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ABSTRACT

Shine a (Night)Light: Decentralization and Economic Development in Burkina Faso*

Decentralization, championed by international institutions, has been one of the most prominent public sector reforms of the last decades, particularly in sub-Saharan Africa. To date, few studies propose a quasi-experimental evaluation of its capacity to contribute to local development. We exploit the phase-in of decentralization at the commune level in Burkina Faso. We use satellite information on night-time light density as a proxy for local development levels, which has the advantage of being measured and comparable over time and space. The communes that were decentralized first can be compared to the others after the reform relative to the pre-reform situation. The difference-in-difference approach includes commune fixed effects and inverse propensity score reweighting to account for time-varying differences across communes. We find a positive impact of decentralization on the night-light intensity trends of the early-decentralized communes. This is supported by alternative measures (remote sensing of built-up settlements and a welfare index), which shows the possibly broader scope of decentralization gains. We show that decentralization did not lift all boats: only the communes with the ability to generate own-source revenues benefited from *effective* decentralization.

JEL Classification: H00, H70, H71, H72, O10

Keywords: decentralization, economic development, local development, Africa, Burkina Faso

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1. Introduction

The unflagging search for good institutions and more equitable access to public goods and services has placed decentralization at the center-stage of policy experiments in many developing and emerging countries. The transfer of powers to local authorities has been seen as a means of ensuring political stability, improving autonomy and ultimately reducing poverty (Bardhan, 2002). By the late 1990s, several developing economies, especially in sub-Saharan Africa, had embarked on a process of creating new frameworks for intergovernmental governance and fiscal management, as well as conducting local democratic elections.[2] Supported by global development agendas, such as the Millennium Project (UNDP, 2005), and endorsed by international donor institutions, decentralization has subsequently become one of the main proposals for institutional reforms. However, despite a growing empirical literature on this topic, the benefits of decentralization are still discussed. Some studies actually point to the risks associated with decentralization, such as poor local capacities, coordination failure between jurisdictions or elite capture (Grossman et al., 2017; Kessing et al., 2007; Bardhan, 2002), as well as to the unequal effects of decentralization in poor countries (Galiani et al., 2008).

To enrich the debate, sound empirical analyses are needed. Yet, there are limited quasi-experimental evaluations of decentralization and its effectiveness in improving households' living standards, access to public services, and local economic development. This is especially the case for developing economies and particularly in sub-Saharan Africa. The main reason is that decentralization often occurred as a uniform policy, established through legal texts that define the attributions and rights of lower-tier governments and simultaneously affect all sub-national units. This implies a lack of counterfactuals or comparison groups, which impedes causal evaluations of the reform.

[2] The initiation of local democracy through elections and the establishment of local governments across the board began in Senegal in 1996, in Burkina Faso in 1995 (as described below), in Benin in 2003, and in Niger in 2004. For insights on the emergence of decentralization trends, see for instance Vaillancourt and Bird (1999), Crawford and Hartmann (2008), Martinez-Vazquez and Vaillancourt (2011), Dafflon and Madiès (2013), Dickovick and Wunsch (2014).

Moreover, there is a lack of credible time-series data on the economic performances of local governments, especially for least-developed economies, most of which have embarked on the decentralization wagon.[3]

Exploiting original information and data on Burkina Faso, this paper attempts to fill this literature gap by proposing a quasi-experimental evaluation of a decentralization reform on local development. Unlike in most countries, decentralization in Burkina Faso was implemented gradually, with communes joining the reform in different waves – effectively in 1995, 2000 and 2005 – thereby creating counterfactual groups among localities. In 1995, 33 communes joined the first wave of reform through local elections and the institution of local government councils. These were followed by 16 communes in 2000 and the rest of the country in 2005. We take advantage of this phased-in reform and adopt a difference-in-difference (DD) approach to study the differential changes in outcomes among established cities with increased autonomy before and after each wave of reform. As such, our setting provides one of the rare quasi-experimental assessments of the effect of decentralization in sub-Saharan Africa.

The suggested approach requires outcomes that are available and comparable across time and space, i.e., over the 1990s and 2000s and across all communes. For that, we rely on satellite information on night-time light density at the local level, which is available from 1992 to 2010. As extensively discussed, it has and can be used as a proxy for local economic development or local economic activity (Henderson et al., 2012; Hodler and Raschky, 2014; Alesina et al., 2016). As a preliminary check, we show that night-light data is relevant in the case of Burkina Faso and strongly correlated with cross-sectional and time variation in local potential resources and – when available – with data on local fiscal capacities. We complete the specification of the DD model with key time-varying controls such as

[3] While multi-level governance, intergovernmental fiscal relations and local democracy are taken as given in most well-established federal and industrialized economies, low- and middle-income countries have less than three decades of experience in these policy settings. There is still a crucial lack of information and fiscal data on these established local governments, both within and across countries.

climatic conditions, which influence energy production and potentially affect night-light intensity.

A potential problem that could undermine the internal validity of the DD is the nature of the communes chosen to initiate the decentralization process. This time-varying selection bias may occur, for instance, if communes that were already on a better economic trajectory were encouraged to be part of the first round. To address this concern, the empirical model includes commune fixed effects, which account for time-invariant confounders such as communes' endowments at the start of the reform, their historical administrative role and influence (as regional capital in particular, cf. Grossman and Lewis, 2014), their geographic characteristics or unobserved political factors (such as favoritism and ethnic distribution for the part that remained stable over the period). Moreover, the parallel trend assumption is verified, which means that the first decentralized and the remaining communes followed the same trend in night-light intensity before the reform. While this is not conclusive evidence that they would follow the same trajectory in the absence of decentralization after 1995, it provides some reassurance that non-decentralized communes can provide a reasonable counterfactual, particularly if they most closely resemble the communes decentralized in 1995. In order to further compare treated and control communes that are most similar, we also suggest DD estimations adjusted by a quasi-matching strategy. Assuming that the matching variables are highly related to unobserved confounders, this approach should reduce the potential bias affecting trend differences between the groups of communes decentralized at different points in time.[4] We also test whether results hold when we include commune characteristics (administrative functions, population size) interacted with time fixed effects or when we focus on more homogenous groups of communes (e.g. provincial communes) while imposing common support.

[4] We assume that this bias can be reduced by conducting the DD in a way that compares treated and untreated communes that are similar in terms of observable characteristics, in the spirit of matching approaches. We do so by applying an inverse propensity score reweighting to capture time-varying differences across communes.

We find a positive and sizable impact of the early phase of the decentralization reform on local development for communes decentralized in 1995 relative to other communes. Even if the results remain suggestive, a battery of alternative estimations – in particular the various robustness checks highlighted above – tend to consolidate our conclusions. Increased luminosity from human activities may reveal the gains from decentralization directly due to electrification and its spillovers in terms of local development but may also be the visible part, with our night-light measure, of more general benefits from more autonomous (but also more accountable) communes. In particular, Schmidt and Moradi (2022), who confirm the strong link between electrification and night-lights in Burkina Faso, emphasize the contribution of electrification to public good provision in different domains.[5] Both to support our main outcome but also to show such a potential extent of the gains of decentralization, we mobilize alternative outcomes, including remote sensing data on built-up settlements (to capture human/economic activity) and the household welfare index from the Demographic and Health Surveys (DHS) (which combines health, education and access to public services). We are relatively limited by data availability regarding communes' fiscal capacities, but available information suggests that the gains from decentralization are associated with communes' ability to generate their own revenues more than their ability to attract national transfers. Commune fiscal capacity is likely to combine faster-growing economies, as supported by evidence on urbanization and household welfare proxies, and the capacity to levy taxes. Finally, we focus on the heterogeneity between communes that were decentralized early. In this group, being regional capitals and benefiting from more political influence seems to provide only a small advantage. Ultimately, the larger gains from decentralization emerge again among those with a greater capacity to raise local resources (more than those better able to attract central government transfers). These results indicate that decentralization did not lift all boats, since only the communes that had the capacity to implement the reform through own-source revenues seemed to experience *effective* decentralization.

[5] In particular, it leads to an increase in infant vaccination rates, electrified schools, drinking water provision and financial inclusion, including for households that do not have an electricity connection.

The rest of the paper is organized as follows. Section 2 provides an overview of the background literature and details the institutional context and the decentralization reform in Burkina Faso. Section 3 describes our data and methodology. Section 4 presents the empirical results, first in graphical form, then with the complete set of estimations. Concluding remarks are found in section 5.

2. Background Information

2.1 Existing Literature and Contributions

Theoretical Advantages of Decentralization. Oates (2005) provides a seminal summary of the theoretical advantages of decentralization. The mechanisms through which the reform can be beneficial are manyfold. First, local governments may have an informational advantage (principle of proximity), i.e. a more holistic understanding of the needs and preferences of their constituents. Hence, by bringing political decision-making closer to the citizens, decentralization is argued to reduce information asymmetries, thereby improving the adequacy of public policies.[6] There are pragmatic advantages to decentralization related to this proximity argument, whether it means informational advantages of local governments over central authorities to better target social programs (Alderman, 2002, Galasso and Ravallion, 2005) or a sense of accountability that should lead to more efficient public service delivery (Prud'homme, 1995, Seabright 1996). Second, there is a possible mechanism associated with Tiebout (1961)'s "voting-by-feet" argument, according to which preferences for public goods can be revealed through inter-jurisdictional self-sorting, leading to the optimum provision of local public goods. This could give rise to competition among local authorities as they attempt to attract and retain mobile tax bases. Some have argued that the Tiebout rationale for decentralization does not apply to developing economies because there are limits to mobility (see the discussion

[6] Several empirical studies have corroborated these arguments by highlighting the informational gain resulting from decentralization which allows public policies to be more in line with local needs (e.g. Bird and Rodriguez, 1999, Faguet, 2004, Galiani et al., 2008, Enikolopov and Zhuravskaya, 2007).

in Gadenne and Singhal, 2014) and insufficient preference differentiation (e.g. Smoke, 2001). Third, `yardstick' competition may exist through the ability of citizens to compare politicians across jurisdictions and operate even in the absence of population mobility.[7] There is only limited evidence on the different mechanisms described above in the context of developing countries. A few studies examine fiscal competition and yardstick competition between districts after decentralization reforms.[8]

Empirical Evidence of Positive Effects of Decentralization in Developing Countries. More generally, several empirical studies corroborate the hypothesized gains from decentralization by studying the positive impacts in *specific domains* or the *specific components* of decentralization reforms that may improve socio-economic outcomes. For instance, decentralization has proven to positively impact educational outcomes in Bolivia (Faguet, 2004) and Argentina (Galiani et al., 2008), yet sometimes in an unequal way. Positive effects have also been evidenced regarding health outcomes in Argentina (see Habibi et al., 2003), health services in Honduras (see Zarychta, 2020), and other countries (see Robalino et al., 2001, for a cross-country analysis). Decentralization has been shown to increase overall social spending (for Eastern Europe, see del Granado et al., 2018) and foster better targeting of the lower-income thresholds of the population (e.g. Alatas et al., 2012, in Indonesia; Alderman, 2002, in Albania; Bardhan and Mookherjee,

[7] With yardstick competition, voters penalize their governments in the electoral process based on a comparison with neighboring jurisdictions, while representatives attempt to stay in power by mimicking the policies of their neighbors (Besley and Case, 1995).

[8] See Arze del Granado et al. (2008), for Indonesia, and contributions in Faguet and Pöschl (2015 eds), for instance for the Philippines and China. Some authors suggest that greater local discretion in China in the 1980s has boosted local economic performance and thereby fostered the country's economic boom (Montinola et al., 1995; Jin et al., 2005; Caldeira, 2012), or point to the existence of strategic complementarity in public spending across jurisdictions (Caldeira et al., 2015, for Benin). The role of information in improving government accountability is also studied (voters can use information on outcomes in neighboring jurisdictions to infer the performance of their local politicians), for instance by Ferraz and Finan (2008) for Brazil and Reinikka and Svensson (2011) for Uganda.

2005, 2006, in West Bengal; or Galasso and Ravallion, 2005, in Bangladesh). [9] Decentralization can reduce poverty through increased capital stock in rural areas, pro-poor investment into rural infrastructure and better designed projects, especially when these projects are informed by local knowledge and local representation (for Cambodia, see Boret et al., 2021). Regarding *Africa* in particular, there are still few studies questioning whether decentralization improves the well-being of households and communities, which is an extra motivation for the present paper. Caldeira et al. (2012) show that decentralization, as measured by the percentage of own sources in total local government revenue, contributes to poverty reduction by improving household access to essential public services in Benin. Sanogo (2019) denotes a positive effect of revenue decentralization on access to public services and poverty alleviation in conflict-setting Cote d'Ivoire. Livingston and Azfar (2010) show that through decentralization, better targeting for public goods delivery seems to be achieved by local governments in Uganda.

Difficulties surrounding Decentralization. Some evidence also shows that decentralization comes with a series of problems. An organization fragmented into various small-scaled sub-national administrative units is sometimes less capable of providing large-scale public goods, does not benefit from economies of scale and is associated with lower local government capacity (Billing, 2019), including a lack of the resources necessary for an effective decision-making process (Grossman et al., 2017). Coordination failure may also arise regarding regulation and taxation-settings when too many jurisdictions compete to attract foreign investors (Kessing et al., 2007). Inversely, decentralization may cause inefficiency due to overlapping functions, over-regulation and over-taxation (Kalamova, 2008). Finally, there is a risk of rent-seeking by local officials with devolved authority and of an elite capture of local governments (Bardhan, 2002).

[9] See the enlightening surveys and discussions by Channa and Faguet (2016), Gadenne and Singhal (2014) or Bardhan (2002). At micro level, some papers also report general outcomes such as the impact of decentralization on citizens' satisfaction or trust in governments (for the OECD and EU countries, see for instance Ligthart and van Oudheusden, 2015, and Diaz-Serrano and Rodríguez-Pose, 2015)
Note that there is also a large literature on the effects of decentralization on countries' macroeconomic performance (see Martinez-Vazquez et al., 2017, for a review).

These aspects contribute to the growing literature pointing to the limitations of political and economic reform in sub-Saharan Africa in general and of reforms leading to administrative unit creation specifically, which highlights that fragmentation may be exploited for political reasons and lead to re-centralization (Grossman and Lewis 2014). Closer to our demonstration, the literature also points to the potentially unequal effects of decentralization in poor countries (Prud'homme, 1995 and Manor, 1999; West and Wong, 1995; Galiani et al., 2008; Caldeira et al., 2012).

Evidence on Decentralization based on Quasi-experiments. Decentralization and territorial reforms are often uniform, leaving limited scope for counterfactuals among jurisdictions within a given country. Closer to us, several studies have used natural experiments to elicit the impact of decentralized governance in low- or middle-income countries. Faguet (2004) finds that the 1994 decentralization reform in Bolivia was associated with a large increase in reported local public investment in education and health. Faguet and Sanchez (2014) exploit the gradual nature of the decentralization process in Colombia to assess its effect on access to health and education. Kis-Katos and Sjahrir (2017) study the 2001 expenditure decentralization in Indonesia, which created two new layers of subnational governments and led to higher investments in public infrastructure in districts that had little infrastructure to start with. Galiani et al. (2008) use a difference-in-difference type strategy to examine the effects of a school decentralization program in Argentina and find improvements in test score performance on average, although these gains are concentrated in non-poor municipalities. Malesky et al. (2014) exploit the re-centralization of Vietnam – namely, the abolition of the elected district councils based on defined criteria – as a quasi-experiment to assess the impact of centralization on public service.[10] Using historical data, Cheng et al. (2020) show that past

[10] Several papers exploit time and province variation in fiscal discretion in China, namely the province-managing-county reform whereby counties move upwards in the vertical ladder (becoming directly managed by the provinces instead of the prefectures). This reform has resulted in the flattening of the government structure and led to more fiscal autonomy of these counties (Jia et al., 2020), to a lower share of spending on education (Wang et al., 2012), and to a misuse of funds and corruption (Bo et al., 2020, and Li et al., 2016).

wars within China have enhanced state capacity, notably by improving local governments' ability to collect taxes, which in turn drives local public goods provision and economic performance. Zarychta (2020) takes advantage of an unexpected pause in reform implementation in Honduras to investigate the effects of decentralization on local health services. Cortes et al. (2010) and Khanna (2023) use the eligibility threshold to evaluate the impact of increased local responsibilities for educational programs on education outcomes in Colombia and India, respectively.[11] In the African context, the present paper stands as the first to assess the impact of decentralization on socio-economic development using a quasi-experimental design.

Night-light Data, Electrification and Development. Given the recourse to remote sensing data in this study, it is important to validate its use as a proxy for development. Indicators measuring gross domestic product (GDP) or economic activity at the sub-national level in low-income countries are limited or non-existent. Several studies in economics or political science overcome this limitation by using remote sensing measures and in particular geo-localized night-time light density as a proxy for economic activity in local communities. Early evidence shows a strong correlation with economic development at the supranational level.[12] More recent studies corroborate the positive

[11] For richer countries, Myck and Najsztub (2020) explore the implications of the Polish administration reform of 1999, which reduced the number of regions from 49 to 16 and thus increased the distance between communes and their regional administrative capital, on socio-economic indicators. Exploiting the spatial decay of communes vis-à-vis their provincial capital, they find no evidence of slower socio-economic development for communes at the periphery. For Switzerland, Flèche (2021) uses variation in tasks and responsibilities of local governments across cantons and points to the detrimental effect of centralization on well-being and political/civic participation.

[12] Donaldson and Storeygard (2016) provide a comprehensive review of the use of satellite data in different areas of economics including growth, development, regional and environmental economics while Gibson et al. (2020) discuss when this type of data can be appropriately used. Elvidge et al. (1997) was the first paper to analyze the relationship between night-time lights and economic activity, studying the connection of luminosity with population, GDP, and electric power consumption for 21 countries at different levels of economic development, during the period 1994-1995. Henderson et al. (2012) used panel data of GDP and night-light intensity between 1992-93 and 2002-03 to proxy income growth and check how it is affected by malaria in sub-Saharan Africa.

correlation between night-light intensity and economic and human activities also at the subnational level (e.g. Sutton and Costanza, 2002; Mellander et al., 2015; Bruederle and Hodler, 2018; Guerrero and Mendoza, 2019), including welfare measures reported in the DHS (Weidmann and Schutte, 2017). Several studies also use nighttime lights as a development proxy to study phenomena such as favoritism (i.e. the economic advantage of the birthplace region of political leaders, cf. Hodler and Raschky, 2014), ethnic inequality (Alesina et al., 2016) and the impact of sub-national government quality (Iddawela et al., 2021) in Africa. Importantly for us, several studies demonstrate that night-time light density is closely related to electricity consumption and is regarded as such as an indicator of economic development (Elvidge et al., 2012; Henderson et al., 2012; Keola et al., 2015). Indeed, it is complementary to the broad literature on electrification, which is shown to contribute to -and coincide- with local development (see Schmidt and Moradi, 2022, for a recent account and new evidence for Burkina Faso).

2.2 Institutional Context and Legal Background

Context. Similar to other French-speaking West African countries, Burkina Faso had placed decentralization as a means of enhancing economic development and ensuring a more inclusive management of public affairs (Dafflon and Madiès, 2013). The implementation of the decentralization reform was rolled out in three phases over 10 years. Before the reform became effective, the Constitution of 1991 had prepared the ground. [13] Articles 143-145 of the Constitution established the current multi-level governance structure and set the basis for self-administration of local units (*collectivités territoriales)* and local democratic participation. The reform was designed and implemented gradually, aiming to grant all stakeholders the time and means to adapt to

[13] See Appendix A for historical context on decentralization in Burkina Faso. In summary, the proposals for decentralizing Burkina Faso are in fact much older, dating back to the colonial period and the aftermath of independence. Yet pre-1991 attempts did not lead to the practical implementation of decentralization. At best, the country experienced a de-concentration with appointed leaders overseen by central authorities. As such, formal public sector decentralization, as studied in this paper, was novelly designed and, both de jure (through various legal texts) and de facto, implemented throughout the country from 1995 onwards.

the new mode of governance (Champagne and Ouedraogo, 2008).[14] In Appendix A, **Table A1** provides a brief chronology of the reform steps and highlights the fact that the phased roll-out of the reform effectively resulted in three waves of decentralization of the communes.

The Phased Roll-out of Decentralization Reform. To begin with, a set of decrees and laws were enacted to operationalize the prescriptions of the Constitution and adopted by the parliament in 1993. These introduced guidelines for territorial administration and local governance, and outlined the special status of the communes of Ouagadougou and Bobo-Diouslasso (respectively the capital and second-largest cities – in practice, the administrative and economic capitals). These legal provisions materialized two years later, *in February 1995, with the first wave of decentralization*, i.e., the organization of local elections in 33 communes, the establishment of local councils, the transfer of competencies to local authorities, and the initiation of the reform's expansion to the entire country. In 1998, the government adopted a series of legal provisions that further defined territorial governance, the organization and functioning of decentralized communes and competencies of different tiers of authority across the vertical spectrum of the public sector. The reform implied significant changes in the country's governance structure as it marked the initiation of local democracy, the transfer of administrative roles and resources to local authorities, and the formal establishment of intergovernmental fiscal relations. Subnational governance was further strengthened through these legal provisions with the introduction of *16 additional decentralized communes in September 2000*, resulting in a total of 49 self-governed units, following local elections held that year. Lastly, the decentralization reform was *expanded to the entire territory in 2005*, with the effective creation of 321 additional communes. The 2006 general elections were a turning point as communes and regions were fully integrated into a democratic electoral process for the

[14] As mentioned in the introduction, it was anchored in a global trend to modernize the public sector in developing and emerging economies in the late 1990s and early 2000s (Vaillancourt and Bird, 1999; Martinez-Vazquez and Vaillancourt, 2011). The process also mobilized national and international actors that contributed to level-up public debates and provided the financial means at every stage.

first time in the country's history. The decree passed in 2009 was another important step towards fiscal decentralization by pushing forward the prerogative of communes (Englebert and Sangaré, 2010).

2.3 Criteria for Early Decentralization and Communes' Characteristics

Decentralization Criteria. Officially, the decentralization process in Burkina Faso prioritized communes that fulfilled two criteria: having a population size of at least 10,000 inhabitants and a municipal budget of at least 15 million CFA francs (around 24,000 USD) (Ouédraogo et al., 2009). However, as shown below, the population criterion was not really a binding constraint (only 11.6% of all communes in 1995 were below the population threshold) and the budget criterion was not respected in practice: very few of those that joined the reform in the first two waves had complied with the minimum local budget requirement. What seemed more relevant in the selection process was the administrative functions. Out of the 33 early decentralized communes, 13 were the regional capitals of Burkina Faso (and simultaneously provincial capitals), while 18 others were provincial capitals. The remaining two communes, Pouytenga and Niangoloko, were none of these but had their own economic dynamics, as described below. Thus, in our attempt to capture the effect of decentralization, a possible confounder is the mere choice of some communes as the go-first due to their pre-existing administrative power, especially if these communes were likely to follow a specific development path in the absence of reform (internal validity issue) or likely to benefit more than the average from decentralization (external validity issue). In what follows, we closely explore the interplay between the territorial-administrative function of a commune and the reform itself to try to mitigate these central concerns.

Communes' Administrative Functions and Hubs. A first attempt in this direction is to provide descriptive information about these functions and examine whether the regional or provincial administrative roles were likely to bring more power and, hence, access to transfers from central government to these communes. In fact, administrative texts convey that even though provincial capitals have official representatives (known as high

commissaries), they are merely administrative intermediaries between the communes and the regions and do not benefit from much political leverage at the central level (Ouédraogo et al., 2009). The 13 regional capitals, on the other hand, are represented by a governor at the national level and have potentially more influence on the decisions regarding central funds and public investments. Beyond the ability to attract state transfers, another key criterion is the ability to generate resources locally and to collect taxes. In francophone systems, the Ministry of Finance plays an important role in collecting revenues and disbursing resources for communes. The fact that the Ministry is present in regional capitals (but not in other communes) could have helped them process revenue collection or disbursement requests (Mahieu & Yilmaz 2010). Finally, another aspect is the mere capacity to generate resources. The two communes decentralized in 1995, which were neither regional nor provincial capitals but met the population and budget criteria, were major economic hubs in Burkina Faso. Pouytenga is the fourth largest city and a center for trade (imports) and commercial activities (including livestock). Niangoloko, is a border city between Cote d'Ivoire and Burkina Faso, thus a crucial entry point for this landlocked country. As confirmed by our empirical analysis hereafter, the economic and strategic relevance of these communes has turned them into priority localities in the decentralization process as they had demonstrated the capacity to leverage their own resources and handle decentralized fiscal responsibilities.[15]

The Dispersion of Communes in terms of Population and Budget. In **Figure A1(a)**, in Appendix B, we visualize this dispersion for the year 1995. Note that here and for most of the outputs presented in the paper, we tend to exclude Ouagadougou and Bobo-Diouslasso: as administrative and economic capitals, these cities benefit from a specific administrative status and are directly related to central power, by definition, so that they are not relevant for an analysis of decentralization. More generally, they are clear outliers

[15] Note that some of the later decentralized communes – Bittou and Garango – were also economically strong. Similarly, to Niangoloko, Bittou is a border city between Burkina Faso and Ghana, and is therefore of commercial and strategic interest. Garango, became an economic hub as a direct result of foreign investment and remittances, mainly from Burkinabe migrants in Italy, a large portion of which are from that specific region (cf. Hazard, 2004).

on many dimensions (here in terms of population size, for instance). In terms of information, population size is recorded for all communes. Yet, fiscal capacity (including own-source revenue and transfers from central government) is available for all years only for the early decentralized communes, and in later years for a third of the other communes. Hence, for the latter, in order to compare all communes, we report the result of an imputation method.[16] The graph shows the 13 regional capitals in dark blue, which are also provincial capitals and were decentralized first. Among provincial capitals that were not also regional capitals, 18 were decentralized in 1995 (light blue) and the other 13 in 2000 (red). Other, late decentralized communes are in small pink circles. We see that there is a lot of dispersion among decentralized communes, as much as among non-decentralized ones, and that the two groups are not completely different. Admittedly, regional capitals (and, to a lesser extent, provincial capitals) tend to be larger than other communes, but there is an overlap with other communes. In particular, some of the regional capitals and many of the provincial capitals decentralized in 1995 have fewer than 50,000 inhabitants, as can be seen in the focus of **Figure A1(b)**. Some of the provincial capitals are small and tend to be close to the average of the communes decentralized last.[17] **Figure A1(a)** shows that many decentralized capitals had large fiscal capacities but not all: many fall below the budget threshold (horizontal dashed line). This diversity is important for our empirical demonstration: it tends to indicate that there may be enough *common support*, at least along population and budget dimensions, for fruitful comparisons between communes. We shall enforce this proximity in our robustness checks by means of matching techniques. **Figure A1(c)** completes this description and conveys that there is also a geographical common support: indeed, communes decentralized in 1995 are not

[16] It is based on a regression of fiscal capacity (for available communes) on a set of relevant variables, which include demographics (population), geographic data (elevation, distance to coasts, borders, roads and large cities) and the average distance to natural resources (gold, gems, water, onshore petrol) and infrastructure/trade (distance to coasts, borders, roads and large cities).

[17] Historical criteria for a commune to become a provincial capital were a population size of at least 25,000 inhabitants and a fiscal capacity above 25 million CFA francs (Article 19, *Code général des collectivités territoriale*s).

concentrated in a specific area, nor disproportionately urban. They are often close to other communes that are part of the later decentralization waves while being similar in terms of administrative status (provincial capital). Ethnic borders cover broader areas that also contain a diversity of communes in terms of decentralization status and administrative function (note that ethnic groups are implicitly included in communes' fixed effects in our estimations).

2.4 Mechanisms: The Implications of Decentralization

The reform had significant implications for decentralized communes, which can explain the mechanisms behind the empirical findings.

General Implications. First and foremost, these implications were political, with the organization of local democratic elections and the establishment of local councils. If political decentralization lowers the costs of organizing collective action, it increases the probably of Pareto gains being realized. Also, the administrative benefits that may result from decentralization materialized with a new organizational structure, the creation of legislative bodies and coordination with central authorities. These benefits may have showed up in improved matching of public goods provision to local preferences.

Concrete Implications for Public Good Provision and the Private Sector. Communes were effectively put in charge of various tasks, such as the management of land and urban planning and natural resources, health services and hygiene, education and vocational training, culture, civil protection, assistance and reliefs, water management, electricity and public lighting (OECD and UCLG, 2019). In addition, there were important fiscal implications: communes were granted revenue-raising powers from local taxes, user fees and charges, as well as fiscal transfers from the central government. A particular aspect is also that autonomous local authorities may be more reactive in times of hardship. This aspect is rarely explored in the literature but is possibly relevant in our case. As we shall see, the first benefit of decentralization in Burkina Faso might have been a lesser degree of shrinkage during the late 1990s and early 2000s, i.e. a stronger ability to mitigate worse economic conditions of that time in early decentralized communes.

Electricity and Decentralization. More directly related to what we observe as the primary outcome, luminosity from nighttime lights, is the question of electrification. In Burkina Faso, electricity supply relies on importations (from Ivory Coast and Ghana in particular), thermal-fossil fuel (28 power stations, 70% of total supply) and hydropower (4 hydropower stations). The main supply strategy is to establish interconnections with neighboring countries and to extend and repair the existing network. Before decentralization, electricity management was a prerogative of the central state, but even then, the responsibility was shared between the state, represented by a national company (SONABEL) in charge of implementing energy policy and planning of the electrification strategy, and local actors. After decentralization, it is expected that communes will have gained more decision power in the electricity supply of their territories. They officially became in charge of creating and managing energy infrastructure, public lighting and the hydraulic sector.[18] In addition, their capacity to incentivize private investments may also result in a fast increase in private equipment such as generators and solar panels.

Treatment Effect. Changes in night-light intensity must therefore capture a double effect in our empirical work: the direct contribution of decentralization to development via the public (co-) provision of energy-related infrastructure and the impact of decentralization on private investment (which results in private sources of electrification). Yet it is interesting to note that luminosity is the 'visible part' of the decentralization gains, which may also pertain to the new prerogative of communes in different domains highlighted above (health, sanitation, education, etc.). Thus, we shall provide additional results based on other outcomes aimed to capture human activities and access to public goods and services.

[18] Note that these aspects are relevant for both urban and rural areas. Access to basic public services, and in particular, public lighting is often a co-responsibility between the central state and local administrations in both areas. While growth in rural areas does not always translate into more light, public lighting remains an indicator of the quality of decentralized public services. Electrification is a major development issue (via its effects on education, in particular) and, in this respect, measuring the effect of decentralization on lighting seems relevant even in rural areas.

3. Empirical Framework

3.1 Empirical Model

Specification of the Difference-in-difference (DD) Approach. We adopt a DD strategy using a comprehensive panel dataset. We focus on night-light intensity as a proxy for local development between 1992 and 2005, our key outcome of interest. As discussed previously, the selection of communes at each stage of the reform "phase-in" was not random. Therefore, the main challenge is to correct for the selection into the reform, i.e. to account for differences between decentralized and non-decentralized jurisdictions that could have influenced the outcome. The DD identification strategy makes it possible to correct for the initial difference in local economic development and thus estimate the differential changes in outcomes across communes before and after each wave of the reform. In technical terms, we estimate the following equation in which y_{it} is the outcome variable, i.e. night-light intensity for commune i in year $t = 1, \dots, T$:

$$\log(y_{it}) = \alpha + \beta \mathrm{D}_i^{1995} \mathrm{POST}_{it} + \theta_t + \eta_i + \rho x_{it}^{'} + \varepsilon_{it} \qquad (1)$$

with D_i^{1995} a dummy variable equal to 1 if the commune i belongs to the group of communes decentralized in 1995 and POST_{it} a dummy equal to 1 if the observation is post-1995. We also include θ_t, which denotes time fixed effects, implicitly accounting for time variation that is common to all communes, for instance, broad climate conditions or other, nationally applied policy measures.

Importantly, η_i represents the fixed effects (FE) for communes and accounts for their background conditions, such as initial size, the extent of urbanization, administrative status and initial fiscal capacity. It also critically captures the time-invariant factors, broadly unobserved, that may help explain why a commune has eventually been chosen to be among the first to be decentralized. As explained, some of it is related to their administrative roles (regional provinces) and their economic and fiscal capacity (hubs). Other factors may play a role in general; for instance, geographic characteristics (such as land-use) and political and cultural factors (including favoritism by the central power

towards specific regions and ethnic influence, cf. Hodler et al. 2014; Alesina et al. 2016). In our context, none of these other factors changed over time in a significant way so they tend to be captured by communes' FE. In particular, we have verified that cross-region ethnic composition remained stable (Harsh, 2017) as di the ruling government (presidency of Blaise Compaoré throughout the period) and the structure of the party system (Riedl and Dickovick 2014).

We also control for a vector $x_{it}^{'}$ that accounts for communes' time-varying characteristics, such as local weather conditions; these variables further capture cross-commune variations, improve precision and reduce bias in the coefficient estimates. As further discussed below, they are important given the nature of our outcome. Finally, in order to check if the decentralization effect is robust to time trends that could be specific to certain communes, and in particular the decentralized ones, we suggest specifications where key commune characteristics $z_i^{'}$ (such as communes' administrative functions or initial population size) are interacted with POST_{it} or, in a more flexible way, with time fixed effects. All estimations are clustered at the commune level to account for auto-correlation.

Parallel Trends. The coefficient of interest is β, i.e. the DD estimator of the early decentralization phase, derived from the comparison between changes in the outcome variable for early decentralized and non-decentralized communes in pre and post-policy periods. We will do so when focusing on the 1992-2000 period, i.e. before any other commune is being decentralized. Since identification hinges on the assumption that the change in outcome experienced by control units is a good proxy for the outcome change experienced by treated units in the absence of treatment, that assumption must be checked for years where no one is treated, i.e. a check of common trends before the first decentralization of 1995.

Handling Multiple Treatments and Periods. Using several years of data makes our approach a two-way fixed effects (TWFE) linear regression. Recent methodological papers characterize the potential issues surrounding TWFE with multiple time periods and multiple treatments (e.g. Callaway and Sant'Anna, 2021; Goodman-Bacon, 2021; de

Chaisemartin and d'Haultfoeuille, 2020; Sun and Abraham, 2021). One issue addressed in this literature is the *cross-unit heterogeneity* of treatment. We focus on the outcome path of the 1995-decentralized communes and discuss extensively why the decentralization `effect' may or may not generalize to the rest of the country. Other issues include the *time-heterogeneity* of treatment and the *use of units that eventually become treated as control groups*. When focusing on the period 1995-2000, our setting is a standard, two-period DD. When extending to 1995-2005, we try to capture longer-term effects and check if there is an increasing advantage of early decentralization (for instance if the 1995-decentralized communes make the most of increased transfers of responsibility at later stages of the process in the 2000s). We also acknowledge that a small group of communes decentralized during an intermediary wave in 2000, which might slightly perturbate the control group as some units become treated. To address this, we suggest additional estimations where we explicitly account for the two types of treatment, using additional years of observation post-2000, namely the model:

$$\log(y_{it}) = \alpha + \beta^{1995}\mathrm{D}_{it}^{1995} + \beta^{2000}\mathrm{D}_{it}^{2000} + \theta_t + \eta_i + \rho z_{it}^{'} + \varepsilon_{it} \qquad (2)$$

with D_{it}^{k} the treatment dummy variable equal to 1 if the commune i belongs to the group of communes decentralized in year *k=1995,2000* and is observed after that year.

Inverse Propensity Score Reweighting. To slightly enhance the DD set-up, we also suggest a propensity score approach. It aims to reduce unobserved time-varying differences between early and late decentralized communes that could confound our results. For this, we are going to mobilize a set of variables $m_{it}^{'}$ that are assumed to be correlated to some extent with time-varying confounders and that allow comparing sub-groups of treated and control communes that are more alike. For example, we might overstate the benefits of decentralization if large communes were the ones that were decentralized first and, at the same time, are the ones that benefit from more dynamic development trends and/or have more political leverage to attract transfers from the central government. Assuming that these unobservable advantages are correlated with observable characteristics (e.g. population size), we can reduce the bias by comparing

treated and control communes that are most similar along a relevant set of observed characteristics of that sort. A well-known approach would consist of matching early decentralized communes with other communes on the basis of these factors. To address the multi-dimensionality issue, we rely on a propensity score (PS) version of the matching strategy in the context of DD. The PS, denoted p hereafter, is obtained as the prediction of a first-stage estimation of a "1995-decentralized" dummy on the set $m_{it}^{'}$ of relevant variables, including key demographic dimensions (population size), geographic characteristics (elevation, distance to the coast, to large cities and to a border) and economic dimensions (access to natural resources including gold, diamonds, gems, onshore petrol). To consider treated and untreated communes that are more similar to each other according to these different criteria simultaneously, we reweight observations using the inverse PS.[19] Namely, we carry out estimations that account for the following weights: $1/\tilde{p}(m_{it}^{'})$ for early decentralized communes and $1/(1-\tilde{p}(m_{it}^{'}))$ for the other communes.[20]

3.2 Data Sources and Key Variables

Main Outcome Variable: Night-time Light Density. We use satellite data on nocturnal light intensity provided by the U.S. Air Forces Defense Meteorological Satellite Program (DMSP) as a proxy for local development in Burkina Faso. The indicator is derived from the average visible band digital number of cloud-free light detections, weighted by the percent frequency of light detection to normalize for variations in the persistence of lighting. For instance, the value for light only detected half the time is discounted by 50%. The quality is such that the effects of cloud cover, ephemeral lights and other noises carry

[19] The approach is suggested by Abadie (2005) for DDs. Smith and Todd (2001) also combines DD and matching techniques. An inverse PS reweighting approach is suggested by Hirano, Imbens, and Ridder (2002) in a general context.

[20] In this way, the modified estimation gives more weight to the late (early) decentralized that are most similar to the early (late) decentralized. We will also explore the heterogeneous impact of the reform by explicitly zooming on groups with similar characteristics (e.g. treated and control communes with high wealth).

sensors that detect light emission from the Earth's surface at night can be neutralized (Mamo et al., 2016). Their spatial resolution makes it possible to obtain a reliable indicator of economic development for subnational units in Burkina Faso. The night-time light density data covers annual averages for the period 1992-2010, providing comparable data points for before and after each of the major waves of decentralization.

Alternative Outcomes. We also leverage alternative outcomes aimed to proxy urbanization and economic development. The first stems from remote sensing data from the Global Human Settlement Layer (GHSL). Gathered by the European Union Joint Research Center (see EU JRC, 2023), this data aims to proxy urbanization level and city growth at the commune-level worldwide and can be used for Burkina Faso. Using imagery from Landsat and Sentinel-2 satellites, the GHSL provides detailed information on built-up surfaces in 5-year intervals from 1975 to 2020. Built-up settlements are defined as above-ground constructions intended or used for the shelter of humans and animals, as well as the production of economic goods or the delivery of services (Kemper et al., 2021), hence include road, businesses and residential constructions. We extracted the data at the commune level for Burkina Faso and for the period of 1985 to 2010. The second source of alternative outcomes is the DHS for Burkina Faso. DHS surveys are a well-known source of micro data, extensively used in academic research.[21] Data is available for 1993, 1998, 2003 and 2010. The DHS is however not representative at the commune-level: while Burkina Faso has 351 communes, the total number of communes covered by the survey ranged from 112 in 1993 (before the reform) to 261 (the highest) in 2010. Thus, our results will be based on the limited set of communes present at each wave and will therefore be indicative at best.

Control Variables. To the above, we add geo-localized climatic and resource-based information for the communes. These data are gathered and compiled by AidData using official geographical and administrative boundaries of respective localities. We focus on

[21] See https://dhsprogram.com/Publications/Journal-Articles-by-Journal.cfm

variables that are related to climatic and geographical conditions: the average annual temperature and the average annual precipitation. In addition to communes and time effects, these variables $z_{it}^{'}$ control for features that may explain variations in local socio-economic outcomes across communes and time. Above all, they correlate with the level of electricity production and consumption due to hydro-electrical sources (Ouédraogo, 2010); it is therefore important to clean night-light variation from what is due to climatic and geographical conditions.

Other Commune Characteristics. Additional data on population and local public finance were mobilized in **Figure A1** and will be used again hereafter. They are provided by the Treasury of Burkina Faso (*Direction Générale du Trésor et de la Comptabilité Publique,* hereafter DGTCP) for the period under study. As indicated, population data is available throughout, but data on local fiscal capacity is unfortunately fragmented (available all years for those decentralized in 1995 and for later years for the others). Fiscal capacity is decomposed between own-source revenues and intergovernmental fiscal transfers in the total budget of the commune. The different variables used in the empirical work are presented in a synthetic way in **Table A2** in Appendix C.

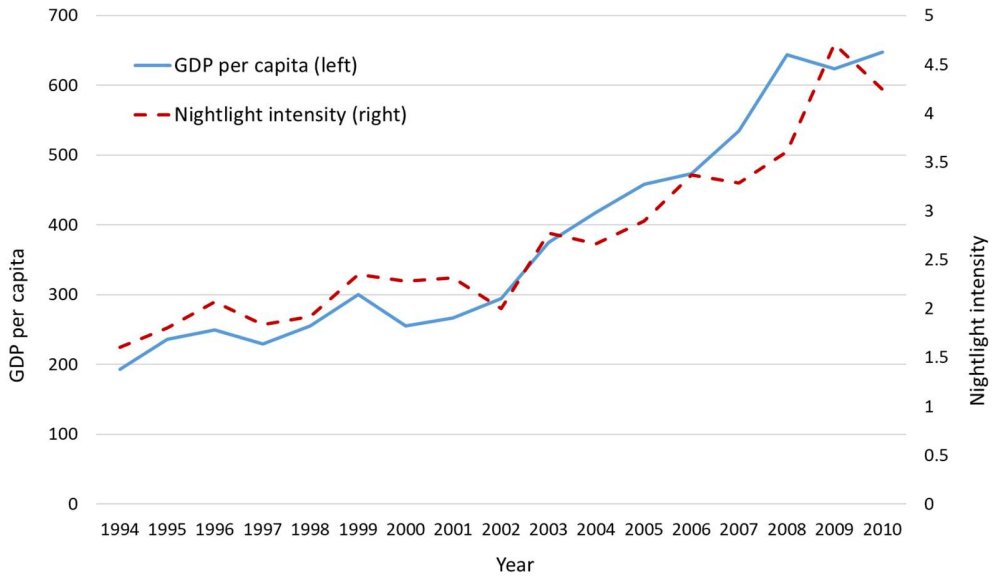
3.3 Discussion and a First Look at Night-light Data

The main justification for our night-light measure is that access to electricity is a key measure of development. We also show that decentralization has possibly been a factor of change in local electricity supply and consumption, reflecting local evolution in terms of economic activity and welfare.

Night-light Density, Development and Climatic Conditions. As noted, night-time light density is closely related to electrification and is regarded as an indicator of economic development (Schmidt and Moradi, 2022). To illustrate this in the context of Burkina Faso, we first check the correlation of night-light density with GDP per capita, which is available only at the national level. **Figure 1** reports trends in GDP per capita (based on the World Development Indicators) and for the yearly night-light data (averaged over all communes, here including Ouagadougou and Bobodioulasso, and weighted by

population size). We observe consistent trends over the period and, in particular, faster growth after 2001. We also regress night-light intensity at the commune level on climatic variables, with estimates reported in **Table A3** in Appendix C. We do so using only (inter-temporal) between-commune variation (column 1) or using also time variation (column 2). In both cases, results are consistent with the discussion above and the fact that communes experiencing less rainfall and higher temperatures suffer more from chronic electricity shortages, which reflects on night-light intensity and is probably a key factor affecting local welfare. The rest of the table points to a strong correlation with alternative development outcomes, which are extensively discussed in the result section.

Figure 1: GDP per capita versus Night-light Intensity



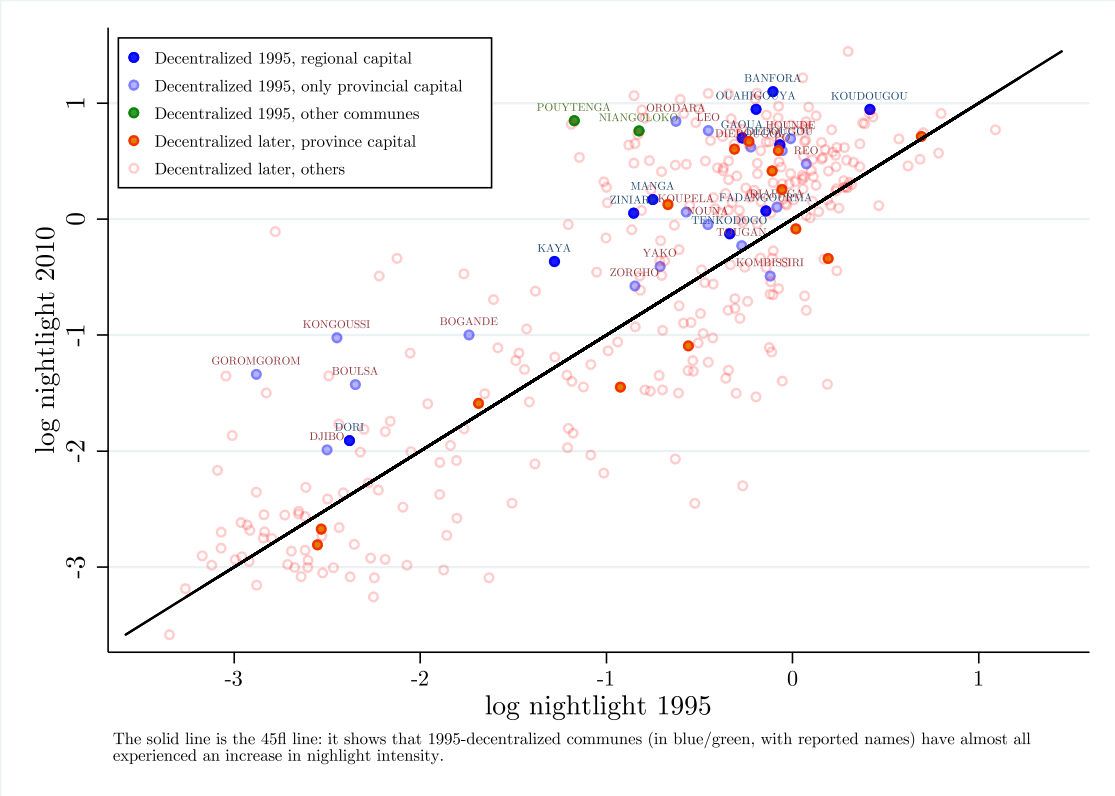
Note: GDP per capita (PPP USD) from the World Development Indicators. Nightlight intensity: DMSP-OLS Night-time lights density corrected for ephemeral events (average over all communes weighted by their population size).

Change in Night-light Density Distribution. A preview of our main results is presented in **Figure 2**. We plot night-light intensity at the commune level for the first year of decentralization, 1995, versus the last available year, 2010.[22] The graph shows that first-wave decentralized communes experience a quasi-systematic improvement in night-light intensity - being scattered almost exclusively above the line - whereas it is not necessarily

[22] Ouagadougou and Bobodioulasso are excluded.

the case for other communes. This is suggestive of the 1995-decentralization effect elicited in the next section. Moreover, this effect seems not to be confined to the communes with local tax capacity and political influence (regional communes, dark blue) or those with a vibrant economy (hubs, in green). Provincial capitals (light blue) also show large improvements, even especially among those with low initial levels of night-light intensity.

Figure 2: Night-light Intensity in 1995 (first Decentralization) and 2010 (End Period) by Decentralization Status



The solid line is the 45fl line: it shows that 1995-decentralized communes (in blue/green, with reported names) have almost all experienced an increase in nighlight intensity.

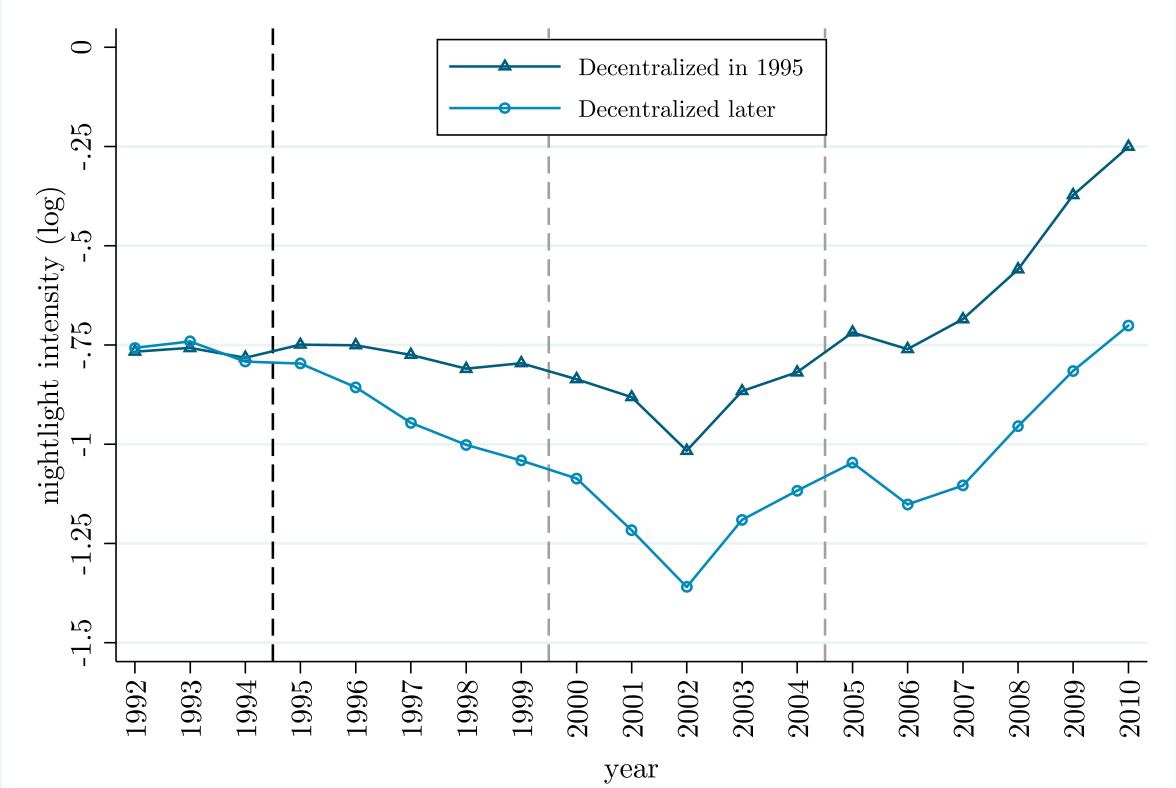
4. Results

We first present graphical results, then move to panel estimations, robustness checks, and heterogeneity analyses. We exclude Ouagadougou and Bobodioulasso in our empirical work: as explained, these two major cities are very specific in a context of decentralization.

4.1 Baseline Graphical Results

We suggest a simple graphical description of the trends in (log) night-light intensity taken as a proxy of local economic development. In **Figure 3**, we compare communes decentralized in 1995 and those decentralized later, taking a long-term perspective (1992-2010). For the pre-reform period, 1992-1995, we observe not only a common trend but also similar night-light levels for the 33 communes decentralized in 1995 and those decentralized later.

Figure 3: Night-light Trends across Decentralization Phases



Moving average nighlight intensity. Dashed vertical lines: decentralization years.

The graph also shows a marked divergence in night-light intensity after the decentralization of 1995. If we focus on the late 1990s and early 2000s, we observe a slow decline for the early decentralized communes but a sharper drop among others. The overall decrease in night-light intensity is consistent with the severe droughts experienced by Burkina Faso in the late 1990s, which have induced a rise in cereal prices, a slow GDP

growth, and an increase in poverty (Traore and Owiyo, 2013), followed by the adverse effects of the crisis in Côte d'Ivoire in 2001-2002. The turnaround after 2002 is consistent with the fast growth in 2003 and the following years, and explained, among other things, by a better climate, very good harvests and a relatively fast reorganization of the country's import and export channels (Grimm and Günther, 2007).[23]

The decentralization `effect', as we interpret it, materializes gradually during the period 1995-2000, i.e. before the later decentralization waves. It does not decrease afterward: the advantage of the 1995- decentralized communes even slightly increases in the 2000s, which could be interpreted as early decentralization helping to better cope with adverse climate and economic conditions or enabling the initial communes to benefit from the ramp-up of the decentralization process (with increased transferred responsibility after the generalized decentralization and specific enhancements such as the 2009 decree, as discussed above).

Alternatively, this is also possibly related to the fact that urban communes decentralized in 1995 had better access to local resources (due to better local economic conditions) or transfers (due to greater political influence), hence more capacity to take advantage of each step enhancing the prerogatives of the communes – a limit to the external validity of our quasi-experiment. It may also be due to better economic trends for these communes, even in the absence of reform, i.e. a threat to internal validity that we investigate in depth in the estimations hereafter. We can actually provide preliminary graphical evidence regarding these concerns. We check heterogeneous trends across communes by focusing on the central factor that influenced the choice of early decentralized communes, namely their political function. Out of 33 initial communes, 13 were the regional capitals, which are represented centrally by a governor defending their interest and may benefit from the presence of the Finance Ministry in their locality. In this way, they may have had a greater ability to attract funding from the central state and manage tax collection. Provincial

[23] Note that these trends differ from the upward trend seen in **Figure 1**, which was merely driven by Ouagadougou and Bobodioulasso.

capitals and other communes also have representatives of deconcentrated structures (high commissioners and prefects), but with less power, as discussed. The two communes that are not regional or provincial capitals, Pouytenga and Niangoloko, are economic hubs and have other advantages, namely a fertile economic environment that helps them rely on their own resources.

Figure 4: Night-light Trends by Decentralization Status and Administrative Role

Moving average nighlight intensity. Vertical dashed: decentralization years.
* Two communes: Niangoloko and Pouytenga

Figure 4 distinguishes night-light trends between these different categories. Hubs (in green) outperform all other communes and do not respect parallel trends before 1995. Thus, they probably follow specific economic paths and should not be considered in our attempt to build relevant control groups to study decentralization. All the other groups show relatively parallel trends before decentralization. Interestingly, despite their administrative advantages and higher initial night-light levels, regional capitals (dark blue) do not display very different trends compared to the early-decentralized provincial

communes (light blue). Remarkably, the latter progress faster than the province capitals that are decentralized later (dashed red line), and to whom they are most comparable, and than other communes (dashed pink line).

4.2 Baseline Estimation Results

We now move to estimations that follow the same logic while controlling for many other dimensions. Baseline DD estimations are reported in **Table 1**. We report estimates of model (1), as well as relative effects based on a regression of night-lights in levels (rather than log) expressed in percentage of the pre-treatment mean outcome. In column (1), we use the first period only (1992-2000) and a DD regression focusing on the effect of the 1995 decentralization wave, as per equation (1), including time and commune FE. All estimations also control for time-varying factors affecting or related to electricity production, namely precipitation and temperature ('climatic controls').

Table 1: Night-light Baseline Estimations

Sample from 1992 to:	2000	2005
	(1)	(2)
Decentralized 1995 x POST 1995	0.224***	0.295***
	(0.064)	(0.078)
Relative to pre-1995 control mean outcome	**14.0%**	**18.8%**
Observations	3,120	4,854
R-squared	0.900	0.897
Year FE	YES	YES
Commune FE	YES	YES
Climatic controls	YES	YES

Estimation of nightlight intensity on a dummy for being decentralized in 1995 and observed post 1995, using different end years. Estimations control for year fixed effects (FE), commune fixed effects and climate variables (precipitation, temperature and vegetation at the time of observation). Robust standard errors in parentheses, clustered at commune level. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

The DD estimate is highly significant, suggesting a positive effect of decentralization. It corresponds to a 14% increase in night-light intensity, interpreted as an increase in local development, for those communes decentralized in 1995 compared to those decentralized

later. If we ignore the group of 16 communes decentralized in 2000 in this estimation, i.e. if we compare the 1995-decentralized to the bulk of communes decentralized in the end, the point estimate and the relative effect hardly change (cf. **Table A4**, column I).

We then extend the period to 1992-2005, in column (2) of **Figure 1**. The estimates are consistent with the graphical results: the decentralization premium for those decentralized first increases slightly, i.e. the relative effects is now 18.8% and may capture slightly longer-term effects of the early decentralization process. Note that the presence of the 2000-decentralized group in these estimations may be an issue for the interpretation of β since this group represents a non-decentralization backdrop for 1992-2000 only. In fact, excluding this small group from the sample leads to a similar estimate, i.e. a relative effect of 18.2% (cf. **Table A4**, column II). The reason is that the intermediary decentralization does not seem to have any effect. To show this, we estimate the model of equation (2), keeping all groups in the estimation and simultaneously testing the effects of belonging to the first and second decentralization waves (compared to being in the third wave). The estimate of β^{2000} is insignificant while the estimate of β^{1995} is very similar to the baseline of **Table 1**, i.e. a relative effect of 18.6% (cf. **Table A4**, column III).[24]

4.3 Robustness Checks and Magnitude and Alternative Outcomes

Robustness Checks. As highlighted before, the main empirical issue pertains to unobservable characteristics associated with the early decentralized communes and potentially responsible for specific time trends in night-light intensity for this group, even in the absence of treatment. In Appendix E (and **Tables A5-A8**), we suggest a series of checks to mitigate this concern, summarized as follows. *First*, by replicating DD estimations for placebo time cutoffs before 1995, we confirm parallel trends between groups of communes. This verification is reassuring, even though it provides only a

[24] The small number of communes decentralized in 2000, the short period before generalized decentralization, and the economic hardships of the early 2000s (as seen in the preceding figures) make it impossible to seriously interpret the insignificant estimates of this intermediary batch of decentralized communes.

minimal test given the short time window available in our data (1992-1995). *Second*, we check the role of commune fixed effects (FE), which aim to account for time-invariant confounders such as communes' geographic characteristics (e.g. border cities, more engaged in international trade and more apt to levy resources), communes' endowments at the start of the reform (including potential development capacity), communes' historical administrative role as regional capital (and the political weight that this may represent), or unobserved political factors (such as favoritism and ethnic distribution, which in any case remained stable over the period). Results are also unchanged with time-varying controls corresponding to climatic factors, which may affect energy provision and night-light intensity. *Third*, augmenting DD estimations with inverse PS reweighting also aims to address potential biases in comparing early and late decentralized communes. Although these communes share common trends, unobserved characteristics might drive distinct economic dynamics post-1995, making comparisons unreliable. To mitigate bias, we reweight observations using a PS predicted on the basis of demographic, geographic and economic variables. Despite differences in PS distributions between groups of communes, there is substantial overlap, and the sample is trimmed to enforce common support. Results show that this reweighting does not significantly alter the estimates. *Fourth*, a more direct way to restrict our DD to communes that are more comparable is to focus on some sub-groups that may be less prone to the selection bias associated with the early decentralization wave. We check this through alternative sample selections, namely keeping communes that are either (i) more similar in size (i.e. enforcing the population threshold), (ii) not border communes (hubs) or, most importantly, (iii) not regional capitals (the latter possibly benefit from specific political and economic dynamics). Alternatively, to the exclusion of these groups, we interact dummies for these excluded communes with the POST variable. We also replicate DD estimates when focusing on provincial capitals, i.e. communes that have much less specific administrative/economic advantages and are largely similar to other communes before reform, notably in terms of fiscal capacity or night-light intensity. Admittedly, province capitals tend to be larger than simple communes, so we also restrict estimations to communes with moderate population

sizes. Our relative effect ranges between 9% and 14% throughout these different specifications but remains significant, bringing some confidence to the results.

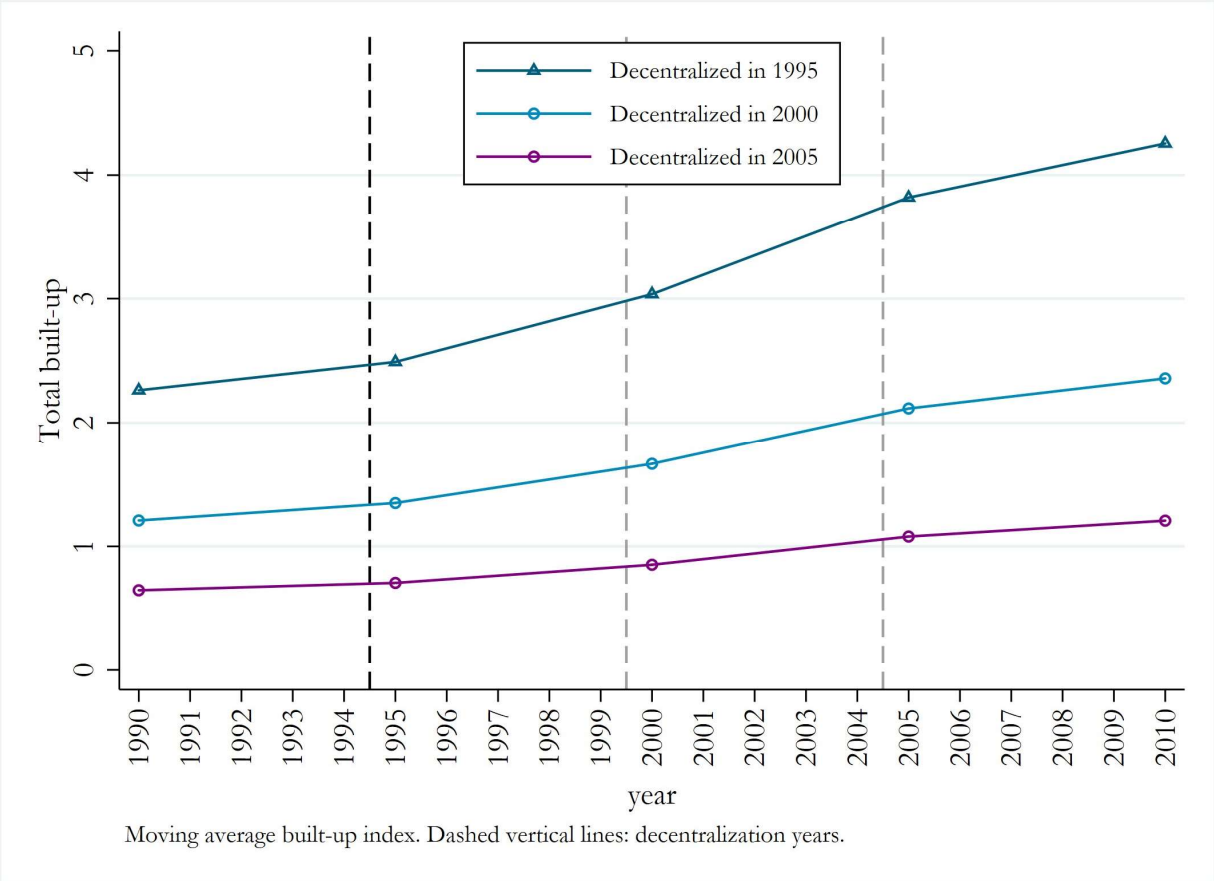
Magnitude. Note that it is difficult to compare the magnitude of these effects to those of the related literature. Indeed, as discussed, the studies using quasi-experimental approaches tend to focus on specific outcomes rather than on a general development measure. Nonetheless, we can report some of the previous estimates. For Indonesia, Kis-Katos and Sjahrir (2017) show that the 2001 decentralization process had moderate or large effects depending on the outcome, for instance, +7% in education and +14% in health care, among localities that had low public infrastructure in the first place. Galiani et al. (2008) find an effect of 4% to 7% of school decentralization on test scores in Argentina. Malesky et al. (2014) find a contribution of 8%-10% of decentralized public services on the access to public transport. Khanna (2023) finds an impact of increased local responsibilities for educational programs of 4% to 11% on the literacy rate. Thus, our most conservative estimates - i.e. a relative effect of 9%-10% on night-light intensity in the short-term - is of a comparable order of magnitude with this literature. One may think that this lowest bound is mostly attributable to provincial capital, which is checked (and tends to be discarded) in heterogeneous analyses below.

4.4 Alternative Outcomes

As discussed, electrification is itself associated with development (see Schmidt and Moradi, 2022) but can be interpreted here as the 'visible' side of the positive effects of decentralization, while other gains are expected, since benefiting communes may have also accelerated their provision of other types of public goods and services (such as better access to health, education and public infrastructures). Thus, we leverage additional data sources to propose alternative outcomes. They provide suggestive evidence only, given their shortcomings as discussed in the data section (shorter periods, which do not allow to check parallel trends, and representativeness issues). Nonetheless, these other outcomes represent an interesting cross-validation with our main night-light outcome

and, in addition, provide concrete information on the implications of decentralization at the local level.

Figure 5: Alternative Outcome: Built-Up Density (Remote Sensing)

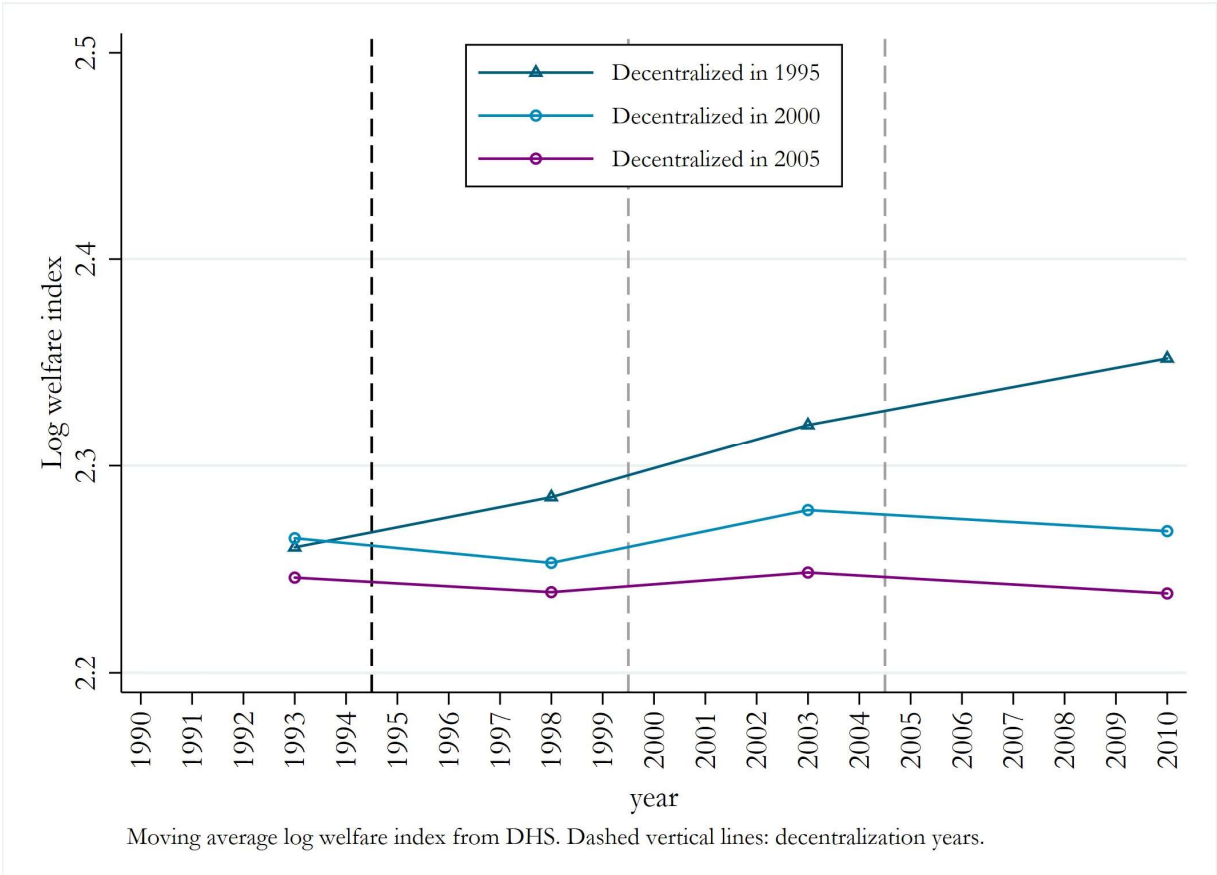


Moving average built-up index. Dashed vertical lines: decentralization years.

Urbanization. First, we leverage remote sensing data from the Global Human Settlement Layer (GHSL), which captures built-up settlements and is used to measure urbanization levels. We do so with insights from the recent literature, as remote sensing data on human settlements have provided a credible alternative source of information to researchers seeking to measure urban and city growth (see for e.g. Rentscheler et al., 2023; Liu et al., 2020). Although differently measured from nighttime light density, we postulate that built-up areas are good proxies for the density of economic activities. We consider the total share of built-up areas (including roads, businesses and residential areas) in each given commune. To facilitate the comparison with baseline results, we present straightforward graphical depictions of this alternative outcome across different groups

of communes based on their decentralization years. **Figure 5** reveals both a parallel trend before 1995 and a higher growth rate in city development post-1995 for the first-wave communes. We also confirm that communes decentralized in 2000 gained only marginally compared to those decentralized last. While this evidence hinges only on a few observations (every five years starting in 1990), it aligns with our findings that the reform primarily benefited those communes that joined during the initial wave. A basic DD calculation points to a relative effect of +25% in favor of the latter when comparing outcomes in 2000 and 1995 (and +10% when comparing those decentralized in 1995 only to those decentralized in 2000).[25]

Figure 6: Alternative Outcome: Log Welfare Index (DHS)

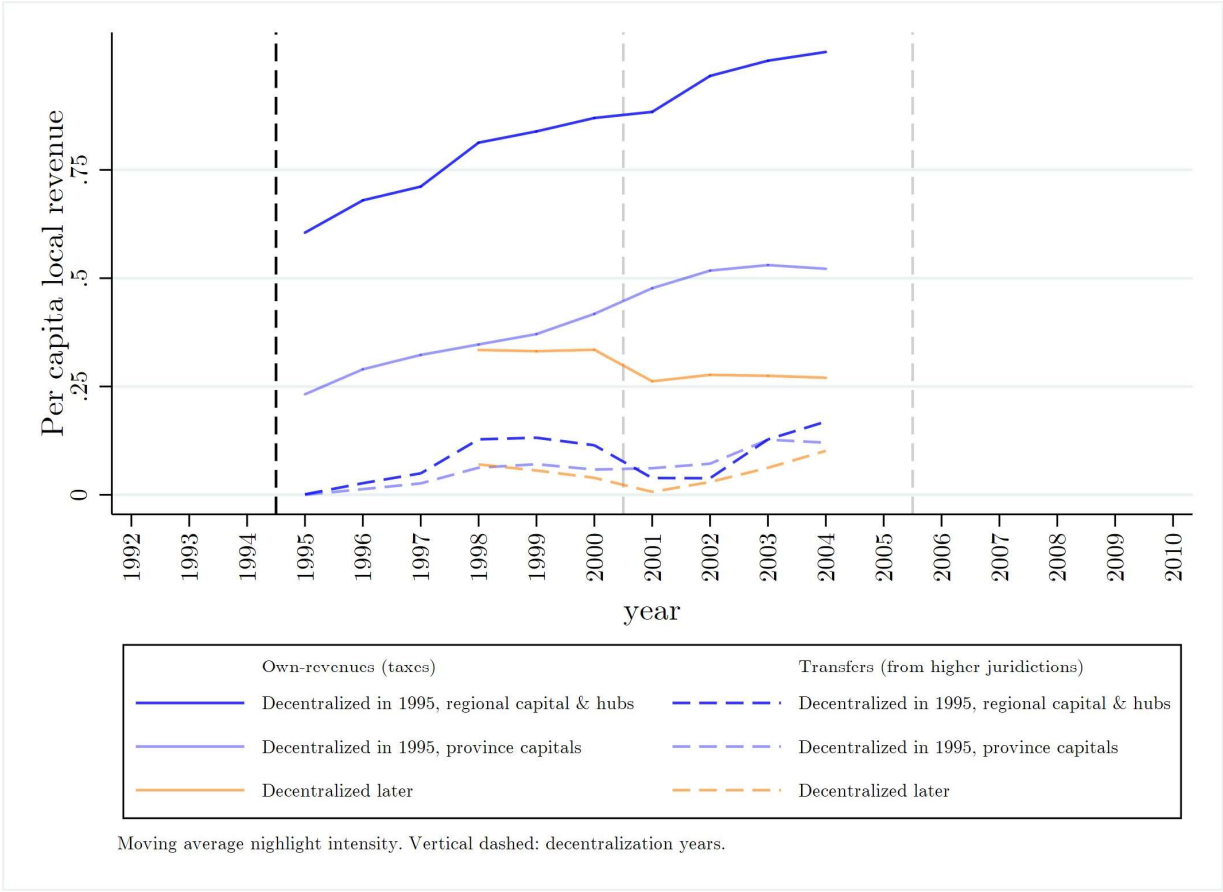


Moving average log welfare index from DHS. Dashed vertical lines: decentralization years.

[25] We also find that the effect is similar both for residential a non-residential areas (the latter corresponding to built-up surfaces such as roads, bridges and similar infrastructure).

Household Welfare. Next, we use DHS data for the subset of communes present at each wave (around 32% of all communes). Despite more limited geographical variation, using DHS is interesting given the availability of a welfare index that combines information on personal assets and access to basic public goods such as water, sanitation, health services and electricity (see its use to study decentralization in Malawi, Nigeria, and Uganda in Grossman, 2017). We report the variation in (log) household welfare at the commune level before and after each wave of the reform. This visualization, shown in **Figure 6**, indicates that households in communes decentralized in 1995 experienced an increase in overall welfare after the reform despite having similar levels in 1993, prior to the first decentralization wave. Again, the intermediary group shows marginal gains compared to the late decentralization communes.

Figure 7: Per Capita Commune Budget (Taxes or Transfers)



Moving average nighlight intensity. Vertical dashed: decentralization years.

Fiscal Capacity. We can also explore the time-variation in per capita commune fiscal capacities, as derived from own-resources (mainly via local taxes and charges) or national transfers. As noted before, this information is fragmented so we used it purely indicatively. It is nonetheless interesting (and we refrain here from using imputed values for missing as we want to compare precisely the different groups of communes on the basis of what is available). As depicted in **Figure 7**, it shows the communes' budgets are derived mainly from their own resources, whatever the timing of decentralization. It also indicates that early decentralized communes – whether they are regional or provincial capitals – benefit from higher levels of per-capita budgets, both in terms of taxes and transfers. Both regional and provincial capitals decentralized in 1995 show fast growths in terms of per-capita own resources while, for commonly available years, other communes show a flat trend (which is also true for other provincial capitals).

Contribution to Night-light Intensity. Again, in a merely suggestive way, we check the contribution of these additional outcomes to changes in night-light intensity by regressing our night-light measure on each of them separately while controlling for communes FE. Results are reported in **Table A3**. Given communes FE, estimates can be interpreted as how changes in night-light density are associated with changes in these development measures. We find very strong correlations, R^2 showing that 81% of the variance in night-light intensity changes is explained by changes in urbanization (column 3), while 75% of this variance is associated with changes in household welfare (column 4), admittedly on a much smaller sample in the latter case. We also find significant relationships between changes in night-light intensities and communes' fiscal capacity (column 5), highlighting the prevailing role of communes' own-resources over access to national transfers (column 6), as previously discussed.

4.5 Heterogeneity

The above results address the internal validity issues as best we can and show that DD estimates based on night-light intensity seem to reveal the gains from decentralization that materialize through electrification but more generally through the development of

human/economic activity and household access to public goods (health, sanitation, and other public goods and services). They also provide elements of answer to the concerns regarding external validity, which we complete with heterogeneous analyses.

Heterogeneity among Treated: Administratively or Economically Specific Communes. The fact that province capitals seem to experience a significant effect of decentralization means that this effect was not confined to regional capitals. This was reassuring for internal validity, given the fact that the latter have political leverage and a greater ability to collect own-source revenue due to pre-existing administrative support (e.g. the presence of the Ministry of Finance). That said, it is likely that decentralization effects were heterogeneous in the group of early decentralized communes. We check this point by interacting the Decentralized × Post 1995 variable with the three types of decentralized communes: regional capitals, hubs, and provincial capitals. Results are reported in panel (a) of **Table 2**. As expected, the coefficients for hubs are huge and – even if imprecisely estimated – may confirm specific development trends for these communes more than decentralization effects. Most importantly, the effect specific to provincial capitals is the smallest in the short run, as anticipated, but not significantly lower than that of regional capitals.

Heterogeneity by Local Resources. We complete this analysis with other heterogeneous effects, which may give some further indication of the communes' characteristics associated with larger decentralization gains. We exclude hubs from the analysis for the reason discussed above (but results are similar when hubs are included). We exploit information on communes' fiscal capacity data for the early decentralized communes, and the source of it, either from own-source revenue or from transfers. We use per capita measures of these resources and choose the median of all communes to define high or low levels of resources. Results in panel (b) first show that in the short-run (1992-2000), decentralization effects are significant only for communes with high, above-median fiscal capacity at the early stage. Panels (c) and (d) also indicate that the important factor for decentralization gains, at least if trends in terms of funding sources were similar just after 1995, appears to be the access to own-source revenues (essentially from tax collection)

more than the amount of state transfers, which is consistent with the comparison between early decentralized communes and the rest established before.

Table 2: Heterogeneous Effects across Commune Types

Heterogenous effects		Using observations :	
		1992 to 2000	1992 to 2005
(a) Decentralized 1995 x POST 1995	x Regional capital	0.226**	0.241*
		(0.090)	(0.125)
	x Hub	0.463*	0.616**
		(0.238)	(0.295)
	x Provincial capital	0.189**	0.240**
		(0.083)	(0.110)
	p-value of equality test (Region=Province)	0.752	0.994
(b) Decentralized 1995 x POST 1995	x Above-median total resources	0.226**	0.322***
		(0.085)	(0.106)
	x Below-median total resources	0.145	0.211
		(0.134)	(0.166)
	p-value of equality test	0.570	0.545
(c) Decentralized 1995 x POST 1995	x Above-median own resources	0.255***	0.361***
		(0.095)	(0.118)
	x Below-median own resources	0.086	0.130
		(0.091)	(0.112)
	p-value of equality test	0.128	0.117
(d) Decentralized 1995 x POST 1995	x Above-median transfers	0.179*	0.258**
		(0.090)	(0.113)
	x Below median transfers	0.248*	0.350**
		(0.131)	(0.153)
	p-value of equality test	0.627	0.603
Year FE		YES	YES
Commune FE		YES	YES
Climatic controls		YES	YES
Inverse PS reweighting		YES	YES

Estimation of nightlight intensity on a dummy for being decentralized in 1995 and observed post 1995. All estimations control for year fixed effects (FE), commune fixed effects, climate variables (precipitation & temperature at the time of observation) and Abadie (1995)'s inverse propensity score (PS) reweighting. Robust standard errors in parentheses, clustered at commune level. Significance level: *** p<0.01, ** p<0.05, * p<0.1

5. Concluding Discussion

We have used night-light intensity as a proxy for local development – which is homogeneously measured and hence comparable across time and space – to study the implications of the gradual decentralization reform in Burkina Faso. Given the phase-in

of the reform, with 33 communes decentralized first in 1995, 16 others in 2000, and the rest of the country in 2005, we adopt a panel difference-in-difference approach (i.e. two-way FE, controlling for time and commune fixed effects). Results suggest a relative increase in night-light intensity among the early decentralized communes compared to other communes, contrasting with the parallel trends of the two groups before the decentralization process started. Multiple robustness checks and the use of inverse propensity score reweighting reduce the risk of unobserved confounders that would explain the choice of certain communes in the early decentralized group and would also influence their trend in the post-1995 period differently from the trend of other communes. We provide alternative robustness checks while controlling for the specific time trends of hubs or communes with political leverage (regional capitals). Results tend to hold and indicate a positive return on decentralization.

Two essential aspects can be discussed on the basis of these findings. First, while the political dimension (regional capital versus provincial capital) does not seem to play a big role, the ability to generate and collect own resources via taxation seems a key factor not only to explain which communes got decentralized first, but also the gains from decentralization (**Figure 7**) and, among the early decentralized communes, those that fared better (**Table 2**). This is consistent with recent quasi-experimental studies. In particular, Cheng et al. (2020) indicate that Chinese states showing better economic performances were those with high fiscal capacity, notably through their ability to boost local activity and extract tax revenues. They also report that economic performances were due to higher government spending both in a direct way, through the provision of public goods and services notably, but also through the incentivization of private investment. In our context, further work should aim to better elicit the relative role of public support and the private sector. Better data could also help to more clearly picture the concrete gains from decentralization through these different channels. Nonetheless, the results based on additional outcomes (**Figures 5 and 6**) are consistent with the fact that decentralization gains are not only associated with firms development and energy production, but reflect

faster urbanization and improvement in household welfare (which includes access to electricity but also to other public goods and services such as health and sanitation).

Second, our results find some echo in the limited literature on the unequal effects of decentralization in poor countries (e.g. Lessman, 2012). In particular, Caldeira et al. (2012) show that decentralization has contributed to improve household access to essential public services in Benin but with increased inequalities across jurisdictions. Decentralization may contribute to a permanent increase in inequalities by benefiting already advantaged populations (Prud'homme, 1995 and Manor, 1999). This is precisely the case if jurisdictions finance their activities from their own resources, which leads only the richest among them to make significant progress in terms of public services, for example, in access to education and health (see West and Wong, 1995, for China, or Galiani et al., 2008, in Argentina, and Bardhan and Mookherjee, 2006, for West Bengal). Our results tend to confirm that decentralization did not lift all the boats. In particular, we have shown that the ability to generate and collect sufficient resources at the local level was a precondition for *effective* decentralization,[26] i.e. a factor that differentiated the level of economic growth also among the early decentralized communes.

[26] Having poor own-source revenues per inhabitant probably renders local policy-making and the effectiveness of decentralization difficult. Englebert and Sangaré (2010) state that there might be a threshold of income below which decentralization is practically unfeasible. If there is insufficient income generation in the villages to offer some basis for taxation, communes remain underfinanced and dependent on the national government. Moreover, the local community might not develop a sense of ownership of their commune if they do not participate significantly in its financing.

References

Abadie, A., 2005., Semiparametric Difference-in-Differences Estimators, Review of Economic Studies, 72/1, 1-19.

Alatas V, Banerjee A, Hanna R, Olken BA, Tobias J. 2012. Targeting the poor: evidence from a field experiment in Indonesia. American Economic Review, 102:1206–40

Alderman, H., 2002. Do local officials know something we don't? Decentralization of targeted transfers in Albania. Journal of Public Economics 83 (3), 375–404.

Alesina, A., Michalopoulos, S., Papaioannou, E., 2016. Ethnic Inequality. Journal of Political Economy 124 (2), 428–488.

Arze del Granado, F., J. Martinez-Vazques, and R.R. Simatupang, 2008. Local Government Fiscal Competition in Developing Countries: The Case of Indonesia. Urban Public Economic Review, 13–45.

Bardhan, P., et D. Mookherjee, 2006. Pro-poor targeting and accountability of local governments in West Bengal, Journal of Development Economics, 79(2), 303-327

Bardhan, P., Mookherjee, D., 2005. Decentralizing antipoverty program delivery in developing countries. Journal of Public Economics 89 (4), 675–704.

Bardhan, P. 2002. Decentralization of Governance and Development, Journal of Economic Perspectives, 16 (4): 185-205

Benassy Quere, A., Gobalraja, N., Trannoy, A., 2007. Tax and Public Input Competition. Economic Policy 50 (22), 385-420, 422-30.

Besley, T., Case, A., 1995. Incumbent Behavior: Vote-Seeking, Tax-Setting, and Yardstick Competition. American Economic Review 85 (1), 25–45.

Bird, R. and E. R. Rodriguez, 1999. Decentralization and poverty alleviation. International experience and the case of the Philippines, Public Administration and Development, 299–319.

Bo, S., Wu, Y., Zhong, L., 2020. Flattening of government hierarchies and misuse of public funds: Evidence from audit programs in China. Journal of Economic Behavior & Organization 179, 141–151.

Boret, N., K. Gawande, D. P. Kobb, 2021. Can decentralization lower poverty? Cambodia's Commune and Sangkat Fund, World Development, 146.

Bruederle, A., Hodler, R., 2018. Night-time lights as a proxy for human development at the local level. PloS one 13 (9), e0202231.

Caldeira, E., 2012. "Yardstick competition in a federation: Theory and evidence from China," China Economic Review, 23(4), 878-897.

Caldeira, E., Foucault, M., Rota-Graziosi, G., 2012. Does Decentralization Facilitate Access to Poverty-Related Services? Evidence from Benin, Cambridge, MA.

Caldeira, E., M. Foucault and G. Rota-Graziosi, 2015. Decentralization in Africa and the nature of local governments' competition: evidence from Benin, International Tax and Public Finance, 22(6), 1048-1076.

Callaway, Brantly, and Pedro H. C. Sant'Anna, 2021. Difference-in-differences with multiple time periods. Journal of Econometrics, 225, 2, 200-230.

de Chaisemartin, Clement, and Xavier d'Haultfoeuille, 2020. Two-way fixed effects estimators with heterogeneous treatment effects. American Economic Review 110.9n 2964-96.

Champagne, E., Ouedraogo, b.M., 2008. Decentralization in Burkina Faso: A Policy Reform Process in Slow Motion. Working Paper 08-2008. Andrew Young School of Public Policy, 21 pp.

Channa, A. and J-P. Faguet, 2016. Decentralization of Health and Education in Developing Countries: A Quality-Adjusted Review of the Empirical Literature, The World Bank Research Observer, 10.1093/wbro/lkw001, 31, 2, (199-241)

Cheng, H., Gawande, K., and Qi, S., 2022. State capacity, economic output, and public goods in China. World Development, 158, 105990.

Cortes, D.F., 2010. Do more decentralized local governments do better? An evaluation of the 2001 decentralization reform in Colombia.

Crawford, G., Hartmann, C. (Eds.), 2008. Decentralization in Africa: A Pathway out of Poverty and Conflict? Amsterdam University Press, Amsterdam, the Netherlands.

Dafflon, B., and Madiès, T., 2013. The political economy of decentralization in sub-Saharan Africa: A new implementation model in Burkina Faso, Ghana, Kenya, and Senegal. World Bank, Washington D.C., xxvii, 310.

del Granado, F.J.A., Martinez-Vazquez, J., McNab, R.M., 2018. Decentralized Governance, Expenditure Composition, and Preferences for Public Goods. Public Finance Review 46 (3), 359–388.

DHS, 1993. Burkina Faso : Enquête Démographique et de Santé 1993.

Diaz-Serrano, L. and Rodríguez-Pose, A., 2015. Decentralization and the Welfare State: What Do Citizens Perceive? Soc. Indic. Res. 120 (2), 411–435.

Dickovick, J.T., Wunsch, J.S. (Eds.), 2014. Decentralization in Africa: The paradox of state strength. Lynne Rienner Publishers, Boulder, Colorado.

Donaldson D. and A. Storeygard, 2016. The View from Above: Applications of Satellite Data in Economics." Journal of Economic Perspectives, 30/4, 171-198.

Elvidge, C.D., Baugh, K.E., Anderson, S.J., Sutton, P.C., Ghosh, T., 2012. The Night Light Development Index (NLDI): a spatially explicit measure of human development from satellite data. Soc. Geogr. 7 (1), 23–35.

Elvidge, C. D., Baugh, K. E., Kim, E. A., Kroehl, H. W., Davis, E. R., Davis, C. W., 1997. Relation between satellite observed visible-near infrared emissions, population, economic activity and electric power consumption. International Journal of Remote Sensing 18 (6), 1373-1379.

Englebert, P., and N. Sangare. 2010. Comparative Assessment of Decentralization in Africa: Burkina Faso Desk Study. Washington, DC: United States Agency for International Development.

Enikolopov, R. and E. Zhuravskaya, 2007. Decentralization and political institutions, Journal of Public Economics 91, 2261–90.

EU JRC, 2023. GHSL - Global Human Settlement Layer: Open and free data and tools for assessing the human presence on the planet.

Faguet, J.-P., 2004. Does decentralization increase government responsiveness to local needs? Journal of Public Economics 88 (3-4), 867–893

Faguet, J.-P. and Sánchez, F., 2014. Decentralization and access to social services in Colombia, Public Choice, 160/1/2: 227–49

Faguet, J.-P. and C. Pöschl (Eds), 2015. Is Decentralization Good For Development?: Perspectives from Academics and Policy Makers, Oxford University Press.

Ferraz C, Finan F. 2008. Exposing corrupt politicians: the effects of Brazil's publicly released audits on electoral outcomes. Quarterly Journal of Economics 123:703–45

Flèche, S., 2021. The Welfare Consequences of Centralization: Evidence from a Quasi-Natural Experiment in Switzerland. Journal of African Economies 103 (4), 621–635.

Gadenne, L. and M. Singhal, 2014. Decentralization in Developing Economies, NBER Working Paper No. 19402

Galasso, E., Ravallion, M., 2005. Decentralized targeting of an antipoverty program. Journal of Public Economics 89 (4), 705–727.

Galiani, S., Gertler, P., Schargrodsky, E., 2008. School decentralization: Helping the good get better, but leaving the poor behind. Journal of Public Economics 92 (10-11), 2106–2120.

Gibson, J., Olivia, S. and Boe-Gibson, G., 2020. Night-lights in economics: sources and uses. Journal of Economic Surveys, 34: 955-980

Goodman-Bacon, A., 2021. Difference-in-differences with variation in treatment timing, Journal of Econometrics, 225, 2, 254-277

Grimm, M. and I. Günther, 2007. Growth and Poverty in Burkina Faso: A Reassessment of the Paradox. Journal of African Economies 16(1):70-101

Grossman, G. and J. I. Lewis, 2014. Administrative Unit Proliferation. American Political Science Review 108 (1), 196–217.

Grossman, G., J.H. Pierskalla and E. Boswell Dean, 2017. Government Fragmentation and Public Goods Provision, The Journal of Politics, 79:3, 823-840

Guerrero, V. M., & Mendoza, J. A., 2019. On measuring economic growth from outer space: a single country approach. Empirical Economics, 971-990

Habibi, N., Huang, C., Miranda, D., Murillo, V., Ranis, G., Sarkar, M., Stewart, F., 2003. Decentralization and Human Development in Argentina. Journal of Human Development 4 (1), 73–101.

Harsch, E., 2021. Revolution and nation building in Burkina Faso. In Beyond Nationalism and the Nation-State (pp. 158–176). Routledge.

Hauptmeier, S., Mittermaier, F., Rincke, J., 2009. Fiscal competition over taxes and public inputs: Theory and evidence. European Central Bank, Frankfurt am Main, Germany..

Hazard, B., 2004. Entre le pays et l'outre-pays. africanistes (74-1/2), 249–274.

Henderson, J.V., Storeygard, A., Weil, D.N., 2012. MEASURING ECONOMIC GROWTH FROM OUTER SPACE. The American economic review 102 (2), 994–1028.

Hirano, K., G. Imbens, and G. Ridder, 2002. Efficient Estimation of Average Treatment Effects Using the Estimated Propensity Score, Econometrica

Hodler, R. and Raschky, P.A., 2014. Regional Favoritism. The Quarterly Journal of Economics 129 (2), 995–1033.

Iddawela, Y., Lee, N., Rodríguez-Pose, A., 2021. Quality of Sub-national Government and Regional Development in Africa. Journal of Development Studies 57 (8), 1282–1302.

Jia, J., Ding, S., Liu, Y., 2020. Decentralization, incentives, and local tax enforcement. Journal of Urban Economics 115, 103225.

Jin, H., Qian, Y., Weingast, B.R., 2005. Regional decentralization and fiscal incentives: Federalism, Chinese style. Journal of Public Economics 89 (9-10), 1719–1742.

Kalamova, M. (2008). Decentralization and Foreign Direct Investment: Evidence from the OECD Countries. mimeo.

Kambou, G. B., 1988. La décentralisation au Burkina Faso: Mythe ou réalité? *Revue Burkinabè De Droit*. (14), 379–389.

Kessing, S. G., Konrad, K. A., & Kotsogiannis, C. (2007). Foreign direct investment and the dark side of decentralization. Economic Policy, 22(49), 6–70.

Khanna, G. (2023). Large-Scale Education Reform in General Equilibrium: Regression Discontinuity Evidence from India. Journal of Political Economy 131(2).

Keola, S., Andersson, M., Hall, O., 2015. "Monitoring economic development from space: using nighttime light and land cover data to measure economic growth". World Development 66/1, 322-334

Kemper, T., Melchiorri, M., & Ehrlich, D., 2021. Global Human Settlement Layer: Understanding human presence on planet Earth science based information on population and human settlements to support informed policy decisions. Luxembourg: Publications Office of the European Union.

Kis-Katos, K. and B. S. Sjahrir, 2017. The impact of fiscal and political decentralization on local public investment in Indonesia, Journal of Comparative Economics, 45, 2.

Lessman, C., 2012. Regional Inequality and Decentralization: An Empirical Analysis. Environment and Planning A: Economy and Space 44 (6), 1363–1388.

Li, P., Lu, Y., Wang, J., 2016. Does flattening government improve economic performance? Evidence from China. Journal of Development Economics 123, 18–37.

Ligthart, J.E., van Oudheusden, P., 2015. In government we trust: The role of fiscal decentralization. European Journal of Political Economy 37, 116–128.

Liu, X., Huang, Y., Xu, X., Li, X., Li, X., Ciais, P., Lin, P., Gong, K., Ziegler, A. D., Chen, A., Gong, P., Chen, J., Hu, G., Chen, Y., Wang, S., Wu, Q., Huang, K., Estes, L., & Zeng, Z., 2020. High-spatiotemporal-resolution mapping of global urban change from 1985 to 2015. Nature Sustainability, 3, 564–570.

Livingston, J. A. and O. Azfar, 2010. Federalist Disciplines or Local Capture?: An Empirical Analysis of Decentralization in Uganda.

Mahieu, S., and S. Yilmaz. 2010. Local Government Discretion and Accountability in Burkina Faso." Public Administration and Development 30 (5): 329–44.

Malesky, E.J., Nguyen, C.V., Tran, A., 2014. The Impact of Recentralization on Public Services: A Difference-in-Differences Analysis of the Abolition of Elected Councils in Vietnam. American Political Science Review 108 (1), 144–168.

Mamo, N., Arezki, R., Bhattacharyya, S., Moradi, A., 2016. Economic Consequences of Mineral Discovery and Extraction in sub-Saharan Africa: Is There a Curse? University of Sussex.

Manor, J. (ed.), 1999. The political economy of democratic decentralization. Washington, D.C.: The World Bank

Marcus, M., and P.H. C. Sant'Anna, 2021. The Role of Parallel Trends in Event Study Settings: An Application to Environmental Economics". Journal of the Association of Environmental and Resource Economists, 8, 2, 235-275

Martinez-Vazquez, J., Lago-Peñas, S., Sacchi, A., 2017. The impact of fiscal decentralization: a survey; Journal of Economic Surveys 31 (4), 1095–1129.

Martinez-Vazquez, J. and F. Vaillancourt, 2011 (Eds.). Decentralization in developing countries: Global perspectives on the obstacles to fiscal devolution. Edward Elgar, Cheltenham.

Mellander, C., Lobo, J., Stolarick, K., Matheson, Z., 2015. Night-Time Light Data: A Good Proxy Measure for Economic Activity? PloS one 10 (10), e0139779.

Montinola, G., Qian, Y., Weingast, B.R., 1995. Federalism, Chinese Style: The Political Basis for Economic Success in China. World Pol. 48 (01), 50–81.

Myck, M. and Najsztub, M., 2020. Implications of the Polish 1999 administrative reform for regional socio-economic development. Economics of Transition and Institutional Change 28 (4), 559–579.

Oates, W.E., 2005. Toward A Second-Generation Theory of Fiscal Federalism. International Tax and Public Finance 12 (4), 349–373.

OECD, UCLG, 2019. 2019 Report on the World Observatory on Subnational Government Finance and Investment: Key Findings. OECD; UCLG, Paris.

Ouédraogo, M., Millogo, E., Guiré, M., Kaboré, M.T., 2009. Les capacités des communes rurales au Burkina Faso: Naviguer entre l'apprentissage et le pré-requis, 76 pp.

Ouédraogo, I. M. (2010). Electricity consumption and economic growth in Burkina Faso: A cointegration analysis. Energy Economics 32 (3), 524–531.

Prud'homme, R., 1995. The dangers of decentralization, World Bank Research Observer, 10(2), 201-20.

Reinikka R and Svensson J. 2011. The power of information in public services: evidence from education in Uganda. J. Public Econ. 95:956–66

Rentschler, J., Avner, P., Marconcini, M., Su, R., Strano, E., Vousdoukas, M., and Hallegatte, S., 2023. Global evidence of rapid urban growth in flood zones since 1985. Nature, 622, 87–92.

Riedl, R. B., and J. T. Dickovick, 2014. Party Systems and Decentralization in Africa. Studies in Comparative International Development 49 (3): 321–42.

Robalino, D., Picazo, O.F., Voetberg, A., 2001. Does Fiscal Decentralization Improve Health Outcomes?: Evidence from a Cross-Country Analysis. Policy Research Working Paper WPS 2565. World Bank Group, Washington D.C, USA, 20 pp. Accessed 6 June 2018.

Sanogo, T., 2019. Does fiscal decentralization enhance citizens' access to public services and reduce poverty?: Evidence from Côte d'Ivoire communes in a conflict setting. World Development 113, 204–221.

Schiavina, M., Melchiorri, M., Pesaresi, M., Politis, P., Carneiro Freire, S. M., Maffenini, L., Florio, P., Ehrlich, D., Goch, K., Carioli, A., Uhl, J., Tommasi, P., and Kemper, T., 2023. GHSL data package 2023. Luxembourg: Publications Office of the European Union.

Schmidt, M.and A. Moradi, 2022. Community Effects of Electrification Evidence from Burkina Faso's Grid Extension. CSAE Working Paper Series 2022-10, Centre for the Study of African Economies, University of Oxford.

Seabright, P., 1996. Accountability and decentralisation in government: An incomplete contracts model, European Economic Review, 40(1), 61-89.

Smith, J. A. and P. E. Todd, 2001. , "Reconciling Conflicting Evidence on the Performance of Propensity-Score Matching Methods," American Economic Review, Papers and Proceedings, 91, 112-118.

Smoke, P., 2001. Fiscal Decentralization in Developing Countries: A Review of Current Concepts and Practice. Geneva: United Nations Research Institute for Social Development.

Sun, L. and S. Abraham, 2021. Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. Journal of Econometrics, 225/2, 175-199

Sutton, P.C. and Costanza, R., 2002. Global estimates of market and non-market values derived nighttime satellite imagery, landcover and ecosystem service valuation. Ecological Economics, 41, 509-527.

Tiebout, C.M., 1961. An economic theory of fiscal decentralization, in: National Bureau for Economic Research (NBER) (Ed.), Public finances: Needs, sources, and utilization. Princeton University Press, 79–96.

Traore, S. and T. Owiyo, 2013. Dirty droughts causing loss and damage in Northern Burkina Faso, International Journal of Global Warming, 5 (No. 4):16

UNDP, 2005. Fiscal Decentralisation and Poverty Reduction, UNDP Primer, United Nations Development Programme, New York

Vaillancourt, F. and Bird, R.M. (Eds.), 1999. Fiscal Decentralization in Developing Countries. Cambridge University Press, Cambridge.

Wang, W., Zheng, X., Zhao, Z., 2012. Fiscal Reform and Public Education Spending: A Quasi-natural Experiment of Fiscal Decentralization in China. Oxford Review of Economic Policy 42 (2), 334–356.

Weidmann, N.B and S. Schutte, 2017. Using night light emissions for the Prediction of local Wealtn, Journal of Peace Research, 54/2, Special issue on forecasting, 125-140

Weingast, B., 1995. The Economic Role of Political Institutions: Market-Preserving Federalism and Economic Development. Journal of Law, Economics and Organization 11 (1), 1–31.

Weingast, B.R., 2009. Second generation fiscal federalism: The implications of fiscal incentives. Journal of Urban Economics 65 (3), 279–293.

West, L. A., and C. P. W. Wong, 1995. Fiscal decentralization and growing regional disparities in rural China: Some evidence in the provision of social services, Oxford Review of Economic Policy, 11(4), 70-84.

Zarychta, A., 2020. Making social services work better for the poor: Evidence from a natural experiment with health sector decentralization in Honduras. World Development, 133, 104996.

Appendix A: Historical and Policy Background

Burkina Faso has been experimenting with municipal and territorial organization since the colonial period. Under the French colonial regime, the towns of Bobo-Dioulasso and Ouagadougou benefited from a special status known as *communes mixtes* (Kambou, 1988). Mayors were appointed by the territorial chiefs and overseen by the colonial administration. In 1956, the two towns became fully-fledged communes, with bodies elected by direct universal suffrage. This rare occurrence for that era constituted the first democratic experience at the local level for Burkina Faso. However, this was short-lived, as in 1959, a law substituted the elected bodies by appointed local dignitaries with general administrative and management powers identical to those of the previous municipal councils. Upon independence in 1960, several new laws and decrees attempted to further the country's territorial organization and de-concentration process, with the creation of rural communities, but these jurisdictions remained governed by appointed representatives. Starting in 1966, political upheavals in the country led to several changes in the management of public affairs. Burkina Faso experienced more than seven transitionary or military governments between 1960 and 1991 (see, for e.g., Harsch, 2021), under which the concerns of local democracy and local governance fell short as a priority and where centralism was the predominant rule. The country still furthered territorial organization and de-concentration, albeit with limited decision-making at the local level. In 1983, the National Revolutionary Council (CNR) restructured the country's governance by creating revolutionary councils at the provincial, departmental, and commune levels. . The communes were then effectively managed by population assembly. Yet they were replaced by special delegations after 1987, under the Popular Front (FP). Thus, analyses of the historical archives and past experience reveal that pre-1991 attempts did not lead to the practical implementation of public-sector decentralization.. Thus, as experienced by francophone West-Africa in the 1990s and early 2000s, the reform studied in this paper was novelly designed implemented throughout the country from 1995 onwards. As described in this paper, this reform was the first to encompass fully the administrative, political and fiscal dimensions of decentralization in post-colonial and (newly) formed

Burkina Faso. It also marked a shift from the top-down management of local government affairs through special delegations or special councils that existed in the aftermath of independence (1960-1994) to fully-fledge local self-governance as voted by the constituents themselves through local democratic elections and the potential crafting of local policies according to local demands.

Table A1: Timeline of the Decentralization Reform in Burkina Faso

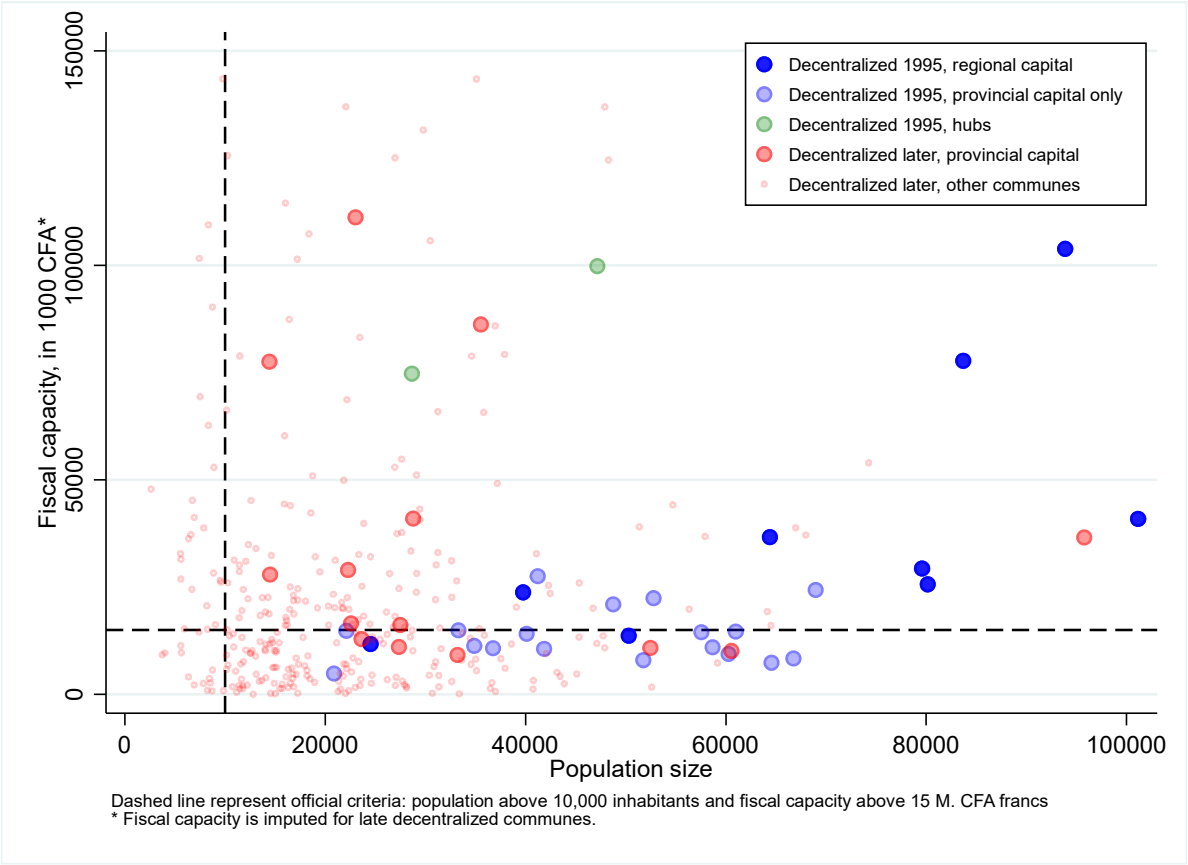
1991	The 1991 Constitution instituted the multi-tier governance system and set the legal basis of the reform (articles 143, 144, 145 and beyond)	
1993	Adoption of the first series of legal provisions on decentralization and local governance	
1995	1st wave of effective decentralization - 33 municipalities	Municipal elections are held in 33 municipalities
1998	Adoption of four major legislation pieces on the decentralisation reform (*textes d'orientation de la décentralisation*)	
2000	2nd wave of effective decentralization – 49 municipalities	Municipal elections are held in 49 municipalities
2004	Adoption of the General Code of Local and Regional Authorities (*Code général des collectivités territoriales*)	
2005-2006	3rd wave of effective decentralization	General municipal elections are held in 321 municipalities

Source: information from the National Parliament (*Assemblée Nationale)* of Burkina Faso (1998), Horizons Solidaires, Ouédraogo et al. (2009), UN Public Administration Network.

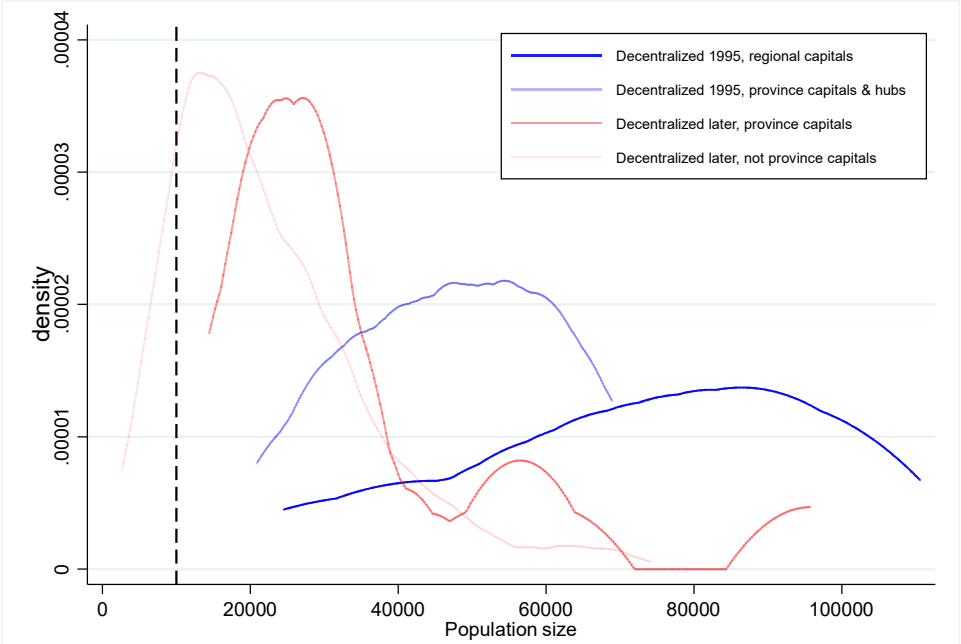
Appendix B: Communes' Characteristics

Figure A1: Communes' Population, Fiscal Capacity, Administrative Role and Decentralization Status

a. Fiscal Capacity (actual or predicted) versus Population Size in 1995, by Commune Type according to their Administrative Function

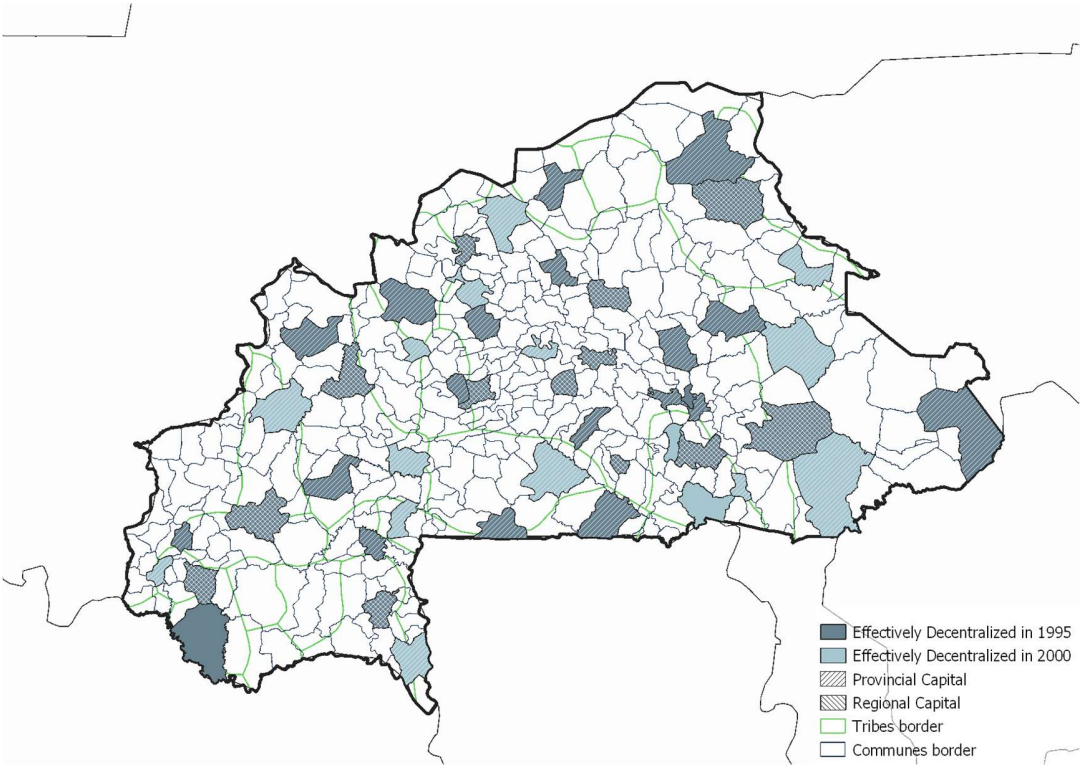


b. Distribution of Population Size in 1995 by Commune Type



Note: Dashed line represent the population criterion (early decentralization if pop>10,000 inhabitants)

c. Distribution of Communes with Administrative Role and Decentralization Status



Appendix C: Data Sources & Night-light Correlates

Table A2: Data Description & Sources

Variable	Description	Data Source
Outcome Variable		
Night-time light density	Proxy for local development. DMSP-OLS Night-time lights density corrected for ephemeral events	DMSP
Built-up Density	Proxy for urbanization and built-up settlements at the commune level, derived from remote sensing data from the GHSL	GHSL 2023
Local Welfare	Proxy for Local Welfare from the DHS Survey Data for Burkina Faso	DHS
Reform Criteria (non-binding)		
Fiscal Capacity	Local Government budget	DGTCP
Population	Population size of a municipality	DGTCP
Control & Grouping Variables		
Precipitation	Yearly mean precipitation from Climate Research Unit (CRU) in millimetres, obtained aggregating (mean) monthly precipitation data	AidData
Temperature	Yearly mean temperature from Climate Research Unit (CRU) in degrees Celsius, obtained by aggregating (mean) monthly mean daily temperature data	AidData
Vegetation Index	Yearly Normalized Difference Vegetation Index, created by aggregating daily data to monthly by taking the maximum value, then averaging the monthly data to get yearly values	AidData
Grouping Variables (or general correlates of nightlight density)		
Distance to water	Average distance to water, measured in meters, derived using World Vector Shorelines combined with rivers and lakes from World Data Bank	AidData
Distance to coast	Distance to coast (on land only), measured in meters and derived using World Vector Shorelines.	AidData
Distance to diamond	Average distance to known diamond deposits, calculated with data from the Peace Research Institute Oslo (PRIO)	AidData
Distance to gold	Average distance to nearest lootable or surface gold deposit. Derived from GOLDATA dataset which consists of 2969 entries for gold occurrences in 108 countries	AidData
Distance to gemstones	Average distance to gemstone deposits, measured in meters, calculated with data from the Peace Research Institute Oslo (PRIO)	AidData
Distance to oil (onshore petroleum)	Distance to onshore petroleum, measured in meters, and derived from PRIO global onshore petroleum dataset.	AidData
Per capita Own-source revenues	Local government own-sources revenues per capita.	Authors with data from DGTCP

DMSP: U.S. Air Forces Defence Meteorological Satellite Program. DGTCP: Treasury and Public Accountancy Directorate (*Direction générale du Trésor et de la Comptabilité publique*).DHS: Demographic and Health Surveys. GHSL: Global Human Settlement Layer.

Table A3: Correlates of Night-light Density

	(1)	(2)	(3)	(4)	(5)	(6)
Climatic conditions						
Precipitation	0.010**	0.032***				
	(0.005)	(0.001)				
Temperature	-0.982***	-0.609***				
	(0.135)	(0.025)				
Elevation	-0.008***	-0.004***				
	(0.001)	(0.000)				
Alternative outcomes						
Total built-up areas (remote sensing)			0.0995***			
			(0.0218)			
Welfare index (DHS)				1.311**		
				(0.572)		
Per capita fiscal capacity					0.448***	
					(0.032)	
Per capita own resources						0.139**
						(0.070)
Per capita national transfers						0.809***
						(0.080)
Observations	349	6,626	1,396	672	878	878
R-squared	0.373	0.390	0.814	0.751	0.184	0.206
Communes FE	NO	NO	YES	YES	YES	YES
Sample years	1995	1992-2010	1992-2010	1992-2010	1992-2010	1992-2010

Estimation of nightlight intensity on climatic conditions and on alternative outcomes. For columns (3)-(6), estimations are clustered at commune level. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Appendix D: Additional Results based on Night-lights

Table A4: Night-light Estimations with both 1995 and 2000 Decentralization Effects

Sample from 1992 to:	2000	2005	2005
Specification	excluding 2000-decentralized		with both treatments
	(I)	(II)	(III)
Decentralized 1995 x POST 1995	0.219***	0.289***	0.292***
	(0.064)	(0.079)	(0.078)
Relative to pre-1995 control groupe mean outcome:	**13.6%**	**18.2%**	**18.6%**
Decentralized 2000 x POST 2000	-	-	-0.081
			(0.067)
Observations	2,976	4,630	6,588
R-squared	0.900	0.896	0.888
Year FE	YES	YES	YES
Commune FE	YES	YES	YES
Climatic controls	YES	YES	YES

Estimation of nightlight intensity on dummies for being decentralized in 1995 or 2000, and observed post 1995, using different end years. Estimations control for year fixed effects (FE), commune fixed effects and climate variables (precipitation & temperature at the time of observation). Robust standard errors in parentheses, clustered at commune level. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Appendix E: Robustness Checks

Parallel trends. We provide a series of estimates using different bandwidths and cutoffs, reported in appendix **Table A5**. The upper panel is based on the whole sample while the lower one shows estimations excluding the hub communes, which violate the parallel trends assumption and are likely to have their own economic development dynamics, as seen before. Columns (1) and (2) correspond to the period 1992-1995 with placebo cutoffs in 1993 or 1994. Both yield insignificant DD estimates, meaning that the parallel trend assumption is verified.

Table A5: Placebo Estimations and First Years Effect

	(1)	(2)	(3)	(4)	(5)	(6)
Sample from 1992 to :	1995	1995	1996	1997	1998	1999
Cutoff:	1993	1994	1995	1995	1995	1995
All sample						
Decentralized 1995 x POST Cutoff	0.028	0.030	0.116*	0.148***	0.188***	0.195***
	(0.080)	(0.053)	(0.064)	(0.051)	(0.058)	(0.064)
Observations	1,386	1,386	1,733	2,080	2,426	2,773
R-squared	0.917	0.917	0.917	0.892	0.893	0.895
Excluding hubs						
Decentralized 1995 x POST Cutoff	0.004	0.017	0.099	0.124**	0.162***	0.168***
	(0.082)	(0.055)	(0.065)	(0.050)	(0.057)	(0.063)
Observations	1,370	1,370	1,713	2,056	2,398	2,741
R-squared	0.918	0.918	0.917	0.892	0.894	0.895
Year FE	YES	YES	YES	YES	YES	YES
Commune FE	YES	YES	YES	YES	YES	YES
Climatic controls	YES	YES	YES	YES	YES	YES

Estimation of nightlight intensity on a dummy for being decentralized in 1995 and observed post 1995, using different end years. Estimations control for year fixed effects (FE), commune fixed effects and climate variables (precipitation and temperature at the time of observation). Robust standard errors in parentheses, clustered at commune level. Significance level: *** p<0.01, ** p<0.05, * p<0.1.

Columns (3) to (6) use the cutoff of 1995, corresponding to the beginning of the decentralization process, and extend the end period from 1996 to 1999. The reform does not materialize right away: the estimate in column (3) is small (it is significant at the 10% level, but the lower part of the table shows that it is driven by the hubs). In the next columns, point estimates gradually converge towards the baseline result obtained when

focusing on the early period 1992-1995. As discussed, parallel trend verifications – especially with a short time window of 1992-1995 – are not conclusive evidence that the early decentralized communes would follow the same pattern as the other communes post-1995 in the absence of decentralization, but nonetheless provide a minimal falsification test.

The Role of Commune FE and Climatic Controls. As extensively discussed, communes FE account for time-invariant confounders such as communes' geographic characteristics (e.g. border cities, more engaged in international trade and more apt to levy and manage their own resources), their endowments at the start of the reform (including potential development capacity for own-source revenue), their historical administrative role as regional capital (and the political weight that this may represent), or unobserved political factors (such as favoritism and ethnic distribution, which in any case remained stable over the period). We have also emphasized the necessity to control for key time-varying factors, such as climatic controls, that may affect energy provision and night-light intensity. Results in **Table A6** provide estimates using either the observations for the 1992-2000 period (upper panel) or the whole period (lower panel), introducing the different controls gradually to check whether some of them have an impact on the magnitude of our estimates. We first account for time dummies only (column 1), then add commune FE (column 2) and time-varying climatic conditions (column 3, baseline). Results are very stable in all these cases.

Table A6: Robustness Checks

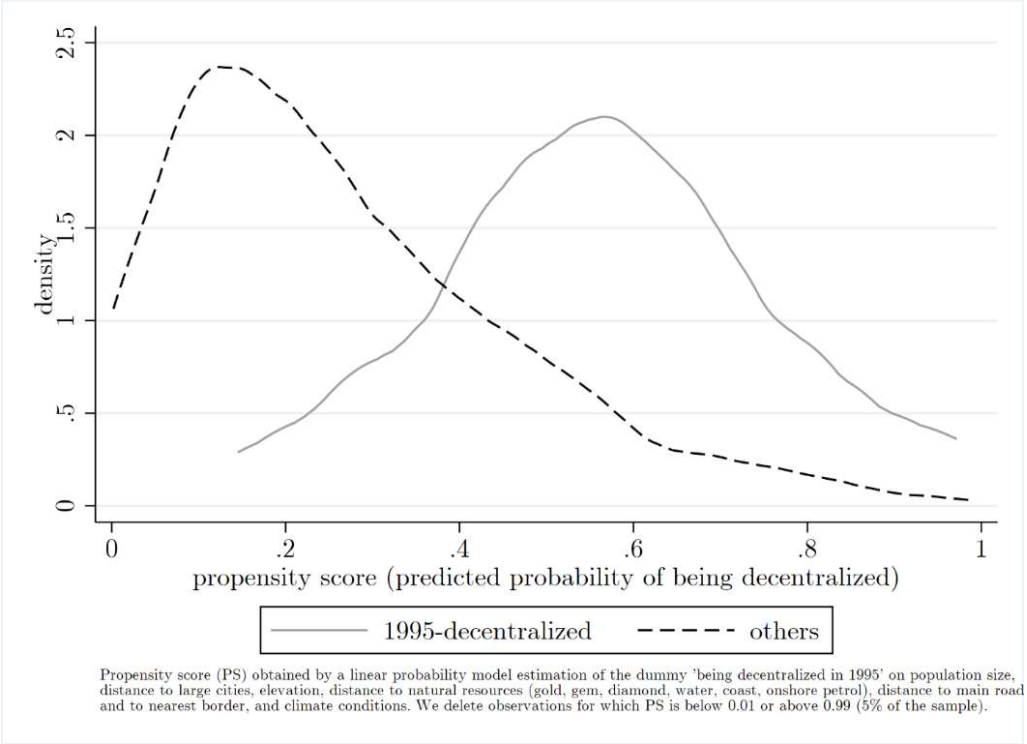
	(1)	(2)	(3) [baseline]	(4)
Using observations from 1992 to 2000				
Decentralized 1995 x POST 1995	0.220***	0.222***	0.224***	0.225***
	(0.061)	(0.064)	(0.064)	(0.065)
Relative to pre-1995 control mean outcome	**13.8%**	**13.9%**	**14.0%**	**13.6%**
Observations	3,120	3,120	3,120	2,998
R-squared	0.010	0.900	0.900	0.900
Using observations from 1992 to 2005				
Decentralized 1995 x POST 1995	0.294***	0.295***	0.295***	0.275***
	(0.075)	(0.078)	(0.078)	(0.087)
Relative to pre-1995 control mean outcome	**18.8%**	**18.8%**	**18.8%**	**17.7%**
Observations	4,854	4,854	4,854	4,655
R-squared	0.035	0.896	0.897	0.895
Year FE	YES	YES	YES	YES
Commune FE	NO	YES	YES	YES
Climatic controls	NO	NO	YES	YES
Inverse PS reweighting	NO	NO	NO	YES

Estimation of nightlight intensity on a dummy for being decentralized in 1995 and observed post 1995, using different end years. All estimations control for year fixed effects (FE) and gradually include commune fixed effects (model 2), climate variables including precipitation & temperature at the time of observation (model 3) and Abadie (1995)'s inverse propensity score (PS) reweighting (model 4). Robust standard errors in parentheses, clustered at commune level. Significance level: *** p<0.01, ** p<0.05, * p<0.1

Inverse Propensity Score Reweighting. Despite common trends between early and late decentralized communes, there may be unobserved characteristics of the early decentralized communes that drive specific economic dynamics post-1995 and make the comparison with other communes unreliable. If these time-varying confounding factors are associated with observed demographic, geographic or economic trends, controlling for the latter may reduce the bias. As discussed before, we consider treated and untreated communes that are more similar to each other by reweighting observations using the inverse PS, as suggested by Abadie (2005) for the DD approach. The PS, denoted p, is obtained as the prediction of a first-stage estimation of the 1995-decentralized dummy on demographic, geographic and economic variables.

As seen in **Figure A2**, the PS distributions are fairly different between early decentralized communes and the other communes, but there is broad common support. We also enforce common support at the observation level by trimming the sample of communes appropriately.[27] The inverse PS reweighting gives more weight to the late (early) decentralized that are most similar to the early (late) decentralized. Results are presented in column (4) of **Table A6**. It turns out that making treated and control more similar through the weighting strategy does not fundamentally affect the estimates. The early decentralization effect relative to pre-treatment average control outcome now range from around 13.6% (using 1992-2000) to 17.7% (using 1992-2005).

Figure A2: Distribution of 'Being Decentralized' Propensity Score by Decentralization Status



Propensity score (PS) obtained by a linear probability model estimation of the dummy 'being decentralized in 1995' on population size, distance to large cities, elevation, distance to natural resources (gold, gem, diamond, water, coast, onshore petrol), distance to main road and to nearest border, and climate conditions. We delete observations for which PS is below 0.01 or above 0.99 (5% of the sample).

[27] Deleting observations for which PS is below 0.01 or above 0.99 (12% of the 1992-2000 sample and 5.4% of the 1992-2010 sample) is enough to guarantee commune-level common support for the PS.

Increasing Comparability and Accounting for Specific Dynamics. Another way to restrict our DD to communes that are more comparable is to focus on some sub-groups that may be less prone to the selection bias associated with the early decentralization group. A minor check consists in restricting the sample to communes above the population threshold announced as a decentralization criterion. As discussed, this criterion was weakly binding and we lose only 11% of the sample (all are non-decentralized communes).

Table A7: Additional Robustness Checks

	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Using observations from 1992 to 2000								
Decentralized 1995 x POST 1995	0.228***	0.199***	0.187**	0.207**	0.222**	0.194**	0.223**	0.220*
	(0.066)	(0.065)	(0.083)	(0.083)	(0.092)	(0.083)	(0.092)	(0.121)
Relative to pre-1995 control mean outcome	**14.2%**	**12.1%**	**9.7%**	**10.6%**	**11.3%**	**10.7%**	**11.3%**	**11.3%**
Observations	2,664	2,962	2,863	2,998	2,998	2,511	2,998	288
R-squared	0.905	0.902	0.902	0.900	0.902	0.906	0.900	0.911
Using observations from 1992 to 2005								
Decentralized 1995 x POST 1995	0.279***	0.238***	0.237**	0.262**	0.267**	0.245**	0.267**	0.299**
	(0.087)	(0.086)	(0.110)	(0.109)	(0.118)	(0.110)	(0.118)	(0.136)
Relative to pre-1995 control mean outcome	**17.8%**	**15.1%**	**12.3%**	**13.8%**	**13.8%**	**12.9%**	**13.8%**	**15.2%**
Observations	4,138	4,599	4,445	4,655	4,655	3,900	4,655	448
R-squared	0.900	0.897	0.899	0.895	0.897	0.903	0.895	0.899
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Commune FE	YES	YES	YES	YES	YES	YES	YES	YES
Climatic controls	YES	YES	YES	YES	YES	YES	YES	YES
Inverse PS reweighting	YES	YES	YES	YES	YES	YES	YES	YES
Restriction on commune type	pop>10,000	excluding Hubs	excl. Regional capitals & Hubs	NO	NO	excl. Regional capitals, Hubs & pop>10,000 or <70,000	NO	Province capital only
Adding *Zi* x *POST 1995*	NO	NO	NO	with Regional capitals x POST and Hubs x POST	with Regional capitals x Year FE, Hubs x Year FE	NO	with Regional capitals x POST, Hubs x POST, Pop. Size x POST	NO

Estimation of nightlight intensity on a dummy for being decentralized in 1995 and observed post 1995, using different end years. All estimations control for year fixed effects (FE), commune fixed effects, climate variables (precipitation, temperature) at the time of observation and, all except model 12, Abadie (1995)'s inverse propensity score (PS) reweighting. Population cutoffs of 10,000 correspond to the population criterion for 1995 decentralization. Robust standard errors in parentheses, clustered at commune level. Significance level: *** p<0.01, ** p<0.05, * p<0.1

Table A7 (column 5) shows that the results do not change much in this case. It is likely that the coefficients are inflated by the presence of hubs, the very economically active border communes. When excluding them (column 6), estimates indeed fall slightly but

remain significant. Most importantly, the central characteristic influencing the participation in the early decentralization process, and possibly associated with specific political and economic dynamics, is the status of regional province. We replicate our estimations without these communes (column 7). Relative effects slightly decrease and, with the sample size reduction, estimates are now significant at the 5% level only. An alternative way to control for specific dynamics associated with regional capitals or hubs is to interact dummies for these communes with the POST variable. Results are in the same order of magnitude in this case (column 8) or when using a more flexible specification where the regional capital and hub dummies are interacted with all the year FE (column 9).

Overall, there seems to be some evidence of a gain from decentralization: the effect remains when excluding regional capitals and hubs (or when accounting for their potentially specific dynamics), i.e. when focusing on a decentralization effect driven by *provincial capitals*. This is reassuring given that the latter communes have much less specific administrative/economic advantages and are largely similar to - or with a common support with - other communes before the reform, notably in terms of fiscal capacity (**Figure A1a**) or night-light intensity (**Figure 2**). Admittedly, province capitals tend to be larger than simple communes. If we now exclude regional capitals and hubs while also restricting to a population size between 10,000 and 70,000 inhabitants – i.e. a segment for which there is much overlap between the early decentralized province capitals and other communes (cf. **Figure A1b**) – we still find a moderately significant decentralization effect (column 10). We can also extend the interaction terms $z_i^{'} \times \text{POST}_{it}$ (as used in column 8) and include population size among the z_i. Estimates are very similar (column 11).

Despite these numerous checks, it might be that the provincial capitals that were decentralized first – even if they have similar characteristics to the other communes – experience unobservable dynamics that bias our conclusions. An ultimate check then

consists in reducing our DD to the group of provincial capitals, i.e. to compare provincial capitals decentralized in 1995 to those decentralized later. Note that these two groups have similar characteristics, as shown in **Table A8**, except for population size. Nonetheless, estimations are still adjusted with an inverse PS that depends, among other things, on communes' population size. Despite the very small sample (due to the restriction to provincial capitals), we still find a mildly significant effect for those decentralized first (column 12 in **Table A7**). We cannot rule out that these communes have specific unobservable characteristics that are not accounted for in the model, so our results remain suggestive. However, it should be noted that the PS also includes all the observed sources of heterogeneity across communes (demographics, geographic variables and economic resources, as described in **Table A8**), which brings some confidence to the results.

Table A8: Mean Characteristics of Provincial Capitals

Decentralized in year:	1995	2000	Diff.
Demographics & geography			
Population size	57521	34397	23123
	(23157)	(21903)	(31874)
Distance to cities>50,000 inhabitants	249	321	-72
	(144)	(197)	(244)
Elevation	309	299	10
	(47)	(46)	(66)
Distance to coast*	13.5	13.5	0.0
	(0.15)	(0.16)	(0)
Distance to border*	11.1	10.7	0.4
	(0.70)	(0.67)	(0.96)
*Economics: distance to resources**			
Gold	11.5	11.7	-0.2
	(0.47)	(0.46)	(0.66)
Diamond	11.8	12.0	-0.2
	(0.64)	(0.49)	(0.81)
Gems	13.3	13.3	0.0
	(0.23)	(0.26)	(0.35)
Onshore petrol	13.8	13.8	0.0
	(0.13)	(0.15)	(0.20)

Standard deviation in brackets. * Log of normalized distance in meters.