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Demographic Pressure and Institutional Change

Village-Level Response to Rural Population Growth in Burkina Faso

Margaret S. McMillan, William A. Masters, and Harounan Kazianga

4.1 Introduction and Motivation

An unusual factor in Africa's twentieth-century agricultural development was a relatively low initial level of average population density coupled with unusually high rates of rural population growth over the last thirty years. As shown in figure 4.1, Africa's year-to-year rate of rural population growth rose above that of Asia around 1975, peaked in 1990, and only recently has fallen below the highest levels ever seen in other regions. All regions have seen a rise and then fall in their annual rates of rural population growth, but in the post-1975 period Africa's growth rate rose more recently and reached a higher level for a longer time than that of other regions.

This project investigates the link between rural population growth and the local institutions and infrastructure needed for market development in agriculture. We use spatial differences in migration exposure to test how village societies have responded to population pressure. Our central hypothesis is that recent increases in rural population densities are associated with a

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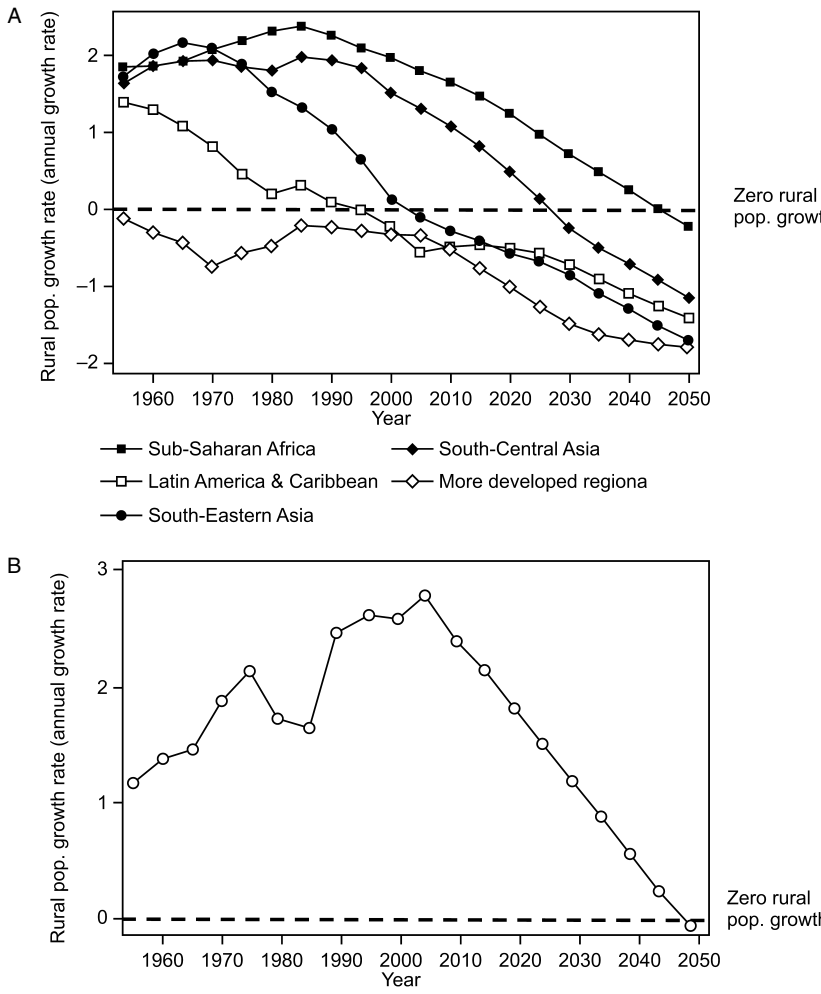

Fig. 4.1 Past and projected rural population growth, by region and country (1950–2050): *A*, Regional aggregates; *B*, Burkina Faso

Source: Calculated from UN Population Projections (esa.un.org/unpp).

wider spread of rural public services, infrastructure, and local marketplaces; a transition from open access to regulated land use, including stronger individual property rights; and more reliance on the rule of law to adjudicate disputes.

Our data come from Burkina Faso, a landlocked West African country of about 13 million people. As shown in figure 4.1, from 1950 to 2005 Burkina Faso's rural population growth rate rose even more dramatically than that of Africa as a whole, to a peak above 2.5 percent per year. Burkina's rural population growth rate is projected to decline rapidly in the coming decades, but

will remain well above zero until the absolute size of the urban population becomes large enough for its annual growth to absorb each year's increase in the country's entire population. Figure 4.1 shows that rapid growth in Burkina Faso's rural population was not uniform in time, with a temporary reversal in the 1980s that may have been associated with migration to Côte d'Ivoire or other factors, followed by a burst of catch-up growth and downward projections until urbanization is sufficient to achieve zero rural population growth around 2050.

Historically, Burkina Faso has had large movements of rural people to its own cities and a large migration to coastal Côte d'Ivoire after colonization and particularly through the 1980s. A large number of those migrants were then forcibly repatriated following civil unrest in Côte d'Ivoire starting in the late 1990s. In addition, the donor-funded Onchocerciasis Control Program quickly eradicated river blindness starting in the 1970s, leading to large population movements into river valleys. These demographic shocks affected villages across Burkina Faso in different ways depending on their location, offering two different exogenous shocks to rural population density with which to study the impact of rural demography on local institutions and infrastructural investments.

We hypothesize that changes in rural population growth change the payoffs from collective action, making it relatively more urgent to develop market infrastructure and institutions. This hypothesis follows Boserup (1965), who argued that rising rural population densities create incentives not only for farm-level adoption of more input-intensive techniques and "induced invention" of new technologies in response to factor scarcity as suggested by Hicks (1932), but also induced institutional changes to allocate newly scarce natural resources more efficiently. A link between rural population density and rural public goods could also be due to political pressures or indivisibilities and scale effects in the provision of infrastructure and institutions. Both relative price and scale effects could be subject to time lags, leading rural population growth to have a Malthusian effect in the short run, even as it facilitates the institutional and technological innovations needed for later agricultural productivity growth.

Modern analyses of how population density and factor scarcity affect agricultural development were pioneered by Hayami and Ruttan (1971) for the United States and Japan, and tested in a large subsequent literature such as Olmstead and Rhode (1993). Only a few of these papers (e.g., Lin 1995) focus on the emergence and adoption of institutions; most ask how institutions affect technology adoption, such as Kazianga and Masters (2002, 2006). Focusing on rural demography also expands on our other previous work regarding the role of environmental factors in economic growth (Masters and McMillan 2001) and African policy choices (McMillan 2001; McMillan and Masters 2003). Here, we focus on changes in village-level institutions, testing how the governance of local resources and market infrastructure has responded to demographic change among local households.

Our focus on the specific challenge of *rural* population growth for agricultural development follows Johnston and Kilby (1975), among others. Most of the development economics literature concerned with demography has focused either on demographic transition in the population as a whole (including the demographic "drag" or "dividend" from age structure emphasized by Bloom and Williamson [1998]), or the structural transformation from farm to nonfarm employment in terms of output and employment shares, including the one-time "growth bonus" associated with shifting from a low productivity to a high productivity sector as in Temple (2005). Focusing on demographic conditions within rural areas addresses a distinctive aspect of Africa's postindependence economic decline and are grounds for optimism about the future as rural infrastructure and institutions adapt to higher levels of population density and the speed of further demographic slows down.

The motivation for our approach begins with an economic view of rural demography. Demographic accounting ensures that each locality's rural population growth is its natural increase (births minus deaths, which in turn are determined by age structure as well as age-specific mortality and fertility), plus or minus each year's net migration to urban or other rural areas. From an economic point of view, however, both fertility and migration are choice variables, and mortality may also be influenced by investment in health. Given this endogeneity, identification of a potentially causal effect of population requires an exogenous shock to rural population size that occurs with sufficient speed and magnitude to induce a measurable institutional response.

Our study design takes advantage of Burkina Faso's unusual demographic history, which includes two large waves of exogenous migration into specific rural areas from the 1970s through the early twenty-first century. One wave flowed into river valleys in response to an international campaign of Onchocerciasis eradication, which made those locations newly attractive, and another wave flowed in from Côte d'Ivoire in response to political violence there. We use three rounds of census data in 1985, 1996, and 2006 to capture the resulting variation in village population, and compare that to variance in institutions and infrastructure as recalled by focus group interviews of village elders.

Our work contributes to an important gap in the literature on institutions and economic development identified by Pande and Udry (2006), who argue that "the research agenda identified by the institutions and growth literature is best furthered by the analysis of much more microdata than has typically been the norm in this literature." Specifically, we study the historical evolution of institutions in response to demographic pressure by focusing on diversity across villages in a setting with wide variation in exposure to clearly exogenous demographic shocks. The closest antecedent is probably Grimm and Klasen (2008), who test for endogenous adoption of land titles

at the village level on Sulawesi in Indonesia. Our surveys include land titles and also consider a very wide range of other institutions, public services, and infrastructure used for market exchange. Methodologically, our use of focus groups to obtain village-level recall data on the location and availability of public services follows Chattopadhyay and Duflo (2004), building on a long tradition of participatory surveys in rural areas (e.g., Chambers 1994). This approach allows us to ask about many different types of public services, with access to physical infrastructure measured by its proximity to the village center.

Though not the central focus of this particular chapter, our survey data could also be used to analyze causal effects of public services and institutions on economic outcomes. For example, Besley (1995) and others have found evidence that institutions significantly affect investment outcomes in rural Africa (see Pande and Udry [2006] for a summary of these studies). In Burkina Faso, Kazianga and Masters (2002) found that stronger cropland tenure was associated with more intensive soil and water conservation. Our approach to changes in village-level infrastructure and institutions is also relevant to the mechanisms by which large-scale public health interventions influence economic development, as in Acemoglu and Johnson (2007), Bleakley (2007), and Cutler et al. (2010).

In the next section, we describe the major exogenous population shifts that might permit identification of how changes in rural population density affect public goods provision. We then turn to our empirical strategy and a description of our data in section 4.3. In section 4.4 we present and discuss our results. Section 4.5 concludes.

4.2 Historical Background

Since independence in 1960, Burkina Faso has experienced two major policy-induced changes in settlement patterns. The first began in 1974 when the Onchocerciasis Control Program was launched by the World Bank to control river blindness in seven West African countries: Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali, Niger, and Togo. The second occurred from the late 1990s until 2002, when up to one million Burkinabe returned from Côte d'Ivoire to escape violence and a suspension of immigrants' rights in that country. Since our ability to draw a causal link between population growth and institutional change hinges on the extent to which these two events were exogenous to other influences on village population size, we describe the two shocks in more detail below.

4.2.1 The Onchocerciasis Control Program

The Onchocerciasis Control Program (OCP) was initiated in 1974 to control river blindness in West Africa, and is widely considered to be among the most successful public health programs ever launched in sub-Saharan

Africa. Onchocerciasis, or "river blindness," is primarily a rural disease that affects sub-Saharan Africa more than anywhere else in the world. The disease is spread through bites from black flies of the genus *Simulium*, which transmit the larvae of a filarial worm, *Onchocerca volvulus*. The worms multiply only in the human body, where they cause debilitating symptoms that include blindness, and are transmitted only by the black fly, which lives in proximity to fast-moving rivers.

The OCP was a multilateral effort that covered eleven countries, including Burkina Faso. The program involved weekly aerial treatment and ground-level treatment of black fly breeding grounds. Annual drug treatments offered immediate relief from the symptoms and elimination of nearly all offspring of the adult worm. Today, the disease is no longer considered a threat in the control zone, which has consequently attracted in-migration from other rural areas (McMillan, Nana, and Savadogo 1992, 1993).

To control the anticipated immigration to these newly attractive areas, the government of Burkina Faso created a special national agency—the Volta Valley Authority (AVV)—and gave the agency control of 75 percent of the river basins. Figure 4.2 shows these locations, and the "planned" villages to which it provided financial and institutional support. However, the pace of spontaneous settlement soon outgrew the ability of the AVV to finance

Fig. 4.2 Location of planned settlements associated with Onchocerciasis control, 1973–1984

Source: McMillan, Nana, and Savadogo (1993).

and create sufficient numbers of sponsored settlements. As a result, there were sizable intra- and interregional differences in the rate of new lands settlement documented by McMillan, Nana, and Savadogo (1992), as well as substantial variation in land-use practices and land management institutions described by McMillan, Nana, and Savadogo (1993).

4.2.2 Repatriation from Côte d'Ivoire

For more than three decades after independence from France in 1960, Côte d'Ivoire was an important destination for immigrants from Burkina Faso, offering peaceful stability and economic prosperity, including rural work associated with opening new forests for cocoa production. The death of the autocratic ruler Felix Houphet-Boigny in 1993 ushered in a new era. His successor, Henri Konan Bedie, has been accused of sowing the seeds of ethnic discord by introducing the concept of "Ivorian-ness" in 1995, allegedly to deny Ivorian citizenship to his main political rival, Alassane Ouattara, thereby excluding him from office. Bedie insisted that Ouattara, a Muslim from the north of the country, was actually from Burkina Faso. Subsequently, attacks on people of foreign descent became increasingly widespread (Human Rights Watch 2001). By that time, more than one quarter of Côte d'Ivoire's population had immigrated to the country since independence, the overwhelming majority of whom had come from Burkina Faso. As shown in figure 4.2, the Côte d'Ivoire census of 1998 identified about 2.25 million Burkinabe living in Côte d'Ivoire, which was close to 20 percent of Burkina's total population at that time.

Peace and stability in Côte d'Ivoire came to an abrupt halt on December 24, 1999, when the military, under the leadership of General Robert Guei, overthrew the elected government of Konan Bedie in the country's first coup d'état. Although the coup was ostensibly prompted by soldiers' unhappiness over pay and conditions, it soon became apparent that, like Bedie, General Guei was also ready to incite ethnic and religious rivalries in order to remove political opposition. Continuing the theme of Ivorian-ness, Guei introduced even stricter eligibility requirements for the 2000 presidential elections, once again excluding Alassane Ouattara on the basis of his alleged links with Burkina Faso.

Though exact numbers are difficult to come by, it is estimated that between 1999 and 2002 hundreds of thousands of Burkinabe were repatriated as a result of political unrest and worsening economic conditions in Côte d'Ivoire. They returned by rail, road, and on footpaths, often but not always to their original villages.

4.3 Empirical Strategy, Data, and Descriptive Statistics

Our evidence on village-level access to public services, infrastructure, and institutions comes from a novel survey conducted for this project by the

Burkina Faso Office of Agricultural Statistics in January through June 2010. This survey asked groups of village elders to discuss and describe the history of the facilities around them, recording the date of any changes in the distance to each kind of facility and any changes in property-rights arrangements. From those underlying observations, we construct a time-varying index of the village's proximity to public services, public infrastructure, religious services, and markets, as well as time-varying indicators of property rights over land. We combine these indexes with population estimates for each village from the Burkina Faso national censuses of 1986, 1996, and 2006 to test whether variance in population size can help explain variance in the provision of public services, infrastructure, and institutions.

To overcome endogeneity between a village's amenities and its population size, we use each village's straight-line distance to any river from which Onchocerciasis could have been eradicated, as well as distance to the Côte d'Ivoire border from which migrants could have returned as instruments for the village's population in each survey year. The result is a set of two-stage least squares (2SLS) regressions asking whether population shocks associated with changes in the attractiveness of rivers and of Côte d'Ivoire are correlated with the spread of rural public services, infrastructure, and market institutions. Our chapter does not identify the mechanism by which more populated villages might attract more rural public services, infrastructure, or market institutions: instead, we are testing for reduced-form relationships, exploiting an unusual natural experiment in rural population density.

Our sample of villages consists of 747 sites that had previously been selected by the Office of Agricultural Statistics for their nationally representative agricultural survey conducted annually since the early 1990s. In this context, villages are very small, averaging about a thousand people. Their boundaries can change somewhat from decade to decade, as some households split off into new settlements. Our final data set consists of 730 villages whose recorded names are the same across the three censuses and our new survey at a correctly recorded geographic information system (GIS) location. We use year and region fixed effects for each of Burkina's forty-five provinces in order to focus on spatial variation across villages within relatively small administrative units.

The survey instrument is provided in the appendix. It was administered by experienced enumerators employed for Burkina's annual agricultural survey, whose structure is designed to accommodate new survey modules. The survey began by assembling a focus group of village elders and officials who were asked a series of detailed questions regarding various types of public services, infrastructure, and institutions available to them. For each variable, we typically asked for its distance from the village and other salient characteristics, at present and in previous years, along with the date of any change. For example, the section on property rights poses the following question: Can land be sold in your village? If the group agrees that the answer

to this question is yes, the interviewer then asks: Since when could land be sold in your village? Questions posed in this way allow us to construct time-varying indexes of public amenities from the point of view of the villagers themselves. Our results focus on two kinds of variables: travel distances to public amenities, and categorical indicators of land-use rights, both as reported for each census year.

The travel distances to collective amenities are grouped into four categories: (a) Public Services and Utilities, defined as the administrative office used to register births, any savings and loan facility, any fixed-line telephone, or any mobile phone reception; (b) Public Infrastructure, defined as a road that is accessible by truck all year, a road accessible by truck seasonally, a bus stop, a primary school, a secondary school, or a health center; (c) Religious Services, defined as any church, mosque, or temple; and (d) Markets, defined as any market with storage facilities, any livestock market, or a private shop. These are all the distances for which our group-interview technique elicited unambiguous agreement in at least 700 of the 730 villages. Other questions, such as distance to water wells, bridges, and electricity supplies, were less likely to elicit agreement, perhaps because those amenities are less salient to villagers' lives or their use is more varied among the respondents. The distances to collective amenities were then aggregated in each of three ways. First, we consider the distance one must travel to have access to *all* the services in a given category, that is, the distance associated with the farthest one. Second, we consider the average distance to all of the services in the group, in other words, the arithmetic mean of each distance. Finally, we consider the distance to *any* of the listed services, that is, the minimum distance among them.

Categorical indicators of land rights address three kinds of land use. First, we ask whether use rights over cropland are undefined or held by individuals, families, or the community. Then we ask whether cropland had ever been rented or sold, which we take to indicate the presence of a land market. Finally, we ask whether villagers recognize a formal authority that regulates access to pasture land, forests, and potentially cropped land.

Table 4.1 presents the proportion of all observations with each category of property right, as reconstructed for the census years of 1985, 1996, and 2006. For example, rights over cropland are not defined in 14.4 percent of village-year observations. Descriptive statistics on all variables as used in the regressions are provided in table 4.2, separately for each year to reveal the time trends. Public services become more closely available and property rights are more tightly regulated in more recent years. Also, note that the average population of all surveyed villages grows from 1985 to 1996, but then falls in 2006. There is likely to have been systematic undercounting of the rural population in 2006, which is why the Burkina government is planning a new census several years ahead of its decennial schedule.

Table 4.1 **Property rights and land use across sample villages in Burkina Faso (n = 2,170)**

Land rights	Percentage of observations in sample
Rights over cropland	
Not defined	14.4
Communal	10.0
Familial	59.9
Individual	15.7
Existence of sales or rental of cropland	
None	92.4
At least one sale or rental has occurred	7.7
Role of traditional authorities in solving cropland conflict	
None	63.8
Some	36.2
Role of elected authorities involved in solving cropland conflict	
None	81.9
Some	18.1
Demarcation and regulation of pastureland	
No delimited pastureland	71.7
Pastureland delimited, access not regulated	80.9
Pastureland delimited, access regulated by tax or quota	19.1
Demarcation and regulation of forestland	
No delimited forestland	70.1
Forestland delimited, access not regulated	15.9
Forestland delimited, access regulated by tax or quota	14.0

Source: Authors' calculations.

Notes: Results shown are from village elders' response to questions asked in local languages, translated by local enumerators from the French questionnaire reproduced in the appendix to this chapter. Items shown are from questionnaire sections VIII (for cropland), IX (for pastureland), and X (for forestland).

4.4 Estimating Equations and Results

Our estimation begins with a set of descriptive ordinary least squares (OLS) regressions showing the correlations between village-level population and public infrastructure or institutions, controlling for year and province fixed effects, using the following specification:

$$I_{jkt} = \alpha + \beta P_{jt} + \delta X_j + \gamma_t + \varepsilon_{jkt}, \quad (1)$$

where I is our measure of infrastructure or institution of type k in village j at time t from the survey data, and P is our measure of the total population in village j at year t from the census data, and γ are time dummies. The X controls for province fixed effects, and in robustness tests also controls for the ethnic composition of village population, or more generally for village fixed effects. Our hypothesis is that $\beta > 0$, as larger populations facilitate the provision of public goods and market institutions, due either to relative

Table 4.2 **Mean and standard deviations for all variables (n = 2,121)**

	Proximity of farthest source (km) (distance to farthest site in each set)				Proximity to all sources (km) (average distance to all services)				Proximity to closest source (km) (distance to closest site in each set)			
Year	Public services	Public infrast.	Religious services	Markets	Public services	Public infrast.	Religious services	Markets	Public services	Public infrast.	Religious services	Markets
1985	35.348	35.458	9.274	12.832	26.915	14.662	6.321	8.585	18.351	3.566	3.536	4.855
	[1.206]	[1.239]	[0.518]	[0.790]	[0.779]	[0.482]	[0.360]	[0.432]	[0.607]	[0.308]	[0.299]	[0.269]
1996	35.635	28.053	7.465	12.735	25.055	11.532	4.726	7.811	15.115	1.817	2.328	3.788
	[1.137]	[0.977]	[0.409]	[0.741]	[0.708]	[0.374]	[0.267]	[0.384]	[0.533]	[0.209]	[0.230]	[0.251]
2006	32.151	20.955	5.218	11.455	19.681	8.099	3.036	6.11	8.596	0.501	1.16	1.975
	[1.005]	[0.771]	[0.331]	[0.611]	[0.543]	[0.278]	[0.194]	[0.276]	[0.415]	[0.083]	[0.138]	[0.176]

	Land ownership rights			Land	Regulated access to			Population	Distance (km) to:	
Year	Individual	Familial	Communal	markets	Pasture	Forest	Crop	(1,000s)	Nearest river	Côte d'Ivoire
1985	0.41	0.665	0.1	0.056	0.152	1.353	2.75	1.6	65.986	506.904
	[0.018]	[0.018]	[0.011]	[0.009]	[0.013]	[0.024]	[0.033]	[0.058]	[1.782]	[8.787]
1996	0.423	0.671	0.099	0.064	0.186	1.44	2.751	1.682	66.876	506.478
	[0.019]	[0.018]	[0.011]	[0.009]	[0.015]	[0.027]	[0.034]	[0.059]	[1.818]	[8.984]
2006	0.453	0.669	0.104	0.107	0.24	1.516	2.786	1.396	66.336	509.231
	[0.018]	[0.017]	[0.011]	[0.011]	[0.016]	[0.029]	[0.033]	[0.091]	[1.777]	[8.753]

Source: Authors' calculations.

Notes: Standard deviations are in brackets. Proximity measures refer to travel distances from the village to reach the closest site offering one or more of each set of collective resources: **Public Services** and Utilities (defined as the administrative office used to register births, any savings and loan facility, any fixed-line telephone, any mobile phone reception); **Public Infrastructure** (defined as a road that is accessible by truck all year, a road accessible by truck seasonally, a bus stop, a primary school, a secondary school, and a health center); **Religious Services** (any church, mosque, or temple); and **Markets** (any open-air food market, livestock market, or private shop). Specific wording of each question is reproduced in the appendix. From the questionnaire as a whole, we retained only those proximity questions that more than 700 of the 730 villages were unable to answer unambiguously. Population is computed from the Burkina Faso national censuses for 1985, 1996, and 2006. Distances to nearest river and to the Côte d'Ivoire border are straight lines calculated from latitude and longitude geocodes.

scarcities as in Boserup (1965) or to indivisibilities at the relevant scale of population size.

Estimates of regression (1) are shown in table 4.3, where X controls only for province fixed effects. In columns (1)–(4) the dependent variable is the maximum distance one must travel to have access to all amenities in each category. In columns (5)–(8) the dependent variable is the average distance one must travel to access any amenity in each category, and in columns (9)–(12) the dependent variable is the minimum distance one must travel to access at least one of them. Both the distances and village population are expressed in natural logs, so that the coefficients can be interpreted as elasticities. We find that larger villages have closer amenities in eleven of the twelve regressions; the one exception is column (3), where only the time trend is significant. Institutions for land use are significantly linked to village population in only two of the seven regressions.

Table 4.4 repeats the diagnostic OLS regression with additional controls for the number of ethnic groups and number of clans in the village, as a crude approximation of the village's social fragmentation that might influence political cooperation and collective action for public goods provision (e.g., Alesina and La Ferrara 2005). The correlation between population size and access to public goods is robust to these controls. Estimated coefficients on population size are somewhat smaller when controlling for ethnic diversity, but contrary to some hypotheses the more diverse villages actually have more public infrastructure than the less diverse ones. In the absence of any clear identification strategy regarding fragmentation, however, for this chapter we focus on the main relationship concerning total population size.

Finding significant coefficients in these OLS regressions is not surprising, as people could choose to locate in villages with closer access to public institutions and services, or both could be caused by something else. To overcome endogeneity, we use instrumental variables for population, so that the only variation in village population that we actually use is associated with distance to rivers and distance to the border with Côte d'Ivoire, and changes in these associations over time.

The first-stage regression of our 2SLS system is specified as follows:

$$P_{jt} = \alpha_0 + \alpha_1 G_j + \alpha_2 T_t G_j + \alpha_3 T_t + \alpha_4 M_j + \epsilon_j \tag{2}$$

where G is a vector of the logs of geographic distance to rivers and to the border with Côte d'Ivoire, T is year dummies for 1996 and 2006, and M is controls imposed through province fixed effects. When using the resulting predicted village populations in equation (1), our identifying assumption is that a village's distance to rivers and to Côte d'Ivoire have no other channel of influence on infrastructure and institutions beyond their importance for population size. Some evidence regarding the validity of those exclusion restrictions is provided here using Hansen's J statistic, but that test is not conclusive. This initial use of our data concerns Burkina Faso as a whole, and

Table 4.3 **OLS regression results for public infrastructure and institutions on village-level population**

	Proximity of farthest source (km)				Proximity to all sources (km)				Proximity to closest source (km)			
	Services (1)	Infrastr. (2)	Religion (3)	Markets (4)	Services (5)	Infrastr. (6)	Religion (7)	Markets (8)	Services (9)	Infrastr. (10)	Religion (11)	Markets (12)
Population	0.045*	0.003	0.153***	0.182***	0.041*	0.049**	0.145***	0.187***	0.108***	0.116***	0.125***	0.228***
	[0.026]	[0.027]	[0.029]	[0.031]	[0.023]	[0.021]	[0.025]	[0.027]	[0.032]	[0.020]	[0.022]	[0.023]
Y = 1996	–0.059	0.174***	0.127**	–0.030	0.025	0.193***	0.167***	0.034	0.191***	0.305***	0.225***	0.193***
	[0.051]	[0.051]	[0.063]	[0.064]	[0.045]	[0.041]	[0.054]	[0.056]	[0.056]	[0.047]	[0.051]	[0.054]
Y = 2006	0.027	0.485***	0.493***	0.072	0.255***	0.538***	0.515***	0.222***	1.109***	0.611***	0.490***	0.628***
	[0.048]	[0.050]	[0.062]	[0.064]	[0.043]	[0.041]	[0.052]	[0.054]	[0.060]	[0.043]	[0.047]	[0.051]
Constant	–3.29***	–3.18***	–2.44***	–3.20***	–2.97***	–2.71***	–2.14***	–3.03***	–2.69***	–1.40***	–1.50***	–2.64***
	[0.223]	[0.209]	[0.266]	[0.341]	[0.197]	[0.175]	[0.220]	[0.292]	[0.268]	[0.167]	[0.195]	[0.243]
Observ.	2,132	2,161	2,040	2,136	2,132	2,161	2,040	2,136	2,132	2,161	2,040	2,136
R-squared	0.097	0.147	0.233	0.220	0.116	0.220	0.265	0.225	0.230	0.234	0.232	0.235

	Land ownership rights				Regulated access		
	Individual (13)	Family (14)	Communal (15)	Land markets (16)	Pasture (17)	Forest (18)	Cropland (19)
lnpopulation	0.012	–0.012	0.012*	0.010*	0.009	–0.021	–0.011
	[0.010]	[0.010]	[0.007]	[0.005]	[0.009]	[0.016]	[0.019]
Year = 1996	0.018	0.005	–0.002	0.008	0.036*	0.086***	0.008
	[0.022]	[0.021]	[0.015]	[0.010]	[0.018]	[0.033]	[0.039]
Year = 2006	0.044**	0.001	0.007	0.053***	0.091***	0.158***	0.032
	[0.022]	[0.021]	[0.015]	[0.011]	[0.019]	[0.034]	[0.040]
Constant	0.324***	0.747***	0.016	–0.013	0.087	1.498***	2.828***
	[0.074]	[0.071]	[0.051]	[0.037]	[0.064]	[0.116]	[0.135]
Observations	2,146	2,146	2,146	2,146	2,146	2,146	2,146
R-squared	0.335	0.294	0.139	0.379	0.181	0.227	0.313

Source: Authors' calculations.

Notes: Population and distance measures are in logs, with proximity defined as its additive inverse (–log[distance]), so that coefficients can be read as elasticities and a positive coefficient implies closer facilities. The regression also controls for forty-five province dummies (not shown). Robust standard errors are in brackets.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Table 4.4 **OLS regression results for public infrastructure and institutions on village-level population and diversity**

	Proximity of farthest source (km)				Proximity to all sources (km)				Proximity to closest source (km)			
	Services (1)	Infrastr. (2).	Religion (3)	Markets (4)	Services (5)	Infrastr. (6)	Religion (7)	Markets (8)	Services (9)	Infrastr. (10)	Religion (11)	Markets (12)
Population	0.027	–0.009	0.107***	0.144***	0.021	0.031	0.107***	0.150***	0.068**	0.100***	0.105***	0.192***
	[0.025]	[0.026]	[0.029]	[0.031]	[0.022]	[0.021]	[0.024]	[0.026]	[0.031]	[0.020]	[0.022]	[0.023]
Clans	–0.001	–0.001	0.017***	0.013***	–0.000	0.001	0.013***	0.012***	0.008**	0.004**	0.006***	0.011***
	[0.004]	[0.003]	[0.003]	[0.004]	[0.003]	[0.002]	[0.002]	[0.003]	[0.004]	[0.002]	[0.002]	[0.002]
Ethnicities	0.063***	0.044***	0.065***	0.057***	0.066***	0.050***	0.058***	0.061***	0.087***	0.028***	0.035***	0.063***
	[0.013]	[0.011]	[0.011]	[0.012]	[0.012]	[0.008]	[0.009]	[0.010]	[0.012]	[0.006]	[0.008]	[0.008]
$Y = 1996$	–0.057	0.175***	0.134**	–0.026	0.028	0.195***	0.173***	0.037	0.196***	0.306***	0.229***	0.197***
	[0.050]	[0.051]	[0.062]	[0.064]	[0.045]	[0.041]	[0.053]	[0.055]	[0.054]	[0.047]	[0.051]	[0.053]
$Y = 2006$	0.025	0.483***	0.487***	0.066	0.252***	0.534***	0.511***	0.216***	1.103***	0.608***	0.488***	0.622***
	[0.047]	[0.050]	[0.060]	[0.063]	[0.042]	[0.040]	[0.051]	[0.053]	[0.059]	[0.043]	[0.047]	[0.050]
Constant	–3.27***	–3.16***	–2.38***	–3.15***	–2.94***	–2.68***	–2.09***	–2.98***	–2.63***	–1.38***	–1.48***	–2.59***
	[0.220]	[0.207]	[0.258]	[0.338]	[0.193]	[0.172]	[0.215]	[0.288]	[0.262]	[0.165]	[0.195]	[0.237]
Observ.	2,132	2,161	2,040	2,136	2,132	2,161	2,040	2,136	2,132	2,161	2,040	2,136
R-squared	0.121	0.157	0.273	0.243	0.150	0.241	0.302	0.258	0.268	0.243	0.247	0.271

	Land ownership rights				Regulated access		
	Individual (13)	Family (14)	Communal (15)	Land markets (16)	Pasture (17)	Forest (18)	Cropland (19)
lnpopulation	0.007	–0.015	0.004	0.008	0.011	–0.030*	–0.013
	[0.011]	[0.010]	[0.007]	[0.005]	[0.009]	[0.017]	[0.019]
Ethnicities	0.009**	–0.002	0.005	0.007**	–0.008**	0.011*	0.004
	[0.004]	[0.004]	[0.003]	[0.003]	[0.003]	[0.006]	[0.007]
Clans	0.001	0.002*	0.005***	–0.000	0.001	0.003	–0.001
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]
Year = 1996	0.019	0.005	–0.001	0.009	0.037**	0.087***	0.008
	[0.022]	[0.021]	[0.015]	[0.010]	[0.018]	[0.033]	[0.039]
Year = 2006	0.044**	0.000	0.005	0.053***	0.092***	0.158***	0.032
	[0.022]	[0.021]	[0.015]	[0.011]	[0.019]	[0.034]	[0.040]
Constant	0.308***	0.756***	0.005	–0.024	0.096	1.487***	2.834***
	[0.075]	[0.072]	[0.050]	[0.036]	[0.064]	[0.117]	[0.136]
Observations	2,132	2,132	2,132	2,132	2,132	2,132	2,132
R-squared	0.335	0.294	0.163	0.383	0.180	0.231	0.307

Source: Authors' calculations.

Notes: Population and distance measures are in logs, with proximity defined as its additive inverse (–log[distance]), so that coefficients can be read as elasticities and a positive coefficient implies closer facilities. The regression also controls for forty-five province dummies (not shown). Robust standard errors in brackets.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

to investigate more deeply with stronger identification, future work could focus on specific regions and times when more narrowly defined natural experiments have occurred.

First-stage results are shown in table 4.5. Our preferred specification with both distances is in column (3), while columns (1) and (2) show results with only (log) distance to rivers and to Côte d'Ivoire, respectively. Columns (1) and (3) indicate that villages located further from rivers are less populated than other villages, with no significant difference between census years. As documented by McMillan, Nana, and Savadogo (1992), much of the population movement triggered by river blindness control had already occurred by the 1985 census, so this effect is primarily cross-sectional in our data.

Table 4.5 First-stage regression results for IV estimation

	(1)	(2)	(3)
Excluded instruments:			
Distance to river	–0.157***		–0.155***
	[0.037]		[0.038]
Distance to river*1996	0.022		0.034
	[0.056]		[0.056]
Distance to river*2006	0.060		0.073
	[0.053]		[0.053]
Distance to border		–0.181*	–0.044
		[0.110]	[0.113]
Distance to border*1996		–0.140**	–0.143**
		[0.067]	[0.067]
Distance to border*2006		–0.149**	–0.157**
		[0.067]	[0.067]
Time trends:			
Year = 1996	–0.001	0.932**	0.813*
	[0.228]	[0.409]	[0.435]
Year = 2006	–0.446**	0.689*	0.458
	[0.213]	[0.415]	[0.448]
Constant	7.275***	7.985***	7.605***
	[0.186]	[0.720]	[0.734]
Observations	2,146	2,146	2,146
R-squared	0.177	0.170	0.180
F-stat. inst.	9.896	5.688	6.831

Source: Authors' calculations.

Notes: Dependent variable for all columns is log of village population size; column (3) is our preferred specification. Distance measures are in logs. Proximity to nearest river is straight-line distance, to capture flight time needed by the black flies that carry Onchocerciasis from the river to people's homes. In contrast, proximity to Côte d'Ivoire is travel distance by roads, train, or footpath. The regression also controls for forty-five province dummies (not shown). Robust standard errors are in brackets.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Repatriation from Côte d'Ivoire occurred later, as shown in columns (2) and (3), where villages further from the border have smaller populations than others in 1996 and 2006. Thus, our preferred first stage (column [3]) has as its significant excluded instruments distance to rivers (in all years) and distance to the border (in 1996 and 2006). Beneath each column, we provide an F-statistic on the joint significance of all excluded instruments. The F-statistic levels indicate that in each case, the null hypothesis that the instruments are jointly irrelevant in the regression can be rejected at the 1 percent level. The F-statistics are, however, smaller than the rule of thumb cut-off suggested by Stock and Yogo (2005), implying that our second-stage estimations may suffer from weak identification in these regressions. Future work could focus on the regions of Burkina Faso where Onchocerciasis control and repatriation from Côte d'Ivoire was concentrated, to strengthen the identification strategy.

Table 4.6A reports the instrumental variable (IV) estimates for our preferred specification. In each column, we report the Hansen J statistics and the associated probability. In columns (1), (2), (3), (4), (6), (9), (10), and (17), we cannot reject the null hypothesis that the instruments are wrongly excluded from the second-stage regression. Results should be interpreted with caution, but it is notable that the IV results are stronger than the OLS estimates in table 4.3, with larger estimated coefficients and greater statistical significance. Variation in a village's population that is linked to being near rivers and to Côte d'Ivoire is positively associated with having more public services, infrastructure, religious facilities, and markets, as well as more individual land rights (as opposed to familial or communal), more land rental or sale transactions, and regulated access to forestland. In tables 4.6B and 4.6C, we test these relationships separately using each of the two kinds of instruments. Table 4.6B shows the IV estimations using only distance to the nearest river, and table 4.6C shows IV results using only distance to the border of Côte d'Ivoire. Both sources of identification produce qualitatively similar results, with somewhat larger point estimates when population is instrumented by distance to the border. The identification is, however, stronger when we use distance to nearest river in table 4.6D. The F-statistic in the first stage is 9.9, and we cannot reject the null hypothesis that the exclusion restrictions do not hold for column (10) only. This contrasts with table 4.6C, where columns (1), (5), (6), (9), (10), (12), and (13) do not pass the overidentification test.

The main results presented in table 4.6A use province fixed effects to control for variation in political and economic circumstances across the country's forty-five administrative regions. This leaves unobserved heterogeneity among villages within each province, and table 4.6D shows results when village fixed effects are used. Two relationships survive these controls: villages with above-trend population increases gain closer proximity to markets and become less likely to use communal property rights over land. The

Table 4.6A **The IV regression results for infrastructure and institutions on village population, instrumented by distance to rivers and Côte d'Ivoire**

	Proximity of farthest source (km)				Proximity to all sources (km)				Proximity to closest source (km)			
	Services (1)	Infrastr. (2)	Religion (3)	Markets (4)	Services (5)	Infrastr. (6)	Religion (7)	Markets (8)	Services (9)	Infrastr. (10)	Religion (11)	Markets (12)
lnpopulation	0.308*	0.574***	1.165***	0.649***	0.410**	0.780***	0.989***	0.718***	0.953***	0.303*	0.629***	0.933***
	[0.175]	[0.202]	[0.235]	[0.239]	[0.166]	[0.187]	[0.199]	[0.215]	[0.246]	[0.171]	[0.174]	[0.211]
Year = 1996	–0.078	0.127**	0.055	–0.071	–0.004	0.134**	0.106*	–0.011	0.119*	0.285***	0.185***	0.135**
	[0.054]	[0.059]	[0.075]	[0.068]	[0.050]	[0.054]	[0.064]	[0.060]	[0.069]	[0.050]	[0.056]	[0.061]
Year = 2006	0.082	0.603***	0.737***	0.173**	0.331***	0.694***	0.721***	0.340***	1.286***	0.643***	0.621***	0.791***
	[0.062]	[0.074]	[0.100]	[0.087]	[0.058]	[0.069]	[0.085]	[0.079]	[0.088]	[0.059]	[0.070]	[0.080]
Observations	2,108	2,137	2,016	2,112	2,108	2,137	2,016	2,112	2,108	2,137	2,016	2,112
Hansen J stat.	18.25	17.03	9.398	5.231	21.42	18.42	6.483	5.490	14.14	20.33	0.170	5.693
Prob. HJS	0.00265	0.00444	0.0942	0.388	0.000674	0.00247	0.262	0.359	0.0148	0.00108	0.999	0.337

	Land ownership rights			Land markets	Regulated access		
	Individual (13)	Family (14)	Communal (15)	(16)	Pasture (17)	Forest (18)	Cropland (19)
lnpopulation	0.221***	–0.246***	0.097*	0.061*	0.102	0.222*	–0.231
	[0.083]	[0.082]	[0.050]	[0.033]	[0.070]	[0.125]	[0.151]
Year = 1996	0.001	0.024	–0.009	0.004	0.028	0.066*	0.025
	[0.024]	[0.025]	[0.016]	[0.010]	[0.020]	[0.035]	[0.042]
Year = 2006	0.088***	–0.049*	0.025	0.064***	0.110***	0.210***	–0.015
	[0.029]	[0.029]	[0.019]	[0.014]	[0.023]	[0.045]	[0.052]
Observations	2,146	2,146	2,146	2,146	2,146	2,146	2,146
Hansen J stat.	7.879	3.175	2.912	1.780	25.70	2.662	1.781
Prob. HJS	0.163	0.673	0.714	0.879	0.000102	0.752	0.878

Source: Authors' calculations.

Notes: First-stage results are shown in column (3) of table 4.5. Population and proximity measures are in logs. All regressions control for forty-five province dummies (not shown). Robust standard errors are in brackets.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Notes: First stage results are shown in Column 3 of Table 5. Population and proximity measures are in logs. All regressions control for 45 province dummies (not shown). Robust standard errors in brackets, and asterisks indicate significance levels at *** p<0.01, ** p<0.05, * p<0.1.

Table 4.6B **The IV regression results for infrastructure and institutions on village-level population, instrumented by distance to rivers only**

	Proximity of farthest source (km)				Proximity to all sources (km)				Proximity to closest source (km)			
	Services (1)	Infrastr. (2)	Religion (3)	Markets (4)	Services (5)	Infrastr. (6)	Religion (7)	Markets (8)	Services (9)	Infrastr. (10)	Religion (11)	Markets (12)
lnpopulation	0.196	0.351*	1.112***	0.463*	0.307*	0.696***	0.947***	0.587**	0.885***	0.465**	0.613***	1.016***
	[0.191]	[0.207]	[0.241]	[0.274]	[0.182]	[0.200]	[0.205]	[0.242]	[0.277]	[0.197]	[0.180]	[0.239]
Year = 1996	–0.068	0.144***	0.059	–0.057	0.005	0.140***	0.109*	–0.001	0.125*	0.273***	0.186***	0.129**
	[0.054]	[0.055]	[0.074]	[0.068]	[0.050]	[0.052]	[0.063]	[0.060]	[0.068]	[0.051]	[0.055]	[0.063]
Year = 2006	0.059	0.555***	0.724***	0.130	0.310***	0.676***	0.711***	0.310***	1.272***	0.678***	0.617***	0.810***
	[0.062]	[0.070]	[0.101]	[0.090]	[0.058]	[0.068]	[0.085]	[0.080]	[0.090]	[0.066]	[0.071]	[0.085]
Observations	2,108	2,137	2,016	2,112	2,108	2,137	2,016	2,112	2,108	2,137	2,016	2,112
Hansen J stat.	2.222	2.382	1.747	1.300	1.900	1.399	1.255	0.619	2.012	5.921	0.0433	0.0556
Prob. HJS	0.329	0.304	0.418	0.522	0.387	0.497	0.534	0.734	0.366	0.0518	0.979	0.973

	Land ownership rights			Land markets	Regulated access		
	Individual (13)	Family (14)	Communal (15)	(16)	Pasture (17)	Forest (18)	Cropland (19)
lnpopulation	0.216**	–0.304***	0.101*	0.077**	0.243**	0.276*	–0.330*
	[0.096]	[0.100]	[0.056]	[0.038]	[0.098]	[0.149]	[0.177]
Year = 1996	0.001	0.029	–0.009	0.003	0.017	0.062*	0.033
	[0.024]	[0.026]	[0.016]	[0.011]	[0.023]	[0.037]	[0.045]
Year = 2006	0.087***	–0.061*	0.025	0.067***	0.141***	0.221***	–0.036
	[0.031]	[0.033]	[0.020]	[0.015]	[0.029]	[0.048]	[0.056]
Observations	2,146	2,146	2,146	2,146	2,146	2,146	2,146
Hansen J stat.	0.106	0.480	0.434	0.493	0.715	1.443	0.310
Prob. HJS	0.948	0.787	0.805	0.781	0.699	0.486	0.857

Source: Authors' calculations.

Notes: First-stage results are shown in column (1) of table 4.5. Population and proximity measures are in logs. All regressions control for forty-five province dummies (not shown). Robust standard errors are in brackets.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Table 4.6C **The IV regression results for infrastructure and institutions on village-level population, instrumented by distance to Côte d'Ivoire only**

	Proximity of farthest source (km)				Proximity to all sources (km)				Proximity to closest source (km)			
	Services (1)	Infrastr. (2)	Religion (3)	Markets (4)	Services (5)	Infrastr. (6)	Religion (7)	Markets (8)	Services (9)	Infrastr. (10)	Religion (11)	Markets (12)
lnpopulation	0.946**	1.476***	2.054***	1.158***	1.073***	1.410***	1.659***	1.162***	1.596***	0.159	0.762*	0.995***
	[0.381]	[0.474]	[0.698]	[0.424]	[0.382]	[0.411]	[0.588]	[0.400]	[0.519]	[0.267]	[0.450]	[0.381]
Year = 1996	–0.133*	0.057	–0.004	–0.108	–0.061	0.085	0.062	–0.044	0.063	0.297***	0.176***	0.130*
	[0.072]	[0.090]	[0.115]	[0.080]	[0.072]	[0.078]	[0.095]	[0.073]	[0.095]	[0.053]	[0.066]	[0.066]
Year = 2006	0.213**	0.797***	0.957***	0.289**	0.467***	0.830***	0.887***	0.442***	1.418***	0.612***	0.654***	0.805***
	[0.103]	[0.137]	[0.200]	[0.126]	[0.104]	[0.120]	[0.167]	[0.118]	[0.142]	[0.071]	[0.122]	[0.109]
Observations	2,108	2,137	2,016	2,112	2,108	2,137	2,016	2,112	2,108	2,137	2,016	2,112
Hansen J stat.	7.231	2.744	2.667	1.084	7.638	6.414	1.977	2.168	6.041	14.23	0.0237	5.384
Prob. HJS	0.0269	0.254	0.264	0.582	0.0220	0.0405	0.372	0.338	0.0488	0.000814	0.988	0.0677

	Land ownership rights			Land markets	Regulated access		
	Individual (13)	Family (14)	Communal (15)	(16)	Pasture (17)	Forest (18)	Cropland (19)
lnpopulation	0.345**	–0.157	0.140	0.042	–0.298**	0.156	–0.001
	[0.141]	[0.118]	[0.093]	[0.048]	[0.116]	[0.173]	[0.246]
Year = 1996	–0.009	0.017	–0.012	0.006	0.061**	0.071**	0.007
	[0.028]	[0.024]	[0.017]	[0.011]	[0.025]	[0.036]	[0.043]
Year = 2006	0.115***	–0.030	0.034	0.060***	0.025	0.196***	0.034
	[0.040]	[0.034]	[0.026]	[0.015]	[0.034]	[0.052]	[0.067]
Observations	2,146	2,146	2,146	2,146	2,146	2,146	2,146
Hansen J stat.	5.067	2.060	2.031	1.072	1.853	1.057	0.132
Prob. HJS	0.0794	0.357	0.362	0.585	0.396	0.590	0.936

Source: Authors' calculations.

Notes: First-stage results are shown in column (2) of table 4.5. Population and proximity measures are in logs. All regressions control for forty-five province dummies (not shown). Robust standard errors are in brackets

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Table 4.6D **The IV regression results for infrastructure and institutions on village-level population, instrumented by distance to rivers and Côte d'Ivoire interacted with year dummies, with village fixed effects**

	Proximity of farthest source (km)				Proximity to all sources (km)				Proximity to closest source (km)			
	Services (1)	Infrastr. (2)	Religion (3)	Markets (4)	Services (5)	Infrastr. (6)	Religion (7)	Markets (8)	Services (9)	Infrastr. (10)	Religion (11)	Markets (12)
lnpopulation	–0.172	0.182	–0.352	1.007**	–0.275	0.016	–0.145	0.758**	–0.111	–0.308	0.360	0.220
	[0.243]	[0.343]	[0.375]	[0.437]	[0.216]	[0.218]	[0.298]	[0.332]	[0.335]	[0.295]	[0.325]	[0.260]
Year = 1996	–0.027	0.181***	0.162***	–0.102	0.067**	0.213***	0.193***	–0.018	0.226***	0.349***	0.225***	0.188***
	[0.040]	[0.048]	[0.049]	[0.063]	[0.034]	[0.032]	[0.038]	[0.048]	[0.047]	[0.044]	[0.040]	[0.037]
Year = 2006	–0.019	0.522***	0.346***	0.253**	0.192***	0.534***	0.434***	0.353***	1.073***	0.523***	0.570***	0.647***
	[0.055]	[0.083]	[0.101]	[0.108]	[0.049]	[0.051]	[0.082]	[0.082]	[0.079]	[0.072]	[0.093]	[0.069]
Number of VFE	716	728	689	717	716	728	689	717	716	728	689	717
Observations	2,095	2,135	1,987	2,101	2,095	2,135	1,987	2,101	2,095	2,135	1,987	2,101
Hansen J stat.	7.673	3.487	2.071	1.095	6.884	1.182	1.727	1.205	5.301	23.27	0.131	2.422
Prob. HJS	0.0533	0.322	0.558	0.778	0.0757	0.757	0.631	0.752	0.151	0.00	0.988	0.490

	Land ownership rights			Land markets	Regulated access		
	Individual (13)	Family (14)	Communal (15)	(16)	Pasture (17)	Forest(18)	Cropland (19)
lnpopulation	–0.004	0.032	–0.029*	–0.034	–0.173**	–0.140	0.080
	[0.051]	[0.027]	[0.017]	[0.040]	[0.085]	[0.119]	[0.059]
Year = 1996	0.021***	0.002	0.003	0.010	0.046***	0.101***	0.003
	[0.007]	[0.003]	[0.003]	[0.007]	[0.013]	[0.020]	[0.011]
Year = 2006	0.041***	0.012	–0.000	0.044***	0.050**	0.135***	0.050***
	[0.013]	[0.007]	[0.003]	[0.011]	[0.020]	[0.029]	[0.018]
Number of VFE	729	729	729	729	729	729	729
Observations	2,145	2,145	2,145	2,145	2,145	2,145	2,145
Hansen J stat.	0.347	0.332	2.266	0.00826	5.880	4.453	0.789
Prob. HJS	0.951	0.954	0.519	1.000	0.118	0.216	0.852

Source: Authors' calculations.

Notes: First-stage results for this regression are not shown. Population and proximity measures are in logs. All results control for village fixed effects. Robust standard errors are in brackets.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

other relationships we see in cross-section become insignificant in changes between census years, as the nationwide expansion of infrastructure and market-oriented institutions dominates change over time. Controlling for village fixed effects and the common time trend, in fact, one of the cross-sectional relationships is now reversed, as villages with above-trend population increase are actually less likely to regulate pasture use. The excluded instruments are now reduced to the interaction terms, since controlling for village fixed effects removes any village-level time-invariant variables, including distance to the nearest river and distance to the Côte d'Ivoire border. The F-test statistic from the first is stage is only 2.06, indicating that the identification is substantially weaker than the specifications where we control only for province fixed effects only. The Hansen J statistic indicates that the exclusion restrictions cannot be rejected in columns (1), (5), and (10). To identify a causal relationship between population and most kinds of infrastructure or institutions we remain reliant on cross-sectional variation within provinces, as in tables 4.6A, 4.6B, and 4.6C.

Using our main specification from table 4.6A, we now turn to the estimated magnitude of these population effects on the provision of public services, infrastructure, and other amenities. The size of estimated population effects depends not only on the estimated elasticity coefficients, but also on the range of population changes that are predicted from the first-stage regression. Table 4.7 calculates each of the estimated effect sizes, when moving from the first to last quintile of the differences in village population predicted by distance to rivers and to Côte d'Ivoire. This amounts to a roughly 15 percent difference in predicted village population, as being closer to rivers or to Côte d'Ivoire is associated with having an additional 152 people against an average predicted size of 1,030. Using the estimated coefficients from our preferred specification in table 4.6A, the resulting difference is similar or larger than each decade's worth of time trends from 1985 to 1996, or from 1996 to 2006.

4.5 Conclusion

This chapter uses migration shocks associated with proximity to rivers and to Côte d'Ivoire to test whether villages with larger populations obtain closer provision of public services, public infrastructure, religious facilities, and markets, and have more market-oriented property rights over land use. Our data on infrastructure and institutions come from a new survey of village elders, which was designed to document change over time and differences across villages. We find strong links between larger rural populations, more local public goods provision, and stronger property rights controlling for province fixed effects and time trends.

The generalizability of our results is limited by the strength of our instruments and the validity of their exclusion from the main regression. Internal

Table 4.7 **Estimated effect sizes of changes in population and time for public infrastructure and institutions**

	Proximity of farthest source (km)				Proximity to all sources (km)				Proximity to closest source (km)			
	Services	Infrastr.	Religion	Markets	Services	Infrastr.	Religion	Markets	Services	Infrastr.	Religion	Markets
Coefficient estimates												
Population	0.308	0.574	1.165	0.649	0.41	0.78	0.989	0.718	0.953	0.303	0.629	0.933
$Y = 1996$	—	0.127	—	—	—	0.134	0.106	—	0.119	0.285	0.185	0.135
$Y = 2006$	—	0.603	0.737	0.173	0.331	0.694	0.721	0.34	1.286	0.643	0.621	0.791
Effect-size estimates												
Pop. from 1st to last quintile	0.327	0.610	1.238	0.690	0.436	0.829	1.051	0.763	1.013	0.322	0.669	0.992
Time from 1986 to 1996	—	0.135	—	—	—	0.142	0.113	0.000	0.126	0.303	0.197	0.144
Time from 1996 to 2006	—	0.506	0.783	0.184	0.352	0.595	0.654	0.361	1.241	0.381	0.463	0.697

	Land ownership rights				Regulated access		
	Individual	Family	Communal	Land markets	Pasture	Forest	Cropland
Coefficient estimates							
Population	0.221	–0.246	0.097	0.061	—	0.222	—
$Y = 1996$	—	—	—	—	—	0.066	—
$Y = 2006$	0.088	–0.049	—	0.064	0.11	0.21	—
Effect-size estimates							
Pop. from 1st to last quintile	0.235	–0.261	0.103	0.065	—	0.236	—
Time from 1986 to 1996	—	—	—	—	—	0.070	—
Time from 1996 to 2006	0.094	–0.052	—	0.068	0.117	0.153	—

Source: Authors' calculations.

Notes: Estimated effect sizes are shown only where coefficients are estimated to be significantly different from zero at $p < 0.05$ or $p < 0.1$. Population shocks are illustrated as the difference between the means of the first and last quintiles of predicted population from our first-stage regression. This turns out to be a difference of 152 people per village (exp[7.420] – exp[6.375]), where the mean predicted population of all villages is 1,030 people (exp[6.938]). The mean predicted population of each quintile, in log form, is 7.420, 7.140, 6.966, 6.786, and 6.375.

and external validity is limited by the potential influence of omitted variables, measurement errors, and reverse causality in these relationships. Further work using our village-level data could probe more deeply, for example, by disaggregating where and when exogenous migration shocks occurred within Burkina Faso, and then testing their impact on specific kinds of infrastructural and institutional change. Another approach to finding natural experiments would be to go even further back in time using archival data, as in Jedwab and Moradi (2011).

One feature of our study is to demonstrate the use of village elders' recall data in constructing time-varying indexes of local infrastructure and institutions. This involves asking about villagers' access to specific amenities, and then aggregating those responses into indexes that capture variation in public amenities from their point of view. The correlations we find demonstrate the potential significance of this approach as a way to overcome the limited availability of other ways to measure variation in public services, infrastructure, and institutions over time and space.

In the particular setting of rural Burkina Faso, we find that variance in village population size is closely correlated with village-level access to local public services and infrastructure. Our point estimate of this effect suggests that moving from the first to the last quintile of village population size associated with rural migration within Burkina Faso is similar or larger than a full decade of time trends across Burkina Faso as a whole. These village amenities are clearly of great importance for rural development. Future work using our data or similar new surveys elsewhere could document further how village infrastructure and institutions are responding to the extraordinary demographic changes recently experienced by rural Africans.

Appendix

BURKINA FASO
Ministry of Agriculture, Water Resources, and Fisheries

DIRECTORATE-GENERAL FOR THE PROMOTION OF THE RURALECONOMY

Directorate of Forecasting and Agricultural and Food Statistics

COMMUNITY SURVEY

N°	Identification Elements	Name	Code
1	Region		|___|___|
2	Province		|___|___|
3	Commune		|___|___|
4	Type of locality 1 = urban 2 = rural		|___|
5	Village / sector		|___|___|___|
6	Latitude		|___|___|___|___|___|___|
7	Longitude		|___|___|___|___|___|___|

Controller name: _____|___|___|___|

Interview date:|___|___| |___|___| |___|___|
Day month year

Supervisor name and siva:_____

Control date: |___|___| |___|___| |___|___|
Day month year

Result of control:……..…|___|
(1 = no problem; 2 = corrected questionnaire; 3 = questionnaire returned)

First and last name of enumerator A:_____|___|___|___|

First and last name of enumerator B:_____|___|___|___|

How many years ago was the village established?:….. |___|___|___|___|

Is it a resettlement village? : (1 = Yes; 0 = No):…… |___|

I. IDENTITY OF RESPONDENTS

Nº.	Category	Number for each category		TOTAL*
		Male	Female	
I.1	Government authorities or administration representatives	|_|_|_|	|_|_|_|	|_|_|_|
I.2	Village leaders	|_|_|_|	|_|_|_|	|_|_|_|
I.3	Village council delegates	|_|_|_|	|_|_|_|	|_|_|_|
I.4	Land chiefs	|_|_|_|	|_|_|_|	|_|_|_|
I.5	Religious chiefs (imams, pastors, priests)	|_|_|_|	|_|_|_|	|_|_|_|
I.6	Group/association heads	|_|_|_|	|_|_|_|	|_|_|_|
I.7	**TOTAL***	|_|_|_|	|_|_|_|	|_|_|_|

*To be completed after the inteview with the group.

II. ACTUAL COMPOSITION OF VILLAGE COMMUNITIES

Nº	Questions	Response
II.1	Approximate number of locals returning from Côte d'Ivoire because of the Ivorian crisis	|_|_|_|_|_|
II.2	Approximate number of immigrants from elsewhere	|_|_|_|_|_|
II.3	Number of ethnic groups in the village	|_|_|_|
II.4	Number of clans in the village	|_|_|_|

III. VILLAGE POPULATION

NB : For this part, the investigator should go to the prefecture or to city hall

Nº	Questions		Responses
III.1	Presence of documents from the 2006 census **(1 = Yes; 0 = No)**		|_|
III.2	Total Population in 2006		|_|_|_|_|_|_|_|
III.3	Population older than 15 years of age	Male	|_|_|_|_|_|_|_|
III.4		Female	|_|_|_|_|_|_|_|
III.5	Population younger than 15 years of age	Male	|_|_|_|_|_|_|_|
III.6		Female	|_|_|_|_|_|_|_|
III.7	Presence of documents from the 1996 census **(1 = Yes; 0 = No)**		|_|
III.8	Total population in 1996		|_|_|_|_|_|_|_|

III.9	Population older than 15 years of age	Male	
III.10		Female	
III.11	Population younger than 15 years of age	Male	
III.12		Female	
III.13	Presence of documents from the 1985 census **(1 = Yes; 0 = No)**		
III.14	Total population in 1985		
III.15	Population older than 15 years of age	Male	
III.16		Female	
III.17	Population younger than 15 years of age	Male	
III.18		Female	

IV. AGRICULTURAL EXTENSION OFFICIAL VISIT

Nº	Questions	Response
IV.1	When was the first visit to your community of an extension agent? *(Write the year or xxxx if never)*	
IV.2	When was the end of proximity-based extension in your area? *(Write the year or xxxx if never)*	
IV.3	When was the start of new-style extension in your area? *(Write the year or xxxx if never)*	
IV.4	When was the last visit by an extension agent to your community? *(Write the year or xxxx if never)*	
IV.5	How many extension visits have you had during the last 12 months? *(Write the year or xxxx if never)*	

V. CENTRAL INFRASTRUCTURE: DISTANCES AND CHANGES

Nº	Questions	Response	
		Distance (in km)	Year established
V.1	**Distance between the village and the central administration office (for birth registration)**		
V.1.1	Currently		
V.1.2	Previously		
V.1.3	Preceding situation		
V.2	**Distance between the village and a road that is accessible by car or bus year round**		
V.2.1	Currently		
V.2.2	Previously		
V.2.3	Preceding situation		

V.3	**Distance between the village and a road that is accessible by car or bus only part of the year**		
V.3.1	Currently	____	____
V.3.2	Previously	____	____
V.3.3	Preceding situation	____	____
V.4	**Distance between the village and a bus/taxi stop in the rural area**		
V.4.1	Currently	____	____
V.4.2	Previously	____	____
V.4.3	Preceding situation	____	____
V.5	**Distance between the village and the credit union offices**		
V.5.1	Currently	____	____
V.5.2	Previously	____	____
V.5.3	Preceding situation	____	____
V.6	**Distance between the village and the nearest town with electricity**		
V.6.1	Currently	____	____
V.6.2	Previously	____	____
V.6.3	Preceding situation	____	____
V.7	**Distance between the village and the nearest town with telephone service**		
V.7.1	Currently	____	____
V.7.2	Previously	____	____
V.7.3	Preceding situation	____	____
V.8	**Distance between the village and the nearest town with mobile telephone service**		
V.8.1	Currently	____	____
V.8.2	Previously	____	____
V.8.3	Preceding situation	____	____

VI. VILLAGE MARKETS

Nº	Questions	Responses		
VI.1	**FREQUENCY OF GENERAL MARKET**			
		Distance (in km)	**Frequency** *1 = every day* *2 = every 3 days* *3 = every 4 days* *4 = each week* *5 = occasionally*	**Year established**
VI.1.1	Currently	⌊___⌋___⌋___⌋	⌊___⌋	⌊___⌋___⌋___⌋___⌋
VI.1.2	Previously	⌊___⌋___⌋___⌋	⌊___⌋	⌊___⌋___⌋___⌋___⌋
VI.1.3	Preceding situation	⌊___⌋___⌋___⌋	⌊___⌋	⌊___⌋___⌋___⌋___⌋
VI.2	**TYPE OF WATER ACCESS IN THE GENERAL MARKET**			
			Type of water source *1 = tap* *2 = hydrant* *3 = drilling* *4 = well* *5 = none*	**Year established**
VI.2.1	Currently		⌊___⌋-⌊___⌋-⌊___⌋	⌊___⌋___⌋___⌋___⌋
VI.2.2	Previously		⌊___⌋-⌊___⌋-⌊___⌋	⌊___⌋___⌋___⌋___⌋
VI.2.3	Preceding situation		⌊___⌋-⌊___⌋-⌊___⌋	⌊___⌋___⌋___⌋___⌋
VI.3	**STALLS IN THE GENERAL MARKET**			
			Stall type *1 = individual* *2 = collective* *3 = none*	**Year established**
VI.3.1	Currently		⌊___⌋-⌊___⌋	⌊___⌋___⌋___⌋___⌋
VI.3.2	Previously		⌊___⌋-⌊___⌋	⌊___⌋___⌋___⌋___⌋
VI.3.3	Preceding situation		⌊___⌋-⌊___⌋	⌊___⌋___⌋___⌋___⌋
VI.4	**ACCESS TO ELECTRICITY IN THE GENERAL MARKET**			
			Availability *1 = permanent* *2 = part of the day* *3 = not at all*	**Year established**
VI.4.1	Currently		⌊___⌋	⌊___⌋___⌋___⌋___⌋
VI.4.2	Previously		⌊___⌋	⌊___⌋___⌋___⌋___⌋
VI.4.3	Preceding situation		⌊___⌋	⌊___⌋___⌋___⌋___⌋

VI.5	FEES (SALES TAX LEVEL IN GENERAL MARKET)			
		Period *1 = each day* *2 = each week* *3 = each month* *4 = each year* *5 = each market day*	**Amount per period**	**Year established**
VI.5.1	Currently	⌊__⌋	⌊__⌋__⌋__⌋__⌋	⌊__⌋__⌋__⌋__⌋
VI.5.2	Previously	⌊__⌋	⌊__⌋__⌋__⌋__⌋	⌊__⌋__⌋__⌋__⌋
VI.5.3	Preceding situation	⌊__⌋	⌊__⌋__⌋__⌋__⌋	⌊__⌋__⌋__⌋__⌋
VI.6	**FREQUENCY OF CATTLE MARKET**			
		Distance (in km)	**Frequency** *1 = each day* *2 = every 3 days* *3 = every 4 days* *4 = each week* *5 = occasionally*	**Year established**
VI.6.1	Currently	⌊__⌋__⌋__⌋	⌊__⌋	⌊__⌋__⌋__⌋__⌋
VI.6.2	Previously	⌊__⌋__⌋__⌋	⌊__⌋	⌊__⌋__⌋__⌋__⌋
VI.6.3	Preceding situation	⌊__⌋__⌋__⌋	⌊__⌋	⌊__⌋__⌋__⌋__⌋
VI.7	**TYPE OF WATER SOURCE FOR CATTLE MARKET**			
			Type of water source *1 = tap* *2 = hydrant* *3 = drilling* *4 = wells* *5 = none*	**Year established**
VI.7.1	Currently		⌊__⌋-⌊__⌋-⌊__⌋	⌊__⌋__⌋__⌋__⌋
VI.7.2	Previously		⌊__⌋-⌊__⌋-⌊__⌋	⌊__⌋__⌋__⌋__⌋
VI.7.3	Preceding situation		⌊__⌋-⌊__⌋-⌊__⌋	⌊__⌋__⌋__⌋__⌋
VI.8	**STALLS IN THE CATTLE MARKETS**			
			Type of stall *1 = individual* *2 = collective* *3 = none*	**Year established**
VI.8.1	Currently		⌊__⌋-⌊__⌋	⌊__⌋__⌋__⌋__⌋
VI.8.2	Previously		⌊__⌋-⌊__⌋	⌊__⌋__⌋__⌋__⌋
VI.8.3	Preceding situation		⌊__⌋-⌊__⌋	⌊__⌋__⌋__⌋__⌋

VI.9	ACCESS TO ELECTRICITY IN THE CATTLE MARKET		
		Availability *1 = permanent* *2 = part of the day* *3 = not at all*	**Year established**
VI.9.1	Currently	⌊__⌋	⌊__|__|__|__⌋
VI.9.2	Previously	⌊__⌋	⌊__|__|__|__⌋
VI.9.3	Preceding situation	⌊__⌋	⌊__|__|__|__⌋

VI.10	FEES (SALES TAXES) FOR CATTLE MARKET			
		Period *1 = each day* *2 = each week* *3 = each month* *4 = each year* *5 = each market day*	**Amount per period**	**Year established**
VI.10.1	Currently	⌊__⌋	⌊__|__|__|__|__⌋	⌊__|__|__|__⌋
VI.10.2	Previously	⌊__⌋	⌊__|__|__|__|__⌋	⌊__|__|__|__⌋
VI.10.3	Preceding situation	⌊__⌋	⌊__|__|__|__|__⌋	⌊__|__|__|__⌋

VII. VILLAGE INFRASTRUCTURE

Nº	Questions	Responses		
		Distance	**Number**	**Year established**
VII.1	**Distance between the village and stores with various provisions (salt, tea, sugar, etc.)**			
VII.1.1	Currently	⌊__|__⌋	⌊__|__⌋	⌊__|__|__|__⌋
VII.1.2	Previously	⌊__|__⌋	⌊__|__⌋	⌊__|__|__|__⌋
VII.1.3	Preceding situation	⌊__|__⌋	⌊__|__⌋	⌊__|__|__|__⌋
VII.2	**Distance between the village and collective wells for potable water**			
VII.2.1	Currently	⌊__|__⌋	⌊__|__⌋	⌊__|__|__|__⌋
VII.2.2	Previously	⌊__|__⌋	⌊__|__⌋	⌊__|__|__|__⌋
VII.2.3	Preceding situation	⌊__|__⌋	⌊__|__⌋	⌊__|__|__|__⌋
VII.3	**Distance between the village and large wells**			
VII.3.1	Currently	⌊__|__⌋	⌊__|__⌋	⌊__|__|__|__⌋
VII.3.2	Previously	⌊__|__⌋	⌊__|__⌋	⌊__|__|__|__⌋
VII.3.3	Preceding situation	⌊__|__⌋	⌊__|__⌋	⌊__|__|__|__⌋

VII.4	**Distance between the village and the collective drilling source for potable water**			
VII.4.1	Currently	⌊__⌋⌊__⌋	⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VII.4.2	Previously	⌊__⌋⌊__⌋	⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VII.4.3	Preceding situation	⌊__⌋⌊__⌋	⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VII.5	**Distance between the village and the collective dam**			
VII.5.1	Currently	⌊__⌋⌊__⌋	⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VII.5.2	Previously	⌊__⌋⌊__⌋	⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VII.5.3	Preceding situation	⌊__⌋⌊__⌋	⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VII.6	**Road bridge built by the village**			
VII.6.1	Currently		⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VII.6.2	Previously		⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VII.6.3	Preceding situation		⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VII.7	**Pedestrian way built by the village**			
VII.7.1	Currently		⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VII.7.2	Previously		⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VII.7.3	Preceding situation		⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VII.8	**Agricultural cooperative store (usable), ONG store, or village group store**			
VII.8.1	Currently		⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VII.8.2	Previously		⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VII.8.3	Preceding situation		⌊__⌋⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋

VIII. LAND RIGHTS ON FARM LAND

N°	Questions	Responses	
VIII.1	**Type of rights applied to farm land** *(if none, mark with an "x" for the implementation year)*		
		Type of rights applied (1 = Yes; 0 = No)	**Year of implementation**
VIII.1.1	Individual property	⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VIII.1.2	Collective-family property	⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋
VIII.1.3	Collective-community property	⌊__⌋	⌊__⌋⌊__⌋⌊__⌋⌊__⌋⌊__⌋

VIII.2	**Farm land location, sales, and loans** *(if none, mark with an "x" for the implementation year)*		
		Possibility of transaction (1 = Yes; 0 = No)	**Year of implementation**
VIII.2.1	Can the land be rented?	⌊___⌋	⌊___⌋___⌋___⌋___⌋
VIII.2.2	Can the land be sold?	⌊___⌋	⌊___⌋___⌋___⌋___⌋
VIII.2.3	Can the land be loaned?	⌊___⌋	⌊___⌋___⌋___⌋___⌋
VIII.3	**Is there rented farm land?** *(if no to question VIII.2.1, mark with an "x" and go to the next question)*		
		Location of land (1 = Yes; 0 = No)	**Year of implementation**
VIII.3.1	Rented to a native person	⌊___⌋	⌊___⌋___⌋___⌋___⌋
VIII.3.2	Rented to a foreigner	⌊___⌋	⌊___⌋___⌋___⌋___⌋
VIII.4	**Of whom should one ask permission to rent one's land?** *(this question should always be posed no matter the response to the previous question)*		
		Contacts *1 = head of family* *2 = land owner* *3 = council elected by the community* *4 = council elected by the government* *5 = no permission*	**Year of implementation**
VIII.4.1	Currently	⌊___⌋-⌊___⌋-⌊___⌋	⌊___⌋___⌋___⌋___⌋
VIII.4.2	Previously	⌊___⌋-⌊___⌋-⌊___⌋	⌊___⌋___⌋___⌋___⌋
VIII.4.3	Preceding situation	⌊___⌋-⌊___⌋-⌊___⌋	⌊___⌋___⌋___⌋___⌋
VIII.5	**Is there farm land that has been sold?** *(if no to question VIII.2.2, mark with an "x" and go to the next question)*		
		Land sales (1 = Yes; 0 = No)	**Year of implementation**
VIII.5.1	Sold to a native person?	⌊___⌋	⌊___⌋___⌋___⌋___⌋
VIII.5.2	Sold to a foreigner?	⌊___⌋	⌊___⌋___⌋___⌋___⌋
VIII.6	**Of whom should one ask permission to sell one's land?** *(this question should always be posed no matter the response to the previous question)*		
		Contacts *1 = head of family* *2 = land owner* *3 = council elected by the community* *4 = council elected by the government* *5 = no permission*	**Year of implementation**
VIII.6.1	Currently	⌊___⌋-⌊___⌋-⌊___⌋	⌊___⌋___⌋___⌋___⌋
VIII.6.2	Previously	⌊___⌋-⌊___⌋-⌊___⌋	⌊___⌋___⌋___⌋___⌋
VIII.6.3	Preceding situation	⌊___⌋-⌊___⌋-⌊___⌋	⌊___⌋___⌋___⌋___⌋

VIII.7	**Is there farm land that is loaned?** *(if no to question VIII.2.3, mark with an "x" and go to the next question)*		
		Land loans (1 = Yes; 0 = No)	**Year of implementation**
VIII.7.1	Loaned to a native person	|___|	|___|___|___|___|
VIII.7.2	Loaned to a foreigner	|___|	|___|___|___|___|
VIII.8	**Of whom should one ask permission to loan one's land?** *(this question should always be posed no matter the response to the previous question)*		
		Contacts *1 = head of family* *2 = land owner* *3 = council elected by the community* *4 = council elected by the government* *5 = no permission*	**Year of implementation**
VIII.8.1	Currently	|___|-|___|-|___|	|___|___|___|___|
VIII.8.2	Previously	|___|-|___|-|___|	|___|___|___|___|
VIII.8.3	Preceding situation	|___|-|___|-|___|	|___|___|___|___|
VIII.9	**Who should be consulted to resolve conflicts regarding use of farm land?**		
		Contacts *1 = land owner* *2 = chief or council elected by the community* *3 = chief or council named by the government* *4 = other authority* *5 = no one*	**Year of implementation**
VIII.9.1	Currently	|___|-|___|-|___|	|___|___|___|___|
VIII.9.2	Previously	|___|-|___|-|___|	|___|___|___|___|
VIII.9.3	Preceding situation	|___|-|___|-|___|	|___|___|___|___|
VIII.10	**What are the forms of ownership of pasture land in this community?** *(if there is no pasture land, mark with an "x"and go to the next question)*		
		Contacts *1 = individual property* *2 = collective-family property* *3 = collective-inherited property* *4 = ollective-community property* *5 = other*	**Year of implementation**
VIII.10.1	Currently	|___|-|___|-|___|	|___|___|___|___|
VIII.10.2	Previously	|___|-|___|-|___|	|___|___|___|___|
VIII.10.3	Preceding situation	|___|-|___|-|___|	|___|___|___|___|

VIII.11	**How many cattle paths are there in the village?** *(if there are no cattle paths, mark with an "x" and go to the next question)*		
		Number	**Year of implementation**
VIII.11.1	Currently	|___|___|	|___|___|___|___|
VIII.11.2	Previously	|___|___|	|___|___|___|___|
VIII.11.3	Preceding situation	|___|___|	|___|___|___|___|

IX. LAND RIGHTS FOR PASTURES

Nº	**Questions**	**Responses**	
IX.1	**Is there land reserved for pastures?** *(if the answer is no, mark with an "x" in the year established)*		
		Existence of pasture (1 = Yes; 0 = No)	**Year established**
IX.1.1	Currently	|___|	|___|___|___|___|
IX.1.2	Previously	|___|	|___|___|___|___|
IX.1.3	Preceding situation	|___|	|___|___|___|___|
IX.2	**What are the access routes to the pastures?** *(if the answer is 2 [another route], mark with an "x"in year established)*		
IX.2.1		**Access routes** *1 = cattle paths* *2 = another route*	**Year established**
IX.2.2	Currently	|___|	|___|___|___|___|
IX.2.3	Previously	|___|	|___|___|___|___|
	Preceding situation	|___|	|___|___|___|___|
IX.3	**What means are there for limiting access to pasture lands?** *(if the response is no for question IX.1, mark with an "x"on the corresponding situation below)*		
		Payment methods *1 = tax per animal* *2 = other type of tax* *3 =limit on number of animals* *4 = unlimited access for natives* *5 = unlimited access for residents* *6 = no restriction*	**Year established**
IX.3.1	Currently	|___|-|___|-|___|	|___|___|___|___|
IX.3.2	Previously	|___|-|___|-|___|	|___|___|___|___|
IX.3.3	Preceding situation	|___|-|___|-|___|	|___|___|___|___|

IX.4	Who is responsible for managing access to the pastures?		
		Contacts *1 = land owner* *2 = chief or council elected by the community* *3 = chief or council named by the government* *4 = other authority* *5 = no one*	**Year established**
IX.4.1	Currently	|___|-|___|-|___|	|___|___|___|___|
IX.4.2	Previously	|___|-|___|-|___|	|___|___|___|___|
IX.4.3	Preceding situation	|___|-|___|-|___|	|___|___|___|___|

X. FOREST USE RIGHTS (FOR WOOD, FRUIT, HUNTING, ETC.)

Nº	Questions	Responses	
X.1	**Are there forests in your community?** *(if the answer is no, mark with an "x"in year established)*		
		Forests (1 = Yes; 0 = No)	**Year established**
X.1.1	Currently	|___|	|___|___|___|___|
X.1.2	Previously	|___|	|___|___|___|___|
X.1.3	Preceding situation	|___|	|___|___|___|___|
X.2	**Are there ways to limit access to the forests?** *(if the answer is no for question X.1, mark with an "x"in the corresponding situation below)*		
		Payment methods *1 = tax per unit of wood* *2 = other type of tax* *3 = direct control of entry and exit* *4 = unlimited access for natives* *5 = unlimited access for residents* *6 = no restriction*	**Year established**
X.2.1	Currently	|___|-|___|-|___|	|___|___|___|___|
X.2.2	Previously	|___|-|___|-|___|	|___|___|___|___|
X.2.3	Preceding situation	|___|-|___|-|___|	|___|___|___|___|

X.3	Who is responsible for managing access to the forests?		
		Contacts *1 = land owner* *2 = chief or council elected by the community* *3 = chief or council named by the government* *4 = other authority* *5 = no one*	**Year established**
X.3.1	Currently	⌊___⌋-⌊___⌋-⌊___⌋	⌊___⌋⌊___⌋⌊___⌋⌊___⌋
X.3.2	Previously	⌊___⌋-⌊___⌋-⌊___⌋	⌊___⌋⌊___⌋⌊___⌋⌊___⌋
X.3.3	Preceding situation	⌊___⌋-⌊___⌋-⌊___⌋	⌊___⌋⌊___⌋⌊___⌋⌊___⌋

XI. EDUCATION AND HEALTH INFRASTRUCTURE

Nº	Questions	Responses	
		Distance	**Year established**
XI.1	**Distance between the village and the primary school most frequented by the village children**		
XI.1.1	Currently	⌊___⌋⌊___⌋⌊___⌋	⌊___⌋⌊___⌋⌊___⌋⌊___⌋
XI.1.2	Previously	⌊___⌋⌊___⌋⌊___⌋	⌊___⌋⌊___⌋⌊___⌋⌊___⌋
XI.1.3	Preceding situation	⌊___⌋⌊___⌋⌊___⌋	⌊___⌋⌊___⌋⌊___⌋⌊___⌋
XI.2	**Distance between the village and the high school most frequented by the village children**		
XI.2.1	Currently	⌊___⌋⌊___⌋⌊___⌋	⌊___⌋⌊___⌋⌊___⌋⌊___⌋
XI.2.2	Previously	⌊___⌋⌊___⌋⌊___⌋	⌊___⌋⌊___⌋⌊___⌋⌊___⌋
XI.2.3	Preceding situation	⌊___⌋⌊___⌋⌊___⌋	⌊___⌋⌊___⌋⌊___⌋⌊___⌋
XI.3	**Distance between the village and the health center most frequented by the village population**		
XI.3.1	Currently	⌊___⌋⌊___⌋⌊___⌋	⌊___⌋⌊___⌋⌊___⌋⌊___⌋
XI.3.2	Previously	⌊___⌋⌊___⌋⌊___⌋	⌊___⌋⌊___⌋⌊___⌋⌊___⌋
XI.3.3	Preceding situation	⌊___⌋⌊___⌋⌊___⌋	⌊___⌋⌊___⌋⌊___⌋⌊___⌋

XII. RELIGIOUS INFRASTRUCTURE

N°	Questions	Responses	
		Distance	Year established
XII.1	**Distance between the villlage and the church most frequented by the village population**		
XII.1.1	Currently	⌊__⌋__⌋__⌋	⌊__⌋__⌋__⌋__⌋
XII.1.2	Previously	⌊__⌋__⌋__⌋	⌊__⌋__⌋__⌋__⌋
XII.1.3	Preceding situation	⌊__⌋__⌋__⌋	⌊__⌋__⌋__⌋__⌋
XII.2	**Distance between the village and the mosque most frequented by the village population**		
XII.2.1	Currently	⌊__⌋__⌋__⌋	⌊__⌋__⌋__⌋__⌋
XII.2.2	Previously	⌊__⌋__⌋__⌋	⌊__⌋__⌋__⌋__⌋
XII.2.3	Preceding situation	⌊__⌋__⌋__⌋	⌊__⌋__⌋__⌋__⌋
XII.3	**Distance between the village and the temple most frequented by the village population**		
XII.3.1	Currently	⌊__⌋__⌋__⌋	⌊__⌋__⌋__⌋__⌋
XII.3.2	Previously	⌊__⌋__⌋__⌋	⌊__⌋__⌋__⌋__⌋
XII.3.3	Preceding situation	⌊__⌋__⌋__⌋	⌊__⌋__⌋__⌋__⌋

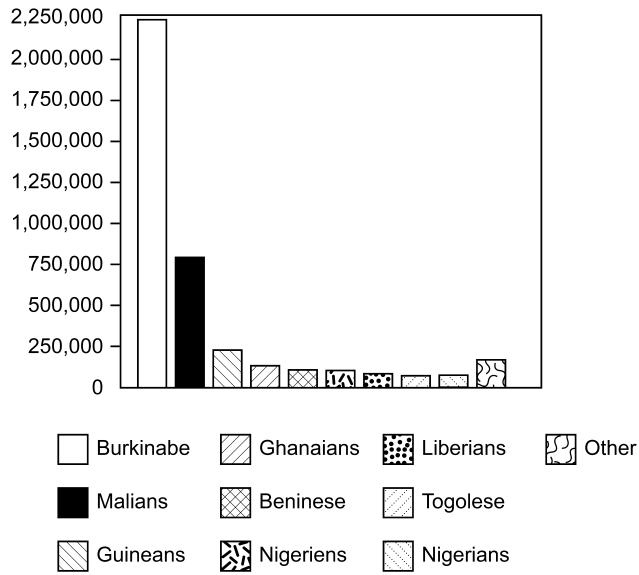

Fig. 4A.1 Foreign population in Côte d'Ivoire by nationality, 1998 census
Source: IRIN News (2002).

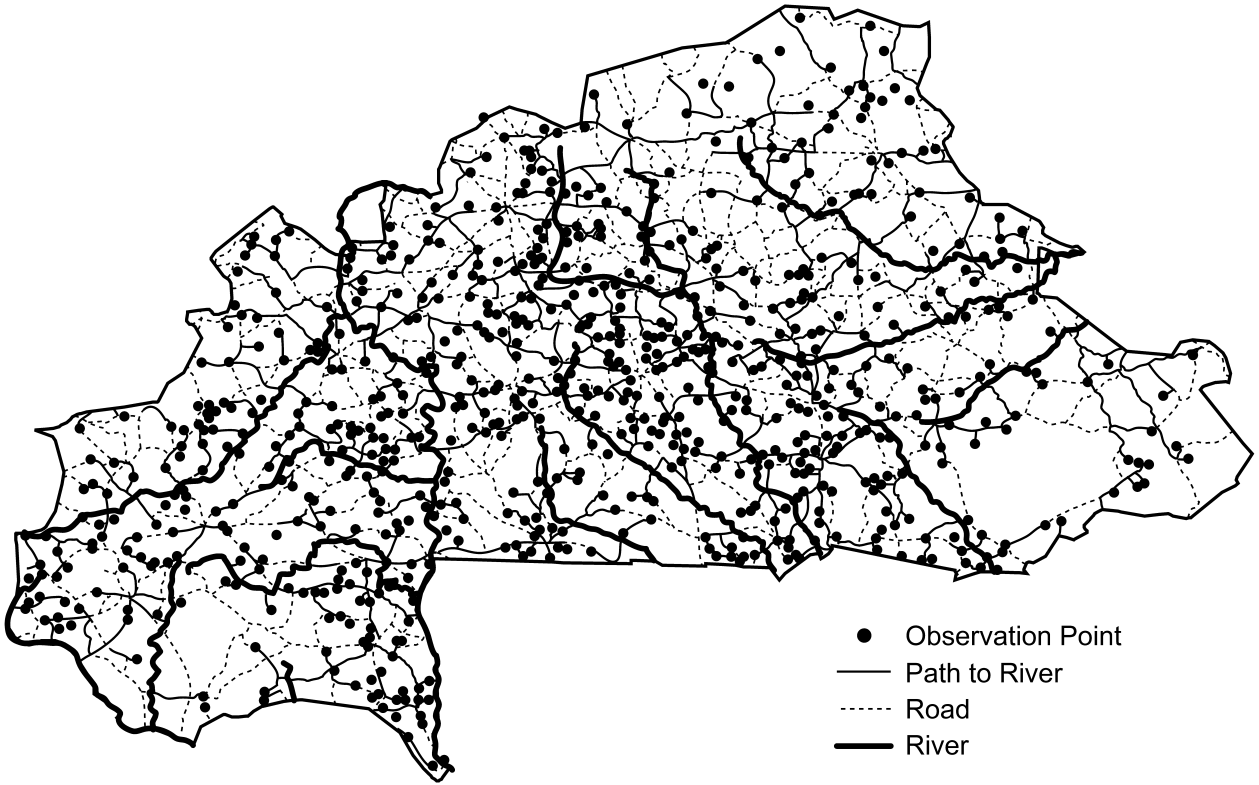

Fig. 4A.2 Location of surveyed villages and rivers used for IV estimation

Source: Authors' calculations. Village locations are drawn from authors' survey data; river locations and paths from villages to rivers are calculated from IFPRI file data. Roads and travel paths are shown for illustration purposes only; data used for hypothesis tests are straight-line distances from the village to the closest river, and travel distance to nearest point in Côte d'Ivoire (at the lower-left of the map shown).

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