Is Urbanization in Sub-Saharan Africa Different?

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Abstract

Recent work has argued that urbanization is different in post-independence Sub-Saharan Africa than elsewhere in the developing world, with implications for African economic growth overall. While African countries are more urbanized than other countries at comparable levels of income, the relevant GDP data are of very low quality. From the perspective of better-measured effective technology, African urbanization matches global patterns overall, though sectoral differences remain. Agricultural price increases deter African urbanization, while promoting urbanization elsewhere, perhaps because agricultural surpluses are more often invested in urban production elsewhere. Finally, historical indicators of good institutions promote urbanization both inside and outside Africa.

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A growing literature argues that, in the period since independence, Sub-Saharan Africa's urbanization process has differed fundamentally from the rest of the developing world.[2] This complements a large literature arguing that many economic processes in Africa are different (e.g., Binswanger and Townsend 2000, Collier and Venables 2007, Ostry, and Subramanian 2007; Acemoglu and Robinson 2010; Block and Bates 2011). The urbanization literature suggests that two stylized facts that hold for the rest of the world do not hold for Africa. First, while rapid urbanization in other developing regions has been accompanied by fast macro-economic growth, Africa has seen urbanization without growth (e.g., World Bank 1999, 2009; Fay and Opal 2000; Barrios, Bertinelli, and Strobl 2010; Gollin, Jedwab, and Vollrath 2012). Second, while, in the rest of the world, urbanization has generally been accompanied by a sector transformation from agriculture to manufacturing, Africa is urbanizing without industrialization (e.g., Fay and Opal 2000; Collier and Venables 2007; Gollin *et al.* 2012).[3]

Empirical evaluation of both stylized facts is complicated by low quality data for Africa and by the difficulty of identifying causality. Jedwab (2012) makes progress on the sector transformation question using a case study, showing empirically that arguably exogenous positive shocks to agriculture spur *local* urbanization in newly cultivated areas. The work is focused on synergies between cities and their immediate hinterlands, not on how positive shocks to agriculture affect national urbanization. Related theoretical work by Gollin, Jedwab, and Vollrath (2012) argues that positive shocks to agriculture will spur national development of a non-traded good and service sector in urban areas, to the detriment of the traded industrial sector in cities. They argue that African cities are primarily "consumer cities" that arise to fulfill increased demand for non-traded, non-agricultural goods, where increased demand is based on increased agricultural and natural resource export rents.

This paper makes two types of innovations to this literature. First, we find different results on both the overall urbanization process and on the effects of sectoral shocks on urbanization. Second, we focus on estimation of causal relationships. On the general urbanization process, African urbanization follows fundamental growth drivers in the same way as the rest of the

[2] For brevity, in the remainder of this paper we frequently refer to Sub-Saharan Africa as either SSA or simply Africa. Similarly, we often refer to the rest of the developing world as just the "rest of the world" or NSSA (non-Sub-Saharan Africa).

[3] Explanations for this lack of industrialization include small country sizes restricting specialization, crowd-out by primary exports, exchange rate overvaluation, high labor costs relative to quality, poor infrastructure, and inadequate institutions (e.g., Johnson *et al.*, 2007, Collier and Venables 2007, Barrios *et al*., 2010).

world. Long term income growth and changes in urbanization are not significantly correlated inside or outside of Africa, although this may be due in part to substantial measurement error in GDP data (Henderson, Storeygard and Weil 2012; Young 2012). More fundamentally, even if we found a positive correlation between changes in urbanization and in accurately measured income, this relationship should not be seen as a causal one. Rather, a country's urbanization and income growth should be viewed as equilibrium outcomes of allocations across sectors which are influenced by capital accumulation and technological sophistication, as well as trade relationships and resource availability. Thus, models of urbanization set in endogenous growth frameworks feature human capital accumulation as the driver of technological progress, leading to productivity growth in both the urban and rural sectors, as well as a shift of labor from the rural (or traditional) sector to the urban (or modern) sector (Galor and Zeira 1993; Lucas 2004; Henderson and Wang 2005; Galor, Moav and Vollrath 2009). Consistent with this, we find that urbanization responds to human capital accumulation in Africa as it does in the rest of the world.

With respect to sector development, simple two sector models in which agriculture is rural and manufacturing is urban suggest that positive shocks to agriculture should deter urbanization by raising rural sector incomes. Unlike Gollin et al (2012), we find empirically that positive shocks to agriculture do deter urbanization in Africa. However we find the opposite in the rest of the developing world. While simple two sector models are consistent with African urbanization, they are not consistent with experiences in the rest of the world. Why? In certain contexts, positive agricultural shocks may not be passed through to farm workers. First, institutionally imposed monopsony purchasing of agricultural products (Jayne and Jones 1997) and collection by the government of agricultural surpluses may mean agricultural surpluses are distributed to urban dwellers, not farmers, as highlighted in the urban bias literature (Renaud 1980; Henderson 1988; Ades and Glaeser 1995; Davis and Henderson 2003; McCormick and Wahba 2003). Second, agricultural surpluses may accrue more to landowners who invest surpluses in capital for "urban activities" in a Galor and Zeira (1992) over-lapping generations framework. Finally, as suggested in Gollin *et al.* (2012), even if farmers get more income they may spend it on non-traded goods produced in cities, as opposed to traded manufactures. It is clear there are considerations beyond the simple two sector model which could lead positive agriculture shocks to promote urbanization. Whether or not they do is an empirical question.

Another way to tackle the relationship between structural transformation and urbanization is to look at shocks to the industrial sector rather than agriculture. Urbanization in developing countries outside Africa responds positively to trade shocks in the "modern manufacturing" sub-sector.[4] The presence of such a response, and its absence in other sub-sectors of manufacturing, is consistent with the existence of strong urban scale effects in this sub-sector (Henderson, Lee and Lee 2001). For Africa, however, we observe no response of urbanization to trade shocks for all industrial sub-sectors, including the modern manufacturing sub-sector. However the African lack of response has a potential explanation. The evidence shows that the response to modern manufacturing shocks is strongly increasing in a country's level of development, or human capital; and, on average, African countries have lower levels of human capital than do other developing countries.

In empirically analyzing sector responses, our econometric challenge is to move away from correlations in the data to identify causal effects. Sector composition and urbanization are simultaneous outcomes influenced by many factors we do not observe. Our innovation is to have effective randomization: we estimate the urbanization response of developing countries to external trade shocks, given historical trade patterns. For agriculture, we have detailed historical export data differentiated by crop type. We use changes in current world commodity prices to shock the agricultural sector of each developing country, using the historical export data to weight crop prices for each exporter. For the industrial sector, we model shocks to the demand for a developing country's exports using OECD country income variation. For each developing country, we know historical bilateral trade-patterns to OECD countries, indicating historical pathways or networks of trade flow destinations by country. We use these to weight the exogenous shocks (changes in OECD country incomes). In both cases we are following a strategy akin to Card (2001). Using import data from OECD and other more developed countries has the added advantage that it is more likely to be reliable than developing country sector composition data.

As a final topic in the paper, we look at the effect of political institutions on urbanization, linking to the literature on whether political institutions account for Africa's poor growth performance. One strand of this literature emphasizes the long run effects of pre-colonial

[4] This sub-sector includes both electrical and non-electrical machinery, telecommunications and transport equipment, instruments, and various other miscellaneous items (arms and ammunition, toys, musical equipment).

institutions on their modern counterparts. Acemoglu and Robinson (2010), for example, argue that governance in many African countries is "neopaternalistic" with the ruler standing above the law in his ability to expropriate and confer rights. Weak institutions perpetuate appropriation risk and bureaucratic rent seeking, thereby lowering private citizens' incentives for saving and investment, as well as governments' incentives to supply public goods, which are important for both agricultural and industrial development (Johnson, Ostry, and Subramanian 2007; Binswanger and Townsend 2000; Block and Bates 2011).[5] However, while weak institutions may inhibit development, we seek to address a different question: do they have any further effect on urbanization, conditional on the degree of development? One hypothesis is that countries with weak underlying determinants of institutions may find it harder to upgrade from the informal institutions that tend to prevail in rural societies to the more formal, structured institutions that are characteristic of urban settings. As such, these countries may be less likely to urbanize.

In addressing the relationship between political institutions and urbanization we are confronted with the well-known problem of the endogeneity of contemporaneous institutions. To deal with this problem we focus on time invariant and pre-determined country conditions thought to independently influence the development of institutions, such as a long history of statehood or less ethno-linguistic fractionalization, to see, first of all, if these have any effect and, if so, whether this effect differs between Africa and the rest of the world.

The remainder of the paper is organized as follows. The next section, Section 1, presents basic correlations which help to set the scene and motivate the subsequent analysis. Section 2 then provides a model of structural change and urbanization. Section 3 presents our econometric specification which derives from this model, as well as our basic results which follow from the estimation of this specification. Section 4 considers the impact of pseudo-random trade shocks on urbanization, while Section 5 examines the relationship between institutions and urbanization. Finally, Section 6 concludes.

[5] Binswanger and Townsend (2000) argue that monopolistic dominance in the purchase of output and inputs (seeds and fertilizer) by government or private concerns, low functioning and biased capital markets, heavy taxation of farm output, and lack of political voice of farmers (who are often disproportionately women) reduce incentives in, and, therefore, also the performance of, agriculture. Block and Bates (2011) argue that TFP in African agriculture is low, with a decline in capital investment and use of fertilizer between 1985 and 2007 due to poor incentives. Using World Bank enterprise surveys for 10 African countries, Kalemli-Ozcan and Sorensen (2012) argue that access to capital markets is restricted and capital is misallocated compared to other regions of the world. In their limited sample, African countries with better institutions, property rights and legal systems have better allocations in capital markets.

1. **Patterns in the data**

For this paper, the sample is all countries that, in 1970, had a population in excess of 300,000 and a level of GDP per capita that was less than the world sample mean for all countries meeting the population criterion.[6] With an average level of GDP per capita of $1,877 in 2009, Sub-Saharan African (SSA) countries in the sample are much poorer on average than countries in the rest of the developing world (non-SSA, or NSSA), where the average is $6,235 (Table 1). Table 1 also shows that African countries are less educated, less urbanized, less industrialized, and with faster population growth. As an alternative definition, we could restrict to countries with incomes less than half of the world mean. Only two of 40 SSA countries in the original sample would be removed, but 19 of 46 non-SSA countries would be. This would leave us with a small non-SSA sub-sample that is more similar to SSA in terms of both GDP per capita and industrialization. [7] Our results are generally similar for both samples. We prefer the larger sample because it provides more power. We try to address this limited overlap between the two samples in other ways. Data sources and definitions, as well as a complete list of sample countries, are provided in Appendix 1.

What associations are there in the data? Figure 1a and Table 2 (column 1) show that the association between GDP per capita and urbanization *levels* that is present in much of the world is absent in Africa in 2010, as suggested in the literature (Fay and Opal 2000, Barrios *et al.* 2006, Collier and Venables 2007). However, two additional facts make us wary of drawing any conclusions from correlations between income and urbanization levels. First, for the period 1970-2010, there is no evidence of a significant long difference relationship between changes in GDP per capita and in urbanization, and this is true for both Africa and the rest of the world (Figure 2a and Table 3, cols 1 and 2). Second as noted earlier, GDP data are particularly suspect in Africa (Young 2012, Henderson *et al.* 2012). As such, these associations are measured with a high degree of error that may differ substantially across regions.[8]

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[6] The world sample mean level of GDP per capita in 1970 for all countries with a population greater than 300,000 was $5,317 (constant 2005 international dollars). In 1970, Gabon was the only SSA country (for which data is available) with a level of GDP per capita greater than this.

[7] The two SSA countries lost are Namibia and South Africa. Restricting attention to countries with less than 50% of 1970 mean income, the average level of GDP per capita for SSA in 2009 is $1,651.

[8] Concerns also exist about the quality of urbanization data (Potts 2012, Satterthwaite 2010), especially when censuses are not regularly conducted, as has been the case in many African countries. A 2013 study commissioned by the World Bank (but not yet released) suggests that the UN World Urbanization Prospects data, which we use,

As argued in the introduction, we learn more about the path of African urbanization by considering it in relation to evolving accumulation processes rather than another outcome variable, such as income. Thus, when, consistent with endogenous growth models of urbanization (Lucas 2004, Henderson and Wang 2005), we instead view urbanization as a function of educational attainment, Africa looks like the rest of the world. More specifically, in Figure 1b and Table 2 (col. 3), we see that the relationship between urbanization and the average years of high school and college per adult for Africa is virtually identical to that for the rest of the world. Similarly, in Figure 2b (see also Table 3, col. 3), we see an association between changes in urbanization and growth in effective technology, as reflected by the growth of educational attainment, that is both significantly positive overall, and not significantly different for Africa. Later panel regressions will substantiate these associations. Africa's faster rate of growth of effective technology, as determined by its pace of human capital accumulation, matches with its higher rate of change in urbanization.[9]

Next we turn to sector differences. As noted above, Africa is less industrialized than the rest of the developing world and also has a higher share of GDP in agriculture – 23% for SSA compared to 14% elsewhere in 2010 (Table 1). The puzzle, which has been highlighted in the literature (e.g., Fay and Opal 2000; Collier and Venables 2007; Gollin *et al.* 2012), is that the distinct cross-section relationship between higher urbanization and lower agricultural share (higher manufacturing share) that exists elsewhere in the world is not present in Africa (Figure 3a and Table 4, cols 1 and 2). Figure 3b shows a negative long difference relationship between agricultural growth and urbanization in the rest of the developing world, but no relationship for Africa. However, the differenced relationships are all insignificant (Table 4, cols 3 and 4), although sample sizes are small. While we are concerned about the quality of African GDP data, we are even more concerned about the accuracy of the sector shares. Hence our econometric analysis will rely on trade data collected by more developed countries.

2. **Conceptualizing urbanization**

are better than other sources of data, reporting past urbanization fairly reliably, even if projections are questionable. We return to this issue later.

[9] We also obtain very similar results when we use average years of schooling at levels other than high school and college as our measure of educational attainment.

In thinking about urbanization in developing countries, researchers have traditionally been guided by classic two-sector models of rural-urban migration (Harris and Todaro 1969; Williamson 1986; Mills and Becker 1986). Implicit in these models is the presumption that economic development involves a transition of employment from a backward rural sector to a modern urban manufacturing sector.[10] More recently, growth models of urbanization have endogenized the employment transition, modeling the switch from a rural or backward sector to an urban or modern sector as human capital accumulates. In Henderson and Wang (2005) this involves a shift from rural production to the production of urban goods. In other models, however, there is no shift *per se* in the good produced. Rather, the transition is from a sector in which production relies on land and unskilled labor to a sector which produces the same good, but instead using skilled labor (e.g., Lucas 2004, Caselli and Coleman 2001, Galor and Zeira 1993) and, in some cases, also physical capital (Galor *et al.* 2009). We do not repeat these models here. Rather, we simply adopt the presumption that the urbanization process is driven by human capital accumulation. Given this presumption, we explicitly consider the impact on this process of trade conditions and shocks, which affect the price of agricultural and natural resource products, relative to manufacturing goods (i.e. the terms of trade).

We start with a two sector model of rural-urban migration, assuming a small open economy with both rural agriculture and urban manufacturing production. As is typical, missing from the specification are non-traded locally produced goods within both the urban and rural sectors. In most developing countries, significant portions of rural employment is in non-agricultural, mostly non-export production, including locally manufactured and consumed food products, cooking utensils, furniture, apparel, and trunks, as well as housing and retail services. For example, the three lower income SSA countries with IPUMS data from the last 10 years, Malawi (2008), Sierra Leone (2004), and Sudan (2008), have 34, 12, and 44 percent, respectively, of their rural workforces in non-agricultural employment. Urban sectors also have huge local non-traded good sectors. Adding a non-traded component to *each* of the urban and rural sectors won't change our general results.[11] The general point is that, in the data, "rural" is not just agriculture and "urban" is not just modern manufacturing; and modeling ignores this fact.

[10] This is consistent with the common portrayal of cities as "engines of growth" (see, for e.g., World Bank 1999/2000, 2009).

[11] However if all such non-agricultural goods are defined to be produced only in the urban sector (and exported domestically to the agricultural sector) as in Gollin et al (2012), then one can get fundamentally different results.

To facilitate a focus on rural-urban transitions in the classic two sector model, we embed this in an endogenous growth model of urbanization based on Henderson and Wang (2005).[12] Within this framework, human capital accumulation fuels urbanization under a fairly straightforward set of conditions, which we note later. We focus on how urbanization is influenced by both the terms of trade and national population growth.

In the rural sector per person production and income is given by

$$I_a = p_a h_a^{\theta_a} g(\bar{K} / N_a), \quad g' > 0 \qquad (1)$$

where I_a is per person rural income. The RHS of (1) contains the per person production technology. p_a is the price of agricultural output. h_a is per person human capital ($0 < \theta_a < 1$) and combines both skill level and sector level of effective technology: the ability of rural workers to absorb and adapt global agricultural technologies. $\bar{K} / N_a$ is the land to labor ratio in the sector. Farmers are assumed to each have an equal claim on returns from land as under, for example, communal based land ownership in Africa (Bruce 1998). As such, they receive their average product as specified in (1). The total value of agricultural output is $p_a h_a^{\theta_a} g(\bar{K} / N_a) N_a$. In Appendix 2, we use a Cobb-Douglas technology where the total value of agricultural output is instead given by $p_a h_a^{\theta_a} \bar{K}^{\psi} N_a^{1-\psi}$. Total population, $\bar{N}$, is divided between the urban and rural sectors, or

$$N_a = \bar{N} - N \qquad (2)$$

where N is the urban population.

Although in Henderson and Wang (2005) there is a system of cities, the urban sector could be conceived of as a single city[13] where there are external scale economies in production that generate initial benefits to having a larger city, but there are also diseconomies in terms of potential work time that is lost in commuting, which increase as city population and spatial area rise. In such models there is a residential sector spatial equilibrium with land rents and commuting distances, but these models all end up with a reduced form expression for per person urban real income, I_u ,

[12] Henderson and Wang's model is itself adapted from Black and Henderson (1999), with a sophisticated version in Rossi-Hansberg and Wright (2008) that adds in a stochastic process, multiple rather than just two sectors, and physical as well as human capital accumulation.

[13] Total urban population is, therefore, given by the population of this city.

$$I_u = h_u^{\theta_u} f(N), \qquad f_N(N; N > N^*) < 0 \qquad (3)$$

In (3), the urban good is the numeraire and h_u is human capital per worker in the urban sector. We assume that returns to human capital are higher in the urban than in the rural sector, i.e. $\theta_u > \theta_a$ where $0 < \theta_u \leq 1$. It is this differential in returns that drives urbanization in this open economy model. $f(N)$ is assumed to be an inverted-U shaped function of city population, which achieves its maximum at N^*. In models with multiple cities, in a stable equilibrium, all city sizes must be equal to or greater than N^*, in which case urban real incomes decline as city size expands. Here, as the urban population expands relative to rural, for stability we need to assume that the rate of growth of urban incomes is less than that of rural incomes. A specific example from Duranton and Puga (2004) gives the form $I_u = h_u^{\theta_u} N^{\delta}(1-\tau N)^{1+\delta}$ to city real income where δ is the degree of scale externalities and τ the cost of commuting a unit distance in the city.

We analyze the allocation of labor between the urban and rural sectors in a small open economy, where agricultural goods are exported internationally, as are urban goods. We note all of the developing countries in our sample exported some modern manufactured products even in the 1960s. With both products traded internationally, we close the model for an instantaneous equilibrium by assuming an absence of rural-urban migration costs. Labor thus moves between the urban and rural sectors to equalize real incomes. Substituting in $N_a = \bar{N} - N$ and equating (1) with (3) we have[14]

$$I_a = p_a h_a^{\theta_a} g(\bar{K}/(\bar{N}-N)) = I_u = h_u^{\theta_u} f(N) \qquad (4)$$

Our estimating equation will be based on a differenced version of (4). We define:

$$M \equiv d[p_a h_a^{\theta_a} g(\bar{K}/(\bar{N}-N)) - h_u^{\theta_u} f(N)]/dN > 0 \qquad (5)$$

M is positive in a stable allocation between the urban and rural sectors. That is, as the urban sector expands, the rise in productivity in the rural sector from an increased land-labor ratio, $\bar{K}/(\bar{N}-N)$, exceeds that in the urban sector. In our estimating equation we look at the change in the urban share over time or $d(N/\bar{N})$. Differencing (4) and rearranging into the estimating form for a LHS of $d(N/\bar{N})$ we have

[14] Or, using the functional forms mentioned above, $I_u = h_u^{\theta_u} N^{\delta}(1-\tau N)^{1+\delta} = I_a = p_a h_a^{\theta_a} \bar{K}^{\psi}(\bar{N}-N)^{-\psi}$

$$d\frac{N}{\bar{N}} = M^{-1}\bar{N}^{-1}\left[[p_a h_a^{\theta_a} g'(\cdot)\frac{\bar{K}\bar{N}}{(\bar{N}-N)^2} - MN]\frac{d\bar{N}}{\bar{N}} - p_a h_a^{\theta_a} g'(\cdot)\frac{\bar{K}}{(\bar{N}-N)}\frac{d\bar{K}}{\bar{K}} + p_a h_a^{\theta_a} g(\cdot)\{-\frac{dp_a}{p_a} + [\theta_u \frac{dh_u}{h_u} - \theta_a \frac{dh_a}{h_a}]\} \right] \quad (6)$$

While $dN / d\bar{N} > 0,$ the effect on the urban share, $N / \bar{N}$, of an increase in national population is ambiguous. Everything else is straightforward. An increase in the relative price of the agricultural good decreases urbanization, because the enhanced returns to agriculture draw people out of the urban sector. An increase in land reduces urban population and share as agriculture becomes more productive. For human capital, as in growth models of the urbanization process, we generally assume $dh_u / h_u \geq dh_a / h_a$. Then, given the assumption $\theta_u > \theta_a$, with fixed terms of trade, human capital growth leads to increased urbanization, given the relative gain in labor productivity in the urban versus rural sector. Given its non-linearities, this model does not, in the closed economy case, lend itself to simple closed form solutions (see Henderson and Wang, 2005). As explained in Appendix 2, for the specific functional forms we use here for a small open economy, we simply assume that there is eventual convergence to an approximate steady-state and that developing countries are still accumulating human capital. In general, urban human capital levels exceed rural, because the return to human capital is higher in the urban sector. Growth rates of human capital in the two sectors may, however, be the same.

Our empirical results for Africa will conform to the results in equation (6). In particular, we find that positive shocks to African agriculture reduce the urban share, but this is not the case for non-African countries. Given the predictions of our simple model, what might explain this result in non-African countries? We consider two additional features noted earlier that might lead to this result: (1) monopsony purchasing by state boards and (2) a class of landowners that invests agricultural profits in cities.

2.1 Monopsony purchasing in agriculture

A government purchasing board that exercises monopsony rights to agricultural products fixes prices paid to farmers at below market prices, $\bar{p}_a$, selling at an international price in excess of $\bar{p}_a$ and distributing surplus rents. In this context, the impact on urbanization of a positive shock to agricultural prices will depend on who receives the additional surplus. In particular, if the additional surplus is distributed to the representative urban resident, then the urbanization response will be positive. However, if the additional surplus is instead distributed only to elites, there will be no urbanization response because, in these circumstances, the shock will not change the margin of choice for the representative rural-urban migrant.[15]

To see this more clearly, consider an example. The income to a rural resident is now given by $\bar{p}_a h_a^{\theta_a} g(\bar{K}/(\bar{N}-N))$. Since rural and urban incomes are equal, national demand for domestically consumed agricultural output can be written as $D(\bar{p}_a h_a^{\theta_a} g(\cdot), \bar{p}_a)\bar{N}$, where for simplicity we assume all domestic consumers pay $\bar{p}_a$. The volume of agricultural exports is then $h_a^{\theta_a} g(\cdot)(\bar{N}-N) - D(\cdot)\bar{N}$ and the surplus $(p_a - \bar{p}_a)[h_a^{\theta_a} g(\cdot)(\bar{N}-N) - D(\cdot)\bar{N}]$. If this surplus is divided equally among urban residents we now have a new urban-rural migration equilibrium condition:

$$\bar{p}_a h_a^{\theta_a} g(\bar{K}/(\bar{N}-N)) = (p_a - \bar{p}_a)[h_a^{\theta_a} g(\cdot)(\bar{N}-N) - D(\cdot)\bar{N}]N^{-1} + h_u^{\theta_u} f(N) \qquad (7)$$

Given the stability requirement that $M_1 \equiv d\left[\bar{p}_a h_a^{\theta_a} g(\bar{K}/(\bar{N}-N)) - \left((p_a - \bar{p}_a)[h_a^{\theta_a} g(.)(\bar{N}-N) - D(.)\bar{N}]N^{-1} - h_u^{\theta_u} f(N)\right)\right]/dN > 0$, it is straightforward to show that

$$dN/dp_a = M_1^{-1}\{[h_a^{\theta_a} g(\cdot)(\bar{N}-N) - D(\cdot)\bar{N}]N^{-1}\} > 0. \qquad (8)$$

The problem with this explanation for the positive response of non-African urbanization to agricultural price shocks is that monopsony purchasing boards have historically been seen as *more* prevalent in Africa than elsewhere (Jayne and Jones 1997, Binswanger and Townsend 2000, Block and Bates 2011). Given this, we turn to a second potential explanation based on another important difference between Africa and the rest of the world.

2.2 Private ownership of land

Our model treats rural land as communally owned, and this does fit Africa better than it does the rest of the developing world. How would private ownership change the comparative statics? To consider this question, suppose there is a class of landowners, distinct from workers, as featured in overlapping generations growth models such as Galor and Zeira (1993) and Galor *et al.* (2009). Consider a small open economy with sectors producing an agricultural good, a modern manufactured good, and a "traditional" manufactured good (e.g., furniture, food utensils, and apparel) which is produced in the rural, as well as potentially the urban, sector. In a set-up like this, increased export demand for either agriculture or modern manufacturing can promote urbanization.[16] To see this, suppose agriculture is produced with land and unskilled labor,

[15] This is the case irrespective of whether the surplus goes to urban or to rural elites.
[16] This result will not be possible in a two-sector model with one relative price.

modern manufacturing with physical and human capital, and traditional manufacturing with unskilled labor. Land is owned by a class of landowner dynasties, in which parents have the knowledge and skills to invest their bequests in physical capital in the urban sector, but rural unskilled labors have neither the mechanisms nor information to undertake such investments.

In this context, an increase in the international price of agriculture has two effects. First, it raises the marginal product of unskilled labor in farming, deterring urbanization. The second effect is to raise the return to land and bequests of landowners. This raises their investment in physical capital, which raises the marginal product of efficiency units of labor in the urban sector. Depending on the magnitude of the first effect relative to the second, the wages in agriculture relative to manufacturing may rise or fall and urbanization may be deterred or spurred.[17]

In many developing countries outside of Africa, agricultural land has been privately owned for at least the last 150 years. Landowners have invested agricultural surpluses in physical capital. Sugar cane plantation owners in Brazil, for example, progressed from food processing to modern light manufacturing (Baer 1979). In the vast majority of African countries, by contrast, rural land is communally owned (Bruce 1998). Such land may be allocated by a village head, with use and, perhaps, control rights. However, if such allocations do not include transfer rights they cannot be used as collateral. And, in general, direct collection of land rental income is rare. In essence, there therefore exists some large class of unskilled farmers with small holdings who earn their average product. This difference in landownership could explain some of the difference in the effect of agricultural price shocks on urbanization in Africa versus the rest of the developing world.

[17] Galor and Zeira (1993) also consider both inequality in land holdings and capital market imperfections. If there is no capital market, having a class of landowners means those with larger holdings have larger bequests to invest in physical capital, which is even more important if there are fixed costs to investment which must be overcome. With imperfect capital markets, small human and physical capital loans may be largely unsecured, raising the costs of borrowing. Human capital collateral is subject to the no-slavery constraint and the secondhand market for immobile, rapidly depreciating special-order machinery used in manufacturing may be very limited. If there is a capital market, families with larger landholding, incomes and bequests can avoid the high costs of unsecured borrowing and are more likely to invest in their own businesses (with some degree of fixed costs). And they can also use their land as collateral to reduce their borrowing costs. In a related political economy story, landowners make urbanization unattractive by under-investing in public education to maintain cheap farm labor (Galor *et al.* 2009). A related empirical literature focuses on tenancy reform and its impact on poverty and agricultural productivity in India (e.g., Besley and Burgess 2000).

3. Econometric specification and base results

The econometric specification is based on equation (6). The base specification examines changes in the urban share as a function of two variables: 1) the national population growth rate and 2) the growth rate in the average years of post-primary (i.e. high school and college) education in the adult population (over age 25), which represents both changes in effective labor units and changes in effective technology. Time invariant country conditions, including geography, culture and underlying institutional determinants, are differenced out. Such features could also affect growth *per se* and we consider this in later variants of our specification. For now, we note only that national land area ($\bar{K}$) may interact with other covariates. For example, in a small country, the urbanization response to rapid population growth may be stronger than in a large country.

The basic specification for country i is

$$\Delta_{10}\left(\frac{N}{\bar{N}}\right)_{it} = b_0\Delta_{10}h_{it} + b_1\Delta_{10}\ln\bar{N}_{it} + b_2\ln\bar{K} + b_3\left(\ln\bar{K}\right)\Delta_{10}\ln\bar{N}_{it} + \beta\Delta_{10}X_{i;t-s} + T_t + \Delta_{10}e_{it}\,. \qquad (9)$$

In this specification, the unit of analysis is first-differences at 10 year intervals, as denoted by Δ_{10}. We pool 4 time periods: 1970-80, 1980-90, 1990-2000, and 2000-10.[18] $\Delta_{10}\left(\frac{N}{\bar{N}}\right)$, $\Delta_{10}h$, and $\Delta_{10}\ln\bar{N}$ are changes in the urban share, human capital (and, hence, effective technology), and national population, respectively. We include time dummies (T_t) to account for global changes in, for example, the world technology level to which all developing countries are adapting. The $\boldsymbol{X}$ term in different specifications includes factors that shock income such as commodity price indices, trade partner income indices, rainfall, and institutional influences. When these are time varying, we generally lag the differences by 2 or 5 years to allow the shocks time to have an impact. We also sometimes smooth measures such as prices and rainfall to reduce noise and give more weight to more persistent shocks. Finally, we cluster errors by country to account for possible country-specific serial correlation (Stock and Watson, 2008).

[18] Since censuses in this sample are carried out at least 10 years apart, using shorter intervals where data are interpolated is unlikely to add any new information to the dependent variable.

3.1 Identification

The chief estimation concern is identification. Everything is potentially endogenous and while we can estimate correlations, claiming causality is a challenge. We address this problem in two ways. First, we consider correlations among country conditions and spell out the assumptions required for effects to be causal in our base case. Second, in later sections, we construct plausibly exogenous shocks to gain pseudo-randomization.

What do we need for identification of the base specification? Let's start with national population growth. Consider a time-varying unobservable such as the urban-rural differential in quality of health care. If such an amenity enters the utility function separably, the effect of differences in relative quality *levels* is differenced out in the growth specification. But relative differences are likely to change over time. Suppose that over the decade $t-10$ to t, urban health care improves both absolutely and relative to rural health care. This improvement could draw more rural migrants to cities thus having an unobserved direct effect on urbanization. But it could also reduce national population growth, if better access to health facilities increases the provision and social acceptance of birth control in urban areas, reducing birth rates aged 5-30 over the decade in cities and therefore also nationally. If both links exist, our estimated effect of population growth on urbanization will be understated. Of course better relative improvements in health care in cities could also reduce national death rates with an opposite bias.

Education presents a related endogeneity concern. Relative improvements in urban education facilities in a decade may cause both a move to cities and directly enhance national educational achievement. Here, however, timing may alleviate the problem, making it less salient. We consider educational attainment of the population age 25 or older. The change in this variable between t and $t-10$ includes information only about people who were aged at least 15 in $t-10$. It may be reasonable to assume that decisions about their educational progress were effectively made before contemporaneous changes in relative urban-rural education quality. However, if *changes* in rural-urban educational quality *differentials* are correlated across decades, then the problem remains.

We first present results using this base specification. Then we turn to trade shocks to the modern sector, rain and price shocks to the agricultural sector and the role of institutions.

3.2 Base results

Table 5 presents results from the estimation of our base specification. In column 1, urbanization is positively and significantly affected by both the growth of national population and the growth of effective technology. In column 2, we estimate the same relationship as in column 1 for a restricted sample in order to reduce concerns about extrapolation in the UN projections (Potts 2012). Specifically, we limit to country-years no more than 5 years after the most recent census. Results are very similar. In column 3, using the original sample, we add interactions with an SSA dummy for all variables (including time dummies) and report its effect on slope coefficients.[19] The SSA differential is not significant for growth in national population or in effective technology, individually or jointly. The point estimates are not small, but small sample sizes limit precision. If anything, changes in effective technology have stronger effects in SSA.[20] If we use alternative measures of education, such as the fraction of the population over 25 with at least some secondary schooling, we get similar results.

In column 4, we add land area and land area interacted with national population growth to account for changes in density. As might be expected, the effect of population growth on urbanization is more modest in countries with larger areas and thus more farm land on average. We keep these additional variables in our base specification for the rest of the paper.[21] Finally, in column 5, we find no compelling SSA differentials in the column 4 specification.

How big are these effects? In column 4, for a country of average ln(land area), a one standard deviation change in the national population growth rate leads to a 0.57 percentage point increase in the percentage of the population classified as urban. For a country with one standard deviation more land, the impact of a one standard deviation change in population growth on the urban share drops to 0.043. A one standard increase in the growth of education (0.30 years) leads to a 1.05 percentage point increase in the growth of urban share (equivalent to 0.28 standard deviations of growth in urban share). The average change in urban share per decade in the

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[19] Whenever we introduce SSA differences in a specification in the paper we always interact *all* covariate coefficients including time dummies. We only, however, report the interactions for the current variables of interest. Although interacting all covariates reduces precision, it also reduces the risk that we are misinterpreting other interaction effects as our effect of interest.

[20] If we measure change in effective technology using growth in GDP per capita, we get similar, but weaker results. Explanatory power falls and the Δ_{10}lnGDPpc coefficient is insignificant at the 5% level. The Δ_{10}lnGDPpc coefficient (s.e.) and the coefficient on Δ_{10}lnGDPpc interacted with SSA are respectively 2.858 (1.455) and -0.705 (1.960). The GDP per capita relationships subject to the measurement problems with GDP discussed above.

[21] We also interacted education with land area. The interaction term is positive but insignificant, and the education effect at mean size is the same as in column 4. The coefficient (s.e.) is 0.453 (0.688).

sample is 4.67, so our results suggest that a standard deviation increase in education growth would raise this to about 5.7.

As we discussed above, both population growth and education are potentially endogenous. However, an instrumental variables strategy poses two major problems. First, we are unable to independently predict both population growth and education growth. Possible instruments include lagged $(t-20)$ population shares of both youths (aged 0-15) and the elderly (over 65), and sex-specific lagged education measures. These generally predict growth in both population and education, and the joint Kleibergen-Papp F-statistic is, at best, between 3 and 4. The second problem is that these variables are unlikely to meet the exclusion restriction, since all may affect contemporaneous migration decisions.

4. Trade shocks to agriculture and manufacturing

In this section we examine the effect of exogenous trade shocks on urbanization, with an emphasis on how Africa might respond differently to these economic forces. We start with trade shocks to agriculture and also natural resources.

4.1 Shocks to agriculture and natural resources

Our main focus is on shocks to agriculture overall. In the last part of the section, we distinguish between food and non-food agriculture, and we consider price shocks to non-agricultural natural resources.

4.1.1 Agriculture

We examine two kinds of agricultural shocks: rainfall and international agricultural prices. Our rainfall measure is based on an annual average aggregated for each country from interpolated gauge data. For price shocks we use an index suggested in Bruckner and Ciccone (2010) and Collier and Goderis (2009). Each country is a long term exporter of a specific set of agricultural commodities such as coffee and cocoa, with their individual export bundles depending primarily on physical geographic factors. As world prices fluctuate for these primary products, so do potential incomes of exporting countries. Equation (6) suggests that increased agricultural product prices will expand agricultural employment and slow national urbanization. However, as equation (8) suggests, if the surplus generated in agriculture does not go to farmers, but is spent instead in cities, then higher prices will instead fuel urbanization.

The expression for the export price environment in country j in time t is

$$PE_{jt} = EXSH_{j,1962-9} \ln PI_{jt}\,, \tag{10}$$

$$PI_{jt} = [\prod_{k=1}^{n} p_{kt}^{a_{kj,1962-9}}]CPI_{USAt}^{-1}, \quad \sum_{k=1}^{n} a_{kj,1962-9} = 1$$

Following Collier and Goderis (2009), we use normalized international prices p_{kt} (in current US \$) in year t for commodity k, and weight by the historical (1962-69) share of agricultural commodity k in country j's total commodity exports, $a_{kj,1962-9}$ from Feenstra *et al* (2005). By construction, weights sum to unity for each exporter. We deflate by the USA CPI because the prices are reported in nominal terms. We chose 24 agricultural products for which we have consistent price series, and for which trade data on a relatively unprocessed form of the good exists.[22] For the price environment, PE_{jt}, we take the log of the index PI_{jt} to ensure that final effects will be invariant to units of commodities used to define unit prices and then multiply by $EXSH_{j1962-9}$, the (average) share of agricultural exports in country j's GDP in the 1960s. This latter adjustment allows for changes in the price of an export commodity to have a bigger impact on the price environment for countries that export more commodities overall. The 10-year change in the price environment, ΔPE_{jt}, enters the regressions below.[23]

We adjust both the price and rainfall data in two further ways. First, we lag the shock by 5 years to allow time for an urbanization response.[24] Hence, the shock variable is $\Delta PE_{jt-5,t-15}$ and we model urbanization during, for example, the 1970s, as a function of price changes from 1965 to 1975. Second we smooth by using three-year centered averages around $t-5$ and $t-15$ (for rainfall and for each commodity price deflated by the CPI before applying weights). This reduces noise and places greater weight on more persistent shocks.[25]

Results are reported in Table 6. We show the price and rainfall shocks together. Coefficients on each are robust to the inclusion of the other. If African weather conditions are affecting world prices for any product then by including both we are separating out the effects. In column 1,

[22] These goods are listed in the data appendix.

[23] In an attempt to expand the sample we also experimented with the use of weights based on 1970-72 data in the definition of the price environment. GDP data are available for a greater number of countries in this period. The results we obtained were similar to those reported. However, since 1970-72 falls within our sample-period, our preferred results are those based on the 1962-69 weights.

[24] We also report results with a 2 year lag.

[25] If fewer than 3 years of data are available for a particular year-variable we smooth over the number of years that are available.

rainfall has a negative effect, consistent with the story that rainfall improves agricultural productivity (effective land, in terms of our theoretical model), raising incomes in agriculture and deterring urbanization. Consistent with Barrios *et al* (2006), the estimated coefficient on the SSA interaction with rainfall in column 2 is negative, implying that the negative effect of rainfall on urbanization is larger in Africa than in the rest of the world. However, unlike Barrios *et al*, we do not find this differential to be significant. We were surprised by the weakness of our results in this area.

Our main results concern agricultural price shocks. In column 1 for the overall sample, there is a positive but insignificant price shock effect. Column 2 indicates a strong and highly significant positive effect of 9 on urbanization for non-SSA countries; and a strong *net* negative significant effect of about -7.6 for SSA countries.[26] For the rest of the world, a one standard deviation increase in the price shock variable (0.046) leads to 0.41 *increase* in the urban share, where the average increase is 4.74. In SSA, such a price increase leads to a 0.35 *decline* in the urban share. To consider the possibility that our results are driven by outliers, we iteratively dropped individual observations whose absence had a noticeable impact on the coefficients of interest (the price shock variable and the SSA differential for that variable). Doing so only strengthened the effects.[27] In column 3, we show weaker results with a 2-year lag structure.

Why do results differ for African versus non-African countries? No data that is consistently available across countries quantifies the phenomenon of capturing agricultural rents and spending them in cities or not. We consider government consumption as a share of GDP as a crude proxy. A regression of changes in government consumption on our base covariates, agricultural price shocks, and all SSA interactions yields a coefficient (s.e) on the agricultural price shock variable of 0.125 (.0657) and the SSA interaction of -0.234 (0.219). This is modest support for the idea that surpluses fund increased government procurement of actual goods and services delivered in cities outside of Africa, with no such reaction in Africa, but differential data quality may again be driving this difference.

In section 2.2, we also speculated that land ownership systems might drive differentials between SSA and non-SSA. We characterized Africa as having communal ownership, while the

[26] When estimated on the SSA sample, the price index coefficient (s.e.) is -7.59 (3.07), significant at the 5% level.

[27] We ran the "dfbeta" command in Stata to find these outliers. First, there are no major outliers of the kind researchers worry about in a small sample: the dfbeta numbers on the two coefficients are all under 0.45 in absolute value. Dropping outliers, defined either as dfbeta values over 0.35 in absolute value or the one country with repeated outliers, strengthens the results.

rest of the world is more likely to have a class of landowners who might invest surpluses in urban businesses. In the absence of a data set on land ownership in non-SSA countries, we cannot test this hypothesis directly. To investigate whether landownership might relate to differentials within Africa, we considered measures of land ownership systems from Bruce (1998). Nine out of 27 African countries in our sample have significant (not necessarily dominant) private ownership. When this private ownership dummy is interacted with the price shock variable in the SSA sample, the prick shock coefficient is -17.8 and its interaction with the dummy is 8.2. While the sign of that interaction is consistent with the land ownership hypothesis, it is insignificant. And it cannot be compared to the NSSA countries, where private ownership dominates. For that comparison, we turned to the Institutional Profiles Database (IPD) of the French government. It asks French embassy officials a myriad of questions about institutions in the country they are posted. The question most relevant to our work asks respondents to what extent rural land ownership is communal, on a scale of 1 to 4. We found no interaction effects between this measure and agricultural price shocks. However, the country coverage of the survey is limited to 53 of the 65 countries in Table 4 and the quality and consistency of the data are more limited than Bruce (1998), which is an in-depth study for each country on this specific question).

Another potential reason for a differential is that effects are somehow conditional on the "stage of development", an issue we will explore for modern manufacturing development. We tried the 1965 level of our education variable as a measure of overall "stage of development". The base price shock coefficient is 9.92 and its interaction with education is -14.2. Neither is significant and the interaction coefficient is opposite in sign to expectations given that SSA countries have lower education levels. Differences in effects might alternatively be related to geography. We considered geographic variables affecting agriculture (Collier and Venables 2007), including distance from the equator, rainfall, fraction of the country in tropical zones, and agricultural potential as modeled by Ramankutty *et al* (2002). None of these variables has noticeable, let alone significant, interactions with agricultural price shocks. Below, we look at interactions with political/institutional variables. They also have no effect.

4.1.2 Non-food agriculture and natural resources

Our results differ from Jedwab (2012). For two African countries, he finds growth is spurred in towns local to areas experiencing positive agricultural rent shocks. His work does not deal with overall national urbanization *per se*, and some local towns may or may not be defined to be in the urban sector, so his specific results are not necessarily inconsistent with ours. However the general claims differ. In this paper positive shocks to agriculture deter urbanization in Africa, while Jedwab (2012) and Gollin *et al.* (2012) argue the opposite. To be fair, Jedwab (2012) focuses on "resource rents", in his case rents from the production of non-food agriculture, whereas we draw on data for all agricultural exports. For comparison, we formed a category of "non-food" products (palm oil, coffee, cocoa, linseed oil, wool, tobacco, cattle hides, copra, sisal, rubber, tea and cotton). Column 4 shows results for this class. Both the SSA and non-SSA price coefficients increase in magnitude, with the same signs as in the specification including food crops, but lose significance. The results are again consistent with consumer cities in the rest of the world but not in SSA.

Finally we turn to natural resource rents from minerals, oil and gas. Collier and Venables (2007) presume increases in rents make rural populations less mobile and reduce urbanization in Africa. A different story is that rents and aid are captured by urban residents and spent in cities, increasing urbanization (Ades and Glaeser 1996; Davis and Henderson 2003). Analogously to our strategy for agriculture, we look at exogenous price shocks to the natural resource sector. The specific resources are listed in Appendix Table 2; note the absence of data for gold and diamonds. We get exactly the same SSA and non-SSA divide we had for agriculture for natural resource shocks, but in this case results are statistically insignificant. Basic results are in Table 7 columns 1-3. Column 1 shows an overall insignificant effect of natural resource price shocks on urbanization. Column 2 shows an SSA versus non-SSA divide similar to what we saw for agriculture, but in this case weaker statistically. In column 3, we remove the one observation where dfbeta > |0.5| reducing the almost the price shock and SSA interaction effects dramatically. We therefore conclude there is no strong evidence that the limited set of natural resource price shocks in our data affect urbanization either inside or outside of Africa.

4.2 Trade shocks to manufacturing

Manufactured products are highly heterogeneous within the categories reported in the trade data, so, unlike agriculture, there are not price data. Instead, we consider shocks to demand, as proxied by income shocks in high-income importer countries. The underlying assumptions are that: (1) demand for certain manufactured products is income elastic, so increased incomes generate demand shocks for manufactured exports from less developed countries, and (2) such products tend to be produced in urban rather than rural areas. While these shocks are probably less salient than price shocks, we focus on a class of goods we call modern manufactured products that: (1) may have relatively high income elasticity, and (2) are relatively more affected by urban scale economies in developing countries (Henderson *et al*. 2001).

In order to focus on the income effect of these shocks, we use data on trade flows from a fixed period (1962-69) before our period of interest. We limit our sample of importers to Organization for Economic Co-operation and Development (OECD) members as of 1974, excluding Turkey, which is a developing country based on our definition in this paper. These 23 countries purchase the vast majority of African exports.[28] The data, as recorded by the importer, are from the NBER trade database (Feenstra *et al*. 2005).

Our demand shocks are income growth of OECD countries applied to historical gross exports ("historical pathways") from developing country j to OECD country i. Exports of commodity c from country j to OECD country i are denoted $b_{jic,62-69}$ and national income by GDP. The "62-69" refers to the fact that $\frac{b_{jic,62-69}}{GDP_{j,62-69}} = [\sum_{s=1962}^{1969} \frac{b_{jic,s}}{GDP_{j,s}}]/8$, so the weights are an average for the 1960s, and define the historical importance of exports of commodity c from a given developing country to a given OECD country.[29] The shock weighted by the size of this pathway is $\Delta_{10} GDP_{i,t-l}$, the change in OECD country i's GDP from t to $t-10$, lagged, in general, by l years to allow time for developing country urbanization to respond to trade shocks. We use a 5-year lag. Hence, we consider, for example, 1970-80 urbanization in developing country *j* as a function of weighted OECD income changes from 1965 to 1975. For income demand shocks, results for a 2-year lag are very similar. More specifically, the demand shock index for country j that we use in a first differenced equation is:

[28] The list is Australia, Austria, Belgium-Luxembourg, Canada, Denmark, Finland, France-Monaco, Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland-Liechtenstein, the United Kingdom and the United States. Countries linked by a hyphen in this list are treated as one in the trade data. Similarly, one region these countries import from in some years is the "South African Customs Union", which includes South Africa, Botswana, Namibia, Swaziland and Lesotho. We apply those base numbers just to South Africa as it is by far the largest economy in the group.

[29] As an alternative to applying fixed weights from the 1960s, we considered time-varying weights for the period 14-16 years before each of our sample years. This might increase the explanatory power of the proxy as it would incorporate the effects of import destinations that have become prominent since the 1960s. However, we worry about endogeneity, since other factors affecting urbanization may also affect exports, and so any results could be driven just by this rise in exports which is correlated with rising urbanization (as opposed to the OECD income shocks). Thus we rely on the results using the 1960s weights for all years.

$$DI_{jct} = \sum_i \left(\frac{b_{jic,62-69}}{GDP_{j,62-69}} \right) \Delta_{10} GDP_{i,t-l} \qquad (10)$$

The income growth shocks use unlogged changes in real GDP measured in PPP units, thereby implying bigger importing countries have a bigger impact.

We define these shocks for several commodity classes, c: (1) heavy manufactures (ferrous and non-ferrous metals and metal products in SITC 67-69), (2) apparel and accessories (SITC 83-86), (3) chemicals (SITC 51-59), (4) traditional products made in rural villages, in addition to other places (leather, rubber & wood products, non-metallic minerals, textiles, wood & paper products, furniture and fixtures in SITC 61-66, 81, 82), and (5) modern products (SITC 71-79, 87-89). We are most interested in modern, which covers non-electrical machinery, electrical machinery and telecommunications equipment, transport equipment, instruments, and miscellaneous (arms and ammunition, toys, musical equipment). This is where we think urban scale economies in developing countries are likely to be strongest, in contrast to what we expect to see for traditional industries and resource-based manufacturing carried out in smaller towns and rural areas. The SITC system is not well-suited for some of these categories, especially modern, so we tried some variants, with little effect on results.

Total exports (not just to OECD countries) of manufactures from our sample of developing countries increased from 2.2% to 6.8% of their aggregate GDP between 1962-69 and 1998-2000. Interestingly, the SSA countries start more manufacturing-intensive and end less so than non-SSA countries.[30] The big growth is in the modern sector, which starts at an average of 0.22% and increases to 2.7% by 1998-2000. For modern, SSA countries start higher than non-SSA, at 0.32% versus 0.15%, but end lower at 2.5% versus 2.9%. If one removes Liberia, which reported substantial exports but a GDP reduced massively by war in 1998-2000, the ending SSA value is reduced to 0.38%, raising the regional differential considerably. All countries in our sample report some modern exports in the 1960s, so these changes are not on the extensive margin at the country level.

Of the five separate manufacturing commodity classes, modern products is the only one for which OECD income shocks have a significant positive effect on urbanization, either overall or for non-SSA or SSA countries, in all specifications of lag structures and bases. Traditional

[30] Eleven countries in our main sample lack 1960s trade data: Albania, Bangladesh, Botswana, Bulgaria, Laos, Lesotho, Malta, Mongolia, Namibia, Swaziland and Vietnam.

manufactures has a significant negative effect overall, which is consistent with village-based production in the rural sector. As our focus is on urbanization, the remaining results emphasize modern products, though some formulations also include all manufacturing commodity classes with the exception of modern products grouped together as a control.

We report our results in Table 8. In column 1, the OECD income shock variable for the modern sector is positive but not significant. Column 2 shows that this result masks two sharply different regional effects. For the rest of world (NSSA), the income shock effect is positive and significant. A one standard deviation ($4.1 billion) increase in the modern shock leads to a 1 percent point increase in the change in the urban share which has a mean of 4.58 in the overall sample (4.81 in NSSA). The effect is both sharp and large. Column 2 also shows that the net effect (25.38 – 23.12) for SSA countries is zero.

To consider the possibility that our results are driven by outliers, we dropped individual observations whose absence noticeably changed the coefficients of interest (the modern manufacturing income shock or the SSA differential for that variable). There are only two such observations, and our results are robust to their removal.[31] As mentioned above, our definition of modern manufacturing is not ideal. In particular, we counted SITC code 89, "Miscellaneous manufactured articles" as modern, and it is a substantial category for some countries. As a robustness check, we removed some sub-categories that are obviously not modern such as works of art, collectors' pieces and antiques (896), basketwork (8997) and small wares and toilet articles (8998) with essentially no effect on results. In column 3, we control for shocks to all other (i.e. non-modern) manufacturing sectors. It has a negative coefficient with an enhanced negative effect for SSA countries, but those effects are not significant. There is no impact of the added controls on the modern sector results.

Why do modern sector trade shocks not spur urbanization in Africa, while they do in the rest of the world as expected? To answer this, we considered whether many African countries with low levels of human capital lack the capacity (in terms of labor force quality and institutions) to respond to trade shocks to the modern sector. We use mean years of high school and college in the adult population in 1965 as a pre-determined control for capacity. As noted earlier (see Table 1), African countries have much lower education levels on average, but there is an overlap in the

[31] We used the *dfbeta* command in Stata with the same 0.35 criterion used with the price shock data. Two observations are dropped, and the coefficient on the basic modern manufacturing shock variable increases in absolute magnitude to 4.37, with SSA countries still having a net zero effect.

distributions. The top quartile of SSA countries is above the bottom quartile of NSSA countries. In column 4, the base coefficient on the modern sector shock is insignificant and negative, but the interaction with 1965 education is positive and highly significant. The point estimate of the base coefficient implies that income shocks have a positive effect starting at a low level of 0.16 average years of education. For the mean education in the overall sample of 0.34, a one standard deviation increase in the trade shock increases urban growth by 0.25 points ((-5.13 + 0.34*32.7) * 0.041 hundred billion), a large effect that increases with development. Interacting all covariates with the education variable yields almost identical coefficients on the shock variables. We tried a horse race for column 4 to see if we interacted everything with SSA whether the education variable worked the same in both regions. This is too much for the data: none of the relevant coefficients are significant at the 5% level and only one at the 10% level (SSA interacted with education X the shock variable). The point estimates of the shock effects are generally positive for most non-SSA country education values and for a number of SSA county values as well.[32] In column 5, we allow 2 years for shocks to take effect rather than 5, but the results are essentially the same.

5. Institutions

In this section, we examine the role of general political and institutional development on urbanization. While weak institutions are widely believed to inhibit development, we ask whether they have any further effect on urbanization, conditional on the degree of development. One hypothesis in this regard is that countries with weak underlying determinants of institutions may find it harder to upgrade from the informal institutions that tend to prevail in rural societies to the more formal, and structured, institutions that are characteristic of urban settings. As such, these countries may be less likely to urbanize. This question is difficult to study empirically, because urbanization may also affect the quality of institutions. Key governmental institutions are located in cities and employ urban residents. Governments may look increasingly to urban residents for political support as urbanization increases.

We address this question initially by using the well-known polity2 and related measures that attempt to capture the degree of democratization and authoritarianism and quality of institutions

[32] The coefficients on the base shock, that shock interacted with SSA, the base shock interacted with education, and that interaction interacted with SSA are respectively 0.00021, -0.00024, -0.000187, and 0.00033.

as they evolve over time. In an effort to mitigate the endogeneity, we use level measures from 15 years ago relative to the present, and also experimented with 10-year changes with a 10-year lag (i.e. change in the decade prior to the current decade's urbanization change). However the issue of endogeneity remains critical.

Thus, we also focus on two measures of long pre-determined historical circumstances that are likely to shape current institutions. First, ethno-linguistic fractionalization (ELF) from the early 1960s, used by Easterly and Levine (1997), Alesina *et al*. (2011), and others, represents the probability that two independently drawn random residents of a country are from the same ethno-linguistic group. It captures potential for within-country conflict that may slow democratization, as well as a force that may reduce the strength of a central government. Second, the length of ancient statehood (Putterman 2007; see also Bockstette *et al.* 2002, Alesina *et al*. 2011) is an index of the geographic and (discounted) temporal extent of domestic governance beyond the tribal level from 1 to 1950 C.E. This is intended to capture the potential for a stronger central government and development of solid institutions.

We enter each of these measures in separate urbanization regressions, but report all four coefficients in column 1 of Table 9. The polity measure is completely insignificant, both on its own and interacted with SSA (not shown).[33] ELF is stronger but also insignificant. Years of ancient statehood increases urbanization, and the effect is significant at almost the 5% level. A one standard deviation increase in years of ancient statehood (0.86) results in a 0.40 increase in the growth of the urban share (mean 4.74). The explanation is that, while informal institutions may suffice in certain rural settings, formal institutions in cities with their complexity and anonymity are needed for better functioning. Weaker institutions and capability inhibit functioning of urban land markets, of formal sector development, and urban and transport planning. Thus overall faster urbanization may occur in places with stronger institutions. None of the four measures show significant interactions with SSA, meaning slope coefficients for SSA are no different from those for the rest of the world. For example, for years of ancient statehood, in the usual specification where all variables are interacted with SSA, the base years of ancient statehood coefficient (s.e.) is 0.631 (0.460) and the SSA differential is 0.072 (0.583).

There is also the notion that institutions may mediate the other effects we have found for agricultural price shocks, and, in particular, that they might explain the SSA dummy. We

[33] Examining just the "constraints on the executive" dimension of polity yields similar results.

interacted all of our measures of institutions with agricultural price shocks. No interaction terms are ever significant at a reasonable level. In columns 2 and 3 of Table 8 we present a sample of these results, for years of ancient statehood and polity2 levels. Although the signs of the estimated coefficients are consistent with the hypothesis that better institutions act to make the effect of agricultural price shocks on urbanization positive, the effects are completely insignificant.

6. Conclusions

Does urbanization in Africa differ from the rest of the world? When, instead of income, urbanization is matched to effective technology, as proxied by educational attainment, the African experience matches global patterns. At a sector level, while positive trade shocks to modern manufacturing promote urbanization in the rest of the developing world, this effect is absent in Africa. We suggest that this may be explained by differences in level of development, where the capacity at low levels of development to respond to modern manufacturing sector shocks may be limited. Our starkest results relate to agricultural price shocks. Thus, whilst recent literature has argued that Africa exhibits an unanticipated positive impact of agricultural shocks on urbanization, we find the opposite: urbanization in Africa responds negatively to trade price shocks, just as we would expect from a simple theoretical model. On the contrary, it is the rest of the developing world where we find a perverse response of urbanization to agricultural trade shocks. In short, to the extent urbanization does differ in Africa, it does not differ in the ways the literature postulates.

Appendix 1: Data

Definition of samples

Our sample consists of all countries that satisfied two criteria in 1970: (i) a population in excess of 300,000; and (ii) a level of GDP per capita that was less than the world sample mean for all countries that satisfied (i). Only countries that have data on both urban share and GDP per capita in 1970 and 2009 or 2010 are included in the sample. Other variables have some missing values within this sample. As discussed in the main text, we also experimented with a narrower sample restricted to countries with a 1970 GDP per capita level that was less than 50 % of the world sample mean (again with the mean defined for all countries with a population in excess of

300,000). Table A1 provides a full list of all countries in our sample. Countries in bold are not included in the more restrictive sample.

Definition of variables and data sources

Population and urban share

Estimates of population and urban share are taken from the CD-ROM edition of *World Urbanization Prospects: the 2011 Revision* (WUP-2011). Although, where possible, WUP-2011 adjusts data to ensure that urban areas within individual countries are consistently defined over time, definitions of urban vary across countries. Estimates are generally based on population and housing censuses, although, in some cases, other sources are incorporated.[34]

GDP per capita and openness

GDP per capita is measured in constant 2005 international dollars at purchasing power parity exchange rates (chain series), whilst openness is measured as the share of exports plus imports in GDP at constant 2005 prices. Data on both variables is from the *Penn World Table v. 7.0* (http://pwt.econ.upenn.edu/php_site/pwt_index.php).

Effective technology

Average years of high school (secondary) and college-level (tertiary) education in the adult population aged 25 and over is used as a proxy for effective technology. Data are from the Barro-Lee Educational Attainment Dataset, 2011 version (http://www.barrolee.com/). We also experimented with an alternative measure of effective technology – the fraction of the population aged 25 and over with at least some high schooling, from the same source. The share of the female population aged 15 and over with at least completed primary school, used as an instrument in section 3.2 of the main text, is also from the same source.

Democratization

Democratization is measured using the revised combined polity score (POLITY2) taken from the Polity IV Dataset (Marshall, Jaggers and Gurr 2010; http://www.systemicpeace.org/polity/polity4.htm). POLITY2 is measured on a -10 to +10 scale where -10 represents a strongly autocratic political regime and +10 a strongly autocratic political regime.[35]

[34] For a more detailed description of the methodology employed in WUP-2011 to arrive at urban share and population estimates see: http://esa.un.org/unpd/wup/Documentation/faq.htm.

[35] Full details of the methodology underlying the construction of the POLITY2 measure can be found in the Polity IV Users' Manual (http://www.systemicpeace.org/inscr/p4manualv2010.pdf).

Ethnolinguistic fractionalization index

The ethnolinguistic fractionalization (ELF) index was taken from the replication data for Alesina et al (2011), who describe it as follows:

"The literature of ethnolinguistic fractionalization has normally focused on one index of fractionalization, the Herfindhal index, which captures the probability that two randomly drawn individuals from the population of the country belong to different groups. The original index was based on a linguistic classification of groups from a Soviet source (the *Atlas Narodov Mira*, Bruk and Apenchenko 1964)."

State Antiquity Index

The State Antiquity Index ("Statehist") Version 3.1 was taken from the replication data for Alesina et al (2011). It is described further below by Louis Putterman as follows (http://www.econ.brown.edu/fac/louis_putterman/State_Antiquity_Index_V3%201.doc ; accessed 12 October 2012)[36]:

"The index used by Bockstette *et al*. was constructed as follows. They began by dividing the period from 1 to 1950 C.E. into 39 half centuries. Years before 1 C.E. were ignored on grounds that the experience of more than 2000 years ago would be unlikely to have much effect today, and in order to avoid low-return research effort using low quality information. For each period of fifty years, they asked three questions (and allocated points) as follows: 1. Is there a government above the tribal level? (1 point if yes, 0 points if no); 2. Is this government foreign or locally based? (1 point if locally based, 0.5 points if foreign [i.e., the country is a colony], 0.75 if in between [a local government with substantial foreign oversight]; 3. How much of the territory of the modern country was ruled by this government? (1 point if over 50%, 0.75 points if between 25% and 50%, 0.5 points if between 10% and 25%, 0.3 points if less than 10%). Answers were extracted from the historical accounts on each of 119 countries in the *Encyclopedia Britannica*. The scores on the three questions were multiplied by one another and by 50, so that for a given fifty year period, what is today a country has a score of 50 if it was an autonomous nation, 0 if it had no government above the tribal level, 25 if the entire territory was ruled by another country, and so on. To combine the data of the 39 periods, Bockstette *et al.* tried alternative rates for discounting the influence of the past, ranging from 0 to a discount of

[36] Note that while this paragraph refers to an earlier version of the dataset, the same document goes on characterize all subsequent edits as additions of new countries using the same methods.

50% for each half century. At a 50% discount rate, for example, the contribution to our index of having had an autonomous state over the whole territory from 1850 to 1900 is $50x(1.5)^{-1} = 33.33$. The bulk of the analysis in the paper used *statehist05*, which has a discount rate of 5% (i.e., 0.05). Finally in order to make the series easier to interpret, the sum of the discounted series was divided by the maximum possible value the series could take given the same discount rate. Thus the value that the index could take for any given country lay between zero and one."

Land ownership

Land ownership data by country come from the Institutional Profiles Database (IPD; http://www.afd.fr/lang/en/home/recherche/bases-ipd) produced by the French Ministry for the Economy, Industry and Employment (MINEIE) and the French Development Agency (AFD) based on surveys of French government officials working in countries around the world.

Rainfall

The rainfall data are in millimeters per year and are aggregated from Matsuura and Wilmott's (2012) 0.5 X 0.5 degree grid (approximately 3000 square km at the equator) to countries using the country grid of Mitchell et al (2002).

Price and income shock data

The price shock indices draw data from several sources. Exports by commodity for 1962-1969 and 1970-1972 are from Feenstra et al (2005). Price data for the 37 commodities listed in table A2 are from World Bank (2012) and UNCTAD (2012). We define all products that are grown, except for logs and sawnwood, as agricultural, and the remainder as (non-agricultural) natural resources. These commodities are a subset of those with world prices listed in these two sources. In order to be included in the present study they had to 1) have uninterrupted price series from either source between 1960 and 2010, 2) correspond to an export category in the Feenstra database in a form embodying little or no processing. CPI is from the US Bureau of Labor Statistics. GDP in current dollars (the units of the exports data) at PPP for 1962-1972 is from Heston, Summers and Aten (2011), except for 6 countries[37] with missing 1960s data. For these, log GDP was predicted based on annual cross-sectional linear regressions of log GDP at PPP from Heston, Summers and Aten (2011) on log GDP in current dollars from the World Development Indicators, log of total population and the urban population share.

[37] Afghanistan, Cambodia, Liberia, Somalia, Sudan, and Swaziland.

The income shocks use the Feenstra et al. (2005), with product categories defined in the text. As represented in Feenstra (2005), the OECD countries are Australia, Austria, Belgium-Luxembourg, Canada, Denmark, Finland, France-Monaco, Germany, Greece, Iceland, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland-Liechtenstein, the United Kingdom, and the United States.

Sector shares and land area

Data on the shares of agriculture, manufacturing and services value added in GDP, as well as land area, are from the *World Development Indicators 2011* (http://data.worldbank.org/data-catalog/world-development-indicators/wdi-2011).

Appendix 2: Model

Growth properties of the model

To see some properties of a growth process we consider two simple growth formulations with exogenous savings, avoiding the even more complicated endogenous growth details as developed in Henderson and Wang (2005). We use the specific functional forms footnoted in the text. We assume all goods are traded internationally at fixed prices, that human capital is converted at the numeraire, and that population grows at an exogenous rate $\dot{\bar{N}} / \bar{N} = g$.

For the simplest case, suppose s fraction of income is saved by all people and that $h_a = h_u = h$, so total savings are $p_a h_a^{\theta_a} \bar{K}^{\psi} (\bar{N} - N)^{-\psi} \bar{N}$, which then equals $\dot{H}$, the total change in human capital. Given equalized urban and rural incomes it is easy to show that the rate of change in per person human where $\dot{h} / h = \dot{H} / H - g$ is

$$\dot{h} / h = sp_a (\bar{N} - N)^{-\psi} \bar{K}^{\psi} h^{\theta_a - 1} - g \,. \qquad \text{(a)}$$

While it might look like there can be steady state growth if $\theta_a = 1$ and convergence to a steady state level if $\theta_a < 1$, it isn't that simple. As h rises for the same population, we know $dN / dh_a > 0$ as long as $\theta_u > \theta_a$, Second, as $\bar{N}$ rises, $dN / d\bar{N} > 0$. Thus, $\bar{N}$ or h rising both cause N to increase. The term $(\bar{N} - N)^{-\psi}$ in (a) is changing. Totally differentiating the expression and using $d\bar{N} / \bar{N} = g$ and dh / h as defined in (a) we couldn't definitively sign the change in $(\bar{N} - N)^{-\psi}$. Moreover since population on its own leads $(\bar{N} - N)^{-\psi}$ to decline we can't define a steady state. What we would have to assume for this simple context is that we are at point in time where $\dot{h}/h > 0$ and θ_a is sufficiently below 1 that we do not have explosive growth.

Once we allow human capital to differ across sectors these issues do not go away. However it is helpful to examine the case briefly to establish relative urban-rural differences in human capital allocations. Families each have the same human capital h which they rent in capital markets. The return to capital r must be equalized in uses so that

$$r = \theta_u p_y h_u^{\theta_u - 1} N^{\delta} (1 - \tau N)^{1+\delta} = \theta_a p_a h_a^{\theta_a - 1} \bar{K}^{\psi} (\bar{N} - N)^{-\psi} .$$

Incomes net of capital rental costs must be equalized across sectors so that

$$p_y h_u^{\theta_u} N^{\delta} (1 - \tau N)^{1+\delta} - r h_u = p_a h_a^{\theta_a} \bar{K}^{\psi} (\bar{N} - N)^{-\psi} - r h_a .$$

Using this expression we can then show that $h_u / h_a > 1$ iff $\theta_u > \theta_a$.

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Table 1. Summary statistics for key variables

Variable	Sub-Saharan Africa					Non-SSA developing				
	n	**Mean**	**Std. dev**	**Min**	**Max**	**n**	**Mean**	**Std. dev**	**Min**	**Max**
Urban share (%)										
1970	40	18.13	10.8	2.4	47.8	46	35.43	19.13	4	89.7
2010	40	36.74	14	10.6	63.2	46	54.65	21.9	12.4	94.7
GDP p.c. (2005 int'l $)										
1970	40	1221	986	300	5281	46	2359	1346	390	5139
2009	40	1877	2208	143	9484	46	6235	4800	1170	25029
Aver. yrs schooling										
1970	31	0.241	0.29	0.03	1.12	45	0.636	0.41	0.08	1.569
2010	31	1.319	0.81	0.168	3.11	45	2.66	1.2	0.593	5.9
% GDP agriculture										
1970	30	37.69	16.7	7.16	70.6	28	27.5	13.04	6.91	67.29
2010	30	23.17	16.1	2.86	61.3	45	14.14	8.6	1.83	35.79
% GDP manufacturing										
1970	24	10.18	5.3	3.32	22.8	27	16.52	6.62	3.71	33.75
2010	28	10.6	8.22	3.07	45.2	45	16.2	6.6	5.9	34.15
Unweighted growth rates, 1970-2009/10 (% pa):										
Urban pop. share	40	2.09	1.15	-0.01	5.27	46	1.29	0.988	-0.65	4.45
Urban pop.	40	4.78	1.31	1.12	8.1	46	3.15	1.4	0.018	6.77
GDP p.c.	40	0.53	1.77	-3.91	5.44	46	2.4	1.57	-1.31	7.69
Avg. yrs. schooling	31	5.23	1.7	1.61	9.12	45	4	1.46	1.39	8.37

Notes:

The means are the unweighted sample means across countries. Growth rates are calculated for the period 1970-2010 with the exception of GDP per capita, for which the period is 1970-2009.

Samples consist of all countries with non-missing data for which 1970 population > 300,000 and GDP per capita < global sample mean.

GDP per capita is measured in PPP at constant 2005 international prices (chain series). Aver. yrs of schooling is the mean number of years of schooling (high school + college) of the adult (aged 25+) population.

Urban share/population data is from *World Urbanization Prospects 2011*; GDP p.c. data from the *Penn World Tables v 7.0*; aver. yrs of schooling is from the 2011 version of the Barro-Lee Educational Attainment Dataset. All other data is derived from the *2011 World Development Indicators*.

Table 2. Urbanization level vs. income per capita and effective technology, 2010

	(1)	(2)	(3)	(4)
	GDP levels	**GDP levels**	**Schooling levels**	**Schooling levels**
Constant	-1.3753***	-0.5720***	0.2689***	0.2324***
	(0.2254)	(0.1342)	(0.0643)	(0.0324)
SSA	1.2498***		-0.0533	
	(0.2805)		(0.0724)	
ln(GDP per capita)	0.2262***	0.1319***		
	(0.0259)	(0.0170)		
SSA*ln(GDP per capita)	-0.1568***			
	(0.0349)			
ln(years of schooling)			0.1061***	0.1161***
			(0.0247)	(0.0168)
SSA*ln(years of postprimary schooling)			0.0119	
			(0.0330)	
F(Joint significance of SSA)	10.11***		0.41	
	(p = 0.0001)		(p = 0.6655)	
	df=(2,82)		df=(2,72)	
Adj R^2	0.539	0.458	0.463	0.463
N	86	86	76	76

Notes: Dependent variable is urbanization level. *** p<0.01, ** p<0.05, * p<0.1; robust standard errors.

Table 3. Urbanization rates and growth in income and effective technology: 1970-2010 long difference

	(1)	(2)	(3)	(4)
	GDP difference	**GDP difference**	**Schooling difference**	**Schooling difference**
constant	0.0099***	0.0158***	0.0003	0.0028
	(0.0023)	(0.0013)	(0.0035)	(0.0033)
SSA	0.0095***		0.0126	
	(0.0027)		(0.0081)	
Growth in GDP per capita	0.1274	0.0545		
	(0.0936)	(0.0688)		
SSA*Growth in GDP per capita	0.1536			
	(0.1590)			
Growth in effective technology			0.2983***	0.2817***
			(0.0989)	(0.0841)
SSA*Growth in effective technology			-0.1563	
			(0.1791)	
F(Joint significance of SSA)	8.71***		3.26**	
	(p = 0.0004)		(p = 0.0440)	
	df=(2,82)		df=(2,72)	
Adj R2	0.202	-0.003	0..213	0.171
N	86	86	76	76

Notes: Dependent variable is the urbanization rate, or change in fraction urban. *** p<0.01, ** p<0.05, * p<0.1; robust standard errors.

Table 4. Urbanization and economic structure: 2010 levels and 1970-2010 long difference

	(1)	(2)	(3)	(4)
	Levels		**Long difference**	
constant	0.6384***	0.8324***	0.4204***	0.3387***
	(0.0414)	(0.0314)	(0.0431)	(0.1232)
SSA		-0.4067***		0.0734
		(0.0582)		(0.1319)
agriculture share	-0.9070***	-2.0182***	-0.1114	-0.375
	(0.2088)	(0.1565)	(0.0871)	(0.2798)
SSA*agriculture share		1.7906***		0.3603
		(0.2326)		(0.2896)
F(Joint significance of SSA)		30.5		1.2
		(p < 0.00005)		(p = 0.3104)
		Df=(2,71)		Df=(2,45)
Adj R2	0.296	0.561	0.007	0.021
N	75	75	49	49
time period	2010	2010	1970-2010	1970-2010

Notes: *** p<0.01, ** p<0.05, * p<0.1; robust standard errors. Agriculture share denotes agricultural value added expressed as a share of GDP.

Table 5. Base results on urbanization rate

	(1)	(2)	(3)	(4)	(5)
	Simple formulation	**Must have recent census**	**SSA differen-tial**	**Base case**	**SSA differen-tial**
Δln(national population)		8.356**	8.457**	42.86**	36.84
	(3.105)	(3.585)	(4.033)	(19.65)	(30.26)
Δln(postprimary education)	3.491***	3.746***	2.892**	3.515***	2.978**
	(1.268)	(1.375)	(1.356)	(1.264)	(1.368)
ln(land area)				0.739**	0.565
				(0.294)	(0.384)
ln(land area)*Δln(national population)				-3.006*	-2.383
				(1.587)	(2.438)
SSA*Δln(national population)			-3.365		33.43
			(6.435)		(41.01)
SSA*Δln(postprim-ary education)			2.29		2.615
			(3.816)		(3.685)
SSA*ln(land area)					0.981
					(0.617)
SSA*ln(land area)*Δln(national population)					-3.321
					(3.303)
Observations	304	255	304	304	304
R-squared	0.1	0.116	0.118	0.126	0.153
countries	76	76	76	76	76
sample	full	recent census	full	full	Full

Notes: Dependent variable is Δln(urban population share). Robust standard errors, clustered by country, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6. Shocks to Agriculture

	(1)	(2)	(3)	(4)
	Base	**SSA interactions**	**2 year lag structure**	**Non-food**
Δln(national population)	59.11**	67.82	73.42	65.98
	(25.55)	(48.14)	(49.63)	(47.32)
ln(land area)	0.978**	0.969	1.049	0.911
	(0.453)	(0.800)	(0.821)	(0.774)
ln(land area)*Δln(national population)	-4.286**	-4.645	-5.067	-4.439
	(2.021)	(3.790)	(3.900)	(3.713)
Δln(postsecondary education)	3.354***	4.151**	4.195**	4.205***
	(1.229)	(1.620)	(1.602)	(1.565)
Δln(rainfall)	-3.219*	-2.448	-0.519	-2.503
	(1.703)	(1.999)	(2.070)	(1.914)
Agricultural price shock	3.28	9.022**	13.40*	48.97
	(3.12)	(4.12)	(7.23)	(32.44)
SSA*Δln(rainfall)		-2.17	-1.734	-2.386
		(3.69)	(2.61)	(3.581)
SSA*Agricultural price shock		-16.61***	-12.12	-59.45*
		(5.11)	(10.18)	(34.42)
Observations	260	260	260	260
R-squared	0.156	0.202	0.178	0.209
countries	65	65	65	65
rain and price lag (years)	5	5	2	
Agriculture class	all	all	all	non-food

Notes: dependent variable is Δln(urban population share). Robust standard errors, clustered by country, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Rainfall is a 3-year smoothed average.

Table 7. Natural resource price shocks

	(1)	(2)	(3)
	Rent price shocks	**Rent price shocks, with SSA interactions**	**Dropping an outlier**
Δln(total nat. population)	64.76**	80.34*	76.75
	(24.93)	(47.18)	(48.78)
Ln (land area)	1.063**	1.150	1.074
	(0.447)	(0.794)	(0.822)
Ln(land area)* Δln(total nat. population)	-4.718**	-5.641	-5.332
	(1.972)	(3.714)	(3.858)
Δln (avg. yrs h.s +college)	3.391***	4.120**	3.963**
	(1.208)	(1.609)	(1.622)
Natural resource price shock, lag 5 year	-2.416	12.81	0.927
	(5.392)	(10.83)	(14.25)
SSA* Natural resource price shock, lag 5 year		-18.63	-6.752
		(12.06)	(15.20)
Observations	260	260	259
R-squared	0.135	0.173	0.167
countries	65	65	65

Notes: dependent variable is Δln(urban population share). Robust standard errors, clustered by country, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 8. Trade Shocks to Industry

	(1)	(2)	(3)	(4)	(5)
	Base	**SSA interact-tions**	**Other sectors**	**Stage of develop-ment**	**2 year lag**
Δln(national population)	63.88**	76.58	76.65	63.71**	63.56**
	(25.05)	(47.69)	(47.69)	(24.91)	(25.01)
ln(land area)	1.071**	1.187	1.191	1.097**	1.091**
	(0.446)	(0.812)	(0.810)	(0.431)	(0.432)
ln(land area)*Δln(national population)	-4.654**	-5.331	-5.336	-4.702**	-4.692**
	(1.980)	(3.758)	(3.757)	(1.960)	(1.967)
Δln(postprimary education)	3.337***	3.722**	3.785**	3.504***	3.515***
	(1.194)	(1.598)	(1.727)	(1.210)	(1.209)
modern manu income shock	6.423	25.38**	25.39*	-5.134	-4.889
	(4.484)	(12.65)	(12.73)	(3.987)	(3.969)
other industry income shock			-0.214		
			(1.896)		
SSA*modern manu income shock		-23.12*	-22.92*		
		(12.74)	(12.82)		
SSA*other industry income shock			-1.820		
			(1.966)		
1965 education*modern manu shock				32.70***	27.89**
				(10.68)	(11.03)
1965 education				-0.950	-0.926
				(0.844)	(0.840)
Observations	260	260	260	260	260
R-squared	0.140	0.184	0.198	0.150	0.147
countries	65	65	65	65	65
shock lag (years)	5	5	5	5	2

Notes: dependent variable is Δln(urban population share). Robust standard errors, clustered by country, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Shocks are measured in hundred billions of dollars.

Table 9. Institutions and mediating effects

	(1)	(2)	(3)
	Political and historical measures	**Rents and political interactions**	
polity 2, lagged 15 years	0.0398 (0.0503)		0.0166 (0.0467)
∆polity 2, lagged 10 years	-0.0557 (0.0385)		
Ethnolinguistic fractionalization [ELF60]	-0.0125 (0.0124)		
ln(years of ancient statehood (Putterman)	0.455* (0.252)	0.408 (0.255)	
Agricultural price shock		-10.02 (21.01)	4.167 (5.987)
ln(years of ancient statehood)* Agric. price shock		2.614 (4.826)	
polity 2* Agric. price shock			0.405 (0.790)
Observations		256	249
R-squared		0.145	0.140
countries		64	64

Notes: dependent variable is ∆ln(urban population share). Column 1 shows coefficients from four separate regressions. Robust standard errors, clustered by country, are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Shocks are measured in hundred billions of dollars. See text for further information

Table A1.1: Full list of countries included in sample

Sub-Saharan Africa (SSA)					Non-SSA Developing (NSSA)				
WB ID	Country	GDP pc 1970[1]	Urban share 1970	Urban share 2010	WB ID	Country	GDP pc 1970	Urban share 1970	Urban share 2010
ZAF	**South Africa**	**0.99**	**47.81**	**61.55**	PER	**Peru**	**0.97**	**57.41**	**76.91**
NAM	**Namibia**	**0.84**	**22.29**	**37.82**	URY	**Uruguay**	**0.91**	**82.37**	**92.45**
AGO	Angola	0.46	14.96	58.38	CHL	**Chile**	**0.86**	**75.23**	**88.94**
ZMB	Zambia	0.43	30.35	38.73	BRA	**Brazil**	**0.84**	**55.91**	**84.34**
MUS	Mauritius	0.37	42.03	41.78	TUR	**Turkey**	**0.83**	**38.23**	**70.49**
LBR	Liberia	0.35	26.03	47.80	MLT	**Malta**	**0.83**	**89.70**	**94.67**
SDN	Sudan	0.27	16.52	33.08	SLV	**El Salvador**	**0.78**	**39.40**	**64.28**
CIV	Cote dIvoire	0.27	28.16	50.56	GTM	**Guatemala**	**0.76**	**35.55**	**49.33**
NGA	Nigeria	0.26	22.71	49.00	DZA	**Algeria**	**0.76**	**39.50**	**72.02**
CMR	Cameroon	0.25	20.30	51.51	NIC	**Nicaragua**	**0.69**	**47.03**	**57.25**
MRT	Mauritania	0.24	14.56	41.23	PAN	**Panama**	**0.65**	**47.64**	**74.61**
SEN	Senegal	0.24	30.00	42.25	ROM	**Romania**	**0.60**	**40.32**	**52.79**
TGO	Togo	0.23	21.28	37.53	ECU	**Ecuador**	**0.59**	**39.28**	**66.86**
COG	Congo, Rep.	0.23	39.13	63.22	COL	**Colombia**	**0.58**	**54.82**	**75.02**
SWZ	Swaziland	0.23	9.71	21.32	KOR	**Korea, Rep.**	**0.57**	**40.70**	**82.93**
BWA	Botswana	0.21	7.83	60.98	DOM	**Dominican Rep**	**0.55**	**40.21**	**69.07**
ZAR	Congo, DR	0.20	30.30	33.73	BOL	**Bolivia**	**0.52**	**39.78**	**66.40**
CAF	Central Afr. Rep.	0.19	27.33	38.85	JOR	**Jordan**	**0.52**	**55.97**	**82.47**
KEN	Kenya	0.19	10.30	23.57	BGR	**Bulgaria**	**0.51**	**52.30**	**72.52**
SLE	Sierra Leone	0.18	23.40	38.88	FJI	Fiji	0.47	34.76	51.84
MDG	Madagascar	0.18	14.10	31.93	ALB	Albania	0.46	31.74	52.32
GHA	Ghana	0.18	28.97	51.22	HND	Honduras	0.44	28.90	51.58
SOM	Somalia	0.17	22.68	37.29	MYS	Malaysia	0.39	33.45	72.01
TCD	Chad	0.17	11.57	21.74	PRY	Paraguay	0.39	37.07	61.37
BEN	Benin	0.17	16.69	44.26	TUN	Tunisia	0.39	43.48	66.10
GMB	Gambia, The	0.17	19.50	56.66	GUY	Guyana	0.38	29.43	28.31
UGA	Uganda	0.15	6.66	15.16	SYR	Syrian Arab Rep	0.34	43.35	55.67
GIN	Guinea	0.15	15.98	34.97	HTI	Haiti	0.31	19.76	51.99
NER	Niger	0.15	8.79	17.62	THA	Thailand	0.30	20.89	33.73
RWA	Rwanda	0.15	3.19	18.81	PHL	Philippines	0.30	32.98	48.65
MWI	Malawi	0.13	6.05	15.54	MAR	Morocco	0.28	34.48	56.68
TZA	Tanzania	0.12	7.85	26.28	MNG	Mongolia	0.27	45.05	67.57
BFA	Burkina Faso	0.11	5.75	25.67	PNG	Pap New Guinea	0.25	9.80	12.43
LSO	Lesotho	0.10	8.61	26.85	EGY	Egypt, Arab Rep	0.25	42.21	43.38
MLI	Mali	0.09	14.33	34.28	PAK	Pakistan	0.22	24.82	35.88
ETH	Ethiopia	0.09	8.59	16.76	LKA	Sri Lanka	0.21	19.51	15.04
MOZ	Mozambique	0.08	5.78	30.96	KHM	Cambodia	0.21	15.97	19.81
BDI	Burundi	0.07	2.38	10.64	IND	India	0.17	19.76	30.93
ZWE	Zimbabwe	0.06	17.36	38.13	IDN	Indonesia	0.16	17.07	49.92
GNB	Guinea-Bissau	0.06	15.13	43.22	AFG	Afghanistan	0.16	11.03	23.24
					BTN	Bhutan	0.16	6.09	34.79
					BGD	Bangladesh	0.15	7.59	27.89
					NPL	Nepal	0.13	3.96	16.66
					LAO	Lao PDR	0.12	9.63	33.12
					VNM	Vietnam	0.11	18.30	30.39
					CHN	China	0.07	17.40	49.23

[1] As a fraction of the world mean GDP per capita in 1970 for all countries with a 1970 population over 300,000.

Table A1.2: Commodities used in price indices

Commodity	agriculture	Source
Aluminum high grade, London Metal Exchange, cash	no	UNCTAD
Bananas, Central America and Ecuador, U.S. importer's price, FOB U.S. ports (¢/lb.)	yes	UNCTAD
Beef, Australia & New Zealand, frozen boneless, U.S. import price FOB port of entry (¢/lb.)	yes	UNCTAD
Cattle hides, U.S. Chicago packer's heavy native steers, FOB shipping point (¢/lb.)	yes	UNCTAD
Coconut oil, in bulk, Philippines, CIF Rotterdam	yes	UNCTAD
Cocoa beans, average daily prices New York/London (¢/lb.)	yes	UNCTAD
Coffee, average of 5 prices	yes	UNCTAD
Copper, wire bars, US producer, FOB refinery (¢/lb.)	no	UNCTAD
Copra, in bulk, Philippines/Indonesia, CIF N.W. European ports	yes	UNCTAD
Cotton, U.S. average of Memphis/Eastern and Memphis/Orleans/Texas, Midd.1-3/32, CFR Far Eastern quotations (¢/lb.)	yes	UNCTAD
Crude petroleum, average of UK Brent (light)/Dubai (medium)/Texas (heavy) equally weighted ($/barrel)	no	UNCTAD
Cottonseed oil, in bulk, United States, PBSY, FOB Gulf	yes	UNCTAD
Groundnut oil, in bulk, any origin, CIF Rotterdam	yes	UNCTAD
Iron ore, Brazilian to Europe, Vale Itabira SSF, 64.5% Fe content, FOB (¢/dmt Fe unit)	no	UNCTAD
Jute, Bangladesh, BWD, FOB Mongla	yes	UNCTAD
Lead, average of London Metal Exchange, cash settlement and North American producer price	no	UNCTAD
Linseed oil, in bulk, any origin, ex-tank, Rotterdam	yes	UNCTAD
Maize ($/mt)	yes	World Bank
Manganese ore, 48/50% Mn Max 0.1% P, FOB metallurgical	no	UNCTAD
Natural gas, average of Europe and US ($/mmbtu)	no	World Bank
average of Palm kernel oil, in bulk, Malaysia, CIF Rotterdam and Palm oil, in bulk, Malaysia/Indonesia, 5% ffa, CIF N.W. European ports	yes	UNCTAD
Pepper, white Muntok, faq spot	yes	UNCTAD
Rice, Thailand, white milled, 5% broken, nominal price quotes, FOB Bangkok	yes	UNCTAD
Rubber, SGP/MYS (cents/kg)	yes	World Bank
Silver (cents/toz)	no	World Bank
Sisal, Tanzania/Kenya, average of n° 2 & 3 long and n° 3 & UG, FOB	yes	UNCTAD
Sunflower oil, in bulk, European Union, FOB N.W. European ports	yes	UNCTAD
Soybeans, in bulk, United States, n° 2 yellow, CIF Rotterdam	yes	UNCTAD
Sugar, in bulk, average of I.S.A. daily prices, FOB Caribbean ports (¢/lb.)	yes	UNCTAD
Soybean oil, in bulk, The Netherlands, FOB ex-mill	yes	UNCTAD
Tea, average of Mombasa, Colombo and Kolkata auctions, (cents/kg)	yes	World Bank
Tin, Kuala Lumpur Tin Market, ex-smelter, and London Metal exchange, cash)	no	UNCTAD
Tobacco, US import u.v. ($/mt)	yes	World Bank
Logs, average of Cameroon and Malaysia	no	World Bank
Sawnwood, Malaysian	no	World Bank
Wheat, United States, n° 2 Hard Red Winter (ordinary), FOB Gulf	yes	UNCTAD
Zinc, average of Prime Western, delivered, North America and special high grade, London Metal Exchange, cash settlement	no	UNCTAD

Figure 1: Urbanization level vs. income per capita and effective technology, 2010: (a) natural logarithm of income per capita; (b) effective technology

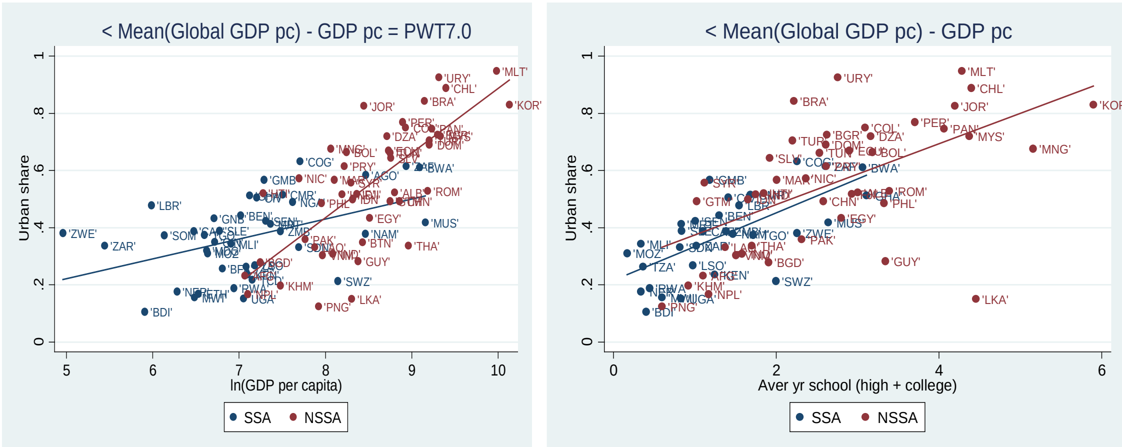

Figure 2: Urbanization rates and growth in income and effective technology: (a) growth in income per capita; (b) growth of effective technology

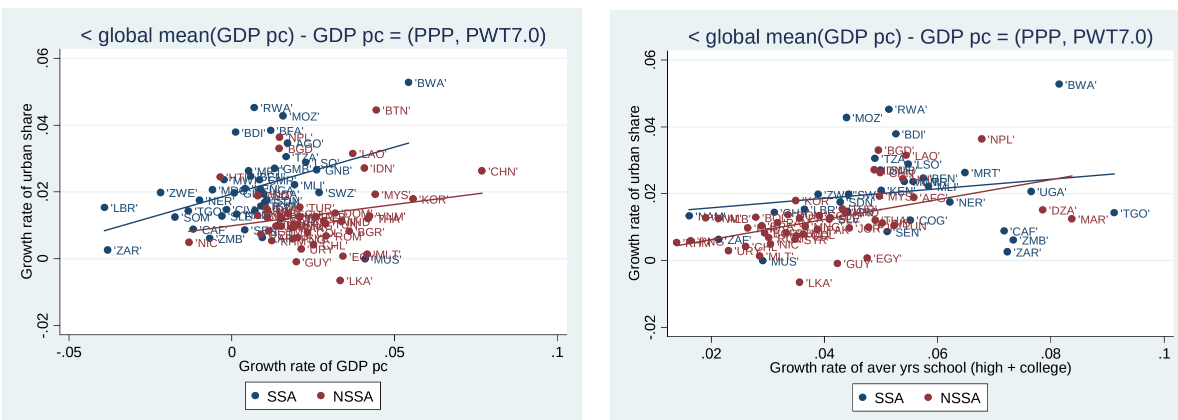

Figure 3: Urbanization and economic structure: (a) urbanization vs. value added in agriculture (% GDP); (b) urbanization vs. value added in manufacturing (% GDP)