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Abstract

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These results support the notion that informality is not simply associated with poverty but also with politics. They indicate that particular political dynamics may have a spatial 'signature' on the urban landscape; that, conversely, certain urban spatial forms may generate certain kinds of politics; or both. The paper provides an example of how newly available data may be used to advance our understanding of the relationship between politics, urban space, and informality.

Keywords

urban, informal, clientelism, politics, spatial, global

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Informal urbanization and clientelism: Measuring the global relationship

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This paper uses newly released data on political behavior (V-Dem) and urban growth (the Atlas of Urban Expansion) to identify, for the first time, a statistical correlation between clientelism (the informal provision of benefits, including urban land and services, to the poor in contingent exchange for political support) and informal urban growth, across a globally representative sample of 200 cities. The paper finds that, consistent with theoretical expectations, cities in more clientelistic countries are likelier to experience urban growth in the form of informal settlements that appear to have been planned in advance of settlement ('informal subdivisions'), but are not necessarily likelier to experience unplanned, ad-hoc informal growth. The main model for informal subdivisions finds that if a country were less clientelistic by one point on a 0-10 scale in 1990, the proportion of residential growth in the form of informal subdivisions between 1990 and 2015 in its cities would decrease by 16% of its previous value, a magnitude equivalent to that of an increase in 1990 GDP per capita of \$2,700.

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Introduction

In order to work more effectively in the increasingly informal cities of the world, urban planners and policymakers need to develop a sophisticated understanding of the various interrelated dimensions of urban informality, including the political and spatial.

Particularly in rapidly urbanizing countries, a blind spot with regard to the relationships between patterns of urban growth and local political dynamics often results in land use plans, infrastructure projects, and urban land tenure policies that prove ineffective. Isolated case studies of the role of politics in urban growth abound, but until recently, a lack of data has prevented the relationships between politics and patterns of urban settlement from being studied empirically across a large number of cities, and in turn from being systematically incorporated into policy discourse and planning practice. This study attempts to use new data to shed some light on this relationship by exploring how clientelism—the informal provision of benefits including urban land and services to the poor in contingent exchange for political support—relates to informal urban growth, across a globally representative sample of 200 cities.

The paper proceeds as follows. The rest of the introduction briefly reviews the literature linking urban politics, particularly clientelism, to urban growth, and identifies the gap that this study aims to partially fill. The next section explains the hypothesis, that clientelism is correlated with a particular kind of informal settlement, and suggests the possible causal mechanisms behind the hypothesized correlation. Next, the paper outlines the data and models, and discusses the results. This is followed by a reflection on the limitations of this kind of analysis and the importance of being cautious in interpreting such results. The

paper concludes by considering the significance of the findings and the ways in which future research can use newly available data to build on this study.

Scholars across disciplines have long studied the relationships between political dynamics and urban growth, either through theoretical explorations (MacLeod, 2011; Molotch, 1976; Ortalo-Magné and Prat, 2014; Phelps and Wood, 2011) or qualitative studies and narrative accounts of individual metropolitan areas (e.g. Atlanta (Keating, 2001), Berlin (Gualini and Fricke, 2019), Brisbane (Clarke and Cheshire, 2018), Toronto (Friskin, 2007), Stockholm and Amsterdam (Bossuyt and Savini, 2018)), states (e.g. Florida (Feiock, 2004), Massachusetts (Hawkins, 2014)), or countries (e.g. China (Fang and Pal, 2016), Denmark (Olesen and Carter, 2018), Egypt (Nada, 2014), India (Sridharan, 2011), Mexico (Miguel Díaz Barriga, 1995), Spain (Solé-Ollé and Viladecans-Marsal, 2007), among others).

The costs and benefits of clientelism to the urban poor have also been debated extensively. Some observe that clientelism allows the poor to access benefits in the absence of formal welfare (Jha et al., 2005; Mitlin, 2014), while others point to ways in which it fosters dependency (Benjamin, 2005), hinders political mobilization and solidarity among the poor (de Wit and Berner, 2009; Satterthwaite and Mitlin, 2013), and is inefficient (De and Nag, 2016; Herrera, 2017) and inequitable (Satterthwaite and Mitlin, 2013).

While clientelism may be involved in the provision of land and services in middle-class neighborhoods (Agyemang and Morrison, 2018) or the allocation of units of public housing (Levenson, 2017), scholars of clientelism in cities have mostly focused on the role that it plays in poor, informal urban settlements, particularly in low- and middle-income

countries. Relevant studies from the last two decades include several in South Asia (e.g. Auerbach, 2016; Banks, 2016; Benjamin, 2005; Björkman, 2014b; Chidambaram, 2011; de Wit, 2017; Hackenbroch and Hossain, 2012; Inskeep, 2011; Jha et al., 2005; Nahiduzzaman, 2006), Southeast Asia (Aspinall and Berenschot, 2019; Hutchison, 2007; Tomsa and Ufen, 2013), Africa (e.g. Adam, 2013; Awal and Paller, 2016; Bénit-Gbaffou, 2012; Fox, 2014; Gandy, 2006; Levenson, 2017; Nathan, 2019; Paller, 2014, 2019; Rajack et al., 2013; Robins, 2008), and Latin America & the Caribbean (e.g. Álvarez-Rivadulla, 2017; Alves, 2018; Auyero, 2000; Gay, 2006; Gray, 2004; Herrera, 2017; Holland, 2017; Shefner, 2006; Weitz-Shapiro, 2012). Some of these studies (e.g. Álvarez-Rivadulla, 2017; Benjamin, 2008; Fox, 2014) discuss the relationship between clientelism and the *growth* of informal settlements.

While many of these studies assume causality in one direction, i.e. from clientelism to the growth of informal settlements, some (Álvarez-Rivadulla, 2017; Auerbach, 2016; Burgwal, 1995) imply that the causality may also run in the opposite direction, that the growth of informal settlements may create conditions suitable to clientelism. In a review of the political science literature on urban politics in the developing world, Post (2018) suggests that more research is needed in order to understand whether this is the case.

The above suggests that many scholars associate politics, including clientelism, with informal settlements. Yet, attempts to systematically measure these relationships have been rare. Some studies do measure the effects of politics on the growth of informal settlements, but do so in individual cities (Alves, 2018; Holland, 2017). There have also been several attempts to model the growth of informal settlements through simulations, though a review of such models (Roy et al., 2014) found that most do not incorporate the role of politics.

The only one to do so is Patel et al's (2012) agent-based model, 'Slumulation', which incorporates the impact of politicians who aim to benefit electorally from a concentration of informal settlements. McGrath (2016) modifies the Slumulation model to incorporate electoral cycles, such that election periods are characterized by lower rents and more lax enforcement of laws in informal settlements.

No study has yet attempted to identify a statistical correlation between clientelism and informal growth across a large cross-sectional sample of cities. This is partly because the kind of consistent data on either clientelism or patterns of urban growth that would be necessary to conduct this analysis on a global scale have not existed until recently. This changed with the release of two new global data sets within the last five years, one on patterns of urban growth and the other on clientelism. The first is the 2016 version of the Atlas of Urban Expansion (Angel et al., 2016), which includes metrics on different categories of urban growth, as discernible from satellite imagery, in a globally representative sample of 200 cities. The other is the eighth version of the Varieties of Democracy ('V-Dem') data set, released in 2018 (Coppedge et al., 2018). V-Dem, headquartered at the University of Gothenburg, Sweden, uses thousands of country experts to produce metrics on political practices in 201 countries from 1789 onwards, in what it describes as "one of the largest-ever social science data collection efforts".¹ The 2018 version includes for the first time a 'Clientelism Index' among its variables. While others

¹ <https://www.v-dem.net/en/about/>. Accessed 8 February 2019.

have produced comparative metrics of clientelism, notably the Democratic Accountability and Linkages Project or DALP (Kitschelt, 2013), V-Dem is more extensive in both geographic and temporal scope (DALP has data on 80 democracies, for 2008-09 and changes since a decade prior). This paper uses these two recent data sets to test the global relationship between clientelism and informal urban growth.

Hypothesis and possible mechanisms

This analysis makes use of a distinction that Angel et al make in the Atlas of Urban Expansion between two forms of informal growth. '*Atomistic*' settlements are those "with irregular layouts that were clearly not subdivided or laid out before residential construction took place. This category includes squatter settlements that grew incrementally without an overall plan, homes built on irregular parcels of land, or homes built on rural plots that were not regularly subdivided before their conversion to urban use" (Angel et al., 2016: 30). By contrast, '*informal land subdivisions*' are residential areas that appear to have been subdivided for urban use, with structures that are "typically laid out along straight or almost-straight roads, with regular intersections and standardized widths" and blocks that are "regular or semi-regular in size and shape, when topography permits", but are nonetheless 'informal' as they "lack visible evidence of conformity to land subdivision regulations such as regular plot dimensions, paved roads, streetlights, or sidewalks" (ibid.). (A later section critically examines the use of the term 'informal' in this manner.)

The other categories of residential land use in the Atlas are 'formal land subdivisions' and 'housing projects'. *Formal subdivisions* "exhibit a higher level of regularity, a higher level of provision of infrastructure [fully paved roads, sidewalks, streetlights], and better

connections to existing roads.” *Housing projects* “range from large apartment tower projects to suburban tract housing” but are all characterized by homogeneity of design, suggesting that they were “built by a single developer using variations on the same plan” (ibid.). Examples of the four categories of residential land use are depicted in Figure 1.

Please insert Figure 1 here

This paper hypothesizes that countries with more clientelistic politics tend to experience a larger share of residential urban growth in the form of ‘informal subdivisions’, i.e. pre-planned informal settlements. We would not necessarily expect to see either more or less of any of the other types of residential urban growth (atomistic settlements, formal subdivisions, or housing projects) in countries with more clientelism.

While this study does not attempt to test causality, in order to establish that the hypothesized correlation is theoretically plausible, possible causal mechanisms are briefly outlined below.

Possible mechanism 1: Clientelism causes the growth of informal subdivisions through direct provision of land (clientelism -> informal subdivisions). Political patrons may own or otherwise control land and distribute it to clients. For example, politicians and government officials own over half the land in Kibera, the large informal settlement in Nairobi, and these figures or their brokers informally subdivide and allocate plots of land to residents (Syagga et al., 2002, cited in Fox 2014). Even if political patrons do not own the land, they may collaborate with informal land brokers to organize the informal settlement of land, as in Karachi, Pakistan (Inskeep, 2011; Khan, 1992). The land may be settled gradually, but the land can be informally subdivided by the brokers in advance.

Possible mechanism 2: Clientelism encourages the growth and persistence of new informal subdivisions through post-settlement protection and regularization (clientelism -> informal subdivisions). Even if political patrons are not involved in the initial occupation of the land, they may become involved in ‘regularizing’ the settlement after it has formed, by intervening to prevent demolitions (Fox, 2014; Gillespie, 2017) and organizing the provision of urban services such as water and electrical connections and neighborhood-level infrastructure like paved roads, sewerage, or public toilets, often through brokers (Álvarez-Rivadulla, 2017; Björkman, 2014b; Burgwal, 1995; De and Nag, 2016; de Wit and Berner, 2009; Gandy, 2006; Herrera, 2017; Inskeep, 2011; Perlman, 2010; Weinstein, 2014).

This kind of post-settlement support may happen regardless of whether the built form of the settlement is as an informal subdivision or an atomistic development. However, evidence suggests that in clientelistic environments, leaders among the urban poor are likelier to organize ‘planned’ land invasions, in which an entire community settles a piece of land in concert. For example, Álvarez-Rivadulla (2017) demonstrates that in Montevideo, Uruguay, the formation of ad-hoc ‘accretion’ informal settlements had always been common, but ‘planned’ land invasions grew in number during a period of intense political competition, when political parties eagerly courted the votes of the urban poor. Burgwal (1995) provides evidence of the connection between clientelism and coordinated, pre-planned settlement with the example of a land invasion in Quito, Ecuador, whose leaders waited several months in order to carry out the land invasion during campaign season, when they would be less likely to be evicted as political candidates fought for their votes. In both examples, settlers appear to have taken the opportunity of a clientelistic atmosphere to execute larger, more organized land invasions. Pre-planned invasions like

these are likelier to involve some level of site planning, which would make them take the form of informal subdivisions rather than atomistic settlements. Alvarez-Rivadulla notes that these pre-planned invasions often subdivide land into streets and individual parcels in advance of settlement. The fact that pre-planned invasions are more likely to be laid out in advance and are also more likely to occur in clientelistic environments suggests that, even when patrons are not involved in the initial settlement, we might expect planned informal subdivisions to be likelier to arise in clientelistic environments.

Possible mechanism 3: Clientelism leads to the 'informalization' of subdivisions

(clientelism -> informal subdivisions): Given that the Atlas does not distinguish between settlements based on their legal status but only on their physical characteristics, some settlements classified as 'informal subdivisions' may have been settled legally but still be poorly served by infrastructure. Clientelism may be a factor in this scenario if political patrons are able to prevent infrastructure from being formally provided or maintained, in order to act as gatekeepers such that access to infrastructure is contingent on political support. The example of the Shivajinagar-Bainganwadi settlement in Mumbai suggests that such a mechanism is plausible. The local government laid out the settlement in a grid pattern and allocated land to households in the 1970s, but antipathy on the part of subsequent political leaders towards its residents has caused it to deteriorate into what is now widely considered an "informal settlement" (Björkman, 2014a).

Possible mechanism 4: Settlements with strong leadership and more coordination are likelier to be laid out in advance and also likelier to foster clientelism (neighborhood leadership -> informal subdivisions & clientelism). Accounts of the growth of informal settlements in Montevideo, Uruguay (Álvarez-Rivadulla, 2017) and Quito, Ecuador

(Burgwal, 1995) also suggest that informal settlements that have strong leadership and coordination from the outset are both likelier to be laid out in advance and better able to successfully engage in clientelistic bargaining with politicians. These communities often proactively seek out patrons, but even if they do not, patrons may be attracted to communities that appear able to provide unified political support. This means that even if there were no clientelism at the time of the emergence of the settlement, the existence of a cohesive community under strong leadership could *induce* clientelism. Given that such a community is also likelier to have subdivided land in advance reinforces the hypothesis that informal subdivision and clientelism are likely to go together, even if clientelism does not directly cause these types of settlements to form.

The argument here is not that clientelism is associated *only* with informal subdivisions and not with other types of residential urban growth. If this were the case, we would see a significantly smaller share of the other types of growth where there is more clientelism. Rather, the argument is that the other types of growth may or may not be associated with clientelism, and so would not necessarily form a larger or smaller share of residential growth in a clientelistic environment. An informal settlement that lacks a regular layout, i.e. an 'atomistic' settlement, may indeed result from clientelism, or may foster clientelism after it forms. Similarly, clientelism may be involved in the provision of land or services to what the Atlas describes as 'formal subdivisions' (Agyemang and Morrison, 2018), or in the allocation of public housing to beneficiaries (Levenson, 2017). However, atomistic informal settlements, formal subdivisions, and housing projects could also arise in the absence of clientelism, whereas the discussion above suggests that informal subdivisions are particularly likely to be linked with clientelism. For this reason, we expect to see a

correlation between clientelism and the share of informal subdivisions, but not between clientelism and the share of the other types of growth.

Research design

The models in this study test whether the share of each of the four types of residential growth experienced by a city between 1990 and 2015 is correlated with the level of clientelism in the country at the beginning of that period, controlling for the country's initial GDP per capita, the city's initial size and density, and other variables.

Data

Categories of residential urban growth. The Atlas of Urban Expansion presents a range of metrics on a globally-representative sample of 200 cities with populations of 100,000 people or more as of 2010.² For each of these cities, the Atlas team digitized and analyzed a random sample of 10-hectare 'locales' within areas of each city that existed before 1990 and areas that grew between 1990 and 2015, using high-resolution Bing and Google Earth imagery. They used this analysis to estimate, within both the pre-1990 areas and the 1990-2015 areas, the shares of each of the four residential categories defined in the previous section, namely atomistic settlements (i.e. those not laid out in advance of settlement),

² The Atlas data are available in the form of interactive charts and maps, as well as downloadable GIS and Excel files, at www.atlasofurbanexpansion.org.

informal subdivisions (which feature signs of coordination and planning prior to settlement), formal subdivisions, and housing projects (see Figure 1).

Clientelism. An index of clientelistic politics at the country level is taken from the Varieties of Democracy (V-Dem) Project (Coppedge et al., 2018). The Clientelism Index is constructed from three indicators, indicating the prevalence of vote-buying, the provision of particularistic vs. public goods, and whether party linkages are programmatic or clientelistic. The original variable is on a 0 to 1 scale, but it is rescaled here to a 0 to 10 scale to facilitate interpretation of coefficients. Like most V-Dem indicators, it is calibrated such that higher values mean ‘more democratic’, which in this case means less clientelistic. In other words, the more clientelistic a country’s political system, the lower its Clientelism Index. It is calculated for each year. The models use the value of the Index at the beginning of the period under consideration (1990-2015). This is represented by the Index’s value in 1990, though models using the average 1985-1995 value are also tested.

Control variables. The control variables included in the models are listed below, along with reasons why they may be expected to determine the shares of the settlement categories. Unless otherwise indicated, they were taken from the Atlas of Urban Expansion, and are 1990 values.

- Gross Domestic Product (GDP) per capita, based on purchasing power parity (PPP) in constant 2011 international dollars (World Development Indicators³): All else equal, cities in wealthier countries may be expected to have a smaller share of informal growth (informal subdivisions and atomistic settlements) and a larger share of formal growth (formal subdivisions and housing projects).
- City population: As more populous cities tend to be more economically vibrant and have a higher demand for land, all else equal, larger cities may be expected to see a smaller share of informal subdivisions, which require larger areas of land at once; a larger share of atomistic settlements, which require less land and may house migrants attracted to large cities; a larger share of formal subdivisions, which may be more affordable to residents of larger cities; and a larger share of housing projects, in response to a high demand for housing.
- City population density: Denser cities may be expected to have a smaller share of formal and informal subdivisions, as they require more land at once; a larger share of atomistic settlements which require less land at once; and a larger share of housing projects, in response to a high demand for housing.
- National annual population growth rate (World Development Indicators⁴, average 1985-1995): Countries with rapidly growing populations may be expected to

³ <https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.KD>. Accessed 23 September 2016.

⁴ <https://data.worldbank.org/indicator/SP.POP.GROW>. Accessed 11 June 2019.

experience more demand for residential land, which would lead to the same outcomes as high population density discussed above.

- National urbanization level (share of population in ‘urban centers’ per Global Human Settlements Data (European Commission, 2016)): Countries that were more urbanized at the beginning of this period may be expected to have lower demand for new urban land, which, all else equal, may lead to a larger share of informal subdivisions, a smaller share of atomistic settlements, and a smaller share of housing projects.
- Capital city: Residential growth in capital cities may be more politicized, and as a result may experience a greater impact of clientelism than other cities in that country, which would lead to more informal subdivisions.
- Cohesion Index: This is a metric approximately expressing how circular in shape a city is, used here as a proxy for the geographic constraints faced by the city as it grows. A more constrained city, e.g. a city in a valley, would have a smaller supply of land, and may have more atomistic settlements and less of the other types of growth.
- Inclusion: This is the proportion of the 1990-2015 ‘growth’ of the city that was in fact outlying development built prior to 1990, with which the city merged as it grew. These areas would have different characteristics than areas actually being settled during this period, though the exact differences are hard to predict.
- USSR: Plotting the data shows that cities in former Soviet countries have a larger share of informal subdivisions in 1990-2015 growth than would otherwise be expected (see supplemental material). While the precise reasons for this would require additional investigation beyond the scope of this study, they are likely

related to the major political, economic, and institutional changes that occurred after the collapse of the USSR at the start of this period.

Model specifications

The models use ordinary least squares regression, with the share of a particular category of residential growth between 1990 and 2015 as the dependent variables, and country-level variables, such as clientelism and GDP per capita, and city-level variables like population size and density, as of 1990 or thereabouts, as independent variables.⁵ In generic terms, the models treat the log-transformed⁶ share of residential growth of a particular category (Y) as a function of country-level factors (X_1) and city-level factors (X_2) which might be expected to be correlated with Y:

$$Y = f(X_1, X_2)$$

In each model, the unit of observation is the city, with cities in the same country being assigned the same value for the country-level variables. To account for this for the purposes of significance testing, standard errors are clustered at the country level. Of the 200 cities in the Atlas data set, eight are dropped due to missing 1990 GDP data.

⁵ The analysis was conducted in R (R Core Team, 2017), and used the ‘car’ (Fox and Weisberg, 2011), ‘estimatr’ (Blair et al., 2018), ‘ggplot2’ (Wickham, 2016), and ‘stargazer’ (Hlavac, 2018) packages.

⁶ For ease of interpretation and to avoid taking the undefined log of 0, the log-transformation used the function $f(x)=\log(100x+1)$, where x is the original variable.

Three types of sensitivity tests were conducted. The first involved adding control variables to each model incrementally to observe changes in the magnitude and significance of the coefficient of clientelism. Second, the models were rerun replacing the Clientelism Index value for 1990 with an average value for 1985-1995, to ensure that the results are not distorted by brief fluctuations in this metric. Lastly, the cities were randomly assigned to five groups of equal size, and the models were run five times with one group removed each time, to test the robustness of the trends to the exclusion of observations.

Results

Table 1 displays the results of two models for each of the types of growth, one with a limited number of controls and another with the full set of controls. Models 1 and 2 use the share of informal subdivisions as the dependent variable. Consistent with expectations, the models find a statistically significant negative relationship between the value of the Clientelism Index in 1990 and the (logged) share of informal subdivisions in residential growth during the 1990-2015 period, i.e. the more clientelistic a country, the higher the share of informal subdivisions. Unsurprisingly, the models find GDP to be strongly negatively correlated to the share of informal subdivisions: the poorer the country, the higher the share of informal subdivisions.

Please insert Table 1 here

Model 1 explains 45% of the variation in the share of informal subdivisions. By taking the exponents of the coefficients in model 1, we find that if a country were one point less clientelistic on a 0-10 scale in 1990, the proportion of residential growth in the form of informal subdivisions between 1990 and 2015 in its cities would decrease by 16% of its

previous value. For comparison, if GDP per capita in 1990 were higher by \$1000, the proportion of informal subdivisions would decrease by 6% of its previous value. The magnitude of the effect on share of informal subdivisions of a 1-point change in clientelism is approximately equivalent to that of a \$2,700 change in GDP per capita.

In the expanded model with many more controls (model 2), these results are very similar. None of the other control variables, other than the one denoting membership of the former USSR, are significantly correlated with the share of informal subdivisions. Cities in former Soviet states have a share of informal subdivisions eight times higher than cities elsewhere, all else equal.

None of the models using the other shares of residential growth as dependent variables (models 3-8) show the coefficient of clientelism to be significant. In other words, clientelism does not appear to be significantly associated either positively or negatively with any of the other kinds of urban residential growth. This is consistent with the theoretical argument above, as these types of growth can occur in both clientelistic and non-clientelistic environments. Other models show that clientelism is also not statistically significantly correlated with the total share of informal growth, i.e. atomistic development plus informal subdivisions (see supplemental material).

GDP is significantly negatively correlated with the share of atomistic settlements and total informal growth, and significantly positively correlated with the share of formal subdivisions, as expected, but is not correlated with the share of housing projects. City population size is not consistently significantly correlated with any of the types of growth. The coefficient of city population density is only significant in the models for atomistic

settlement, where an additional ten people per hectare corresponds to an increase in the share of atomistic settlements of 3% of its previous value. Cities in former Soviet states had a significantly lower share of atomistic settlements, all else equal.

The sensitivity tests suggest that the main results are robust to small changes in the models (see supplemental material). For the informal subdivision models, the coefficient of clientelism is much larger (-0.357) when clientelism is the only independent variable, but once GDP is included as a control, the clientelism coefficient remains relatively stable, between -0.154 and -0.173 regardless of the addition of other controls, and is consistently significant. When the Clientelism Index value for 1990 is replaced with a 1985-1995 average, the coefficients for clientelism in models 1 and 2 change from -0.171 and -0.170 to -0.184 and -0.161 respectively but are still significant in both cases. When the full model with all controls (corresponding to model 2) is run with samples arbitrarily reduced by 20% each time as explained above, the coefficient of clientelism is slightly less stable, varying from -0.146 to -0.194, but is still consistently significant. This range of values suggests that if a country were one point less clientelistic on a 0-10 scale in (or around) 1990, the proportion of residential growth in the form of informal subdivisions between 1990 and 2015 in its cities would decrease by between 13.6% and 17.6% of its previous value.⁷

⁷ There is moderate collinearity in the models. Most notably, there is a correlation +0.60 between GDP and the Clientelism Index. A full correlation table is provided in the supplemental material.

Discussion

The results of the statistical analysis are generally consistent with the expectations established above. The evidence suggests that more clientelism is associated with a greater share of residential growth occurring in the form of informal subdivisions, but does not suggest that clientelism is associated with any other type of growth. The fact that clientelism is significantly correlated with more informal subdivisions but not less of any of the other three categories that make up residential growth suggests that the additional informal subdivisions that are associated with clientelism would not have taken the form of a specific one of the other types of growth in a less clientelistic environment.

The main models above suggest that if a country were one point less clientelistic on a 0-10 scale in 1990, the proportion of residential growth in the form of informal subdivisions between 1990 and 2015 in its cities would decrease by approximately 16% of its previous value. To understand what this means, we can take the example of Lahore, Pakistan, the city whose share of informal subdivisions is most accurately predicted by model 1 (the model predicts 31.36%, very close to the observed share of 31.38%). Pakistan's Clientelism Index in 1990 was 2.6 on a scale of 0 to 10. If it were one point worse in terms of clientelism, at 1.6 (between Nigeria and Nepal), holding all other variables constant, the predicted share of informal subdivisions would change from 31% to around 37%. This is equivalent to the effect of reducing Pakistan's 1990 GDP per capita from \$3,057 to around \$360, close to that of the poorest country in the sample (Mozambique). If it were one point better in terms of clientelism in 1990, at 3.6 (between Egypt and the Philippines), the share of informal subdivisions would reduce from 31% to 26%. This is equivalent to the effect of increasing Pakistan's 1990 GDP from \$3,057 to around \$5,760, close to that of Tunisia.

Limitations and precautions

Identification of informal settlements based on standardized, purely visual characteristics

While this study borrows the term ‘informal subdivisions’ from the data source, it does so with full acknowledgment that informality is a complex and multifaceted phenomenon, one which varies widely between contexts. Many scholars argue that informality is not simply a physical fact that can be recognized from satellite imagery, but rather a designation resulting from the perceptions and prejudices of authorities (Ghertner, 2015; Roy, 2012; Yiftachel, 2009). Settlements perceived as ‘informal’ may or may not be illegal in their origins (Björkman, 2014a), and indeed, properties that are considered ‘formal’ may violate as many regulations as those that appear ‘informal’ (Roy, 2012). McFarlane and Waibel (2012) explain that informality is not simply a spatial category (the ‘slum’), but also an organizational form, characterized by spontaneity and tacit knowledge rather than explicit rules; a governmental tool which enables certain modes of intervention; and a ‘negotiability of value’ shaped through shifting social relations. Satellite imagery alone reveals little about the political circumstances or intentions surrounding the growth of a settlement. Recent scholarship also argues against what it sees as a reductive and constrictive ‘formal-informal’ duality, which implicitly ‘others’ the informal (Acuto et al., 2019). By using ‘informal subdivisions’ as a globally consistent category, as discerned from satellite imagery, this paper risks further reinforcing this formal-informal duality, ‘flattening’ the cross-context variation in modes of informality, and associating informality primarily with visual characteristics of the built environment. If so, it does this in service of the larger goal of showing how these seemingly superficial characteristics are in fact linked to informal behavior on the part of powerful actors in the supposedly ‘formal’

political system, and that despite local variations, there is some global regularity in the link between these phenomena.

Subjectivity in input data

Both of the key data sets used in the statistical analysis, namely the classification of types of spatial expansion using satellite imagery from the Atlas of Urban Expansion and the classification of national political environments from the V-Dem data set, rely on subjective assessments. While both projects go to considerable lengths to harmonize the classifications from different evaluators, there is still room for variation in perceptions.

Use of national-level data at the city level

In the absence of city-level data for clientelism and GDP, national-level data have to be used uniformly across all cities in a country, even though the levels of clientelism and wealth may vary between cities in a country. This is particularly problematic for the largest countries, which are the most represented in the Atlas sample of 200 cities: China (34 cities), India (17 cities), and the United States (14 cities). The statistical technique of clustering standard errors only addresses the impact that this has on statistical significance in the models and does not address the underlying accuracy concern.

Long time-period in Atlas data

For each city, classification of residential land use is available in the Atlas data for just two unbroken periods of growth: pre-1990 and 1990-2015. The latter period, the one relevant to this study, covers a quarter-century in which the income levels of many countries increased dramatically, and in which political environments are likely to have gone

through multiple phases. The effects of these changes on urban growth cannot be measured with these data.

Inability to infer causality

While this analysis observes a correlation between clientelism and the growth of informal subdivisions, it does not attempt to establish causality. While the models use values of clientelism for 1990 and urban growth for a subsequent period (1990-2015), this should not be taken to mean that clientelism necessarily ‘caused’ this growth, since hypothetically the clientelism may have been caused by settlements in the pre-1990 areas of the city, which may be similar to post-1990 areas. In theory, regression models could use clientelism as the dependent variable and the types of growth as independent variables. However, the data currently available do not lend themselves to testing this direction of causality, because clientelism is only available at the national level and not the city level. It would be a stretch to claim that the presence of informal subdivisions in certain cities could determine the overall level of clientelism across an entire country.

Conclusion

While the relationship between clientelism and informal settlements has been observed across regions of the world in individual studies, this study is the first to measure this relationship empirically across a large, globally representative sample of cities. Using novel data, it finds evidence for a theoretically plausible relationship between clientelism and informal subdivisions, i.e. informal settlements that show evidence of prior organization.

These specific findings have a broader significance for our understanding of the relationship between politics, urban space, and informality. The analysis here supports the notion that informality is not simply associated with poverty but also with politics. The results indicate that particular political dynamics may have a spatial ‘signature’ on the urban landscape; that, conversely, certain urban spatial forms may generate certain kinds of politics; or both. This in turn emphasizes the notion that for planners and policymakers to make positive contributions in informal settlements, they must understand the informal political dynamics that tend to accompany them. To the extent that clientelism may interfere with the ability to implement formal spatial plans, the fact that some degree of informal planning already appears to take place in clientelistic environments suggests that professionally-trained planners might find it more effective in certain cases to provide their expertise directly to informal settlers, or perhaps even to political patrons and their brokers.

This study only uses a fraction of the indicators that are now publicly available through the Atlas of Urban Expansion and V-Dem, as well as others such as the Global Human Settlements Urban Centre Database (Florczyk et al., 2019). Future research can build on this study and use these data to explore many other such relationships, complementing the already advanced qualitative literature through quantitative studies that are only now becoming possible.

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Figure 1: Four types of residential land use identified in the Atlas of Urban Expansion: Atomistic settlements (top left), informal subdivisions (top right), formal subdivisions (bottom right), and housing projects (bottom left). Source: Angel et al (2016).

Table 1: Results of expanded models

Model no.	1	2	3	4	5	6	7	8
Dependent variable (logged share of 1990-2015 growth)	Informal subdivisions		Atomistic settlements		Formal subdivisions		Housing projects	
Clientelism Index (0-10 scale), 1990	-0.171* (0.083)	-0.170** (0.056)	0.030 (0.049)	0.037 (0.055)	0.012 (0.074)	0.001 (0.076)	0.056 (0.124)	0.044 (0.115)
GDP per capita (thousands), 1990	-0.063** (0.022)	-0.058*** (0.014)	-0.014* (0.007)	-0.018** (0.007)	0.064*** (0.011)	0.058*** (0.008)	-0.011 (0.029)	-0.016 (0.032)
City population (millions), 1990	-0.028 (0.025)	-0.031 (0.024)	0.017 (0.012)	0.012 (0.012)	0.042* (0.020)	0.042 (0.024)	0.037 (0.031)	0.033 (0.031)
City pop. density (p/ha), 1990	-0.003 (0.002)	-0.003 (0.002)	0.003** (0.001)	0.003** (0.001)	-0.001 (0.001)	-0.001 (0.001)	-0.001 (0.002)	-0.001 (0.002)
National annual pop. growth rate (%), avg. 1985-1995		0.149 (0.162)		-0.092 (0.122)		-0.138 (0.164)		-0.136 (0.290)
National urban population (share of total), 1990		0.486 (1.018)		-0.450 (0.705)		0.449 (0.809)		0.656 (1.279)
Capital city (N=0, Y=1)		0.090 (0.202)		0.077 (0.149)		-0.137 (0.257)		-0.043 (0.299)

Cohesion		0.322		-0.523		-0.355		-0.343
Index (0-1		(0.889)		(0.427)		(0.502)		(0.770)
scale), 1990								
Inclusion		-0.972		0.149		0.684		0.321
growth		(0.958)		(0.876)		(1.004)		(1.075)
(proportion),								
1990-2015								
Former USSR		2.080***		-1.090*		-1.097		-0.575
(N=0, Y=1)		(0.392)		(0.519)		0.628		(0.483)
Constant	4.818***	4.079**	2.757***	3.565***	1.858***	2.262*	1.735***	2.073
	(0.256)	(1.292)	(0.328)	(0.634)	(0.473)	(0.974)	(0.465)	(1.509)
R ²	0.457	0.588	0.125	0.201	0.363	0.403	0.017	0.039
Adjusted R ²	0.445	0.562	0.106	0.156	0.349	0.370	-0.004	-0.014

Number of observations in each model = 192

Figures in parentheses are standard errors, clustered by country.

*p<0.05; **p<0.01; ***p<0.001