Extractive Institutions and Gains From Trade: Evidence from Colonial Africa[*]

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A common explanation for African current underdevelopment is the extractive character of institutions established during the colonial period. Yet, since colonial extraction is hard to quantify, its precise mechanisms and magnitude are still unclear. In this paper, I tackle these issues by focusing on colonial trade in French Africa. By using new data on export prices, I show that the colonizers used trade monopsonies and coercive labor institutions to reduce prices to African agricultural producers way below world market prices. As a consequence, during the colonial period, extractive institutions cut African gains from trade by at least one-half.

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I Introduction

Many leading hypotheses about current African underdevelopment emphasize the role of colonialism. If the early literature underlined how colonial rule relegated Africa to exporter of primary commodities [Rodney, 1972], more recent works have instead focused on the long-term consequences of colonial extractive institutions [e.g. Acemoglu et al., 2001, 2002, Englebert, 2000, Herbst, 2000, Nunn, 2007].[1] Yet, to explain how colonial institutions affect *current* development, we need to understand the extent of extraction *during* the colonial period. Many of the institutions established by the colonizers were, in fact, maintained in the post-independence period. Moreover, the extent to which they were extractive in the colonial period affects how extractive they are after independence [Acemoglu et al., 2001, Bates, 1981]. However, since colonial extraction is hard to quantify and its exact mechanisms are unclear, we still do not know precisely how successful the colonizers were in extracting wealth from Africans.

This paper investigates this issue by exploiting the peculiar structure of labor and trade policies employed by the French colonizers. The focus on trade in the French colonies offers two main advantages for understanding the mechanisms of extraction in the colonial period. First, because of the low population densities of French Africa and the high cost of labor relative to land, the colonizers faced there powerful incentives to use coercive labor institutions.[2] Second, focusing on trade allows us to use price data in order to evaluate colonial extraction. By using the gap between prices in Africa and world market prices as a measure of extraction, I analyze how colonial trade monopsonies and coercive labor institutions affected African gains from trade during the colonial period.

Because of limited data on colonial institutions and prices in Africa, this question has

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[1]Extractive institutions can be defined as those arrangements "designed to extract incomes and wealth from one subset of society [masses, African populations] to benefit a different subset [elite, colonizers]" [Acemoglu and Robinson, 2012].

[2]When coercion is a feasible option, a higher land/labor ratio might not translate into higher wages, but in an increase of coercion of labor [Domar, 1969]. Fenske [2013] tests this hypothesis in the African context showing that lower population density is correlated to the extent of indigenous slavery.

so far remained unanswered. On one hand, historians have collected information about colonial institutions, but they have not attempted to systematically quantify the level of extraction. On the other hand, economists have often overlooked the temporal variation in colonial extraction, increasing the risk of "compression of history" and making it difficult to understand how extractive institutions persist over time [Austin, 2008].[3]

My first contribution then is to provide a new yearly dataset of labor institutions and prices in Africa for the main commodities exported from each French colony between 1898 and 1959. I collected the data on labor institutions from historical and ethnographic studies and the data on prices from a variety of colonial publications, including statistical reports of the Ministry of the Colonies, customs statistics, and *Bulletins Economiques* of the different colonies.

My second contribution is to use these data to understand how monopsonies and labor coercion affected African gains from trade.[4] The main difficulty in answering this question is that, since extractive institutions were used in all colonies, we cannot observe colonial trade in absence of extraction. However, since in a competitive market the prices to African producers should be equal to the difference between world market prices and trading costs, we can use this measure as a counterfactual.

Building on this insight, I proceed in three steps. First, I use my price dataset to check whether extractive institutions implied a reduction in prices to African producers. I show that prices in Africa were much lower than world market prices and that this difference cannot be explained by trading costs. On average, prices to Africans were reduced by about 30% with respect to what they would have been in absence of monopsonies and coercive labor

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[3]Previous works by economists exploited spatial variation in some colonial policy or institution, observed at one point in time. Huillery [2009] studies the impact of colonial investments in education in French Africa. Gallego and Woodberry [2010] and Nunn [2010] analyze the effect of colonial missionary activity on schooling and religious conversion. Michalopoulos and Papaioannou [2011] estimate the effect of arbitrary colonial borders on civil war. Berger [2009] studies the modern impact of colonial policies on public good provision in Nigeria. Notable exceptions are Cogneau and Moradi [2014]'s analysis of colonial policies across the border between French and British Togo, Huillery [2014]'s study of the costs of colonization for France, and Frankema and van Waijenburg [2012]'s analysis of real wages in British Africa.

[4]Trade monopsonies as a mechanism of rent extraction were first emphasized by Bates [1981] in his analysis of marketing boards in British Africa.

institutions.

Second, I use the newly collected data on labor institutions to disentangle the effect of labor coercion from the effect of monopsonies. I present evidence that coercive labor institutions allowed the colonizers to further reduce African prices even with respect to monopsony prices. Prices were reduced by about 25% with simple monopsonies and by about 40% with monopsonies and coercive labor institutions. I identify this relationship by using variation of institutions within the same colony/commodity, taken into account common and specific time shocks such as potential changes in the political climate, productivity, or quality of the goods.

Finally, by exploiting the insight of a simple model of colonial trade under extractive institutions, I construct lower bounds for the losses that monopsony and labor coercion together implied for African welfare: on average, colonial extraction reduced African gains from trade by over one-half.[5]

To interpret these estimates, it is important to remember which is the counterfactual at which we are looking. We are not comparing African gains from trade to what they would have been without colonization, but instead to what they would have been if the colonizers had implemented non-extractive institutions. The results of the paper do not dismiss the fact that Africans might have benefited from the increased access to international markets brought by colonization, but underline that it was the colonizers (and not the colonies) who captured most of these benefits.

The paper is structured as follows. Section II provides some historical background about French colonies in Sub-Saharan Africa, monopsonistic trading companies, and labor institutions. Section III proposes a theoretical model of colonial trade under extractive institutions. The following three sections test the implications of the model: Section IV explores the effect of colonial extraction on prices to Africans, Section V focuses on the impact of coercive labor institutions, and Section VI provides lower bounds for the overall reduction of the gains from

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[5]The losses in total gains from trade are larger than the simple price reduction because they take into account also the fact that Africans were forced to produce at a price lower than cost.

trade. Section VII offers concluding remarks and delineates directions of future research.

II   HISTORICAL BACKGROUND

Most of the military conquest of French Africa occurred between 1880 and 1900. Towards the end of 19th century there still existed some small pockets of resistance (Mauritania did not fall under full French control until 1936), but the conditions were ready for the development of the colonial system [Coquery-Vidrovitch, 1969, Suret-Canale, 1971]. The French government organized the colonies in two federations: French West Africa (1895)—including Mauritania, Senegal, French Sudan (now Mali), Niger, Upper Volta (now Burkina Faso), Guinea, Ivory Coast, and Dahomey (now Benin)—and French Equatorial Africa (1908)—including Gabon, Congo, Ubangi-Shari (now Central African Republic), and Chad. After WW1, part of Togo and almost all of Cameroon were added to the French colonies in continental Sub-Saharan Africa (see Figure I).

The extension of French possessions was reflected in the heterogeneity of their natural environment, including, from the coast towards the interior, tropical forests, savannas, and arid-desertic regions. The coastal forestry regions were suitable to produce bananas, coffee, cocoa, and rubber, while the drier interior areas were suitable for peanuts and cotton. In general, Western colonies were more prosperous than Equatorial colonies and, with the exception of the peanut-producing areas of Senegal, coastal regions were usually wealthier with respect to interior regions because of the higher value of their crops and lower transportation costs [Hopkins, 1973].

Given the variety of environments and commodities, the colonizers structured economic activity and trade in the colonies in different ways. Exports were almost exclusively based on African peasant production. European trading companies limited themselves to buying crops from Africans and reselling them at higher prices in Europe. After WW1, Europeans began to enter the productive sector, establishing plantations (e.g. cocoa and coffee in Ivory coast, bananas in Guinea) and exploiting forestry concessions. Mining was a minor activity.

Trading companies collected the production from African peasants at trade posts and directly exported it to Europe, while plantation and concessionary companies often used other trading firms as intermediaries. The colonial government benefited from this trade by establishing customs duties and by taxing part of the companies' profit [Suret-Canale, 1971].

Nevertheless, given French Africa's low population densities and abundant cultivable land in the indigenous sector, African incentives to produce cash crops were very limited. If the trading companies were to pay free market prices, this would have greatly reduced their profit. For these reasons, they lobbied the colonial government to establish trade monopsonies and coercive labor market institutions, such as compulsory cultivations and various forms of forced labor in European plantations.[6]

Some monopsonies were conceded *de iure* from the colonial government to specific companies, while others came into being *de facto* as a consequence of economic crises and protectionistic policies [Coquery-Vidrovitch, 1972, Manning, 1998, Suret-Canale, 1971, Thompson and Adloff, 1957]. Formal monopsonies were established in the Equatorial colonies. In the early XX century, the French government divided Equatorial Africa among thirty concessionary companies with monopsony power over given territories. African laborers were forced to collect crops, especially rubber, for the concessionaires who employed harsh coercive methods. Rubber monopsonies were abolished in the 1920s just to be reintroduced a few years later for cotton exports.

In West Africa, instead, *de facto* monopsonies were the norm. At the beginning of the 20th century, trade in the Senegal/Mali region was controlled by a group of eight Bordeaux trading firms, while Guinea and Congo were in the hands of business houses from Marseilles or Paris. Smaller traders were allowed a share of exports as long as they respected the prices fixed by the main trading firms. After WW1, the *de facto* monopsony of these companies grew stronger: economic crises eliminated competition from smaller companies, German business interests were canceled by the war, and protectionist measures were taken

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[6]We can interpret these institutions as subsidies given by the colonial government to the European trading and concessionary companies.

against British trade. Protectionist policies were not applied everywhere and did not completely eliminate non-French trade (especially in Guinea and Dahomey). Nevertheless, the number of the remaining trading firms became sufficiently small to allow agreement and ban entry into the African market [Suret-Canale, 1971]. As a result, at the beginning of WW2, fewer than a dozen companies monopolized almost all of trade from French West Africa and two French companies (Société Commerciale de l'Ouest Africain, Compagnie française de l'Afrique Occidentale) and a British one (Unilever) controlled between 50% and 90% of exports [Suret-Canale, 1971, p. 167].

In addition to creating monopsony power for the trading companies, the colonizers attempted to reduce prices and wages to Africans by interfering with labor markets and implementing coercive institutions. Three main kind of institutions were used (free peasant production, compulsory peasant production, and concession/forced labor production) and the type of coercive arrangements available to the colonizers depended on whether agricultural production was African-based or European-based.

When the colonizers limited themselves to trade and production was left to African peasants, the colonial governments could introduce compulsory productions. In this case, quotas were set of produce that Africans had to cultivate or gather and sell for a fix price to the colonizers. The most notable example of this institution were the cotton quotas established by Felix Eboué in Ubangi-Shari and Chad between 1924 and 1927 [DeDampierre, 1960]. Under this arrangement, every village had to produce amounts of cotton in proportion to its population and sell it to one of four trading companies with monopsony power. The costs for the recruitment of cotton producers were borne by the colonial government, and payments were often in the form of tax vouchers. Cotton quotas were abolished in 1956, just four years before independence.

Alternatively, when the colonizers entered the productive sector, establishing concessions and plantations, forced labor could be implemented. It took the direct form of labor taxes and the indirect form of contract labor. With labor taxes, all males between 18 and 60 had

to contribute a certain number of days of unpaid labor (usually from 8 to 12 per year) to whatever enterprise the administration assigned them. Labor taxes were used mostly for porterage and public works, but not infrequently for private enterprises, especially in the early days of the colonial period. They were finally abolished for both the private and public sector in 1946 [Fall, 1993].[7] Contract labor was instead a system of formal labor recruiting used mainly for private enterprises. While not forced labor, it was far from a free market system. The most important figure in this system was the labor recruiter who rounded up manpower in villages. Local chiefs received payments for every man supplied and were therefore encouraged to cooperate with the recruiter. The compulsory nature of this system decreased in the late 1930s, when freer forms of recruitment started to appear.[8]

However, coercive labor institutions were not implemented everywhere. When neither compulsory cultivations nor forced labor were used, the prices or wages were still fixed by the colonizers, but the African peasants could decide whether to work for the colonizers in the case of European-based production or how much crop to produce in the case of African-based production.

The French administration fixed the import prices in France by ministerial decree, following world market prices, and the prices to African producers, in accord with the trading companies, usually as a percentage of the world market price.[9] For example, cotton price paid to Ubangi-Shari farmers was 15% of the FOB price of cotton in New York [DeDampierre, 1960]. The sum of price to producer, processing and inland transport costs, commission for the exporter, and custom duties made what was called price at the exit port. The (usually positive) difference between price FOB and price at the exit port was shared between the trading company and the colonial government.

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[7]Other institutions such as labor drafts, convict labor, and military labor worked in a similar manner.

[8]In addition to these institutions, the colonizers also used indirect methods, such as poll taxes. Introduced to raise the revenue of colonial governments, they also served the function of forcing Africans to enter the wage labor force or to produce cash crops in order to earn the money needed to pay taxes. In Equatorial Africa, for example, poll taxes were introduced in 1902 as a way to facilitate rubber collection for the concessionary companies. Given the low population densities, land alienation was a less attractive option to generate a labor force than it was in East Africa.

[9]The question is here whether this percentage reflects trading costs or colonial extraction.

III A Model of Colonial Extraction

Although both economists and historians agree on the importance of colonial institutions, the extent of extraction has been difficult to assess. How much did colonial extractive institutions reduce African prices and gains from trade? In order to answer this question, we need to identify the proper counterfactual. To do so, I outline a simple model of colonial trade under monopsony and coercive labor institutions.

The model has three stages: in stage 1, the Colonial Government decides the institutional setting (competition among trading companies, simple monopsony, monopsony and coercive labor institutions); in stage 2, the Trading Companies fix the price to African producers; in stage 3, the African Peasants produce crops and sell to the Trading Companies, and payoffs are realized.

The maximization problems of the agents are the following. Given the price to producers p_A, the African Peasants produce the quantity Q in order to maximize

$$\Pi_A = p_A Q - C(Q) \tag{1}$$

where $C(Q)$ is a convex cost function.

Given the African supply function $Q(p_A)$, the Trading Companies choose the price p_A to maximize

$$\Pi_C = (1 - \tau)(p - t - p_A)Q(p_A) \tag{2}$$

where τ is the tax rate on the trading company's profit, p is the (exogenous) world market price and t are trading costs.

The Colonial Government chooses the institution which maximizes

$$\Pi_G = \tau(p - t - p_A)Q(p_A) - K \tag{3}$$

where K is the cost of enforcing coercive labor institutions. If the Colonial Government uses

coercion, $K > 0$ and the African's supply function becomes $Q_c(p_A) = Q(p_A + c)$, where c is the level of coercion. The interpretation is that coercive institutions force the African Peasants to produce more than they would like at any given price.[10]

Solving the model generates two results, one relative to African prices and one relative to the choice of institutions, formally stated in the following two propositions. The first result is important to identify the right counterfactual to measure colonial extraction. The second result will be used in the empirical analysis to address concerns of endogeneity of institutions.

Proposition 1 : Prices to Africans. *The Trading Companies will pay lower prices under Simple Monopsony than under Competition, and even lower prices under Monopsony and Coercive Labor Institutions.*

Proof.

Solving the model by backward induction, in stage 3 the FOC of African Peasants implies that the quantity is such that the marginal cost is equal to the price. The African supply function is thus $Q(p_A) = MC^{-1}(p_A)$, where MC is the marginal cost function. In stage 2, the price paid to Africans varies according to the kind of institutions governing trade and production: perfect competition among trading companies, simple monopsony, monopsony and coercive labor institutions. Let us consider each of the three cases.

1. *Perfect Competition*

    Suppose that there are (infinitely) many trading companies competing for African production. If one company sets a price $p_A < p - t$, then a second company might set a higher price, buy the entire production, and still make a positive profit. The equilibrium price to Africans p_{A_f} is just the difference between price in Europe and trading

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[10]Since the interests of the Colonial Government are aligned to those of the Trading Company, we could also specify an alternative two-stage model in which the colonial government fixes both institutions and prices to Africans, as it happened in some cases.

costs

$$p_{A_f} = p - t \tag{4}$$

In this case, the profit of the Trading Companies is zero.

2. *Simple Monopsony*

   Suppose that one Trading Company has the right to buy all African production. In this case, the FOC for the Trading Company's maximization problem implies

$$p_{A_m} = p - t - \frac{Q(p_{A_m})}{Q'(p_{A_m})} \tag{5}$$

   where p_{A_m} is the price to African producers under simple monopsony. Since both $Q(.)$ and $Q'(.)$ are positive, the price to Africans is lower under monopsony than under competition.

3. *Monopsony and Coercive Labor Institutions*

   Suppose that in addition to monopsony the Trading Company has access to coercive labor institutions. In this case, the FOC implies

$$p_{A_c} = p - t - \frac{Q(p_{A_c} + c)}{Q'(p_{A_c} + c)} \tag{6}$$

   where p_{A_c} is the price to African producers under monopsony and coercive labor institutions. Suppose by contradiction that $p_{A_c} \geq p_{A_m}$. Then, by (5) and (6), $\frac{Q(p_{A_c}+c)}{Q'(p_{A_c}+c)} \leq \frac{Q(p_{A_m})}{Q'(p_{A_m})}$. But, since $Q(.)$ is increasing and concave and $c > 0$, this contradicts the hypothesis. Thus, $p_{A_c} < p_{A_m}$: the price under monopsony and coercive labor institutions is then lower than the price under simple monopsony. ∎

Proposition 2: Choice of Institutions. *The Colonial Government will never choose Perfect Competition and it will choose to use Monopsony and Coercive Labor Institutions*

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instead of Simple Monopsony when:

1. *the effectiveness of coercion c is high;*

2. *the cost of coercion K is low;*

3. *the world market price net of trading costs $p - t$ is high;*

4. *the productivity of Africans is large, where colony 1 is more productive than colony 2 if*
   $$Q_1(p_A) = Q_2(p_A + \gamma) \text{ with } \gamma > 0.$$

Proof.

Let us compare the profit of the Colonial Government in the three cases, by substituting the expressions for the African price in the government's profit function (3)

- *Perfect Competition*: $\Pi_{G_f} = 0$

- *Simple Monopsony*: $\Pi_{Gm} = \tau \frac{Q^2(p_{A_m})}{Q'(p_{A_m})}$

- *Monopsony and Coercive Labor Institutions*: $\Pi_{G_c} = \tau \frac{Q^2(p_{A_c}+c)}{Q'(p_{A_c}+c)} - K$

Since $\Pi_{Gm} > 0$ and $\Pi_{G_f} = 0$, the Colonial Government will never choose Perfect Competition. Let us now compare simple monopsony to monopsony with labor coercion. Since $p_{A_m} + \frac{Q(p_{A_m})}{Q'(p_{A_m})} = p_{A_c} + \frac{Q(p_{A_c}+c)}{Q'(p_{A_c}+c)}$ from (5) and (6) , and $p_{A_c} < p_{A_m}$ from Proposition 1, then $\frac{Q(p_{A_c}+c)}{Q'(p_{A_c}+c)} > \frac{Q(p_{A_m})}{Q'(p_{A_m})}$. Thus, since $Q(.)$ is increasing and concave, $p_{A_c} + c > p_{A_m}$. By consequence, the profit from monopsony and coercion is larger than the profit from simple monopsony if the cost K is sufficiently low. To prove 1) trough 4), I will show that the profit from coercion increases as the variable of interest changes in the specified direction. If this is true, at a certain point the profit will be high enough to pay for the cost of coercion. Points 1) and 2) derive from the fact that Π_{G_c} is increasing in c and decreasing in K. Point 3) derives from the fact that p_{A_c} is increasing in $p - t$ (equation 6) and that Π_{G_c} is increasing in p_{A_c}. Point 4) derives from the fact that $\gamma > 0$ and $Q(.)$ is increasing and concave.∎

Let us now consider the implications of these institutional arrangements for African gains from trade.

- *Simple Monopsony*

  Since the price under simple monopsony is lower than the price under competition, the traded quantity will also be lower. African gains from trade are thus lower. Without coercive labor institutions the marginal cost of each unit is always lower than the price, so Africans still get some gains from trading, but less than if they were facing competition among trading firms.

- *Monopsony and Coercive Labor Institutions*

  With coercive labor institutions, the price is lower than under simple monopsony. Given the presence of coercion, the traded quantity is higher, but Africans will produce the additional quantity at a cost higher than the price. For this reason, African gains from trade are lower under monopsony and coercive labor institutions than under simple monopsony. Moreover, notice that, because the Africans receive a price lower than the marginal cost, they might be worse off with respect to not trading at all.

The model yields three predictions about the features of colonial extraction in French Africa:

1. Prices to Africans were lower than they would have been with competition.

2. They were further reduced with respect to monopsony prices by the presence of coercive labor institutions.

3. Extractive institutions reduced African gains from trade.

In the rest of the paper, I will empirically test these predictions.

IV   Reduction of Prices to Africans

In this section I explore the first prediction of the model, checking whether the prices to Africans in the French colonies were lower than competitive prices.

To test this hypothesis, I use newly-collected data on values in Africa, values in France, and trading costs. I focus on eight main agricultural commodities exported from French Africa between 1898 and 1959: peanuts, palm kernels and oil, cotton, cocoa, coffee, rubber, and bananas. The commodities included in the dataset account for 65% of the value of all exports from West and Equatorial Africa during the whole colonial period. Overall, the dataset includes 1510 observations (colony-commodity-year) and I have data on prices in Africa, prices in France, and trading costs for 1285 of them. The years covered are: 1898-1914, 1920-1951, 1953, 1956, 1958, and 1959.

Prices in Africa and Quantities Exported

Colonial customs statistics reported the total quantity and value of commodities exported from each colony every year. These statistics were registered at the local customs offices and then aggregated at the colony level. The reported values (*valeurs mercuriales*) were measured at the exit port and included the price paid to African producers together with processing, inland transport, warehousing and port costs, and a commission for the trading company.[11]

Using these customs statistics, I collected data on prices in Africa and quantities exported from each colony for eight main commodities between 1898 and 1959. I exploited numerous yearly issues of different colonial publications, including, but not limited to, statistical reports of the Ministry of Colonies, *Bulletins Economiques* of the various colonies, and *Annuaire Statiques* of West and Equatorial Africa.[12] Given the variety of the sources and the length of the period considered, the names of the territorial units for which the customs statistics were registered changed over time and sometimes data were reported only for larger territorial units. To solve these issues, I first tracked the variation in the names

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[11]Values include also customs duties since 1945 for Cameroon, since 1947 for Equatorial Africa, and since 1950 for West Africa.

[12]See the appendix for more details on the sources.

of colonies. Then, I assigned each commodity from a larger territorial unit to the smallest territory (colony or group of colonies) that I could identify by excluding those colonies which did not produce that specific commodity.[13] I deflated all prices in 1900 French francs.[14]

Prices in France

I collected prices in France from various issues of the *Statistiques Mensuelles du Commerce Extérieur de la France*, a monthly publication by the *Direction Générale des Douanes* reporting the total values and quantities of the commodities imported from the French colonies in every year. As a control, I also used different issues of the *Annuaire Statistiques de France* reporting similar information. I deflated all prices in 1900 French francs.

Not all exports from French Africa went to France. Nevertheless, given the importance of the French market, using export prices in France is a good approximation. By 1949, France was the destination of about 80% of the total exports originating from its African colonies [Duignan and Gahan, 1975]. Moreover, French prices are highly correlated with world market prices, as shown in appendix A.1.

Trading Costs

Since the values in Africa already include processing, inland transport, warehousing, and port costs, the relevant trading costs are shipping, insurance, and custom duties.

Unfortunately, extensive data on shipping costs between Africa and France are not available. To solve this problem, I constructed estimates for each colony-commodity-year in my dataset according to the following procedure. First, I computed the distance to Marseilles from the closest African port for each colony.[15] Then, I used data on average freight rates from the West African coast to France for the main exports in 1938 to compute the average

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[13]For example, all cocoa exports 1898-1907 recorded as from French Congo (including Gabon and Congo) are assigned to Gabon because there was no registered cocoa production in Congo before 1927. Territorial units involved are AEF, French Congo, AOF, and Senegal-Haut Senegal-Niger.

[14]Inflation data come from France-Inflation.com (2013).

[15]The main ports are identified from the map reported at page 149 of Duignan and Gahan [1975]. The distance to Marseilles is computed by using http://ports.com/sea-route.

shipping cost per km for each commodity in 1938.[16] Finally, I multiplied this measure by the distance to Marseilles for each colony (both West and Equatorial Africa) and by an index of transportation costs between 1898 and 1959 with base 1938=1 from Mohammed and Williamson [2004].[17]

Marine insurance costs were computed as a percentage of the value of goods in France. As transportation technology improved over time, risk and insurance rates decreased. Studying transatlantic wheat trade, Persson [2004] reports rates of about 1% of the value since the 1920s and rates of 1.75% to 1.5% between 1850 and 1920. It seems thus a reasonable approximation to estimate insurance costs from Africa to France as 2% of the French price before 1920 and 1% after 1920. Direct data from French Africa show that this is likely to be even an overestimate at least for the later periods, as insurance rates for cocoa from Ivory Coast in 1958-59 amounted to about 0.6% [France, 1967].

Customs export duties were a percentage of the value of the good at the African port and, at the contrary of import duties, they were levied only on some commodities. Their total revenue was sent to the central colonial government (e.g. Dakar for French West Africa) and redistributed to the colonies according to their needs. Duties tended to be larger, even in relative terms, for more valuable crops. Thompson and Adloff [1960] report that in Equatorial Africa before 1950 customs duties ranged from 3% for oleaginous products to 18% for cotton fibers. I used this fact to estimate customs duties as: 3% of the value at the port for low-value commodities (average world market price less than 0.35 francs per kg) such as bananas, palm oil, peanuts, and palm kernels; 18% for high-value commodities (more than 0.90 francs per kg) such as cotton and rubber; and 13% for intermediate-value crops, such as cocoa.

Looking at variation over time, it is important to remember that during the Great Depression the colonial governments reduced export duties in order to stimulate the declining trade. Huybrechts [1970] provides interesting data on customs duties and shipping costs as proportion of total trading costs for palm oil and cocoa in the Belgian Congo. With these

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[16]Documents et statistiques - Ministère de la France d'Outremer, Service de statistique, 1949-52.

[17]I construct this index from the global real freight rate deflated by commodity prices.

data, we can estimate that in 1934 customs duties ranged from 0 to 2% of the value of the goods at the port. I assigned then a 1% tax for commodities exported during the 30s. Using Equatorial Africa data also for West Africa is not a problem and actually tends to overestimate customs duties. Export taxes were in fact larger in Equatorial Africa, where, because of international treaties, import duties had to be kept low and the colonial government had to raise revenue by taxing exports [Thompson and Adloff, 1960].

IV.2 Results

Before measuring the extent of colonial extraction by using direct estimates of trading costs, let me show some preliminary evidence by comparing price gaps between Africa and France to those between US and UK. The idea is that if the Africa-France price gap was larger than the price gap between the United States and Britain, this would suggest that the difference between prices in Africa and in France was not due exclusively to trading costs.

To check this, I collected yearly data on wholesale cotton prices in New York and Liverpool between 1898 and 1938.[18] Table I reports the percentage price gap in the two markets for 5-year periods. The results show that, on average, the percentage price difference between France and the colonies was about 10 times higher than the difference between UK and US. Given its magnitude, this result is unlikely to be driven by differences in trading costs. It seems that at least for cotton the prices that the colonizers paid to Africans were lower than competitive prices.

To test whether this applies also to other commodities and to take into account directly trading costs, I compare observed and competitive prices at the African exit port. The observed price at the exit port is the sum of price to producers, inland transport costs, warehousing and port costs, and commission for the exporter.[19] The competitive price is the difference between price in France and trading costs, including shipping, insurance costs, and

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[18]My sources are the *Historical Statistics of the United States* [1975] and the Mitchell's *Abstract of British Historical Statistics* [1988].

[19]After WW2, prices tend to include also export taxes. To make prices comparable across years, I subtract custom duties from all observations which include them.

customs duties. Table II shows summary statistics for all these price components. Without colonial extraction, the price at the exit port should be equal to the competitive price, while under monopsony and labor coercion it should be lower. The ratio between observed and competitive price can be then taken as a measure of colonial extraction at the exit port

$$E = \frac{p_A + s}{p - t} \tag{7}$$

where $p_A + s$ is the observed price at the port (including price to producer p_A and costs within Africa s) and $p - t$ is the competitive price at the port computed as difference between price in France p and trading costs from Africa to France t.

Under the null hypothesis of no extraction $E = 1$; under the alternative $E < 1$. Since E is not normally distributed (see figure II), I test whether $ln(E) < 0$. Standard errors are clustered at the colony/commodity level. In addition, in order to take into account potential correlations across commodities and across colonies, I also use a more conservative specification, allowing for two-way clustering at the colony level and at the commodity level [Cameron et al., 2006].[20]

Table III presents the results. Panel A tests for the presence of colonial extraction considering the full sample: $ln(E)$ is negative and statistically different from zero at 1% level. We can thus reject the null hypothesis of no colonial extraction. On average, prices at the port were only 73% of what they should have been in a competitive market, without monopsony and labor coercion.

In panels B, C, and D, I check whether this result depends on specific periods, crops, or regions. In all samples $ln(E)$ is less than zero and highly statistically significant. All commodities, years, and regions were subject to some extraction. However, there were differences in magnitude. Extraction was larger in the early colonial period: prices were one-third to three-fourth of competitive prices before 1930 and more than 80% of competitive prices after

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[20]Given the small numbers of clusters, this procedure is very conservative and tends to over-reject the null hypothesis. Nevertheless, the results are unaffected.

WW2. In the 1930s, as a consequence of decreasing world market prices, gaps were lower, while they were larger during WW2 (panel B). Moreover, the average price reduction varied across commodities (panel C): about 40% for rubber; 20-30% for peanuts, cotton, bananas, palm oil, and cocoa; and about 20% for palm kernels and coffee. Equatorial Africa colonies had on average lower prices than West Africa colonies, but the difference is not statistically significant (panel D).

To get a sense of the magnitude of these estimates, it is interesting to compute the ratio E between actual and competitive price for other markets not subject to colonial extraction. Persson [2004] estimates the wheat price gap between UK and US prices as 13.3% of the US price in 1900, shipping costs as 6.9%, and insurance and ports charges as 3%. Prices at the export port were thus about 97% of the competitive price, that is $E = 100/(113.3-6.9-3) = 0.97$.[21] In French Africa colonial markets, prices were a much lower percentage of competitive prices, ranging from 60% to 80%.

IV.3   Robustness Checks

The results of table III show that there existed a large gap between prices at African ports and French prices which cannot be explained by trading costs. To be able to interpret this as evidence of colonial extraction, we need to make sure that we have not underestimated trading costs and that we are able to rule out alternative explanations for price gaps.

Unobserved and Underestimated Trading Costs

The first possibility is that we observe gaps just because we are not considering some of the trading costs between African and French port. Nevertheless, many of these costs are either already included in the price at the African port or they are excluded from the price at the French port and cannot explain the difference between the two. Inland transport costs, warehousing and port costs in Africa, and commission for the exporter are already included

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[21]The residual 3% can be explained by inefficient arbitrage.

in price at the African port, while port charges in France and possible import taxes are not part of the price at the French port.

The second possibility is that we are considering all trading costs, but we are underestimating them. However, this is unlikely to be the case. Given how price data are constructed, the relevant trading costs are shipping, insurance, and customs duties. First, underestimating duties cannot explain price differentials since we still find a 18% gap even when we limit the analysis to those observations for which duties are already included in the price at the African ports (ln(E)=-0.20; st.err=0.03; N=192). Second, consider that the average price in Africa is 60% of the average price in France and observable trading costs are about 13%: if price gaps were due to underestimated costs, we would be underestimating them by over three times (see table II). Finally, it is important to remember that, since the price at the African port is the sum of price to producer and trading costs within Africa, measuring colonial extraction at the port (E) is actually a lower bound for extraction at the producer level $\left(\frac{p_A}{p-t-s}\right)$ because $\frac{p_A+s}{p-t} > \frac{p_A}{p-t-s}$. Moreover, the colonizer's profit is even larger than $1-E$ since the prices at the African ports include the commission for the trading company and since customs revenues were often used to pay for colonial administration itself.

Alternative Explanations for Price Gaps

The observed gaps in prices between African and French ports cannot be explained by omitted or underestimated trading costs. There are, however, potential alternative explanations of these price differences that do not need to assume colonial extraction. To interpret gaps as evidence of extraction, we need to rule them out.

- *Quality Differences.* Since prices to producers were fixed by the colonial government as a percentage of an average world price computed across different qualities (see DeDampierre [1960] for cotton), we do not need to worry about observing different grades of the same crop in Africa with respect to France. Nevertheless, one might think that we observe gaps just because the quality of African commodities was lower

than the average world quality and lower-quality goods were paid lower prices.

However, given their magnitude, quality differences cannot explain price gaps. Variations in quality can account for 15-35% of difference in prices within one same market [Persson, 2004]. Since trading costs account for about one third the price difference between Africa and France, even if we assumed the largest quality difference, we would still not be able to explain the residual 30% gap.

- *Market Frictions.* Given potential contractual and informational problems in early twentieth century trade, prices in Africa might not necessarily respond immediately to variations in world prices. In particular, if because of these frictions African prices tended to remain low when world prices increased, we would observe positive gaps between African and French prices which cannot be attributed to colonial extraction.

  To mitigate this concern, consider that if $p_A = p - t$ at time 0 (no extraction) and African prices are "sticky", gaps at time 1 should be positive when the world price increases, but negative when the world price decreases. Thus, if we limit our analysis to years in which world prices net of trading costs decrease and we still find positive gaps, we can be confident that this is not due to market rigidities, but instead to colonial extraction. In effect, when we reduce the sample to just those observations for which the competitive price at time 1 is lower than at time 0, the average price gap is still positive (24%) and statistically significant (ln(E)=-0.27; st.err=0.03; N=902).

- *Insurance of African Producers.* Bates [1981] reports that, in the case of British colonies, trade monopsonies had the *de iure* aim to insure African producers against fluctuations of world market prices through the mechanism of marketing boards. Farmers had to sell their production to the government and were paid less than world prices when prices were high. The difference was collected by the marketing board and was used, in theory, to pay higher prices to farmers whenever world prices were low. Similar institutions were established in French Africa with the name of *caisses de stabilisation.*

We could then think that the observed gap between prices in Africa and France might actually be an "insurance premium" which Africans had to pay in order to stabilize commodity prices.

This interpretation however is not likely. First, marketing boards did not fully reach their objective of insuring producers and soon became a way to transfer resources from farmers to urban sectors of the society in order to gain political support [Bates, 1981]. In effect, in my sample, prices at the African port are larger than prices in France net of trading cost in only 20% of cases. Moreover, marketing boards and *caisses de stabilisation* were established only late in the colonial period (since 1940 in British Africa and since 1954 in French Africa, Nabe [1999]) and cannot explain price gaps that we observe from 1900s to 1940s.

- *Investments in Africa.* Even if it is now clear the described price gaps do exist, one might still be skeptical about interpreting them as evidence of extraction. In particular, one might argue that these price differentials were used for colonial investments in public goods (transports, education, health) that would benefit the African populations.

  A closer look to colonial budgets show, however, that this could not be the case. Colonial investments were very small with respect to the profit from price differentials. In her working paper, Huillery [2014] provides relevant information on French West Africa. Colonial public investments included education, health, infrastructure, and support to productive sectors. Investments in health and education were extremely low: in an average year between 1907 and 1957 there were about 1,000 teachers and 1,400 doctors covering a population ranging from 12 to 25 millions. Support to productive sectors was equally low, averaging 1.6 million 1914 francs per year. The situation for Equatorial Africa was likely to be even worse. Investments for infrastructure represented the majority of public investments, with an average of 58 million francs per year between 1907 and 1957.

It is interesting to notice how much larger were profits from price differentials, amounting at about 77 million. Even if the colonizers had used only price differentials to fund public investments, which is very unlikely, they would have still made a significant profit. It is clear that this difference is likely to be even higher since part of price differential was taken directly by the trading company and did not increase the colonial government's revenue.

Comparing prices within the same commodity, year, and federation

As an additional strategy to rule out omitted costs, quality differences, and market rigidities as alternative explanations for price gaps, I compare prices in Africa within the same commodity, year, and federation (West or Equatorial French Africa). The idea is that since trading costs, quality, and market efficiency for a given year and commodity should be the same in nearby colonies, if we find variation in prices, this must be explained by differences in colonial extraction.

To do so, I first identify for each commodity, year, and federation the colony with the highest price in Africa, $p_{A_{max}} = p - t - e_{max}$, where p is the world price, t are trading cost, and e is colonial extraction. Then I subtract the price for each colony $p_{A_i} = p - t - e_i$ from the maximum price. Since both colonies share the same world price and trading costs, $p_{A_{max}} - p_{A_i} = e_i - e_{max}$. Finally, I compute the average difference across colonies $Y = E(p_{A_{max}} - p_{A_i})$. We can then test for the presence of colonial extraction by testing whether $Y > 0$.

The overall mean value of Y across all federations, crops, and years is greater than zero and statistically significant (mean=0.18, standard error=0.04, N= 492). We observe variations in prices to Africans within the same commodity, year, and federation. Since trading costs are common, the only possible explanation has to be colonial extraction.

V LABOR INSTITUTIONS AND PRICES TO AFRICANS

The large gaps between prices in Africa and in France cannot be explained by trading costs, differences in quality, market rigidities, insurance mechanisms, or public investments. Overall, the evidence suggests that the colonizers reduced prices to African producers with respect to competitive prices. In this section, I test the second prediction of the model. Did coercive labor institutions allow the colonizers to reduce the prices even with respect to monopsony prices? How much of the price reduction was attributable to monopsonies and how much to labor coercion?

V.1 Data and Empirical Strategy

To answer these questions, I collected data about labor institutions in the French colonies of West and Equatorial Africa between 1898 and 1959. As described in the historical background, three main kinds of labor institutions were used:

- *Free peasant production*: the colonizer fixed the price, but the African peasants were free to produce how much they wanted at the given price.

- *Compulsory peasant production*: the colonizer both fixed prices and set quantities that the African peasants were forced to produce.

- *Concession production*: production was run by the colonizer who hired African workers, using various levels of compulsion.

Historians and ethnographers have gathered information about the institutional arrangements used in the production of different crops in the various colonies, in general works about French colonization or country-specific studies. For example, Coquery-Vidrovitch [1972] wrote about rubber quotas in Congo in 1910s, while Suret-Canale [1971] analyzed free peasant production of peanuts in Senegal. By systematically extracting information from this literature, I was able to associate one of the three labor institutions - free production, compulsory production,

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or concession production - to each colony, commodity, and year.[22]

By using these data, I evaluate the importance of the three institutions. Table IV reports the relative shares of the total value of exports. Since the kind of labor arrangement may have affected the prices paid to African producers, the value of exports is computed using prices in France. Column (1) shows the shares of institutions considering the whole French Africa for the entire colonial period. Free peasant production was used in the majority of cases, accounting for about two thirds of the total value of exports; concession and compulsory production followed with about one fourth and and one tenth. Columns (2a) and (2b) present the export share by institutions in West and Equatorial Africa. Free peasant production was much more diffused in West African colonies, where it accounted for about 70% of exports compared to only 40% of exports from Equatorial Africa. In contrast, compulsory production was implemented more frequently in Equatorial Africa.

Most of the variation in labor arrangements was across crops. Simple crop fixed effects account in fact for a large portion of the variance in institutions, while the explanatory power of colony fixed effects is much lower. Table V shows that, in a regression of labor institution dummies on crop, colony, and year fixed effects, crops explain 39% of the variance, while colonies and years only 10% and 2%, respectively. Peanuts and palm kernels were mostly produced by free peasant production, cotton and rubber by compulsory peasant production, and coffee and bananas in European concessions. Nevertheless, some variation in institutions existed also within the same crop, across colonies and over time. Coffee was produced with concessions in Equatorial Africa, while some free peasant production was used in West Africa. Cotton was cultivated via compulsory production in the Equatorial colonies, but with both compulsory production and concessions in the Western colonies. Compulsory production was used for cocoa and rubber in Equatorial Africa, while concessions and some free peasant production were employed in West Africa. Over time, as the political pressure to abolish coercive institution increased, we observe a reduction in the level of compulsion and an

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[22]See the appendix for the sources.

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increase in the extent of free peasant production.

To check the impact of labor institutions on prices, I regress the (ln) price at the African port on institution dummy variables, controlling by the competitive price

$$ln(p_{A_{cit}}) = \alpha + \beta_1(COMPULSORY) + \beta_2(CONCESSION) + Z\gamma + \eta ln(p_{ct} - T_{cit}) + \epsilon_{cit} \quad (8)$$

where $p_{A_{cit}}$ is the African price for commodity c, colony i, and year t, Z is a vector of control variables, and $(p - T)$ is the competitive price. Free peasant production is the baseline. Standard errors are clustered first at the colony/commodity level and then, with a two-way clustering procedure, at the colony level and at the commodity level [Cameron et al., 2006].[23]

We expect $\beta_1 < 0$: prices should be lower under compulsory peasant production than under free peasant production. Instead, we expect $\beta_2 > 0$: prices should be higher when European companies run production than when production is run by African peasants. In the case of concessions, in fact, since the profit from colonial trade had to be shared between the trading and the concessionary company, the prices at African ports should be higher. Notice that this does not necessarily mean that the level of extraction from African workers was lower under concession production, but just that the export prices of commodities at the port should be higher with respect to peasant production.[24]

A potential concern with this approach is that omitted variables might in principle affect both African prices and institutions. Proposition 2 of the model suggests what these variables could be. The colonizers tend to impose coercive labor institutions if: 1) the world price net of trading cost is high; 2) the cost of coercion is low relative to its effectiveness; 3)African productivity is high. Let us consider each factor one by one. World prices net of trading costs are not a concern. Since they are measurable, we can directly control for them in

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[23]As mentioned before, this procedure is very conservative and tends to over-reject the null hypothesis. Nevertheless, the main results are unaffected by the clustering choice.

[24]We can write a similar model to that of section III in which: 1) Africans choose the number of workers L to maximize $wL - c(L)$, where w is the wage and $c(L)$ convex is the outside option; 2) the concessionary company chooses w to maximize $p_A f(L(w)) - wL$, where $f(.)$ is the production function; 3) the trading companies chooses the price p_A to pay to the concessionary company.

the regression. In addition, even if we did not, the coefficient β_1 would be biased against the hypothesis since high world prices imply both more coercion and higher African prices. Similarly, omitting the cost of coercion is not a problem since it does not affect directly prices.

We must be concerned, however, by productivity differences. Since the colonizers establish coercive institutions and offer lower prices if productivity increases, omitting productivity would bias the coefficients in favor of the hypothesis. To solve this problem, the main strategy is to estimate the regression with colony/commodity and year fixed effects: the relationship between institutions and prices is then identified by variations within the same commodity and the same colony over time, taking into account common productivity shocks. Intuitively, this is a solution if the change in institutions within each colony/crop over time does not depend on changes in productivity.

The historical evidence supports this view. Most of the changes in institutions within the same colony/crop happened after WW2.[25] Since the post-war period was characterized by rising productivity, if productivity were the main determinant of these institutional changes, we would expect an increase in the use of coercion. Nevertheless, all institutional transitions were instead towards free production. Productivity cannot explain the change in institutions after WW2. Forced labor was abolished in 1946 in the entire French Africa. Compulsory productions in Equatorial Africa persisted for a little longer, but were also abolished in 1956. These changes are much more likely to reflect the political climate before independence than changes in productivity. In fact, the closer we got to independence, the more difficult it became for the colonizer to justify the use of coercive institutions in front of the public opinion both in France and in the colonies.

To see whether the data are consistent this hypothesis, I check if lagged prices in Africa affect institutions. Table VI reports the results of a multinomial logit regression of institutions on lagged African prices. Higher prices are correlated with a higher probability of having compulsory or concession production instead of free peasant production (column 1).

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[25]The crops/colonies involved were: all cotton producing colonies; cocoa in Congo and Gabon; rubber in Cameroon, Congo, Gabon, and Ubangi-Shari.

Nevertheless, the marginal effect of prices on institutions is insignificant when we look at the within colony/commodity variation (column 2). Prices can explain the variation of institutions across commodities, but cannot explain the institutional change within the same colony/commodity over time. Since prices reflect productivity differences, we can be confident that the change in institutions within each colony/crop over time did not depend on changes in productivity.

V.2   Results

Table VII reports the estimates of regression (8). In column (1) I regress the (ln) price in Africa on institution dummies, (ln) competitive price, and colony/commodity fixed effects.[26] The coefficient of compulsory production is negative and significant: within the same commodity/colony, prices in Africa were about 29% lower when compulsory production was used instead of free production. The coefficient of concession production is positive and significant: the prices at African ports were about 36% higher during the years under concession production than during the years under free peasant production.

In column (2) I allow the effect of institutions to vary during the Great Depression and WW2, by interacting the institution dummies with a 1930s dummy and a WW2 dummy. In the 1930s the effect of compulsory or concession production is not statistically different than in the other periods. During WW2 instead, the difference in prices between free and compulsory production increased, while the gap between concession and free peasant production became close to zero.

These results show that within the same commodity and colony, prices were lower in the years when the commodity was produced under compulsory cultivation and higher in the years when it was produced under European concessions. The main concern here is whether compulsory (or concession) production-years were different from free production-years because of factors other than labor institutions. One might worry for example about

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[26]Colony/commodity fixed effect will take into account most of the variation in inland trading costs.

other policy changes, such as land or political reforms, which might be coincidental to changes in labor institutions and affect prices. To solve this problem, I first take into account year-specific changes common to all colonies and crops, then I consider differences specific to each colony/crop.

In column (3) I consider policy changes that involve all colonies and all commodities (e.g. general political climate), by including year fixed effects. Even if prices under compulsory production are not significantly different than prices under free production during the 1930s and WW2 (prices under concession instead are always higher), the main result is unaffected. Taking into account common time shocks, prices were still lower in compulsory production-years and higher in concession production-years for the greater part of the colonial period, before 1930 and after WW2.

The relationship between labor institutions and prices is not driven by common changes in other factors which affect simultaneously all colonies and crops. Still, we might be worried that the timing of labor institution change can be endogenous to prices: the colony/crop-specific year in which institutions change might be driven by colony/crop-specific factors which also affect prices, such as changes in productivity or in the quality of the goods. Similarly, these same factors could affect whether formal labor institutions were enforced or not. As mentioned in the previous section, changes in productivity should not be a concern since increasing productivity cannot explain the within colony/commodity change in institutions. It is however possible that the larger price gaps between African and world prices under compulsory production actually only reflect a larger gap between African and international good quality. In fact, compulsory productions were sometimes used to introduce new crops and we can expect that at the beginning inexperienced African peasants would produce commodities of a lesser quality.

To reduce this problem, in column (4) I add lagged prices in Africa to the specification with colony/crop and year fixed effects. The underlying assumption is that the quality of goods, as well as all colony/crop-specific factors reflected in African prices, must be the same

between year $t-1$ and year t. The results are the same as in column (3). As an additional control, in column (5) I include (ln) quantity, to take into account changes in productivity and size of the market. The results do not vary.

Coercive labor markets allowed the colonizers to reduce prices to producers when production was based on African peasants, while prices were much higher when production was directly controlled by Europeans, as in the case of concessions. These effects are not only statistically significant, but also economically meaningful. According to the estimates with the full set of controls, a change from free to compulsory peasant production within the same colony and commodity, netting out common and colony/crop-specific time shocks, implies a 22% reduction in African prices; while a change from free to concession production implies a 20% increase.[27]

VI   Colonial Extraction and Gains from Trade

The evidence shows that the type of institutions put in place by the colonizers affected the price received by African producers. Prices were lower than what they would have been with competition between trading companies and coercive labor institutions allowed the colonizers to reduce them even further. Using these results, I can now explore the third result of the model, computing by how much monopsonies and labor coercion reduced African gains from trade.

The idea is to measure gains from trade as the surplus of African producers, computed as the difference between received price and cost of production, times quantity produced. The main difficulty here is that, at the best of my knowledge, we do not have information about production costs. Nevertheless, we can exploit the theoretical model described in section III to construct lower bounds for the reduction of gains from trade due to colonial extraction.

Figure III describes the loss of gains from trade under the different institutional arrange-

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[27]These results are consistent with the historical evidence documenting the increase of rent extraction after the introduction of coercive labor institutions. Suret-Canale [1971, p.223], for example, reports that, after compulsory cultivations were established for cotton in Equatorial Africa, a rise in world prices would have implied an increase of profit for the trading companies which was twice as much as that for African farmers.

ments. Subscripts C, M, and ME denote competition, monopsony, and monopsony with extractive labor institutions, respectively. Taking competition as a benchmark, area 1 is the African loss due to monopsony. The sum of areas 1, 2, 3, 4 is the loss due to monopsony and extractive labor institutions (areas 1 and 2 are the losses due to the reduction in price; areas 3 and 4 are the losses due to receiving a price lower than the marginal cost). The sum of areas 1, 2, 3, and 4 is slightly larger than $(p_C - p_{ME})Q_{ME}$, which can be computed as a lower bound for the absolute loss.

We can now construct a lower bound for the relative loss. Since the supply function is convex and $Q > 1$, African gains from trade under competition are less than $\frac{1}{2}p_C Q_{ME}$. A lower bound for the relative loss is then $\frac{(p_C - p_{ME})Q_{ME}}{\frac{1}{2}p_C Q_{ME}}$, that is

$$L = 2(1 - \frac{p_{ME}}{p_C}) \tag{9}$$

Notice that, since prices are measured at the African port, the actual losses at the level of African producers are even larger. In fact, denoting by s all (unobservable) trading costs between the producer and the port, the competitive producer price is $p_C - s$, while the actual price is $p_{ME} - s$. The lower bound of the relative loss at the producer level is then $2(1 - \frac{p_{ME}-s}{p_C-s})$, which is larger than L since $p_{ME} < p_C$. By consequence, the losses are larger especially when inland transport cost are higher, such as in the early colonial period or in the Equatorial colonies.

Table VIII presents the average lower bounds of the relative loss. In an average year, colony, and commodity, Africans lost at least 37% of the possible gains from competitive trade due to monopsonies and coercive labor institutions. If we compute the average weighted by the value of production (at French prices), the losses rise to more than 48%. The rest of the table reports relative losses by period in Equatorial and West colonies. In general, the reduction of gains from trade tended to be lower in West than in Equatorial colonies and decreased towards the end of the colonial period.

To intepret the magnitude of these estimates, it is important to remember that exports to

Europe accounted for a large part of African income, while imports from Africa accounted for a relatively small proportion of French GDP. Given the volume of trade, colonial extraction implied small gains for Europeans at a cost of big losses for Africans.

VII   Conclusions

Extractive colonial institutions are considered one of the main causes of current African underdevelopment [Acemoglu et al., 2001, Nunn, 2007]. Yet, since colonial extraction is hard to quantify and its precise mechanisms are not well understood, we still do not know exactly how successful the colonizers were in extracting wealth from Africans.

In this paper, I investigated this issue by exploiting the peculiar structure of trade and labor policies employed by the French colonizers. By using new datasets of prices in Africa and labor institutions, I showed that the colonizers were very successful in extracting income from Africans and that they were able to do so by reducing the prices to producers through a combination of trading monopsonies and coercive labor institutions. Without extractive institutions, colonial trade should have raised income for African populations. However, the lack of competition between trading firms and the presence of coercion on labor forced Africans to accept prices lower than their marginal cost of production, thus reducing their welfare. My estimates show that colonial extractive institutions reduced African gains from trade by at least one-half.

Having clarified the mechanisms and the extent of extraction during the colonial period, the next step is to understand the details of the impact of colonial institutions on current economic development. The level of extraction, in fact, varied greatly across colonies and crops and this variation can help explaining the different paths of growth in African countries and regions. Moreover, there are reasons to believe that the extractive character of these specific institutions persisted in the post-colonial era. Coercive labor institutions were abolished by independence, but trading monopsonies persisted and post-independence governments kept practicing price policies that discriminated against agricultural producers [Bates and Block,

2009]. Our clearer understanding of extraction during colonialism calls now for future research aimed at examining how institutions established in colonial times still affect current agricultural trade policies and economic development.

A.1   *Prices in France and World Market Prices*

One of the assumptions of the model is that prices in France are exogenous and follow world market prices. In this section, I provide evidence in favor of this assumption by comparing prices in France to prices in Great Britain.

To do so, I use British commodity prices collected by Jacks et al. [2011] from various yearly statistical publications, such as Sauerbeck's *Prices of Commodities* and The Statist's *Wholesale Prices of Commodities*.[28] Since the prices are reported in different units (shillings per hundredweight, pence per pound) I convert all in pounds per kg.[29] Then, I use the exchange rates dollar-sterling and dollar-franc reported by Officer [2013] to convert all prices in francs per kg.

The commodities for which I have both prices in France and in Great Britain are: coffee, cotton, and palm oil.[30] Because exchange rates are available only since 1913 and the WW2 and post-war periods are characterized by strong appreciation and then depreciation of the franc, I focus my analysis on the period 1913-1940.

Figure IV compares British and French prices between 1913 and 1940 for the three commodities. For all of them, British and French prices follow the same trend: the data for French prices are closely tied to world market prices.

A.2   *Data Sources*

This section describes in detail the sources of the data on prices, quantities, and institutions.

Prices in Africa and Quantities. Prices are in 1900 French francs per kg. I obtain them by diving the total value by the total quantity of exports. Quantities are in tons. Cocoa and coffee are in grains; peanuts can be shelled or unshelled; cotton is ginned.

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[28]http://www.sfu.ca/ djacks/data/publications.

[29]The conversion rates used are: 20 shillings per 1 sterling; 50 kg per hundredweight.

[30]British coffee is Brazilian from Rio; cotton is American-middling.

Values in Africa are either in French francs or in francs CFA (franc des Colonies françaises d'Afrique). The conversion rate is 1 franc CFA=1 FF before 1946, =1.7 FF between 1946 and 1948, =2 FF after 1949. Exchange rates between francs, pounds, and dollars come from Officer [2013]. To deflate prices in 1900 FF, I use data from France-Inflation.com, reporting inflation rates since 1901. For 1898-1900, I assume the same inflation as in 1901.

The sources are: *Statistiques coloniales. Commerce* volumes from 1898 to 1906; *Statistiques du commerce des colonies françaises*, volumes from 1907 to 1914 (excluding 1908); *Reinsegnements généraux sur le commerce des colonies françaises et la navigation* volumes from 1920 to 1928; *Bulletin Economique de l'Afrique Equatoriale française*, volumes from 1931 to 1936; *Bulletin mensuel de l'Agence économique de l'Afrique Occidentale Française*, volumes from 1930 to 1939; *Bulletin mensuel d'information. Cameroun, Togo*, volumes from 1933 to 1937; *Annuaire statistique de France 1935*; *Annuaire Statistique de l'AOF, 1933-38*; *Chambre de Commerce du Cameroun. Statistiques Commerciales 1935-37*; *Statistique du Commerce Exterieur de l'AEF, 1936-47*; *Annuaire Statistique du Cameroun, 1938-45*; *Annuaire Statistique de l'AOF et du Togo* volumes 1949 and 1950-54; *Annuaire Statistique de l'AEF* volumes 1936-50 and 1951-55; *Bulletin de la Statistique Générale de l'AOF, 1956*; *Bulletin Statistique Mensuel du Togo, 1957*; *Bulletin Mensuel Statistique et Economique 1959-60*; *Ministère de la France d'Outremer. Documents et Statistiques, 1949-67*.[31]

For some colonies and years, sources are not available. In particular: 1922, 1929-32, 1939-55, 1957 for Togo; 1922-23, 1929-31, 1946-57 for Cameroon; 1908, 1915-19, 1931, 1939-55, 1957 for West Africa colonies; 1908, 1915-19, 1937-50 (at colony level), 1953-57 for Equatorial Africa colonies.

Prices in France. In 1900 French francs per kg. I obtain them by dividing the total value by the total quantity of imports to France from the colonies. The sources are *Statistiques du commerce extérieur de la France*, volumes from 1902 to 1959.

Labor Institutions. The main sources are: Berg [1965], Coquery-Vidrovitch [1972],

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[31]Details about the sources used for each specific colony, commodity, and year are available upon request.

Cordell and Gregory [1982], DeDampierre [1960], Duignan and Gahan [1975], Fall [1993], Gray and Ngolet [1999], Hopkins [1973], Suret-Canale [1971], Thompson and Adloff [1957], and the *Cambridge History of Africa* [1986]. An appendix with the specific sources for each colony/crop is available from the author.

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B.1 Tables

TABLE I

Cotton Price Gap between UK and US vs. France and French
Africa

	$\dfrac{\text{price UK - price US}}{\text{price US}}$	$\dfrac{\text{price France - price Africa}}{\text{price Africa}}$
1898-1902	.12	..
1903-1907	.10	6.27
1908-1912	.09	1.62
1913-1917	.19	2.25
1918-1922	.12	.77
1923-1927	.06	1.40
1928-1932	.17	.32
1933-1938	.15	.54

Sources: see text.

TABLE II

Prices in Africa, Trading Costs, and Prices in France

variable	mean	% price at French port	sd	min	max
exit price at African port	0.863	60%	1.302	0.030	17.900
trading cost	0.181	13%	0.291	0.011	3.606
insurance	*0.021*	*1%*	*0.049*	*0.001*	*0.387*
shipping	*0.042*	*3%*	*0.022*	*0.009*	*0.200*
custom duties	*0.118*	*8%*	*0.245*	*0.000*	*3.222*
price at French port	1.439	100%	2.458	0.100	19.360

In 1900 French francs. N=1285.

TABLE III
Testing for Presence of Colonial Extraction

		mean ln (E)	clustered st. err. st. err.	double-clustered st. err.	N	African price as % of competitive price
A	overall	-.31*** ”	.03	.05	1285	73%
	pre-WW1	-.28 *** ’	.10	.15	186	76%
	20s	-.41 *** ”’	.03	.05	411	66%
B	30s	-.21 *** ”’	.03	.05	406	81%
	WW2	-.70 *** ”’	.09	.08	69	50%
	post-WW2	-.20 *** ”’	.03	.06	213	82%
	rubber	-.52 ***	.04	..	209	59%
	peanut	-.38 ***	.05	..	197	68%
	cotton	-.37 ***	.06	..	164	69%
C	bananas	-.35 ***	.08	..	51	70%
	palm oil	-.27 ***	.03	..	146	76%
	cocoa	-.22 ***	.06	..	158	80%
	palm kernel	-.20 ***	.04	..	178	82%
	coffee	-.14*	.07	..	182	87%
	West Africa	-.28 *** ”’	.04	.06	740	76%
D	Equatorial Africa	-.35 *** ”’	.04	.05	545	70%

$ln(E)$ is the natural logarithm of the ratio between African and competitive price, defined in equation 7. ***, **, and * indicate statistical significance at 1%, 5%, and 10% level with standard error clustered at the colony/commodity level. ”’, ”, and ’ indicate statistical significance at 1%, 5%, and 10% level with standard error double clustered at the (1) colony and (2) commodity level.

TABLE IV
Share of Exports, by Institutions

	(1) All French Africa	(2a) French West Africa	(2b) French Equatorial Africa
free peasant production	.65	.73	.43
compulsory production	.11	.02	.39
concession production	.24	.27	.18

The table shows the share of the total value of exports produced under each of the main labor institutions.

TABLE V
Variance of Institutions

	% variance explained	F-stat	p-value
crop fixed effects	.39	167.8	0.00
colony fixed effects	.10	17.3	0.00
year fixed effects	.02	1.2	0.16

ANOVA of institutions, N=1513.

TABLE VI
Effect of Prices on Institutions

	(1)	(2)
Compulsory peasant production		
ln(price Africa) at t-1	2.21***	-.69
st. error	(.38)	(.69)
marginal effect	+25%***	0%
Concession production		
ln(price Africa) at t-1	2.13***	3.36**
st. error	(.52)	(1.41)
marginal effect	+29%***	0%***
commodity/colony FE	No	Yes
N	1052	1052

Multinomial logit. The baseline is free peasant production. Standard errors clustered at the colony/commodity level are reported in parenthesis. ***, **, and * indicate statistical significance at 1%, 5%, and 10% level.

TABLE VII
Effect of Labor Institutions on Prices

	Dependent variable is ln(price Africa)				
	(1)	(2)	(3)	(4)	(5)
compulsory peasant production	-.29** '	-.35*** "'	-.23* '	-.22** '	-.22** '
	(.12)	(.12)	(.12)	(.10)	(.10)
	[.16]	[.12]	[.12]	[.12]	[.12]
compulsory*30s		.12	.38*** "	.10	.11
		(.09)	(.11)	(.09)	(.09)
		[.17]	[.19]	[.11]	[.11]
compulsory*40s		-.31*	.60** "'	.33* '	.33* '
		(.17)	(.25)	(.18)	(.18)
		[.08]	[.16]	[.11]	[.11]
concession production	.36*	.37*	.19	.20*	.20*
	(.19)	(.20)	(.16)	(.11)	(.11)
	[.25]	[.28]	[.19]	[.13]	[.13]
concession*30s		.06	.32*** "'	.03	.04
		(.09)	(.07)	(.06)	(.06)
		[.04]	[.08]	[.06]	[.07]
concession*40s		-.28*** "'	.28* '	.17	.17 '
		(.08)	(.16)	(.11)	(.10)
		[.08]	[.15]	[.11]	[.10]
ln(competitive price)	.72*** "'	.70*** "'	.69*** "'	.42*** "'	.42*** "'
	.04	(.06)	(.07)	(.06)	(.06)
	[.05]	[.08]	[.07]	[.04]	[.04]
ln(competitive price)*30s		.05	-.12**	.01	.02
		(.04)	(.06)	(.04)	(.04)
		[.06]	[.10]	[.05]	[.05]
ln(competitive price)*40s		.37*** "'	-.04	-.02	-.03
		(.08)	(.12)	(.08)	(.08)
		[.08]	[.10]	[.08]	[.07]
ln(price Africa) at t-1				.44*** "'	.44*** "'
				(.04)	(.04)
				[.06]	[.06]
ln(quantity)					-.00
					(.01)
					[.02]
commodity/colony FE	Yes	Yes	Yes	Yes	Yes
year FE			Yes	Yes	Yes
R2	.87	.88	.91	.94	.94
N	1285	1285	1285	886	886

The baseline is free peasant production. Standard errors are in round brackets if clustered at the colony/commodity level and in squared brackets if double clustered at the colony and commodity level.***, **, and * indicate statistical significance at 1%, 5%, and 10% level with standard error clustered at the colony/commodity level. "', ", and ' indicate statistical significance at 1%, 5%, and 10% level with standard error double-clustered at the (1) colony and (2) commodity level.

TABLE VIII

Lower Bounds for Percentage Reduction of Gains From Trade

	simple average		weighted by value		
	mean % loss	st. err	mean% loss	st. err	N
Overall	37%	2%	48%	1%	1285
pre-WW1					
West Africa	18%	14%	60%	6%	125
Equatorial Africa	24%	9%	53%	7%	61
1920s					
West Africa	43%	4%	55%	1%	262
Equatorial Africa	70%	5%	68%	3%	149
1930s					
West Africa	36%	4%	31%	1%	222
Equatorial Africa	14%	5%	40%	2%	184
WW2					
West Africa	..	..	..	..	0
Equatorial Africa	92%	6%	90%	2%	69
post-WW2					
West Africa	20%	7%	24%	2%	131
Equatorial Africa	34%	6%	17%	2%	82

The table reports lower bounds for the relative losses of gains from trade due to colonial extraction. Lower bounds are estimated according to equation (9). Values are computed at French prices.

Table IX
Shares of World Production, 1961

	Main Producer	Share Main Producer	Share French Africa
Cotton	Chad	0.2%	0.5%
Rubber	Cameroon	0.4%	0.5%
Palm oil	Cameroon	0.5%	1.2%
Bananas	Cameroon	0.7%	2.1%
Coffee	Ivory Coast	4.1%	5.9%
Palm kernels	Cameroon	5.0%	13.8%
Cocoa	Ivory Coast	7.2%	14.9%
Peanuts	Senegal	7.2%	12.7%

The table shows the share for the main producing country in ex-French Africa and for the entire ex-French Africa as a proportion of the total world production for the different commodities in 1961. Source: elaboration from FAO [2013]. During the colonial period, these shares are even lower: in the late 1940s, coffee from Ivory Coast and peanuts from Senegal account for only 2% of world production, cocoa from Ivory Coast and palm kernels from Cameroon account for 4%.
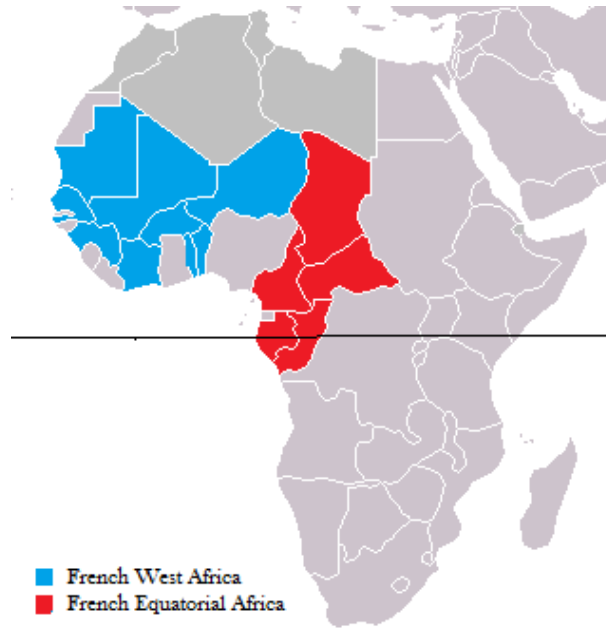
Figure I
French West and Equatorial Africa

Togo and Cameron were not formally part of the two main federations, but they were traditionally included in West and Equatorial French Africa, respectively.
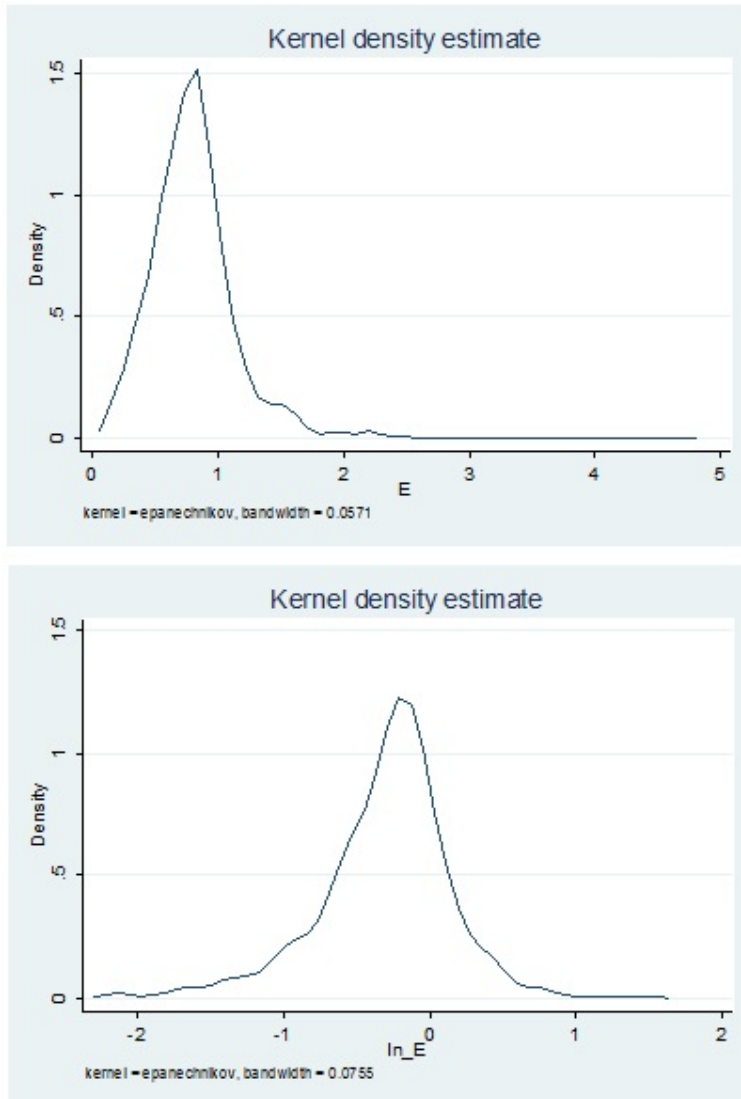
FIGURE II

Kernel densities of E and ln(E)

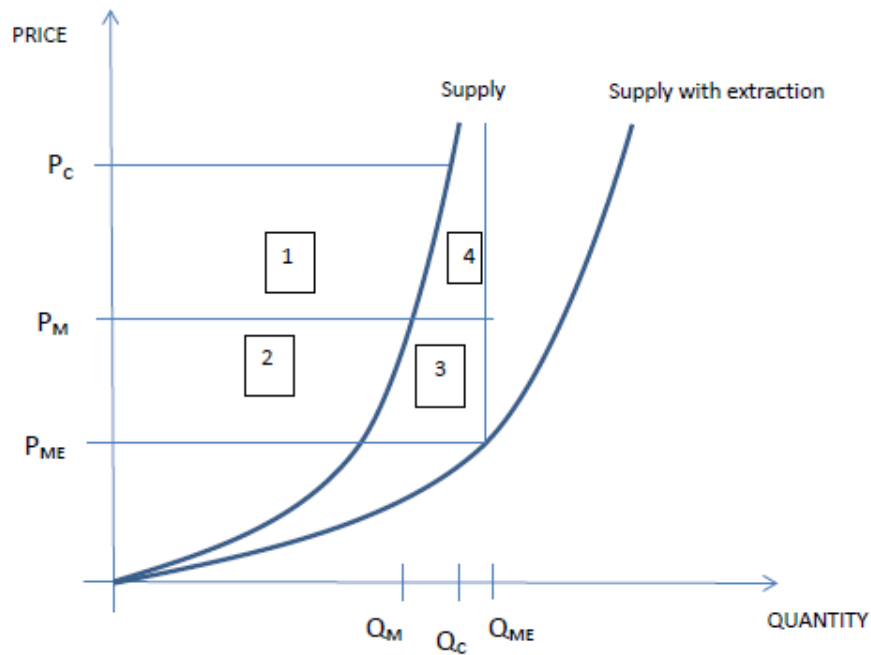E is the ratio of observed and competitive price at the exit port, defined in equation (7).

FIGURE III
African Gains from Trade

C subscript refers to competition, M to monopsony, and ME to monopsony and extractive labor institutions.
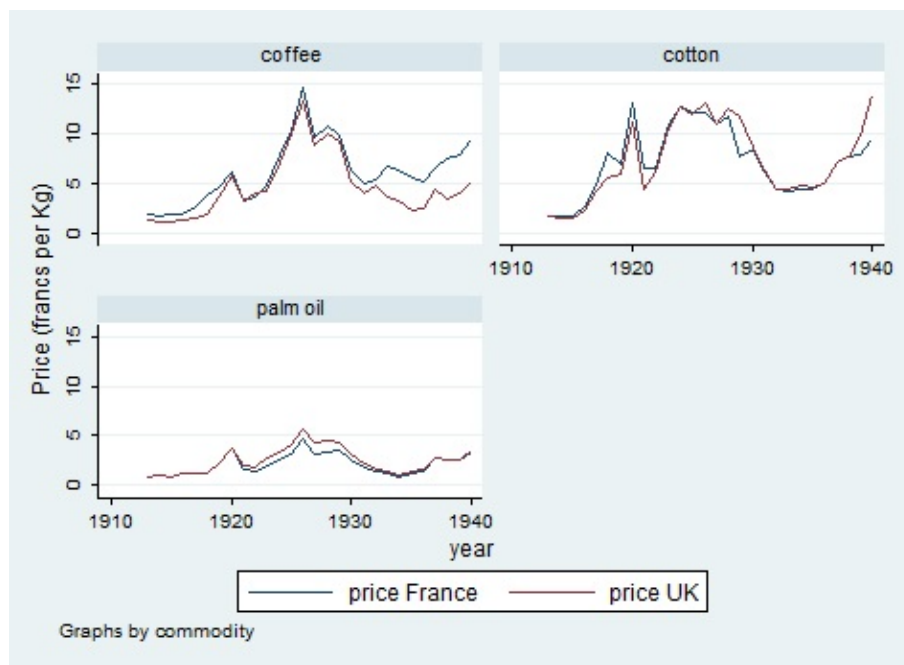

FIGURE IV
Prices in France and UK
In 1900 French francs.

49