Measuring Informality:
Why Bother? An Application to Latin America

Ciro Biderman and Martim O. Smolka

Lincoln Institute of Land Policy
Working Paper

Lincoln Institute Product Code: WP12CB1

Abstract

This paper suggests that informality in Latin America is falling (getting better), but not in all places and at the same rates of change. Apparently, there is a built-in inertia in the system, with cities that have improved most in the past continuing to do so in the present, whereas low-performance cities seem to be trapped in a bad equilibrium state. The improvements seem to result from deliberate/organized intervention, suggesting that public policy not only matters but, most importantly, also depends on local political will rather than a generalized process affecting all cities in the same manner. Changes in urban poverty do not seem to be a determining factor in explaining changes in informality attributes. Different combinations of attributes usually describe informal settlements. The paper shows that the effectiveness of policies addressing a given attribute vary considerably, even within the same country. Further research is needed to explain the causes of such variance.

Key Words: Informality, Cities in Developing Countries, Measures of Informality, Informality Trends

About the Author(s)

Ciro Biderman is an economist, a member of the faculty of the Lincoln Institute of Land Policy, and an affiliated researcher in the Department of Urban Studies and Planning at the Massachusetts Institute of Technology. He is also an associate professor at the Getúlio Vargas Foundation and an associated researcher at the Center for the Study of the Politics and Economics of the Public Sector in São Paulo, Brazil.

Contact: biderman@mit.edu

Martim O. Smolka is senior fellow and cochair of the Department of International Studies and Director of the Program on Latin America and the Caribbean at the Lincoln Institute of Land Policy. He has been an adjunt professor at the Urban and Regional Research and Planning Institute (IPPUR) at the Federal University of Rio de Janeiro, Brazil.

Contact: msmolka@lincolninst.edu

Contents

Measuring Informality:
Why Bother? An Application to Latin America

Introduction

Despite their many names—slums, squatters, shanties, *barriadas, favelas, tugurios, villas miseria*, among others—informal settlements have no common definition, let alone consistent and measurable indicators. This failure makes it difficult to formulate policies and assess their effectiveness in mitigating the problem. Indeed, as this paper suggests, conventional wisdom seems to hold many misconceptions and/or ill-founded propositions, including: that informality is getting worse, that it is mostly attributed to or associated with urban poverty; and that it is a rampant and universal phenomenon in Latin America (found in most countries and city sizes, albeit at different levels). Moreover, informality is thought to be simultaneously determined by problems that tend to accumulate or overlap, so that illegally occupied areas would typically lack services (water, sewage, etc.). As a result, an indicator of one dimension of informality may be used as proxy for all other dimensions.

On the side of policy assessment, there also seems to be much room for disagreement or perplexity. For example, there are strong proponents for titling programs based on their belief that a property title is capable of triggering private housing investment and other improvements. Such a position is diametrically opposed to that of analysts who argue that titles should only be provided once the informal settlement is upgraded and complies with official urban standards. More importantly, there is apparently no consensus on how effective public interventions have been, mostly because there are practically no systematic and consistent evaluations. The few evaluations available are confined to the project level, such as with the Favela-Bairro program (see IADB), with no major overall assessment based on comprehensive national or city data.

Drawing on comprehensive data system comprising census information for eight Latin American countries and about 600 cities in those countries, this paper reveals the mixed behavior of the main variables used to construct indicators of informality. In doing so, the paper comments on the implications of using different definitions for the variables in the selected countries and cities, and calls attention to the unexploited potential for international comparisons and cross-city analysis to evaluate the impact of public programs in the 1990s. In the process, the paper reexamines some of the misconceptions and propositions that dominate conventional wisdom and policy debate, and draws fresh policy implications from some (surprising) results obtained by looking at each attribute of informality separately.

The paper first presents a brief review of how informality is conceived and measured, and discusses the requirements and challenges of empirical analysis. It then describes the database assembled with census information from selected Latin American countries. Using this information, the next sections address several specific questions related to informality: Is it getting worse? Are the indicators of informality moving in the same direction and pace? What about the alleged triggering effect of titling? Are the improvements in reducing informality general or localized at the city level? Are all cities improving at the same rate? How are

conversion rates distributed among cities? Is urban poverty associated with informality? To what extent are initial poverty conditions associated with better or worse performance in reducing informality? The concluding section summarizes the findings and their policy implications, and suggests new lines for future research on informality.

The Informality Issue

Informality is typically associated with housing inadequacy bearing on at least three realms: the public, relating to access to urban infrastructure and services; the private, pertaining to investments in physical improvements to the house (such as durable materials); and the institutional, as it defines tenure status, including legal protections and/or rights. The definition of informality also involves the cultural sphere as expressed in acceptable land use standards and their corresponding regulations. Housing inadequacy may therefore be geographic and time-dependent.

Indeed, the definition of informality is a moving target. If measured by the percentage of housing without electricity, for example, informality has clearly improved over the last 20 years—indeed, to the point of near-elimination in some Latin American countries. But if measured by full compliance with land use and building regulations, informality remains an enormous problem that can even spill over to high-end settlements such as gated communities and penthouse extensions.

In an effort to tackle the issues at a global scale, UN-HABITAT defined slum households (a surrogate for informality) as a group of individuals living under the same roof lacking any one of the following elements:

1. *access to improved water*: minimum of 20 liters/person/day costing less than 10 percent of household income and requiring less than 1 hour of effort/day;
2. *access to improved sanitation facilities*: excreta disposal system shared with a reasonable number of people;
3. *security of tenure*: evidence of documentation to prove secure status or de facto or perceived protection from eviction;
4. *durability of housing*: built in a nonhazardous location and protecting its inhabitants from the extremes of climatic conditions; and
5. *sufficient living area*: no more than two people sharing a room.

These criteria—especially coming from a credible international institution—were intended to set a minimum standard for housing as well as define outcomes to be used in analyzing the impact of national housing policies. But different countries and institutions design their own indicators according to their needs, taking into account data availability. In practice, indicators are needed to identify and quantify a problem. But recognizing the existence of the problem precedes, or provides the motivation for, collection of the data required to construct the indicator. This interactive process explains why countries differ in the types of data they collect and the improvements in that collection over time. One would thus expect a country's past performance to explain a significant share of the international variance among informality indicators. One of

the merits of the UN-HABITAT effort to measure informality at a global scale—in addition to raising awareness of the problem within the framework of the Millennium Declaration of 2000—is that it sets standards for countries to cope with housing informality, if for no other than international comparison purposes.

An effective operational definition of informality must be connected to a concept that makes it possible to analyze the problem both theoretically and empirically, to propose policies, and to evaluate those policies. To cover its various dimensions, the definition of informality would be a mix of indicators including the quality of the house structure, access to services, security of tenure, and site characteristics. The complexities introduced by these multiple dimensions imply that, by their nature, housing informality indicators are difficult to assemble. Conceptual definitions of variables (such as strength of building materials or hygiene of a septic tank), as well as the criteria used to aggregate and/or weight data collection (such as density within the house or the settlement) are also difficult to come by. These and other technical issues, including the definition of tenure security, add to the complexity of measuring informality—not to mention the inevitable shortcuts required for political or administrative reasons. The difficulty of measurement has important implications for the access, interpretation, and use of informality indicators.

Measurement Challenges: Difficulties Related to Informality Indicators

There are many areas of concern when measuring informality that pertain to information availability, precision, and comparability. Consider that measurable indicators cannot easily capture all the relevant aspects of housing inadequacy suggested by theory. This is particularly evident for attributes associated with the site and its location. Site information is difficult to collect and often absent from typical household surveys.[1] Another obvious missing attribute of location is distance to centers of activity or commuting time.[2] Many housing developments located in distant peripheral areas may add to the stock of social housing but are not always used as such. There is evidence of abandoned new housing by actual or potential buyers who consider them inadequate due to commuting time and cost. These housing developments may therefore be counted as part of the stock of inadequate (informal) houses. Recent estimates (Censo de Población y Vivienda 2010) put the number of new empty housing units in Mexico at around 5 million, out of a stock of 36 million new units, clearly demonstrating the inadequacy of dormitory-type settlements produced by large-scale private developers.

The site dimension is probably the most difficult to measure. As described in case studies and observable from satellite images, slums usually have narrow, unpaved streets or alleys, no street lighting or sidewalks, and irregular layouts, among other characteristics. The geographic characteristics of the site are also important, particularly the slope of the land, the risk of

[1]The Brazilian census attempts to circumvent the problem by including a normal/subnormal classification for the house according to the layout of the settlement where it is located.

[2] Although UN-HABITAT (2005) presents data on travel time for work trips for selected cities, it does not present this information decomposed by slum dwellers and non-slum dwellers, probably because such information is rarely available.

flooding or landslides, and the fragility of the environment. This information is difficult to collect because it is not an attribute of the house or of the household.

The Brazilian census introduced the subnormal category in an attempt to capture the site characteristics of a census block (rather than of the household), although it is somewhat mixed with other dimensions. But this site category does not have a metric for site location. To assess the quality of site location requires identifying the relevant center or centers of activity and defining accessibility by measuring commuting time for family members to reach their jobs, schools, or other recurrent destinations.

Household surveys do not typically ask for site information. Indeed, within Latin America, the Brazil 2000 census is the only survey to include a site-related variable. A few surveys (with smaller sample sizes) do, however, have a categorical variable reflecting commuting time.

In addition to the operational difficulties of measuring site characteristics, the absence of metrics for this dimension likely reflects the lack of theory behind it. In measuring the quality of the land itself, it is important to keep in mind that some locations are simply inappropriate for housing. One extreme example is land below a bridge, which is worth virtually nothing. Land at risk of frequent flooding is another example. The site dimension is difficult to handle theoretically since it requires a discontinuity in the rent gradient. As a result, an advance of theory may be needed, as well as development of appropriate metrics.

Another aspect of the site that is seldom considered relates to hazardous site occupation and layout, such as crowding. Hazardous crowding may occur when areas are occupied at very high densities. For example, a four-story building attached to other housing units and facing a two-meter-wide alley with barely any ventilation or light (typical in many consolidated inner-city settlements) should certainly be considered less than adequate, even though it might comply with all five UN-HABITAT housing standards.

A second difficulty has to do measuring quality of public services, the quality of the house structure, or the level of tenure security. This is a particularly sensitive issue given the nature of the indicator of housing inadequacy used. For example, a house may have piped water but for only a few hours per day; the same may also be true for electricity. Measuring security of tenure may be even more complex. Although researchers often associate tenure security with freehold, a better characterization may be as a "bundle of rights" (Durand-Lasserve and Selod, 2007). Following those authors, the continuum is from no rights at all up to the full bundle, including rights to develop, inherit, transfer, or mortgage the land. In addition to administrative and legal definitions of tenure security, local tradition may provide various levels of tenure rights. This raises the question of *de facto* versus *de jure* formalization of land tenure.[3] Lanjouw and Levy (2002) studied household perceptions while measuring property rights, and concluded that even

[3] The formalization of tenure may even jeopardize customary rights. In the presence of customary rights, titling can increase tenure insecurity "if it becomes unclear which system of rights will prevail" (Lanjouw and Levy 2002, 988).

when perceived security differs systematically from actual security it is the better variable for measuring the importance of tenure security for the household.[4]

Whether a house is rented or not also affects the measurement of tenure security. Although most demographic censuses in Latin America include questions on the type of property, these questions are not standardized across countries. Similarly, most censuses separate tenants from owners, but some (as in Argentina and Brazil) split owners of the land from owners of the structure, as well as non-owners who occupy the house for free with (or without) the consent of the owner. When information on tenure status is split between house and land, it is possible to use ownership of just the structure as a proxy for insecure tenure, but this measure is likely to mix groups with different levels of perceived and actual tenure security. This is not an inconsequential issue because results may vary widely depending on how the survey question is phrased. According to the National Institute of Statistics (INDEC) in Buenos Aires, the percentage of households without secure tenure is 1.37 percent if the measure is defined as households not owning the land they occupy. The share jumps to 10.19 percent if it is defined as the lack of a title or legal document proving one's property right (Smolka and Biderman 2011).

Countries also define the relevant variables in different ways. For example, in most census forms in the eight Latin American countries examined in this paper, security of tenure is associated with the respondents' perception that they own the land they occupy. In other countries and in the criteria adopted by UN-HABITAT, however, the definition is the perception of risk of eviction. Nowhere is "proper documentation" from the respondent used to check tenure status. At the same time, most censuses define sewage services using a much stricter definition than an "excreta disposal shared with a reasonable number of people." Questions asked regarding access to water and to the physical structure of the house show similar discrepancies.

Shortcuts to Deal with Measurement Challenges

To cope with the difficulties mentioned above, most indicators rely on proxies. At the one extreme, they may reduce the number of missing variables using a single "representative" indicator, as when informal land occupation is attributed to all poor or low-income households. Alternatively, indicators measured for one geographic unit (city or country) may be used to make inferences about another. The problem with these procedures is that the proxies are seldom validated by objective information but are instead based on anecdotal evidence or the use of arbitrary criteria.

It is known, for instance, that UN-HABITAT allowed for latitude in the estimates from different countries when rental status was taken as a proxy for tenure insecurity. For countries lacking specific information, UN-HABITAT admits to having developed estimates based on information from other countries. All in all, these shortcuts were inevitable in such a massive effort to develop and implement a methodology for analyzing different household surveys. The downside is that because the treatment of differences in survey questionnaires and design across countries is not transparent, the datasets may not be comparable. On the positive side, however, is that this

[4] A survey of policy officials in Latin America in 2009 indicated that they consistently over or under estimated security of tenure by country and city compared with census data (Smolka and Biderman 2009, 15).

is mostly likely the first time that so many surveys were pooled together. This strategy enabled UN-HABITAT to calculate the number of slum dwellers in 316 countries.

The direction of the bias between UN-HABITAT proxy estimates and actual data available in many of these countries is therefore difficult to assess. Comparing the census forms in Latin America with the criteria used by UN-HABITAT, it is clear that such criteria underestimate informality with regard to sewage provision and overestimates it from the standpoint of tenure security. It remains to be seen whether the mismatch of the five UN-HABITAT criteria and the criteria used in most Latin American censuses over- or underestimates the presence of slums in the region.

Data Used in the Paper

To assess improvements in housing quality during the 1990s, the following analysis focuses on eight countries in Latin America for which information was available for the two periods. The countries are Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, and Venezuela. Since the five largest countries in the continent were included, a large share of the population was considered in the analysis. The countries in the sample represent 44 percent of the total number (18) of countries in the region (excluding the Guyanas) and include about 80 percent of the population of Latin America. The set of countries may nevertheless be biased toward the bigger and richer countries,[5] which are likely to keep better statistics.

Given that informal housing is primarily a concern in urban areas, the analysis also looks at conditions in about 600 cities[6] with more than 100,000 inhabitants. Living in an urban area without a water connection is very different from doing so in a rural area. Indeed, a rural household may have access to water from a spring that is even better than that from the city network. Another reason to work with the sample of cities with more than 100,000 inhabitants is that the urban area tends to coincide with the municipality, which is the administrative level for which data are available. The city sample covers more than 50 percent of the population in each country.

The variables used to measure housing informality include: connection to water and sewage systems; quality of the floor, roof, and walls; and tenure status (see Appendix A for definitions). The variable chosen for tenure status—perceived security of tenure—applies only to households living in their own houses,[7] i.e., is not applicable to renters. This information is publicly available as microdata and REDATAM (Retrieval of Data for Small Areas by Microcomputer), and the census categories are matched for each of the variables (see Appendix C for country-

[5] Notably absent from the list of richer countries are Uruguay and Panama.

[6] The number of cities for which data are available for all variables varies from 619 for water and sewage, 473 for tenure; and 169, 279, and 403, respectively, for the roof, floor, and wall characteristics of the housing.

[7] The tenure variable is split in two. The tenure1 measure uses the total number of households (renters and owners and thus probably understates the extent of informality with regard to tenure unless there are no houses for rent in the informal market, which is not the case. For that reason, we also present indices owners only, referred to as tenure2.

specific definitions). All definitions are binary (appropriate/inappropriate). For example, a household is defined as having appropriate water supply if it is connected to the public water supply network; appropriate sanitation if connected to the public sewage network or to a septic tank; and appropriate tenure security if it reports owning the house as well as the land. Definitions of appropriate ceiling, floor, and wall quality differ widely across countries and some definitions are incompatible.

Each country in the sample carried out and published two censuses in the past two decades,[8] with one conducted close to 1990 and one close to 2000. (Appendix C also provides the census years for each country.) In this analysis, censuses closer to 1990 are referred to as "first-period data" or "1990s," and the censuses closer to 2000 as "second-period data" or "2000s." Because the number of years between the first and second periods is not uniform across countries, it was necessary to compute the geometric annual average change[9] and then average the annual change for all countries. This measures the absolute variation in each item but not necessarily over the exact same period. For example, the rate applies to 1991–2000 in Brazil and to 1993–2007 in Peru.

The primary concern, however, is relative behavior. If the population of a country or city is increasing rapidly, the number of informal houses is unlikely to remain constant. If all countries and cities selected are growing at the same rate, the change would only be in level. This is not the case, however: the population in Argentina was growing 1.1 percent per year in the 1990s, while that in Chile was growing 1.3 percent; in contrast, the pace of growth in most other sample countries was at least 1.6 percent. To analyze relative change in one attribute/index, we estimate the increase in the number of houses with the attribute/index net of population growth.[10]

Addressing the Main Questions

Is Informality Getting Worse?

The results presented in table 1 are striking. As indicated by the net percent change, the proportion of informal housing in Latin America fell by all measures during the 1990s. And for most indices, the decline was in absolute terms. The reduction is more pronounced for the weighted average, indicating that larger countries performed better.

[8] While we were able to collect 2001 census data for Bolivia, we do not have any information for the 1990s. As a result, we cannot use this information in the analysis.

[9] Average growth for variable y is defined as:

$\sqrt[T]{y_{t+T}/y_t} - 1$ Where T is the number of years between censuses.

[10] To measure the net variation, we compute the following index:

$\sqrt[T]{(y_{t+T}/y_t)/(p_{t+T}/p_t)} - 1$ Where p_t is the population in year t.

Table 1: Informality Indices for Selected Latin American Countries (percentages)

Index	Unweighted				Weighted				Share of Latin American Population		Number of Countries
	1990s	2000s	Change	Net Change	1990s	2000s	Change	Net Change	1990s	2000s	
Water	23.4	20.3	0.3	-2.2	22.5	13.8	-2.6	-5.0	78	79	8
Sewage	36.6	21.7	-2.1	-4.7	41.2	26.8	-1.7	-4.1	78	79	8
Tenure1	10.6	5.0	-3.1	-5.8	13.4	5.9	-5.0	-7.5	55	56	6
Tenure2	13.9	6.9	-3.1	-5.6	17.4	7.8	-5.0	-7.6	55	56	6
Roof	51.6	45.8	1.4	-1.3	50.3	39.1	.0	-2.7	25	26	3
Floor	29.0	22.7	-3.2	-4.2	27.6	23.0	-3.6	-4.2	22	23	4
Wall	20.9	19.5	1.7	-0.5	22.5	16.9	-0.7	-2.7	45	47	7

Note: Countries include Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru and Venezuela.

Sources: IPUMS International; ECLAC Redatam On Line Census.

Country-specific results are shown in table 2. Given that the eight countries analyzed cover a large majority of the Latin American population, the weighted average should be close to the continent average, suggesting a general improvement in housing conditions in the region as a whole.

Table 2: Informality Indices for Highest and Lowest Performing Countries (percentages)

Country	1990s	2000s	Change
Inappropriate Water Connection			
Costa Rica	13	3	-5.2
Peru	53	36	-0.1
Inappropriate Sewage Connection			
Chile	30	9	-8.9
Peru	60	41	-0.1
Venezuela	20	14	-0.2
Inappropriate Tenure Security-1			
Argentina	16	4	-11.3
Peru	4	5	4.3
Inappropriate Tenure Security-2			
Argentina	27	6	-11.3
Peru	6	8	4.3
Inappropriate Roof			
Mexico	48	33	-1.1
Venezuela	66	62	2.5
Inappropriate Floor			
Argentina	7	2	-11.4
Peru	57	48	1.4
Inappropriate Wall			
Colombia	17	7	-3.7
Venezuela	23	22	3.3

Notes: Change in a given house attribute is measured as the annual geometric average of change. See Appendix B for a complete list of indices by country.

Sources: IPUMS International; ECLAC Redatam On Line Census.

Access to Water

There was an overall improvement in water provision in the countries in the sample, as well as some convergence among those countries. Indeed, Brazil, Chile, Colombia, and Mexico had a similar proportion of houses (about 10 percent) that were not connected to the public water system in the second period. Argentina and Venezuela fall below that level.

To interpret the second period change by country, it is necessary to take into account the level attained in the first period. For example, Chile ranks fifth in water provision in the second period but started with the best performance in the first period. Costa Rica started at a relatively good level in 1984 and had the best performance among the selected countries, essentially universalizing this service in 2000.

Access to Sewage

Confirming reports from the World Bank and InterAmerican Development Bank, the sample countries apparently invested in their sewage networks during the decade. But although the share of housing with sewage connections increased in almost all countries, the starting point and the pace of improvement vary widely. In all countries except Argentina, coverage expanded at considerable rate. The Chilean effort is impressive, but the Peruvian performance is not, especially considering that Peru ranked last in the first period and would therefore be expected to improve more rapidly. In addition, the second period for Peru is much more recent (2007) than in most other countries, which makes its performance as a whole the second-worst after Argentina.

Tenure Security Perception

The main advance during the 1990s was in tenure security. As noted earlier, tenure is measured as perceived tenure security, not as having a registered property title. It should be noted, though, that the direct cost of providing titles is negligible compared with infrastructure upgrading, and civil society may have played a large role in making eviction more difficult during this period (thus increasing occupants' perceptions of tenure security). These factors may help to explain the two-digit rate of decrease in insecure tenure in Argentina, Brazil, and Costa Rica. In sharp contrast, the number of households in Chile, Colombia, and Peru reporting insecure tenure did not decline in relative terms.

The most unexpected result is for Peru. Although the country conducted a massive titling program in the late 1990s (see Fields 2007 for details), the proportion of households with declared tenure insecurity increased during the period. This may be evidence that such programs encourage (new) households to live in informal housing.[11] It may also be the case that formal titling is much clearer in Peru, so perceptions may relate more closely to actual title status.

[11] In theory, a comprehensive titling program may signal that any invasion will eventually be legalized. This may reduce the uncertainty of the return to invasion and thus increase its expected return (Smolka and Biderman 2011).

Again, considering that the first period for Peru is 1993 and the second is 2007, it is possible that the concept changed as a result of the massive titling program.[12]

The question remains why security of tenure perception increased so rapidly in Argentina, Brazil, and Costa Rica. In the case of Brazil, one possible explanation is that the new constitution of 1988 shortened the period for adverse possession from 25 to just 5 years for occupations of private lands, and even some rights over illegal occupation of public land (*Concesão real de direito de uso*). These provisos may have enhanced considerably the perception of legitimate occupancy, thereby boosting affirmative responses to the question of whether the occupant "owned" the land.

It is also interesting to note that Argentina performed well on this indicator while performing poorly on the infrastructure dimension. In contrast, Chile made only slow improvement in reducing perceived insecurity of tenure but led the increase in serviced land, probably reflecting the massive investments in social housing made over the decade. Colombia presents a similar pattern, with one of the largest gains in serviced land but a relatively small improvement in perceived security of tenure.

Private Investment in Home Improvements

The results for private investment in home improvements are somewhat surprising.[13] Although the overall appropriateness of roofs, floors, and ceilings did increase, the improvement occurred at a very slow pace. Given that the government typically funds the bulk of public infrastructure services and titling, this seems to suggest that the public sector invested more in low-income housing than the owners themselves. These results may indicate either that the lack of private resources is greater than believed or that the investment preferences of households are below government standards. In the case of Brazi,.this evidence seemingly contradicts Dowall's longstanding argument to the effect that "although dwelling unit production is satisfactory relative to household formation, the provision of infrastructure and urban services is unsatisfactory" (Dowall 2007, 405). However, Dowall's assertion is about the number of dwellings, not their quality.

Looking at cities with more than 100,000 inhabitants, table 3 shows that all measures point to a relative reduction in informal housing. Since large cities were growing at a slower pace in the 1990s than small cities, the difference between the absolute and relative change is more pronounced in this city sample.

[12] In 1993, we define the lack of tenure security in Peru as households declaring that they owned their houses by "their rights" (*ocupada de hecho*); in 2007, we define the lack of tenure security as households declaring that they had invaded the land (*propria por invasion*) because the census bureau changed its definition. In Chile and Colombia, the definition is "owned for free" (*gratuita* and *vive sin pago alguno,* respectively). Although the definitions are not exactly comparable across countries, they do reveal the occupants' perceptions of tenure security.

[13] Unfortunately, Brazil did not include questions on private investment in its 2000 census even though use of inadequate materials was still widespread in 1991. As a result, it is unclear how close the (weighted) sample is to the Latin American total.

Table 3: Change in Informality Indices for Large Latin American Cities (percentages)

Index	Unweighted				Weighted				Share of Latin American Population		Number of Cities
	1990s	2000s	Change (*)	Net Change	1990s	2000s	Change (*)	Net Change	1990s	2000s	
Water	15.6	13.4	-4.7	-7.6	11.0	7.9	-4.5	-7.5	42	44	619
Sewage	30.7	20.6	-2.9	-5.7	24.9	15.9	-3.0	-5.9	42	44	619
Tenure1	12.9	4.6	-7.7	-10.4	13.1	5.0	-6.5	-99.3	30	32	473
Tenure2	16.7	6.1	-7.7	-10.4	17.1	6.7	-6.5	-9.4	30	32	473
Roof	42.7	33.1	-0.7	-3.8	35.1	27.5	-0.7	-3.8	13	13	169
Floor	14.5	13.0	-0.4	-2.5	13.6	14.3	.0	-2.4	15	16	279
Wall	12.9	10.8	2.0	-0.5	10.5	8.8	1.2	-0.9	24	26	403

Notes: Selected cities had at least 100,000 inhabitants in the 2000s. Change in a given house attribute is measured as the annual geometric average of change.

Sources: IPUMS International; ECLAC Redatam On Line Census.

At this pace of improvement, the problem of informality in large Latin American cities would be essentially eliminated by 2010 when, on average, just 2 percent of houses would be without water connection, 4 percent without sewage, and 1 percent with perceived tenure insecurity. This trend is similar to that observed for electricity in the previous decade. In cities with less than 100,000 inhabitants, though, the problem with water and sewage connections would still be considerable. Keeping the rate of improvement constant, 9 percent of houses in smaller cities would not be connected to the general water system in 2010, 19 percent would not have adequate sewage, and the use of inadequate materials would also be quite widespread. Nevertheless, perceptions of insecure tenure would have fallen to 2.7 percent even in small cities.

Comparing results at both the country and city levels, the trends are generally but not always consistent. For the country as a whole, Colombia made a considerable reduction in the share of houses without water connections, from 30 percent to 11 percent, over the decade. At the city level, though, the proportion of homes without water service edged up from 10 percent to 11 percent. In Costa Rica as well in the 10 cities with more than 100,000 inhabitants, the share of housing without water access fell from a low 7.8 percent to 2.9 percent. In both cases, the percentage of households lacking water in small and large cities converged. In Costa Rica, service access was almost universal; in Colombia, it seems to have stalled at an unacceptably high rate.

In Chile, Brazil, Mexico, and Costa Rica, the proportion of households connected to the water system in large cities is similar to the country average. As expected, the level of inadequacy is lower in the second period. Large cities in Chile had the smallest share of households without water access, ending the period at just 2.5 percent.

In terms of sewage connections, the best performance for large cities was found in Costa Rica, Chile, and Mexico. Chile started out with the highest standards and outperformed all countries in making water and sewage coverage almost universal in large cities. Peru's performance in sewage connections for large cities was reasonable but still below that of the top-ranking countries. Improvement in Brazil was moderate, close to that of Colombia but starting from a worse position.

The perception of secure tenure in large cities increased at a rapid rate. Perceived insecurity of tenure dropped by 6.7 percent during the decade. This is true whether the sample is weighted or not. Peru still presents a puzzle in that the reduction in insecure tenure in large cities was slower than that in the three top-performing countries. It would be of interest to check after release of 2010 censuses for these countries whether the last decade confirms the trend. At this point, we can only speculate that it may not have. Factors like the democratization and institutional changes of the 1990s might have had a role in boosting the legitimization of informal occupations in several countries in the region, but possibly not in subsequent years.

As noted earlier, the indicators for private investment in housing showed the least improvement for the countries as a whole. In large cities, the fastest rate of improvement was observed in roofing (-3.8 percent), which is still less than in the expansion of sewage connections and significantly less than the gains in water provision and tenure security. The outcomes are similar when the sample is weighted by city population.

Contrary to widespread belief, informality in Latin America has fallen by any of the measurements adopted in this paper. This does not, however, mean that it is falling at the same rate in all places and this evidence says nothing about the likely causes of the improvement.

Are All Indicators of Informality Moving Together? Assessing Alleged Triggering Effects of Titling

Table 4 shows the correlations between indicators of levels of informality across cities. If there was a perfect correlation among all indices we could use one of them, or a linear combination of them, as an indicator of housing informality.[14] If the indices are not correlated, however, we have no idea what a combination of indices would reveal.

The two indices for infrastructure services—water and sewage connections—are considerably correlated (55 percent). As expected, the indices for tenure security are highly correlated (99 percent), but only weakly correlated with the proportion of households not connected to water or sewage systems. This means that relying on perceived security of tenure as an indicator for adequate infrastructure services would be senseless. The weak correlation between infrastructure services and security of tenure also suggests that upgrading programs have not accompanied titling programs in Latin American countries. While proponents of titling programs were inspired by De Soto's ideas that secure tenure would prompt private investment in housing, the evidence does not support this claim. The correlation between these variables is insignificant with the exception of the index for inappropriate roof (which is still below 50 percent).

[14] This assumes the UN-HABITAT criteria that any household outside the threshold for any single index would automatically be counted as informal (a slum unit).

Table 4: Correlations between Informality Indices

	Water	Sewage	Tenure1	Tenure2	Roof	Floor	Wall
Water	1.000						
Sewage	0.552	1.000					
Tenure1	0.137	0.402	1.000				
Tenure2	0.117	0.368	0.990	1.000			
Roof	0.050	0.264	0.491	0.491	1.000		
Floor	0.085	0.070	0.064	0.078	0.130	1.000	
Wall	0.325	0.197	0.007	-0.018	0.577	0.284	1.000

Sources: IPUMS International; ECLAC Redatam On Line Census.

In fact, the indices for private investment in home improvements are weakly correlated with the other indices except inadequate roofing, which is more closely correlated with security of tenure.[15] The higher sensitivity of roofing to tenure may reflect the densification of consolidated informal settlements. where top surfaces of houses are sold as land to other parties or built on by owners to accommodate extra family members or produce rental units.[16] In this sense, the indices may more closely support De Soto's claims.

Are the Improvements Generalized or Localized at the City Level?

Using a sample of cities makes it possible to analyze the distribution of each index. Although all indices of informality improved during the 1990s, the average rate of improvement varied greatly. And the dynamic by country is also very specific depending on the index chosen. As discussed earlier, the indices are proxies for three dimensions of informality. They are in general well correlated within each dimension (except adequate roofing in the house quality dimension), but weakly correlated between dimensions. As a result, we can choose one variable to represent each dimension.

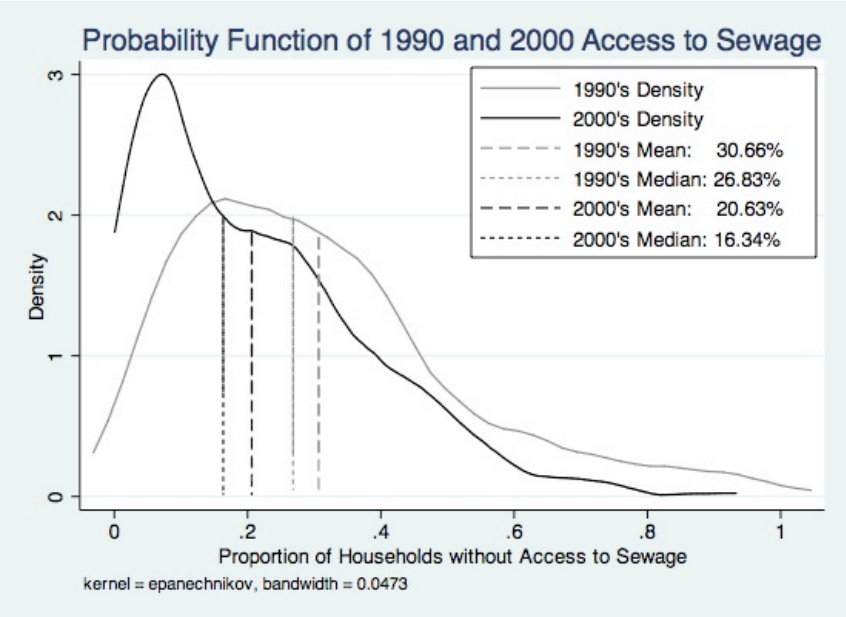
For the following analysis on the performance of cities, sewage connection represents infrastructure services since it is more difficult to supply sewage than water service. We use tenure2 (owner-occupied houses) because tenure1 (including both owners and renters) will underestimate the index. And we use walls for private investment in the house since it is the single indicator for private investment in the house that is more correlated with the other two (floor and roof). The following graphs present the probability density functions (pdfs) for these three variables in the two periods analyzed.

[15] The surprisingly low correlation between adequate roofing and adequate floors and walls possibly reflects the fact that data on roofing are available for only three countries and on floors for just four countries.

[16] Abramo (2006) has found a flourishing rental market in the consolidated informal settlements of six major Latin American cities (Bogota, Buenos Aires, Caracas, Lima, Mexico DF and Rio de Janeiro).

The distribution function for access to sewage service, shown in graph 1, is asymmetrical in both periods and biased toward low values, but the pdf changed considerably. In the 1990s, the function rose steadily (up to 16 percent) and then decreased slowly. In the 2000s, it was growing very rapidly (up to a peak around 10 percent), followed by a monotonic decline. For this index, many more cities reached the minimum value zero in the second period than for the other two indices.

Graph 1

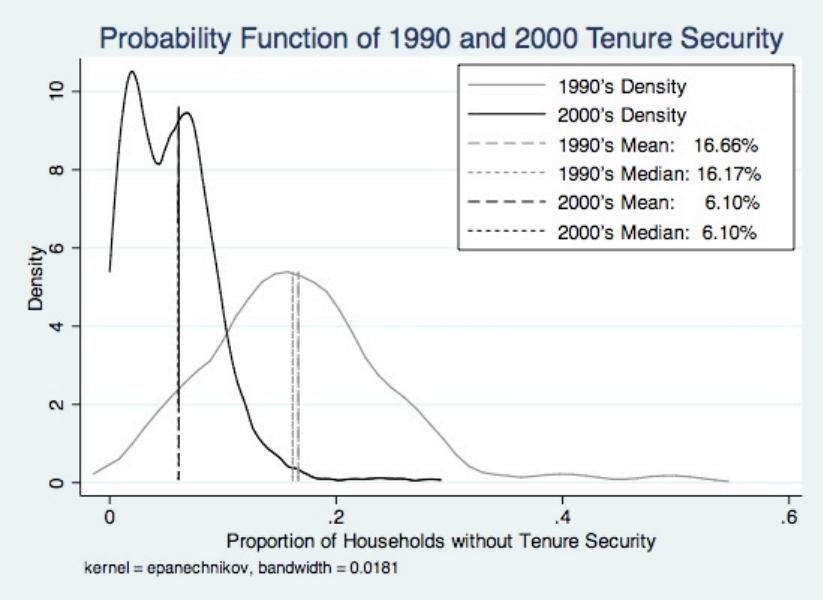


Sources: IPUMS International; ECLAC Redatam On Line Census.

The probability density function for insecure tenure in graph 2 shows a shift to the left in the entire distribution as well as a dramatic increase in the number of households perceiving that they had secure tenure. In the second period, there is virtually no city in the sample where more than 20 percent of households perceived their tenure as insecure.

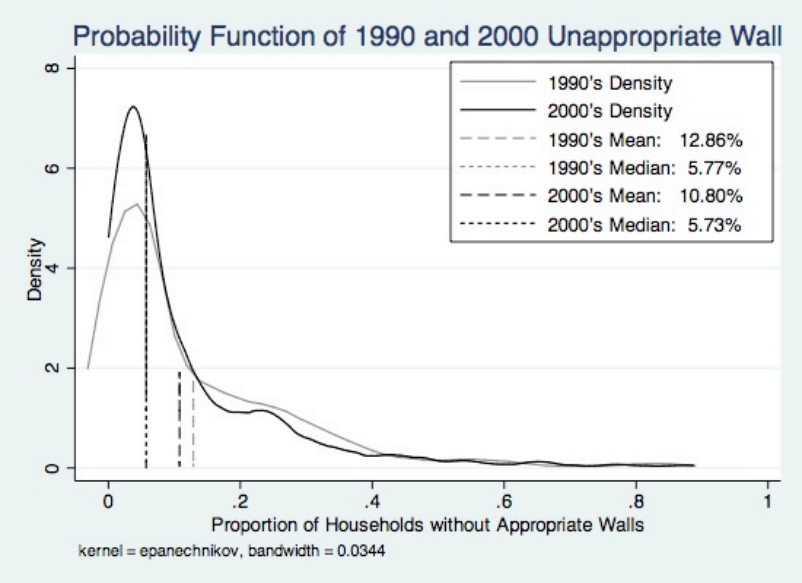
The dynamics for inappropriate walls, presented in graph 3, differ from those for the two other indices. The shift is concentrated in the lower end of the distribution and is almost unchanged to the right of the median. Unlike the other indicators, private investment in housing improved very slowly relative to other attributes. And the improvements have been concentrated at the upper end of the market, i.e., in cities with a small stock of housing with inappropriate wall materials.

Graph 2



Sources: IPUMS International; ECLAC Redatam On Line Census.

Graph 3



Sources: IPUMS International; ECLAC Redatam On Line Census.

While the analysis of the distribution of the indices reveals something about each dimension, it still leaves some major questions. First, how does population affect the distribution of each index? Are the problems more concentrated in small or large cities? Are they uniformly distributed by city size? To answer these questions, graphs 4–6 in Appendix D depict the cumulative distribution of each index conditional on cumulative city population for each period. As in the Lorenz curve for income, if the distribution were totally uniform by population, we

would observe a 45-degree line in this relationship. Thus, if the problem were concentrated in smaller cities, the actual function would be above the 45-degree line and below otherwise.

We note in graph 4 that the proportion of households without access to sewage connections is more concentrated in large cities, a situation that did not change in the decade analyzed. This may reflect the fact that lower-cost septic tanks might be used more frequently in smaller cities. The situation is practically unchanged with respect to tenure, as shown in graph 5. For cities with more than 100,000 inhabitants independent of the size of the city, the proportion of housing lacking tenure security in both 1990 and 2000 was very much uniform. These results are consistent with recurring policy effectiveness: it is not the size of the city that would determine its tenure security but rather some exogenous change triggered perhaps by appropriate housing policies.

For inappropriate walls, the cumulative distribution conditional on population changed considerably in the last decade (graph 6). In the 1990s, medium-large cities were accumulating more housing with inadequate walls than large cities. The reverse is observed in the 2000s when large cities accumulated a relatively larger proportion of housing with inadequate walls. This may reflect the fact that secondary cities were growing more rapidly than large cities during the 1990s. If their relatively faster growth reflected better economic conditions (lower poverty levels and higher family incomes), one would expect more improvement in private housing investment in medium-large cities than in large ones.

Are All Cities Improving at the Same Rate? What Is the Distribution of Conversion Rates among Cities?

We now examine the links between improvements in the second period, taking into account the initial level. The question now is whether cities with larger stocks of inadequate housing reduced the proportion of such housing at a faster or slower rate, with the former implying a convergence to a common standard or zero at the limit.

To assess convergence of the indices toward the minimum level zero, we need to compare the initial proportion of inappropriate housing to its rate of change. Since we expect fast-growing cities to increase the absolute number of households with inadequate housing, the analysis must focus on changes in the relative proportion of households lacking some attribute. That is, we need to compare the initial share of households with inadequate housing to its net change, as defined previously on tables 1 and 2. Graphs 7–12 in Appendix E show these two relationships for each index. To determine the rate of convergence, we use an exponential decay model and report the "half-life" for each index to converge to zero.[17]

---

[17] The half life was estimated running the following regression: $\frac{1}{T_i}\left(\ln(y_{i,t2}) - \ln(y_{i,t1})\right) = \lambda \ln(y_{i,t1}) + \varepsilon_{i,t}$ where $y_{i,tJ}$ is the index under analysis for city i in period J; T_i is the time elapsed between $t1$ and $t2$ for city i; $e_{i,t}$ is a random error with the desired properties and $\lambda \equiv (e^{-\beta \overline{T}} - 1)/\overline{T}$ with b representing the exponential decay. The half-life conditional on population growth is given by running the same regression but adding (log of) population to the regression, while conditioning on both population growth and poverty change would mean adding (log of) the number of households bellow the poverty level.

This analysis shows that the proportion of inadequate houses is converging (to zero) at a very slow pace, even though at the aggregate level we observe a reduction in the average and in the median for lack of sewage connection and insecure tenure, and a smaller reduction in the average proportion of inadequate housing structures. Evidently, zero convergence might be too stringent. There might be a residual in the housing market similar to the "natural or frictional" vacancy rate or unemployment rate.

In any case, it is fitting to ask why the proportion of inappropriate housing is converging so slowly. Reconciling this evidence with the consistent reduction in the average and median values for sewage provision and tenure security, one is led to conclude that the improvement is happening in cities where conditions were relatively better. Even for private housing investment, the mean hides the fact that the improvement is concentrated in some cities that were already performing relatively well. Conversely, cities with widespread housing informality might be trapped in that situation. To illustrate the slow pace of convergence, table 5 presents absolute convergence, conditional on population growth, and conditional on population growth and initial poverty level for a sample of Brazilian cities with more than 100.000 inhabitants.

Table 5: Convergence Timing for Large Brazilian Cities

Measure	Half-Life (Years)		
	Sewage	Tenure	Wall
Absolute Convergence	203	75	Divergent
Convergence Conditional on Population Growth	126	55	868
Convergence Conditional on Population Growth and Initial Poverty	94	55	N/A

Note: Selected cities had more than 100,000 inhabitants in 2000s

Sources: IPUMS International; ECLAC Redatam On Line Census.

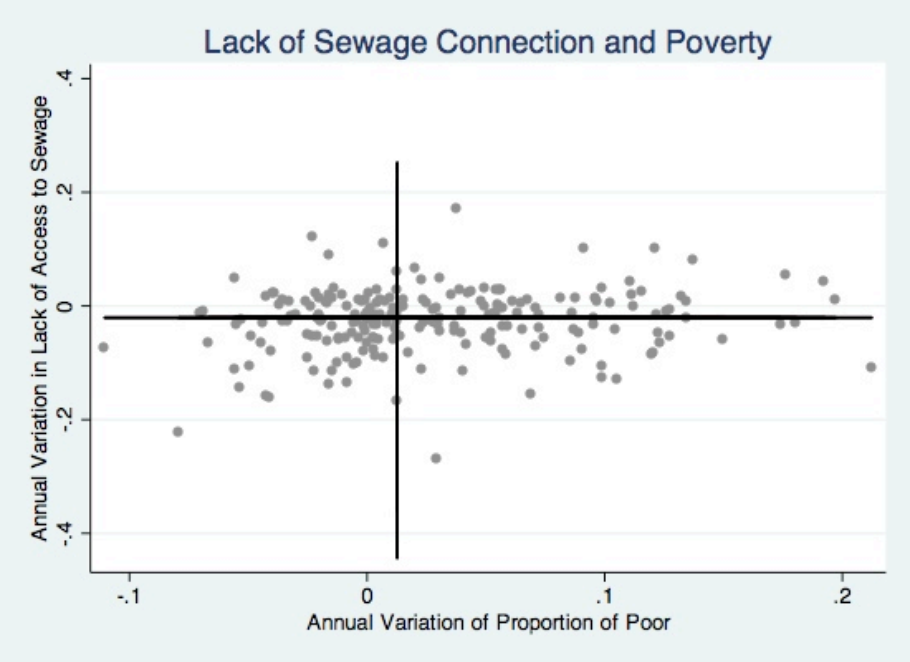
This exercise focuses on Brazilian municipalities because city-level poverty data are not available for the other countries. Although conditioning on population growth reduces the number of years considerably (especially for sewage connections), the convergence time is still quite high. Therefore, even if all cities stop growing and eradicate absolute poverty, it would take more than a century to reach a point in which no house is below the established standard. Thus, it seems that the problem of housing informality in Latin America resides not in the aggregate number of inadequate homes, but rather in cities trapped with a high and persistent proportion of inappropriate housing. We note further that conditioning the improvement on initial poverty level does not substantially accelerate the process. This result likely reflects the fact that lack of sewage and of tenure security does not overlap with poverty, making initial poverty level basically irrelevant to the initial sewage and tenure conditions.

Is Urban Poverty Associated with Informality? To What Extent Can problems of Better- and Worse-Performing Cities Be Attributed to Initial Urban Poverty?

If poverty at the city level were closely associated with informality, falling poverty rates would accelerate the reduction in inadequate housing. But the above analysis indicates that this is clearly not the case. In fact, as we now show, the connection between housing informality

indices and poverty is apparently not as straightforward as often mentioned in the literature. Graphs 13 and 14 compare the variation in the proportion of poor households with the variation in the proportion of households lacking sewage connections and secure tenure. Both graphs are indeed impressive in showing that there is no correlation between changes in the proportion of population below the poverty line and changes in these two dimensions of informality. As a matter of fact, the correlation of the change in poverty with that in sewage coverage and in tenure security is just 0.1448 and 0.1999, respectively. Similarly, Graphs 15 and 16 show that there is no correlation between change in income and changes in sewage connection or lack of tenure security.

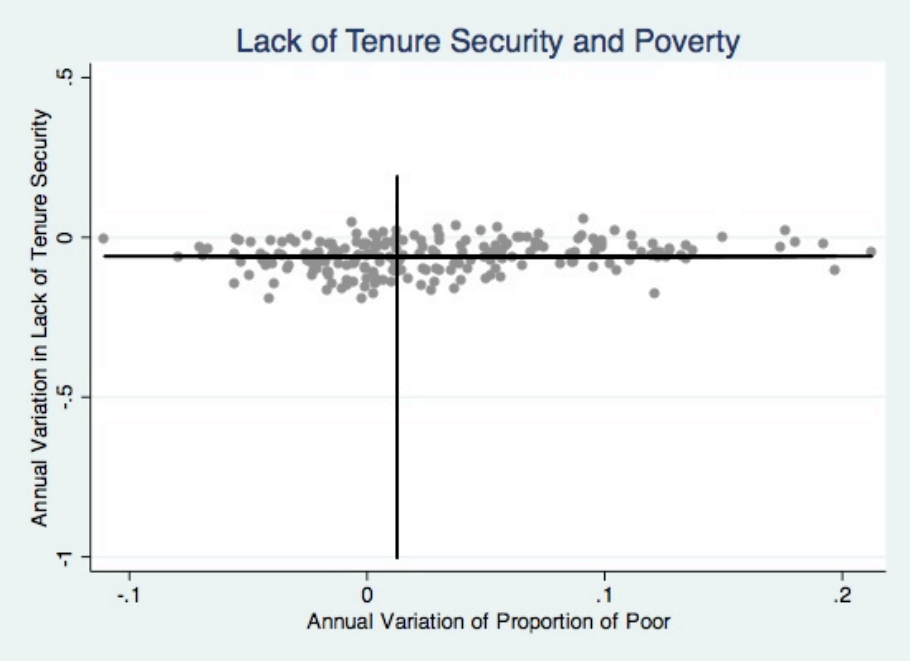
Graph 13



Source: Brazilian Demographic Census, Micro Data Sample (IBGE).

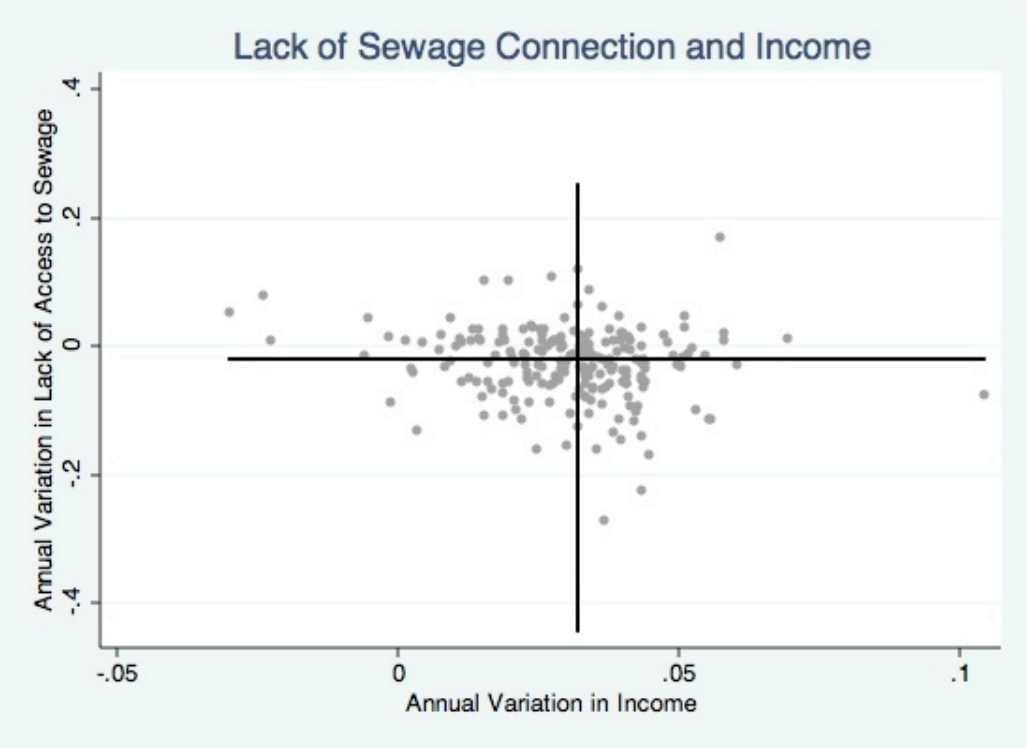
This analysis reinforces the argument made by Smolka and Biderman (2011) that the causes of—and therefore solutions to—informality are not intrinsically connected to urban poverty. This leaves room for more complex arguments that the (dis)function of urban land markets could be playing a larger role in informality. Conversely, improvements in services provision or titling could mitigate informality but not necessarily urban poverty. The corollary is even more far-fetched, since income policies and other means to increase payment capacity may not reduce informality if the market or public policies cannot provide a sufficient supply of serviced land at affordable prices.

Graph 14

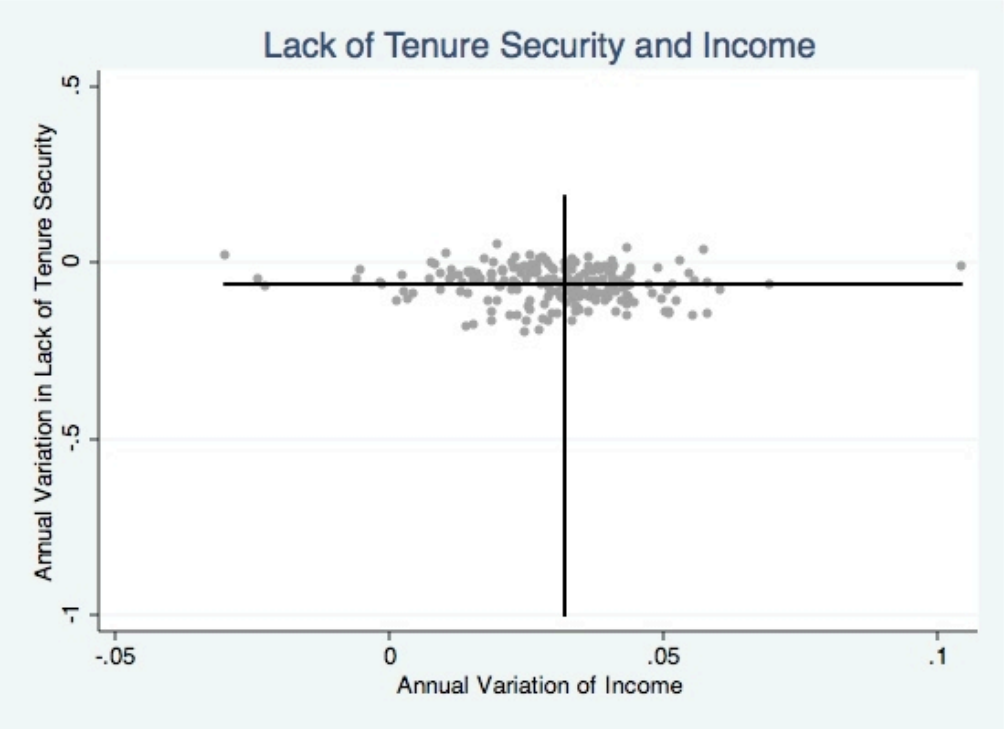


Source: Brazilian Demographic Census, Micro Data Sample (IBGE).

Graph 15



Graph 16



Informal Groups: You See One, You See Them All?

Using data from the 1991 and 2000 Brazilian censuses, this section presents a housing typology based on different combinations of three attributes used as proxies for informality—lack of access to infrastructure (measured by the lack of connection to the general sewage network or septic tank); insecure tenure (measured by ownership of the house but not of the land); and noncompliance with urban standards (measured by census block type, with subnormal equated with inadequate).[18] The house structure (building materials) is not included because the 2000 Brazilian census did not ask questions about this dimension of housing quality.

Combining the three variables and splitting the groups between owners and renters creates 12 possible housing types. The census asks owners of houses if they also own the land. By the definition adopted here, there is thus no rental housing with insecure tenure. In 2000, this variable was split in two and since it then became possible to decompose ownership of the house and ownership of the land.[19] Again, we are analyzing reported ownership that is not supported by documentation, since the census does not ask for proof.

[18] In Brazil, a block is considered subnormal if it meets the following conditions: (1) a nucleus (group) is made up of more than 50 housing units; (2) the land occupation is illegal; and (3) either (a) the development pattern is disorderly, or (b) the block lacks essential public services and utilities. The subnormal definition thus captures the hazards of the site.

[19] In 1991, it was not possible to know if the owner did not own the land because it was given to him by someone (e.g., the government) or for other reasons such as invasion. The 2000 definition provides more details on the rights over the land. However, to make it compatible, we use only the broader category.

In table 6, each of the 12 housing types is assigned a letter: type A stands for owner-occupied houses in a normal census block with sewage service and secure tenure; type B is identical except that the occupants are renters. These two types of housing meet the minimum standards implicit in the UN-HABITAT definition of informality. All other types would be considered slum housing. Indeed, if one defines types C through L as inadequate housing, about 48 percent of Brazilian households lived in slums in 1991 and 35 percent in 2000—similar to the shares calculated by the UN (45 percent and 37 percent, as shown in table 1).

The share of type A housing increased sharply over the decade, up from 39 percent to 53 percent. In contrast, the share of type B units fell slightly, suggesting that some renters in the formal market bought the houses they formerly rented.

The largest proportional decline was in the group of owner-occupied houses with secure tenure, located in normal census blocks but without sewage connections (type E). It is probably the case that the increase in the proportion of type A owners came from the expansion of sewage service affecting this middle group of the housing market in 1990s. It is nevertheless puzzling why this group has not increased the size of the (formal) rental market. And it is hard to believe that this behavior would have no impact on the rental price in the formal housing market. This is troubling since it may mean that people without access to the credit market but able to make monthly rent payments are less able to find adequate-quality housing.

Table 6: A Typology for the Housing Market in Brazil

Perceived Property Rights	Service	Block Type	Tenure Status	Type	Rent (*)	Proportion %		Income (**)		Urban %	
						1991	2000	1991	2000	1991	2000
Yes	Yes	Normal	Owner	A		38.7	53.0	1,783	1,502	96	90
			Rental	B	321	13.0	12.3	1,559	1,383	99	99
		Subnormal	Owner	C		0.6	1.6	785	634	97	99
			Rental	D	253	0.2	0.2	753	621	99	99
	No	Normal	Owner	E		31.5	21.7	606	670	59	71
			Rental	F	155	5.2	3.0	684	689	93	94
		Subnormal	Owner	G		1.1	0.6	532	497	84	97
			Rental	H	183	0.2	0.1	510	487	95	99
No	Yes	Normal	Owner	I		1.9	4.0	989	627	94	73
		Subnormal	Owner	J		0.9	0.7	704	590	98	100
	No	Normal	Owner	K		4.7	2.3	340	422	45	66
		Subnormal	Owner	L		2.0	0.5	538	493	92	99
Country Average					272	100.0	100.0	1,185	1,188	82	86

Notes: (*) Declared average rent is in December 2000 reais.
(**) Average household monthly income is in December 2000 reais.

Sources: Brazilian 1991 and 2000 Demographic Census, authors' tabulations using Micro Data Sample (IBGE).

The shares of owner-occupied houses with sewage connections and secure tenure but located in subnormal census blocks (type C) increased over the decade, as did those of owner-occupied houses with sewage connections but lacking secure tenure, located in normal census blocks (type I). This suggests that the sewage network was extended to untitled houses, even though urban

regulations in Brazil generally bar municipalities from providing infrastructure in areas that are illegally occupied. With re-democratization in the 1990s, however, the pressure to serve such areas increased considerably, which highlights the importance of the political side of housing informality.

Table 6 also reveals the social stratification in Brazil's housing market. The average income of type A and B households is more than twice that of the other types. But even though types A and B are better off, it is not clear that the other types form an income hierarchy. One advantage of using disaggregated data is that it allows comparisons of one attribute while controlling for the others. For example, to analyze the impact of infrastructure provision, one can compare types A versus E; B versus F, C versus G, etc. In these comparisons, one notices that the difference between households with sewerage connections and those without is highly stable. This is surprising given that one would expect a reduction in this difference. Similar comparisons can be made for security of tenure and compliance with urban regulations.

It is revealing that the group lacking only secure tenure (type I) had the highest average income in 1991 among the groups that lacked at least one attribute of housing quality. This is clear from comparing the income of this group with that of other groups lacking only one attribute (types C and E). These groups possibly include middle- and even upper-middle-class households living in untitled housing, which is not unusual in Brazil. Moreover, although type A and B households have the highest income, it does not follow that households lacking all three housing quality attributes (type L) are necessarily the poorest. Given that renters in all groups tend to have lower incomes, the last statement may even be underestimated.

Looking at the distinction between rural and urban households, it is worth noting that part of the increase in sewage coverage took place in rural areas, since the proportion of type A urban households decreased from 1991 to 2000. This result may be a distortion arising from the definition of the urban boundary by municipalities. Ideally, the analysis would include high-end settlements as well as slums located at the periphery of metropolitan areas, with both types of developments probably motivated by the opportunity to avoid urban regulations.

To facilitate the analysis, we focus on the subset of cities with more than 100,000 inhabitants and compress the typology by aggregating a few types. Table 7 presents these types by income level.

The municipalities with more than 100,000 inhabitants represent about 10 percent of Brazilian cities and include 45 percent of the population. Comparing tables 6 and 7, the increase in adequate housing occurred more slowly in large cities than in the country as a whole. The improvement was also slower than in smaller cities, even though the share of type A households in smaller cities is lower than in larger cities. Using a definition of informality similar to that of UN-HABITAT, the number of slum dwellers in large cities only decreased from 31 percent to 25 percent, compared with a drop from 48 percent to 35 percent in the country as a whole

Table 7: A Typology of the Housing Market in Large Brazilian Municipalities[1/]

Type	Rent [2/]	Proportion %		Income [3/]		Urban %	
	1991	1991	2000	1991	2000	1991	2000
Titled, Served, Normal, Owner (type A)	---	50.5	59.1	2,108	1,961	98	98
Titled, Served, Normal, Rental (type B)	366	18.9	16.1	1,720	1,593	99	99
Untitled, Served, Owner (types I&J)	---	5.6	8.0	933	753	98	98
Tenure Security, Not Served, Owner (types E&G)	---	15.2	11.9	858	748	89	93
Tenure Security, Not Served, Rental (types F&H)	197	4.2	2.1	769	691	97	97
Tenure Security, Served, Subnormal, Rental (typeD)	265	0.3	0.5	759	625	98	99
No Tenure Security, Not Served, Owner (types K&L)	---	5.4	2.4	562	502	93	95
Country Average	335	100.0	100.0	1,636	1,594	97	98

Notes: 1/ Table refers to cities with more than 100,000 inhabitants in the 2000s. 2/ Declared average rents are in December 2000 reais. 3/ Average household monthly income is in December 2000 reais.

Source: Brazilian 1991 and 2000 Demographic Census, Micro Datta Sample (IBGE).

The typology in table 7 clearly shows that the bottom group, comprising households living in houses without secure tenure and without infrastructure services, have the lowest income. As usual, the incomes of households living in rented houses are lower than those of owners. But renters living in houses not connected to sewage systems but with secure tenure have incomes about 90 percent of those of owners—suggesting that there is less distinction between owners and renters living in lower-quality housing.

Table 7 also suggests that gaining access to sewage service is more difficult than improving perceived tenure security, even though the share of owners living in their own houses with insecure tenure in normal census blocks in large cities increased over the decade from 5.6 percent to 8 percent. This is also true for Brazil as a whole, where the share jumped from 2.8 percent to 4.7 percent. These results confirm that sewage services were extended to untitled houses in Brazil during the 1990s as observed in the more disaggregated typology. In sum, the typologies help highlight the fact that it is not possible to define informality using dichotomous variables, because doing so masks important changes across dimensions (or attributes).

Conclusion

A clear definition of housing informality is essential for policy evaluation, for making inter- and intra-country comparisons, and for designing public interventions that are effective in reducing informality. And how informality is defined affects all of these applications.

A measure of informality that aggregates its different dimensions—such as the one devised by UN-HABITAT—is extraordinarily useful in drawing attention to the problem and in placing informality on the international agenda. An aggregated measure of informality, however, hides the fact that countries define informality based on different criteria, measure its incidence using indicators that are not necessarily comparable, and give different weights to those indicators.

The proportion of inadequate housing in any given city or country, or groups thereof, changes over time and at different rates. Another feature of the dynamics of informality is that cities grow at a different pace and city size affects the incidence of informality.

All in all, this paper suggests that informality is decreasing in Latin America but not in all places or at the same rate. At the aggregate level, housing informality has fallen in relative terms for every dimension analyzed and in absolute terms in almost all countries in our sample. It is decreasing more rapidly with respect to security of tenure, but the aggregate performance of infrastructure provision is also very good; the improvement in private housing investment is somewhat slower than in either of those dimensions.

Despite the observed improvement in aggregate performance, however, cities are converging to eradicate housing informality at a very slow pace for all dimensions analyzed. To reconcile these trends, one must consider not only the significant variation across cities, but—even more important in light of the consistently good performance of many cities—that some cities may be trapped in a very bad equilibrium with a persistently large stock of informal housing. This trap does not seem to be connected to poverty. The apparent inertia also suggests that cities that have improved most in the past continue to do so in the present. The reduction in informality might result from deliberate/organized interventions, meaning that public policy does matter. But it also suggests that the local political will to implement effective policies is more important than general processes affecting all cities.

A new batch of census data from around 2010 will become available in many countries quite soon. These new data should allow the updating of the analysis presented in this paper and a reevaluation of the critical propositions made herein. Three points in time provides a much better sense of secular trends than two. The contribution of this paper is to provide the blueprint for comparative international and cross-city analysis using disaggregated data. We are convinced that revisiting this set of issues with fresh new data could be very useful for informing and improving land policy aimed at reducing informality.

References

Abramo, Pedro. 2006. *Características estruturais do mercado informal de solo nas grandes metrópoles latinoamericanas*. Unpublished manuscript submitted to the Lincoln Institute of Land Policy.

———, ed. 2009. *Favela e mercado informal: A nova port de entrada dos pobres nas cidades brasileiras*. Porto Alegre, Brazil: Coleção Habitare/FINEP.

Dowall, David E. 2007. Brazil's urban land and housing markets: How well are they working? In *Land Policies and their Outcomes*, eds. Gregory K. Ingram and Yu-Hung Hong. Cambridge, MA: Lincoln Institute of Land Policy

Durand-Lasserve, A., and H. Selod, 2007. *The formalization of urban land tenure in developing countries.* World Bank 2007 Urban Research Symposium, May 14–16, Washington DC.

ECLAC Redatam On Line Census. http://www.eclac.org/cgi-bin/getProd.asp?xml=/redatam/noticias/paginas/7/13277/P13277.xml&xsl=/redatam/tpl/p18f.xsl&base=/redatam/tpl/top-bottom.xsl.

Fields, E. 2007. Entitled to work: Urban property rights and labor supply in Peru. *Quarterly Journal of Economics* 122(4):1561–1602.

IPUMS International. https://international.ipums.org/international.

Lanjouw, Jean O., and Philip Levy. 2002. Untitled: A study of formal and informal property rights in urban Ecuador. *The Economic Journal* 112 (October), 986–1019.

Smolka, Martim O. and Ciro Biderman, 2009. Measuring informality in housing settlements: Why bother? *Land Lines* 21(2):14–19. Cambridge, MA: Lincoln Institute of Land Policy.

———. 2011. Housing informality: An economist's perspective on urban planning**.** Working paper. Cambridge, MA: Lincoln Institute of Land Policy.Forthcoming as Chapter 35 in *Oxford Handbook of Urban Economics and Planning*, N. Brooks, K. Donaghy, and J. G. Knaap, eds. Oxford University Press, NY.

UN-HABITAT. 2003a. *The challenge of slums: Global report on human settlements 2003*. London and Sterling, VA: Earthscan Publications Ltd.

———. 2003b. Slums of the world: The face of urban poverty in the new millennium? Working paper. Nairobi, Kenya: UN-HABITAT.

———. 2005. *Financing urban shelter: Global report on human settlements 2005*. London and Sterling, VA: Earthscan Publications Ltd.

Appendix A: Definition of Variables

Water Connection	% of households with water connected to the general network
Sewage Connection	% of households connected to the sewage network or to septic tank
Tenure Security-1	% households that own both the structure and the land
Tenure Security-2	% households that own both the structure and the land relative to total households living in their own houses
Appropriate Roof	% households with roof made from tiles, cement or concrete
Appropriate Floor	% households with roof made from cement, tile, stone, vinyl, brick or other finished, n.e.c.
Appropriate Walls	% households with walls made from wood, brick, block, stone, or cement

Appendix B: Informality Indices by Country

(percentages)

1.1 Inappropriate water connection

Country	1990s	2000s	Change*
Argentina	23	20	-0.5
Brazil	20	10	-4.3
Chile	14	9	-2.1
Colombia	29	11	-3.8
Costa Rica	13	3	-5.2
Mexico	20	11	-2.5
Peru	53	36	-0.1
Venezuela	14	14	2.6

1.2 Inappropriate sewage connection

Country	1990s	2000s	Change*
Argentina	32	29	-0.1
Brazil	47	32	-2.4
Chile	30	9	-8.9
Colombia	30	13	-1.3
Costa Rica	33	11	-3.2
Mexico	39	25	-1.0
Peru	60	41	-0.1
Venezuela	20	14	-0.2

1.3 Inappropriate tenure security-1

Country	1990s	2000s	Change*
Argentina	16	4	-11.3
Brazil	16	6	-7.4
Chile	6	5	1.3
Colombia	9	7	2.2
Costa Rica	12	2	-7.9
Mexico	0	2	ND
Peru	4	5	4.3
Venezuela	0	0	NA

1.4 Inappropriate tenure security-2

Country	1990s	2000s	Change*
Argentina	27	6	-11.3
Brazil	25	8	-7.4
Chile	8	7	1.3
Colombia	13	13	2.2
Costa Rica	21	3	-7.9
Mexico	0	3	ND
Peru	6	8	4.3
Venezuela	0	0	NA

1.5 Inappropriate roof

Country	1990s	2000s	Change*
Argentina	ND	24	ND
Brazil	60	ND	ND
Chile	41	42	2.7
Colombia	ND	ND	ND
Costa Rica	ND	10	ND
Mexico	48	33	-1.1
Peru	ND	ND	ND
Venezuela	66	62	2.5

1.6 Inappropriate floor

Country	1990s	2000s	Change*
Argentina	7	2	-11.4
Brazil	ND	ND	ND
Chile	20	12	-2.6
Colombia	33	29	-0.2
Costa Rica	ND	17	ND
Mexico	47	ND	ND
Peru	57	48	1.4
Venezuela	ND	ND	ND

1.7 Inappropriate wall

Country	1990s	2000s	Change*
Argentina	6	5	-2.3
Brazil	6	ND	ND
Chile	9	6	-2.7
Colombia	17	7	-3.7
Costa Rica	ND	18	ND
Mexico	22	15	-0.8
Peru	64	53	1.3
Venezuela	23	22	3.3

Note: Change in a given attribute is measured as the annual geometric average change.

Sources: Microdata from IPUMS International Information (https://international.ipums.org/international/); and ECLAC Redatam On Line Census (http://www.eclac.org/cgi-bin/getProd.asp?xml=/redatam/noticias/paginas/7/13277/P13277.xml&xsl=/redatam/tpl/p18f.xsl&base=/redatam/tpl/top-bottom.xsl).

Appendix C: Country-Specific Census Definitions for Housing Quality Indicators

B.1: Water Connection

Country: Argentina; Year: 2001; Source: REDATAM	
Category	Connected
Red pública (agua corriente)	Yes
Perforación con bomba a motor	No
Perforación con bomba manual	No
Pozo con bomba	No
Agua de lluvia	No
Transporte por cisterna	No
Río, canal, arroyo	No
Pozo sin bomba	No
Country: Argentina; Year: 1991; Source: IPUMS	
Category	Connected
Piped inside dwelling	Yes
Piped within the building or plot of land	Yes
No piped water	No
Unknown	No
Country: Bolivia; Year: 2001; Source: REDATAM	
Category	Connected
CAÑERÍA DE RED	Yes
PILETA PÚBLICA	No
CARRO REPARTIDOR	No
POZO O NORIA CON BOMBA	No
POZO O NORIA SIN BOMBA	No
RIO, VERTIENTE, ACEQUIA	No
LAGO, LAGUNA, CURICHE	No
OTRA	No
Country: Brazil Year: 2000; Source: IBGE	
Category	Connected
Piped inside dwelling	Yes
Piped outside the dwelling	Yes
No piped water	No
Country: Brazil Year: 1991; Source: IBGE	
Category	Connected
Piped inside dwelling	Yes
Piped outside the dwelling	Yes
No piped water	No

B.1 (continued): Water Connection

Country: Chile Year: 2002; Source: REDATAM	
Category	Connected
Red pública (Cía. Agua Potable)	Yes
Pozo o noria	No
Río, vertiente, estero	No
Country: Chile Year: 1992; Source: REDATAM	
Category	Connected
Red pública (Cía. Agua Potable)	Yes
Pozo o noria	No
Río, vertiente, estero	No
Otro origen	No
Country: Colombia Year: 2005; Source: REDATAM	
Category	Connected
Acueducto	Yes
Pozo con o sin bomba	No
Agua lluvia	No
Pila pública	No
Carrotanque, aguatero	No
RÍo, quebrada, manantial, nacimiento	No
Agua embotellada o en bolsa	No
No Informa	No
Country: Colombia Year: 1985; Source: IPUMS	
Category	Connected
Yes, piped water	Yes
No piped water	No
Country: Costa Rica Year: 2000; Source: REDATAM	
Category	Connected
Acueducto AyA	Yes
Acueducto rural o municipal	No
Pozo	No
Río, quebrada o naciente	No
Lluvia u otros	No

B.1 (continued): Water Connection

Country: Costa Rica Year: 1984; Source: REDATAM	
Category	Connected
Red Publica: Solo esta vivienda	Yes
Red Publica: Esta y otras viviendas	Yes
Red Privada: Solo esta vivienda	Yes
Red Privada: Esta y otras vivienda	Yes
Pozo con bomba	No
Pozo sin bomba	No
Río o quebrada	No
Fuente pública	No
Lluvia y otros medios	No
Country: Mexico Year: 2000; Source: IPUMS	
Category	Connected
Piped inside dwelling	Yes
Piped within the building or plot of land	Yes
Piped outside the building or lot	Yes
Have access to public piped water	Yes
No piped water	No
Unknown	No
Country: Mexico Year: 1990; Source: IPUMS	
Category	Connected
Piped inside dwelling	Yes
Piped within the building or plot of land	Yes
Have access to public piped water	Yes
No piped water	No
Unknown	No
Country: Peru Year: 2007; Source: REDATAM	
Category	Connected
Red pública Dentro de la vivienda	Yes
Red Pública Fuera de la vivienda	Yes
Pilón de uso público	No
Camión-cisterna u otro similar	No
Pozo	No
Río, acequia.manantial o similar	No
Vecino	No
Otro	No

B.1 (continued): Water Connection

Country: Peru Year: 1993; Source: REDATAM	
Category	Connected
Red pública Dentro de la vivienda	Yes
Red Pública Fuera de la vivienda	Yes
Pilón de uso público	No
Camión-cisterna u otro similar	No
Pozo	No
Río, acequia.manantial o similar	No
Otro	No
Country: Venezuela Year: 2001; Source: IPUMS	
Category	Connected
Piped inside dwelling	Yes
Have access to public piped water	Yes
Have access to public piped water	No
Country: Venezuela Year: 1990; Source: IPUMS	
Category	Connected
Yes, piped water	Yes
Have access to public piped water	Yes
No piped water	No
Unknown	No

B.2: Sewage Connection

Country: Argentina; Year: 2001; Source: REDATAM	
Category	Connected
Inodoro con descarga y desagüe a red pública	Yes
Inodoro con descarga y desagüe a cámara séptica	Yes
Inodoro con descarga y desagüe a pozo ciego	No
Inodoro sin descarga o sin inodoro	No
Country: Argentina; Year: 1991; Source: IPUMS	
Category	Connected
Connected to sewage system or septic tank	Yes
Sewage system (public sewage disposal)	Yes
Sewage system (public sewage disposal)	Yes
Not connected to sewage disposal system	No
Cesspool, cess pit, septic pit	No
Unknown	No

B.2 (continued): Sewage Connection

Country: Bolivia; Year: 2001; Source: REDATAM	
Category	Connected
NO TIENE SERVICIO SANITARIO	No
AL ALCANTARILLADO	Yes
A UNA CAMARA SEPTICA	Yes
A UN POZO CIEGO	No
SUPERFICIE (CALLE. QUEBRADA O RÍO)	No
Country: Brazil; Year: 2000; Source: IBGE	
Category	Connected
Sewage system (public sewage disposal)	Yes
Septic tank (private sewage disposal)	Yes
Not connected to sewage disposal system	No
Cesspool, cess pit, septic pit	No
Unknown	No
Country: Brazil; Year: 1991; Source: IBGE	
Category	Connected
Sewage system (public sewage disposal)	Yes
Septic tank (private sewage disposal)	Yes
Not connected to sewage disposal system	No
Cesspool, cess pit, septic pit	No
Unknown	No
Country: Chile Year: 2002; Source: REDATAM	
Category	Connected
Conectado a alcantarillado	Yes
Conectado a fosa séptica	Yes
Cajón sobre pozo negro	No
Cajón sobre acequia o canal	No
Químico	No
No tiene	No
Country: Chile Year: 1992; Source: REDATAM	
Category	Connected
Alcantarillado o fosa séptica	Yes
Cajón sobre pozo negro	No
Cajón sobre acequia o canal	No
Otro sistema	No
No tiene	No

B.2 (continued): Sewage Connection

Country: Colombia Year: 2005; Source: REDATAM	
Category	Connected
Inodoro conectado al alcantarillado	Yes
Inodoro conectado a pozo séptico	Yes
Inodoro sin conexión, letrina, bajamar	No
No tiene servicio sanitario	No
Country: Colombia Year: 1985; Source: IPUMS	
Category	Connected
Sewage system (public sewage disposal)	Yes
Septic tank (private sewage disposal)	Yes
Not connected to sewage disposal system	No
Country: Costa Rica Year: 2000; Source: REDATAM	
Category	Connected
Conectado alcantarilla pública	Yes
Conectado tanque séptico	Yes
Pozo negro o letrina	No
Otro sistema	No
No tiene	No
Country: Costa Rica Year: 1984; Source: REDATAM	
Category	Connected
Cloaca/tanque séptico: Esta vivienda	Yes
Cloaca/tanque séptico: Esta y otras viviendas	Yes
Pozo negro planché: Esta vivienda	No
Pozo negro planché: Esta y otras vivienda	No
Pozo negro madera: Esta vivienda	No
Pozo negro madera: Esta y otras vivienda	No
Otro: Esta vivienda	No
Otro: Esta y otras vivienda	No
No tiene	No
Country: Mexico Year: 2000; Source: IPUMS	
Category	Connected
Sewage system (public sewage disposal)	Yes
Septic tank (private sewage disposal)	Yes
Not connected to sewage disposal system	No
Unknown	No
Country: Mexico Year: 1990; Source: IPUMS	
Category	Connected
Sewage system (public sewage disposal)	Yes
Septic tank (private sewage disposal)	Yes
Not connected to sewage disposal system	No
Unknown	No

B.2 (continued): Sewage Connection

Country: Peru Year: 2007; Source: REDATAM	
Category	Connected
Red pública de desague dentro de la Viv.	Yes
Red pública de desague fuera de la Viv.	Yes
Pozo séptico	Yes
Pozo ciego o negro / letrina	No
Río, acequia o canal	No
No tiene	No
Country: Peru Year: 1993; Source: REDATAM	
Category	Connected
RED PUBLICA DENTRO DE LA VIVIEDA	Yes
RED PUBLICA FUERA DE LA VIVIENDA	Yes
POZO CIEGO O NEGRO	No
SOBRE ACEQUIA / CANAL	No
NO TIENE SERVICIO HIGIENICO	No
Country: Venezuela Year: 2001; Source: IPUMS	
Category	Connected
Sewage system (public sewage disposal)	Yes
Septic tank (private sewage disposal)	Yes
Not connected to sewage disposal system	No
Country: Venezuela Year: 1990; Source: IPUMS	
Category	Connected
Sewage system (public sewage disposal)	Yes
Septic tank (private sewage disposal)	Yes
Not connected to sewage disposal system	No
Unknown	No

B.3: Tenure Status

Country: Argentina; Year: 2001; Source: REDATAM	
Category	Ownership
Propietario de la vivienda y terreno	Owner
Propietario sólo de la vivienda	Not titled
Inquilino	Renter
Ocupante por préstamo	Conceeded
Ocupante por trabajo	Conceeded
Otra situación	Other

B.3 (continued): Tenure Status

Country: Argentina; Year: 1991; Source: IPUMS	
Category	Ownership
Occupant-owned building and land	Owner
Occupant-owned building only	Not titled
Renting	Renter
Occupied de facto/squatting	Not titled
Provided by employer	Conceeded
Free, without work or services	Not titled
Not owned, other	Other
Unknown	Other
Country: Bolivia; Year: 2001; Source: REDATAM	
Category	Ownership
PROPIA	Owner
ALQUILADA	Renter
EN CONTRATO ANTICRETICO	Other
EN CONTRATO MIXTO	Other
CEDIDA POR SERVICIOS	Conceeded
PRESTADA POR PARIENTES O AMIGOS	Conceeded
OTRO	Other
Country: Brazil Year: 2000; Source: IBGE	
Category	Ownership
Owned, already paid	Owner
Owned, still paying	Owner
Renting	Renter
Provided by employer	Conceeded
Free, without work or services	Not titled
Not owned, other	Other
Country: Brazil Year: 1991; Source: IBGE	
Category	Ownership
Occupant-owned building and land	Owner
Occupant-owned building only	Not titled
Renting	Renter
Provided by employer	Conceeded
Free, without work or services	Not titled
Not owned, other	Other

B.3 (continued): Tenure Status

Country: Chile Year: 2002; Source: REDATAM	
Category	Ownership
Propia (pagada totalmente)	Owner
Propia (pagando a plazo)	Owner
Arrendada	Renter
Cedida por trabajo o servicio	Conceeded
Gratuita	Not titled
Otra situación (somente 1992)	Other
Country: Chile Year: 1992; Source: REDATAM	
Category	Ownership
Propia (pagada totalmente)	Owner
Propia (pagando a plazo)	Owner
Arrendada	Renter
Cedida por trabajo o servicio	Conceeded
Gratuita	Not titled
Otra situación (somente 1992)	Other
Country: Colombia Year: 2005; Source: REDATAM	
Category	Ownership
Arriendo pagando	Renter
Vivienda propia	Owner
Vive sin pago alguno	Not titled
Vive o tenecia o posesión	Other
Vive en otra situación	Other
Sin información	Other
Country: Colombia Year: 1985; Source: IPUMS	
Category	Ownership
Owned	Owner
Renting	Renter
Not owned, other	Other
Country: Costa Rica Year: 2000; Source: REDATAM	
Category	Ownership
Ocupada Propia, totalmente pagada	Owner
Ocupada Propia, pagando a plazos	Owner
Ocupada Alquilada	Renter
Ocupada En precario	Not titled
Ocupada Otra (Cedida, prestada)	Conceeded
Desocupada Alquilar o vender	Other
Desocupada En construcción o reparación	Other
Desocupada Temporal(Vacacionar,p/ trabajadores)	Other
Desocupada Otra	Other

B.3 (continued): Tenure Status

Country: Costa Rica Year: 1984; Source: REDATAM	
Category	Ownership
Ocupada: Alquilada	Renter
Ocupada: Propia	Owner
Ocupada: Otra	Not titled
Desocupada: Alquilar o vender	Other
Desocupada: Construcción o reparación	Other
Desocupada: Para veranear	Other
Desocupada: Otra	Other
Country: Mexico Year: 2000; Source: IPUMS	
Category	Ownership
Owned, already paid	Owner
Owned, still paying	Owner
Owned, other	Not titled
Renting	Renter
Renting, other	Other
Unknown	Other
Country: Mexico Year: 1990; Source: IPUMS	
Category	Ownership
Owned	Owner
Renting	Renter
Not owned, other	Not titled
Unknown	Other
Country: Peru Year: 2007; Source: REDATAM	
Category	Ownership
Alquilada	Renter
Propia por invasion	Not titled
Propia pagando a plazos	Owner
Propia totalmente pagada	Owner
Cedida por el Centro de Trabajo / otro hogar / institución	Conceeded
Otra forma	Other
Country: Peru Year: 1993; Source: REDATAM	
Category	Ownership
ALQUILADA	Renter
PROPIA - PAGANDOSE	Owner
PROPIA - PAGADA	Owner
USADA - SIN PAGO	Conceeded
OCUPADA DE HECHO	Not titled
OTRA FORMA	Other

B.3 (continued): Tenure Status

Country: Venezuela Year: 2001; Source: IPUMS	
Category	Ownership
Owned, already paid	Owner
Owned, still paying	Owner
Renting	Renter
Free/usufruct (no cash rent)	Conceeded
Not owned, other	Other
Country: Venezuela Year: 1990; Source: IPUMS	
Category	Ownership
Owned, already paid	Owner
Owned, still paying	Owner
Renting	Renter
Not owned, other	Not titled
Unknown	Other

B.4: Roof Appropriateness

Country: Argentina; Year: 2001; Source: REDATAM	
Category	Material
Cubierta asfáltica o membrana con cielorraso	Appropriate
Baldosa o losa (sin cubierta) con cielorraso	Appropriate
Pizarra o teja con cielorraso	Appropriate
Chapa de metal (sin cubierta) con cielorraso	Appropriate
Chapa de fibrocemento o plástico con cielorraso	Appropriate
Otros materiales con cielorraso	Appropriate
Cubierta asfáltica o membrana sin cielorraso	Appropriate
Baldosa o losa (sin cubierta) sin cielorraso	Inappropriate
Pizarra o teja sin cielorraso	Inappropriate
Otros materiales sin cielorraso	Inappropriate
Chapa de metal (sin cubierta) sin cielorraso	Inappropriate
Chapa de fibrocemento o plástico sin cielorraso	Inappropriate
Chapa de carton	Inappropriate
Caña, tabla o paja, paja sola	Inappropriate
Country: Argentina; Year: 1991; Source: IPUMS	
Category	Material
Tile, unspecified	Inappropriate
Clay tile	Appropriate
Sheet metal	Inappropriate
Cane, wood, straw	Inappropriate
Cardboard	Inappropriate
Other, unspecified	Inappropriate
Unknown/missing	Inappropriate

B.4 (continued): Roof Appropriateness

Country: Bolivia; Year: 2001; Source: REDATAM	
Category	Material
Calamina o Plancha	Inappropriate
Tejas (Cemento, Arcilla o Fibrocemento)	Appropriate
Losa de Hormigon Armado	Appropriate
Paja, Caña, Palma o Barro	Inappropriate
Otro	Inappropriate
Country: Brazil Year: 1991; Source: IBGE	
Category	Material
Concrete	Appropriate
Tile, unspecified	Appropriate
Clay tile	Inappropriate
Zinc or tin	Inappropriate
Wood	Inappropriate
Thatch (straw, grass, leaves, palm, etc.)	Inappropriate
Other or mixed materials	Inappropriate
Discarded or scrap material	Inappropriate
Country: Chile Year: 2002; Source: REDATAM	
Category	Material
Tejas (arcilla, metálica, cemento)	Appropriate
Tejuela (madera, asfáltica)	Appropriate
Losa de hormigón	Appropriate
Zinc	Inappropriate
Pizarreño	Appropriate
Fibra de vidrio/Femocolor	Inappropriate
Fonolita	Inappropriate
Paja embarrada	Inappropriate
Desechos (lata, cartones, plástico, etc.)	Inappropriate
Country: Chile Year: 1992; Source: REDATAM	
Category	Material
Zinc	Inappropriate
Loza de hormigón	Appropriate
Pizarreño	Appropriate
Tejas (arcilla, metálica, cemento)	Appropriate
Tejuela de Madera	Appropriate
Fonolita	Inappropriate
Paja embarrada	Inappropriate
Otros materiales	Inappropriate

B.4 (continued): Roof Appropriateness

Country: Costa Rica Year: 2000; Source: REDATAM	
Category	Material
Lámina de metal o zinc	Inappropriate
Fibrocemento	Appropriate
Otro	Inappropriate
Material desecho	Inappropriate
Country: Costa Rica Year: 1984; Source: REDATAM	
Category	Material
Tejas de barro: Bueno	Appropriate
Tejas de barro: Regular	Appropriate
Tejas de barro: Malo	Appropriate
Láminas de metal: Bueno	Inappropriate
Láminas de metal: Regular	Inappropriate
Láminas de metal: Malo	Inappropriate
Asbesto cemento: Bueno	Appropriate
Asbesto cemento: Regular	Appropriate
Asbesto cemento: Malo	Appropriate
Otro material: Bueno	Inappropriate
Otro material: Regular	Inappropriate
Otro material: Malo	Inappropriate
Country: Mexico Year: 2000; Source: IPUMS	
Category	Material
Masonry, concrete, clay tile, or tiles of unspecified type	Appropriate
Tile, unspecified	Inappropriate
Metal or asbestos	Inappropriate
Wood and other plant materials	Inappropriate
Discarded or scrap material	Inappropriate
Cardboard	Inappropriate
Unknown/missing	Inappropriate
Country: Mexico Year: 1990; Source: IPUMS	
Category	Material
Masonry, concrete, clay tile, or tiles of unspecified type	Appropriate
Tile, unspecified	Inappropriate
Metal or asbestos	Inappropriate
Wood and other plant materials	Inappropriate
Other or mixed materials	Inappropriate
Cardboard	Inappropriate
Unknown/missing	Inappropriate

B.4 (continued): Roof Appropriateness

Country: Venezuela Year: 2001; Source: IPUMS	
Category	Material
Sheet metal	Inappropriate
Platabanda	Appropriate
Clay tile	Appropriate
Asphalt tile	Inappropriate
Asbestos	Inappropriate
Other, unspecified	Inappropriate
Country: Venezuela Year: 1990; Source: IPUMS	
Category	Material
Metal sheet	Inappropriate
Roof slab	Appropriate
Tile	Inappropriate
Asbesto or similar	Inappropriate
Other	Inappropriate

B.5: Floor Appropriateness

Country: Argentina; Year: 2001; Source: REDATAM	
Category	Material
Cerámica, baldosa, mosaico, mármol, madera o alfombrado	Appropriate
Cemento o ladrillo fijo	Appropriate
Otros	Inappropriate
Tierra o ladrillo suelto	Inappropriate
Country: Argentina; Year: 1991; Source: IPUMS	
Category	Material
None (earth)	Inappropriate
Brick or cement	Appropriate
Other finished, n.e.c.	Appropriate
Unknown/missing	Inappropriate
Country: Bolivia; Year: 2001; Source: REDATAM	
Category	Material
TIERRA	Inappropriate
TABLON DE MADERA	Appropriate
MACHIEMBRE, PARQUET	Appropriate
ALFOMBRA, TAPIZON	Appropriate
CEMENTO	Inappropriate
MOSAICO, BALDOSA O CERÁMICA	Appropriate
LADRILLO	Appropriate
OTRO	Inappropriate

B.5 (continued): Floor Appropriateness

Country: Chile Year: 2002; Source: REDATAM	
Category	Material
Parquet	Appropriate
Baldosín cerámico	Appropriate
Entablado (madera)	Appropriate
Alfombra muro a muro	Appropriate
Baldosas de cemento	Inappropriate
Plásticos (flexit, linóleo, etc.)	Appropriate
Radier	Inappropriate
Tierra	Inappropriate
Country: Chile Year: 1992; Source: REDATAM	
Category	Material
Parquet, Entablado (Madera)	Appropriate
Baldosín cerámico	Appropriate
Alfombra muro a muro	Appropriate
Plásticos (flexit, linóleo, etc.)	Appropriate
Baldosa de cemento, radier	Inappropriate
Ladrillo	Appropriate
Tierra	Inappropriate
Otros materiales	Inappropriate
Country: Colombia Year: 2005; Source: REDATAM	
Category	Material
Alfombra, mármol, parqué, madera pulida	Appropriate
Baldosa, vinilo, tableta, ladrillo	Appropriate
Cemento, gravilla	Inappropriate
Madera burda, tabla, tablón, otro vegetal	Appropriate
Tierra, arena	Inappropriate
Country: Colombia Year: 1985; Source: IPUMS	
Category	Material
None (earth)	Inappropriate
Wood	Inappropriate
Other finished, n.e.c.	Appropriate
Country: Costa Rica Year: 2000; Source: REDATAM	
Category	Material
Terrazo, mosaico, cerámica,etc.	Appropriate
Cemento (lujado o no)	Inappropriate
Madera	Appropriate
Otro	Inappropriate
No tiene (piso de tierra)	Inappropriate

B.5 (continued): Floor Appropriateness

Country: Costa Rica Year: 1984; Source: REDATAM	
Category	Material
Madera: Buena	Appropriate
Madera: Regular	Appropriate
Madera: Mala	Appropriate
Mosaico: Bueno	Appropriate
Mosaico: Regular	Appropriate
Mosaico: Malo	Appropriate
Otro material: Bueno	Inappropriate
Otro material: Regular	Inappropriate
Otro material: Malo	Inappropriate
No tiene (piso de tierra)	Inappropriate
Country: Mexico Year: 1990; Source: IPUMS	
Category	Material
None (earth)	Inappropriate
Cement	Appropriate
Other finished, n.e.c.	Inappropriate
Unknown/missing	Inappropriate
Country: Peru Year: 2007; Source: REDATAM	
Category	Material
Tierra	Inappropriate
Cemento	Appropriate
Losetas, terrazos	Appropriate
Parquet o madera pulida	Appropriate
Madera, entablados	Inappropriate
Laminas asfálticas	Inappropriate
Country: Peru Year: 1993; Source: REDATAM	
Category	Material
PARQUET	Appropriate
LAMINA	Inappropriate
LOSETAS	Appropriate
MADERA	Inappropriate
CEMENTO	Appropriate
TIERRA	Inappropriate
OTRO	Inappropriate
Country: Venezuela Year: 2001; Source: IPUMS	
Category	Material
None (earth)	Inappropriate
Cement	Appropriate
Other finished, n.e.c.	Appropriate

B.5 (continued): Floor Appropriateness

Country: Venezuela Year: 1990; Source: IPUMS	
Category	Material
None (earth)	Inappropriate
Cement	Appropriate
Tile, stone, vinyl, brick	Appropriate
Other finished, n.e.c.	Appropriate
Unknown/missing	Inappropriate

B.6: Wall Appropriateness

Country: Argentina; Year: 2001; Source: REDATAM	
Category	Material
Ladrillo, piedra, bloque u hormigón con revoque exterior	Appropriate
Adobe con revoque exterior	Inappropriate
Madera	Inappropriate
Ladrillo, piedra, bloque u hormigón sin revoque exterior	Appropriate
Adobe sin revoque exterior	Inappropriate
Chapa de metal o fibrocemento	Inappropriate
Otros materiales	Inappropriate
Chorizo, cartón, palma, paja sola o material de desecho	Inappropriate
Country: Argentina; Year: 1991; Source: IPUMS	
Category	Material
NIU (not in universe)	Appropriate
Wood	Appropriate
Brick, block, stone, or cement	Appropriate
Adobe	Inappropriate
Bundle of mud, straw, other materials	Inappropriate
Metal or fibercement sheeting	Inappropriate
Other material	Inappropriate
Unknown/missing	Inappropriate
Country: Bolivia; Year: 2001; Source: REDATAM	
Category	Material
LADRILLO, BLOQUE DE CEMENTO, HORMIGON	Appropriate
ADOBE-TAPIAL	Inappropriate
TABIQUE-QUINCHE	Inappropriate
PIEDRA	Appropriate
MADERA	Inappropriate
CAÑA-PALMA-TRONCO	Inappropriate
OTRO	Inappropriate

B.6 (continued): Wall Appropriateness

Country: Brazil Year: 1991; Source: IBGE	
Category	Material
Cardboard, scrap, and miscellaneous materials	Inappropriate
Waste, scrap, or discarded material	Inappropriate
Wood	Appropriate
Other plant-based materials	Inappropriate
Masonry, stone, cement, adobe, metal, glass, and other fabricated materials	Inappropriate
Country: Chile Year: 2002; Source: REDATAM	
Category	Material
Hormigón armado, piedra	Appropriate
Ladrillo	Appropriate
Paneles estructurados, bloque (prefabricado)	Appropriate
Madera o tabique forrado	Appropriate
Internit	Appropriate
Adobe, barro empajado	Inappropriate
Desechos (lata, cartones, plástico, etc.)	Inappropriate
Country: Chile Year: 1992; Source: REDATAM	
Category	Material
Ladrillo, concreto, bloque	Appropriate
Madera o tabique forrado	Appropriate
Adobe	Inappropriate
Barro empajado, quincha, pirca	Inappropriate
Desechos (lata, cartones, plástico, etc.)	Inappropriate
Otros materiales	Inappropriate
Country: Colombia Year: 2005; Source: REDATAM	
Category	Material
Bloque, ladrillo, piedra, madera pulida	Appropriate
Tapia pisada, adobe, bahareque	Inappropriate
Madera burda, tabla, tablón	Inappropriate
Material prefabricado	Appropriate
Guadua, caña, esterilla, otros vegetales	Inappropriate
Zinc, tela, cartón, latas, desechos, plásticos	Inappropriate
Sin paredes	Inappropriate
Country: Colombia Year: 1985; Source: IPUMS	
Category	Material
No walls	Inappropriate
Fabric or discarded material	Inappropriate
Wood	Appropriate
Plantain leaves and similar material	Inappropriate
Bamboo or cane	Inappropriate
Masonry, stone, cement, adobe, metal, glass, and other fabricated materials	Appropriate

B.6 (continued): Wall Appropriateness

Country: Costa Rica Year: 2000; Source: REDATAM	
Category	Material
Bloque o ladrillo	Appropriate
Zócalo con forro	Appropriate
Zócalo sin forro	Appropriate
Madera con forro	Inappropriate
Madera sin forro	Inappropriate
Prefabricado	Appropriate
Otro	Inappropriate
Material desecho	Inappropriate
Country: Costa Rica Year: 1984; Source: REDATAM	
Category	Material
Madera: Buena	Appropriate
Madera: Regular	Appropriate
Madera: Mala	Appropriate
Ladrillo/block: Bueno	Appropriate
Ladrillo/block: Regular	Appropriate
Ladrillo/block: Malo	Appropriate
Adobe-bahareque: Bueno	Inappropriate
Adobe-bahareque: Regular	Inappropriate
Adobe-bahareque: Malo	Inappropriate
Otro Material: Bueno	Inappropriate
Otro Material: Regular	Inappropriate
Otro Material: Malo	Inappropriate
Country: Mexico Year: 2000; Source: IPUMS	
Category	Material
Brick, block, stone, or cement	Appropriate
Wood	Appropriate
Brick, block, stone, or cement	Inappropriate
Cardboard sheet	Inappropriate
Reed, bamboo, or palm	Inappropriate
Adobe	Inappropriate
Clay or clay-covered sticks	Inappropriate
Metal or asbestos sheet	Inappropriate
Unknown/missing	Inappropriate

B.6 (continued): Wall Appropriateness

Country: Mexico Year: 1990; Source: IPUMS	
Category	Material
Brick, block, stone, or cement	Appropriate
Wood	Appropriate
Cardboard, scrap, and miscellaneous materials	Inappropriate
Cardboard sheet	Inappropriate
Reed, bamboo, or palm	Inappropriate
Adobe	Inappropriate
Clay or clay-covered sticks	Inappropriate
Metal or asbestos sheet	Inappropriate
Unknown/missing	Inappropriate
Country: Peru Year: 2007; Source: REDATAM	
Category	Material
Ladrillo o Bloque de cemento	Appropriate
Adobe o tapia	Inappropriate
Madera	Inappropriate
Quincha	Inappropriate
Estera	Inappropriate
Piedra con barro	Inappropriate
Piedra o Sillar con cal o cemento	Inappropriate
Otro	Inappropriate
Country: Peru Year: 1993; Source: REDATAM	
Category	Material
Ladrillo	Appropriate
Piedra	Inappropriate
Adobe	Inappropriate
Quincha	Inappropriate
Barro	Inappropriate
Madera	Inappropriate
Estera	Inappropriate
Otro Material	Inappropriate
Country: Venezuela Year: 2001; Source: IPUMS	
Category	Material
Concrete	Appropriate
Cement blocks or brick	Appropriate
Wood, formica, and other	Appropriate
Cement blocks or brick, unfinished	Inappropriate
Adobe walls with plaster exterior	Inappropriate
Adobe walls without plaster exterior	Inappropriate
Other material	Inappropriate

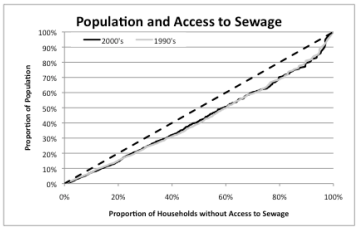
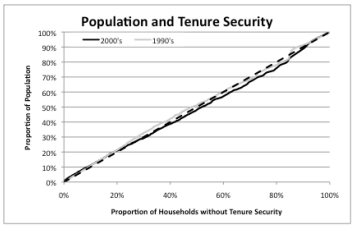
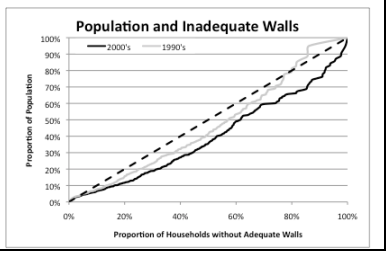
B.6 (continued): Wall Appropriateness

Country: Venezuela Year: 1990; Source: IPUMS	
Category	Material
Finished cement block-brick	Appropriate
Concrete	Appropriate
Wood, formica, fiberglass or similar	Appropriate
Unfinished cement block-brick	Inappropriate
Unfinished adobe, mud, stick-and-mud not frisonado	Inappropriate
Other	Inappropriate

B.7: Regional Division by Country

Country	Regional Division
Argentina	Departamento
Chile	Comuna
Costa Rica	Cantón
Brazil	Município
Bolivia	Sección municipal
Colombia	Município
México*	Município
Venezuela*	Município
Peru	Distrito

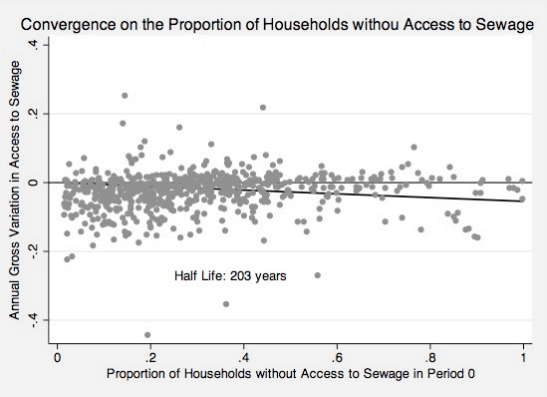
Appendix D: Distribution of Indices Conditioned on Population

Graph 4	Graph 5	Graph 6
		

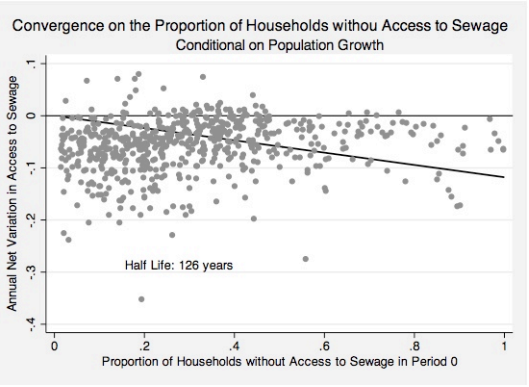
Sources: Microdata from IPUMS International (https://international.ipums.org/international/); ECLAC Redatam On Line Census (http://www.eclac.org/cgi-bin/getProd.asp?xml=/redatam/noticias/paginas/7/13277/P13277.xml&xsl=/redatam/tpl/p18f.xsl&base=/redatam/tpl/top-bottom.xsl).

Appendix E. Convergence Distribution

Graph 7

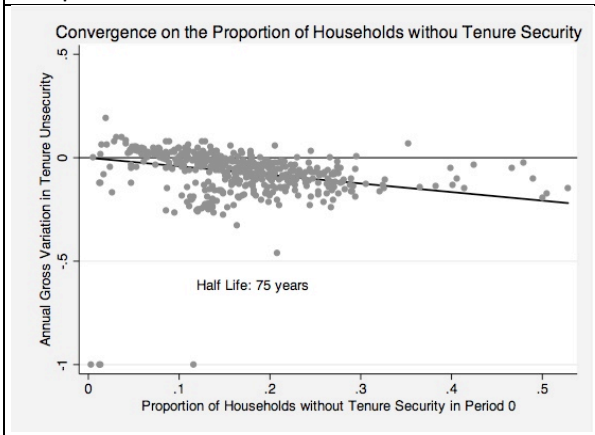


Graph 8

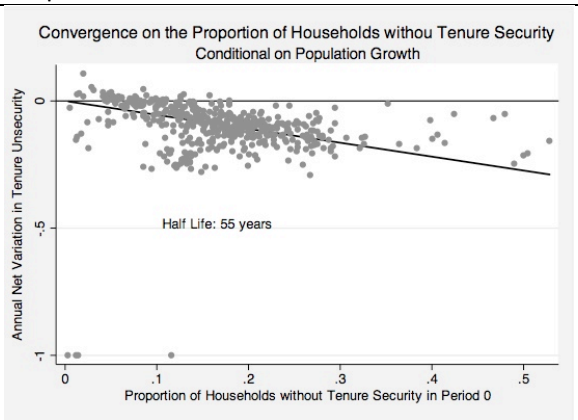


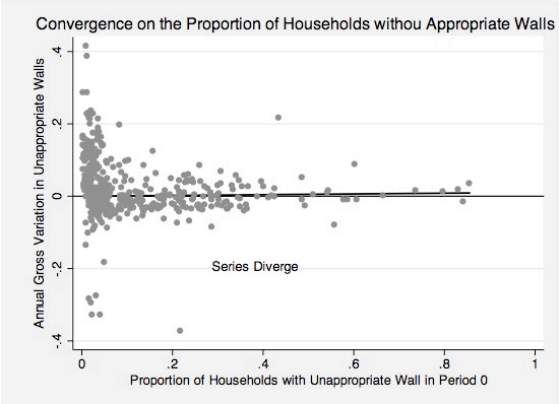
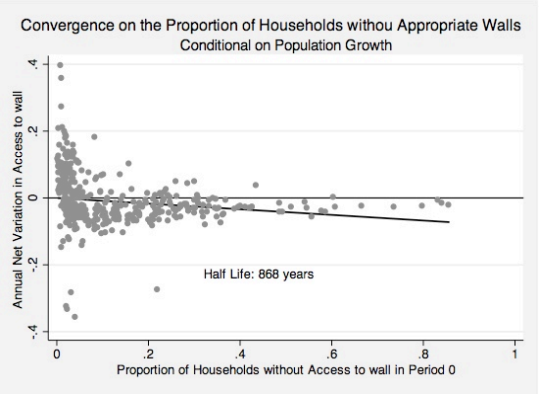
Sources: Microdata from IPUMS International (https://international.ipums.org/international/); ECLAC Redatam On Line Census (http://www.eclac.org/cgi-bin/getProd.asp?xml=/redatam/noticias/paginas/7/13277/P13277.xml&xsl=/redatam/tpl/p18f.xsl&base=/redatam/tpl/top-bottom.xsl).

Graph 9



Graph 10



Graph 11	Graph 12
	

Sources: IPUMS International; ECLAC Redatam On Line Census.