Urbanization *without* Structural Transformation: Evidence from Consumption Cities in Africa*

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Abstract: Africa has recently experienced dramatic urbanization. Standard theories of structural transformation cannot explain this result, as it was not driven by a green revolution or an industrial revolution, but by natural resource exports. I explain how the Engel curve implies that resource windfalls are disproportionately spent on urban goods and services, which gives rise to "consumption cities". I illustrate this theory using both cross-country evidence and within-country evidence from Ivory Coast and Ghana using new data spanning one century and two identification strategies (an instrumental variables strategy and a fixed effects approach). I find a strong causal effect of the production of cocoa, a rural-based natural resource, on the growth of cities. I discuss the implications of urbanization *without* structural transformation for long-run growth.

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1. INTRODUCTION

Urbanization is typically seen as a consequence of economic growth. As a country develops, people move out of the rural-based agricultural sector into the urban-based manufacturing and service sectors. Standard structural transformation models identify "labor push" and "labor pull" factors as the main drivers of this transition. The labor push approach shows how a rise in agricultural productivity - a *green revolution* - reduces the "food problem" and releases labor for the modern sector. The labor pull approach describes how a rise in non-agricultural productivity - an *industrial revolution* - attracts underemployed labor from agriculture into the modern sector .[1] These mechanisms all lead to greater non-agricultural employment, and thus greater urban employment as a proportion of total workforce.

However, in many parts of the world, urbanization has occurred without structural transformation towards manufacturing and services (Gollin, Jedwab & Vollrath, 2013). Figure 1 shows the relationship between urbanization and the fraction of economic activity engaged in manufacturing and services in 2000 for 119 developing countries, along with a quadratic fit line. There are many countries for which the processes of urbanization and structural transformation are disconnected. An explanation for this paradox can be seen by breaking up the sample based on the importance of natural resource exports.[2] Countries for which resource exports account for more than 10% of GDP are denoted in grey. These countries make up the vast majority of the countries that urbanized without structural transformation.

Sub-Saharan Africa offers a perfect example of this type of urbanization. At the turn of the 20th century, Africa's urbanization rate was 5%, the same level as in Medieval Europe (Bairoch, 1988). In 1960, Africa's urbanization rate was 15%, as low as in the European Renaissance. It is now around 40%, as high as contemporary Asia, or developed countries after the Industrial Revolution.[3] Standard structural transformation models can not account for African urbanization. First, there has been no green revolution. Africa's food yields have remained low (Evenson & Gollin, 2003; Caselli, 2005; Restuccia, Yang & Zhu, 2008); in 2009, cereal yields were 2.8 times lower than in Asia, while yields were 2.1 times lower for starchy roots (FAO, 2012). Second, there has been no industrial revolution. Africa's manufacturing and service sectors are relatively small and unproductive (McMillan & Rodrik, 2011; Badiane, 2011; Jedwab & Darko Osei, 2012). In 2007, employment shares in industry and services were 10% and 26% for Africa, but 24% and 35% for Asia, and African labor productivity was 1.7 and 3.5 times lower in industry and services, respectively (World Bank, 2012). Third, while Asia has followed the standard pattern of urbanization and structural change, Africa's urbanization appears to be driven by a *natural resource revolution* (Gollin, Jedwab & Vollrath, 2013). This is confirmed by Figure 2 which plots the urbanization rate in 2000 against the average contribution of resource exports to GDP in 1960-2000 for Africa.[4] This relationship

[1] For studies that have focused on the link between a green revolution and structural change, see Schultz (1953), Caselli & Coleman II (2001), Gollin, Parente & Rogerson (2002, 2007), Nunn & Qian (2011) and Michaels, Rauch & Redding (2012). For studies of an industrial revolution, see Lewis (1954), Harris & Todaro (1970), Hansen & Prescott (2002), Lucas (2004, 2009) and Alvarez-Cuadrado & Poschke (2011). An industrial revolution facilitates the modernization of agriculture (Restuccia, Yang & Zhu, 2008; Yang & Zhu, 2010). Alternatively, a country with a comparative advantage in manufacturing can import food (Matsuyama, 1992; Yi & Zhang, 2011).

[2] My category of "natural resource exports" includes point source natural resources, such as oil and minerals, and non-point source natural resources, such plantation crops and timber.

[3] I alternatively use the expressions "Sub-Saharan Africa" and "Africa" in the rest of the paper to refer to 46 countries south of the Sahara. Africa's urbanization rate was 37% in 2010, while it was 40% for Asia (United Nations, 2011). It was 45% in England in 1850 and 42% in the U.S. in 1910 (Bairoch, 1988). I also use data on cities larger than 750,000 to find that they make up 39% of urban population in Africa and 44% in Asia.

[4] The historical contribution of natural resource exports to GDP is more than 10% for 34 countries. The most

cannot be explained by resource production industries being large employers of urban workers. Since point-source natural resources are capital-intensive, their numerical contribution to urban employment is small. For example, mining and quarrying only account for 0.9% of Africa's urban workforce in 2000.[5] Cash crops mostly contribute to rural employment.

In this paper, I study the role of resource exports in creating a disconnection between the processes of urbanization and structural transformation. The first part of the paper establishes that the pattern seen for Africa (Figure 2) is robust to other factors of urbanization. A contribution of this study is to document that there are different paths of urbanization. I also investigate whether these different paths are associated with different sectoral compositions of the urban workforce, which is important for both economic theory and policy.

The second part of the paper offers a conceptual framework for thinking about the role of resource exports in urbanization. I examine different models in the literature and explain how they could be modified to account for the stylized facts described above. Given differences between the international price and local production costs, the export of natural resources has often generated a considerable surplus for producing countries. If the Engel curve implies that this surplus is mainly spent on urban goods and services, resource exports drive urbanization. Since greater opportunities in the urban sector attract people to cities, the theory is in line with the labor pull hypothesis, except the resource sector is the main driver of this transformation. First, as wealth is created in the non-urban sector and spent in the urban sector, these "consumption cities" arise due to demand factors. Second, if manufactured goods and tradable services are imported from abroad, the mix of urban workers is heavily skewed towards non-tradable services. These countries urbanize without structural transformation. Third, countries that specialize in the export of (urban-based) manufactured goods and tradable services urbanize with structural transformation. This specialization effect gives rise to "production cities", with a mix of workers in tradable and non-tradable sectors.

The third part of the paper provides within-country evidence consistent with the stylized facts and channels discussed above. I use new data from Ghana and Ivory Coast to investigate the causal effect of the production of cocoa, a rural-based natural resource, on the growth of cities at the district level over one century. Cocoa production boomed in the 1920's in Ghana and the 1950's in Ivory Coast (Ruf, 1995*a*), when they became the two largest producers in the world.[6] Overall, cocoa production has accounted for 60% of their exports after 1948. I believe that examining cocoa in these two countries provides me with the perfect natural experiment to study the role of resource exports in urbanization. Given the scarcity of historical data for African countries, it is usually very difficult to study questions over such a long period. However, I have used various historical sources to recreate district-level data on resource production and urbanization in Ghana from 1901-2000 and Ivory Coast from 1948-1998. This would not have been possible for most other African countries. They are now two of the most urbanized countries in Africa, with urbanization rates around 50% in 2010; although, cocoa is produced on farms mostly owned by smallholders. Cocoa cultivation has few production linkages. Its mode of production has remained very traditional, with limited used of modern (urban) inputs. There is no local transformation of cocoa beans and transportation activities

urbanized countries export fuels and mineral products (Gabon, Republic of the Congo, South Africa, Botswana, Nigeria, Angola, Namibia, Liberia, Zambia) or plantation crops (Ivory Coast, Ghana, Senegal, Gambia, Cameroon).

[5]For example, Angola's urbanization rate was 15% before the oil boom in the 1970's, but it was 58% in 2010. Crude oil now accounts for 62% of GDP, but it employs fewer than 10,000 nationals. Botswana's urbanization rate is similar, but while the diamond sector accounts for 38% of GDP, it only provides employment for 13,000 people.

[6]Since Ivory Coast is a major coffee exporter and since Ivorian cocoa farmers also produce coffee that shares the same agronomic features as cocoa, I examine both. I alternatively use the expressions "cocoa production" and "cash crop production" in the rest of the paper, although they always include coffee for Ivory Coast.

generated by their export contribute little to urban employment. Only consumption linkages can account for this relationship. Lastly, cocoa cultivation has four unique features, which I exploit in order to identify its causal effect on the extent and the type of urban growth.

The first unique feature of cocoa production is that only forested areas are suitable for cocoa cultivation, which limits production to the South in each country. Cocoa is produced by "consuming" the forest (Ruf, 1995*a*,*b*), as cocoa smallholders go to a patch of virgin forest and replace forest trees with cocoa trees. The causality is unlikely to run from cities to cash crop production because settlement in the forest was historically limited due to tall trees, thick vegetation, high humidity and disease incidence. Farmers overcame these constraints when they achieved an income high enough to pay the fixed costs of deforestation, which was the case with cocoa. Given its traditional mode of production, there is also no role for cities in the diffusion of technological innovations used in this sector.

Within the forest, some areas are relatively more suitable for cocoa cultivation due to richer soil nutrients, and yields are much higher for the same level of inputs. Interestingly, highly suitable and poorly suitable areas are not different to the naked eye, since they only differ with the respect of the soil content. I estimate a long difference model: I regress the total district value of cash crop production on the change in the district urbanization rate between the beginning and the end of the period (1948 and 1998 for Ivory Coast, 1901 and 2000 for Ghana). I classify the districts into three groups: the *non-suitable*, the *poorly suitable* and the *highly suitable* districts. We expect the cash crop production over the long period to be much higher in the latter group, which then has a strong effect on urbanization. That is why I instrument the total district value of cash crop production with a dummy whose value is one if the district is highly suitable. I can also restrict the analysis to the suitable districts only. The instrument then captures the effect of being relatively more "suitable" than the other districts of the tropical forest, which makes it an even stronger identification strategy.

An unique agronomic feature of cocoa production is that yields begin to decline 20 years after planting (Ruf, 1995*a*,*b*). Cocoa trees become too old and must be replaced. However, the forest initially provides agronomic benefits (e.g., a high level of humidity and abundant rainfall) which are also extinguished after 20 years of local deforestation. Replanted cocoa trees die or are much less productive, which force farmers to move to a new forest a few years later, usually 25 years after cocoa trees were first planted. This extensive production strategy gives rise to district production cycles that can last several decades. For historical reasons, the cocoa front started in the East of each country. Production first spread out one century ago in the South-East of Ghana, in the vicinity of Aburi Botanical Gardens from where the British colonizer distributed cocoa seedlings to the local farmers. Production later started in the Southeast of Ivory Coast because the local tribes had heard of the wealth of the Ghanaian cocoa farmers and also wanted to adopt the crop. These factors resulted in the cocoa front moving across the South of each country from east to west. As production moved westward, new cities appeared in the West. Thus, when a district's production booms, we expect to see a rise in its urbanization rate. Therefore, I estimate a short difference model with district fixed effects: I regress the district value of cocoa production on the change in the district urbanization rate using several periods (1948, 1955, 1965, 1975, 1988, 1998 for Ivory Coast). I do not have panel data on district urbanization rates for Ghana (1901-2000), as administrative boundaries have been considerably modified across years, this impeding any consistent reaggregation. By using the panel dimension of the data and including district fixed effects, I capture the effects of these local resource booms on local urbanization. I also include district time trends and region-year fixed effects. The identification then comes from non-linear variations within districts over time, while simultaneously controlling for regional effects specific to some years. To see any effect for a district, it must be that cocoa production booms, across periods and relatively to the neighboring districts of the same region, in a difference-in-difference spirit.

Finally, I use the westward wave to identify the short-term and long-term effects of resource exports on the sectoral composition of these consumption cities. I do not find that cities collapse in the old producing areas in the east. Therefore, I can compare cities in the new and old producing areas using cross-sectional employment data for the recent period. Although the cities in the east have boomed relatively earlier and have lost their access to the resource rent, I find that these cities are still not specialized at all in manufactured goods and tradable services. I also find that the employment share of these sectors is relatively small in the government districts, which I define here as the districts of the capital and second largest city. In the end, both the old producing and government districts have urbanized without structural transformation. Lastly, I use cross-sectional data on capital accumulation and infrastructure investments to investigate the mechanisms of urban persistence in these areas.

The last part of the paper uses the results of the previous three parts to discuss the implications of urbanization without structural transformation for long-run development.

This paper is related to a large body of work on the relationship between urbanization and growth. While the structural transformation literature cited above portrays urbanization as a by-product of economic development, the economic geography literature suggests that agglomeration promotes growth, in both developed countries (Rosenthal & Strange, 2004; Henderson, 2005) and developing countries (Overman & Venables, 2005; Henderson, 2010). Given that urbanization is a form of agglomeration, it has thus been argued that cities could promote growth in developing countries (Duranton, 2008; Venables, 2010; McKinsey, 2011).[7] Yet evidence that urbanization drives growth is rather weak in cross-country regression frameworks (Henderson, 2003). Whether urbanization promotes growth is likely to depend on the type of the city. This paper shows that resource exports create consumption cities, with small manufacturing and tradable service sectors. If these "missing" sectors are more likely to exhibit agglomeration effects and provide incentives for capital accumulation, consumption cities could have a relatively lower positive impact on long-run growth than other cities.[8]

This paper also contributes to the Dutch disease and resource curse literatures (Corden & Neary, 1982; Matsuyama, 1992; Sachs & Warner, 2001; Michaels, 2011). Dutch disease models suggest that a country deindustrializes when its resource sector booms. The boom shifts labor and other resources away from the manufacturing sector into the non-tradable service sector, but the net effect on urbanization is ambiguous. These models do not explain why resource-rich developing countries have urbanized with almost no industrialization. I highlight a new dimension of the resource curse – the rise of "consumption cities" that may not produce the same agglomeration economies that are found in typical urban areas.

Finally, my research is related to the literature on the respective roles of geography and history in development. The locational fundamentals theory argues that natural advantages have a long-term impact on economic activity (e.g. Sokoloff & Engerman, 2000; Davis & Weinstein, 2002), while the increasing returns theory posits that there is path dependence in the loca-

[7] McKinsey (2011) writes (p.3-19): "Africa's long-term growth also will increasingly reflect interrelated social and demographic trends that are creating new engines of domestic growth. Chief among these are urbanization and the rise of the middle-class African consumer. [...] In many African countries, urbanization is boosting productivity (which rises as workers move from agricultural work into urban jobs), demand and investment."

[8] Consumption cities arise as market towns (Von Thunen, 1826; Christaller, 1933) or as places offering better consumption amenities (Glaeser, Kolko & Saiz, 2001; Rappaport, 2008). Government cities are also consumption cities because their growth is related to the government consumption of urban goods and services (e.g., civil servants) in specific urban locations (De Long & Shleifer, 1993; Ades & Glaeser, 1995; Davis & Henderson, 2003).

tion of economic activity (e.g. Rosenthal & Strange, 2004; Henderson, 2005; Bleakley & Lin, 2012). As in Nunn & Qian (2011), areas suitable for agricultural production are more developed today. However, I look at cash crops while they consider food crops, for which different mechanisms may be at play. Here the natural advantage is transitory, not known before the arrival of cocoa cultivation and not existing after exploitation. The fact that old-producing areas are still relatively more urbanized, but not necessarily more industrialized, indicates that path dependence is possible even without much structural change.

The paper is organized as follows: The next section shows there is urbanization without structural transformation in Africa. Section 3 offers a conceptual framework for thinking about the role of resource exports in urbanization. Section 4 presents the background of cocoa production and cities in Ivory Coast and Ghana and the data used in this study. Section 5 presents the empirical strategy and results. Section 6 discusses the results. Section 7 concludes.

2. PATTERNS OF URBANIZATION IN AFRICA

In this section, I document that there are different paths of urbanization, using Africa as an example. I establish that the pattern seen in Figure 2 is robust to other factors of urbanization. I also investigate whether these different paths are associated with different sectoral compositions of the urban workforce. Interestingly, Gollin, Jedwab & Vollrath (2013) obtain the same results when using a sample of 119 (African and non-African) developing countries.

2.1 Cross-sectional Robustness Checks

Table 1 presents results of cross-sectional regressions using a sample of 46 African countries for the year 2000. The first three columns use the urbanization rate as the dependent variable, regressed on the average contribution of resource exports to GDP in 1960-2000. Columns (1) shows there is a strong positive (unconditional) effect of resource exports on urbanization. There are several alternative theories for urbanization within Africa, that may make this result spurious. A few studies argue that Africa has urbanized without it being fully explained by growth (Fay & Opal, 2000). This excessive urbanization is attributed to pull and push factors feeding rural exodus. Some argue that urban growth could be driven by rural poverty (Barrios, Bertinelli & Strobl, 2006; Poelhekke, 2010). Others have focused on theories of urban bias, arguing that urban-biased policies have led to overurbanization and primacy in poor countries (Lipton, 1977; Bates, 1981; Ades & Glaeser, 1995; Davis & Henderson, 2003). Furthermore, if resource exporters systematically use different methods for calculating urbanization rates, the results may simply reflect measurement errors (see Potts 2012 for Nigeria).

In column (2) I incorporate a number of other controls to account for several of these alternative theories. These are country area in sq km, population in thousands, rural density, population growth from 1960–2000 (in percent), a dummy if the country is landlocked, a dummy if the country is often affected by droughts, a dummy for whether the country has experienced an interstate or civil conflict since independence, and a dummy if a country has been mostly autocratic since independence. In addition, we include dummies for four different types of urban definitions used by African countries.[9] As can be seen in the table, the inclusion of these controls does not alter the positive association of resource exports with urbanization rates. The magnitude is high: A one standard deviation increase in natural resource exports

[9] See the data appendix for a full description of the sources for all of these variables.

leads to a .62 standard deviation increase in the urbanization rate. In column (3), we control for initial conditions, i.e. the urbanization rate and the contribution of resource exports to GDP in 1960. The regression is then similar to a long-difference model: The identification comes from variation across countries over time. Results are almost unchanged.[10]

2.2 Composition of Urban Workforce

The evidence of the prior section established that natural resources are strongly associated with urbanization in Africa. Here I establish the second important fact regarding resources and urbanization, related to the composition of labor in urban areas. I use IPUMS census data, various census reports, labor force surveys and household surveys to recreate the sectoral composition of the urban sector for 27 African countries for the year 2000.[11] Although the different sources often use a standard classification of nine sectors as in McMillan & Rodrik (2011), I only focus on four sectors: *Manuf. & Fire* ("Manufacturing" and "Finance, Insurance, Real Estate and Business Services", a proxy for tradable services), *Trade & Transp.* ("Wholesale and Retail Trade, Hotels and Restaurants" and "Transport, Storage and Communications"), *Govt Services* ("Public Administration", "Education" and "Health") and *Other Sectors* ("Agriculture, Fishing and Forestry", "Mining", "Public Utilities", "Construction" and "Community, Social and Private Services"). I run the same regression as before, except the dependent variable is the employment share of each sector, for the urban sector only (columns (4)-(7)) and the largest city only (columns (8)-(11)). I also control for the urbanization rate in 2000.

Column (4) indicates that cities in resource-rich countries have less manufacturing and tradable services, for the same urbanization rate. The magnitude is also high: A one standard deviation increase in resource exports leads to a .63 standard deviation decrease in their employment share. The employment share of trade and transportation is then larger in these cities (see column (5)). A one standard deviation increase in resource exports leads to a .47 standard deviation decrease in their employment share. The explanation is simple: Resource rich countries run large export surpluses that they use to import food and manufactured goods. I find that resource exports strongly increase the share of (non-resource) imports in GDP (not shown, but available upon request). This creates opportunities in the import and domestic trade sectors (when imported goods are "dispatched" to the rest of the country). Second, it has been documented that public employment levels are high in these countries (Lipton, 1977; Bates, 1981). I also find that the employment share of government services is larger, although this effect is not significant (see column (6)). One reason for this might be that the structural adjustment programmes in the 1980's and 1990's had a very negative effect on the provision of government services, which reduced the effect for the year 2000 (Jedwab & Darko Osei, 2012). Or there are heterogeneous effects: For example, the employment share of government services is much higher in countries that are both resource rich and

[10]Although the goal of this section is not to identify a causal effect of resource exports on urbanization, I also estimate a short difference model with country and region-year fixed effects. The identification comes from variations within countries over time, while simultaneously controlling for regional effects specific to some years. The short-term effect is lower than the long-term effect, 0.10** against 0.62*** (see column (3) of Table 3). This is expected if the effects are not immediate. When I also include lags of resource production, I find that the combined effects of resource exports strongly increase. Back-of-the-envelop calculations confirm that these sequential short-term effects can explain the magnitude of the long-term effect. Both methods are thus complementary.

[11]First, I was only able to find data for 27 out of 46 African countries, but these countries account for more than 80% of the continent's population. Regressions being population-weighted, adding more countries is unlikely to change the results. Second, because the census and survey years differ from the year 2000, I always use data for the closest year. Table A.1 lists all the countries and years for which I have employment data.

not democratic. Results are robust to considering the largest city only. To conclude, resource rich countries have experienced urbanization without structural transformation.

3. THEORETICAL IMPACTS OF RESOURCE EXPORTS ON URBANIZATION

This section offers a conceptual framework for thinking about the role of resource exports in urbanization. In Model Appendix B, I adapt a new structural change model that I discuss here. As emphasized before, resource production contributes little to urban employment. For resource exports to create cities, there must be consumption or production linkages.

Assume a small economy, one production factor - labor - and four sectors: food, resources, urban tradables (tradable manufactured goods and services) and urban non-tradables (non-tradable manufactured goods and services).[12] The production of urban tradables and non-tradables takes place in the cities (the resource sector is considered as non-urban). Only urban non-tradables are not tradable. Without a green revolution, food productivity is low and the food problem constrains the reallocation of labor to the urban sectors. Now, if the country has a comparative advantage in resource exports, it can trade natural resources for food and urban tradables. If the international commodity price is higher than domestic production costs, resource exports generate a surplus for the country. With non-homothetic preferences, this surplus is disproportionately spent on urban goods and services, i.e. urban tradables and non-tradables. This creates opportunities in the urban sector, which attracts people to cities. The country urbanizes through the rise of "consumption cities".

Because greater opportunities in the urban sector attract people to cities, the theory is in line with the labor pull hypothesis, except the resource sector is the main driver of this transformation. As wealth is created in the non-urban sector and spent in the urban sector, these consumption cities arise due to demand factors. If domestic and foreign foodstuffs are imperfect substitutes and/or internal trade costs are high, making imports too expensive for the hinterland, the food sector will not entirely disappear. But if urban tradables are mostly imported from abroad, the mix of urban workers is heavily skewed towards urban non-tradables. The country urbanizes without structural transformation. One limitation of the model is that it does not permit capital accumulation in the urban tradables sector, which could increase productivity over time and change the country's comparative advantage. However, if there are dynamic externalities, the original structural of comparative advantages is reinforced over time, and it is difficult for the country to compete with countries that industrialized earlier. On the contrary, countries that specialize in the export of (urban-based) manufactured goods and tradable services urbanize with structural transformation. This specialization effect gives rise to "production cities", with a mix of workers in tradable and non-tradable sectors.

In the model, any rise in the resource rent increases the labor share of urban non-tradables. First, if the supply of natural resources is very inelastic, as it is the case for minerals (e.g., oil and diamonds) and some cash crops (e.g., cocoa), the international price is much higher than domestic production costs. The size of the surplus will then determine the urbanization rate. For countries that have a comparative advantage in urban tradables, the income effect is much smaller because these markets are much more competitive. They mostly urbanize because of the specialization effect. Second, productivity in the resource sector could be so

[12] Urban tradables consist of manufactured goods and services (finance, insurance, business services, etc.) that are internationally traded. This assumes that domestic and foreign versions of these goods and services are relatively substitutable. The urban non-tradables sector addresses the specific demand for domestic manufactured goods and services, that are not internationally traded, whether its is due to local preferences or trade costs.

high that the resource rent is like a "manna from heaven", for example when we compare countries exporting minerals and countries exporting cash crops. We expect the urbanization rate to be higher for the former. Third, any rent produces urbanization, for example aid and remittances. However, the total values of aid and remittances are 9.8 and 9.0 times smaller than the total value of resource exports for developing countries in 2010 (World Bank, 2012). Fourth, because resource rich countries are more integrated with the rest of the world, they have larger trade and transportation sectors. Fifth, government taxation augments the effect of resource exports on urbanization if the government's Engel curve for urban non-tradables (e.g., civil servants) is steeper than the private Engel curve. If the government also concentrates its urban consumption in its own region, this increases the primacy rate.

4. BACKGROUND AND DATA IN IVORY COAST AND GHANA

In this section, I discuss some essential features of the Ghanaian and Ivorian economies, and introduce the data I have collected to analyze how cash crop production has contributed to urbanization. The Data Appendix contains more details on how I construct the data.

4.1 New Data on Ivory Coast and Ghana, 1891-2000

To evaluate the impact of cash crop production on urbanization, I construct a new data set on 79 Ghanaian districts from 1891-2000 and 50 Ivorian districts from 1948-1998.[13]

I first collect data on cocoa production in tons for Ghanaian and Ivorian districts for available years. I use linear interpolation for missing years. Knowing the producer price for each year, I calculate the district value of production in year 2000 U.S. dollars. Since Ivory Coast is a major coffee exporter and since Ivorian cocoa farmers also produce coffee, I proceed similarly for this crop. In the end, I obtain an annual panel data set with the value of cash crop production (cocoa and coffee) from 1891 to 2000 in Ghana and from 1948 to 1998 in Ivory Coast.

I construct a GIS database of cities using census reports. My analysis is limited to those years for which I have urban data, which is approximatively decadal in both countries.[14] Historical studies on urbanization define a city as any locality with more than 5,000 inhabitants (e.g. Bairoch, 1988; Acemoglu, Johnson & Robinson, 2002).[15] Using the same approach, Ghana had 9 cities in 1901 and 324 cities in 2000, while Ivory Coast had 0 cities in 1901 and 376 cities in 1998.[16] Since the production data is at the district level, I use GIS to construct district urban population for the above-mentioned years.[17] I also add district total population to the Ivorian panel. This is not possible for Ghana, as the cocoa districts for which I have production data differ from the administrative districts for which population data is available.

[13] The number of Ghanaian districts has been decreasing over time, while the number of Ivorian districts has been increasing. I use various sources and GIS to reconstruct the data set using the same boundaries for the whole period; 1960 cocoa district boundaries for Ghana and 1998 administrative district boundaries for Ivory Coast.

[14] These years are 1891, 1901, 1911, 1921, 1931, 1948, 1960, 1970, 1984 and 2000 in Ghana, and 1901, 1911, 1921, 1931, 1948, 1955, 1965, 1975, 1988 and 1998 in Ivory Coast.

[15] Bairoch (1988, p.217-219) discusses why the 5,000 population threshold is optimal: "In the instances where use is made of the criterion of size (that is, in most censuses), the limit of 5,000 most nearly approximates the average of the various limits employed." For 61 developing countries using a size criterion in 2000, I find that the average threshold is 4,390 inhabitants (United Nations, 2011). 7 countries adopt a size criterion above 5,000.

[16] Using Google Earth, I verify that each city can be clearly identified as such for the most recent census year. I also aggregate localities that actually belong to a same agglomeration.

[17] Cash crop production only booms from the 1960s in Ivory Coast. I use urban data before 1948 to understand urban patterns before the boom.

I complement the data set with various statistics at the country, regional and district levels, such as economic geography (e.g., transportation networks and Euclidean distance to the coast), physical geography (e.g., soil suitability for cocoa cultivation and rainfall), employment composition and migration. This data was obtained from GIS data sets, household surveys, census microdata and reports, country-level databases and agronomic studies.

4.2 Agronomic Background on Cocoa

Cocoa is produced by consuming tropical forests (Ruf, 1995*a*,*b*; Petithughenin, 1995). Cocoa smallholders go to a patch of virgin forest and replace forest trees with cocoa trees.[18] Pod production starts 5 years after planting and peaks after 20 years. Pods give beans that are dried and sent unprocessed to a port for export.

The forest initially provides agronomic benefits in growing cocoa (Ruf, 1995*b*, p.7): “weed control, soil fertility, protection against erosion, moisture retention for soil and plants, protection against disease and pests, protection against drying winds, [...] stabilizing effect on precipitation."[19] After 20 years, cocoa trees become too old and need to be replaced or the farmer will face a continuous decline in yields. However, the agronomic benefits of the forest are also extinguished after 20 years of local deforestation, and replanted cocoa trees die or are much less productive (Petithughenin, 1995, p.96-97). Establishing a new cocoa farm in a cleared primary forest requires 86 days of manual labor, against 168 days for manual replanting (Ruf, 1995*b*, p.9). Also, it is twice as expensive to opt for a replanting strategy as intermediate inputs (fertilizers, pesticides) are needed to compensate for tree mortality and low yields (Ruf, 1995*a*, p.240). As a result, farmers look for a decline in pod production over the course of a few years - which normally occurs 25 years after planting - as a sign to move to a new patch of virgin forest and initiate a new production cycle. These agronomic patterns at the plantation level, and the abundance of forested land for most of the 20th century, explain why African cocoa farmers have always preferred an extensive production strategy.

The aggregation of household migration patterns gives rise to regional cocoa booms that last several decades (Ruf, 1995*a*, p.190-203). Regional production at a given point in time is equal to cocoa land area times cocoa yields. Cocoa land area depends on the forest endowment and the number of farmers, while yields reflect soil nutrients and the age distribution of trees. Booming regions experience massive in-migration of farmers. In the words of Ruf (1995*b*, p.15), "It seems that all it takes is for people to see money from the first sale of a crop in the hands of the first migrant planters before a cocoa migration and boom is triggered". This is for several reasons. First, land is cheap to buy.[20] Second, farmers do not need much capital to start their own plantation (Ruf, 1995*b*, p.22); they only use land, axes, machetes, hoes, cocoa beans and labor. Third, farmers can easily intercrop cocoa with food crops such as cassava, taro and yam. Lastly, yields are high in the early years of production.

A few decades later, trees are old, yields have decreased and regional production declines, although production decreases can be slowed or even reversed if formerly protected forests in the region are opened to cultivation. Cocoa cultivation becomes less profitable. Ruf (1991, p.87) writes: “Planting cocoa gives social status, reflecting the ownership of capital yielding

[18]The involvement of multinationals in cash crop production in Africa is very recent.

[19]Ruf (1995*b*, p.95-100) describes how rainfall has diminished and become more erratic in old producing areas.

[20]Ruf (1995*a*, p.252-260) documents how the land price is initially low in unexploited forests. Migrant farmers buy large amounts of land from the chiefs of forest tribes, which causes the price to rise. This land colonization process was encouraged by the government. Ivorian President Houphouët-Boigny liked to say that “land belongs to him who cultivates it."

a huge profit. It's the golden age [...]. Then comes the phase of ageing cocoa trees: owning an old farm, attacked by insects, bearing a less valuable product, does not give any status anymore. Everything happens as if a biological curse [...] was inherent to any golden age, as if a recession should succeed any cocoa boom." Young adult males of producing households move to a new forest, participating in a new cycle elsewhere, while the old members remain on the old farm which they convert into farmland for food production.[21]

When the forest is exhausted, cocoa moves to another country or continent. Production was dominated by Latin American countries till the early 20th century, then moved to Africa and is now spreading in Asia (Ruf, 1995*a*, p.63-70). Economic and political factors can accelerate or decelerate regional cycles (Ruf, 1995*a*, p.300-359): changes in the international and producer prices, land regulations, migration policy, demographic growth, etc.

4.3 The Cash Crop Revolution in Ivory Coast and Ghana

Ghana and Ivory Coast have been two leaders of the African "cash crop revolution". They are the largest cocoa producers, and cocoa has been the motor of their development (Teal, 2002; Cogneau & Mesplé-Somps, 2002). Production boomed after the 1920s in Ghana and the 1960s in Ivory Coast. The cocoa boom was accompanied by a coffee boom in Ivory Coast, as cocoa farmers also produce coffee there.[22] Cocoa and coffee have accounted for 60.2% of exports and 20.6% of GDP in Ivory Coast in 1948-2000, while cocoa has amounted to 56.9% of exports and 12.1% of GDP in Ghana over this period.

The South of each country was covered with tropical forest, while the North is savanna. In the Southern forest, some areas were more suitable for cocoa and coffee cultivation due to richer soil nutrients. Figure 3 shows *highly suitable* and *poorly suitable* districts for cocoa and coffee.[23] Figure 4 displays the total value of cash crop production in 1891-2000 for each Ghanaian district and in 1948-1998 for each Ivorian district. The comparison of Figures 3 and 4 confirms that cash crop production has been concentrated in highly suitable districts.

Cocoa was introduced to Ghana by missionaries in 1859, but production did not develop before 1900 (Hill, 1963). Production first spread out in the South-East of Ghana, in the vicinity of Aburi Botanical Gardens which were opened in 1890. British Governor W.B. Griffith wrote in 1888 (Hill, 1963, p.174): "It was mainly with the view of teaching the natives to cultivate economic plants in a systematic manner for purposes of export that I have contemplated for some time the establishment of an agricultural and botanical farm and garden where valuable plants could be raised and distributed in large numbers to the people." Cocoa seedlings were imported from São Tomé and distributed to local farmers. Since cocoa cultivation was very profitable, many farmers adopted the crop and production boomed. It peaked in the Eastern province in the 1930s (see Figure 3 and 5), before plummeting due to the Cocoa Swollen

[21]Ivorian cocoa farmers also produce Robusta coffee. Contrary to Arabica coffee which is grown at higher altitudes, Robusta coffee shares the same agronomic features as cocoa. It is grown in tropical forests and necessitates high levels of rainfall and humidity. Cherry production starts after 5 years and declines after 20 years, as the coffee tree becomes too old. This explains why cocoa and coffee have moved across regions together in Ivory Coast.

[22]Yet coffee production has never exceeded 300,000 tons per year. The cocoa boom was therefore three times more important than the coffee boom.

[23]The cocoa soil type is obtained in GIS from digitized historical soil classification maps. I also verify that these maps are consistent with contemporary maps of the forest. The soil type is not affected by initial deforestation, but the nutrient content of the soil decreases as the forest is exploited. A district is *suitable* if more than 25% of its area consists of cocoa soils, i.e. the tropical forest. A district is *highly suitable* if more than 50% of district area consists of forest ochrosols, the best cocoa soils. A district is *poorly suitable* if it is suitable but not highly suitable.

Shoot Disease and World War II which reduced international demand. A second cycle started in the Ashanti province (see Figure 6 and 7). But low producer prices after 1958, restrictive migratory policies after 1969, and droughts in the early 1980s precipitated the end of this cycle (see Figure 8).[24] High producer prices from 1983 pushed farmers to launch a third cycle in the Western province, the last forest of Ghana.

It was not till the 1910s that the French authorities promoted cocoa and coffee in Ivory Coast (Ruf, 1995*a*,*b*). Ivorians were originally reluctant to grow these crops, except in "Indénié" in the East (Centre-East, see Fig. 3) where farmers heard of the wealth of Ghanaian cocoa farmers (Ruf, 1995*b*, p.29). Production did not boom until the 1960s.[25] Cocoa (and coffee) again moved from the East to the West (see Figures 5-8). The production of both crops is now concentrated in the South-West region, the last tropical forest of Ivory Coast.

To conclude, in both countries, cocoa production was confined to the South and started in the South-East. Due to the 25-year agronomic patterns at the plantation level, it moved westward (as it could not do otherwise).[26] As population growth was high and cocoa was profitable, many people specialized in it and participated in the expansion of productive land. Both countries have extracted the same quantity of cocoa in total: 24 million tons in Ghana versus 22 in Ivory Coast, that did so in a much shorter time period. As the forest is about to disappear, so will cocoa production, unless farmers switch to intensive production strategies.[27]

4.4 The Urban Revolution in Ivory Coast and Ghana

While neither country was at all urbanized at the turn of the 20th century, their respective urbanization rates (using the 5,000 threshold) were 43.8% and 55.2% in 2000, making them two of the most urbanized African countries. Ghana started its urban transition earlier than Ivory Coast, but both experienced rapid urbanization after 1948. This is all the more impressive considering that the populations of Ghana and Ivory Coast have increased by 9.7 and 15.7 times respectively between 1900 and 2000. Ghana had 324 cities in 2000, while Ivory Coast had 376 in 1998, when 53.4% of urban inhabitants in Ghana and 54.8% Ivory Coast lived in small cities in the population range 5,000-20,000.

Defining as national cities the capital city and the second most important city, I calculate that they explain 45.7% of urban growth in 1901-2000 Ghana and 46.1% in 1948-1998 Ivory Coast.[28] Of the remaining urban growth, 66.3% in Ghana and 80.0% in Ivory Coast was in areas suitable for cocoa. This strong correlation between historical cash crop production and

[24]Ghana (from 1948) and Ivory Coast (from 1960) have fixed the producer price to protect farmers against fluctuating international prices. The *Ghana Cocoa Marketing Board* (COCOBOD) and the Ivorian *Caisse de stabilisation et de soutien des prix des productions agricoles* (CSSPPA) were responsible for organizing the cocoa system. Since the producer price was below the international price, this served as a taxation mechanism of the sector.

[25]Three factors explain this Ivorian "lateness". First, cocoa did not reach the Ghanaian border before 1920. Second, the French forced the Ivorians to grow cocoa and coffee through a system of mandatory labour (the *corvée*) and Ivorians only saw them as European crops. Third, production increased in the 1920s but the boom was stopped by the Great Depression and World War II.

[26]Data on regional yields for post-1948 years also displays a westward movement in yields. The largest producing region always has the highest yields. For Ghana, this was Ashanti in the 1960s, Brong-Ahafo in the 1970s and Western in the 1990s. For Ivory Coast, this was Centre in the 1960s, Centre-West in the 1970s and early 1980s, and South-West in the late 1980s and 1990s. Data on regional production per rural capita confirms this analysis.

[27]The forested surface of Ivory Coast has decreased from 15 million hectares in 1900 to 2.5 million in 2000, while it has decreased from 9 million in 1900 to 1.6 million in 2001 in Ghana.

[28]The capital cities are Accra in Ghana, and Abidjan and Yamoussoukro in Ivory Coast, since Houphouët-Boigny made his village of birth Yamoussoukro the new capital in 1983. The second most important cities are Kumasi in Ghana and Bouaké in Ivory Coast. The growth of these cities is disconnected from the local context.

the emergence of cities is documented in Figure 4. This correlation is also spatio-temporal, as cities have followed the cash crop front (see Figures 5-8). As production moved westward, new cities appeared in the West, but cities in the East did not collapse. Our analysis must thus account for both city formation and city persistence.

5. EMPIRICAL STRATEGIES

Let $y_{d,T}$ be the urbanization rate of district d at the end of the period, in year T. The urbanization rate being a stock variable, given the fixed costs of building cities, it is a function of the total district value of resource production between the beginning (t_0) and the end (T) of the period NRX_{d,t_0-T}. If there is urban persistence, $y_{d,T}$ is also a function of the initial urbanization rate y_{d,t_0}. Controlling for the initial urban conditions allows me to study the effect of resource production on the long difference of the urbanization rate:

$$y_{d,T} = \alpha + \beta NRX_{d,t_0-T} + \theta y_{d,t_0} + u_d \tag{1}$$

I argue that the causality is unlikely to run from cities to cash crop production. First, there are few cities in areas that have not boomed yet (see Fig. 5-8). Settlement is limited in tropical forests due to tall trees, thick vegetation, high humidity and disease incidence. Farmers overcome these constraints when they achieve an income high enough to pay the fixed costs of deforestation, which is the case with cocoa. Second, cocoa cultivation does not depend on cities for the provision of capital and inputs, as it only requires forested land, axes, machetes, hoes, cocoa beans and labor, and farmers use small amounts of fertilizers and insecticides. This traditional mode of production is not conducive to a role for cities in the diffusion of technological innovations. Third, the ability of farmers to find labor does not depend on urban proximity. West African labor markets are highly integrated, with many laborers originating from northern regions or other countries. Later, I verify there are no effects of urbanization on future cocoa production. I will also show that the effects of cocoa production on urbanization are smaller in the short term, which is in line with the following sequence for settlement patterns: (1) tropical forest, (2) booming production associated with rural growth, (3) increasing urbanization over time.

Second, there could be some unobserved factors that would drive both resource production and urbanization over time. To deal with factors that could affect a district's urban growth path, I first control for a vector of district covariates. These controls are: (i) political economy: dummies for containing a national city, i.e. the capital and second largest cities, or a regional capital;[29] (ii) economic geography: dummies for having an international port, and for being connected to the railway network or the paved road network, all measured at independence (1958 in Ghana, 1960 in Ivory Coast), and Euclidean distance to the coast and Euclidean distance to the largest city, as these factors could drive both production and urban growth; (iii) physical geography and demography: district area, a dummy for being a coastal district, 1900-1945 average annual precipitation, mean altitude, and initial rural population (for 1931 in Ghana, 1948 in Ivory Coast), to control for pre-existing settlement patterns.[30]

[29] National cities (Abidjan, Bouaké and Yamoussoukro in Ivory Coast, Accra and Kumasi in Ghana) may grow for reasons unrelated to local production. Regional capitals at independence were also regional capitals during colonization. I thus capture any effect that would stem from the colonial urban organization.

[30] The first year for which I have district rural population for the whole territory is 1931. I have data for Southern districts only in 1901.

However, there could be some unobserved factors that could still drive both resource production and urbanization. To address this concern, I instrument the total district value of cash crop production with a dummy whose value is one if the district is highly suitable for cocoa cultivation. The identification assumption is that conditionally on district geographical, political and economic characteristics, high land suitability does not affect the outcome independently of its impact on cash crop production. I also verify that the results hold when I restrict the analysis to the suitable districts only, i.e. all the districts of the tropical forest that are located in the south. The instrument then captures the effect of being relatively "more" suitable than other suitable districts. As argued before, highly suitable and poorly suitable areas are not different to the naked eye, differences in yields come from different nutrients in the soil that are not easily observable, even be experienced cocoa farmers. We thus predict a much higher resource rent in the highly suitable areas.

Another strategy is to exploit the fact that cocoa cultivation had to shift spatially over time. As explained above, cocoa farmers move to a new location every 25 years. This gives rise to district production cycles that can last up several decades. Besides, in a context of demographic growth, we observe an acceleration of the westward wave over time. When district production booms, we should expect to see a rise in urbanization. By using the panel dimension of the data and including district fixed effects, we can capture the effects of these local resource booms on local urbanization. I can also include district time trends and region-year fixed effects. The identification then comes from non-linear variations within districts over time, while simultaneously controlling for regional effects specific to some years. To see any effect for a district, it must be that cocoa production booms, across periods and relatively to the neighboring districts of the same region, in a difference-in-difference spirit. For Ivory Coast, I have panel data on district urbanization rates in 1948-1998. For Ghana, I do not have panel data on district urbanization rates in 1901-2000 because administrative boundaries have been considerably modified across years, this impeding any consistent reaggregation.

Lastly, there could be a few econometric concerns that both strategies cannot solve. For example, one could argue that logging enables cash crop production and urbanization. However, tree varieties are not different between the highly and poorly suitable areas, since productivity differences come from the soils. Restricting the sample to the suitable districts only should allow me to distinguish the effects of cash crop production and logging. Also, the export of forest products has only amounted to 10.1% and 16.1% of exports in Ghana and Ivory Coast in 1948-2000. Logging has been dominated by a few parastatal companies, and profits have been repatriated to the capital rather than spent locally. So we should expect no "local" effect of logging on urbanization. Lastly, even if there were such local channels, this would not alter the message of the paper that resource exports drive urbanization, as forestry exports belong to this category. My coefficients then capture the effects of cocoa, coffee and forestry.

5.1 Results

Table 2 presents the main results for 1948-1998 Ivory Coast (columns (1)-(4)) and 1901-2000 Ghana (columns (5)-(8)). In columns (1) and (5), I show the unconditional results, for which there is a strong positive effect of district resource production on district urban growth. The results are not modified when I include the geographical, political and economic controls, as shown by columns (2) and (6). In columns (3) and (7), I instrument the value of cash crop production by the highly suitable district dummy. In the first stage, I find a strong effect of the dummy on resource production, but no effect of initial urban conditions. This confirms that the early colonial cities did not play a role in the diffusion of cocoa cultivation. The effect of cash crop production on urbanization increases to 11.7-12.0 percentage points. The Kleibergen-Paap rk Wald F Stats are high, above 15. The IV estimates indicate that the effects of resource production were downward biased before. The magnitude of these effects is high: I find that one standard deviation in cash crop production increases the urbanization rate by a .54-.57 standard deviation. In columns (4) and (8), I restrict the sample to the suitable districts only, i.e. the districts of the tropical forest. The instrument captures the effect of being relatively "more" suitable than other suitable districts. Although the point estimates decrease, they are not significantly different from the standard IV estimates.

I run a few robustness checks, whose results are presented in Table 2. Column (1) reproduces the main results from Table 1 (see column (3)). In column (2), I include the interacted effect of the high suitability dummy and the initial urbanization rate. I thus verify that there is no effect of initial urban conditions on resource production for highly suitable areas, in the first stage. In column (3), I use the share of district area that is highly suitable as the instrument instead of a dummy for being above the 50% cut-off. In column (4), I include 10 regional fixed effects for each country. In column (5), I account for spatial autocorrelation by reporting Conley standard errors using a distance threshold of 100 km.[31] In column (6), I include the total regional value of cash crop production to account for local spillovers. I do not find any effect of regional production, which indicates that resource production only has local linkages. In column (7), I drop the national cities, i.e. the capital and the largest cities. In column (8), I use another urban outcome, which is the number of cities in year T, controlling for the number of cities in year t_0. Cash crop production has a strong positive effect on the number of cities, as already observed in Figures 4-8.

I show the results for the fixed effects approach in Table 3. There are 50 districts and 5 years for Ivory Coast, hence 250 observations. As discussed above, the coefficients are likely to be smaller for the panel estimation. First, the long difference estimation relates urban change to cash crop production over a very long period, thus capturing the long-term effect of the latter on the former, while the panel estimation captures the short-term effect. Second, due to the inclusion of district fixed effects, the short-term relationship between resource production and urban growth is attenuated by what is happening in the following periods, especially if cities persist although cocoa production eventually declines. Column (1) shows the unconditional results. In column (2), I include the baseline controls interacted with a linear trend. In column (3), I add the district fixed effects. The point estimate, 3.87, is exactly three times lower than the point estimate for the long difference model (11.69, see column (3) of Table 2), as expected. This result is relatively robust to including region-year fixed effects (see column (4)) and district trends (see column (5)). In column (5), the identification comes from non-linear variations within districts over time, while simultaneously controlling for regional effects specific to some years. It must be that districts urbanize as cocoa production booms, as already observed in Figures 4-8. In column (6), I also include the lag of the urbanization rate, to account for the fact that there could some urban path dependence. I also verify that the lag of the urbanization rate has no effect on the district value of cash crop production when it is used as a dependent variable instead. There is no effect of cities on cash crop production in the short-term, which reduces the concern of reverse causality. In column (7), I include the lag of the district value of cash crop production, i.e. resource production between the years $t-2$ and $t-1$. If the short-term effects are lower than the long-term effects, we should expect the short-term effect to increase over time, which is what we observe here. The coefficient is

[31] The plug-in HAC covariance matrix approach is to plug-in a covariance matrix estimator that is consistent under heteroskedasticity and autocorrelation of unknown form (Conley, 1999). By clustering standard errors at the regional level before, I was already accounting for spatial autocorrelation using a different approach.

relatively higher for the lag of resource production (4.20). The point estimate also increases for resource production (3.32), as we are now controlling for some of the long-term effects. When I add the two effects (7.52), I find that one standard deviation in cash crop production leads to a .57 standard deviation of the urbanization rate, after two periods (against .57 when using the long-difference estimation). Lastly, I investigate the short-term effects of resource production on the number of cities (see column (8)), and also find that these effects are lower than the long-term effects and that they increase over time. To conclude, the cocoa-producing districts urbanize, as the share of the urban population increases and more cities are created over time, which indicates some urban decentralization within these districts.

Lastly, I perform additional robustness checks whose results are not reported but available upon request. Results are robust to: (i) using production in volume (tons), (ii) using cocoa production only for Ivory Coast, (iii) using urban density instead of the urbanization rate, (iv) including the squares of controls, and (v) interacting controls with a non-linear trend.

5.2 Evidence on Consumption Cities [TO BE COMPLETED]

I now discuss the type of cities produced by natural resources and their long-term effects. Due to the scarcity of data in both countries, I do not have repeated measurements of income and other relevant dimensions at the district level and cannot carry out the same type of estimation as for the main results. Instead, I rely on historical data at a more aggregate spatial level and rough cross-sectional correlations on contemporary data. The sources I use are household survey and census data (the 1985-88 LSMS, 1998 and 2002 ENV in Ivory Coast; the 1987-88, 1997-98 and 2005-06 GLSS, the 2000 *Population Census* and *Facility Census* in Ghana), administrative reports, cross-country databases and agronomic studies.

5.2.1 Who Lives in These Cities?[TO BE COMPLETED]

Result 3 of the model suggests that natural resources create consumption cities. What does this imply in terms of urban employment? I compare the sectoral composition of cities in Ghana and Ivory Coast with that of cities in non-African countries with the same urbanization rate of 45-50% (using a similar urban threshold of 5,000). I use U.S. cities in 1920 and Chinese cities in 2008.[32] Interestingly, Ivorian and Ghanaian cities have a relatively larger agricultural sector (17-22% against 1-3% for the U.S. and China) and a more limited industrial sector (11-24% against 43-44% in the U.S. and China). When investigating the composition of each sector, I find that they have a much smaller manufacturing sector: 7% for Ivory Coast and 16% for Ghana, against 35% in the U.S. and 28% in China. Their manufacturing exports being small, manufacturing production must address the demand for local manufactured goods. 75% of Ghanaian and Ivorian manufacturing employment consists of textile and clothing, food products, beverages and tobacco, and furniture. The same sectors account for only 30% of manufacturing employment in the U.S. and 25% in China. They also have a smaller financial and business services sector, which we could interpret as tradable services: 3% in Ivory Coast, 2% in Ghana, 6% in the U.S. and 11% in China. Given

[32] I obtain historical U.S. census data from IPUMS USA. Using the 5,000 urban threshold, I estimate that the U.S. urbanization rate was 47% in 1920. The National Bureau of Statistics of China reports the urban sectoral composition on its website. It defines as a city any independent settlement of more than 3,000 inhabitants, which is quite comparable and gives an urbanization rate of 45%. I verify that my results can be generalized by extending the analysis to countries for which the urbanization is around 40-50%, the urban definition is close to the 5,000 threshold and census microdata is available. The list of these countries is available in the Data Appendix.

that Ghana and Ivory Coast do not export such services, this sector only supplies the local demand. I more generally argue that these cities are consumption cities because they arise as a result of increased demand (and not from productivity gains in the urban sector). I now investigate what gives rise to this composition, distinguishing production and consumption linkages arising from cocoa production. I abstract from including coffee to my analysis, as it is not different from cocoa.

5.2.2 Production Linkages[TO BE COMPLETED]

Backward production linkages were unlikely in this context, given the small level of urban inputs used in cocoa production. First, cocoa yields have doubled between 1960 and 2009, yet this increase has been permitted by the diffusion of high-yielding trees from the 1960s (Ruf 1995*a*, p.75-79). Aside from this innovation, production has remained traditional. Cocoa cultivation only requires forested land, axes, machetes, hoes, cocoa beans and labor. Farmers can use fertilizers and pesticides to increase yields. Yet only 6.9% of Ivorian cocoa farmers were using fertilizers in 1985-88; this share was 0.4% in Ghana in 1987-88. Meanwhile, 23.5% of Ivorian farmers were using insecticides in 1985-88 (11.6% in Ghana in 1987-88). From Ghanaian data reported by Teal, Zeitlin & Maamah (2006), I find that cocoa farmers used 3.6 kg of fertilizer and 0.14 liter of insecticide per hectare in 2002. By comparison, FAO data shows that Indonesian cocoa farmers used 95 kg of fertilizer and 0.80 liter of insecticide per hectare. The world used 94 kg of fertilizer and 3 liters of insecticide per hectare considering all crops. The data also reveals that both countries import their consumption of chemical fertilizers and insecticides.

Forward production linkages were also very unlikely in this context. First, there is no local processing of the crop. Cocoa farmers harvest cocoa pods during the peak season, which are opened to collect fresh cocoa beans. These are fermented between banana leaves, and dried by being spread in the sun on mats. The cocoa beans are later bagged and transported to the international port for export. The whole process provides no incentive for capital investments. Ruf (1995*a*, p.296) writes: "Unlike rubber or palm oil, no factory is needed to export cocoa beans. This relative absence of capital and technology contributes to slow down the development of agro-industries." Chocolate manufacturing is highly capital-intensive and requires refrigerated factories and ships for transport in high temperature environments. These constraints and the failure of African countries to boost manufacturing due to rent-seeking could explain why cocoa processing did not develop. I find that Ghana and Ivory Coast were responsible for 49.9% of cocoa exports in 2008, but only 0.9% of chocolate exports (FAO, 2012). Second, the agronomic literature has shown how the proceeds of cocoa farming were reinvested in buying new land, building houses and sending children to school, rather than starting new sectors (Hill, 1963; Ruf, 1995*a*). The cocoa sector is dominated by a myriad of smallholders, who are reluctant to deposit their savings in the formal bank system (Ruf, 1995*a*, p.379). Profits were thus unlikely to fund industrial projects. Third, the logistics of cocoa exports involves local and regional depots and transportation companies. Since their activity is urban-based, this could translate into more urbanization. But I find that people working in this subsector only represent 0.8% of the tertiary sector in the forest cities of Ivory Coast (1985-88).

5.2.3 Consumption Linkages[TO BE COMPLETED]

I argue that cocoa farmers spend their rising income on urban goods and services. Ruf (1995*a*) writes (p.379): "The possibility to enter the cocoa sector without much capital contributes to limit investments and fuels consumption fever." First, the influx of cocoa-producing households usually account for two thirds of population change in booming regions.[33] Second, cocoa farmers are wealthier than the non-cocoa farmers of the same region. Using household survey data, I regress household expenditure on a dummy equal to one if the household produces cocoa and I include village fixed effects to compare cocoa and non-cocoa farmers *within* the same locality. Cocoa (and coffee) farmers are 33.4% wealthier than other farmers in the forested areas of Ivory Coast in 1985-88. In the forest regions of Ghana, they are 22.1% wealthier in 1987-88.[34] Third, I find that cocoa farmers allocate around 30% of total consumption to home food production (mostly starchy roots, vegetables and cereals), 30% to food expenses (mostly "tasty" food such as seafood, cereals, sweets and meat) and 40% to other goods and services (mostly clothing, transfers and events, education, health and housing). Although I cannot identify which good is *urban* per se, I assume that food and non-food expenses imply the growth of the urban sector.[35] To summarize, cocoa farmers account for around 2/3 of population change in a booming region, are around 30% wealthier than other farmers, and spend around 70% of their income on urbanizing goods. If production had not boomed and if cocoa farmers had been *counter-factually* replaced by a number 50% lower of non-cocoa farmers, back-of-the-envelope calculations suggest that the aggregate income spent on urban goods and services would have been 2.9 times lower.[36] How this can be related to urban employment growth is difficult to say, but the evidence generally suggests large consumption linkages.[37]

5.2.4 Government Taxation and Redistribution [TO BE COMPLETED]

I now investigate whether state capture affects the composition and spatial distribution of urbanization effects (Result 4). As explained before, the government has respectively captured 40.5% and 49.9% of cocoa (and coffee) exports in Ivory Coast. The cocoa tax accounted for around 20% of government spending in 1961-2000. Also, around two thirds of government spending corresponds to government consumption (public employment), while the rest consists of government investments (infrastructure). In cities of producing districts, I find that public employment represented around 10% of total employment in the 1980s, in line

[33] They respectively account for 79.7% and 62.9% of population change in the Ivorian Centre-West region between 1988 and 1998 and the Ghanaian Western province between 1984 and 2000.

[34] In Jedwab & Moradi (2011), we describe a very similar story for the Eastern province in 1931. As production boomed there, there was a massive influx of migrants who were getting rich by working on cocoa farms. Cardinall (1931) writes (p.84): "An influx of strangers drawn here as it were to El Dorado has opened up the country to an extent that no man could have foreseen as possible within so short a period."

[35] Dercon & Hoddinott (2005) show on Ethiopian data that rural households go to the nearest market town to: (i) buy 47% of crop inputs, (ii) sell a large share of crop production, (iii) get non-agricultural income by selling artisanal products, and (iv) purchase 55% of their consumables.

[36] Assuming that cocoa farmers would have been replaced by half less non-cocoa farmers without any cocoa boom is a more than reasonable hypothesis, given the high fixed costs of deforestation. As argued earlier, farmers were willing to overcome those costs only when agricultural production was profitable, which was the case with cocoa and coffee.

[37] Another issue is why so many cocoa (and non-cocoa) farmers live in town. As argued earlier, living in the forest can be difficult and the prevailing production technologies may allow farmers to commute to their land only when necessary. Cities also offer better consumption amenities, such as leisure and recreational activities, durable housing and infrastructure.

with the national average. These cities thus did not grow as administrative centres. But I find that villages and cities of the old producing districts have better infrastructure. This could make these villages grow and pass the 5,000 threshold, or this could contribute to the growth of existing cities. I first create district measures of infrastructure provision for Ghana in 2000. I then create district dummies if cocoa production has boomed in the 1980s or 1990s (the newly producing districts) or before the 1980s (the old producing districts).[38] Finally, I regress the various measures of infrastructure on these district dummies, including the same baseline controls as before. Results from Table 5 confirm that rural and urban inhabitants of old producing districts are more likely to have access to health facilities (col. (1)-(4)), schools (col. (5)-(10)), communications (col. (11)-(14)), utilities (col. (15)-(18)) and roads (col. (19)), while newly producing districts do not seem to have relatively better infrastructure. Results for Ivory Coast are similar (not reported but available upon request). Public employment accounts for around 20% of total employment in national cities (Abidjan, Bouaké and Yamoussoukro in Ivory Coast, Accra and Kumasi in Ghana), which indicates their role as administrative centres. Besides, around two thirds of the total civil servant wage bill is concentrated in these cities. As we know the total amount of the cocoa tax, its spatial allocation rule (based on the wage bill), and assuming one million dollars leads to 74 additional urban inhabitants (see section 4.3), I find that state capture respectively explains 29.5% and 48.4% of the urban growth of national cities in Ghana and Ivory Coast. Indeed, Abidjan is the fifth largest city in Sub-Saharan Africa, despite the fact that Ivory Coast is only the thirteenth largest country.

6. DISCUSSION

The economic geography literature suggests that agglomeration promotes growth, in both developed countries (Rosenthal & Strange, 2004; Henderson, 2005) and developing countries (Overman & Venables, 2005; Henderson, 2010). Given that urbanization is a form of agglomeration, it has thus been argued that cities could promote growth in developing countries (Duranton, 2008; Venables, 2010; McKinsey, 2011). Yet evidence that urbanization drives growth is rather weak in cross-country regression frameworks (Henderson, 2003).

Whether urbanization promotes growth is likely to depend on the type of the city, and the sectors in the city, if different sectors have different effects on long-run growth. This paper shows that resource exports create consumption cities, with small manufacturing and tradable service sectors. There are several channels through which this type of urbanization could have a relatively lower effect on long-run growth. First, there could be dynamic externalities in the urban tradables sector, as in Young (1991) or Matsuyama (1992), and the resource rich countries and cities could experience lower rates of overall technical progress. Second, incentives for productivity improvement could be greater due to the threat of global competitors, as in Galdon-Sanchez & Jr. (2002), Bustos (2011) or Aw, Roberts & Xu (2011). Third, there could be large intersectoral linkages from the urban tradables sector. Fourth, the urban tradables sector could provide more incentives for human capital accumulation Galor & Mountford (2008), which would then affect overall productivity. Lastly, cities in resource rich countries could be more corrupt and associated with a high degree of income inequality. This would then have a significant effect on the quality of institutions at the national level, that

[38] I use infrastructure data from the 2000 *Facility Census* and *Population Census*. As they adopt the administrative district decomposition in 2000 (N = 110), which differs from the one I have used before, I identify new and old producing districts by studying regional patterns of production. Production boomed in the districts of the *Western* province in the 1980s or 1990s.

would affect overall productivity.

7. CONCLUSION

This paper documents several new facts regarding the processes of urbanization and structural transformation using cross and within country evidence. While most developing countries (e.g., in Asia) have urbanized with structural transformation (i.e., a shift of labor towards manufacturing and tradable services), resource rich developing countries (e.g., in Africa) have experienced urbanization without structural transformation. The Engel curve implies that resource windfalls are disproportionately spent on urban goods and services, which gives rise to consumption cities. If manufactured goods and tradable services are imported from abroad, the mix of urban workers is heavily skewed towards non-tradable services.

In order to estimate the causal effect of resource exports on the extent and type of urban growth, I use a natural experiment in Ivory Coast and Ghana. Using new district data spanning one century and two identification strategies (i.e., an instrumental variables strategy and a fixed effects approach), I find a strong causal effect of the production of cocoa, a rural-based natural resource, on the growth of cities. However, I do not find that these cities industrialized over time. Therefore, these countries urbanized without structural transformation.

This paper makes three contributions to our understanding of the relationship between natural resources, urbanization and economic development.

The first contribution is establishing that there are many countries for which the processes of urbanization and structural transformation are disconnected. Africa offers a perfect example of this type of urbanization. In contrast to standard theories of structural transformation, Africa did not urbanize following a green revolution or an industrial revolution, but as a result of natural resource exports.

Secondly, I provide evidence on the relationship between economic development and urbanization. This paper shows that resource exports leads to urbanization. Whether urbanization in turn promotes growth might depend on the type of cities created. I argue that resource exports create consumption cities, with small manufacturing and tradable service sectors. These different types of cities may have different long-run growth effects. If these "missing" sectors are more likely to exhibit agglomeration effects and provide incentives for skill accumulation, consumption cities will have a relatively small impact on long-run growth.

Finally, this paper confirms that resource exports have positive economic effects in the short term, as producing regions accumulate cities. However, I highlight a new dimension of the resource curse – the rise of consumption cities may not produce the growth effects that are found in typical urban areas.

This paper leaves several open questions that warrants further study. Future research should explore why most resource rich countries in Africa, in particular, Ghana and Ivory Coast, have been unable to develop a comparative advantage in the non-resource sectors. As we acquire more data, later studies can investigate whether these consumption cities will evolve into production cities over time, as they did in the United States and a few Southeast Asian countries.

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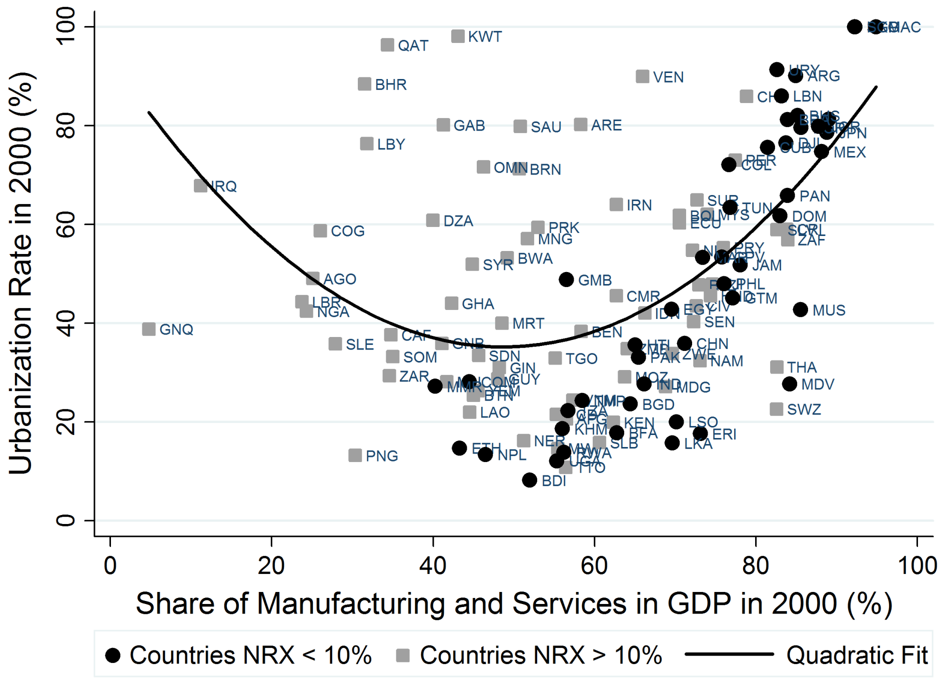
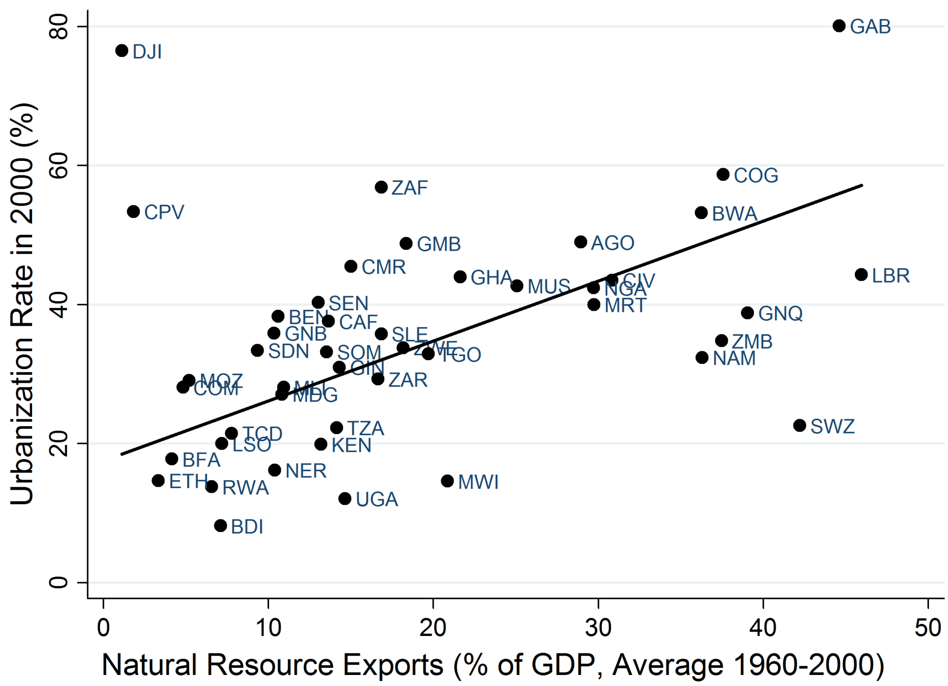
Figure 1: Urbanization and the Contribution of Manufacturing and Services to GDP for Developing Countries, by Type of Countries, 2000.



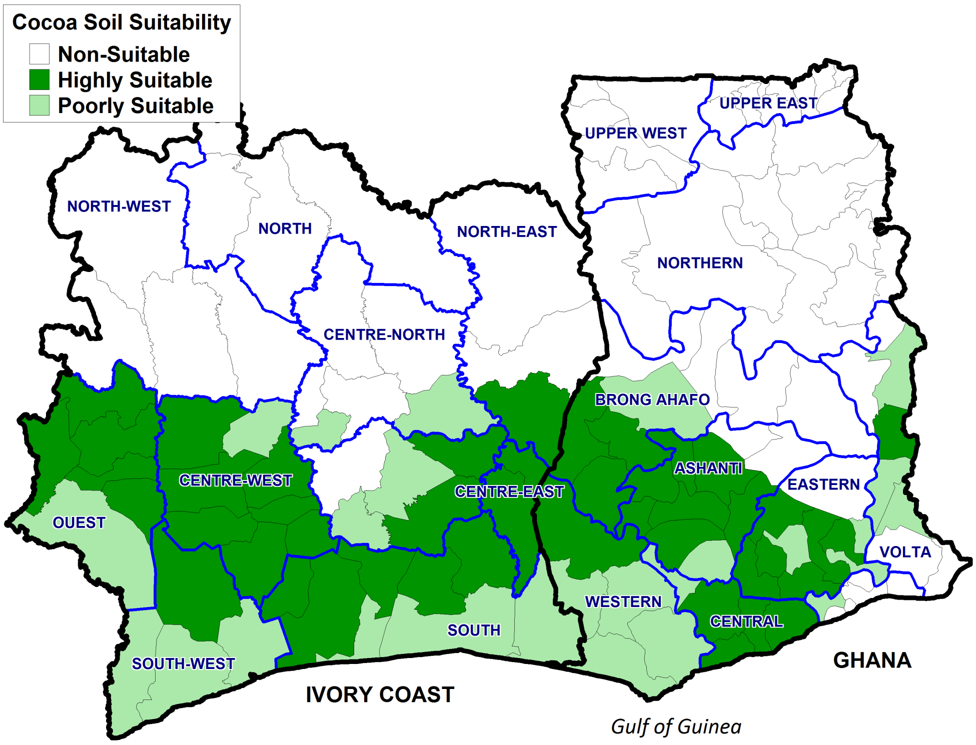
Notes: This figure shows the relationship between the urbanization rate (%) and the contribution of manufacturing and services to GDP (%) for 119 developing countries across four areas in 2000: Asia (30), Latin America and the Caribbean (26), Sub-Saharan Africa (46), and Middle-East and North Africa (17). Countries for which natural resource exports NRX (fuels, mining, forestry and cash crops) account for less than 10% of GDP in 2000 are in black. Countries for which natural resource exports NRX account for more than 10% of GDP in 2000 are in grey. The quadratic fit is estimated using population in 2000 as weights. See Data Appendix for data sources and construction of variables.

Figure 2: Urbanization and Natural Resource Exports in Africa, 1960-2000.



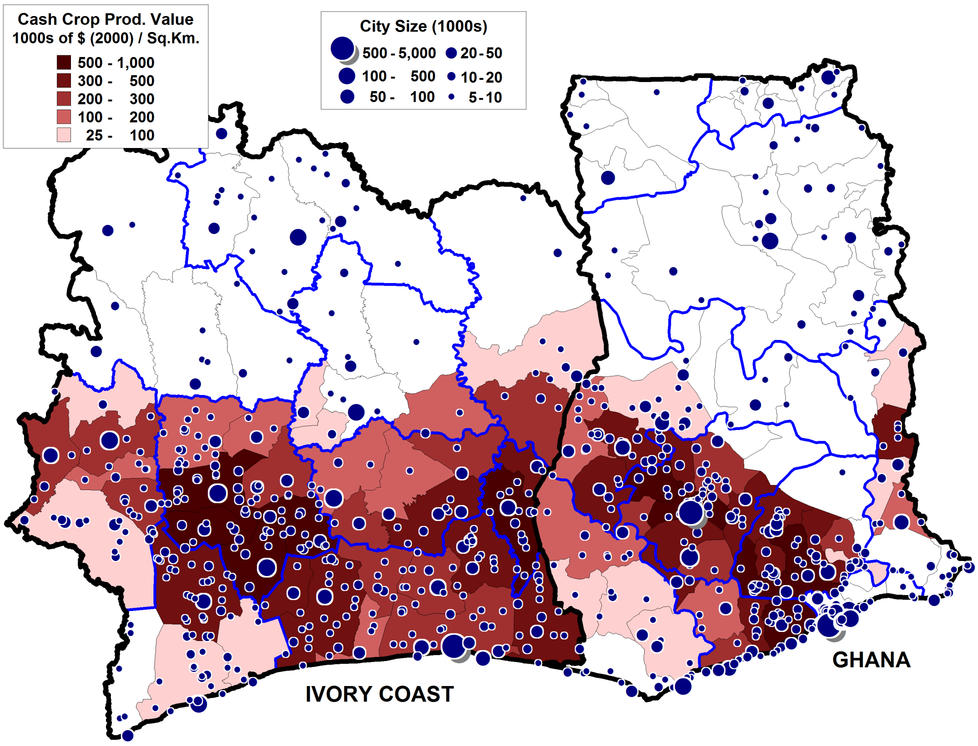
Notes: This figure shows the relationship between the urbanization rate (%) in 2000 and the average contribution of natural resource exports (fuels, mining, forestry and cash crops) to GDP (%) in 1960-2000 for 46 Sub-Saharan African countries. The linear fit is estimated using population in 2000 as weights. See Data Appendix for data sources and construction of variables.

Figure 3: Cocoa Soil Suitability and Regional and District Boundaries.



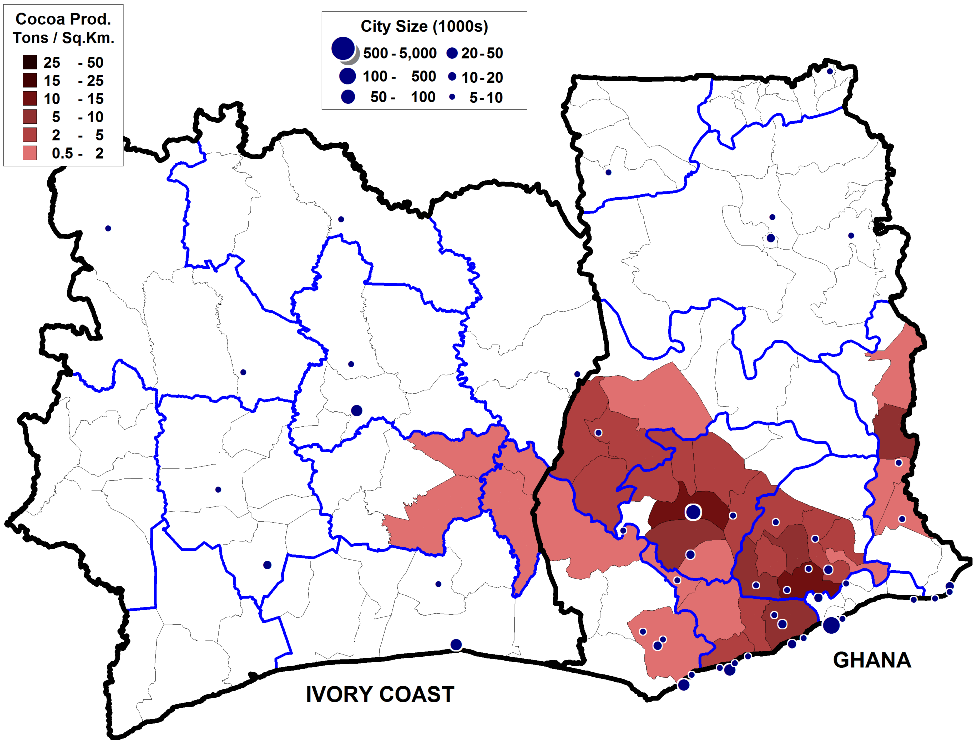
Notes: This figure shows the regional and district boundaries (N = 50 in Ivory Coast, N = 79 in Ghana), and the districts suitable for cocoa cultivation. The South of each country was historically covered with dense tropical forest. A district is defined as *suitable* if more than 25% of its area consists of cocoa soils (the tropical forest). A district is defined as *highly suitable* if more than 50% of its area consists of forest ochrosols, the best cocoa soils. It is defined as *poorly suitable* if it is suitable, but not highly suitable. See Data Appendix for data sources and construction of variables.

Figure 4: Value of Cash Crop Production (1900-2000) and Cities (2000).



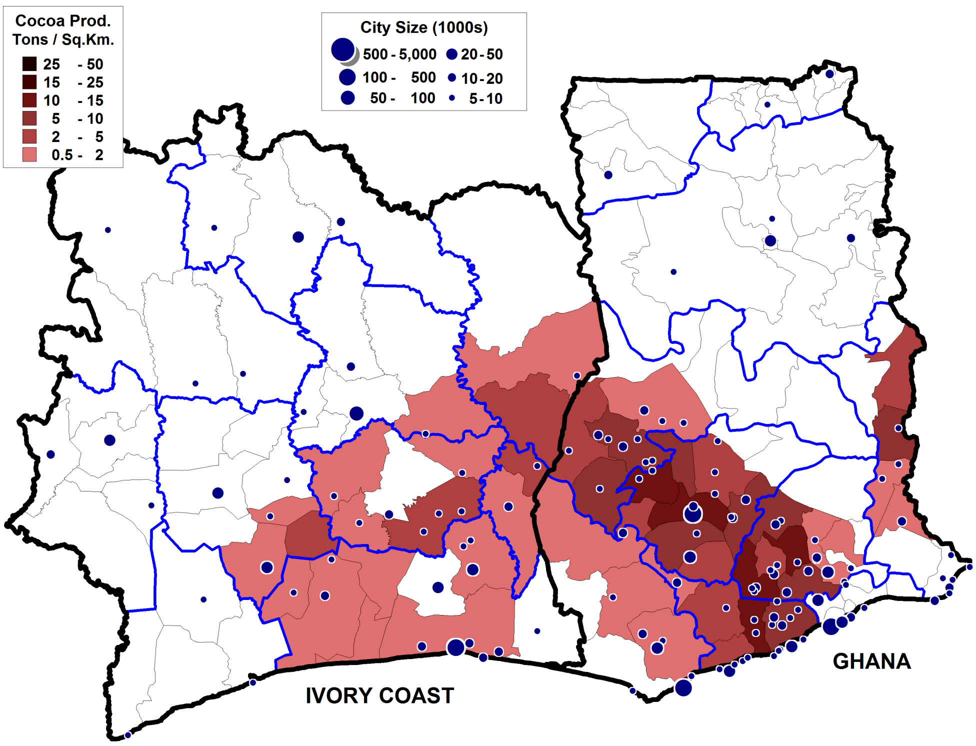
Notes: This figure shows the district total value (in thousands of year 2000 U.S. dollars per sq.km.) of cocoa production in Ghana from 1891 to 2000, and cocoa and coffee production in Ivory Coast from 1948 to 2000. It also shows the cities in 2000 (1998 for Ivory Coast), defined as the localities whose population is superior to 5,000 inhabitants. See Data Appendix for data sources and construction of variables.

Figure 5: District Density of Cocoa Production and Cities in 1948.



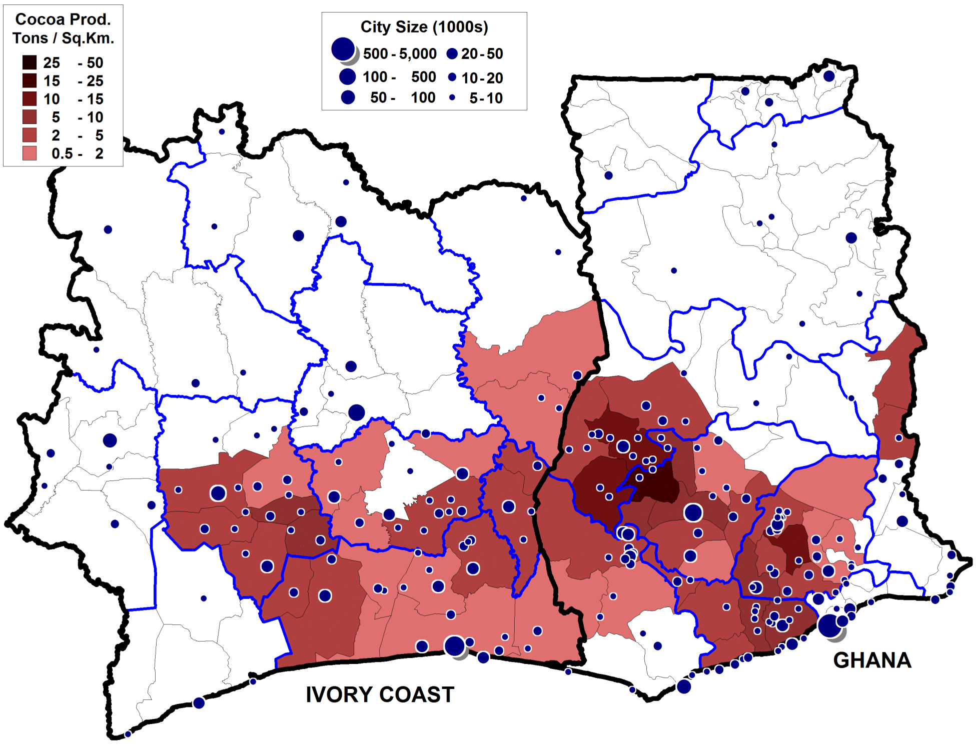
Notes: This figure shows the district density of cocoa production (in tons per sq.km.) of cocoa production in Ghana and Ivory Coast in 1948. It also shows the cities in 1948, defined as the localities whose population is superior to 5,000 inhabitants. See Data Appendix for data sources and construction of variables.

Figure 6: District Density of Cocoa Production and Cities in 1960-1965.



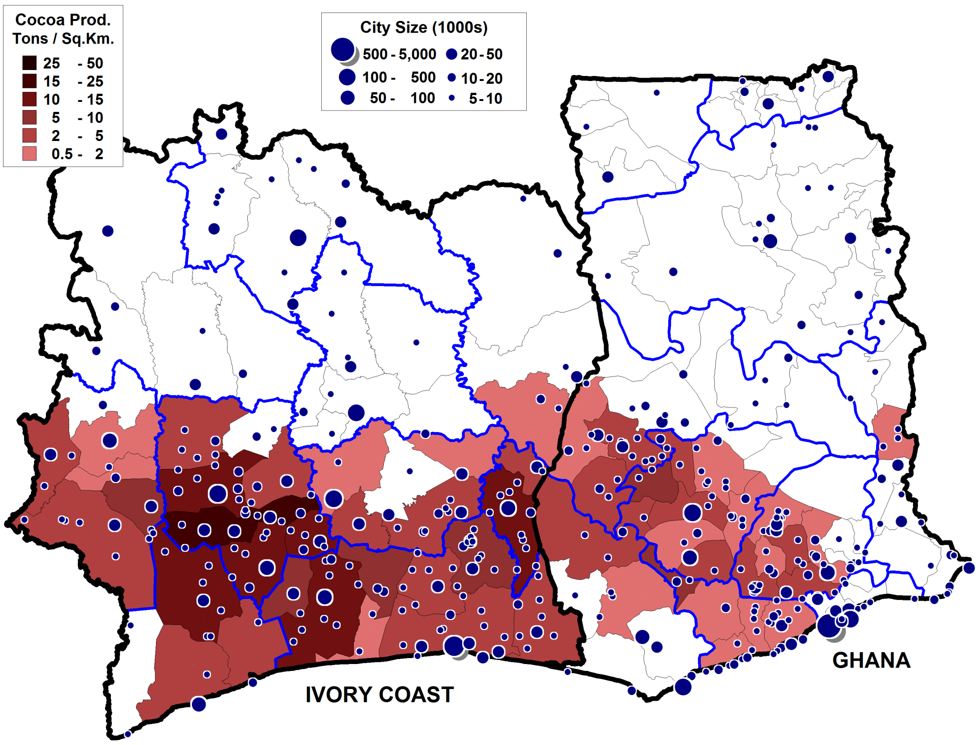
Notes: This figure shows the district density of cocoa production (in tons per sq.km.) of cocoa production in Ghana in 1960 and Ivory Coast in 1965. It also shows the cities for the same years, defined as the localities whose population is superior to 5,000 inhabitants. See Data Appendix for data sources and construction of variables.

Figure 7: District Density of Cocoa Production and Cities in 1970-1975.



Notes: This figure shows the district density of cocoa production (in tons per sq.km.) of cocoa production in Ghana in 1970 and Ivory Coast in 1975. It also shows the cities for the same years, defined as the localities whose population is superior to 5,000 inhabitants. See Data Appendix for data sources and construction of variables.

Figure 8: District Density of Cocoa Production and Cities in 1984-1988.



Notes: This figure shows the district density of cocoa production (in tons per sq.km.) of cocoa production in Ghana in 1984 and Ivory Coast in 1988. It also shows the cities for the same years, defined as the localities whose population is superior to 5,000 inhabitants. See Data Appendix for data sources and construction of variables.

TABLE 1: URBANIZATION AND NATURAL RESOURCE EXPORTS
LONG-DIFFERENCE AND CROSS-SECTIONAL ESTIMATIONS, SUB-SAHARAN AFRICA, 1960-2000

Dependent Variable:	**Urb. Rate (%)**			**Empl. Share (%), Urban Sector Only**				**Empl. Share (%), Largest City Only**			
			Long Diff. Model	***Manuf. & Fire***	***Trade & Transp.***	***Govt Services***	***Other Sectors***	***Manuf. & Fire***	***Trade & Transp.***	***Govt Services***	***Other Sectors***
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Natural Resource Exports	0.86***	0.77**	0.62***	-0.37**	0.32*	0.12	-0.07	-0.37**	0.31*	0.15	-0.09
(% of GDP, Av. 1960-2000)	(0.06)	(0.16)	(0.10)	(0.08)	(0.12)	(0.12)	(0.12)	(0.09)	(0.13)	(0.14)	(0.23)
Urbanization Rate				0.61***	-0.22	0.04	-0.44***	0.57**	-0.43	-0.15	0.02
(%, 2000)				(0.08)	(0.16)	(0.14)	(0.06)	(0.11)	(0.23)	(0.09)	(0.20)
Controls	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	46	46	46	27	27	27	27	27	27	27	27
R-squared	0.40	0.63	0.88	0.74	0.78	0.16	0.49	0.89	0.85	0.03	0.50

Notes: OLS regressions using cross-sectional data for 46 Sub-Saharan African countries in 1960-2000. Robust standard errors clustered at the regional level are reported in parentheses; * $p<0.10$, ** $p<0.05$, *** $p<0.01$. There are four regions: Western Africa, Central Africa, Eastern Africa and Southern Africa. The variable of interest is the average contribution of natural resource exports (fuels, mining, forestry and cash crops) to GDP (%) in 1960-2000. The dependent variable in columns (1)-(3) is the urbanization rate (%) in 2000. In column (3), we control for initial conditions, i.e. the urbanization rate (%) and the contribution of resource exports to GDP (%) in 1960. The regression is a long-difference model. The dependent variable in columns (4)-(7) is the employment share of four different sectors for the urban sector only. We have data for 27 countries that account for 80.0% of the continent's population. The four sectors are: (i) *Manuf. & Fire*: "Manufacturing" and "Finance, Insurance, Real Estate and Business Services", (ii) "Trade & Transp.": "Wholesale and Retail Trade, Hotels and Restaurants" and "Transport, Storage and Communications", (iii) *Govt Services*: "Public Administration", "Education" and "Health", and (iv) *Other Sectors*: "Agriculture, Fishing and Forestry", "Mining and Quarrying", "Public Utilities", "Construction" and "Community, Social and Private Services". The dependent variable in columns (8)-(11) is the employment share of these sectors for the largest city only. All regressions are population-weighted and include the following controls at the country level: area (sq km), population (1000s), rural density (1000s of rural population per sq km of arable area), annual population growth rate in 1960-2000 (%), four dummies for each type of urban definition ("administrative", "threshold", "threshold and administrative", and "threshold plus condition"), the population threshold when this type of definition is used, a dummy equal to one if the country is a small island (< 50,000 sq km), a dummy equal to one if the country is landlocked, a dummy equal to one if the country has experienced more droughts than the rest of Africa in 1960-2000, a dummy equal to one if the country's average combined polity score since independence is lower than -5 (the country is autocratic), and a dummy equal to one if the country has experienced an interstate or civil conflict since independence. Columns (8)-(11) also include a dummy equal to one if the largest city is the capital city. See Data Appendix for data sources and construction of variables.

TABLE 2: URBANIZATION AND NATURAL RESOURCE EXPORTS LONG-DIFFERENCE ESTIMATIONS, IVORY COAST AND GHANA, 1901-2000

Country, Period:	**IVORY COAST, 1948-1998**				**GHANA, 1901-2000**			
Dependent Variable:	**Urbanization Rate (%) in 1998**				**Urbanization Rate (%) in 2000**			
Method:	OLS	OLS	IV	IV	OLS	OLS	IV	IV
Restricted Sample:				*Suitable Only*				*Suitable Only*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Main Equation								
Value of Cash Crop Exports	6.62***	7.50***	11.69**	10.68**	5.21***	5.54***	12.03**	7.18**
(Standard Score, Same Period)	(0.93)	(1.36)	(4.78)	(4.70)	(1.96)	(1.74)	(5.29)	(3.17)
Urbanization Rate, Ex Ante	0.62**	0.53**	0.54*	0.46***	0.56***	0.12	0.15	0.76***
(Iv. Coast = 1948, Ghana 1901))	(0.25)	(0.26)	(0.28)	(0.011)	(0.07)	(0.13)	(0.15)	(0.19)
Panel B: First Stage								
Highly Suitable District			1.28***	1.23***			1.45***	1.38***
(Dummy, Ex Ante)			(0.29)	(0.23)			(0.37)	(0.29)
Urbanization Rate, Ex Ante			-0.01	-0.00			-0.01	-0.03
(Iv. Coast = 1948, Ghana 1901))			(0.02)	(0.02)			(0.01)	(0.03)
Kleibergen-Paap rk Wald F Stat			19.4	27.1			15.6	23.0
Controls	N	Y	Y	Y	N	Y	Y	Y
Observations	50	50	50	35	78	78	78	36
R-squared	0.46	0.60	0.57	0.63	0.20	0.57	0.53	0.61

Notes: OLS and IV regressions using cross-sectional data for 50 districts in Ivory Coast in 1948-2000 and 78 districts in Ghana in 1901-2000. Robust standard errors clustered at the regional level are reported in parentheses; * p<0.10, ** p<0.05, *** p<0.01. There are ten regions for each country. The dependent variable in columns (1)-(4) is the urbanization rate (%) in 1998 for Ivory Coast and 2000 for Ghana. In all regressions, we control for initial urban conditions, i.e. the urbanization rate (%) in 1948 for Ivory Coast and 1901 for Ghana. *Value of Cash Crop Exports* is the standardized district total value of cash crop production in 1948-2000 for Ivory Coast (cocoa and coffee) and 1901-2000 for Ghana (cocoa). *Highly Suitable District* is a dummy equal to one if more than 50% of district area consists of forest ochrosols (the best cocoa soils). In columns (4) and (8), I restrict the sample to the districts suitable for cocoa cultivation, whether they are highly or poorly suitable. The regressions in columns (2)-(4) and (6)-(8) include various controls at the district level. Political economy: dummies equal to one if the district contains a national city (the capital and second largest city) or a regional capital. Economic geography: dummies for whether the district has a paved road, a railroad or a port at independence (1958 in Ghana, 1960 in Ivory Coast), Euclidean distances (km) to the largest city, and the coast. Physical geography: district area (sq km), a district dummy for being a coastal district, 1900-1945 average annual precipitation (mm), mean altitude (m) and initial rural population (1948 in Ivory Coast, and 1931 for Ghana, the data being very imperfect for 1901). The regressions for Ghana also includes the district total value of mineral production (gold, bauxite, manganese and diamonds) in 1901-2000. See Data Appendix for data sources and construction of variables.

TABLE 3: URBANIZATION AND NATURAL RESOURCE EXPORTS
LONG-DIFFERENCE ESTIMATIONS, ROBUSTNESS, IVORY COAST AND GHANA, 1901-2000

Dependent Variable:	**Urbanization Rate (%) in 1998 (Ivory Coast), 2000 (Ghana)**							**Number of Cities 1998/2000**
Method:	IV	IV	IV	IV	IV	IV	IV	IV
Robustness Check:	Main	HighlySuit. x Urb.Rate	Continuous Share	Regional FE	Conley 100 km	Regional Value	Drop Top Cities	Main
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Ivory Coast, 1948-1998								
Value of Cash Crop Exports	11.69**	11.76**	9.00**	13.85***	11.69***	10.63***	12.31**	5.96***
(Standard Score, Same Period)	(4.78)	(4.92)	(4.12)	(5.10)	(4.10)	(2.66)	(4.97)	(0.88)
1st Stage: Highly Suitable District	1.28***	1.29***	0.02***	1.15***	1.28***	1.33***	1.25***	1.28***
(Indicator or Share, Ex Ante)	(0.29)	(0.28)	(0.01)	(0.27)	(0.28)	(0.29)	(0.31)	(0.29)
Panel B: Ghana, 1901-2000								
Value of Cash Crop Exports	12.03**	11.62**	8.57**	16.77**	12.03**	11.86*	11.80**	5.58***
(Standard Score, Same Period)	(5.29)	(5.00)	(4.34)	(8.60)	(2.86)	(6.11)	(5.78)	(1.36)
1st Stage: Highly Suitable District	1.45***	1.51***	0.02**	1.41***	1.45***	1.41***	1.30***	1.45***
(Indicator or Share, Ex Ante)	(0.37)	(0.36)	(0.01)	(0.40)	(0.40)	(0.40)	(0.36)	(0.37)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Observations	50; 78	50; 78	50; 78	50; 78	50; 78	50; 78	50; 78	50; 78

Notes: OLS and IV regressions using cross-sectional data for 50 districts in Ivory Coast in 1948-2000 and 78 districts in Ghana in 1901-2000. Robust standard errors clustered at the regional level (except in column (5)) are reported in parentheses; * $p<0.10$, ** $p<0.05$, *** $p<0.01$. The dependent variables in columns (1)-(7) is the urbanization rate (%) in 1998 for Ivory Coast and 2000 for Ghana. In column (8) the dependent variable is the number of cities (localities > 5,000 inh.). In all regressions, I control for initial urban conditions. *Value of Cash Crop Exports* is the standardized district total value of cash crop production in 1948-2000 for Ivory Coast (cocoa and coffee) and 1901-2000 for Ghana (cocoa). *Highly Suitable District* is a dummy equal to one if more than 50% of district area consists of forest ochrosols (the best cocoa soils). Column (2): I control for the interacted effect of high suitability and the initial urbanization rate to see if urbanization has an effect of future cocoa production. Column (3): I use the share of district area that is highly suitable as the instrument instead of the 50% cut-off. Column (4): I include regional fixed effects (N = 10 for each country). Column (5): I report Conley standard errors using a distance threshold of 100 km. Column (6): I control for the regional value of cash crop exports to account for spillovers. Column (7): I drop the national cities, i.e. the capital and second largest cities. All the regressions include various controls at the district level. These controls are described in the footnote of Table 2. See Data Appendix for data sources and construction of variables.

TABLE 4: URBANIZATION AND NATURAL RESOURCE EXPORTS FIXED EFFECTS APPROACH, IVORY COAST, 1948-1998

Dependent Variable:	**Urbanization Rate (%) in year t**							**Number of Cities in year t**
Method:	OLS (1)	OLS (2)	OLS-FE (3)	OLS-FE (4)	OLS-FE (5)	OLS-FE (6)	OLS-FE (7)	OLS-FE (8)
Value of Cash Crop Exports	6.06***	5.19***	3.87***	3.11***	2.07**	2.04**	3.32***	2.17***
(Standard Score, Between t-1 and t)	(0.88)	(0.64)	(0.68)	(0.90)	(0.90)	(0.88)	(1.15)	(0.38)
Lagged Dependent Variable						-0.10	-0.35***	-0.07
(Year $t-1$)						(0.07)	(0.11)	(0.17)
Value of Cash Crop Exports							4.20**	3.99***
(Standard Score, Between t-2 and t-1)							[1.708]	(1.05)
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Baseline Controls x Year	N	Y	Y	Y	Y	Y	Y	Y
District Fixed Effects	N	N	Y	Y	Y	Y	Y	Y
Region-Year Fixed Effects	N	N	N	Y	Y	Y	Y	Y
District Trends	N	N	N	N	Y	Y	Y	Y
Observations	250	250	250	250	250	250	200	200
R-squared	0.49	0.77	0.82	0.87	0.92	0.92	0.94	0.96

Notes: OLS regressions using panel data for 50 districts in Ivory Coast in 1948-2000. We cannot perform the same analysis for Ghana as I do not have panel data on the district urbanization rates over one century. Robust standard errors clustered at the regional level are reported in parentheses; * p<0.10, ** p<0.05, *** p<0.01. There are ten regions. The dependent variables in columns (1)-(7) is the urbanization rate (%) in year t for Ivory Coast. In column (8) the dependent variable is the number of cities (localities > 5,000 inh.) in year t. In all regressions, I control for the lag of the dependent variable, i.e. the urbanization rate or the number of cities in year $t-1$. *Value of Cash Crop Exports, Between* $t-1$ *and* t is the standardized district total value of cash crop production (cocoa and coffee) between year $t-1$ and year t. All the regressions include various controls at the district level interacted with a time trend. These controls are described in the footnote of Table 2. See Data Appendix for data sources and construction of variables.

Appendices

A Data Appendix

This appendix describes in detail the data I use in my analysis.

A.1 Cross-Country Analysis

Spatial Units: I assemble data for 46 Sub-Saharan African countries. I classify them into four regions: Western Africa, Central Africa, Eastern Africa and Southern Africa.

Urbanization Data: I use WUP (2011) to study urbanization rates for 119 developing countries in 2000 and 46 African countries in 1960-2000. The urbanization rate is the share of the urban population in total population (%). There are four different types of urban definition: (i) "administrative": cities are administrative centers of territorial units (e.g., districts, communes, etc.), (ii) "threshold": cities are localities whose population is superior to a population threshold of X inhabitants (e.g., 5,000 or 2,500), (iii) "administrative or threshold": cities are either administrative centers or localities whose population is superior to a population threshold, and (iv) "threshold with condition": cities are localities whose population is superior to a population threshold and whose a large share of the labor force is engaged in non-agricultural activities. We also use WUP (2011) to obtain a list of Asian and African megacities (> 750,000 inh.). WUP (2011) also reports total population for each country in 2000.

Manufacturing and Service GDP and Employment Data: I use WB (2012) to estimate the contribution of manufacturing and services to GDP for 119 developing countries in 2000. Data on the employment structure of the urban sector and largest city in selected countries was recreated using the IPUMS census sample for the closest year to 2000 (IPUMS 2012). Census reports, labor force surveys and household surveys were used for other countries. Table A.1 lists all the countries and years for which we have the urban sectoral composition.

Natural Resource Exports: They consist of fuel, mineral, cash crop and forestry exports. I use WB (2012) and USGS (2012) to estimate the share of fuel and mineral exports in total exports (%) for the 46 African countries every five years in 1960-2000.I use FAO (2012) to obtain the export shares of cash crops and forestry for the same countries and years. Lastly, we use Maddison (2008) and WDI (2012) to obtain the share of merchandise exports in GDP for the same countries and years. Knowing the share of merchandise exports in GDP (%), I can easily reconstruct the contribution of resource exports to GDP (%).

Controls: We use various sources to reconstruct a range of controls at the country-level. Country area (sq km) is obtained from WB (2012). Rural density is defined as the ratio of rural population (1000s) to arable area (sq km) in 2000. The arable area of each country is reported by FAO (2012). Population growth is calculated as the percentage change in country population between 1960 and 2000. We create a dummy if the country is a small island. From wikipedia, we obtain a list of all the island countries in the world. An island country is "small" if its area is smaller than 50,000 sq km. We use GIS to create a dummy if the country is landlocked. We create a dummy if the country has experienced more droughts than the rest of the continent in 1960-2000, 3.8 droughts on average (CRED 2012). We use the Polity IV data series to calculate the average polity score for each country from independence to 2000 (Polity IV 2012a). We then create a dummy if it is lower than -5, the threshold for not being considered as autocratic. Lastly, the Polity IV data series include a measure of political violence for each country from 1964 to date. We create a dummy if the country has ever experienced an interstate or civil conflict from independence to 2000 (Polity IV 2012b).

A.2 Within-Country Analysis

Spatial Units: I assemble data for a panel of 78 districts in Ghana, from 1891 to 2000, and a panel of 50 districts in Ivory Coast, from 1948 to 1998. Ghanaian districts correspond to *cocoa districts* in 1960, which significantly differ from administrative districts.[39] Ivorian districts correspond to administrative districts _ or *départements* _ in 1998.[40] Ghanaian and Ivorian districts belong to 10 regions in each country.

Urban and Population Data: I collect urban population data from various decadal statistical publications.[41] Defining as a city any locality with more than 5,000 inhabitants, I obtain a geospatialized sample of 364 cities in Ghana (1891, 1901, 1911, 1921, 1931, 1948, 1960, 1970, 1984 and 2000) and 398 cities in Ivory Coast (1901, 1911, 1921, 1931, 1948, 1955, 1965, 1975, 1988, 1998). Using GIS, I can recalculate district urban population for any spatial decomposition, but I am limited by the type of cash crop production data at my disposal. In Ivory Coast, production data is reported at the administrative district level. After reaggregating data to account for administrative changes, I obtain a consistent sample of 50 districts. I only have total population and rural population data from 1948. In Ghana, production is available at the *cocoa district* level (78). As cocoa districts differ from administrative districts, I privilege the former decomposition when creating the urban data set. Besides, administrative boundaries have been considerably modified across years, this impeding any consistent reaggregation. This also means I cannot have panel data on total and rural populations for Ghanaian districts. I nevertheless obtain population data for 36 Southern districts in 1901 and all the districts in 1931.[42]

Cash Crop Production and Price Data: The data on cash crop production was collected from a variety of sources.[43] For both Ghana and Ivory Coast, I am able to create a consistent

[39]Ghanaian production data is not available at the administrative district level. The number of cocoa districts has been decreasing over time, but I use various sources and GIS to reconstruct the data set using the same boundaries for the whole period. As it was not always possible to recreate data by reaggregating or disaggregating districts, I had to make some assumptions when constructing the data. The quality of Ghanaian production data is lower as a result.

[40]The number of Ivorian districts has been increasing over time, but I use various sources and GIS to reconstruct the data set using the same boundaries for the whole period.

[41]Publications for Ghana are: *Population and Housing Censuses* 1891, 1901, 1911, 1921, 1931, 1948, 1960, 1970, 1984 and 2000. Publications for Ivory Coast are: *Rapports statistiques* 1900-1920; *Rapports périodiques des gouverneurs et chefs des services* 1895-1940; *Annuaire statistique de l'A.O.F. 1949-1951 and 1950-1954*; *Population de l'A.O.F. par canton et groupe ethnique 1950-1951*; *Répertoire des villages de la Côte d'Ivoire 1955*; *Inventaire économique de la Côte d'Ivoire 1947-1958*; *Côte d'Ivoire 1965: Population*; *Recensement général de la population 1975*; *Population de la Côte d'Ivoire, Analyse des données démographiques disponibles 1984*; *Recensement général de la population et de l'habitat* 1988 and 1998. I also use Geopolis 2010, a previous attempt by geographers to collect urban data for African countries.

[42]I digitize population maps published in the census reports to obtain population at a fine spatial level in 1901 and 1931. I use GIS to reconstruct population at the district level. As the 1901 census was exhaustive in the South only, I recreate population only for Southern districts.

[43]Sources for Ghana are: *1927 Yearbook of the Gold Coast*; *Ghana Population Atlas* 1960; *Annual Reports and Accounts of the Ghana Marketing Board* 1957-1962, 1965, 1970; Dickson (1968); *Reports of the Department of Botanical and Agricultural Department* 1904-1955; *Analysis of Cocoa Purchases by Societies, Districts and Regions* 1961-1975, 1989 and 1994-1999; *Ghana Cocoa Marketing Board Newsletter* 1966-1974; *Ghana Cocoa Marketing Board Monthly Progress Reports* 1972-1985; and a summary of 2001-2009 district purchases (Ghana Cocoa Marketing Board). Sources for Ivory Coast are: *Annuaire Statistique de l'A.O.F.* 1949-1951; *Inventaire Economique de la Côte d'Ivoire 1947-1958*; *Documentary Material on Cacao* 1947; *Annuaire rétrospectif de statistiques agricoles et forestières 1900-1983*; *Atlas de Côte d'Ivoire, 1971-1979*; *Caisse de stabilisation et de soutien des prix des productions agricoles*; and *Pesage systématique du café et du cacao à l'entrée des usines de conditionnement et de transformation 2009*.

dataset of cash crop production (cocoa in Ghana, cocoa and coffee in Ivory Coast) for most years. When a year is missing, it is obtained by linear interpolation, giving production data for 79 districts in Ghana for every year between 1891 and 2009, and 50 districts in Ivory Coast for every year between 1948 and 2009.[44] I also collect information on regional cocoa yields whenever it is available. I then use the same sources and additional sources to obtain the international and producer prices in year 2000 U.S. dollars.[45] By multiplying cocoa production and the deflated producer price, I get the annual deflated total value of cocoa production going to farmers. Similarly, using the difference between the international and producer prices, I get the annual deflated total value of cocoa production being captured by the state. I proceed similarly for coffee in Ivory Coast. Lastly, I estimate the total value of cash crop production between each census year for each district to match the temporal structure of the urban database.

Geographical Data: Forest data comes from land cover GIS data compiled by Globcover (2009). The data displays those areas with virgin forest and areas with mixed virgin forest and croplands, which were areas with virgin forest before it was cleared for cash crop production. I then use historical cocoa soil map which I digitize in GIS to recalculate for each district the area share of each cocoa soil type (forest ochrosols, forest intergrades and forest oxysols).[46] A district is defined as *suitable* if more than 25% of district area consists of cocoa soils. Suitable land area in the two countries exactly corresponds to the area initially covered by tropical forest. A district is *highly suitable* if more than 50% of district area consists of forest ochrosols, the best cocoa soils. A district is defined as *poorly suitable* if it is suitable, but not highly suitable. I then use GIS: (i) to estimate district area (sq km), (ii) to reconstruct district average annual precipitations (mm) in 1900-1945 and district mean altitude (m),[47] (iii) to create a dummy for coastal districts, and (iv) to calculate the district Euclidean distances (km) to the coast, the largest city (Abidjan in Ivory Coast, Accra in Ghana).

Mining Production and Price Data: I use annual mining production data for Ghanaian mines in 1891-2000 for four commodities: gold (ounces), bauxite (tons), manganese (tons) and diamond (carats).[48] As I have the geographical coordinates of each mine and the export price in year 2000 U.S. dollars, I reconstruct the district annual value of mining production.

Household Survey and Census Data: I use household surveys and census microdata to calculate a range of statistics. In Ivory Coast, these are: the 1985-1988 *Living Standards and Measurement Study* (LSMS), the 1998 and 2002 *Enquêtes sur le niveau de vie des ménages* (ENV). In Ghana, these are: the 1987-1988, 1997-1998 and 2005-2006 *Ghana Living Standard Survey* (GLSS), and the 2000 *Population and Housing Census* IPUMS sample.

Agronomic Data: I use various agronomic statistics at the national or regional levels. In addition to household surveys, I exploit Ruf (1995a; 1995b), Teal, Maamah and Zeitlin (2006) and FAO (2012). The aggregate number of cocoa farmers is obtained from census reports and household survey data.

[44] Ghanaian cocoa production data only corresponds to the main crop (October-July). This is not an issue as this amounts to 94.7% of total production from 1948 to 2000.

[45] Additional sources are Bateman (1965), Teal (2002), FAO (2012) and World Bank (2012b). I use parallel exchange rate data when the black market premium is different from zero.

[46] The documents I use for obtaining cocoa soil maps are: *Survey of Ghana: Classification Map of Cocoa Soils* 1958, *Atlas de Côte d'Ivoire: Carte pédologique 1976* and Petithughenin (1998).

[47] Climate data comes from *Terrestrial Air Temperature and Precipitation: 1900-2006 Gridded Monthly Time Series, Version 1.01*. Altitude data comes from *NASA/JPL SRTM30*.

[48] Mining production and price data is collected from the following documents: *The Mineral Industry of the British Empire and Foreign Countries 1913-1919*; *Reports of the Mines Department of the Gold Coast* 1931-1958; and *The Mineral Industry of Ghana* 1963-2000 (USGS 2012).

Infrastructure Data: I collect data from various sources on the spatial allocation of infrastructure. First, I create three control variables intended to capture transportation infrastructure at independence (1958 in Ghana, 1960 in Ivory Coast). A GIS data set of railways and roads in 2010 is obtained from *Digital Chart of the World*. I then use various sources to identify international ports and reconstruct the railway network around 1960: Dickson (1968) and *Atlas de Côte d'Ivoire, 1971-1979*. I use Michelin road maps to reconstruct in GIS the road network around 1960. Michelin road maps allow me to distinguish paved and unpaved roads. I then use GIS to create district dummies for whether a district is connected to the railway network in 1960, or the paved road network in 1960, or contains an international port in 1960. Second, I collect infrastructure data for a cross-section of districts in 2000. For Ghana, I use the 2000 *Facility Census* to calculate for each district the share of rural and urban inhabitants less than 10 km from the following facilities: primary school, junior secondary school, senior secondary school, hospital, health centre, post office and telephone. I then use the 2000 *Population and Housing Census* to calculate for each district the share of rural and urban inhabitants with access to electricity and tapwater. Lastly, I use a recent Michelin road map which I have digitized in GIS to estimate the district density of paved roads (in meters per sq km).

Demographic Data: Using various sources, I am able to track the evolution of birth and death rates separately for urban and rural 1960-2000 Ghana and 1965-1998 Ivory Coast.[49]

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B Model Appendix: Natural Resource Exports and Urbanization

In this appendix I develop a model where resource exports drive urbanization. To highlight the mechanism as clearly as possible, the model assumes a small economy, one production factor - labor - and four sectors: food, resources, urban tradables and urban non-tradables.

B.1 Set-Up

There are four sectors i: food (f), natural resources (r), urban tradables (d) and urban non-tradables (n). Food and resources are tradable. Urban tradables are tradable manufactured goods and services. Urban non-tradables are non-tradable goods and services.[50] There is one representative agent endowed with one unit of labor. The production technologies are:

$$Y_i = A_i L_i. \tag{2}$$

where Y_i, A_i and L_i are the output, productivity and labor share of sector i. Productivity is exogenous. Food and resources are produced in the non-urban sector. Manufactured goods and services being produced in urban areas, the urbanization rate is $L_u = L_d + L_n$. The representative agent has the following non-homothetic preferences:

$$U(C_f, C_r, C_d, C_n) = (C_f - \bar{C_f})^{\alpha_f}(C_r)^{\alpha_r}(C_d)^{\alpha_d}(C_n)^{\alpha_n}. \tag{3}$$

where C_f, C_r, C_d and C_n denote the consumption of food, resources, urban tradables and urban non-tradables. Resources are not used as intermediary goods in other sectors. The sum of consumption weights is equal to one ($\Sigma_i \alpha_i = 1$). $\bar{C_f}$ is a food subsistence requirement. With $\bar{C_f} > 0$, the income elasticity of the demand for food is below one. The representative agent maximizes utility (2) subject to the budget constraint:

$$w = p_f C_f + p_r C_r + p_d C_d + p_n C_n. \tag{4}$$

where w, p_f, p_r, p_d and p_n are the wage rate and the prices for each sector.

B.2 A Closed Subsistence Economy

I first consider a closed economy. The consumer maximizes utility subject to the budget constraint. This yields the following demands:

$$C_f = \bar{C_f} + \frac{\alpha_f}{p_f}(w - p_f \bar{C_f}), \qquad C_j = \frac{\alpha_j}{p_j}(w - p_f \bar{C_f}) \quad \text{for } j = \{r, d, n\}. \tag{5}$$

The consumption of i is increasing in the wage rate w and i's utility weight α_i, and decreasing in i's price p_i. The food subsistence requirement $\bar{C_f}$ increases food consumption C_f but decreases the consumption of other goods. Perfect competition for labor implies that:

$$w = p_f A_f = p_r A_r = p_d A_d = p_n A_n. \tag{6}$$

Goods and labor markets clearing conditions are:

$$C_i = Y_i = A_i L_i\,, \quad \Sigma_i L_i = 1. \tag{7}$$

[50]This sector addresses the specific demand for "domestic" manufactured goods and services.

Combining (4)-(6), we find the following demands and labor shares:

$$C_f = \alpha_f A_f + (1-\alpha_f)\bar{C_f}\ , \quad C_j = \alpha_j A_j - \alpha_j \frac{A_j}{A_f}\bar{C_f} \quad \text{for } j = \{r,d,n\}\ , \tag{8}$$

$$L_f = \alpha_f + (1-\alpha_f)\frac{\bar{C_f}}{A_f}\ , \quad L_j = \alpha_j - \alpha_j \frac{\bar{C_f}}{A_f} \quad \text{for } j = \{r,d,n\}. \tag{9}$$

The food labor share is greater than α_f but converges to it as food productivity increases. Conversely, the labor share of other sectors is lower than the consumption weight, but converges to it as the food constraint is relaxed. The representative agent lives at the subsistence level if food productivity is low enough. Assuming $A_f = \bar{C_f}$, market clearing gives:

$$C_f = Y_f = A_f L_f = \bar{C_f} L_f. \tag{10}$$

Consumption C_f is below the subsistence requirement $\bar{C_f}$ unless $L_f = 1$. When food productivity is sufficiently low, she only consumes food and only works in the food sector:

$$C_f = \bar{C_f}\ , \quad C_j = 0 \quad \text{for } j = \{r,d,n\}\ , \quad L_f = 1\ , \quad L_j = 0 \quad \text{for } j = \{r,d,n\}. \tag{11}$$

The movement of labor out of the food sector into other sectors is constrained by the need to satisfy food requirements. There cannot be urbanization without a food surplus.

B.3 Natural Resource Exports in a Small Open Economy

I now consider a *small open economy*. The agent takes international prices p_f^*, p_r^* and p_{ut}^* as given. If the economy has a comparative advantage in natural resources, the autarky relative price of resources is lower than the international relative price:

$$p_r/p_f < p_r^*/p_f^*\ , \quad p_r/p_d < p_r^*/p_d^*. \tag{12}$$

The structure of comparative advantages implies that the country exports resources (X_r) and imports its consumption of food (M_f) and urban tradables (M_d). Demands are not changed, but the country has two producing sectors and perfect competition for labor means that:

$$w = p_r^* A_r = p_n A_n. \tag{13}$$

Goods and labor markets clearing conditions are:

$$X_r + C_r = Y_r = A_r L_r\ , \quad C_n = Y_n = A_n L_n\ , \quad C_f = M_f\ , \quad C_d = M_d\ , \quad \Sigma_i L_i = 1. \tag{14}$$

The balanced trade assumption stipulates that imports equal exports:

$$p_r^* X_r = p_f^* M_f + p_d^* M_d. \tag{15}$$

Using (4) and (12), and defining $R = p_r^* A_r - p_f^* \bar{C_f}$ as the surplus income available to individuals once they have met their subsistence requirement, we find the following demands:

$$C_f = \bar{C_f} + \alpha_f \frac{R}{p_f^*}\ , \quad C_j = \alpha_j \frac{R}{p_j^*} \quad \text{for } j = \{r,d\}\ , \quad C_n = \alpha_n A_n \frac{R}{p_r^* A_r}. \tag{16}$$

Since $\bar{C_f} = A_f$ and $p_r/p_f < p_r^*/p_f^*$, $R > 0$ and $C_f > \bar{C_f}$. The country gains from trade. The share of available income R allocated to sector i increases with i's consumption weight α_i and decreases with i's price p_i. Combining (14)-(17) and (18), the labor shares are:

$$L_r = (1-\alpha_n) + \alpha_n \frac{p_f^* \bar{C}_f}{p_r^* A_r}, \quad L_n = \alpha_n - \alpha_n \frac{p_f^* \bar{C}_f}{p_r^* A_r}. \tag{17}$$

First, the country urbanizes, because the food constraint has been relaxed and the consumption of urban non-tradables has increased. Now, any rise in the resource rent ($p_r^* A_r$) increases the labor share of urban non-tradables. Assume there are two types of resource sectors, fuels and mining where productivity A_r is high and cash crops where it is much lower. The urbanization rate is higher in the former, because the surplus per worker is higher. In the extreme, resource productivity is so high (like a "manna from heaven") that the country fully urbanizes. Second, urbanization takes place in consumption cities with non-tradable workers only.

B.4 Discussion and Possible Extensions

The model shows that resource exports can produce urbanization without structural transformation. I now discuss how the model could me modified to become more realistic. See Gollin, Jedwab & Vollrath (2013) for a complete model of resource exports and urbanization.

Complete specialization. First, the current model is overly simplistic as it predicts that the food sector disappears. The model could be enriched by modeling imperfect substitutability between domestic and foreign foodstuffs and/or allowing for internal trade costs that would make food imports too expensive for the hinterland. Second, the country does not industrialize at all. However, if there is imperfect substitutability and/or internal trade costs, there could be some employment in the urban tradables sector. We could also permit capital accumulation in that sector, which could increase productivity over time and change the country's comparative advantage in the longer run. It is perfectly possible that the country experiences structural change ex post. However, if there are dynamic externalities in the urban tradables sector, the original structural of comparative advantages will be reinforced over time, and it will be difficult for the country to compete with countries that industrialized earlier.

The sectoral composition of consumption cities. First, the export of natural resources and the import and domestic trade of food and urban tradables could create employment in the trade and transportation sectors. The labor share of urban non-tradables could be a function of the trade volume: $L_n = A_n Y_n = A_n [C_n + \zeta(X_r + M_f + M_d)]$. Second, the government could tax the resource sector: $w = (1-\tau) p_r^* A_r$, with τ being the tax rate. This augments the effect of natural resources on urbanization if the government's Engel curve for urban non-tradables (e.g. civil servants) is steeper than the private Engel curve ($\alpha_n^g > \alpha_n$). If there are two regions - *production* and *government* - and the government concentrates its urban consumption in its own region, this increases the primacy rate. Government cities are also consumption cities. Lastly, if some resource workers have a strong preference for urban living (i.e., a high α_n), the wealthiest of them will live in city and these agro-towns are also consumption cities.

Urbanization without urban tradables and long-run growth. There are several channels through which this type of urbanization could have a relatively lower effect on long-run growth. First, there could be dynamic externalities in the urban tradables sector or incentives for productivity improvement could be greater due to the threat of global competitors: $\Delta A_d = \lambda A_d$, with $\lambda > 0$. Second, there could be large intersectoral linkages from that sector. Third, that sector could provide more incentives for human capital accumulation, if the production technology is $Y_d = A_d L_d H_d$ and H affects productivity in the other sectors: $\Delta A_{-d} = \eta H_d$, with $\eta > 0$. Fourth, resource exports could have a negative effect on the quality of institutions θ, that would affect sectoral productivities: $A_i = f_+(\theta)$, for all i.

TABLE A.1: URBAN WORKFORCE SOURCE INFORMATION BY COUNTRY

Country	Year	Largest City	Source
Angola	1993	Luanda	Labor Force Survey 1993 (ILO)
Benin	2002	Cotonou	Questionnaire des Indicateurs de Base du Bien-Etre 2002
Botswana	2005	Gaborone	Labor Force Survey 2005 (ILO)
Burkina Faso	1998	Ouagadougou	Enquete Prioritaire 1998
Ethiopia	2004	Addis Ababa	Labor Force Survey 2004 (ILO)
Gambia	1993	Banjul	Household Economic Survey 1993
Ghana	2000	Accra	Population and Housing Census 2000 (IPUMS)
Guinea	1996	Conakry	Population and Housing Census 1996 (IPUMS)
Guinea-Bissau	1993	Bissau	Inquerito ao Consumo e Orcamentos Familiares 1993
Ivory Coast	2002	Abidjan	Living Standard Survey 2002
Kenya	1999	Nairobi	Labor Force Survey 1999 (ILO), Population and Housing Census 1989 (IPUMS)
Liberia	2010	Monrovia	Labor Force Survey 2010 (ILO)
Madagascar	2002	Antananarivo	Enquete Aupres des Menages 2001, 2002, Population and Housing Census 1993 (Census Report)
Malawi	1998	Lilongwe	Population and Housing Census 1998 (IPUMS)
Mali	1998	Bamako	Population and Housing Census 1998 (IPUMS)
Mauritius	2000	Port-Louis	Population and Housing Census 2000 (Census Report)
Mozambique	2004	Maputo	Labor Force Survey 2004 (ILO)
Namibia	2000	Windhoek	Labor Force Survey 2000 (ILO)
Nigeria	2005	Lagos	General Household Survey 2005
Rwanda	2002	Kigali	Population and Housing Census 2002 (IPUMS)
Senegal	2004	Dakar	Enquete Senegalese Aupres des Menages 2004
Sierra Leone	2004	Freetown	Population and Housing Census 2004 (IPUMS)
South Africa	2001	Johannesburg	Population and Housing Census 2001 (IPUMS)
Sudan	2008	Khartoum	Population and Housing Census 2008 (IPUMS)
Tanzania	2006	Dar Es Salaam	Labor Force Survey 2006 (ILO)
Uganda	2002	Kampala	Population and Housing Census 2002 (IPUMS)
Zambia	2008	Lusaka	Labor Force Survey 2008 (ILO)

Notes: Employment data are for all economically active persons aged 15+. IPUMS is the International Public-Use Microdata Series. ILO is the International Labor Organization. Census reports and household surveys were used for other countries. These 27 countries account for 80.0% of Sub-Saharan Africa's population in 2000. The large African countries (> 10 million inh. in 2000) for which no data could be found are the Democratic Republic of the Congo, Cameroon, Zimbabwe and Niger.