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Economic Growth, Size of the Agricultural Sector, and Urbanization

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by

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Abstract: This paper exploits the significant positive response of the share of agricultural value added and GDP per capita growth to variations in the international prices for agricultural commodities and rainfall to construct instrumental variables estimates of the causal effect that changes in the size of the agricultural sector and GDP per capita growth have on the urbanization rate for a panel of 41 African countries during the period 1960-2007. The paper's two main findings are that: (i) decreases in the share of agricultural value added lead to a significant increase in the urbanization rate; (ii) conditional on changes in the share of agricultural value added GDP per capita growth does not significantly affect the urbanization rate. The empirical results confirm the predictions of theoretical models that economic shocks which differentially affect the return across sectors matter for the rural-urban migration decision, and that economic growth mostly affects the urbanization rate through a sector shift out of agriculture.

Key words: Economic Growth, Sectoral Shocks, Urbanization

JEL codes: O0, R0

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1. Introduction

The effects that economic growth has on the urbanization rate is a central issue at the intersection of development and urban economics. A key challenge in this literature is obtaining an estimate of the causal effect that economic growth has on the urbanization rate. This task is complicated by the endogenous response of economic growth to changes in the urbanization rate as changes in the urban population share affect the relative supply of labor and the relative demand for public good provision.[1] Attempts have been made to address this simultaneity problem by using lagged variables as instruments in a panel fixed effects estimation framework, see Davis and Henderson (2003). However, as is well recognized in the panel data literature lagged variables are not a panacea if there are significant anticipation effects or if there is substantial measurement error in the explanatory variables.[2]

This paper seeks to make an empirical contribution to the debate on the causal effect that economic growth has on the urbanization rate by using an instrumental variables approach that exploits the significant response of real GDP per capita growth to plausibly exogenous variations in the international commodity prices and rainfall in African countries. Increases in the international prices for exported agricultural commodities and improved rainfall conditions significantly increase the share of agricultural value added and real GDP per capita growth, while increases in the international prices for exported natural resource commodities significantly increase GDP per capita growth but decrease the share of agricultural value added. The significant response of GDP per capita growth and the share of agricultural value added in African countries to these plausibly exogenous shocks provides a unique opportunity to construct instrumental variables estimates of the causal effect that variations in GDP per capita growth and the size of the agricultural sector have on the urbanization rate. From a policy perspective the paper's focus on African countries is also justified as there is a fierce policy debate on

1 For theoretical papers that provide a model on how economic growth and sectoral shocks can affect the urbanization rate see for example Brueckner (1990) or Becker and Morrison (1999).

2 Moreover, lagged variables will not necessarily mitigate omitted variables bias.

the causes and consequences of urbanization in developing countries, in particular for countries located in Africa.

The first main finding of this paper is that within-country decreases in the share of agricultural value added lead to significant within-country increases in the urbanization rate. Controlling for country and year fixed effects, an instrumental variables estimate yields that a one standard deviation increase in the share of agricultural value added increases the urbanization rate within one year by about 0.5 standard deviations, and by about 0.8 standard deviations when cumulated over a 5-year period.

The paper's second main finding is that conditional on the agricultural value added share economic growth does not have a significant average effect on the urbanization rate. This result derives from a two-stage least squares regression where both GDP per capita growth and the agricultural value added share are instrumented by commodity prices and rainfall. The two-stage least squares estimate on real GDP per capita growth in this regression is quantitatively small and statistically insignificant while the estimate on the agricultural value added share is quantitatively large and highly significant. The paper's second main result therefore suggests that, beyond changes in the size of the agricultural sector, GDP per capita growth has only minor effects on the urbanization rate.[3]

The paper's findings are relevant for the literature on the determinants of urbanization in several aspects. First, they show that plausibly exogenous shocks which differentially affect the relative economic size of the rural sector have a significant effect on the rural-urban migration decision. Second, the instrumental variables estimates identify a key channel through which economic growth affects urbanization: the sector shift out of agriculture. Third, the estimates provide a quantitative benchmark against which to compare predictions from general equilibrium models.

The empirical results are also relevant for policy makers. Policy makers involved in city and

3 Importantly, the paper shows that unconditional on the agricultural value added share GDP per capita growth does have a significant positive average effect on the urbanization rate.

regional population planning need to have an understanding of the quantitative effects that economic growth has on the demand for urban settlement. In particular for Africa, there is a fierce debate on the socio-economic consequences that urbanization bears for the population.[4] While the time-series data on variables such as poverty, crime, income inequality, and education are too sparse to conduct a rigorous panel data fixed effects analysis, it is possible with the instrumental variables estimates to obtain an endogeneity adjusted estimate of the effect that urbanization has on GDP per capita growth by using a two-step estimation procedure that adjusts for the direct effect that economic growth has on the urbanization rate. Such an instrumental variables estimate yields that in African countries increases in the urbanization rate had a significant negative average effect on GDP per capita growth. A one standard deviation increase in the urbanization rate led to a decrease in real GDP per capita growth by about 0.4 standard deviations. Thus, when measured by the change in average incomes per capita a change in the population share from the rural to the urban sector had a significant negative average effect on economic development. This result resonates the findings of other researchers (e.g. Henderson, 2003) who have shown that at low income levels increases in the urbanization rate can have a significant negative effect on growth.

The remainder is organized as follows. Section 2 describes the data. Section 3 discusses the estimation strategy. Section 4 presents the main empirical results. Section 5 concludes.

2. Data

Commodity Price Index and Rainfall. The country-specific international commodity export price index for agricultural and natural resource commodities is constructed as:

$$ComPI_{i,t} = \prod_{c \in C} ComPrice_{c,t}^{\theta_{i,c}}$$

4 See Kessides (2006) for a review of the issues.

where $ComPrice_{c,t}$ is the international price of commodity c in year t, and $\theta_{i,c}$ is the average (time-invariant) value of exports of commodity c in the GDP of country i. The data on annual international commodity price data for the 1970-2007 period are from UNCTAD Commodity Statistics. The data on the value of commodity exports are from the NBER-United Nations Trade Database. The commodities included in the agricultural commodity export price index are beef, coffee, cocoa, cotton, maize, rice, rubber, sugar, tea, tobacco, wheat, and wood. The commodities included in the natural resource export price index are aluminum, copper, gold, iron, and oil. In case there were multiple prices listed for the same commodity a simple average of all the relevant prices is used.

The annual rainfall data are from Terrestrial Air Temperature and Precipitation: 1900-2006 Gridded Monthly Time Series, Version 1.01 (Matsuura and Willmott, 2007). The rainfall data come at a high resolution (0.5°x0.5° latitude-longitude grid) and each rainfall observation in a given grid is constructed by interpolation of rainfall observed by all stations operating in that grid. Rainfall data are then aggregated to the country level by assigning grids to the geographic borders of countries.

GDP Per Capita, Agricultural Value Added Share, Urbanization Rate. Annual real per capita GDP data are from the Penn World Tables, version 6.3 (Heston et al. 2009). The data on the agricultural value added share and the urbanization rate (measured as the share of the population living in urban areas) are from the World Development Indicators (2010). Summary statistics on these variables are provided in Table 1.

3. Estimation Strategy

The main equation of interest relates the change in the urbanization rate (*UR*) to the change in real Gross Domestic Product per capita (*GDP*) and the change in the agricultural value added share (*AVAS*):

(1) $$\Delta UR_{i,t} = a_i + b_t + c\,\Delta\, ln(GDP)_{i,t} + d\,\Delta\, ln(AVAS)_{i,t} + z_{i,t}$$

where a_i and b_t are country and year fixed effects and $z_{i,t}$ is an error term that is clustered at the country level.[5] To adjust for a potentially endogenous response of GDP per capita growth and the share of agricultural value added to changes in the urbanization rate, equation (1) is estimated by two-stage least squares where the log-changes of GDP per capita and the agricultural value added share are instrumented by the log-changes in the international commodity price indices and the level of rainfall and rainfall squared.

The baseline specification of equation (1) deserves several remarks. First, the coefficient c in equation (1) reflects the average effect that economic growth has on the urbanization rate beyond the effect that economic growth has on the agricultural value added share. Likewise, the coefficient d reflects the average effect that a change in the agricultural value added share has on the urbanization rate beyond the effect that a change in the agricultural value added share has on economic growth. Because economic growth and the change in the share of the agricultural value added are negatively correlated, it is also of interest to examine the unconditional effects that economic growth has on the urbanization share and these results will be shown in the robustness section.

The second point to note about equation (1) is that the equation includes as control variables country fixed effects (that capture country-specific time-invariant variables such as history and geography which jointly determine GDP per capita growth, the share of agricultural value added, and the urbanization rate) and year fixed effects (that capture common year shocks such as changes in global demand or changes in the world technology frontier). The slope coefficients in equation (1) are therefore identified from the within-country variation of the data.

A third issue are omitted variables, that vary at the within-country level. From a theoretical point of view one cannot rule out that variables such as government expenditures, civil war, and within-

5 It should be noted that the literature on urbanization has also focused on variables other than the urbanization rate to capture the urbanization process (e.g. primacy). Unfortunately, for African countries the urbanization rate is the only variable available that has a sufficiently long annual time-series dimension to allow for rigorous panel data fixed effects analysis.

country changes in political institutions affect the urbanization rate beyond their effect on economic growth and the agricultural value added share. However, under the assumption of valid instruments (i.e. instruments that are not correlated with the second-stage error term $z_{i,t}$) these omitted variables will not lead to inconsistent slope estimates in the instrumental variables regression. To strengthen this point, the robustness section will report also instrumental variables estimates that explicitly control for variables such as government expenditures, civil war, and within-country changes in political institutions. If indeed these variables do not affect urbanization beyond their effect on economic growth and the agricultural value added share then (i) the estimates on economic growth and the agricultural value added share should not change substantially when including these additional control variables, and (ii) the slope estimates on the additional control variables should be quantitatively small and statistically insignificant.

An important issue in the instrumental variables estimation is whether the instruments are uncorrelated with the second stage error term. Certainly, rainfall is an exogenous variable that is not affected by changes in the economic environment. And variations in the international commodity prices are plausibly exogenous for most commodities and African countries too as these economies are price takers on the international commodity market. Hence, the instrumental variables estimates will be immune to an endogeneity bias that arises from reverse causality and the main advantage of the instrumental variables estimation will be to adjust for reverse causality bias that arises in the least squares estimation of equation (1).

Whether the instrumental variables estimates will also adjust for omitted variables bias depends crucially on whether the instruments fulfill the exclusion restriction; that is, whether rainfall and changes in the international commodity price index only affect the urbanization rate systematically through their effect on real GDP per capita growth and the urbanization rate. To examine this point empirically the paper reports the p-value on the Hansen test of the overidentifying restriction. The

Hansen test is a joint test on the hypothesis that the instruments are uncorrelated with the second stage error. A significant p-value of the Hansen test is a red light that the exclusion restriction is violated.

4. Main Results

4.1 Reduced Form Estimates

Table 2 presents reduced form estimates that link within-country variations in the agricultural and natural resource commodity price index and rainfall to within-country variations in the urbanization rate. Column (1) shows that, in a pooled panel data regression which does not account for country or year fixed effects that there is a highly significant positive average effect on the urbanization rate of increases in the international prices for natural resource commodities and a highly significant negative average effect of increases in the international prices for agricultural commodities while the effect of rainfall is insignificant. Column (2) shows that similar results are obtained when including year fixed effects. When these year fixed effects are substituted in column (3) for country fixed effects the coefficient that reflects the impact effect of rainfall on the urbanization rate becomes also statistically significant and negative in sign. However, column (4) shows that when both year and country fixed effects are included as controls in the regression only variations in the international commodity prices have a significant impact effect on the urbanization rate.[6]

It is possible that there are lagged effects of these economic shocks on the urbanization rate due to an adaptive rather than instantaneous urban-rural migration decision. To examine these lagged effects Table 3 reports reduced form estimates from a distributed lag model that includes up to five (year) lags of the right-hand side regressors. Controlling for country and year fixed effects, these estimates show that indeed there are significant lagged effects of economic shocks on the urbanization rate. Increases in the agricultural commodity prices induce a significant decrease in the urbanization

6 Both the country and year fixed effects are jointly significant at the 1 percent level.

rate on impact and on each of the five year lags. Similarly, increases in the natural resource commodity prices trigger a significant increase in the urbanization rate on impact and on each of the five year lags. Regarding rainfall the impact effect on the urbanization rate continues to be negative but insignificant, while the lagged effects are negative and statistically significant at the conventional confidence levels.

Summing up the impact and lagged effects, column (7) of Table 3 shows that variations in rainfall, agricultural, and natural resource commodity prices have a significant medium/long-run effect on the urbanization rate. Quantitatively, the sum of the coefficients reported in column (7) implies that a one standard deviation increase in the agricultural (natural resource) commodity price index decreased (increased) the urbanization rate over a five year period by about 0.4 standard deviations; an increase in rainfall of size one standard deviation (above the average) reduced the urbanization rate by about 1.6 standard deviations and this effect is significantly declining at higher rainfall levels.

Table 4 provides a rationale for these results by reporting the first-stage effects that variations in the international commodity prices and rainfall have on real GDP per capita growth and the agricultural value added share. Column (1) shows that increases in the international prices for exported commodities and improved rainfall conditions have a significant positive average effect on real GDP per capita growth. This result is well documented in the literature (the main channel being a change in the terms of trade and a change in agricultural productivity).[7] What is not so well documented in the literature, is that increases in the agricultural commodity prices and rainfall significantly increase the agricultural value added share while increases in the natural resource commodities significantly decrease this share. Economically, this differential effect on the agricultural value added share of changes in the agricultural and natural resource commodities is plausible as an increase in the agricultural commodity prices increases the relative return in the agricultural sector while an increase in

7 See for example Deaton (1999), Miguel et al. (2004), Barrios et al. (2010), Brückner and Ciccone (2010, 2011), or Brückner (2011). The quadratic term on the rainfall variable captures that extreme increases in rainfall (flooding) can be detrimental for agricultural production.

the natural resource commodity prices increases the relative return in the natural resource sector, thus decreasing the ratio of agricultural value added over total value added. Similarly, improved rainfall conditions are a positive productivity shock to the agricultural sector and as the data show this positive productivity shock increases the agricultural value added share.[8]

4.2 Second Stage Estimates

To get a better sense for the economic size of the reduced form estimates, Table 5 reports the second stage of the instrumental variables estimates that use rainfall and the agricultural and natural resource commodity price index as instruments for real per capita GDP growth and the agricultural value added share. The instrumental variables estimates in columns (1)-(3) show that increases in the agricultural value added share have a significant negative effect on the urbanization rate while the conditional effect of real GDP per capita growth is insignificant. Quantitatively the two-stage least squares coefficient estimate on the agricultural value added share in column (1) implies that a one standard deviation increase in the urbanization rate increases the agricultural value added share by about 0.5 standard deviations. The joint first-stage F-statistic on the statistical significance of the excluded instruments is 6.2, which implies that according to the critical values tabulated in Stock and Yogo (2005) the hypothesis of a relative IV bias larger than 20 percent can be rejected at the 5 percent level. Columns (2) and (3) show that similar results are obtained when using instead of the two-stage least squares estimator the Fuller modified LIML estimators.

Column (4) of Table 5 reports the corresponding least squares estimates. These are quantitatively smaller in absolute size than the instrumental variables estimates and produce insignificant results for the agricultural value added share. One reason for this difference in the size of

8 The rationale for the negative coefficient on the quadratic rainfall term is that after a certain point too much rainfall (i.e. flooding) is detrimental for agricultural productivity, and hence for GDP per capita growth and the agricultural value added share.

the least squares and instrumental variables estimates is measurement error in the national accounts statistics of African countries which expectedly is large (Heston, 1994; Deaton, 2005). If this measurement error is classical it will attenuate the least squares estimates towards zero but not the instrumental variables estimates. Another reason for the difference between the IV and LS estimate is that the instruments violate the exclusion restriction. However, this alternative explanation is not supported by the Hansen J test, which produces an insignificant p-value on the hypothesis that the instruments are uncorrelated with the second-stage error term.

To provide further support for the assumption that the effects of the instrumental variables which go beyond real GDP per capita growth and changes in the agricultural value added share are of second order, Table 6 reports second-stage estimates that control for within-country changes in the total population size, government expenditures, the incidence of civil war, and political institutions. The estimates on these additional control variables are mostly insignificant, which resonates the findings of other papers that have shown that changes in government policies have only indirect effects on the urbanization rate through their effect on the agricultural sector composition (e.g. Davis and Henderson, 2003). Most importantly, Table 6 confirms that there is a significant negative average effect of changes in the agricultural value added share when controlling for these additional variables.[9]

Another interesting issue is whether lagged changes in GDP per capita and the agricultural value added share have a significant effect on the urbanization rate. Lagged effects could arise for example if there are significant adjustment costs associated with the rural-urban migration decision. Table 7 therefore reports instrumental variables estimates that include up to five (year) lags of GDP per capita growth and the agricultural value added share on the right-hand side of the estimating equation. The main result is that in these distributed lag estimates the effects of GDP per capita growth are

9 Appendix Table 1 shows that there is also a significant negative effect of changes in the agricultural value added share on the urbanization rate in the two-stage least squares estimation when using different functional forms, and Appendix Table 2 shows that there is also no significant effect of GDP per capita growth on the urbanization rate when adding a squared GDP per capita growth term.

statistically insignificant while the impact and lagged effects of the agricultural value added share are negative in sign, and statistically significant for the first year lag. The size of the coefficients on the lagged variables are declining with the lag length and this suggests that the importance of past shocks for the current migration decision is declining over time (see columns (1)-(6)). Summing up the coefficients for the impact and lagged effects yields that a one standard deviation increase in the agricultural value added share over a 5 year period leads to a significant decrease in the urbanization rate of about 0.8 standard deviations. This effect is statistically significant at the 97 percent confidence level.

Table 8 reports estimates of the effects of economic growth on the urbanization rate based on a two-stage least squares regression that does not control for the change in the agricultural value added share. These estimates are positive in sign and yield that a one standard deviation increase in real GDP per capita growth increases on impact the urbanization rate by about 0.3 standard deviations and by about 0.6 standard deviations over a five year horizon. Hence, unconditional on the agricultural value added share an instrumental variables estimate confirms the common view in the urbanization and development economics literature that increases in real GDP per capita lead to significant increases in the urbanization rate.

Given the estimates in Table 8, it is also possible to compute an endogeneity adjusted estimate of the effect that changes in the urbanization rate have on real GDP per capita growth. This can be done by using the residual variation in the urbanization rate that is not due to GDP per capita growth as an instrumental variable.[10] By construction this residual variation in the urbanization rate will be exogenous to economic growth and hence can be used as an instrumental variable to adjust for the reverse causal effect that economic growth has on the urbanization rate. Table 9 presents the instrumental variables results. The main message of these results is that increases in the urbanization

10 This methodology is commonly used in the empirical macro literature (see for example, Blanchard and Perotti, 2002; Fatas and Mihov, 2003; or Bruckner, 2011)

rate were associated with decreases in real GDP per capita growth. The cumulative estimates in column (7) show that on average a one standard deviation increase in the urbanization rate led to a decrease in real GDP per capita growth by about 0.4 standard deviations. Given that changes in the urbanization rate are driven by many factors, such as e.g. African civil wars, this negative effect should not be surprising; certainly it does not reflect necessarily the average effect that a policy induced change in the urbanization rate would have for economic growth in Africa. Yet, the negative response of GDP per capita growth to changes in the urbanization rate resonates the findings of other researchers (e.g. Henderson, 2003) who have shown that at low income levels increases in the urbanization rate can have a significant negative effect on economic growth.

5. Conclusion

This paper exploited the significant response of the agricultural value added share and GDP per capita growth of African countries to plausibly exogenous variation in rainfall and international commodity prices to construct instrumental variables estimates of the within-country effect that changes in economic growth and the size of the agricultural sector have on the urbanization rate. Increases in the international prices for agricultural commodities and improved rainfall conditions significantly increased the urbanization rate while increases in the international prices of natural resource commodities significantly reduced the urbanization rate. This significant reduced form response of the urbanization rate provided the basis for an instrumental variables analysis that jointly analyzes the effects that economic growth and changes in the agricultural value added share have on the urbanization rate. The instrumental variables analysis yielded two main results: (i) changes in the agricultural value added share have a statistically significant and economically meaningful effect on the urbanization rate; (ii) conditional on changes in the agricultural value added share the effects of economic growth on the urbanization rate are insignificant. The empirical analysis thus showed that plausibly exogenous economic shocks, which differentially affect the return in the agricultural sector have a significant effect on the rural-urban migration decision in Africa, and that economic growth mostly affects the urbanization rate through a sector shift out of agriculture.

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Table 1. Summary Statistics

	Mean	Std. Dev.	Min	Max	Obs.
Urbanization Rate	0.298	0.171	0.020	0.869	2223
Change in Urbanization Rate	0.005	0.004	-0.005	0.030	2223
Share of Agricultural Value Added	0.306	0.172	0.018	0.949	1780
Share of Agricultural Value Added Growth	-0.016	0.120	-0.863	0.708	1747
Real GDP Per Capita	1791	2508	88.48	24281	2242
Real GDP Per Capita Growth	0.011	0.076	-0.217	0.338	2242
Rainfall	0.010	0.006	0.0007	0.04	1992
Rainfall Growth	0.0015	0.2543	-1.7021	2.0053	1992
Agricultural Commodity Price Index Growth	0.0006	0.004	-0.0181	0.0598	1957
Natural Resource Commodity Price Index Growth	0.0024	0.0162	-0.0507	0.3113	1957

Table 2. Commodity Prices, Rainfall, and Urbanization
(Reduced Form: Impact Effect)

	ΔUrbanization Rate			
	(1)	(2)	(3)	(4)
Δln(Agricultural ComPI)	-0.056**	-0.092***	-0.023	-0.061*
	(-2.58)	(-2.89)	(-1.02)	(-1.71)
Δln(Natural Resource ComPI)	0.052***	0.056***	0.022***	0.019***
	(5.24)	(5.11)	(4.38)	(3.01)
Rainfall	-0.093	-0.073	-0.322	-0.260
	(-0.32)	(-0.25)	(-1.62)	(-1.24)
Rainfall Squared	7.592	6.575	13.268**	8.892
	(0.61)	(0.52)	(2.16)	(1.39)
Country FE	No	No	Yes	Yes
Year FE	No	Yes	No	Yes
Observations	1384	1384	1384	1384
Countries	41	41	41	41

Note: The dependent variable is the change in the urbanization rate. T-values in parentheses are based on Huber robust standard errors that are clustered at the country level. *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Table 3. Commodity Prices, Rainfall, and Urbanization
(Reduced Form: Distributed Lag Model)

	ΔUrbanization Rate						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Impact Effect at *t*	Lagged Effect at *t*-1	Lagged Effect at *t*-2	Lagged Effect at *t*-3	Lagged Effect at *t*-4	Lagged Effect at *t*-5	Cumulative Effect *t* to *t*-5
Δln(Agricultural ComPI*)*	-0.095*** (-2.92)	-0.060*** (-2.65)	-0.067** (-2.40)	-0.065** (-2.51)	-0.069*** (-3.29)	-0.079*** (-3.22)	-0.434*** (-2.98)
Δln(Natural Resource ComPI)	0.016*** (3.28)	0.016* (1.91)	0.016*** (4.46)	0.021*** (5.16)	0.021*** (3.01)	0.024*** (5.77)	0.110*** (4.30)
Rainfall	-0.160 (-0.77)	-0.322* (-1.93)	-0.212 (-1.43)	-0.316** (-2.49)	-0.265** (-2.38)	-0.263** (-2.61)	-1.539** (-2.02)
Rainfall Squared	5.804 (0.94)	10.51** (1.96)	5.900 (1.49)	10.311*** (2.64)	6.332* (1.95)	6.983** (2.29)	45.891** (2.05)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1309	1309	1309	1309	1309	1309	1309
Countries	41	41	41	41	41	41	41

Note: The dependent variable is the change in the urbanization rate. T-values in parentheses are based on Huber robust standard errors that are clustered at the country level. *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Table 4. Commodity Prices, Rainfall, Size of the Agricultural Sector, and Economic Growth (First Stage)

	Δln(GDP Per Capita)	Δln(Share of Agricultural Value Added)
	(1)	(2)
	LS	LS
Δln(Agricultural ComPI*)*	0.378 (0.40)	1.666*** (2.93)
Δln(Natural Resource ComPI)	0.937*** (2.95)	-0.777*** (-5.37)
Rainfall	8.505** (2.30)	16.992*** (2.85)
Rainfall Squared	-231.096* (-1.85)	-405.281** (-2.25)
Test H0: Coefficient Δln(Agri ComPI)= Δln(Natres ComPI)	0.5571	0.0001***
Country FE	Yes	Yes
Year FE	Yes	Yes
Observations	1372	1372
Countries	41	41

Note: The dependent variable in column (1) is the log-change in real per capita GDP. In column (2) the dependent variable is the change in the urbanization rate. T-values in parentheses are based on Huber robust standard errors that are clustered at the country level. *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Table 5. Economic Growth, the Size of the Agricultural Sector, and Urbanization
(Baseline 2SLS Estimates)

	ΔUrbanization Rate			
	(1)	(2)	(3)	(4)
	2SLS	Fuller (4)	Fuller (1)	LS
Δln(GDP Per Capita)	0.006 (0.67)	0.007 (0.69)	0.006 (0.60)	0.009* (1.90)
Δln(Share of Agricultural VA)	-0.016** (-2.14)	-0.015** (-2.17)	-0.017** (-2.08)	-0.002 (-0.69)
Hansen J, p-value	0.174	0.174	0.174	.
First-Stage F-stat	6.243	6.243	6.243	.
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	1372	1372	1372	1372
Countries	41	41	41	41

Note: The dependent variable is the change in the urbanization rate. The instrumental variables in columns (1)-(3) are the log-changes in the agricultural and natural resource commodity price index, and rainfall and rainfall squared. T-values in parentheses are based on Huber robust standard errors that are clustered at the country level. *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Table 6. Economic Growth, the Size of the Agricultural Sector, and Urbanization
(Robustness to Additional Control Variables)

	ΔUrbanization Rate			
	(1)	(2)	(3)	(4)
	2SLS	Fuller (4)	Fuller (1)	LS
Δln(GDP Per Capita)	0.007	0.007	0.006	0.002***
	(0.68)	(0.70)	(0.60)	(2.66)
Δln(Share of Agricultural VA)	-0.015**	-0.015**	-0.017**	-0.001
	(-2.07)	(-2.09)	(-2.01)	(-0.97)
Δln(Population)	0.003	0.003	0.003	0.003
	(0.26)	(0.25)	(0.26)	(0.22)
Δln(Gov. Expenditures)	-0.001	-0.001	-0.001	0.001
	(-1.34)	(-1.31)	(-1.39)	(1.13)
ΔCivil War	0.0001	0.0013	0.00006	0.0008***
	(0.29)	(0.35)	(0.15)	(2.65)
ΔDemocracy	-0.0004	-0.0004	-0.0005	-0.0002
	(-0.77)	(-0.77)	(-0.75)	(-0.81)
Hansen J, p-value	0.177	0.177	0.177	.
First-Stage F-stat	5.786	5.786	5.786	.
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	1372	1372	1372	1372
Countries	41	41	41	41

Note: The dependent variable is the change in the urbanization rate. The instrumental variables in columns (1)-(3) are the log-changes in the agricultural and natural resource commodity price index, and rainfall and rainfall squared. T-values in parentheses are based on Huber robust standard errors that are clustered at the country level. *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Table 7. Economic Growth, the Size of the Agricultural Sector, and Urbanization
(Robustness Distributed Lag Estimates)

ΔUrbanization Rate

Panel A: 2SLS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Impact Effect at *t*	Lagged Effect at *t*-1	Lagged Effect at *t*-2	Lagged Effect at *t*-3	Lagged Effect at *t*-4	Lagged Effect at *t*-5	Cumulative Effect *t* to *t*-5
Δln(GDP Per Capita)	0.004 (0.48)	-0.004 (-1.63)	-0.002 (-1.37)	-0.001 (-0.53)	-0.001 (-1.07)	0.001 (0.26)	-0.003 (-0.28)
Δln(Share of Agricultural VA)	-0.016** (-2.30)	-0.004** (2.13)	-0.003 (-1.62)	-0.002 (-1.49)	-0.002 (-1.39)	-0.001 (-0.82)	-0.028** (-2.14)
Hansen J, p-value	0.385	0.385	0.385	0.385	0.385	0.385	0.385
First-Stage F-stat	6.640	6.640	6.640	6.640	6.640	6.640	6.640
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1191	1191	1191	1191	1191	1191	1191
Countries	41	41	41	41	41	41	41

Panel B: LS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Δln(GDP Per Capita)	0.003** (2.07)	0.0003 (0.31)	0.0002 (0.22)	0.0001 (0.19)	0.0001 (0.01)	-0.0007 (-1.06)	0.0026 (0.57)
Δln(Share of Agricultural VA)	-0.0008 (-1.42)	-0.0004 (-0.64)	-0.005 (-0.63)	-0.0010 (-1.01)	-0.0015 (-1.24)	-0.0012 (-1.21)	-0.0054 (-1.09)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1191	1191	1191	1191	1191	1191	1191
Countries	41	41	41	41	41	41	41

Note: The dependent variable is the change in the urbanization rate. The instrumental variables in Panel A are the log-changes in the agricultural and natural resource commodity price index, and rainfall and rainfall squared. T-values in parentheses are based on Huber robust standard errors that are clustered at the country level. *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Table 8. The Effect of Economic Growth on the Urbanization Rate

	ΔUrbanization Rate						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Impact Effect at *t*	Lagged Effect at *t*-1	Lagged Effect at *t*-2	Lagged Effect at *t*-3	Lagged Effect at *t*-4	Lagged Effect at *t*-5	Cumulative Effect *t* to *t*-5
Δln(GDP Per Capita)	0.018**	0.008	0.006*	0.002	0.002	-0.003	0.033*
	(2.54)	(1.47)	(1.90)	(0.61)	(0.67)	(-0.84)	(1.64)
Hansen J, p-value	0.425	0.425	0.425	0.425	0.425	0.425	0.425
First-Stage F-stat	7.191	7.191	7.191	7.191	7.191	7.191	7.191
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1191	1191	1191	1191	1191	1191	1191
Countries	41	41	41	41	41	41	41

Note: The dependent variable is the change in the urbanization rate. The instrumental variables in columns (1)-(3) are the log-changes in the agricultural and natural resource commodity price index, and rainfall and rainfall squared. T-values in parentheses are based on Huber robust standard errors that are clustered at the country level. *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Table 9. The Effects of Changes in the Urbanization Rate on Economic Growth

	Δln(GDP Per Capita)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Impact Effect at *t*	Lagged Effect at *t*-1	Lagged Effect at *t*-2	Lagged Effect at *t*-3	Lagged Effect at *t*-4	Lagged Effect at *t*-5	Cumulative Effect *t* to *t*-5
Δ(Urbanization Rate)	-81.630***	75.996***	-0.772	2.383	4.261	-7.627***	-7.391***
	(-5.03)	(4.98)	(-0.20)	(0.99)	(1.50)	(-2.71)	(-2.89)
First-Stage F-stat	47.386	47.386	47.386	47.386	47.386	47.386	47.386
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1191	1191	1191	1191	1191	1191	1191
Countries	41	41	41	41	41	41	41

Note: The dependent variable is the log-change in real per capita GDP. The method of estimation is two-stage least squares. The instrumental variable is the residual variation in the urbanization rate that is obtained from the two-stage least squares estimates in Table 8. T-values in parentheses are based on Huber robust standard errors that are clustered at the country level. *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Appendix Table 1. Alternative Functional Form

	ΔUrbanization Rate			
	(1)	(2)	(3)	(4)
	2SLS	Fuller (4)	Fuller (1)	LS
	Panel A: Dependent Variable is ΔUrbanization Rate			
Δln(GDP Per Capita)	0.024	0.022	0.023	0.003
	(1.01)	(1.01)	(1.01)	(2.81)
Δ(Share of Agricultural VA)	-0.002*	-0.002*	-0.002*	-0.0001
	(-1.87)	(-1.91)	(-1.88)	(-1.10)
Hansen J, p-value	0.753	0.753	0.753	.
First-Stage F-stat	4.311	4.311	4.311	.
	Panel B: Dependent Variable is ΔUrbanization Rate			
Δln(GDP Per Capita)	0.013	0.012	0.013	0.003
	(1.24)	(1.23)	(1.24)	(2.81)
Δln(Share of Agricultural VA)	-0.075**	-0.063**	-0.077*	-0.0004
	(-2.19)	(-2.25)	(-2.17)	(-1.09)
Hansen J, p-value	0.411	0.411	0.411	.
First-Stage F-stat	4.311	4.311	4.311	.
	Panel C: Dependent Variable is Δln(Urbanization Rate)			
Δln(GDP Per Capita)	0.006	0.008	0.006	0.009
	(0.23)	(0.31)	(0.23)	(1.91)
Δln(Share of Agricultural VA)	-0.043*	-0.039*	-0.044*	-0.002
	(-1.71)	(-1.75)	(-1.71)	(-0.69)
Hansen J, p-value	0.415	0.415	0.415	.
First-Stage F-stat	6.243	6.243	6.243	.
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	1372	1372	1372	1372
Countries	41	41	41	41

Note: The instrumental variables in columns (1)-(3) are the log-changes in the agricultural and natural resource commodity price index, and rainfall and rainfall squared. T-values in parentheses are based on Huber robust standard errors that are clustered at the country level. *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.

Appendix Table 2. Nonlinear Growth Effects

	ΔUrbanization Rate			
	(1)	(2)	(3)	(4)
	2SLS	Fuller (4)	Fuller (1)	LS
Δln(GDP Per Capita)	0.017	0.014	0.019	0.004
	(0.82)	(0.81)	(0.82)	(0.66)
$[\Delta\ln(\text{GDP Per Capita})]^2$	-0.050	-0.042	-0.018	0.046
	(-0.81)	(-0.79)	(-0.83)	(1.06)
Δln(Share of	-0.017***	-0.016***	-0.018***	-0.001
Agricultural VA)	(-2.66)	(-2.64)	(-2.66)	(-0.64)
Hansen J, p-value	0.167	0.167	0.167	.
First-Stage F-stat	1.52	1.52	1.52	.
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	1372	1372	1372	1372
Countries	41	41	41	41

Note: The dependent variable is the change in the urbanization rate. The instrumental variables in columns (1)-(3) are the log-changes in the agricultural and natural resource commodity price index, and rainfall and rainfall squared. T-values in parentheses are based on Huber robust standard errors that are clustered at the country level. *Significantly different from zero at 90 percent confidence, ** 95 percent confidence, *** 99 percent confidence.