Working Paper 2006-08

Brazil's Urban Land and Housing Markets:
How Well Are They Working?

David E. Dowall

Institute of Urban and Regional Development
University of California, Berkeley

Acknowledgments

The author would like to thank Pedro Peterson for his research assistance in support of the preparation of this paper. Valuable comments and suggestions were provided by Mila Freire, Edesio Fernandes, Paul Avila, and Fernanda Furtando and from participants at a World Bank–Lincoln Institute Seminar in Brasília on March 6, 2006. Greg Ingram and Martim Smolka of the Lincoln Institute provided detailed comments on the paper. Any errors that remain are the responsibility of the author.

Table of Contents

List of Figures

List of Tables

Brazil's Urban Land and Housing Markets: How Well Are They Working?

David E. Dowall

Introduction

This paper uses a macro, national-level perspective to assess urban land and housing market outcomes across Brazil. It is based on available empirical data from IBGE, field studies, the Fundação João Pinheiro, and other sources. The paper starts by posing and answering the following questions: What are the characteristics of well-functioning urban land and housing markets? How well are Brazil's urban land and housing markets performing relative to other countries? It then proceeds to provide an assessment of urban land and housing market outcomes in Brazilian cities. The paper concludes by exploring a range of opportunities for enhancing urban land and housing market outcomes.

This paper is one of four papers prepared under a collaborative World Bank–Lincoln Institute of Land Policy project. The other papers are:

- Paulo C. Avila, "Urban Land Use Regulations in Brazil: Land Market Impacts and Access to Housing."
- Fernanda Furtado and Pedro Jorgensen, "Value Capture in Brazil: Issues and Opportunities."
- Edesio Fernandes, "Legal Aspects of Urban Land Development in Brazil."

Each paper takes a distinct perspective on the overall topic of urban land policy in Brazil. Paulo Avila's paper reviews the various models of urban land use planning and regulation in Brazilian cities. He then analyzes the effects of planning regulations, titling, and infrastructure provision on residential land prices and the efficiency of residential land subdivision. Avila's paper is one of the few quantitative econometric and financial analyzes of urban land and housing markets, building on the previous work of Serra, Dowall, Motta and Donovan (2004). His analysis indicates that land use planning regulations and infrastructure provision significantly and positively affect urban residential plot prices.

Fernanda Furtado's and Pedro Jorgensen's paper explores the concept of land value capture—the range of tax and policy instruments that can be used to generate public resources to fund public investments to

support urban development. These instruments work by assessing fees, taxes, and charges on the incremental increase in land values generated by public investments. Furtado and Jorgensen outline eight types of value capture models and illustrate how they might be used to finance, in whole or in part, the costs of upgrading informal settlements throughout Brazil.

Edesio Fernandes's paper presents an historical analysis of land and property legislation in Brazil which provides a thorough understanding of the role of federal legislative actions from the early twentieth century to the significant policy reforms of the past ten years, culminating in the promulgation of the City Statute (2001). Fernandes's paper discusses the fundamental issues surrounding informality and lack of secure land tenure in favelas and irregular settlements. He outlines issues and opportunities for reforming land titling and registration systems in Brazil and discusses how these reforms could contribute to the regularization and upgrading of low-income settlements embedded in Brazil's vast system of cities.

The present paper attempts to make the case for reforming urban land and housing policies in Brazil, by arguing that the historical as well as current performance of Brazil's urban land and housing markets are below their potential. As a consequence, urban land and housing markets are not providing sufficient housing opportunities for low- and middle-income families and contribute to a growing housing deficit and widespread housing informality (FJP, 2002 and 2005). The paper attempts to make the case that, although dwelling unit production is satisfactory relative to household formation, the provision of infrastructure and urban services is unsatisfactory.

Characteristics of Well-Functioning Urban Land and Housing Markets

Urban land and housing markets should efficiently allocate land and housing resources between suppliers and demanders. Housing supply should reasonably match the housing demands of households in terms of prices, locations, and quality attributes. In most market economies, private production (from large merchant builders to self-built housing to informally provided housing in favelas and irregular settlements) is the predominant mode of housing production. Aside from a few countries, such as Singapore, public provision of housing is miniscule relative to overall production. The full range of housing supply, including new as well as existing units, should provide households with affordable options for purchase and rental. Depending on household incomes and housing prices, the private real estate market typically produces housing that is

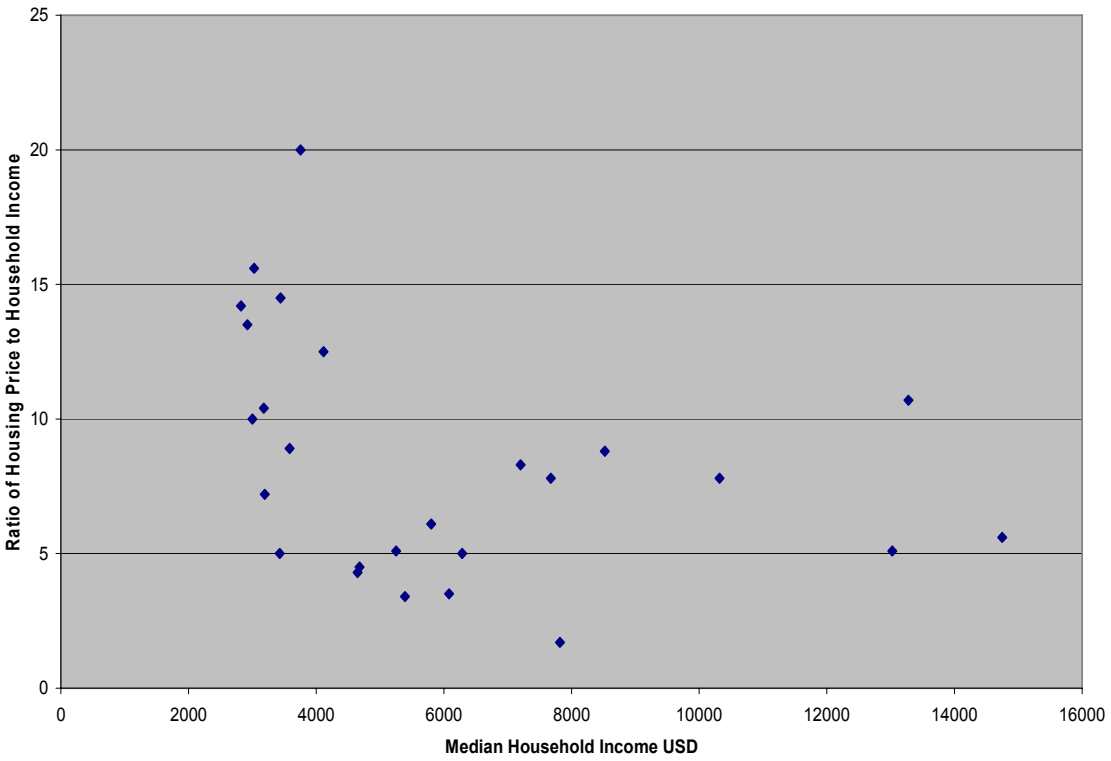
affordable to households at the 30th to 40th percentile of the income distribution (Dowall, 1989 and 1990). Households with lower incomes typically rent accommodations, share housing with extended families, or postpone forming households. Some are fortunate to receive housing assistance from government sources.

Achieving this level of performance requires that housing markets produce housing that is priced between 3 and 6 times total household income. Middle- and low-middle income households should be able to afford such units by saving money for down payments and taking out mortgages from housing lenders. Unfortunately, housing supplies are frequently constrained and housing prices are much higher in relation to income. This is due to restrictive land use regulations, complex land titling and registration, lack of investment in basic infrastructure to serve residential development projects, and limitations on the availability of construction and borrower financing.

In middle-income developing countries, housing price to income ratios vary considerably. As household incomes rise, the variation of the ratio diminishes as housing and real estate markets mature and broaden the range of housing products (and prices). In cases where formal housing production is constrained, housing price to income ratios increase. Figure 1 illustrates the relationship between housing price to income ratios and household incomes for a 27 middle-income countries.[1] It is based on tabulations of the World Bank's housing Indicators program. The data were collected in 1998 and are based on data from a sample of large cities in each country (WDR, 2000). The ratio of median housing prices to median household income ranges from a low of 1.7 for Poland to 20 for Lithuania. Brazil has a ratio of 12.5. This is higher than all Central and Latin American countries included in the data series. Only five countries have higher ratios than Brazil—Panama, Serbia and Montenegro, Latvia, Cote d'Ivoire and Lithuania. On the other hand, 11 of the 27 countries have ratios below 6, suggesting good performance.

[1] Middle-income countries, as defined by the World Bank, have per capita Gross National Incomes ranging from $826 to $10,065 (in 2004 dollars). This is further divided into low-middle-income ($826–$3255) and upper-middle-income ($3256–$10,065).

FIGURE 1.
Median Housing Prices and Median Household Income, Middle-Income Countries, 1998



Source: World Bank, World Development Report, 2000.

Is there a Brazilian Paradox?

To motivate the reader, I would like to suggest that the Brazil urban housing market suffers from a paradox—housing is expensive relative to income (Figure 1) and it lacks infrastructure services and secure land tenure. The private sector is capable of producing satisfactory numbers of dwelling units, despite the fact that the public sector is not capable of producing enough infrastructure services or planning and approving enough residential subdivisions to support housing development. The result is an urban land and housing market paradox—expensive housing lacking water and sanitation, secure land tenure,[2] adequate circulation, and common areas for schools and parks. Table 1 compares the housing characteristics of Brazilian cities with those in other countries,[3] and lends some credence to the paradox. In Brazilian cities, 93

[2] According to the World Bank's Doing Business survey, Brazil ranks eighth out of nine countries on ease of property registration (Doing Business Survey, 2005).

[3] The World Bank classifies Brazil as a low-middle-income country.

percent of the housing stock is classified as permanent; this is significantly higher than the comparable rate for low-middle-income countries—86 percent. On the other hand, Brazil does poorly with respect to the percentage of housing units with piped water connections—64 percent versus 74 percent for cities in low-middle-income countries. At the same time, its portion of unauthorized housing units, 23 percent, is well below levels found in other low-middle-income countries—36 percent. So the overall scorecard for Brazil is again a paradox—both good—a relatively low rate of unauthorized housing and a high portion of permanent structures—and bad—a relatively low level of access to water supply. Compared to other Latin American countries, Brazil ranks poorly in terms of providing infrastructure to support residential development (UNECLAC, 2003).[4]

TABLE 1.
How Do Brazilian Cities Compare to Cities in Other Countries (1990s)?

CITIES IN	PERCENTAGE OF HOUSING UNITS THAT ARE PERMANENT STRUCTURES	PERCENTAGE OF HOUSING UNITS WITH PIPED WATER	PERCENTAGE OF HOUSING UNITS THAT ARE UNAUTHORIZED	AVERAGE PER CAPITA GNI, 2004, US$
LOW-INCOME COUNTRIES	67	56	64	507
LOW-MIDDLE-INCOME COUNTRIES	86	74	36	1,686
BRAZILIAN CITIES	93	64	23	3,000
MIDDLE-INCOME COUNTRIES	94	94	20	4,769
MIDDLE-HIGH-INCOME COUNTRIES	99	99	3	16,046
HIGH-INCOME COUNTRIES	100	100	0	32,112

Source: UNCHS, *An Urbanizing World*, Global Report on Human Settlements, 1996.

[4] The percentages in Table 1 have limitations. They are based on binary definitions of service access and do not reflect poor quality of service, such as water supply limits to 3–4 hours per day.

Caveats About the Data Used in this Paper

In Brazil, like most other developing countries, housing and urban planning experts constantly discuss the informal housing crisis—slums, shanty towns, squatter settlements and the like. Many settlements take on iconic positions: Cairo's "City of the Dead," a squatter settlement encamped on top of one of the city's largest cemeteries; "Smokey Mountain," a massive slum located on top of Manila's main garbage dump; or Mumbai's Dharavi, "Asia's biggest slum." These settlements are horrific manifestations of society's inability or unwillingness to address the housing needs of low-income residents.

Urban planners and housing policy professionals and advocates are fully justified in voicing outrage about these terrible conditions. But at the same time, they fail to provide any systematic assessment of actual urban land and housing market outcomes in developing country cities. This paper attempts to bridge this gap by providing a quantitative assessment of Brazil's urban land and housing markets.

There are a number of important caveats that I need to offer before proceeding. First of all, this paper starts by taking an integrated approach to evaluating Brazil's urban land and housing markets. It looks at the entire spectrum of housing units, both formal and informal; this includes dwelling units located in fully approved housing projects—subdivisions and apartment complexes—as well as favelas and irregular and illegal settlements. This definition is broad, incorporating a wide range of housing conditions, and has the advantage of allowing one to make a macro-level assessment of overall housing supply and demand. How many total units are produced in Brazil over a year? How many new households are formed each year? How many units need to be replaced due to deterioration, demolitions, and change of use? As will be explained below, total housing production of both formal and informal dwelling units is slightly less than new household formation (World Bank, 2002).

The second caveat relates to the definition of informality. Our review of the literature on housing informality indicates that it is based on three distinct but interdependent factors—type of land tenure, access to infrastructure, and physical characteristics of settlements and dwelling units. As is commonly the case in many countries, census data on informal housing stocks is highly inaccurate. Some countries ignore informal housing altogether; others grossly undercount it. Brazil is no exception, and data from IBGE are problematic. In order to maintain the empirical mode of analysis, I have chosen to define informal housing based on the most inclusive single measure—access to infrastructure services. This definition permits widespread measurement of stock and flow trends for

municipalities and metropolitan regions over time. However, it may understate informality by excluding cases where urban services are available, but where households lack secure and legal land title or that the subdivisions where the housing units are located are poorly planned and executed. With these caveats in mind, the next sections of the paper map out a broad assessment of Brazil's urban land markets.

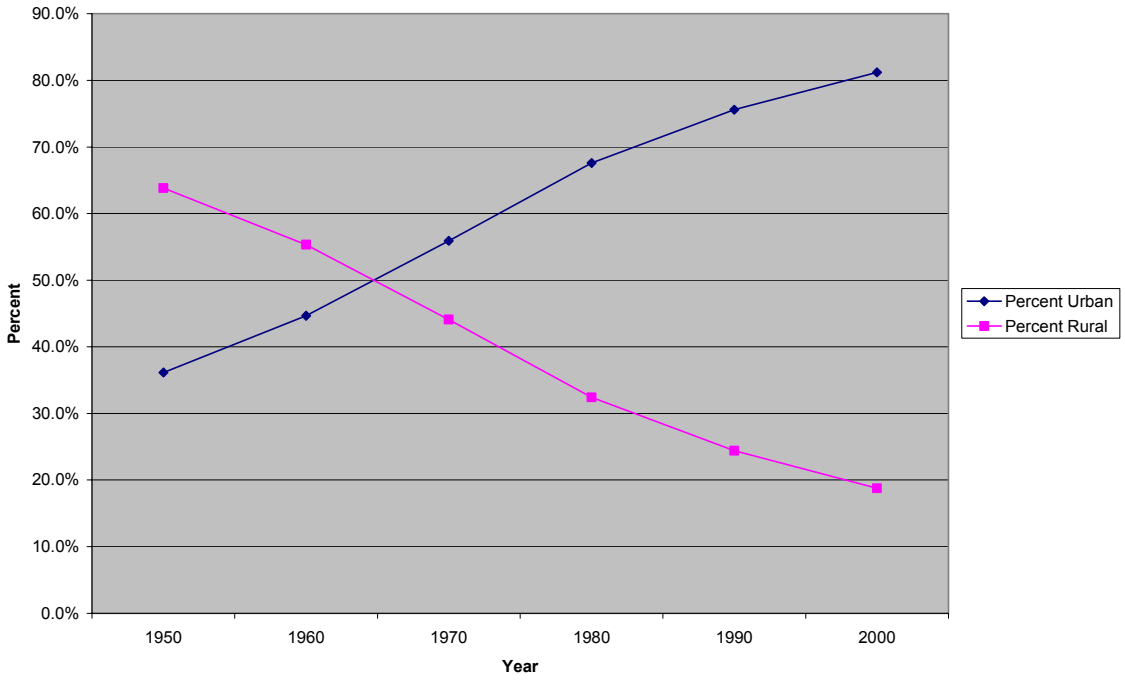
Performance of Brazil's Urban Land and Housing Markets During the Last Half of the Twentieth Century

At the country level, Brazil has undergone a massive shift in the spatial patterns of its population. Between 1950 and 2000, the country added 117,600,000 persons, approximately 2.4 million per year. More dramatically, the spatial structure of the population shifted from being predominately rural to urban. As this section will illustrate, the most challenging period of rapid urbanization has passed. In the 1990s, population and household growth slowed as Brazil passed through its urban transition. Using IBGE census data, Figures 2 and 3 illustrate that, in 1950, about 64 percent of Brazil's population was located in rural areas and 36 percent was located in urban areas. By 1980, the pattern was completely reversed—32 percent rural and 68 percent urban. Since then, urban population dominance has increased, and by 2000, approximately 81 percent of the Brazilian population lived in cities and 19 percent lived in rural areas.

In absolute terms, the increase in urban population has been enormous. Table 2 shows that between 1950 and 2000, the country's urban population increased by 118,914,548, while at the same time, its rural population slightly decreased by 1,314,502. While some of these changes reflect alterations of administrative boundaries and definitions of what constitutes an urban place, they overwhelmingly reflect massive rural to urban migration—on average, cities in Brazil added 2,378,291 persons per year between 1950 and 2000.

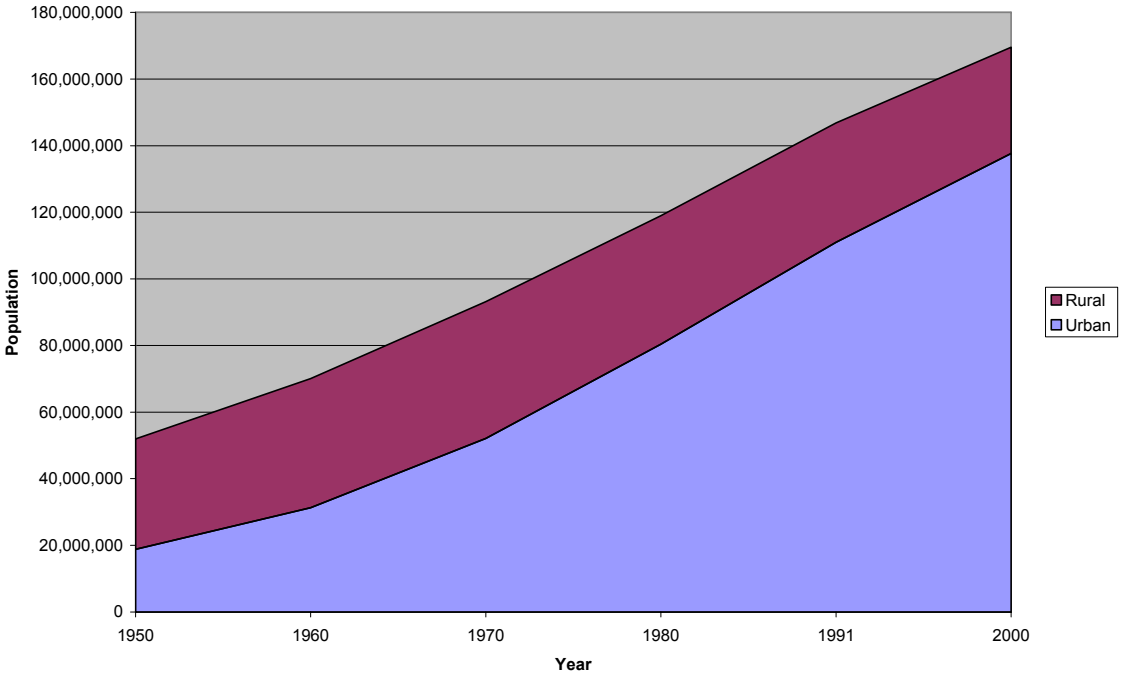
Rural–urban migration was particularly strong in the 1950s and 1960s, reflecting the country's emerging economic growth and social transformation. During the 1970s, 1980s and 1990s, rural–urban migration slowed and, as a consequence, urban population growth slowed as well. In percentage terms, annual urban population growth has ranged from a high of 3.0 percent during the 1950s to a low of 1.4 percent during the 1990s. This decline in the percentage rate of growth is common throughout Latin America as rural areas depopulate and as overall rates of natural population increase slow. However, in absolute terms, annual urban population growth continued to grow up until the 1990s and will continue

FIGURE 2.
Percent Distribution of Urban and Rural Population



Source: IBGE, 2005.

FIGURE 3.
Urban and Rural Population Trends in Brazil, 1950–2000



Source: IBGE, 2005.

TABLE 2.
Decade-by-Decade Change in Urban and Rural Population and Percent Annual Average Change, Brazil, 1950–1960 to 1991–2000

	POPULATION CHANGE			ANNUAL PERCENT CHANGE		
	TOTAL	URBAN	RURAL	TOTAL	URBAN	RURAL
1950–1960	18,126,060	12,520,143	5,605,917	3.0%	5.2%	1.6%
1960–1970	23,068,580	20,781,950	2,286,630	2.9%	5.2%	0.6%
1970–1980	25,863,669	28,351,425	-2,487,756	2.5%	4.4%	-0.6%
1980–1991	27,822,769	30,554,581	-2,731,812	2.1%	3.3%	-0.7%
1991–2000	22,718,968	26,706,449	-3,987,481	1.4%	2.2%	-1.2%
1950–2000	117,600,046	118,914,548	-1,314,502	2.4%	4.1%	-0.1%

Source: IBGE, 2005.

to do so in the future, but it will be driven mainly by natural population increase and less by rural–urban migration.

Rural areas of Brazil have actually been losing population since the 1970s and contain about 10,000,000 fewer persons in 2000 than in 1970. On the other hand, urban areas have been increasing rapidly since the 1950s, growing from 18.8 million persons in 1950 to 137.7 million in 2000—more than a sevenfold increase. Annual urban population growth has ranged from approximately 1.25 million during the 1950s to a peak of 3 million during the 1980s. During the 1990s, the annual rate of growth slightly declined to 2.7 million persons.

Urbanization of Brazil's 15 Largest Metropolitan Regions

Urbanization trends can be disaggregated to examine population growth in Brazil's fifteen largest metropolitan areas. Table 3 presents tabulations of population trends for Brazil's 15 largest metropolitan regions from 1950 to 2000. Over the fifty-year period, these cities accounted for a decreasing share of total urban population, falling from 54.8 percent of total urban population in 1950 to 42.8 percent in 2000—indicating a deconcentration of urban population.

However, despite the declining share, absolute population change has been significant. Table 4 presents population increases for the fifteen metropolitan areas by decade from 1950–1960 to 1991–2000. Population growth in the 15 metropolitan areas was greatest during the 1970–1980 decade when a total of 12.6 million persons was added. Since then, the absolute decadal increases have declined, and during the 1991–2000 period, they stood at 9.2 million. This is consistent with their decreasing share of total urban population; these 15 metropolitan areas accounted for a relatively declining share of countrywide increases in urban population, falling from 52 percent of the total increase during the 1950s to 34.6 percent during the 1990s. These trends show that, over the 50 years, urbanization has gradually slowed in Brazil's 15 largest metropolitan areas. This is due to two factors—urban growth is shifting to areas outside the boundaries of the 15 metropolitan areas, and that second-tier metropolitan areas are accounting for an increasing share of population increase.

TABLE 3.
Urban Population Trends in Brazil's 15 Largest Metropolitan Regions, 1950–2000

METROPOLITAN REGION	TOTAL POPULATION					
	1950	1960	1970	1980	1991	2000
BELÉM	268,252	422,648	669,768	1,021,473	1,401,305	1,795,536
BELO HORIZONTE	565,970	990,055	1,719,490	2,676,352	3,515,542	4,349,425
BRASÍLIA		141,742	537,492	1,176,908	1,601,094	2,051,146
CURITIBA	333,138	554,515	875,269	1,497,352	2,061,531	2,726,556
FORTALEZA	464,507	699,262	1,091,117	1,651,744	2,401,878	2,984,689
GOIÂNIA	82,826	196,596	442,790	827,446	1,230,445	1,639,516
GRANDE SÃO LUÍS	119,785	180,747	302,609	498,958	820,137	1,070,688
GRANDE VITÓRIA	123,281	213,449	410,103	744,744	1,126,638	1,425,587
MACEIÓ	178,705	240,733	357,514	522,173	786,643	989,182
NATAL	169,293	245,303	373,754	554,223	826,208	1,043,321
PORTO ALEGRE	842,390	1,263,401	1,751,889	2,468,028	3,230,732	3,718,778
RECIFE	843,409	1,275,125	1,827,173	2,386,453	2,919,979	3,337,565
RIO DE JANEIRO	3,178,310	4,869,103	6,891,521	8,772,277	9,814,574	10,894,156
SALVADOR	463,545	739,799	1,147,821	1,766,724	2,496,521	3,021,572
SÃO PAULO	2,662,776	4,791,245	8,139,705	12,588,745	15,444,941	17,878,703
TOTAL 15 METROS	10,296,187	16,823,723	26,538,015	39,153,600	49,678,168	58,926,420
TOTAL BRAZIL URBAN	18,782,891	31,303,034	52,084,984	80,436,409	110,990,990	137,697,439
15 METROS AS A % OF TOTAL URBAN	54.8%	53.7%	51.0%	48.7%	44.8%	42.8%

Source: IBGE, 2005.

TABLE 4.
Urban Population Change in the 15 Largest Metropolitan Areas, 1950–1960 to 1991–2000

METROPOLITAN REGION	CHANGE IN POPULATION				
	1950–1960	1960–1970	1970–1980	1980–1991	1991–2000
BELÉM	154,396	247,120	351,705	379,832	394,231
BELO HORIZONTE	424,085	729,435	956,862	839,190	833,883
BRASÍLIA	141,742	395,750	639,416	424,186	450,052
CURITIBA	221,377	320,754	622,083	564,179	665,025
FORTALEZA	234,755	391,855	560,627	750,134	582,811
GOIÂNIA	113,770	246,194	384,656	402,999	409,071
GRANDE SÃO LUÍS	60,962	121,862	196,349	321,179	250,551
GRANDE VITÓRIA	90,168	196,654	334,641	381,894	298,949
MACEIÓ	62,028	116,781	164,659	264,470	202,539
NATAL	76,010	128,451	180,469	271,985	217,113
PORTO ALEGRE	421,011	488,488	716,139	762,704	488,046
RECIFE	431,716	552,048	559,280	533,526	417,586
RIO DE JANEIRO	1,690,793	2,022,418	1,880,756	1,042,297	1,079,582
SALVADOR	276,254	408,022	618,903	729,797	525,051
SÃO PAULO	2,128,469	3,348,460	4,449,040	2,856,196	2,433,762
TOTAL 15 METROS	6,527,536	9,714,292	12,615,585	10,524,568	9,248,252
TOTAL BRAZIL URBAN POPULATION CHANGE	12,520,143	20,781,950	28,351,425	30,554,581	26,706,449
PERCENT 15 OF TOTAL	52.1%	46.7%	44.5%	34.4%	34.6%

Source: IBGE, 2005.

Housing Demand and Housing Production in Urban Brazil

Housing demand is determined by population growth, household formation, income, and requirements to replace old dilapidated housing stock and replace housing units removed from the stock. Housing production trends in Brazilian cities has largely followed trends in urbanization, and overall production of formal and informal housing has reasonably paced increases in household growth.

Table 5 presents trends in housing units by metropolitan region for census years 1970 to 2000 for Brazil's fifteen largest metropolitan areas. During the 30-year period, informal and formal housing stock increased from 5.4 to 16.5 million units—a gross increase of 11.2 million units. On an annual basis, this is 373,000 units a year. For all urban areas in Brazil, the total housing stock increased from 10.5 to 38.7 million between 1970 and 2000. This is approximately 940,000 units per year. Overall, this is a remarkable level of residential construction and investment, although, as we will explain below, much of it is produced through informal channels

TABLE 5.
Permanent Dwelling Units for 15 Largest Metropolitan Regions and Decade-by Decade Change in Stock, 1970–2000

METROPOLITAN REGION	NUMBER OF DWELLING UNITS			
	1970	1980	1991	2000
BELÉM	105,675	184,364	292,218	419,791
BELO HORIZONTE	319,386	568,116	858,303	1,189,609
BRASÍLIA	99,303	253,950	386,396	556,762
CURITIBA	178,338	342,427	543,032	790,982
FORTALEZA	188,412	320,663	523,219	731,278
GOIÂNIA	83,514	180,810	312,228	467,227
GRANDE SÃO LUÍS	49,228	90,563	167,174	249,682
GRANDE VITÓRIA	74,579	161,041	279,674	401,091
MACEIÓ	66,028	104,667	176,051	247,536
NATAL	65,023	109,867	183,440	260,220
PORTO ALEGRE	380,128	630,867	936,221	1,153,274
RECIFE	332,871	481,456	678,819	873,407
RIO DE JANEIRO	1,489,189	2,152,226	2,743,178	3,302,119
SALVADOR	205,588	353,789	581,080	807,352
SÃO PAULO	1,721,964	2,999,178	4,083,306	5,079,188
TOTAL OF THE 15 MR	5,359,226	8,933,984	12,744,339	16,529,518
PERSONS PER DWELLING UNIT	5.0	4.4	3.9	3.6
TOTAL URBAN	10,501,000	18,364,477	28,532,388	38,678,933

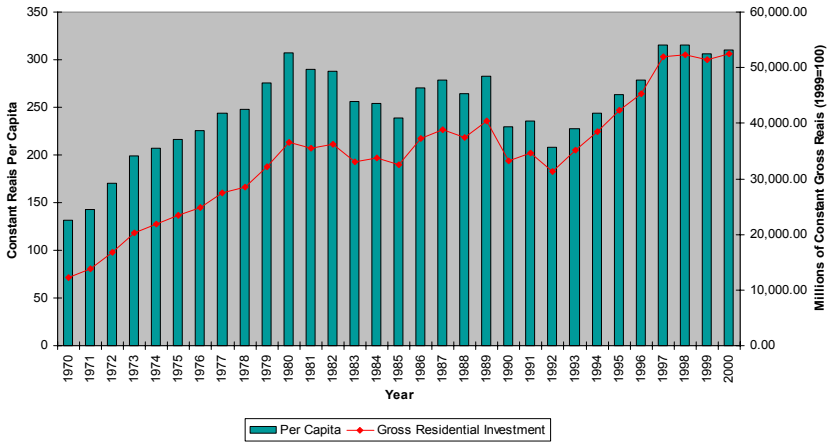
METROPOLITAN REGION	CHANGE IN NUMBER OF DWELLING UNITS			
	1970-80	1980-1991	1991-2000	1970-2000
BELÉM	78,689	107,854	127,573	314,116
BELO HORIZONTE	248,730	290,187	331,306	870,223
BRASÍLIA	154,647	132,446	170,366	457,459
CURITIBA	164,089	200,605	247,950	612,644
FORTALEZA	132,251	202,556	208,059	542,866
GOIÂNIA	97,296	131,418	154,999	383,713
GRANDE SÃO LUÍS	41,335	76,611	82,508	200,454
GRANDE VITÓRIA	86,462	118,633	121,417	326,512
MACEIÓ	38,639	71,384	71,485	181,508
NATAL	44,844	73,573	76,780	195,197
PORTO ALEGRE	250,739	305,354	217,053	773,146
RECIFE	148,585	197,363	194,588	540,536
RIO DE JANEIRO	663,037	590,952	558,941	1,812,930
SALVADOR	148,201	227,291	226,272	601,764
SÃO PAULO	1,277,214	1,084,128	995,882	3,357,224
TOTAL 15 MR	3,574,758	3,810,355	3,785,179	11,170,292
TOTAL URBAN	7,863,477	10,167,911	10,146,545	28,177,933

Source IBGE, 2005.

and is not supplied with adequate infrastructure and secure land titling. It is also significant that persons per household declined dramatically over the 30-year period, falling from 5.0 persons per unit to 3.6 persons per unit, a 28 percent decrease.

Regardless of whether these units are located in legal or illegal residential subdivisions, or favelas, the increases in housing stock are impressive. They represent significant financial accomplishments of households, especially for low- and moderate-income households. Figure 4 illustrates countrywide (urban and rural) private gross residential capital outlays and per capita outlays in constant 1999 Reais (IBGE, 2005).[5] As it shows, spending has been robust and has increased in per capita real terms from R$ 131.4 in 1970 to R$ 310.0 in 2000. Despite the ups and downs of the Brazilian economy during the 1980s, private investment in housing has increased on a decade-by-decade basis. In constant Reais, private residential investment has increased 4.3 times between 1970 and 2000.

FIGURE 4.
Private Investment in Housing is Robust and Increasing in Real Terms



Source: Suzigan, W. *A Indústria Brasileira : Origem e Desenvolvimento*. São Paulo: Brasileiense, 1986; Abreu, M. P. & Verner, D. *Long-term Brazilian Economic Growth: 1930–1994*. Paris: OECD, 1997. (Development Centre Studies. Long-term growth series/OCDE); IBGE, Diretoria de Pesquisas, Departamento de Contas Nacionais.

[5] The figures pertain to fixed capital only and do not include land, operating or maintenance costs.

How adequate has this spending been in terms of providing sufficient housing stock for new households? The question can be partially answered by comparing the relationship between housing production and increases in households. Table 6 presents estimates of increases in household formation for the 15 major metropolitan regions from 1970 to 2000. Table 6 reveals that household formation has been robust in the 15 metropolitan areas. Between 1970 and 2000, these 15 metropolitan regions added approximately 10.6 million households. In total, the number of households in all urban areas of Brazil increased by 27.2 million over the 30-year period—about 900,000 households per year. As pointed out above, a main factor of increased household formation is the reduction in persons per household. With a smaller number of persons per dwelling unit (and, by extension, persons per household) a falling household size means that the number of households per 1,000 people will increase. It is interesting to note that the 28 percent decline in persons per dwelling unit reflects a flexible response in housing supply to accommodate more households per 1,000 people.[6]

Table 7 compares the housing stock increases of Table 5 with the increases in households presented in Table 6. Focusing on the 15 largest metropolitan areas, the 11.2 million housing stock increases between 1970 and 2000 closely tracked the 10.6 million-increase in households. The overall ratio of housing stock increase to household increase for the 15 metropolitan areas is 1.1—suggesting that 1.1 housing units were added to the stock of the 15 metros for every 1 household increase. Closer inspection of the ratio across the metropolitan areas reveals that 10 of the 15 metros are producing relatively more housing units per increase in household. On the other hand, housing markets in the metropolitan regions of Belém, Fortaleza, Grande São Luís, Maceió, and Natal are not producing enough units to accommodate new household formation.

These ratios are very impressive, given the fact that they incorporate housing stock demolitions and removals. The net increase in the stock has, with the exception of the 1980s, kept pace with strong household formation, driven by both population increases and smaller average household size.

[6] If housing supply was tightly constrained, we would expect to see a stable or increasing number of persons per dwelling unit as people delayed household formation, doubled up with other households or extended families.

TABLE 6.
Trends in Household Formation 15 Largest Metropolitan Regions, 1970–2000

METROPOLITAN REGION	HOUSEHOLDS			
	1970	1980	1991	2000
BELÉM	128,063	219,200	332,063	477,536
BELO HORIZONTE	328,774	574,324	833,067	1,156,762
BRASÍLIA	102,771	252,555	379,406	545,518
CURITIBA	167,355	321,320	488,514	725,148
FORTALEZA	208,627	354,452	569,165	793,800
GOIÂNIA	84,663	177,564	291,575	436,041
GRANDE SÃO LUÍS	57,860	107,073	194,345	284,757
GRANDE VITÓRIA	78,414	159,816	266,976	379,145
MACEIÓ	68,358	112,054	186,408	263,080
NATAL	71,463	118,932	195,784	277,479
PORTO ALEGRE	334,969	529,620	765,576	989,037
RECIFE	349,364	512,114	691,938	887,650
RIO DE JANEIRO	1,317,690	1,882,463	2,325,728	2,897,382
SALVADOR	219,469	379,125	591,593	803,610
SÃO PAULO	1,556,349	2,701,447	3,659,939	4,754,974
TOTAL 15	5,074,190	8,402,060	11,772,078	15,671,920
TOTAL URBAN	17,610,993	25,156,482	37,843,782	44,857,290

METROPOLITAN REGION	HOUSEHOLD CHANGE			
	1970–1980	1980–1991	1991–2000	1970–2000
BELÉM	91,137	112,863	145,473	349,473
BELO HORIZONTE	245,550	258,742	323,695	827,988
BRASÍLIA	149,784	126,851	166,111	442,747
CURITIBA	153,965	167,194	236,633	557,792
FORTALEZA	145,825	214,714	224,635	585,174
GOIÂNIA	92,900	114,011	144,467	351,378
GRANDE SÃO LUÍS	49,212	87,273	90,412	226,897
GRANDE VITÓRIA	81,403	107,160	112,170	300,732
MACEIÓ	43,696	74,354	76,672	194,722
NATAL	47,468	76,852	81,695	206,016
PORTO ALEGRE	194,651	235,957	223,460	654,067
RECIFE	162,751	179,824	195,712	538,286
RIO DE JANEIRO	564,772	443,266	571,653	1,579,691
SALVADOR	159,657	212,467	212,017	584,141
SÃO PAULO	1,145,098	958,491	1,095,036	3,198,625
TOTAL 15	3,327,870	3,370,018	3,899 ,842	10,597,730
TOTAL URBAN	7,545,489	12,687,300	7,013,508	27,246,297

Source IBGE, 2005.

TABLE 7.
Ratio of Change in Permanent Dwelling Units to Changes in the Number of Households, for the 15 Major Metropolitan Regions, 1970–1980 to 1991–2000

METROPOLITAN REGION	CHANGE IN PERMANENT DWELLING UNITS / CHANGE IN HOUSEHOLDS			
	1970–1980	1980–1991	1991–2000	1970–2000
BELÉM	0.86	0.96	0.88	0.90
BELO HORIZONTE	1.01	1.12	1.02	1.05
BRASÍLIA	1.03	1.04	1.03	1.03
CURITIBA	1.07	1.20	1.05	1.10
FORTALEZA	0.91	0.94	0.93	0.93
GOIÂNIA	1.05	1.15	1.07	1.09
GRANDE SÃO LUÍS	0.84	0.88	0.91	0.88
GRANDE VITÓRIA	1.06	1.11	1.08	1.09
MACEIÓ	0.88	0.96	0.93	0.93
NATAL	0.94	0.96	0.94	0.95
PORTO ALEGRE	1.29	1.29	0.97	1.18
RECIFE	0.91	1.10	0.99	1.00
RIO DE JANEIRO	1.17	1.33	0.98	1.15
SALVADOR	0.93	1.07	1.07	1.03
SÃO PAULO	1.12	1.13	0.91	1.05
TOTAL 15 MR	1.07	1.13	0.97	1.05
TOTAL URBAN	1.04	0.80	1.45	1.03

Source: Tables 5 and 6.

Our first, level evaluation of Brazil's housing market indicates that there is a strong private (informal and formal) sector and that housing production is substantial. Private Gross Fixed Capital formation in the housing sector has increased by more than fourfold in constant terms. On a per capita basis, real constant reais investments in housing have increased by about 2.35 times between 1970 and 2000. But, as we shall see, most of the housing stock increases are in informal settlements with limited infrastructure services available.

How Large is Brazil's Informal Housing Sector?

The previous section outlined the overall performance of Brazil's urban land and housing market, looking at both the formal and informal sectors of housing production and consumption. This section explores the role and performance of the informal sector in producing housing in Brazilian cities.

As noted in the introduction to this paper, defining and systematically exploring informal housing is problematic (Pontual, 2005; Pontual and Serra, 2005). In the case of Brazil, there are widely differing estimates of housing informality both in terms of the size of the informal housing stock and the rate at which informal housing units are added to the supply of housing.

What defines informality? Informal housing can be defined along three main conceptual lines: security of land tenure; access to infrastructure services; and the physical characteristics of the settlement and the housing structures in it. Informal land subdivisions are a predominant component of informal housing provision. In the Brazilian case, there are two types of informal land subdivisions—illegal subdivisions and clandestine subdivisions.

Illegal subdivisions are produced by a landowner or his agent. The subdivision of the parcel typically is done without government permission (approval of subdivision plan), lack of a legal physical cadastre identifying plots, and incomplete infrastructure provision. Purchasers of such lots will usually build housing over a 2–5 year period and, given the lack of legal status, will construct housing without obtaining building permits and inspections.

Clandestine subdivisions refer to settlements that are produced on land not owned by the developer or real estate agent. It is uncommon, but not impossible, for clandestine subdivisions to be located on government land. Houses in clandestine subdivisions usually do not have secure tenure and usually do not have complete urban infrastructure services.[7] Favelas are also invasions of land, but the subdivision of the land is typically unorganized and does not follow a plan. Plots in favelas do not have legal title nor do they have access to services.

The physical characteristics of informal settlements vary considerably. In clandestine subdivisions and favelas, housing construction can range from very poor, temporary arrangements to reasonably good conditions—brick walls, concrete floors and tin roofs. Condition varies by the age of the settlement—newer ones are more precarious, and more established settlements have better housing conditions. Over time, virtually all settlements go through an incremental process of upgrading. Some of this upgrading is self-organized, and some is based on government programs, where government agencies work with

[7] For example, some favelas in Rio de Janeiro (such as Favela da Rochinha) have most services, but still lack formal title. Also, as mentioned earlier, classifying settlements as either having or not having infrastructure services is problematic since this binary treatment does not capture the variable quality of infrastructure services.

residents of informal settlements to provide secure tenure, make infrastructure investments in water, wastewater collection and treatment, drainage, electricity, and solid waste collection. These programs also include assistance to homeowners to make improvements to their houses. In cases where governments do not support or sanction upgrading, even community-based efforts are organized to improve conditions through self-help activities. The overall result is that in most metropolitan regions the stock of informal housing is constantly changing through additions, resettlements, and upgrading efforts.

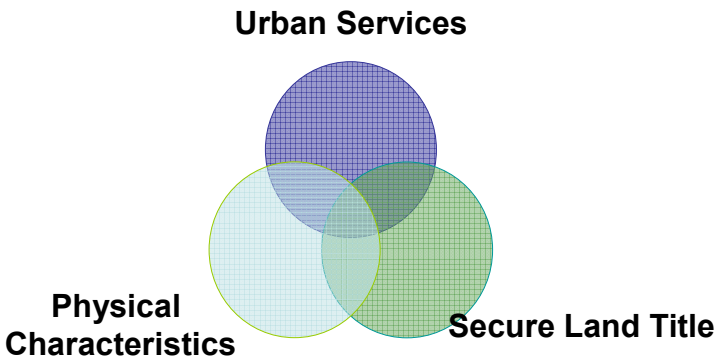
Figure 5 illustrates how the three dimensions of informality can be combined to categorize housing settlements and housing production into formal and informal classifications. Unfortunately, in terms of empirical data, Brazilian statistics on informal housing stock are incomplete, and in some cases, misleading. Census data from IBGE on housing units combines informal and formal units and does not provide any basis for distinguishing between the two types. The work of the Fundação João Pinheiro (2002, 2005) also does not shed much light on this matter. While their extensive research on Brazil's housing deficit provides specific tabulations of inadequate housing, overcrowding, lack of access to infrastructure, and excessive rental payments, these figures cannot be aggregated into overall estimates of informal housing stock.

IBGE does, however, collect information on whether the housing units have access to infrastructure services, on the physical conditions of each dwelling unit, and tabulations of the number of households where the occupant has legal right to the structure, but not the land. But here again, the tabulations cannot be aggregated without the risk of significant double counting (IBGE, 2000).

As Figure 5 shows, informality can be limited to lack of infrastructure, lack of secure land title, and poor physical conditions of housing and settlement layout. Quite often, housing informality occurs with combinations of two or three of the above conditions. Since IBGE does not have data on land tenure, we have only two of the three variables necessary to measure informality.

Reliance on access to services and physical conditions, while foregoing information on land tenure, is likely to undercount the stock of informal dwelling units in Brazil's urban areas. Unfortunately, we simply do not know how serious the underestimation is. If the incidence of dwelling units with infrastructure, good physical conditions, and lack of secure land tenure is low, then the underestimation will be low. On the

FIGURE 5.
Defining Informal Housing is Complicated



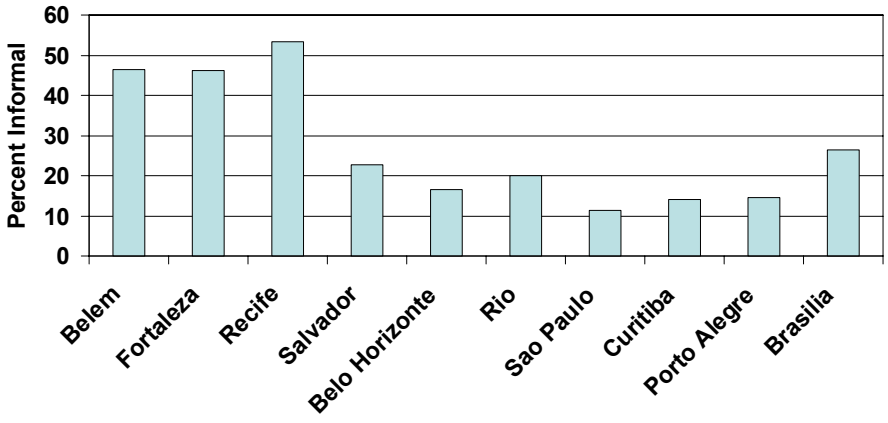
other hand, if there are substantial numbers of units in cities that lack secure land title, but have infrastructure and are in good physical condition, then the underestimation will be large.

Discussions with housing and land tenure experts in Brazil indicate the range of underestimation probably varies from city to city, with it being higher in the north and northeast, where land titling and registration are less common [conversation with Edesio Fernandes, March 6, 2006]. In addition, many housing experts have noted that the IBGE data on access to infrastructure and physical conditions are inaccurate and frequently undercount informal housing. Despite the limitations with IBGE's data on informal housing, their estimates of housing units with access to infrastructure may provide a useful picture of housing conditions in Brazilian cities, and therefore, we will use them as a proxy for informal housing.

Figure 6 provides a tabulation of the percent of housing units without urban infrastructure services, by major metropolitan region in Brazil, based on the 2000 census. The figures range from over 10 percent for São Paulo to nearly 55 percent for Recife.

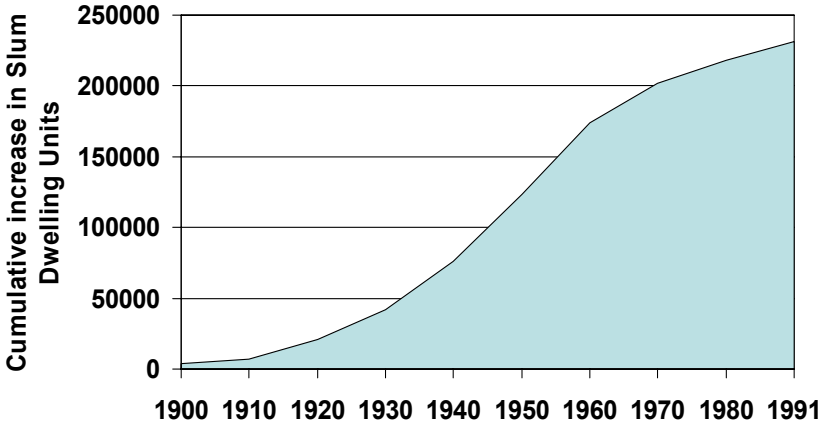
Figure 7 provides an example of changes in the informal housing stock in Rio de Janeiro. Informal housing increased from virtually zero in 1900 to over 225,000 units in 1991. Since the 1960s, the rate of growth has slowed, but it is still increasing and overspilling into outlying areas (O'Hare and Barke, 2003). As a result, the proportion of Rio's housing stock that is located in favelas is declining. In 1970, about 13.5 percent of the housing stock was located in favelas, whereas by 1991, the portion had slightly declined to 12 percent, which is roughly consistent with the percentage indicated in Figure 6.

FIGURE 6.
Level of Informality Varies Widely Across Brazil, 2000



Source: FJP, 2005.

FIGURE 7.
Number of Favela Dwelling Units in Rio de Janeiro, 1900–1991



Source: Development Planning Unit, *Understanding Slums: Case Studies For The Global Report*, 2003.

Table 8 provides an estimate of informal housing stock for both 1991 and 2000 which is based on access to adequate infrastructure. The table enumerates formal and informal housing stock for 1991 and 2000, and it provides estimates of the net flow of formal and informal dwelling units for the 10 largest metropolitan areas in Brazil and other urban areas. The overall portion of informal units has increased from 13 to 23 percent. In some cities—Brasília, Belém and Recife—the portion of informal units

has doubled. In others—Curitiba, Salvador, and São Paulo—it has remained constant. However, experts familiar with Salvador indicate that the ratio of unserviced informal housing is grossly underestimated [comment by Ivo Imparato at World Bank Seminar on March 6, 2006].

These data provide a rough estimate of relative contribution of formal and informal housing production in Brazil's urban areas between 1991 and 2000. The most important result of the tabulations presented in Table 8 is that the informal sector accounted for over half—56 percent—of the increase in Brazil's urban housing stock between 1991 and 2000. Out of the total 10-million-unit increase in permanent dwelling units between 1991 and 2000, informal production accounted for 5.6 million units.

Table 8 also suggests that informality is now more prevalent outside the 10 largest metropolitan regions. In 1991, informal housing accounted for 13.7 percent of the total housing stock outside the 10 largest metropolitan areas in Brazil. In 2000, the figure increased to 24.1 percent. By 2000, 22.9 percent of the urban housing stock in Brazil could be classified as informal (lacking access to infrastructure).

Looking at the net flow of informal housing production between 1991 and 2000, in the 10 largest metropolitan regions, informal unit change accounted for 43.1 percent of the total increase. Put another way, between 1991 and 2000, 4 out of every 10 units developed in the 10 metropolitan areas were without infrastructure access. In Brazil's smaller metropolitan areas and cities, informal production accounted for 63.7 percent of total net housing production. This indicates that informality is growing rapidly in small and medium-sized cities—between 1991 and 2000, the portion of housing units lacking infrastructure increased from 14 to 26 percent. In 2000, Brazil's urban housing stock totaled 44.8 million units. Of these, 10.3 million units were informal, lacking access to infrastructure.

Compared to other Latin American countries, Brazil ranks poorly in terms of access to infrastructure. According to a survey by the United Nations Economic Commission of Latin America and the Caribbean (2004), it ranked 8th out of 13 in terms of the percent of dwelling units with access to piped water, ranked 11th out of 13 with respect to sewage collection and treatment connections, and ranked 5th out of 14 with respect to access to electricity.[8] These are not impressive standings, and they

[8] With a per capita GNI of $3000, Brazil ranks below, Mexico, Argentina, Chile, and Uruguay, and these countries score higher on infrastructure access. However, some lower income countries, such as Honduras, Guatemala, El Salvador, and Nicaragua, score higher than Brazil on water and sanitation.

TABLE 8.
Total Dwelling Units and Those Lacking Adequate Infrastructure, by Metropolitan Region, 2000

METROPOLITAN REGION	1991 TOTAL PERMANENT DWELLINGS*	1991 INFORMAL DWELLING UNITS**	1991 PERCENT OF TOTAL	2000 TOTAL PERMANENT DWELLINGS*	2000 INFORMAL DWELLING UNITS***	2000 PERCENT OF TOTAL	INFORMAL INCREASE AS A % OF TOTAL INCREASE
BELÉM	274,186	38,386	14.0%	416,176	193,271	46.4%	109.1%
FORTALEZA	479,852	146,355	30.5%	723,197	333,262	46.1%	76.8%
RECIFE	605,880	181,764	30.0%	859,574	459,352	53.4%	109.4%
SALVADOR	547,678	124,323	22.7%	796,200	180,904	22.7%	22.8%
BELO HORIZONTE	822,147	229,379	27.9%	1,295,824	214,114	16.5%	-3.2%
RIO DE JANIERO	2,753,543	273,669	9.9%	3,252,659	654,324	20.1%	76.3%
SÃO PAULO	3,967,579	273,669	6.9%	4,992,570	571,466	11.4%	29.1%
CURITIBA	508,699	72,744	14.3%	776,060	108,938	14.0%	13.5%
PORTO ALEGRE	840,660	81,544	9.7%	1,112,752	162,856	14.6%	29.9%
BRASÍLIA	363,222	6,538	1.8%	777,473	205,787	26.5%	48.1%
TOTAL METROPOLITAN REGIONS	11,163,447	1,428,371	12.8%	15,002,485	3,084,274	20.6%	43.1%
OTHER METROPOLITAN REGIONS	23,571,268	3,224,240	13.7%	29,774,255	7,176,802	24.1%	63.7%
TOTAL URBAN BRAZIL	34,734,715	4,652,611	13.4%	44,776,740	10,261,076	22.9%	55.8%

Source: * Census Table 2432
**Fundação João Pinheiro (FJP), Centro de Estatística e Informações (CEI), Table 4, 2002
***Fundação João Pinheiro (FJP), Centro de Estatística e Informações (CEI)
Déficit Habitacional no Brasil – Municípios Selecionados e Microrregioes Geográficas, 2005

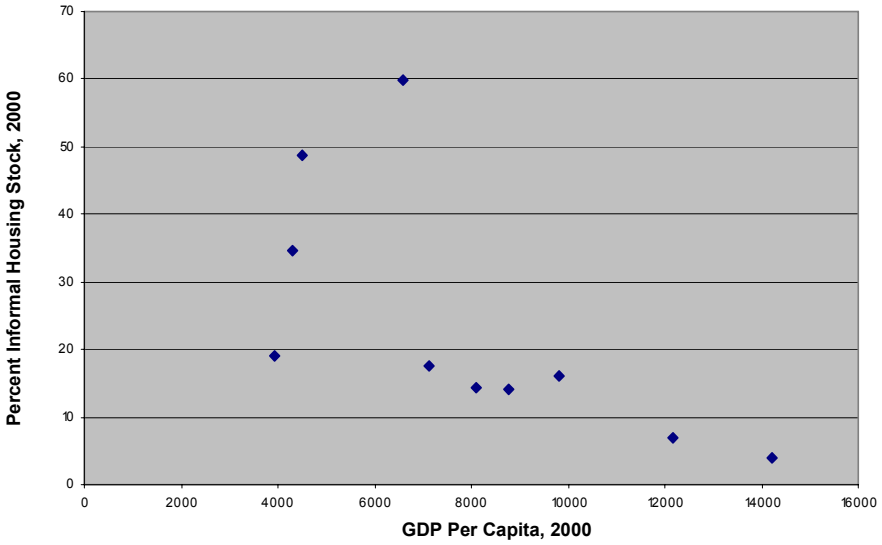
reflect the limited options open to low- and medium-income households to secure shelter.

Despite high levels of private investment in residential construction, urban housing production in Brazil is predominantly based on informal housing construction. Based on available data, more than half—56 percent—of the housing stock increase between 1991 and 2000 was informally provided (see Table 8). This is largely a reflection of the failure of formal urban housing and land markets to generate sufficient supply at affordable prices. However, informality is not simply a manifestation of low incomes. As Figure 8 illustrates, levels of informality are not highly correlated with incomes. Informality varies considerably within a narrow range of metropolitan areas with GDPs between Reais 4,000 to 6,000.

---

[10] The total area of the core is 7,850 hectares—π*radius^2.

FIGURE 8.
Low Income Does Not Entirely Explain Informality



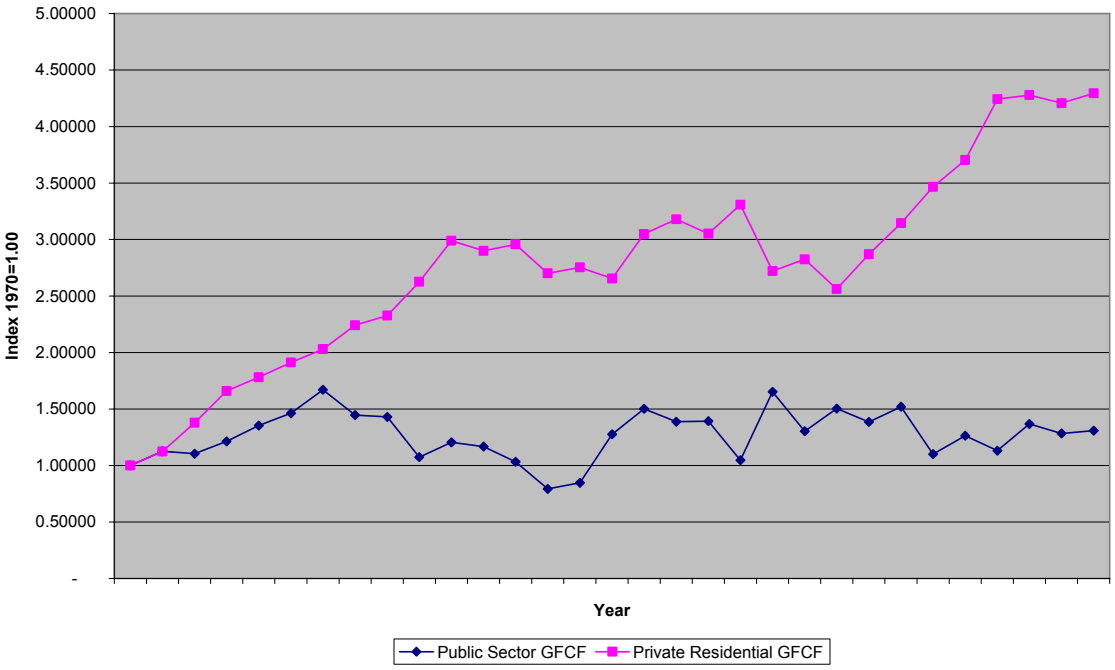
Source: FJP, 2005.

The most important obstacles to increased supply are lack of serviced, subdivided land. Public infrastructure services are not expanding fast enough to meet housing production, and there are over 10 million units that do not have access to adequate infrastructure. Figure 9 illustrates that public sector investment in infrastructure has not kept pace with housing production. Public sector gross fixed capital formation has lagged behind. As a consequence, much of Brazil's housing production is delivered without the support of public infrastructure services.

If present trends continue, Brazil's urban housing stock will become increasingly dominated by informal production. While there will be some modest increase in slum upgrading and regularization that will move informal units into the formal category, it is quite likely that the overall proportion of informal urban dwelling units in Brazil will increase over the next several decades. In fact, if the trends in informal and formal housing production that took place between 1991 and 2000 continue, Brazil's urban informal housing stock can be expected to increase to 35 percent overall by 2030.

One of the most significant consequences of urbanization and housing construction is the spatial development of cities. Over time, as cities grow and expand their spatial structure changes (Angel et al., 2005). Motorization and increasing use of automobiles are now the principal factors driving low density metropolitan development. As the next section

FIGURE 9.
Trends in Public Sector Gross Fixed Capital Formation and Private Residential Gross Fixed Capital Formation, 1970–2000



Source: Suzigan, W. *A Indústria Brasileira : Origem e Desenvolvimento*. São Paulo: Brasileiense, 1986; Abreu, M. de P. & Verner, D. *Long-term Brazilian Economic Growth: 1930–1994*. Paris: OECD, 1997. (Development Centre Studies. Long-term growth series/OCDE); IBGE, Diretoria de Pesquisas, Departamento de Contas Nacionais.

illustrates, Brazilian cities are decentralizing and consuming more land per persons added.

The Urban Land Use Consequences of Urbanization

Brazil's rapid urbanization has profoundly shaped the physical development of its cities and metropolitan regions. Because urban population growth must be supported by urban land, as cities grow, their urban areas (built-up areas) increase in size. Table 9 provides summary statistics on the built-up areas and population densities for selected Brazilian and Latin American cities. As the table illustrates, gross population densities in Latin American cities range from 35 persons per hectare in Curitiba to a high of 101 persons per hectare in Rio de Janeiro.

The urban development challenges posed by increasing urban population growth are substantial. Additional population requires additional housing stock, water supply and wastewater treatment, solid waste collection, schools, health facilities, streets, transport, and

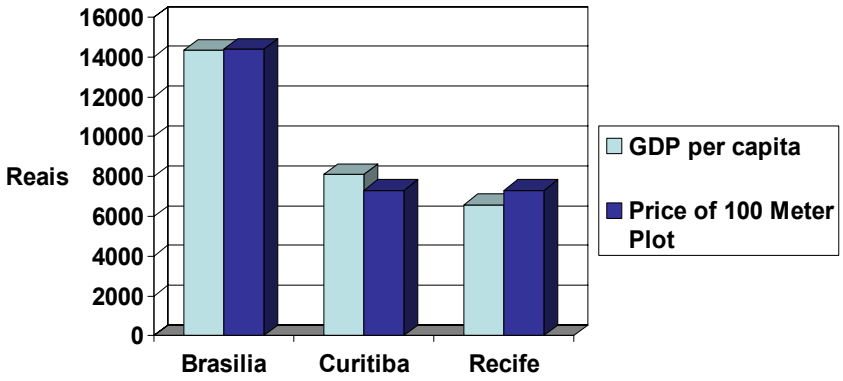
employment opportunities. All of this requires land to support such development. In fact, the supply of serviced land is one of the principal determinants of urban land market performance. When the supply of serviced land is limited, urban land prices are typically high relative to income and economic activity. This makes housing and non-residential real estate more expensive. Figure 10 provides a tabulation of land prices relative to GDP per capita in three Brazilian cities—Brasília, Curitiba, and Recife. As it illustrates, in all three cities, the price of 100 square meters of serviced residential land roughly equals the per capita GDP of the metropolitan area.

TABLE 9.
Population, Urban Land Use, and Gross Population Density in Latin American Cities, 1990 and 2000

CITY	YEAR	POPULATION	URBAN LAND USE, HECTARES	GROSS POPULATION DENSITY/ URBANIZED HECTARE	SOURCE
BOGOTA	1990	5,484,200	158,700	34.6	Brinkhoff, 2003
BRASÍLIA	2000	2,403,000	61,648	39.00	Serra, Dowall, Motta, Donovan 2005
BUENOS AIRES	1990	7,974,000	115,700	68.9	Alain Bertaud, 2004
CARACAS	1990	1,822,465	43,300	42.1	Brinkhoff, 2003
CURITIBA	2000	2,594,000	109,629	23.7	Serra, Dowall, Motta, Donovan 2005
MEXICO CITY	1990	8,235,700	149,900	54.9	Brinkhoff, 2003
RECIFE	2000	3,339,000	37,669	88.6	Serra, Dowall, Motta, Donovan 2005
RIO DE JANEIRO	1990	5,480,800	54,265	101.0	Alain Bertaud
SANTIAGO	1990	4,518,100	55,700	81.1	Simmonds and Hack, 2000
SÃO PAULO	1990	15,416,400	203,800	75.7	Simmonds and Hack, 2000

Sources: http://alain-bertaud.com/; Thomas Brinkhoff, http://www.citypopulation.de/index.html; M.V. Serra, David E. Dowall, Diana Motta and Michael Donovan, *Urban Land Markets and Urban Development: An Examination of Three Brazilian Cities: Brasília, Curitiba and Recife*. Brasília: IPEA, 2005; and Roger Simmonds and Gary Hack, *Global City Regions: Their Emerging Forms*, London: Spon, 2000.

FIGURE 10.
Residential Land is Expensive Relative to GDP Per Capita



Source: Serra, Dowall, Motta and Donovan, 2005.

Households earning incomes below the GDP average are forced out of the formal market and must seek shelter in informal settlements, generating overcrowding as households share dwellings. It is no coincidence that informal housing production, despite rigorous enforcement in the center of Brasília, is higher than in Curitiba. In the case of Recife, the very high rates of informality are due to both affordability gaps and limited land for residential development (Serra, Dowall, Motta, Donovan, 2004).

Recent research on land markets in Brasília, Curitiba, Recife, and São Paulo provides some indication of the relationship between population growth and urban land development. Table 10 presents data on these patterns for the four metropolitan areas. Using population and land use data from 1991 and 2000, the table illustrates the clear and direct relationship between population growth and urban land development. Depending on the metropolitan region, each additional 1,000 person increase in population requires between 6 and 37 hectares of land to be developed. The amount of land needed depends on a range of factors, such as persons per household, the density of residential development (houses per hectare), the extent to which new population is accommodated through urban redevelopment of older buildings, and the additional demand for urban development that comes from non-residential uses such as commercial and industrial activities. In the cases of both Recife and São Paulo, development is taking place at higher population densities. This is most likely due to denser residential development whether formal or informal. However, over time, the overall density of metropolitan areas declines.

TABLE 10.
Trends in Population and Built-up Area, Selected Brazilian Cities, 1991 and 2000

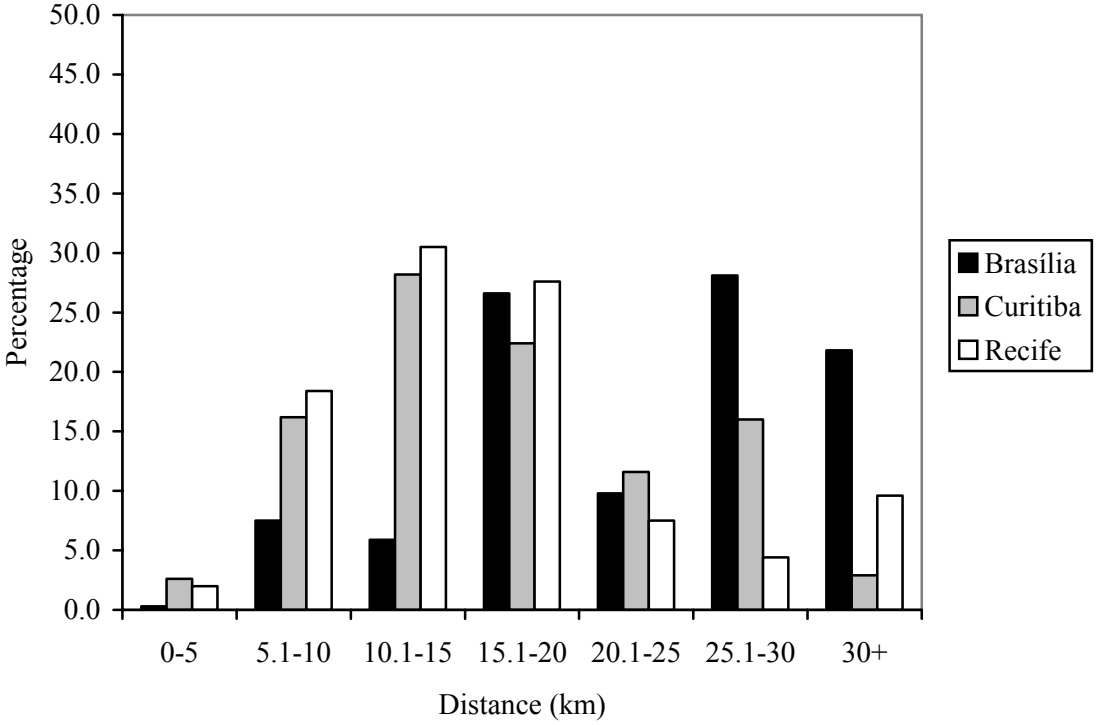
METRO AREA	1991 POPULATION	2000 POPULATION	1991 BUILT-UP AREA (HECTARES)	2000 BUILT-UP AREA (HECTARES)	CHANGE IN POPULATION	CHANGE IN BUILT-UP AREA (HECTARES)	HECTARES PER 1000 POPULATION INCREASE
BRASÍLIA	1,592,000	2,403,000	40,213	61,648	811,000	21,435	26.4
CURITIBA	2,051,000	2,594,000	89,659	109,629	543,000	19,970	36.8
RECIFE	2,917,000	3,339,000	31,559	37,669	422,000	6,110	14.5
SÃO PAULO	10,730,000	15,416,000	126,350	155,430	4,686,000	29,076	6.2
TOTAL / AVERAGE	17,290,000	23,752,000	287,781	364,376	6,462,000	76,591	11.9

In this section, we examine the spatial structure of the three cities—Brasília, Curitiba and Recife—looking at the distribution of population and the compactness of urban land development. Examination of the spatial distribution of population in the three cities provides the opportunity to compare and contrast the overall compactness of urban development. We measure compactness by calculating the cumulative percentage of total population located within specific radii of the city center. Compactness will change over time, depending on the spatial distribution of residential development taking place between 1991 and 2000.

Figures 11 arrays the spatial distribution of population change for the three cities between 1991–2000 according to seven distance bands, expressed in terms of distance (kilometers) from the city center. In order to foster comparison, the bands are defined to reflect the overall spatial distribution of the three cities.

Change in population between 1991 and 2000 reveals several interesting results. The first and most dramatic finding is that Brasília's population is distributed quite differently than Curitiba's or Recife's—most of its population is concentrated far from the city center. In 1991, over half (53.6%) of Brasília's metropolitan population was located more than 25 kilometers from the city. By 2000, the percentage had declined somewhat to 50%, but still remained distinctly different from the spatial patterns in the other two cities. The percentage of population located within 10 kilometers of Brasília's center averaged about 8% for both 1991 and 2000.

FIGURE 11.
Spatial Distribution of Population Change: Brasília, Curitiba and Recife, 1991–2000



In sharp contrast, in 1991 nearly 70% of Curitiba's population resided within 10 kilometers of the city center. By 2000, Curitiba's population had begun to decentralize and 58.5% of the total metropolitan population was located within 10 kilometers of the center. Peripheral population in Curitiba was low in comparison to Brasília—less than 6% in 1991 and less than 9% in 2000 of the total population resided more than 25 kilometers from the central city.

In Recife, the patterns are similar to Curitiba. In 1991, over 48% of the population resided within 10 kilometers of the city center. In 2000, the portion was 44%. Recife's peripheral population was about the same as Curitiba's, and well below that of Brasília. In 1991, 8.5% lived more than 25 kilometers from the city center. In 2000, the figure increased to 9.2%.

The spatial distribution of population in the three cities between 1991 and 2000 largely reflected the baseline spatial structure of 1991. In Brasília, about half of the population growth took place in areas more than 25 kilometers from the center. It is significant to note that approximately 27% of the population change took place in the distance band of 20.1–25

kilometers—reflecting the growth in the area northeast of the city center. This decentralized, sprawling pattern of population change in Brasília suggests that planning restrictions and government ownership of land introduces profound distortions into Brasília's urban land market. Since development is blocked in areas adjacent to the city center, residential growth is forced to the periphery. It is interesting to contrast this with both Curitiba and Recife, where land use regulations are far less stringent.

In Curitiba, population growth moved out beyond 10 kilometers from the city center. Between 1991 and 2000, nearly half of the increase took place in areas between 10 and 20 kilometers from the city. This suggests that Curitiba has been relatively successful in achieving compact development—channeling growth into areas that are contiguous to existing urban areas. Compact development is not necessarily high density. In the case of Curitiba, the city used 37 hectares of land for each additional 1,000 persons—this is much more land than in Brasília, which used 26 hectares.

In Recife, approximately 58% of the increase in population between 1991 and 2000 occurred between 10.1 and 20.1 kilometers from the city center. Like Curitiba, Recife's growth has been compact, moving out beyond the densely developed core. But unlike Curitiba, Recife is developing at a much higher density—it used about 15 hectares per 1,000-person increase in the population.

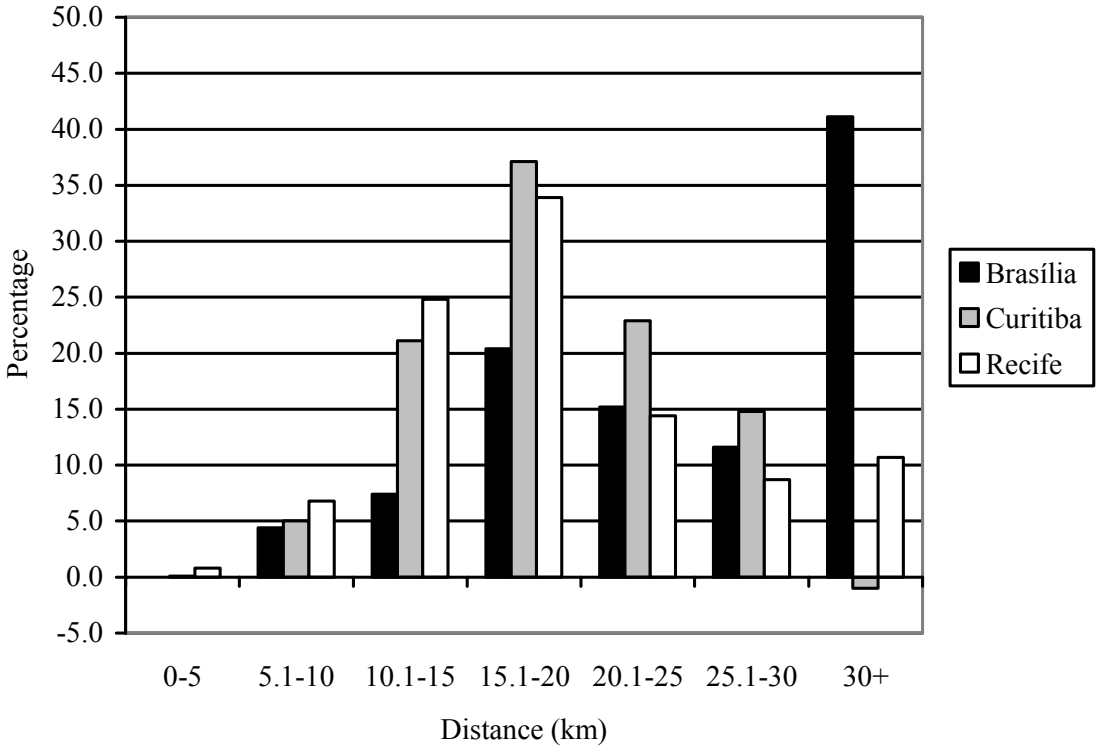
Figure 12 illustrates the change in urban developed land between 1991 and 1997/2000 for the three cities. In the core of Brasília (within 5 kilometers), less than 10% of the total urban land area is developed.[10] In contrast, over 90% of the land in the core of Curitiba is developed. In Recife, about 80% of its developable core is urbanized. In Brasília, net new urban development in the core—conversion of vacant land to urban uses—is effectively zero (1 hectare). In Curitiba, net urban development in the core increased by 14 hectares, and Recife had the greatest increase at 48 hectares.

As far as urban land development beyond the core, Curitiba's and Recife's urban development is concentrated in the 10- to 25-kilometer bands. Between 1991 and 2000, 81% of Curitiba's change in developed, urbanized land was located in this 10–25 kilometer band. In Recife, 73% was similarly located. In contrast, in Brasília, less than 50% was located within 10 to 25 kilometers. In fact, approximately 53% of urban land development in Brasília between 1991 and 1997 took place beyond 25 kilometers from the city center—suggesting that Brasília is sprawling.

What are the implications of these alternative forms of urban land development in the three cities? There are three important issues that

emerge from this comparison. First, cities that sprawl—like Brasília—consume more land per person than those that develop compactly. Brasília developed 19,620 hectares of land to accommodate 811,000 persons—24 hectares per 1,000 additional persons. In contrast, Recife developed 6,738 hectares of land to accommodate 422,000 additional persons—16 hectares of land per 1,000 persons. However, Curitiba developed 19,220 hectares of land to accommodate 543,000 additional persons—35 hectares of land per 1,000 persons—suggesting that Curitiba experienced substantial low-density development.

FIGURE 12.
Spatial Distribution of Change in Urban Land Development: Brasília, Curitiba and Recife, 1991–1997/2000



A second factor is the welfare implications of forcing the population to travel greater distances to the center of the city. As Bertaud and Buckley have suggested for India, low-density urban sprawl introduces significant transportation costs on residents. A good comparative measure of compactness is the average per capita distance from the city center (Bertaud, 2001). This is calculated as the weighted average distance of each population in each zone. In 2001, the average per capita distance for Brasília was 24.3 kilometers; for Curitiba it was 11.2 kilometers; and for Recife it was 13.1 kilometers. In all cases, the average per capita distance to the city center increased between 1991 and 2001. In 1991, Brasília's average was 22.5 kilometers, Curitiba's was 9.75 kilometers, and Recife's was 12.62 kilometers. In a recent paper, Bertaud and Bruckner (2004) illustrated that cities with restrictive development controls take up more space and have higher commuting costs. Given the fact that distances are approximately twice as great in Brasília than in Curitiba or Recife, there is clearly a compelling case for assessing the welfare implications of the capital's dispersed spatial structure.[11]

The third impact is that more compact development economizes on urban infrastructure costs, whereas low-density, sprawling development typically requires higher infrastructure costs per capita.[12]

The experiences in Curitiba and Recife are consistent with empirical research on patterns of population density in Latin America and worldwide, showing that, over time, population densities decline. As Ingram points out:

> Over time, a universal finding is that metropolitan populations have become more decentralized (population density gradients become flatter)—due to the effects of increases in income (promoting housing consumption) and improvements in transport performance (higher speeds and lower costs relative to incomes). Population growth in large cities usually does not increase the population density of high density areas, but promotes densification of less-developed areas and expansion at the urban fringe [Ingram, 1998, pp. 1021–1022].

---

[11] In fact, average distance per capita figures for other national capitals, such as Moscow (10.57 km), Paris (10.24 km), and London (12.63 km), are less than half of Brasília's despite the fact that they have larger populations.

[12] See Robert W. Burchell et al., *The Costs of Sprawl*. TCRP Report 74. New Brunswick, NJ: Center for Urban Policy Research, 2000.

Density gradients measure the relationship between population density and distance from the city center. Normally, as cities expand, population density gradients "flatten out" as people move to suburban rings of the metropolitan area to find housing (Mills, 1972). This flattening out is the result of two changes in the gradient—first, the population at the center declines, and second, there is a decline in the rate at which population density falls with distance from the city center. Empirical research has shown that the following simple exponential function provides a reasonable basis for describing the pattern of declining population density in metropolitan areas:

$$D_x = D_0 e^{-gx}$$

where D_x is the population density at x kilometers from the city center, D_0 is the population density at the center of the city, and g is a population density gradient parameter to be estimated from the data.

Table 11 presents the results of separate regression models estimating the population density gradients for a range of Brazilian cities. Intercept data and gradients are presented for two time periods. In all cases, the gradients "flatten out" over time. With the exception of Recife, the intercept population density (the estimated population density in the city center) decreases over time, suggesting that residential occupancy decreases in the center—perhaps signaling conversion to non-residential uses or residential population shifts to newer outlying areas. The increase in central city population in Recife, although modest, may suggest that the preservation of high-density favelas in ZEIS areas near the city center is an effective means for preserving residential areas in central cities.

The flattening out of population density gradients has important implications for urban land management. As cities grow, the amount of land supply needed per person will increase. Therefore, looking toward the future, cities in Brazil will spatially expand as densities decrease. This increase in urban population will generate considerable demand for urban land and infrastructure services.

Sprawl also poses a major challenge for metropolitan management and planning institutions. If the population growth of Brazil's largest metropolitan areas is spilling over into outlying municipalities, central city governments like Rio de Janeiro and São Paulo are losing their control of spatial development policies and infrastructure investment decisions.

TABLE 11.
Population Density Gradients in Selected Brazilian Cities, 1991 and 2000

CITY	YEAR	INTERCEPT (D_0)*	GRADIENT (g)	Source
Belo Horizonte	1991	122	-0.082	Avila
	2000	113	-0.052	
Curitiba	1991	140	-0.201	Dowall
	2000	124	-0.166	
Fortaleza	1991	206	-0.166	Avila
	2000	171	-0.108	
Porto Alegre	1991	166	-0.187	Avila
	2000	158	-0.168	
Recife	1991	165	-0.076	Dowall
	2000	179	-0.073	
Rio de Janeiro	1991	169	-0.040	Avila
	2000	148	-0.029	
Salvador	1991	219	-0.146	Avila
	2001	198	-0.100	
São Paulo	1991	200	-0.073	Avila
	2000	154	-0.049	

* Density is persons per hectare
Source: Dowall, 2004; and Avila, 2005.

Looking Forward: Brazil's Future Urban Housing Needs and Prospects for Reaching Them

Projections of future urban population growth for Brazil suggest robust growth (UNECLAC, 2004). As illustrated in Table 12, between 2000 and 2030 Brazil's total population is projected to increase by 65,961,000, reaching 235,505,000. All of this increase will occur in urban areas, as rural hinterlands are expected to continue losing population. Total urban population will increase from 138,000,000 in 2000 to 215,000,000 in 2030—an increase of 77,000,000; this is like adding 7 Rio de Janeiro's over the 30-year period. On an annual basis, the increase in urban population will average over 2,500,000 persons per year—almost like adding a Curitiba each year. These are huge numbers that imply massive challenges for city planning and public sector capital investment programming.

TABLE 12.
Projections of Brazil's Total, Urban and Rural Population, 2000–2030

YEAR	POPULATION		
	TOTAL	URBAN	RURAL
2000	169,544,443	137,697,439	31,847,004
2005	186,405,000	157,041,000	29,364,000
2010	198,497,000	171,904,000	26,593,000
2015	209,401,000	185,052,000	24,349,000
2020	219,193,000	196,573,000	22,620,000
2025	227,930,000	206,557,000	21,373,000
2030	235,505,000	214,940,000	20,565,000

YEAR	ANNUAL PERCENT CHANGE		
	TOTAL	URBAN	RURAL
2000–2005	2.0%	2.8%	-1.6%
2005–2010	1.3%	1.9%	-1.9%
2010–2015	1.1%	1.5%	-1.7%
2015–2020	0.9%	1.2%	-1.4%
2020–2025	0.8%	1.0%	-1.1%
2025–2030	0.7%	0.8%	-0.8%

Source: ECLAC, United Nations, 2004.

Accommodating Urban Growth: How Much Urban Land Supply is Needed?

We can roughly approximate the urban land supply requirements to accommodate future urban population growth in Brazil. Estimates are based on combinations of Tables 10 and 12, using the overall average 11.9 hectares of built-up area to support a 1,000-person increase in urban population; the total urban land requirements to accommodate 77 million persons becomes approximately 916,300 hectares or 9,163 square kilometers. Put another way, accommodating this urban population growth will require a built-up area equivalent to 7 São Paulos.

Of course, this estimate is speculative. It may be possible to accommodate the population growth at higher densities, by redeveloping inner city areas with housing, and by increasing the density of suburban development (Dowall and Treffeisen, 1991). By shifting away from single-family dwelling units (in both formal and informal settlements) to mid-rise condominiums and more compact low-rise residential development, per capita urban land requirements can be reduced.[13] For example, if the urban land supply requirements per 1,000 persons could be reduced by about 25 percent, only 9 hectares of urban land would be required for each 1,000 persons (111 persons per hectare). This would reduce the aggregate land supply requirement to 693,000 hectares—6,930 square kilometers. However, increasing density will make it more difficult for the informal sector to operate, since higher density multi-family units will be needed. In order for this approach to work, such housing must be affordable to low- and moderate-income households. This suggests that the government should concentrate its efforts on providing urban infrastructure to land suitable for development.

What Can Be Done to Improve Urban Land and Housing Market Outcomes?

Brazil's national government, in partnership with local governments, non-governmental organizations and the private sector, could do much to foster increased production of affordable housing. This section outlines what such a strategy might look like.

First and foremost, the urban land and housing strategy should be multi-faceted and similar to policy models used by public health professionals; it should include both "curative" and "preventive" programs. The curative aspects of the strategy would focus on upgrading and improving housing conditions in informal areas. Preventive strategies should be implemented to reduce the growth of informal areas. This requires opening up more land for residential development, providing public infrastructure and facilities, and creating incentives for the provision of low- and moderate-income housing. Both approaches are needed. On its own, the curative approach will not succeed. While existing favelas and irregular settlements can be upgraded, this approach does not prevent the formation of new informal settlements—these will continue to expand as long as urban land and housing markets fail to produce affordable housing.

[13] See Burchell et al., Ibid.

Effective upgrading programs should include community participation, provide secure land tenure, and give access to critical residential infrastructure—water, wastewater collection and treatment, drainage, electricity, schools, clinics, and parks and recreation facilities. Large-scale programs such as São Paulo's Guarapiranga project have been largely successful and provide useful models for replication (City of São Paulo, 2000). However, due to their complexity, they are difficult to implement and replicate (Cohen, 1983). This suggests that more work is needed to design more efficient and simpler procedures as well as generate more professional expertise about upgrading.

Preventing the continued expansion of informal housing requires that Brazil's urban land and housing markets begin producing more housing and providing more affordable housing that is located within reasonable commuting distances to jobs. If this can be accomplished, then the demand for informal housing should decline as households shift to less expensive formal housing. What would it take to achieve such a result?

First, cities and metropolitan regions need to better understand how their land and housing markets operate. Urban planners, housing specialists, and policy makers need better empirical data on urban land and housing markets—both current demand and supply information on land and housing prices and projections of future housing and urban land requirements to accommodate demographic and economic growth (Dowall and Clarke, 1991).

Second, these data and projections should be used to prepare master plans for cities and metropolitan regions. The plans should ensure that adequate supplies of serviced urban land are available to support residential demand. This will require pro-poor land use plans and zoning regulations (UN Habitat, 2004). Lands should be targeted for residential development, and tax incentives should be used to encourage owners to bring land to the market for residential development. Governments will need to provide the funding for infrastructure provision so that developers will be encouraged to construct housing.

Third, massive investments in private infrastructure are needed to foster residential subdivision development. Brazil's national, state, and local governments need to develop more fiscal resources to finance infrastructure. This can be accomplished through a range of policy interventions, including levying user and beneficiary charges and implementing value capture programs as outlined by Furtado and Jorgensen (2006).

Fourth, land subdivision and building regulations should be reviewed to assess their impacts on housing costs. Subdivision standards

frequently impose excessive standards on developers—large minimum lot sizes, high land dedication requirements, and investments in non-essential infrastructure (Avila, 2006). Building codes often prove costly and impose too much of a burden on low- and moderate-income households (Dowall, 1992). One interesting model is Colombia's "minimum norms" for low-income settlements (Carroll, 1980). Another possibility is to create a zoning classification that permits the development of sites and services projects—this would, in effect, legalize irregular settlements if they met basic standards for circulation, plot size and layout (UN Habitat, 2004).

Fifth, the government needs to develop cost-effective and replicable models for land titling and registration. These issues and policy reforms are comprehensively outlined by Fernandes (2006).

Taken together as a package, these five initiatives could foster increased affordable land and housing production. To launch this effort, the central government needs to articulate a policy framework and then collaborate with local governments to design and implement plans and programs. Over time, the framework as well as specific programs should be evaluated and modifications should be made as necessary.

References

Angel, S.; Sheppard, S.; & Civco, D. 2005. *The Dynamics of Global Urban Expansion*. Washington, DC: World Bank.

Avila, P.C. 2006. *Urban Land Use Regulations in Brazil: Land Market Impacts and Access to Housing*. Lincoln Institute–World Bank.

Avila, P.C. & Mandell, P. 2005. Interpretation of Population Density Gradients: A Brazilian Perspective. *Third Urban Research Symposium on Land Development, Urban Policy and Poverty Reduction*, Brasília.

Bertaud, A. 2001. *Metropolis: A Measure of the Spatial Organization of 7 Large Cities*. Accessed from website: http://alain-bertaud.com/

Bertaud, A., Buckley, R.; & Owens, K. 2003. Is Indian Urban Policy Impoverishing? Washington: World Bank: Urban Research Symposium.

Bertaud, A. & Brueckner, J. 2003. Analyzing Building Height Restrictions: Predicted Impacts, Welfare Costs, and a Case Study of Bangalore, India. Accessed from website: http://alain-bertaud.com/

Brinkhoff, T. http://www.citypopulation.de/index.html;

Burchell, R., et al. 2000. *The Costs of Sprawl*. TCRP Report 74. New Brunswick, NJ: Center for Urban Policy Research.

Carroll, A. 1980. *Pirate Subdivisions and the Market for Residential Lots in Bogotá*. Working Paper No. 435. Washington, DC: World Bank.

City of São Paulo. 2000. Guarapiranga: Urban and Environmental Rehabilitation in the City of São Paulo.

Cohen, M. 1983. The Challenge of Replicability: Towards a New Paradigm for Urban Shelter in Developing Countries. *Regional Development Dialogue* 4(1) Spring.

Development Planning Unit. 2003. Understanding Slums**:** Case Studies for The Global Report 2003.

Dowall, D. E. 1992. The Benefits of Minimal Land Use Regulations in Developing Countries. *Cato Journal*, 12(2):413-423.

Dowall, D. E. 1992. A Second Look at the Bangkok Land and Housing Market. *Urban Studies*, 29(1):25–38.

Dowall, D.E. 1989. Bangkok: A Profile of an Efficiently Performing Housing Market. *Urban Studies* 26(3):327–339.

Dowall, D. & Clarke, G. 1991. *A Framework for Reforming Urban Land Policies in Developing Countries* [Policy Paper]. Washington, DC: Urban Management Program.

Dowall, D. & Treffeisen, A. 1991. Spatial Transformation in Cities of the Developing World: Multinucleation and land-capital substitution in Bogotá, Colombia. *Regional Science and Urban Economics* 21:201–224.

Economic Commission for Latin America and the Caribbean. 2004. Progress of the Latin American and the Caribbean Region Towards Sustainable Development in the Issues: Human Settlements, Sanitation, Water. *Regional Preparatory Process for the Twelfth Session of the Commission on Sustainable Development* [unpublished].

Fernandes, E. 2006. *Legal Aspects of Urban Land Development in Brazil*. Lincoln Institute–World Bank.

Fundação João Pinheiro. 2002. Déficit Habitacional no Brasil 2000. *Informativo CEI – Demografia*. Belo Horizonte, Brasil: Government of Minas Gerais.

Fundação João Pinheiro. 2005. *Déficit Habitacional no Brasil: Municípios Selecionados e Microregiões Geográficas, 2a Edição*. Belo Horizonte, Brazil: Government of Minas Gerais.

Furtado, F. & Jorgensen, P. 2006. *Value Capture in Brasil: Issues and Opportunities*. Lincoln Institute–World Bank.

Ingram, G. [1998]. Patterns of Metropolitan Development: What Have We Learned? *Urban Studies, 35,* 1019-1035.

Instituto Polis. 2001. *The Statute of the City*. Nairobi: UN–Habitat.

Macedo, J.; O'Dell, W.; & Smith, M. 2005. Affordable Housing Needs Assessment Methodology: The Adaptation of the Florida Model to Brazil. In *Enabling Strategy for Moving Upgrading to Scale in Brazil*, M.V. Serra & D. Motta, eds. Washington, DC: Cities Alliance.

O'Hare, G. & Barke, M. 2003. The Favelas of Rio de Janiero: A Temporal and Spatial Analysis. *Geoforum* 56:225–240.

Pontual, R. 2005. Sistema estatístico de informações habitacionais: Proposta para criação de um sistema nacional de informações habitacionais. In *Enabling Strategy for Moving Upgrading to Scale in Brazil*, M.V. Serra & D. Motta, eds. Washington, DC: Cities Alliance.

Pontual, R. & Serra, M. V. 2005. Análise da habitação informal: A Evolução da habitação informal em três metrópoles do Brasil – Recife, Curitiba, e Distrito Federal. In *Enabling Strategy for Moving Upgrading to Scale in Brazil*, M.V. Serra & D. Motta, eds. Washington, DC: Cities Alliance.

Serra, M. V.; Dowall, D.; Motta, D.; & Donovan, M. 2005. *Urban Land Markets and Urban Land Development: An Examination of Three Brazilian Cities: Brasília, Curitiba and Recife*. Working Paper No. 1082. Brasília: Instituto de Pesquisa Econômica Aplicada.

Simmonds, R. & Hack, G. 2000. *Global City Regions: Their Emerging Forms*. London: Spon.

United Nations–Habitat. 2004. *Pro-Poor Land Management*. Nairobi.

World Bank. 2000. *World Development Report*. Washington.

World Bank. 2005. *Doing Business Survey*. Washington.

World Bank. 2002. *Urban Housing Sector Reform in Brazil*. World Bank Policy Note, September, 2002.

World Bank. 2002. *Brazil: Progressive Low-Income Housing: Alternatives for the Poor*. Washington.

World Bank. 1989. *Malaysia – The Housing Sector: Getting the Incentives Right*. Washington.