d; while the railway takes baled cotton from Zaria to Lagos at under 2d per ton-mile. (1926, 29–30)[9]

These numbers were widely reproduced, for example in Hailey's famous survey (1938, 1540). Yet Ormsby-Gore provided no further information about who gave him these figures or what sources they used to calculate them. Clearly, taken at face value, these numbers suggest that head porterage was extremely inefficient. According to these numbers, while the cost of shipping freight by railway was two pence per ton-mile, the cost of head porterage was two shillings and six pence, or fifteen times more!

Sir Frederick Lugard similarly regarded head porterage as extremely inefficient:

> For uncounted centuries the African has been his own beast of burden, and a simple calculation shows that the cost of land transport by such means with a wage rate of 9d. per day is about 3 shillings per ton mile. (1922, 461)

This number is also very widely reproduced. In a footnote, Lugard noted that this calculation was based on assuming that a porter carried sixty-five pounds and could walk twelve miles a day and was then adjusted upward to

[9] The notation d. means pence, s. means shillings; there were twelve pence in a shilling and twenty shillings in a pound.

Table 10.1. *Contemporary estimates of the relative cost of different methods of transportation (cost in shillings and pence per ton-mile)*

	House of Commons (1909)	Ormsby-Gore (1926)	Ogunremi (1982)
Cask Rolling	1s.21/2 d. – 1s.11d.		
Hand Trucks	1s. 10d		
Head Porterage	3s.1d – 5s.	2s.6d.	1s.10d. – 2s.
Motor Lorry	1s.8d.	1s.	
Railway		2d.	
Donkey		11d.	9d. – 10d.

allow for sickness and supervision. He also observed that "for bulky loads the cost is much more." Elsewhere Lugard remarked that "a railway train of average capacity and engine power will do the work of 13,000 carriers at one twentieth of the cost" (1922, 462–3).

Other calculations suggest similar things about the relative efficiency of different forms of transportation. For example, the numbers taken from the House of Commons (1909) come from an extensive survey of methods of transportation in the entire British Empire undertaken by the secretary of state for the colonies. In this survey, carried out in 1907, the governors of the different colonies were requested to provide information to a standardized set of questions about the nature of transportation in their colonies. The information provided for the Gold Coast, presented by E. F. W. Wilkinson, acting director of public works, suggests that transportation by head porterage cost between three shillings and one pence to five shillings per ton-mile (House of Commons 1909, 43). These figures are as much as twice those for Zaria, perhaps indicating the relative labor scarcity of the Gold Coast during that period. They are, however, consistent with Lugard's numbers.

For our purposes at the moment, the most interesting comparison is between head porterage and the railways.[10] These oft-quoted numbers suggest that head porterage was about fifteen to twenty times as costly as the railway. Yet it is not clear how these numbers were constructed. Most crucially, it is not clear whether they factor in the large fixed cost of constructing

[10] Forms of transportation other than head porterage were very important in different precolonial contexts. For instance, Hill (1972) describes how tobacco produced in Katsina in northern Nigeria was shipped as far south as Ilorin using donkeys, and the great kola trade between Nigeria and Ghana was carried out mostly by donkey (Lovejoy 1980).

the railway or whether they are based just on the variable cost. Because it is precisely the large cost of constructing modern transportation systems in West African conditions that Hopkins (1973) argues made them economically irrational, we need to assess the efficiency of different systems of transportation properly taking these costs into account – something we will do by calculating the social rate of return.

10.3 THE DATA

10.3.1 Railways

The surveys for railway construction were carried out at different dates in British West Africa. For Sierra Leone, they were undertaken in 1893–4, and for Lagos, they were undertaken in early 1893 during the tour of Governor Sir Gilbert Carter. Construction on the Sierra Leone and Lagos railways started in 1896, while construction on the Gold Coast Railway started in 1898 (see Shelford 1920). The Sierra Leone railway ran southeast from Freetown and reached Pendembu in 1908. The first railway in the Gold Coast went inland from the port of Sekondi toward the Asante goldfields, and it reached Kumase in 1903. The second line, linking Kumase to Accra, was started in 1909 and completed in 1923. The first railway line in Nigeria started at Lagos and reached Jebba on the Niger river in 1909. The second railway linked Kano to the port of Baro on the Niger, and it was completed in 1911. All the lines were built and operated by the colonial governments.[11]

Our main source of data on the costs of constructing, maintaining, and running the railway, the amount of freight hauled, the number of passengers carried, and the revenues generated from freight and passengers is the various reports of the colonial governments to London, particularly the reports of the railways and transportation departments. We focus on three dates, 1909 (1911 for Sierra Leone because earlier reports did not present the appropriate data), 1924/25, and 1934/35. The financial year for all colonies started on January 1 for 1909/11, but it switched to April 1 for the Gold Coast and Nigeria during the 1920s and 1930s – whence the fact that for our latter two colonies and dates, the data on railways straddles two years. Our basic data on railways for the Gold Coast comes from the 1909 "Report of the General Manager upon the Government Railways," and the Gold Coast Railway Administrative Reports for 1924–5 and 1934–5. For Nigeria, we have the "Lagos Railway Annual Report 1909," the "Nigerian Railway

[11] For a contemporary discussion of the pros and cons of government versus private ownership and operation of the railways, see House of Commons (1924).

and Udi Coalmines Administrative Report for the Year ending 31st March 1925," and for 1934/35 the "Annual Report on the Government Railway and Colliery of Nigeria for the Financial Year ending 31st March 1935." Finally, for Sierra Leone, we have the "Report on the Transport Department for the Year 1911" and the Administrative Reports of the Railway for 1925 and 1935.

These sources of information give us extensive data to calculate the amount of freight and passengers the railways carried in these three years. The reports also provide information on current receipts and expenditures, as well as capital outlays to date on railway construction and maintenance.

A potentially important and obvious advantage of the railway is that it moved people much faster than they could have moved by walking. We can estimate the social savings associated with this change, because for most years the railway reports tell us the total number of passenger miles traveled. We can estimate how long it took to travel this number of miles if we know how fast the trains went, and also how fast it took to walk. Unfortunately, we have only discovered a railway timetable for Nigeria in 1921 (Burns 1921), but not for either the Gold Coast or Sierra Leone, and the reports of the Railway Department never mention how long it took trains to travel between stations (though they do assiduously report the percentage that were late). The data in Burns (1921) implies an average speed of fifteen miles per hour. As a reality check, a rough calculation of the speed of the trains can be backed out of the travel account of Alldridge (1910), who visited Sierra Leone in the early twentieth century. Alldridge traveled on the train from Freetown to Bo leaving at seven in the morning and arriving at five in the evening. Because the distance between the stations is 136 miles, we can say that the average speed in Sierra Leone was 13.6 miles per hour. This appears to be very slow, but it is partly justified by the fact that the Sierra Leone railway had a narrow gauge, which possibly meant that it had to go slower than one would have expected. We have no comparable account of travel from the Gold Coast or Nigerian railways. These used broader gauges, so the fifteen miles per hour in Nigeria seems completely reasonable. Thus we choose fifteen miles per hour as a conservative estimate. For an estimate of how fast someone could walk in this region, we use Wilks (1989, chapter 1), who has an extensive discussion of travel times between different parts of Asante during the nineteenth century. All his estimates are close to fifteen miles per day, which is the modal estimate of how far a head porter could walk, and we shall take this as the relevant travel speed for passengers on foot. This implies a speed of two miles per hour.

To value the time saved by travel on the railway, it is natural to take the wage rate as the opportunity cost of time. Exactly what the correct wage to use is depends on who the traveler was. For example, in 1924–5 in the Gold Coast, of the 1,487,164 passengers who traveled by train, 14,851 traveled first class, 21,988 traveled second class, and the rest traveled third class. We do not have the information necessary to decompose the total passenger miles into components of different groups, so we could assume instead that the passenger miles were allocated in proportion to the numbers of each class (i.e., on average each type of person traveled the same distance). This implies that of the 41,751,573 total passenger miles, 416,936 (1%) were first class passenger miles, 617,305 (1.5%) were second class passenger miles, and the rest (97.5%) were third class passenger miles. To value the time saved by the introduction of the railway, we need to impute some opportunity cost of time to these different groups. For third class passengers, we could choose the unskilled wage rate of 9d. per day or 1d. per hour, assuming a nine-hour workday. Skilled wages in the Blue Books range from 2s.6d. to 5s. To calculate the value of time for first and second class passengers, we value the hours saved at the rate of 5s. per day. Unfortunately, this (1924–5) is the only time for which our sources document the breakdown among the different classes of passengers. And yet, as is evident, first and second class travel was relatively so unimportant that year-to-year changes in the composition of passenger miles are unlikely to drive our results. Therefore, we proceed with the simple assumption that time can be valued at the unskilled wage rate. This is 9d. per day for all the colonies for the first two dates and then 12.d., 8.d., and 11.d. in the mid-1930s for the Gold Coast, Nigeria, and Sierra Leone, respectively.

10.3.2 Head Porters

To compare to the cost of using head porters, we need data on how much a head porter could carry and the rate of pay. Though information on this is much less systematic than the data from the railways, the consensus seems strong on what the right numbers are. Ormsby-Gore notes:

> [T]here is a considerable body of labour temporarily employed on road and railway construction. The supply of voluntary labour for the latter purposes has always proved inadequate in Nigeria, and recourse is had to compulsory or "enlisted" – sometimes called "political" – labour for these essential public works and services. All the railways and most of the roads in Nigeria have involved the use of this compulsory labour.... Such compulsory labour is recruited by the native authorities. It is only called upon to work for a definite period, usually, and never more than, one

month at a time. It is paid, usually at a rate of 9d. per day.... Unpaid compulsory labour legalized under the Roads and Rivers Ordinance of Northern Nigeria is only used for keeping clean roads and rivers within local boundaries when called upon to do so by the Resident. (1926, 133)

Nine pence a day is the figure that is widely quoted from all over British West Africa for the cost of a head porter from around 1910 until the middle of the 1920s, though head porterage was surely much less prevalent in 1925. Ormsby-Gore reported a higher number from his visit to Sierra Leone: 1s.3d. per day in the Colony (the capital Freetown and its environs) and 1s. per day in the Protectorate (the hinterland and interior of what is now Sierra Leone) (1926, 58).

Just as there is a consensus on wages in the primary sources, there is also a consensus that a head porter could carry about sixty pounds. Indeed, this seems to have been more or less the official load colonial officials used when they hired porters for government work (Ogunremi 1975, 47). The numbers on how far a fully loaded porter could walk in a day do vary, with perhaps fifteen miles being the consensus. For instance, in the Sierra Leone case, Ormsby-Gore reported that a porter usually carried forty-five to fifty pounds of weight and could walk twelve to fifteen miles per day (1926, 58). A command paper from the House of Commons on mechanized transportation suggested that in the Gold Coast:

The motor lorries carry about 1 ton to 2 1/2 tons; a cask of palm oil weighs 17 3/4 cwt.; a cask of cocoa weighs about 12 cwt.' a hand truck carries from 15 to 20 cwt with 6 to 8 men to a truck; head loads are about 60 lbs. (House of Commons 1909, 42)

Moreover, "casks, hand trucks and head loads get over 20 miles per day." The chief commissioner for the Northern Territories of the Gold Coasts reported that, although "native rates [are] impossible to gauge," the government paid "10d. a day for loads of 50 to 60 lbs., 1d. a day of which goes to the chief who provided the carriers." As for how far a porter could walk, the commissioner noted, "At present natives are content to do 10 to 15 miles a day." Northern Nigeria presents a similar situation, with sixty pounds mentioned as the normal head load and wages for hammock men listed at nine pence and those for a laborer at nine pence to one shilling per day (House of Commons 1909, 22–3). In Sierra Leone, "Head loads 60 to 100 lbs. Hand carts 1 ton to 30 cwts" (House of Commons 1909, 102). Though this report provided no information on the wage paid to head porters in Sierra Leone, it noted that a barrel roller, a similarly unskilled worker, was paid one shilling per day. This figure is identical to the wage Ormsby-Gore recorded for a head porter.

To judge if these wage rates are reasonable, we can compare them to other readily available information. For example, Oyemakinde notes that workers who were recruited by compulsion to build the railways in northern Nigeria between 1911 and 1915 were paid nine pence per day, while in Yorubaland, where workers freely took up such employment, they were usually paid one shilling per day (1974, 318). The House of Commons command paper detailing the costs of railway construction in the Gold Coast, Nigeria, and Sierra Leone does report the daily wage rate of unskilled workers used in railway construction (House of Commons 1904). These were ten pence a day in Sierra Leone, one shilling a day in Lagos, and one shilling three pence a day in the Gold Coast.

All in all, these scattered numbers are quite consistent with each other, and for the period around 1909 they suggest that Lugard's number of three shillings per ton-mile is a reasonable figure for the cost of head porterage, at least to the extent that he corrected it for the health of the porters, which would explain why the cost is higher than other simple calculations. Ormsby-Gore's 1926 figures suggest that this number is reasonable for 1924–5 as well. For our 1935 estimates, we do not have contemporary information on the rates of pay of head porters. However, the Blue Books for the colonies report unskilled workers' wages. Because the wage rates we have for head porters in earlier periods correspond closely to the wages for unskilled workers as stated in Blue Books, we can use the latter data to get a counterfactual wage for head porterage in 1935. In the Gold Coast, this wage ranged from nine pence to fifteen pence; in Nigeria, the range three pence to one shilling per day is given; and in Sierra Leone, unskilled workers' wages are reported as eleven pence. We therefore used the wage rates of twelve pence for the Gold Coast, eight pence for Nigeria, and eleven pence for Sierra Leone.

Rather than use Lugard's three-shilling estimate, we assume in our calculations for 1909/11 and 1924/25 that head porters could walk fifteen miles in a day, carry sixty pounds, and were paid nine pence in all the colonies. These numbers imply a cost of one shilling and ten pence per ton-mile for head porterage. For 1934/35, this cost increases in the Gold Coast by one third to two shillings and six pence per ton-mile, it falls to one shilling and eight pence per ton-mile in Nigeria, and it increases to two shillings and three pence per ton-mile in Sierra Leone.

An important issue that can limit the applicability of the social savings approach to colonial Africa is the nature of the labor market. Coerced labor (or "political" labor, as colonial officials called it) was used extensively to build roads and railways; at the same time, slaves were also commonly used as head porters, and some of these slaves were no doubt supplied by chiefs

to help railway and road construction as well. In the Gold Coast in particular there appears to have been a great labor shortage at the time the British were building the railway, and the supply of Africans that were forthcoming at the wages that the British were prepared to pay was insufficient to get the work done. Colonial officials therefore induced local chiefs to provide labor (see Akurang-Parry 2000; Mann 1995; and Thomas 1973 for studies of forced labor, and Mason 1978 and Swindell 1992 for specific studies in the context of railway construction all in the context of British West Africa). One could argue that because labor could be coerced either to build and run railways or to work as porters this should not influence the relative benefits of the two methods of transportation. Nevertheless, because head porterage is much more labor intensive than railway construction, a natural conjecture would be that the ability to repress labor would bias downward the social savings from railways. We return to this when we discuss the West African colonies in comparative perspective. We note, however, that coerced labor was not everywhere used for head porterage. For example, in East Africa, Rockel (2006) shows that there was a basically free labor market for head porterage, so this problem may be much more important there (see Coquery-Vidrovitch and Lovejoy, eds. 1985 for comparative studies).

10.3.3 GDP Estimates

To get some sense of how big the cost differences between different methods of transportation were, it is useful to have something to compare the costs to. The most obvious normalization is with respect to GDP, and this is the standard approach in the social savings literature. However, to our knowledge, with the exception of Szereszewski's (1965) pioneering construction of GDP estimates for the Gold Coast in 1891, 1901, and 1911, no estimates of GDP for the colonies of interest exist for this period. Szereszewski's approach was based on colonial Blue Books, which contain extensive information about imports and exports and the public sector. He used a number of assumptions to construct estimates of consumption and capital formation. Most speculatively, he also constructed estimates of the consumption and investment made by the "native economy," of which there are only population estimates during this period. Nevertheless, Szereszewski's approach uses the existing information in a very creative way and produces quite believable estimates. We therefore used it to construct from the Blue Books estimates of nominal GDP for the three colonies, for all of the relevant periods. These calculations may be of independent interest, and we discuss them in detail in the appendix to this chapter.

10.4 WERE THE RAILWAYS ECONOMICALLY EFFICIENT? A SOCIAL SAVINGS APPROACH

Though the calculations discussed previously are interesting, they fall very short of a systematic treatment of the issue. Moreover, one could easily imagine that colonial officers, anxious to legitimize their "civilizing mission" in Africa, may have been inclined to overemphasize the technological backwardness of Africa and therefore the advantages of "modern" methods of transportation.

The conventional method for tackling the issues broached in this chapter is that of social savings introduced by Fogel (1964) and Fishlow (1965). The social savings of a given method of transportation, such as the railways, is the difference between the actual cost of shipping the goods and people by that method of transportation and the cost of shipping them without that method of transportation. As Fogel (1979) points out, the social savings associated with a particular efficient method of transportation is the loss of national income associated with the substitution of an inefficient method of transportation for the efficient one. In our case, we focus on the social savings associated with using railways rather than head porterage to move goods and people.

This approach has been heavily criticized, requires strong assumptions about the nature of the economy, and fails to capture important impacts of transportation innovations (see Crafts 2004; Fogel 1979; Leunig 2010; O'Brien 1977; and Summerhill 2003 for extensive discussions of the pros and cons of this approach). For our purposes, one central problem with this method is that it requires the assumption that one is studying a perfectly competitive industry in long-run equilibrium, so that price (average revenue) is equal to long-run average cost. Obviously railways, which involve a huge fixed cost, cannot be in such an equilibrium. Moreover, in all the West African colonies the prices charged for freight and passengers were not determined by perfect or imperfect competition; they were set by the colonial administration.[12] Furthermore, basic social savings calculations cannot incorporate the potentially large externalities created by the construction of the railways. It is clear from contemporary discussions that

[12] Indeed, it is not just that the colonial administration regulated ton-mile prices; it also regulated other activities in ways that heavily influenced the profitability of the railways. For example, in 1936 the Gold Coast government passed Ordinance 38, which prevented the carriage by roads of key export goods (such as cocoa) and key imports because road transportation was diverting traffic from the railways. Sierra Leone adopted a similar measure the following year (Ordinance 6 of 1937) (see Hailey 1938, 1559–60 and Church 1956).

colonial officials strongly believed these externalities were real and significant. Harry Johnston, an avid colonizer of Africa, noted in 1889 that:

> There is no civiliser like the railway, and to build a railway through an uncivilized country is to centuple its existing trade, or to create commerce if none exists: the railway saps race prejudices and dissolves fanaticism. (quoted in McPhee 1926, 111)

British observers in many places echoed his views. McPhee argued that:

> Slavery in Northern Nigeria found its chief buttress in the demand for cheap transport in a region where animal transport was not feasible on account of the tsetse fly ... the Government built railways, and slave carriage died a natural death, because it became uneconomical. (McPhee 1926, 126–7)

Lugard observed about the construction of the railway in Nigeria that "it has killed the slave trade" (1922, 463). Knowles extensively discussed positive externalities flowing from railway construction (1928, 138–52).

Despite these caveats, in the absence of sufficient data to calibrate a general equilibrium model, the social savings methodology does present us with a simple method of looking at the economic impact of the railways; and because these caveats would apply to all such studies, the comparison between our results and those of others is in itself interesting. To apply this methodology, we follow the simplest approach of Fogel (1964) in assuming a zero elasticity of demand for transportation services. Maybe more important in the present context, we assume that, in the counterfactual scenario where the freight hauled by the railways is carried instead by head porterage, there is no impact on the labor market; with this assumption, we can use the observed wages to calculate the counterfactual cost of moving the freight by head porterage. Hence, we are assuming that labor supply is completely elastic.

10.4.1 Results from the Gold Coast

Table 10.2 presents basic data on the Gold Coast railways for the three dates of interest. In 1909, only 168 miles of track were open in the colony, from Secondi on the coast up to the Asante capital of Kumase. By 1924–5, the railroad had expanded to 394 miles, because by then a line linked Kumase to the colonial capital of Accra, and by 1934–5 it had grown to 500 miles, as the grid had been extended to a number of smaller feeder railways (Gould 1959 gives a good overview). Between 1909 and 1924–5, the amount of freight hauled expanded dramatically, with the number

Table 10.2. *Basic data on the Gold Coast railways*

	1909	1924–5	1934–5
Mile of Track Open	168	394	500
Total Freight Hauled (Tons)	56,454	796,888	730,382
Total Freight in Ton-Miles	3,763,552	43,170,885	42,952,026
Total Passengers Moved	215,729	1,487,164	1,822,093
First Class		14,851	
Second Class		21,988	
Third Class		1,450,325	
Total Passenger Miles		41,751,573	44,704,654
Total Freight Revenues (£)	146,845	850,238	633,525
Total Passenger Revenues £)	38,565	214,703	150,840
Total Expenditures (£)	73,914	568,012	487,530
Total Capital Outlays (£)	1,808,323	7,419,086	9,241,698

of ton-miles growing by more than 1,000 percent. From that point until 1934–5 there was a contraction, which no doubt reflects the impact of the Great Depression; the economic collapse in Britain and elsewhere severely restricted the demand for tropical exports. The data for total passenger miles is unfortunately incomplete and does not exist for the earlier date (or dates near it), and we only have the breakdown of passenger traffic into different classes for the period 1924–5. We also record in Table 10.2 total freight and passenger receipts, which rose sharply but then fell quite significantly between 1924–5 and 1934–5. Finally, we record total capital outlays to date for the three dates.

Table 10.3 contains our three sets of estimates of social savings from freight for 1909, 1924–5, and 1934–5. In all columns, the first set of calculations relates to our direct measure of the relative costs of the different methods of transportation. The first row reports total ton-miles of freight transported in the different years; these numbers are taken from Table 10.2. The second row contains the information from Table 10.2 on total freight revenues. The third row shows how much it would have cost to move the observed ton-miles of railway freight with head porters, given our assumptions that a head porter walked fifteen miles a day and could carry sixty pounds (there are 2,240 lbs in a British ton). As discussed earlier, for the first two columns we assume a wage rate of nine pence per day, increasing to twelve pence a day in 1934–5. The social savings from railways are then simply the difference between lines 3 and 2. In all cases, these are positive,

Table 10.3. *Estimates of social savings from freight in the Gold Coast*

	1909	1924–5	1934–5
Total Freight Ton-Miles	3,763,552	43,170,885	42,952,026
Total Freight Revenues (£)	146,845	850,238	633,525
Total Cost of Head Porterage (£)	344,992	3,957,331	5,369,003
Social Saving (£)	198,147	3,107,093	4,735,478
GDP (in current £)	26,266,269	53,108,142	61,068,569
Freight Social Saving (as a % of GDP)	0.8	5.9	7.8

suggesting that the introduction of the railways did indeed increase national income. To get some relative quantitative sense of how big these numbers are, we record our estimates of nominal GDP in row 5, and then we present measured social savings as a percentage of GDP in row 6. In 1909, as the railway was getting under way, social savings were negligible, but by 1924–5 they were up to 5.9 percent of nominal GDP, with the number increasing further in 1934–5 to 7.8 percent of GDP. This latter increase shows up in the data mostly as a consequence of the assumed rise in head porter wages over time. The numbers are not disproportionately large but are nevertheless significant.

In Table 10.4, we calculate the social savings from passenger transportation. For 1924–5 and 1934–5, the colonial sources record the total passenger miles traveled. The second row then calculates the total time used up in moving these passengers by rail based on the assumption that trains moved at fifteen miles per hour. We then compare this to the amount of time it would have taken for passengers to walk this far on foot, rather than travel by train, on the assumption that they could walk at two miles per hour. The third row shows how long it would have taken by foot – clearly much longer than it would have taken by rail. To calculate the social savings, we then price the time difference between the two modes of travel using different wage rates, 1d. per hour for 1909 and 1924–5 and 1.33d. per hour for 1934–5, as we mentioned previously. Row 5 shows the value of the time saved by moving people by rail instead of having them walk. To calculate the social savings, we compare this to total passenger revenues in the next line. It is clear that revenues were actually greater than the value of the time saved, suggesting that the benefit of moving people by rail did not compensate for the extra cost of doing so. Hence the social savings are negative.

Table 10.4. *Estimates of the social savings from passengers in the Gold Coast*

	1909	1924–5	1934–5
Total passenger miles		41,751,573	44,704,654
Total time required to travel by rail (at 15 miles per hour) (hours)		2,783,438	2,980,310
Total time required to travel by foot (at 2 miles per hour) (hours)		20,875,786	22,352,327
Travel time saved (hours)		18,092,348	19,372,017
Value of Time Saved (£)		85,939	118,653
Total Passenger Revenues (£)	38,565	214,703	150,840
Passenger Social Saving (£)		−128,764	−32,186
GDP (in current £)	26,266,269	53,108,142	61,068,569
Passenger Social Saving (as a % of GDP)		−0.24	−0.05

Table 10.5. *Basic data on the Sierra Leone railways*

	1911	1925	1935
Mile of track open	255.5	338	341
Total freight hauled (tons)	55,540	72,298	71,628
Total freight in ton-miles	5,971,693	9,437,472	10,569,611
Total passengers moved	339,332	587,944	450,707
Total passenger miles		11,047,266	11,377,080
Total Freight Revenues (£)	82,086	167,687	107,868
Total Passenger Revenues (£)	22,644	52,305	28,383
Total Expenditures (£)	69,503	176,482	128,862
Total Capital Outlays (£)	989,194	1,359,680	6,994,715

10.4.2 Results from Sierra Leone

Table 10.5 mimics for Sierra Leone the structure of Table 10.2. By 1911, the railway grid in Sierra Leone was 255.5 miles in length, longer than the amount of track open at the time in the Gold Coast, but it grew much more slowly than the Gold Coast's thereafter. Row 3 shows that the growth in freight haulage was also much smaller in Sierra Leone. Though in 1911 the Sierra Leone railway hauled more freight than the Gold Coast railway, by 1925 it was hauling less than a quarter of the amount hauled by the Gold Coast railway. This is a reflection of the rapid expansion of the cocoa economy in the Gold Coast over this period, a development that had no analogy in Sierra Leone. The Sierra Leone railway also moved far fewer passengers,

Table 10.6. *Estimates of the social savings from freight in Sierra Leone*

	1911	1925	1935
Total Freight Ton-Miles	5,971,693	9,437,472	10,569,611
Total Freight Revenues (£)	82,086	167,687	107,868
Total Cost of Head Porterage (£)	547,405	865,102	1,189,081
Social Saving (£)	465,319	697,415	1,081,213
GDP (in current £)		25,444,186	32,818,287
Social Saving as a % of GDP		2.7	3.3

about one-third by the mid-1920s, a pattern that, like the relative freight haulage, continued into the 1930s. Unsurprisingly, freight revenues were much lower in Sierra Leone.

These differences partially show up in Table 10.6, in the sense that total social savings in pounds are considerably lower by the mid-1920s in Sierra Leone and also make up one-half the size relative to GDP (we do not have estimates for GDP in Sierra Leone in 1911) as compared to the Gold Coast.

In Table 10.7, we move to the social savings for passengers in Sierra Leone. The findings here are very similar to those for the Gold Coast. Social savings are negative but hardly distinguishable from zero, as was the case in Table 10.4. The methodology is identical in both cases, except that we apply the wage rate of 1.22d. per hour to the last column to reflect the increase in nominal wages between the mid-1920s and the mid-1930s.

10.4.3 Results from Nigeria

Table 10.8 then records the basic data from Nigerian railways. Though in 1909 the length of track open in Nigeria was slightly larger than that in Sierra Leone and around two-thirds greater than that in the Gold Coast, it is already evident that Nigerian railways were much more active. The freight ton millage, for example, is about three times greater and freight revenues about double that of Sierra Leone. This divergence becomes more stark by 1924–5. The amount of ton-miles of freight is more than twenty times that of Sierra Leone and more than five times that of the Gold Coast. Moreover, this gap is even bigger by 1934–5. By this time there were 2,184 miles of track open in Nigeria, more than four times the amount in the Gold Coast and about six and a half times the amount in Sierra Leone.

Table 10.7. *Estimates of the social savings from passengers in Sierra Leone*

	1911	1925	1935
Total passenger miles		11,047,266	11,377,080
Total time required to travel by rail (at 15 miles per hour) (hours)		736,484	758,472
Total time required to travel by foot (at 2 miles per hour) (hours)		5,523,633	5,688,540
Travel time saved (hours)		4,787,149	4,930,068
Value of Time Saved (£)		19,946	25,061
Total Passenger Revenues (£)	22,644	52,305	28,383
Passenger Social Saving (£)		−32,359	−3,321
GDP (in current £)		25,444,186	32,818,287
Passenger Social Saving (as a % of GDP)		−0.13	−0.001

Table 10.8. *Basic data on Nigerian railways*

	1909	1924–5	1934–5
Mile of Track open	272	1,220	2,184
Total freight hauled (tons)	165,150	680,107	866,681
Total freight in ton-miles	16,024,024	218,427,093	293,186,018
Total passengers moved	285,202	1,922,580	5,080,016
Total passenger miles	13,353,158	92,283,840	148,165,399
Total Freight Revenues (£)	154,126	1,736,194	1,721,825
Total Passenger Revenues (£)	46,387	290,639	230,270
Total Expenditures (£)	131,820	970,446	1,038,758
Total Capital Outlays (£)	1,377,284	14,978,225	23,014,851

Table 10.9 reports the basic social savings calculations for Nigerian freight. In absolute terms, these are much larger than those of the Gold Coast or Sierra Leone, but expressed relative to GDP they are quite similar. For example, in 1909 they are 1.2 percent of GDP and after that the numbers are very close to those of the Gold Coast.

Table 10.10 examines the social savings associated with passenger travel. The findings here are very similar to those from the Gold Coast and Sierra Leone, though for 1934–5 we do find positive, but very small, social savings on passenger transportation.

Table 10.9. *Estimates of the social savings from freight in Nigeria*

	1909	1924–5	1934–5
Total Freight Ton-Miles	16,024,024	218,427,093	293,186,018
Total Freight Revenues (£)	154,126	1,736,194	1,721,825
Total Cost of Head Porterage (£)	1,468,869	20,022,480	24,432,170
Social Saving (£)	1,314,743	18,286,286	22,710,345
GDP (in current £)	105,316,616	300,260,499	300,859,733
Social Saving as a % of GDP	1.2	6.1	7.5

Table 10.10. *Estimates of the social savings from passengers in Nigeria*

	1909	1924–5	1934–5
Total passenger miles	13,353,158	92,283,840	148,165,399
Total time required to travel by rail (at 15 miles per hour) (hours)	890,211	6,152,256	9,877,693
Total time required to travel by foot (at 2 miles per hour) (hours)	6,676,579	46,141,920	74,082,699
Travel time saved (hours)	5,786,368	39,989,664	64,205,006
Value of Time Saved (£)	24,109	166,624	238,094
Total Passenger Revenues (£)	46,387	290,639	230,270
Passenger Social Saving (£)	−22,277	−124,015	7,824
GDP (in current £)	105,316,616	300,260,499	300,859,733
Passenger Social Saving (as a % of GDP)	−0.02	−0.04	0.003

10.4.4 A Comparative Context

To give some comparative context, Table 10.11, adapted from Leunig (2010, 791, table 1), records benchmark estimates of the social savings of railways in different countries of the world using the methodology that we have used here. In particular, these are estimates that assume zero elasticity of demand for transportation services, so that the actual amount of passengers and freight moved by the railways is taken as the amount that would have been moved by the less efficient method of transportation in the absence of railways. Table 10.11 shows that the types of numbers we have found are fairly normal for the social savings literature. They are, however, much smaller than the numbers Summerhill calculated for 1913 Brazil, where social savings were not less than 18 percent of GDP and quite likely more, and much smaller than the even larger numbers Coatsworth (1979) found

Table 10.11. *Estimates of social savings for various countries*

Belgium		
1846	Freight and passenger	1%
1865	Freight and passenger	2.5%
1912	Freight and passenger	4.5%
Brazil		
1913	Freight	18%–38%
	Passengers	4.6%
China		
1933	Freight and passenger	0.5%
Colombia		
1924	Freight	4.8%
England and Wales		
1865	Freight	4.1%
1890	Freight	29.1%–31.6%
1843–1913	Passengers	1.5%–14%
France		
1872	Freight	5.8%
	Passengers	1.7%
Germany		
ca. 1900	Freight	<5%
Mexico		
1910	Freight	24.9%–38.5%
Russia		
1907	Freight	4.6%
	Passengers	1.6%
Spain		
1878	Freight	7.5%
1912	Freight	11%
United States		
1859	Freight	3.7%
1859	Passengers	1.6%
1890	Freight	4.9%
1890	Passengers	4.8%

for Mexico in 1910. Both of these scholars attributed the large social savings to the very inefficient alternative means of transport in their countries of study. Because neither Mexico nor Brazil had a canal system like the United States', freight had to be moved by very inefficient (according

to their calculations) mule cart in the non-railroad counterfactual world. Fogel himself argued that in the nineteenth-century United States, social savings might have been as high as 30 percent of GDP, were it not for the relative efficiency of the American canal system. Now, especially in light of all the remarks by colonial officers complaining about head porterage, one would have anticipated that the same argument that worked for Mexico and Brazil would apply to West Africa: head porterage, a highly inefficient pre-railway method of transportation (even more so than mule carts), would imply large social savings from railway adoption. As we described, however, we find small social savings, which is quite surprising. One likely reason for this is the ability of both precolonial African rulers and colonial governments to coerce labor into head porterage at below market prices (something strongly suggested by the historical record). This coercion would then make head porterage seem cheaper in our data than it would have been if wages had been set at normal market clearing levels. There were no mechanisms of this type in Brazil and Mexico that could artificially keep down the costs of alternative methods of transportation.

10.4.5 Social Savings from other Forms of Transportation

Having made these calculations for the railways, we can make simpler calculations for other forms of transportation. From Table 10.12, we do have estimates of the cost per ton-mile of freight carried with simpler methods of transportation, in particular barrel rolling, handcarts, and motor lorries. Using the data from the 1909 Parliamentary Report on these issues, we can investigate the social savings of using these other "wheeled" methods of transportation as opposed to head porterage. We do this just for the Gold Coast. For comparability, therefore, we take the data for the cost per ton for head porterage from this report, which gives 48.5d. per ton-mile (the midpoint of 3s.1d. and 5s.), which is significantly higher than our own estimates based on the information we have. To calculate the social savings associated with cask rolling, for example, we take the midpoint of the estimate presented in the Parliamentary Report on the cost per ton-mile of cask rolling and assume that all of the freight moved by the railway was moved by cask rolling (with the usual zero elasticity of demand for freight and zero supply of labor assumptions). We then compare the cost of moving all of this freight by cask rolling to the cost of moving it by head porterage. These simple calculations suggest that all forms of wheeled transportation created positive social savings though the numbers are modest expressed relative to GDP.

Table 10.12. *Implied social savings relative to head porterage of different methods of transportation in 1909 in the Gold Coast*

Total freight carried by the railways (in ton-miles)	3,763,552
GDP (in current £)	26,266,269
Total Cost of Head Porterage (£)	760,551
Total Cost of Cask Rolling (£)	258,744
Social Savings of Cask Rolling (£)	501,807
Relative to GDP (%)	1.9
Total Cost of Hand Trucks (£)	344,992
Social Savings of Hand Trucks (£)	415,559
Relative to GDP (%)	1.6
Total Cost of Motor Lorry (£)	313,629
Social Savings of Motor Lorry (£)	446,922
Relative to GDP (%)	1.7

10.5 THE SOCIAL RATE OF RETURN

We now turn to a different way of looking at this issue. Instead of asking what the social savings associated with the construction of railways was, we ask what the social rate of return from these projects was. We can do this in the case of railway construction, because we have detailed knowledge of the capital expenditures involved in building the railways. This methodology has the advantage that it explicitly takes into account the capital costs associated with the construction of the railways; the fact that social savings calculations ignore this has often been cited as a major drawback of this approach. The construction of the numbers needed here is straightforward; the social rate of return of the railways in any particular year is simply the social savings in that year plus the net railway revenues, as a percentage of the capital outlays to date. While results using this method are not necessarily reflective of the relevant decision margins, that is, they are not marginal social rates of return for an additional unit of capital, they serve the key purpose of illustrating the magnitude of the railways' effect on the economy.[13] The findings of this calculation, reported in Table 10.13, are very striking. They show that the social rate of return was remarkably high in these West African colonies, even exceeding 100 percent in Nigeria: in

[13] For a different approach to measuring social rates of return, with a critique of the current method, see Mercer (1970).

Table 10.13. *Social rates of return %*

	1909/1911	1924–5	1934–5
Gold Coast	11.0	41.9	51.2
Sierra Leone	48.0	51.3	15.5
Nigeria	95.5	122.0	98.7

other words, the social savings in a single year were sufficient to cover the entire capital outlays until then. To give some sense of how large this rate of return is, we present in Table 10.14 some estimates of social rates of return for railroads in other countries.[14] Estimates of social rates of return for historical railways are less common than social savings calculations, so we cannot be as certain in our comparative assertions about West Africa as we were in Table 10.11. Nonetheless, as Table 10.14 makes clear, the social rate of return in West African railways was, at its lowest, significantly larger than the largest recorded social rate of return for Western European economies. Even in the Brazilian example, which Summerhill (2003, 2005) has convincingly argued shows a much larger effect of railway adoption than that in the United States and Western Europe on account of the country being a "small, laggard economy," the social rate of return was between 17 and 23 percent, depending on various assumptions about the extent of social savings. Only Coatsworth's calculations for Mexico approach the magnitude of our estimates, and even then they are at their highest half the size of the rates of return we find in Nigeria.[15]

How could it be that while social savings in West Africa were so modest, the social rate of return was so high? The obvious answer is that, quite contrary to the argument that it was expensive to build railways in the forest zone of West Africa, building railways there was remarkably cheap by international standards. This is not entirely surprising. Though building these lines did require cutting down trees, West Africa is mostly very flat, and in the three cases we consider, railway construction did not face the

[14] For England and Wales, we use Hawke's estimates of gross social returns without passenger comfort considerations (1970, 406, table XV.01, column 5) combined with Kenwood's capital expenditure figures, net of depreciation, and maintenance expenses (1965, 322, column 1), rather than Hawke's own. Kenwood's capital expenditure data have the advantage of stretching back to 1825 and are separated into net and gross categories.

[15] These rates of return we find are also outsized in comparison to other forms of infrastructure investment. For instance, in a related calculation outside of the railway context, Maurer and Yu (2011) showed that the social rate of return on the construction of the Panama Canal oscillated between 3 percent and 16 percent, depending on the year.

Table 10.14. *Estimates of social rates of return (%) for various countries*

Country/ year	Social Rate of Return (%)	Source
Brazil		
1913[a]	17.9–23.1	Summerhill (2005, 87, table 7).
England and Wales		
1854[b]	13.58	Constructed from Hawke (1970, 406, table XV.01, column 5) and Kenwood (1965, 322, column 1).
1855	13.68	ibid.
1856	14.61	.
1857	14.54	.
1858	13.98	.
1859	15.15	.
1860	16.07	.
1861	15.77	.
1862	15.51	.
1863	15.98	.
1864	16.67	.
1865	16.46	.
1866	17.18	.
1867	17.62	.
1868	17.91	.
1869	18.43	.
1870	19.68	.
Mexico		
1881[c]	1.8	Coatsworth (1972, 141, table IV.12).
1882	10.4	ibid.
1883	14.2	.
1884	9.7	.
1885	18.8	.
1886	14	.
1887	15.3	.
1888	18.9	.
1889	20.3	.
1890	26.6	.
1891	35.9	.
1892	34.9	.
1893	27.2	.
1894	25.3	.
1895	29.1	.
1896	30.3	.
1897	31.6	.
1898	33.4	.
1899	52	

(*continued*)

Table 10.14. (*continued*)

Country/ year	Social Rate of Return (%)	Source
USA		
1859	15	Fishlow (1965)
1890[d]	12.3–15.8	David (1969, 522–3), social savings from Fogel (1964)
1890[e]	15.8–20.4	ibid.

Notes: a) Uses demand elasticity of -1. b) See text. c) Refers only to the largest railroad company. d) Returns net of maintenance expenditures. e) Returns gross of maintenance expenditures.

problem of bridging large rivers (the railways skirted or went around what large rivers there were, such as the Volta or Niger). In the United States and the British isles, the relative abundance of good waterways that made the railways less appealing also made them more expensive to build. This topic deserves further investigation.

10.6 WHAT STOPPED TECHNOLOGY ADOPTION?

If wheeled transportation, particularly railways, was economically efficient, why did African societies not adopt it? Part of the explanation for this stems from the nature of African polities. Most of the continent had relatively low levels of political centralization and consolidation, which would make it difficult to implement public works projects with such a large fixed cost. In Sierra Leone, for example, Abraham (2003) shows how the south of the country, Mendeland, was divided into a system of nine competing and warring states in the second half of the nineteenth century. He makes a distinction between territorial states, such as the Sherbro, Lugbu, Gallinas, Bumpeh, and Kpaa-Mende states, which had well-defined territories and which were not identified with a single person, and the Hegemonies, such as the Tikongoh state of Makavoray and the Luawa state of Kai Londo, which were. Nevertheless, even the territorial states were not bureaucratized and did not collect systematic taxes from their inhabitants, though they did collect tribute and organize compulsory labor and armies. It is difficult to imagine that these states could have cooperated sufficiently to create large-scale public works like a railway, even if they had been able to raise the capital and attract the expertise. This lack of political centralization in much of sub-Saharan Africa is plausibly part of the explanation for why railways were not built (though it does not explain the failure to adopt much simpler wheeled technologies).

Nevertheless, this explanation can hardly apply to larger, more bureaucratic, and consolidated African states such as Asante and Ethiopia (see Hopkins 2000a, 2000b; Warner 1999). In both these historical cases, we have direct evidence relevant to the issue of railway adoption; Asante made a belated attempt to construct a railway to Kumase, and Ethiopia did in fact build a railway before its colonization. We also have evidence for Zanzibar, where a similar project to build a railway was started by the independent sultan and then collapsed.

In the case of Asante, Wilks notes, "from the reign of Mensa Bonsu onwards, the Asante government began to explore the possibilities of utilizing European capital and skills to create a railroad system in Asante" (1989, 41). Asantehene (king) Mensa Bonsu came to the throne in 1874 and ruled until being deposed in 1883. Agyeman Prempe took the throne in 1888. Prempe's chief of his "foreign affairs bureau" was John Owusu Ansa, who took up the task of developing a railway. To this aim, he proposed setting up the "Ashanti and Prah Mining and Trading Company." On April 26, 1892, the Asantehene signed an agreement with Dr. J. W. Herivel to start the company, which was to finance and manage the construction of railroads in cooperation with the Asante government; the government even agreed to immediately supply four hundred laborers to begin laying track. As Wilks notes:

> Governor Griffith of the Gold Coast viewed the project with considerable alarm, and deemed it expedient to deter Herivel from pressing forward with a scheme which might greatly have strengthened the Asante economy. In 1893 the actual agreement between the Asantehene and Herivel was impounded by the High Court of the Gold Coast, and Herivel was harassed by the Customs Department until finally in 1894 he was obliged to abandon the scheme. (1989, 636)

This setback did not deter the Asantehene, however. In early 1895, he sent an embassy headed by Ansa to London. In October of that year, the Asante entered into an agreement with George Reckless, giving him "a Charter for the opening up of Ashantee to British enterprise and skill" (Wilks 1989, 650). Part of what Reckless agreed to do was to build a railway from the coast to Kumase. As Wilks puts it, "Chamberlain's reaction was to refuse to accept the validity of the concession" (1989, 652). Ansa responded by hiring a barrister, and Chamberlain was forced to concede the charter was legal. Nevertheless, even before Ansa was on the boat back to West Africa, Chamberlain had cabled Governor Maxwell to inform him that the

"expedition must go [to] Kumasi at all events" (Wilks 1989, 655). British military intervention blocked any chance of autonomous adoption of the railway.

The evidence from Asante suggests that one reason that African states did not adopt railways during the nineteenth century was perhaps precisely because they were economically efficient. European powers, embarked on colonial expansion, had an interest in blocking the diffusion of technology to places they considered valuable colonies. The modernization of Asante would have made it more difficult to colonize, which explains why the British opposed it. This mechanism seems likely to have operated quite widely during the nineteenth century.

The case of Ethiopia is just as revealing about the mechanisms that prevented African states from building railways during the nineteenth century, and it independently paints a picture that is very consistent with the evidence from Asante (see Gilmour 1906 for an entertaining contemporary account). Plans to build a railway from the coast to the capital city of Addis Ababa moved forward the moment that Menelik II came to the throne in 1889. In February 1893, Menelik empowered one of his advisers to create a company, and Leon Chefneux, a French trader who had been living in Ethiopia since 1882, was sent to Europe to look for capital to build a railway between Djibouti, in French Somaliland, and Addis Ababa. By this time, the Italians had declared Ethiopia a protectorate of Italy, which made it difficult to raise capital and also made the French government reluctant to allow the construction of a railway across French territory. However, the military defeat of the Italians by the Ethiopians at the battle of Adowa in 1896 solved these problems. There was a great deal of internal opposition to the railways, however. Ras Makonnen, a leading aristocrat, told Menelik, "When the railway reaches Harar, Harar will no longer be yours and when it reaches Addis Ababa, Shoa will no longer be yours" (Pankhurst 1968, 307). Gleichen, a British diplomat, recorded that "a large number of the chiefs ... strongly object to such a new fangled idea ... on the grounds that it would introduce into the country the all-pervading white man" (Pankhurst 1968, 308). Work began on the line in October 1897, though it took until July 22, 1901 for the first train to run. At that point the track going inland from Djibouti was 106 kilometers long and had just passed into Ethiopian territory at Dire Dawa. The British, whose colony of Somaliland was just next to Djibouti, disliked the fact that a French private company ran the railway. With the encouragement of the colonial office, British investors began buying up shares in the company, and in response the French government effectively nationalized it in 1902. In the process, the French unilaterally

rewrote the concession violating both the original details and the spirit of the deal signed with the Ethiopian monarch. Menelik was incensed: "the Emperor, arguing that his original concession had been violated, withdrew various priviledges [*sic*] ... [and he] refused to grant permission to start on construction of the line between Dire Dawa and the capital" (Pankhurst 1968, 323). He announced that, while he still wanted the railway, "he would not permit the line to be built by a foreign government or by a company controlled by a foreign government" (quoted in Pankhurst 1968, 323). In response to this crisis, various schemes were proposed; British and French interests, for example, suggested the internationalization of the railway, while Menelik attempted to raise the needed capital himself, directly from international financial markets. The reasoning behind the French takeover of 1902 surfaced in a remarkably frank debate in the French Senate on April 1, 1905, when the Comte d'Aunay remarked:

> [W]e were able to cherish the finest hopes for our position in Abyssinia. We had the monopoly of the railway, which gave us a precious instrument of penetration; one could say that the Empire of Menelik would become a colony for us from which we could gather the benefits without assuming any of the responsibilities. (Quoted in Pankhurst 1968, 327)

In mid-1906, an exasperated Menelik began the construction of the railway from Addis Ababa to Dire Dawa. Regardless, by 1908, Chefneux's company went bankrupt. Menelik, unable to build the railway himself without external financing, gave a second concession to the French, who agreed that this concession would again be a private company run through the Banque de l'Indo-Chine. The new company was charged with extending the line up to Addis Ababa, which it reached in 1917 after the death of Menelik and during the regency of Ras Tafai (later Haile Selassie).

The evidence from the Ethiopian case makes clear that a key obstacle preventing African polities from adopting the modern technology of the railway was that they feared this adoption would accelerate colonization.

Finally, we see similar, if not identical, political pressures affecting the decision of African polities to introduce railways in the Sultanate of Zanzibar. The Sultanate of Zanzibar was descended from the Arab monarchy that ruled Oman, which had established political supremacy along the East African coast before the massive entry of European interests into the region. After the abolition of slavery in the British colonies, when British efforts to eliminate the slave trade shifted to East Africa, the British refrained from extending any formal political authority in the region, leaving the Sultanate's sovereignty intact. Moreover, colonial officers tried to

strengthen the monarchy and its state apparatus, and then relied on informal influence to pressure Zanzibari rulers into curbing the trade in their domain. Thus, by the 1870s, the Sultanate of Zanzibar claimed suzerainty over wide swathes of the land extending from the coastline of modern Tanzania, Kenya, and Somalia into the East African interior as far as southern Sudan and the Great Lakes, making it one of the largest political entities in Africa at the time.

Secondary sources describe strategic reasoning by the Sultan of Zanzibar that strongly resembles the considerations facing Menelik in Ethiopia, when proper allowances are made for the very different nature of the two kingdoms. In the 1870s, the Egyptian Khedive's plans to expand his empire deep into the Sudan threatened the territorial claims of the Sultan. At the same time, the East African interior had begun to attract the interest of William Mackinnon, a politically connected British shipping magnate (Galbraith 1972). In 1876, Sultan Bargash therefore seriously considered giving a concession to a British company led by Mackinnon where, in exchange for the right to function almost as an autonomous government (taxing, regulating trade in arms and liquor, garrisoning troops) in the Sultan's inland domain, the company committed to constructing roads and railroads on the Sultan's behalf and upholding his sovereign claims over the area. The decision was far from straightforward. As Coupland described, the Sultan reasoned that:

> If he called European capital and enterprise to his aid, he would profit financially, all going well, from the increase in duties in the mainland trade, and he would profit politically by the establishment of effective control in the interior. The financial and commercial interests he enlisted in his service would be mobilized to prevent any more attempts like [the Khedive] Ismail's to question his authority and violate the integrity of his domains. But there was an obvious risk. His servants might become his masters. Those European pioneers might prove to be more than philanthropists and business men. They might be converted into instruments of national aggrandisment; and, once they had got a firm grip on the interior in the Sultan's name, they might coolly hand it over to their Government. (Coupland 1939, 305)

Coupland argues that Bargash was willing to face this risk because the alternatives were quite likely the loss of sovereignty to the Khedive or eventual colonization where none of his sovereign rights would be recognized. The negotiations advanced considerably, with the Sultan demonstrating strong commitment to the project, and in fact this proposal received approval at the highest levels of the British government. Disagreement exists in the historical literature on why exactly the negotiations collapsed, but at least part of the reason was that "[Bargash's] advisers remonstrated against his inclinations to transfer his rights, even his sovereign power, to a European company. The Europeans would preempt trade with the interior, and the Arabs would be deprived of their livelihood" (Galbraith 1972, 67). Thus, in this case as well, the benefits of technology adoption were weighed against the political risks arising from the threat of colonization and European control.

10.7 CONCLUSIONS

In this chapter, we have undertaken preliminary calculations to examine the economic benefits of introducing modern methods of transportation into the British West African colonies of the Gold Coast, Nigeria, and Sierra Leone during the early twentieth century. We did this in the context of an academic literature that has argued that the reason that Africans did not adopt modern technologies, such as wheeled transportation, was that they were not appropriate technologies given the underlying factor endowments and circumstances. The bulk of this chapter focused on the introduction of railways. Though this is not the cleanest case for examining the economic rationality of wheeled transportation, it is facilitated by the very rich data that the British colonial state collected on the construction and operation of the railways. The main question we ask is whether constructing the railways was economically rational compared to moving goods by head porterage and moving passengers by foot. We tackle this issue in two ways, first by using the social savings approach of Fogel (1964) and second by calculating the social rate of return. Our results are very contrary to the conventional wisdom. Though it is true that the social savings railways created were modest compared to estimates of national income, the more interesting concept, the social rate of return on capital, was very high. In the case of Nigeria, it averaged around 100 percent per annum, suggesting that the social savings in one year were sufficient to cover the entire capital expenditures until then.

We would also argue that in a sense these calculations almost certainly underestimate the economic impact of the adoption of the railway. This is for the simple reason that the British colonial government built the railways not simply as an economic activity, but also as part of a strategy of extending colonial rule. For instance, Tsey (1986) points out that the first railway built in the Gold Coast, though it headed north into the Asante goldfields, which seems economically sensible, was extended to Kumase to allow the British to extend their military domination into the heart of the Asante state, not from any obvious economic motive. Similarly, in the case of Sierra Leone,

when construction of the first railway started, the original plan was for the tracks to run from Freetown to the north of the country. In 1898, however, a massive rebellion, the "Hut Tax Rebellion," (known in modern Sierra Leone as the Bai Bureh War) broke out. Though it started in the north, it was most intense and lasted the longest in Mendeland in the south. After they defeated the rebellion, the British changed the planned route of the railway line, and instead of building it to the north, they built it to the south, right into the heart of Mendeland. To the extent that military and strategic factors were important in determining the routes the railways took, and to the extent that the relevant economic fundamentals were not perfectly correlated with the political fundamentals that made some places harder to govern, the railways could not have been built in the most economically optimal places for them. Therefore our findings surely underestimate the economic potential for railway construction.

Nevertheless, the fact that railways were economically efficient but not adopted by Africans does not imply in any sense that Africans were irrational or not able to ascertain the relevant costs and benefits. In fact, in the case of railways, we showed that three circumstances inhibited African polities from adopting such technologies. First, there was little political centralization (so that private costs and benefits diverged from social costs and benefits); second, technology adoption was blocked by potential colonial powers who did not want autonomous African development; third, the African polities feared that railway construction would in itself accelerate colonization.

APPENDIX: RECONSTRUCTING COLONIAL GDP

This appendix describes the procedure we followed to reconstruct the GDP for the Gold Coast, Sierra Leone, and Nigeria. To the best of our knowledge, no other systematic attempts to reconstruct GDP for the prewar era have been constructed for these countries, except for the pioneering work of Szereszewski (1965). We largely follow his method, which we outline for the Gold Coast together with our deviations from his method. We present a full result for the Gold Coast in 1909 in Table 10.A2. Finally, we briefly discuss differences between reconstructing Gold Coast GPD and GDP for Sierra Leona and Nigeria.

Szereszewski's Work

Szereszewski tries to understand the structure of the Ghanaian economy to investigate the process that transformed the Gold Coast from an agricultural society into the largest cocoa exporter in the world in 1911. For 1891, 1901, and 1911 (coinciding with census years), he constructs three "successive accounting models which would assess quantitatively the structural changes of the economy over the two decades and the magnitude of its growth" (1965, 128). He considers an *introduced* and an *indigenous* sector, broadly corresponding to the coastal area and the hinterland in Ghana (and the Colony and Protectorate in Nigeria and Sierra Leone).

Table 10.A1. *Components of colonial GDP*

Symbol from (1)	Category
C	(2) Private Consumption of Imported Goods
	(4) Consumption of Public and Related Services
	(6) Traditional Consumption
G	(3) Consumption of Government Services
I	(5) Gross Capital Formation
E	(1) Export Production
M	(7) Imports of Goods and Non-factor Services

Data and Methodology

All data are taken from the so-called Blue Books, which are colonial reports submitted to the British government (Government of the Gold Coast, 1909, 1926, 1935; Government of Northern Nigeria, 1909; Government of Southern Nigeria, 1909; Government of Nigeria, 1925, 1935; and Government of Sierra Leone, 1909, 1925, 1935). These reports contain, aside from a short descriptive part, data on imports and exports and on government activity. From these data we constructed an estimate of GDP following a standard GDP from expenditure formula:

$$Y = C + G + I + E - M$$

where Y stands for GDP, C for consumption, G for government expenditure, I for investment, E for exports, and M for imports. We break this formula down into two building blocks, the introduced part of the economy (G, I, (E-M) and the introduced part of C) and the traditional (indigenous) consumption (the indigenous part of C). The letters in the equation correspond to categories in our GDP calculation (see Table 10.A2). Table 10.A1 lists the inputs in the equations and their equivalents in our calculation. The names of the equivalents have been chosen to conform to Szereszewski (1965) and to match closely to the Blue Books.

Table 10.A2. *Estimated Expenditures on GDP – Gold Coast 1909 – in pounds*

Category from Table A1		Total
(1) Export Production		2,656,000
Seaborne	2,656,000	
(2) Private Consumption of Imported Goods		3,490,178
Spirits	775,200	
Textiles	1,048,000	
Tobaccos	158,400	
Provisions	779,850	
Miscellaneous	728,728	
(3) Consumption of Government Services		746,000
(4) Consumption of Public and Related Services		199,000
Post and Telegraph	5,000	
Education	12,000	
Railway	182,000	
(5) Gross Capital Formation		746,240
Buildings and construction	820,000	
Equipment	512,400	
Cocoa	0	
Net accumulation of specie	133,000	
Changes in stock of imported goods	8,000	
(6) Traditional Consumption		20,646,650
(7) Imports of Good and Non-factor Services		2,217,800
Seaborne	2,205,000	
Services other than insurance and freight	12,800	
New imports of specie	133,000	
GDP is the total of categories 1–5 minus 7.		
GDP including (6)		26,266,270
GDP excluding (6)		5,619,618
	Total Population	Unskilled wage (pence)
	1,696,985	8

The indigenous consumption part (category (6)) accounts for the contribution of the indigenous population to GDP. Szereszewski computes a typical consumption basket for the Gold Coast and multiplies this by the population to arrive at the money value of traditional consumption. This measure is hard to replicate, and it isn't easily transferable across countries. Therefore, we assume that the minimum unskilled labor daily wage rate is set such that the population was made indifferent between subsistence farming and unskilled day labor. We then find the minimum day labor wage from the Blue Books and multiply this with the population to arrive at a measure of the traditional expenditure on GDP. The other components of our analysis, the categories in Table 10.A1, will be dealt with later in this appendix.

Export Production

Because exports are paid for from abroad, they add to GDP. The total figures for exports, including imports duties and c.i.f. (cost, insurance, and freight) costs, in one particular year can be taken directly from the Blue Books. Overland exports were usually not measured in any coherent way. Therefore, we confine ourselves to seaborne exports.

Private Consumption of Imported Goods

Szereszewski computed ratios between the import and the consumption of different classes of goods. With these ratios and the import figures from the Blue Books we can compute domestic consumption of these goods. In the Blue Books, all imported commodities are listed with their respective import value and are taken from the "home consumption" categories in the Blue Books. We have aggregated the individual commodities into five categories; Spirits, Textiles, Tobacco, Provisions (food, paper, candles, etc.), and Miscellaneous (tools, fuel, medicine, etc). From Szereszewski we take the following conversion factors:

Spirits, 1.7
Textiles, 1.6
Tobacco, 1.6
Provisions, 1.5
Miscellaneous, 1.4.

This means that, for instance, in the Gold Coast in 1909 total spirit imports were worth 456,000 pounds and total consumption of spirits was worth 775,200 pounds.

Consumption of Government Services

This category records the expenditures of the government, given directly in the Blue Books. To this have been added the expenditures of the local governments such as, in the case of the Gold Coast, the governments in Accra,

Cape Coast, and Secondi. Traditional government is not included. Also, government expenditure on construction is considered separately.

Consumption of Public and Related Services

This category records consumption of the services offered by the postal service and the railway services. Both quantities can be recorded directly from the Blue Books. For the Gold Coast in 1909, we were able to include expenditure on missionary schools as well.

Gross Capital Formation

As a means of accounting for investment, several capital formation categories are computed.

Buildings and construction. We have used government expenditure on construction works as a measure of the capital investment in building and construction. Szereszewski uses the money value of the imports of building and construction materials times a "construction coefficient" meant to capture the relation between the money value of the imports and the eventual investment value for GDP. He estimates this coefficient at four. We have used this methodology only for the Gold Coast in 1909, lacking detailed government expenditure data. To the government expenditure on buildings and construction, the government expenditure on railway plant and rolling stock is added.

Equipment. Spending on equipment is constructed from the import lists in the Blue Books. However, only for the Gold Coast in 1909 and Sierra Leone in 1925 could detailed figures on equipment imports be found. For other country/years the ratio between construction spending and equipment spending (0.26) for the Gold Coast in 1909 has been assumed constant and has subsequently been applied to the construction figures to generate the data for the equipment category.

Agriculture. Although all agricultural output was created by labor inputs, there is one category, the establishment of new cocoa farms, that deserves attention. We measure the investment/expenditure on GDP by the extra acreage of cocoa planted. The acreage we get from the tonnage of cocoa exported, which is mentioned in the Blue Books. Using the average yield formula from Szereszewski of four hundred twenty pounds per acre we can compute the total acreage that was used for growing the exported tonnage of cocoa. This is subsequently multiplied by the number of days it takes to bring an acre of cocoa to bearing age (170 days; sources are in Szereszewski). Finally, we use the unskilled labor wage rate to assign a money value to these days worked. This gives the money value of the investment needed to grow the exported quantity of cocoa. This investment is recorded in the year of export, although it was actually invested seven years before, which is the time it takes for cocoa to grow to maturity. However, we record expenditures as they enter output, so the data of the year of inquiry can be used to "trace" the original investment and assign it to the current year. No other crops or agricultural investment can be assessed in a similar way.

Accumulation of specie. The category records the difference between the imports and exports of specie (foreign currency).

Changes in stocks of imported goods. This category records the difference between total imports and the imports cleared through consumption (in the "home consumption" categories in the Blue Books). The difference represents the goods stock in warehouses in the ports and includes mainly spirits and textiles and can be seen as an stockpiling investment.

Traditional Consumption

This category records the traditional consumption as outlined earlier. It uses the population figures and unskilled wage figures from the Blue Books to assess the money value of the traditional consumption. We assume that the unskilled wage rate was set such that people were made indifferent between (subsistence) farming and unskilled labor.

Imports of Goods and Non-Factor Services

This category records the money value of imports which are to be deducted from total GDP because the money to pay for the imports in added to the exporting country's GDP. Also, the imports of specie are deducted here because the domestic currency to pay for the foreign currency accrues to the other nation's GDP. As a last element, the remunerations for services performed by firms abroad are added here (f.i., the treatment of soldiers/officers in hospitals in England).

Table 10.A2 gives a complete reconstruction using the aforementioned methodology for the GDP of the Gold Coast for the fiscal year 1909. This same methodology can be applied, mutatis mutandis, to Sierra Leone and Nigeria. Their total GDP figures, together with the remaining figures for the Gold Coast, are given in Table 10.A3.

Table 10.A3. *Colonial GDP for the Gold Coast, Nigeria and Sierra Leone, in pounds*

	(Fiscal) Year	GDP with traditional consumption	GDP without	Population	Unskilled wage rate (pence)
Gold Coast	1909	26,266,270	5,619,620	1,696,985	8
Sierra Leone	1909	2,330,890	1,398,250	76,655*	8
Nigeria (North)	1909	94,832,020	29,336,230	6,714,038	9
Nigeria (South)	1909	10,484,600	9,937,100	60,000*	6
Nigeria (Total)	1909	105,316,620	39,27,330	6,774,038	
Gold Coast	1924/25	53,108,140	21,913,280	2,279,077	9
Sierra Leone	1924/25	25,444,1890	4,419,280	1,536,066	9
Nigeria	1924/25	300,26,500	14,561,340	18,900,391	9
Gold Coast	1934/35	61,068,570	17,969,230	3,163,568	9
Sierra Leone	1934/35	32,818,270	3,233,090	1,768,480	11
Nigeria	1934/35	300,859,730	28,225,050	19,918,516	9

* Population without Protectorate (Colony only).

Nigeria and Sierra Leone

The main differences between the analysis for the gold coast and Sierra Leone and Nigeria come from two sources. The first source, which applies only to Nigeria, is that Nigeria was for administrative purposes split into Northern and Southern Nigeria in 1909. GDP figures for both colonies plus a total are given in Table 10.A3. By 1925 the colonies had merged. The second source, which applies to both countries, has to do with population figures. In 1909 the population figures in the Blue Books give only the population figures for the Colony and not for the Protectorate, causing an underestimation of total GDP.

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