TEXTO PARA DISCUSSÃO Nº 1083

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TEXTO PARA DISCUSSÃO

Publicação cujo objetivo é divulgar resultados de estudos direta ou indiretamente desenvolvidos pelo Ipea, os quais, por sua relevância, levam informações para profissionais especializados e estabelecem um espaço para sugestões.

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SUMÁRIO

SINOPSE

Este trabalho apresenta a adaptação da "Metodologia de Avaliação das Necessidades de Habitação Popular da Florida" para o caso brasileiro (Noll *et al.*, 1997). Esta foi uma tarefa desenvolvida conjuntamente pela equipe da Universidade da Florida com pesquisadores do IPEA e do Banco Mundial. A "Metodologia de Avaliação das Necessidades de Habitação Popular", desenvolvido pelo *Shimberg Center for Affordable Housing* para o Estado da Florida, baseia-se em estimativas de unidades familiares calculadas a partir da taxa de formação de famílias e projeções da população por faixa etária.

O Modelo Brasileiro foi desenvolvido para quatro regiões: *i*) o país como um todo; *ii*) a Região Integrada de Desenvolvimento do Distrito Federal e o Entorno (RIDE do DF); *iii*) a Região Metropolitana do Recife; e *iv*) a Região Metropolitana de Curitiba. Este texto descreve o processo de adaptação, apresenta o Novo Modelo de Necessidades de Habitação Popular desenvolvido para o Brasil e analisa os resultados desse modelo.

ABSTRACT

This paper presents the adaptation of the "Florida Affordable Housing Needs Assessment Methodology" (Noll *et al.*, 1997) to Brazil. This was a task developed jointly by the Florida team with researchers from IPEA and the World Bank. The Affordable Housing Needs Assessment Methodology, developed by the Shimberg Center for Affordable Housing for the State of Florida, is based on household estimates calculated from household formation rates and population-by-age projections.

The Brazilian Model was developed for four regions: the country of Brazil as a whole, the Integrated Development Region of the Federal District (RIDE of DF), and the Metropolitan Regions of Recife and Curitiba. This paper describes the adaptation process, presents the newly developed Brazilian Affordable Housing Needs Assessment and analyzes output from the model.

1 INTRODUCTION

The World Bank asked IPEA and the Shimberg Center to adapt the Florida Affordable Housing Needs Assessment Methodology (Noll *et al.*, 1997) to Brazil. This is part of a broader study on urban land and housing markets in Brazil coordinated by the World Bank and financed by the Cities Alliance. The measurement of housing demand and needs plays an important role: (a) in the formulation of sound national and local housing policies, *inter alia*, by helping estimate the need for subsidies and for the investments of municipalities and public utilities; and (b) in helping the private sector better gauge the need for housing finance and the supply effort necessary to meet housing and land demand.

In Brazil, Florida researchers worked closely with researchers from IPEA. This project could not have been completed without this collaboration. IPEA's knowledge was essential in four areas: participating in the conceptual discussions preceding the development of the model, collecting the necessary data for the model, developing the household formation rates, and finally, helping Florida researchers solve the myriad practical details of adapting the Florida Model to Brazil.

This paper describes the adaptation process, presents the newly developed Brazilian model and analyzes output from the model. A brief description of the Florida model is important to understand the similarities and challenges that had to be dealt with during the adaptation process. An explanation of the Brazilian context is also necessary, particularly given the fact that tenure issues and practices in Brazil are different from conventional notions in the US. In addition, there are cultural differences that modify the way in which people consume housing. These nuances are crucial to an understanding of why certain decisions were made in the development of the Brazilian Affordable Housing Needs Assessment.

The paper is divided into four sections, besides this introduction. The next section presents a brief description of the Florida Model. Section 3 reports the process of adaptation of the Florida Model to the Brazil Context. The fourth section provides a description of the Data Analysis for the entire country of Brazil, the metropolitan regions of Curitiba, Recife and the RIDE of Federal District, respectively. The final section presents the comparative analysis and outlines some conclusions.

2 THE FLORIDA MODEL: A BRIEF DESCRIPTION[1]

Adopted by the 1985 Legislature, Florida´s Growth Management requires all counties and municipalities to adopt Local Government Comprehensive Plans that guide future growth and development. One of the requirements of the comprehensive plan is a housing element[2]. To facilitate the preparation and updates of the housing element of the comprehensive plans the Florida Legislature directed the Florida´s Department

1. This section is heavily based on Noll et al. (1997). For more details on AHNA see also < http://www.flhousingdata.shimberg.ufl.edu/TFP_AHNA_about.html>.

2. Comprehensive plans contain chapters or "elements" that address future land use, housing, transportation, infrastructure, coastal management, conservation, recreation and open space, intergovernmental coordination, and capital improvements (for more information on this subject see <http://www.dca.state.fl.us/fdcp/dcp/compplanning/index.cfm>).

of Community Affairs (DCA) to conduct an affordable housing needs assessment for all local jurisdictions with four objectives:

- Assist local governments in the preparation of updates to the Housing Elements of Comprehensive Plans;
- Focus more attention on affordable housing needs;
- Provide local governments with a common starting point for subsequent evaluation of the Housing Element; and
- Provide state agencies with a consistent database with which to analyze housing needs at the state level.

Subsequently, to develop the housing needs assessment methodology, the DCA contracted with the Shimberg Center for Affordable Housing at the University of Florida, in June 1995, to establish a uniform methodology and data source for housing elements, that can be used by all jurisdictions regardless of size.

The Affordable Housing Needs Assessment Methodology (AHNA) developed by the Shimberg Center for Affordable Housing for the State of Florida, henceforth referred to as the Florida Model, includes both components of the Supply-side and Components of the Demand-side for Housing.

The first step in the methodology is the inventory of the existing housing stock or supply side analysis, using data for the more recent decennial census that includes:

- Total housing inventory: the total number of occupied and vacant units;
- Housing units by type (single family, multi family, mobile home);
- Housing units by tenure (owner or rented);
- Housing by age of unit;
- Vacancy status;
- Rental housing by gross rent levels;
- Rental housing distributed by rent-to-income ratios for households at different income levels;
- Owner housing units by values ranges;
- Monthly costs of owner-occupied housing units; and
- Owner housing distributed by cost-to-income ratios for households at different income levels.

The second component of the housing inventory assesses the condition of the housing units and includes the number of dwelling units that:

- Lack complete plumbing;
- Lack complete kitchen facilities;
- Use no heating fuel; and
- Are overcrowded.

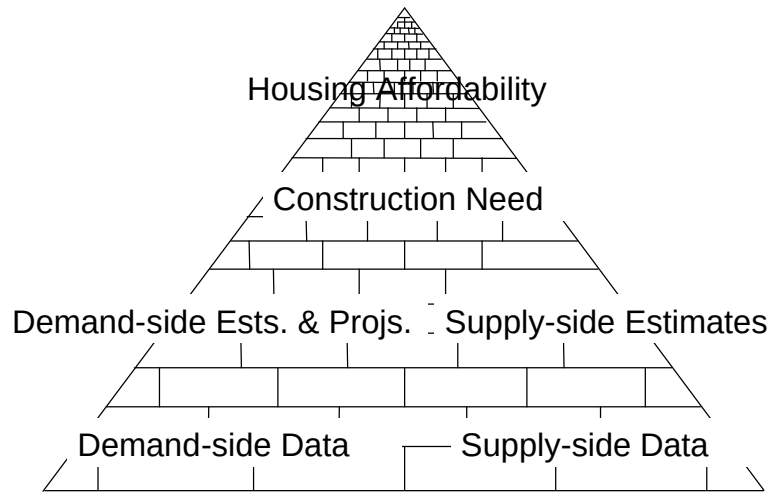
The third component is an inventory of assisted rental units. The final component of the housing inventory is an update from the most recent census (new construction, mobile home placements, conversions and removals).

The second part of the needs assessment comprises estimates and projections of housing demand for 1990 to 2025 and is based on household estimates calculated from household formation rates and population-by-age projections. There are five basic dimensions of demand: tenure, age of head of household, size of household, income of household, and cost burden. Household estimates are constructed based on the assumption that household formation rates and the distribution of household characteristics remain constant across the projection horizon. The household formation rates are age specific and are derived from the most recent decennial Census.

For the Florida Model, three data sets are needed–number of householders by tenure and age, population by age from 1990 and 2000 Census for each jurisdiction, and population projections for each age group. A headship rate is calculated from the 2000 census data by dividing the number of householders in each tenure/age group by the total population of that age group. The projection of householder by age/tenure is then calculated by applying that ratio (headship rate) to the age group projections of population for each projection period. The methodology assumes a constant headship rate in each age category.

Finally, complex cross-tabulations from the Census are required to calculate other household characteristics. These cross-tabulations include income, size and cost burden projected by age group in each tenure category. The result is a projection of various household characteristics that can be compared to the housing supply to determine the need for net new units, that is, construction need.

FIGURE 1
Housing needs assessment diagram of contents



Source: O'Dell and Macedo, 2003.

3 THE BRAZIL MODEL: A COMPLEX ADAPTATION

All researchers involved in this project knew, even before looking at the data, that a revision would be required to apply the Florida Model to Brazil. As expected, the adaptation required new assumptions and alternative approaches. The first adaptation came as a result of available data. An obvious example is the

Brazilian decennial census. The information collected by the Brazilian Census Bureau, henceforth referred to as IBGE (Instituto Brasileiro de Geografia Estatística), is different from that collected by the US Census Bureau and used by the Florida Model. During the adaptation process, researchers used a smaller and simpler data set, the PNAD (National Survey by Household Sample)[3] to test some of the assumptions and to aid in the development of a methodology reflecting the Brazilian situation.

As established by the contract, the Brazilian Model would be developed for four regions: the country of Brazil as a whole, the Integrated Development Region of the Federal District (RIDE),[4] and the Metropolitan Regions of Recife and Curitiba, capitals of the States of Pernambuco and Paraná, respectively. Thus, data for these four regions had to be collected in a consistent manner to allow for comparisons, and that in itself was the first challenge.

FIGURE 2
Brazil – Metropolitan study areas

3. The PNAD (Pesquisa Nacional por Amostra de Domicilios) is an annual survey done by IBGE, based on a smaller sample of households by Census tracts, and updated every year between the decennial census years.

4. The Região Integrada de Desenvolvimento do Distrito Federal e Entorno (RIDE) is the designation for the metropolitan region of Brasília and includes municipalities in the States of Goiás and Minas Gerais in addition to the Federal District.

Sources: Instituto Brasileiro de Geografia e Estatística (IBGE) and ESRI/Data & Maps CD.

3.1 POPULATION PROJECTIONS

As mentioned above, jurisdiction-level, population-by-age projections are a fundamental building block of the AHNA methodology. Although population projections are available for all States in Brazil up to 2050, population-by-age projections were neither available at the jurisdiction level nor at the metropolitan level. Nor were we successful in finding regional authorities that had produced population-by-age projections for their metropolitan regions. The research team then decided to take a different approach: by constructing the population-by-age projections for all the jurisdictions in the State and controlling that to the projected total,[5] we could then develop consistent population-by-age projections for the metropolitan areas in the study.

The jurisdiction-level population-by-age projections require two time periods, typically decennial Census. Brazil had, because of institutional and organizational issues, a 1991, rather than a 1990 Census. So we had to balance the use of consistent data sources with the practicality of significant reprogramming of the Florida model. Fortunately, a special tabulation for 1990 population existed, which we felt was a reasonable substitution for the 1991 Census data.[6]

A second alteration dealt with the way new cities were created in Brazil. For political and institutional reasons, a number of municipalities had been created between 1991 and 2003. In Brazil, states are divided into municipalities and there are no unincorporated areas. This meant that the new municipalities were actually areas that had been partially split from existing jurisdictions, sometimes twice, and although the population was the same, it was counted under different jurisdictions in each year. So the programmers involved in the research project had to create an artifice to include these split jurisdictions in the population projections. In addition, one of the study regions, the RIDE, comprises jurisdictions in the states of Goiás and Minas Gerais, besides the Federal District. Since there were only two small jurisdictions in the state of Minas Gerais, with a total population of 90,400 in the year 2000, which represented three percent of the total RIDE population, the team decided not to include those in the projection.[7] Thus, the RIDE population used in the study comprises the populations of the Federal District plus 19 municipalities in the state of Goiás that are part of the Integrated Development Region of the Federal District (RIDE).

Finally, the last obstacle was the fact that, since the population data for 1990, 2000 and 2003 and the population-by-age total projection were all from different sources, programmers had to insert simple controls to assure consistency.

5. Population by age projections for each State up to 2020 were provided by CEDEPLAR.

6. This is an example of a very practical application of the Florida model to the Brazilian context. Utilizing a 9-year cohort would have required not only reprogramming of the existing model but also a series of additional interpolations to produce the appropriate projection years.

7. Today, there are actually three municipalities in the State of Minas Gerais that belong to the RIDE. Cabeceiras Grande split off Unaí in 2001. Unaí was included in our estimates of Minas Gerais population in the RIDE and would have been part of our projections as Unaí. The third jurisdiction simply incorporated about ten percent of the original jurisdiction's population.

3.2 HOUSEHOLD ESTIMATES AND PROJECTIONS: THE DEMAND-SIDE OF HOUSING

Household formation rates are used to determine what percentage of each population age group will form a new household in each projection interval. Household formation rates and the distribution of household characteristics are assumed to remain constant across the projection horizon. That is, the proportions of householders observed in the year 2000 in each age cohort are maintained in the calculation of subsequent years.

The five basic dimensions of demand used for the Florida Model were maintained in the development of the Brazil Model: tenure, age of head of household, size of household, income of household, and cost burden. What follows is an explanation of each dimension and the changes made to the categories within each, as well as the assumptions and adaptations that had to be made to create a Brazilian Model.

3.2.1 Tenure

The Florida Model has two tenure categories: owners and renters. The headship rates for renters tend to be higher for younger people and as the age of the householders increase, so increases the probability that they will own a house. In Brazil, researchers were faced with multiple tenure categories, although home-ownership is encouraged and most housing assistance programs focus on ownership rather than rent. Extensive discussions among IPEA staff and researchers from both Florida and Brazil, including staff from the Ministry of Cities, took place to determine the ideal tenure typology. The first conceptual question concerned land ownership. Informal settlements have provided housing for the poor in developing countries for years. These settlements, albeit substandard by any definition, sometimes represent the only opportunity that poor families have to acquire a house. The idea developed by Turner (1968, 1972, 1976) was that through self-help, such as that going on in informal settlements, the poor could gain ownership if infrastructure and security of tenure were provided. Abrams (1964) went as far as suggesting that what most people often regarded as a problem was in fact the solution to house the poor. Nonetheless, the Housing Needs Assessment Methodology projects the need for adequate housing. Since informal settlements usually present other structural deficiencies besides lack of title, researchers decided to develop special criteria to quantify these additional characteristics of substandard dwellings.

One set of criteria was possible because IBGE collects separate information on the housing unit and the land it sits on. The Census questionnaire includes six different types of housing unit ownership and three different types of land ownership. At the onset, there were three reasons to support an argument to leave the land ownership variable out of the equation. First, the Affordable Housing Needs Assessment methodology estimates the need for net new housing units (comprising the lot and the house), not for titling or regularization of existing units built on squatter settlements. Second, the percentage of units declared not to be on owned land was very small, 0.3 percent of the total number of households and 4.2 percent of the owned houses. Third, serious questions exist about the accuracy of the land ownership status since the information collected by IBGE is self-declared, which

means that dwellers may perceive (and thus declare) themselves as owners of the land their house sits on even though they have no legal title to it.[8]

In sum, the research team's rationale was that, if a housing unit were otherwise standard, lack of land title would not constitute a housing need. Moreover, given the ambiguity in the system of private property and the expectations that the Brazilian legal and political systems will move (and have moved) to eliminate this issue over time, it could be assumed that land title would eventually be issued to those families who have successfully secured a lot for a certain period of time.[9] Despite this argument, researchers decided to keep the variable land ownership in the tabulations. Since most households declaring themselves as not owning the land were located in substandard areas and had incomes lower than three minimum monthly wages, the methodology would in the end categorize them as substandard.

The six types of housing unit tenure used by the Census include: owned – house paid for, owned – still paying, rented, lent by employer, lent by other, and other conditions. The three types of land ownership include: owned, lent, and other condition. Since both these items are self-declared, an overwhelming majority of the households declares themselves owners. As far as housing unit ownership, most households declare themselves in the first category, owned – house paid for (68 percent), and only 4.2 percent of those declare they do not own the land on which the house sits. Conversations with Brazilian researchers and technicians confirmed the perception that the Census numbers did not reflect the reality of the tenure situation in Brazil. The problem, as in the land tenure category, is the fact that information is self-declared.

The researchers' objective was to produce a methodology that would be useful to Brazilian institutions, reflecting programmatic uses as well as addressing quality of life issues. Since the informal/formal discussion seemed to be at the forefront of Brazilians concerns, the set of developed criteria honed concepts as precisely as the Census data would allow. However, the literature on informal settlements discusses tenure mainly from an institutional and political standpoint. Because of the applied nature of this methodology, researchers developed the criteria in terms of standard and substandard, taking into consideration certain physical characteristics that would indicate adequacy of shelter. Nonetheless, land tenure was included since it is a measure of security that, if not guaranteed, could represent a need for housing (Turner, 1968, 1972, 1976).

The first item utilized to redefine (aprimorar) tenure information was Sector Type. This is not a self-declared item; the Census surveyor analyzes the type of settlement as a whole and classifies it as standard or substandard.[10] Since most informal settlements are classified as substandard sectors, researchers decided to use this item as a filter, that is, by crossing the self-declared housing unit and land

8. Furthermore, the majority of people who live in informal settlements have actually paid for the land, but since they purchased it through an illegal transaction, they do not have any legal proof of ownership and thus, do not have any guaranteed property rights, nor the obligations that follow from those, such as property taxes.

9. Provisions of the Estatuto da Cidade, Federal Law no. 10257, approved on July 10th, 2001, suggest that land ownership will be gained by families living in consolidated informal settlements. This legislation implements articles of the 1988 Constitution that established the social function of the land.

10. Besides standard and substandard, the Census has six additional types of sector included in this item, mostly group quarters, such as military bases, camping grounds and tents, boats, Indian tribes, prisons, and orphanages, convents, hospitals and asylums.

ownership numbers with the sector type it was possible to separate those households that, even though they had been declared owned and paid for were actually part of informal settlements. Another assumption was made in consonance with the objectives of the Affordable Housing Needs Assessment Model. Since this model estimates need for housing and that means adequate housing, the housing units located in these substandard sectors would, at minimum, require some kind of improvement or upgrade so they should be counted separately from the "formal" housing stock.

After this first "filtering," the percentage of households that would be considered "informal" was still much lower than expected; only four percent of all households are shown by IBGE to be in substandard sectors. One caveat is that IBGE only collects information on Sector Type for settlements larger than 50 units. In an attempt to identify those households that were living in substandard conditions within areas that would not be considered substandard as a whole or that would be part of smaller settlements, researchers decided to use information on infrastructure to determine their adequacy. In Brazil, water and power are considered a right of every citizen and many informal settlements take advantage of this provision to acquire public services. So researchers decided to use sewerage disposal as a qualifier. One caveat regarding sewerage data is that the Census considers sewage going into storm drains as appropriately disposed, so households either connected to the sewerage network (including storm drains) or to a septic tank with draining field are included in the methodology as standard.

Most dwellings in rural areas have what is called a rustic tank, that is, a septic tank without draining field. Even though these dwellings would otherwise be considered standard according to other definitions of the typology established in the methodology, these rustic tanks present an environmental threat and should be considered, at minimum, in need of upgrading. The decision to not include rustic tanks as appropriate sewerage infrastructure would only present a potential problem in rural areas, and primarily in the Northeast region, where the percentages of substandard housing are higher for rural areas than for urban areas. Since this study focuses on three metropolitan regions and since the impact of considering rustic tanks appropriate for urban areas would be greater than not considering it appropriate in rural areas, we decided to follow the Census definition of appropriateness. By crossing tenure with type of sector with sewerage network information, a better picture was produced. The team went a little further and also included information collected by IBGE regarding the existence of indoor plumbing and toilet facilities; this was intended to account for those units within areas perceived as "formal" that do not have minimum basic sanitation conditions and therefore would require, at minimum, rehabilitation or upgrading.

Another assumption made to narrow down the number of tenure categories concerns renters and households living in housing lent by employers or other people, such as relatives. Families who declared they lived in lent-housing were included in the renters categories and considered to have a no-cash rent situation. Essentially, these households occupy dwellings free of rent and the only calculation affected by this would be cost burden. Since cost burden for Brazil can only be calculated for renters, the team decided to collapse the lent housing categories with the renters categories.[11] Lastly, the households counted by the Census as "other tenure

11. For a complete explanation of cost burden calculations, assumptions and exceptions, see item Cost Burden.

conditions" were all included as substandard units since, by definition, illegal occupations and inadequate dwellings, such as renters of rooms in non-residential properties or leasing rural properties, are included in that category.

Another group that certainly represents a housing need but, given the manner in which the Census questionnaire is structured, is not included in any of the above categories is called "improvised." These would be akin to the homeless in the US, plus families living in temporary shelters or other inadequate conditions, such as rooms in commercial properties. Although this group did not represent a high percentage of the total number of households (0.3 percent), researchers agreed that it would add insight and provide additional information about the large percentage of population perceived to live in "informal" conditions. Thus, those households classified by the Census as "improvised" have been included as substandard in the tabulations to be used by the Brazil model. Through this gradual and cumulative exercise, the research team was able to identify specific characteristics of households and narrow the initial eleven tenure categories down to four: owners in standard areas, owners in substandard areas, renters in standard areas, and renters in substandard areas.

3.2.2 Age

The Brazilian Model comprises six age groups – 15 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, and over 65. The household formation rates for the age group 15 to 24 are much lower than those experienced in Florida because, unlike the US, in Brazil most children live with their parents until they finish college, and often until they get married. This was found to be a cultural phenomenon known in Brazil as "late-stayers" (Carneiro *et al.*, 2002). The groups with higher household formation rates are the 35 to 44 and 45 to 54 groups.

Even though researchers observed some difference in the sample household formation rates calculated with PNAD data for the groups 65 to 74 and over 75, it was not possible to use those age categories for the Brazil model because population-by-age projections were not available. The sample tabulations also confirmed the lower household formation rates for the age group 15 to 24; however, the team decided to keep it as a separate category because, if the "late-stayers" phenomenon changes in the near future, changes in house consumption patterns for young householders can be easily detected.

3.2.3 Size

This category also differs somewhat from that adopted by the Florida Model. Households in Brazil tend to be larger and often accommodate extended family members. The phenomenon of increasing one-person households that has been experienced in the US for some time now is not present in Brazil. The number of one-person households is negligible. However, sample tabulations revealed that more than half of all households comprise three or four persons. Therefore, the household size categories used in the Brazil Model are: 1 to 2, 3, 4, and 5 or more persons per household.

An observed phenomenon in Brazil is the presence of multiple families in one household. The argument that some families share a household by choice is very plausible, given the Brazilian culture and custom of having extended family members

living together. Most people participating in the preliminary discussions of the model development phase agreed that additional families in a household would only represent a need for additional housing if they were not adequately accommodated, that is, they would definitely represent a potential demand for new housing if they were living in overcrowded conditions. Since IBGE collects information on families as well as households, it was possible to account for those families who share a household.[12]

To avoid overestimating the number of families in need of housing, the research team thought it would be necessary to identify and differentiate those families who share a household by choice from those who do it by necessity. One way of making that distinction is to cross the information about household sharing with overcrowding.[13] In other words, if there were multiple families occupying the same household in overcrowded conditions, the sharing is occurring out of necessity and represents a demand for new housing. Likewise, if there were multiple families occupying the same household but not overcrowded, the model would assume that they were choosing to share the household and no additional demand exists. Thus, criteria were developed by researchers to "spin-off" multiple families sharing overcrowded households and count them as a demand for new housing.

Another assumption made in relation to overcrowded conditions has to do with multifamily units known as "cômodos." These are essentially rooms or studio-style apartments that are part of a multifamily unit. They can be rooms in a previously single-family home that has been subdivided or they can be individual units, similar to tenements in the US, but without direct access to a street or other public areas. The Census collects information about these units in the dwelling typology item that includes single-family, detached house; multifamily, apartment or condo unit; and "cômodos." The reason it was suggested to the research team that these units be treated separately was that most of them present inadequate living conditions. However, they could not simply be treated as substandard units since most of them are in areas with infrastructure and, judging by their physical characteristics would match the criteria used in the model to qualify as standard. To resolve these methodological conflicts and the perception that "cômodos" offer inadequate living conditions, each additional family living in "cômodos" was treated as representing a need for a new housing unit.

For the purposes of this model, the "additional" families in overcrowded, shared households are called secondary families, differentiating them from the primary family represented by the householder or head of the entire household. All secondary families in multifamily overcrowded shared households/units and in "cômodos" are counted as additional demand for units. These additional families are incorporated into the count of households by tenure, age, size and income and thus influence the calculation of the overall household formation rate. In order to assign the four household characteristics to the additional, secondary families we use information in the Census for that secondary family or its householder (head) – age, size and income

12. The term used in Portuguese for this phenomenon is "cohabitação" (literally translating, cohabitation). Because the word "cohabitation" in English has a different connotation, we adopted the term used by Coccato (1996), who refers to this phenomenon as household sharing.

13.In this study we´ve considered a dwelling unit as overcrowded if it has more than 3 people per room used as dormitory, following a methodology adopted by the Ministry of Cities and Fundação João Pinheiro (FJP) in the Calculation of the Brazilian Housing Deficit (FJP, 1995; FJP, 2001 and FJP 2004).

– and we assign the secondary family to the same tenure category as the primary family.

3.2.4 Income

The Florida Model uses income categories based on percentage of jurisdiction medians. In Brazil, the prevailing income unit is the Monthly Minimum Wage, which is established by the Federal government. This has actually facilitated the development of the income category for the Brazilian model, since the same income levels are used for all study areas.

Most housing programs in Brazil are based on the Monthly Minimum Wage (m.m.w.). The lower income housing programs are for families earning between 0 and 3 m.m.w. Other programs are for families earning between 3 and 5 m.m.w. Most recently, new housing programs are being developed and, although the 0 to 3 m.m.w. category has remained, new housing programs are designed for families with incomes up to 6 m.m.w. and above 6 m.m.w. There is also one program that facilitates financing for families with incomes above 12 m.m.w., and although the number of families in this income bracket is very small, it was considered as a separate category.

The largest percentage of the total country population (75 percent) earns less than three Monthly Minimum Wages. Therefore, it was necessary to break down the lower income categories. The Brazil Model resulted in six income categories: less than 1 m.m.w., 1 to 1.99 m.m.w., 2 to 2.99 m.m.w., 3 to 6 m.m.w., 6 m.m.w. to 12 m.m.w., and over 12 m.m.w. These categories should reveal a clear picture of the housing situation concerning poverty levels and the connection between income and lack of adequate housing, which will prove useful for programmatic analysis and policy decisions.

3.3 HOUSING INVENTORY: THE SUPPLY-SIDE

The supply-side of the Florida model comprises the housing inventory adjusted for seasonal occupancy and vacancies. The same will occur for the Brazil model. IBGE collects information on occupied dwellings as well as seasonal and vacant units. Unfortunately, the level of detail provided by the Census information does not allow for a precise diagnosis of vacant units. That is, Census data do not indicate whether the dwelling is vacant because it is on the market, or because it is rundown and not in condition to be occupied, or it has simply been abandoned.

As a general rule, group quarters would be excluded from all appropriate data. However, the population projections used for the Brazil model did not exclude the population living in group quarters. Thus, to exclude these households of estimates and projections would be incongruent. In addition, the population living in group quarters represent a rather small proportion of households. The total number for Brazil is 72,052 households, which represents 0.13 percent of the total number of households. Each one of the metropolitan regions included in the study had less than one thousand such households, representing between 0.09 and 0.11 percent of the total number of households in each region. Therefore, rather than exclude group quarters from supply while the population occupying them were included in the population projections, researchers decided to include them in the household formation rates and household projections.

3.4 CONSTRUCTION NEED AND PROJECTED TOTAL DEMAND FOR HOUSING

The 2005-2020 projection of construction need is based on occupied housing (households) and a percentage allowance for vacant units (a percentage allowance for units expected to be lost due to various causes is not estimated) compared to the supply of permanent units in 2000. To determine the total number of additional housing units that will be in needed in the metropolitan area over the projection horizon (construction need), we establish a relationship between households and housing units. The number of housing units that are needed at any point in time is equal to the number of households plus the number of units needed to provide an adequate vacant supply from which householders may choose.

The number or percentage of housing units representing an adequate vacant supply will vary by place. Only units that are in the permanent housing stock are considered in this estimate; this excludes seasonal units. The vacancy rate used for the projections is a constant and set at the rate in 2000 (from the 2000 Census). The vacancy rate is the permanent vacancy rate, that is, for units occupied or expected to be occupied by permanent (not seasonal) households.

To calculate total housing demand the permanent vacancy rate is applied to the 2005-2020 projections of total households [projected total households are multiplied by one over one minus the vacancy rate = total households X 1/(1-vacancy rate). Construction need is the difference between demand at any point in time and the available supply in 2000. So, for example, the supply available in 2000 (from the Census) is subtracted from the projected demand in 2005 to calculate a basic construction need for housing units in the year 2005.

4 DATA ANALYSIS: BRAZIL, METROPOLITAN REGIONS OF CURITIBA, RECIFE AND THE RIDE OF FEDERAL DISTRICT

The population projections utilized for this research project were provided to the Florida research team by CEDEPLAR.[14] The household data were processed by IPEA staff from IBGE's 2000 Census microdata, based on the methodology developed by Shimberg Center researchers in collaboration with IPEA staff. Shimberg Center programmers then applied these two data sets to the Brazil model. The analysis that follows applies to the three metropolitan regions used in the production of the Brazil model, the Metropolitan Region of Curitiba, Paraná, and the Metropolitan Region of Recife, Pernambuco, and the metropolitan region of Brasília, which receives the designation of Federal District Integrated Development Region (Região Integrada de Desenvolvimento do Distrito Federal e Entorno – RIDE). Although there are significant regional differences in the country of Brazil, the same analysis is done for the country as a whole. The assumptions made are the same for all study areas.

14. The population projections used for the Brazil model were supplied by Centro de Desenvolvimento e Planejamento Regional da Faculdade de Ciências Econômicas (CEDEPLAR) at the Minas Gerais Federal University (Universidade Federal de Minas Gerais). These projections were part of projects done in agreements with PRONEX and INEP from the Education Ministry.

4.1 BRAZIL

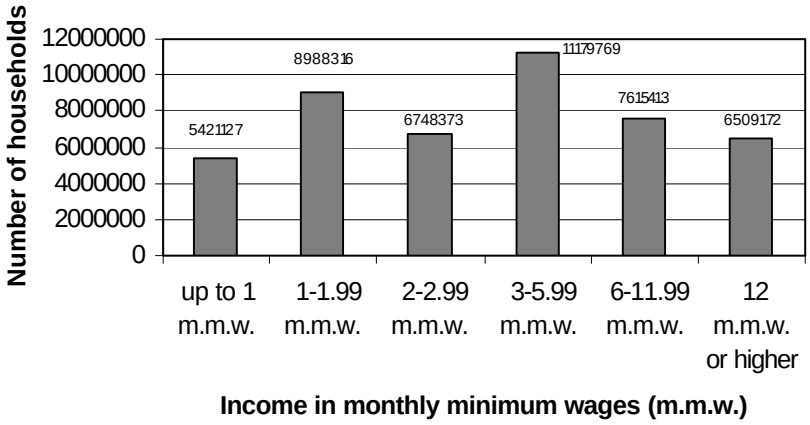
According to the 2000 Census, Brazil had a total population of 169,799,170. Comprising 26 states and one Federal District, Brazil has well-developed agricultural, mining, manufacturing, and service sectors, outweighing the economies of all other South American countries. Nonetheless, an estimated 22 percent of its population lives below the poverty line. Brazil also has a rather uneven distribution of wealth; the Gini index published in 1998 was 60.7 percent (World Bank, 2003).

4.1.1 Housing profile

According to the 2000 Census, there were 44,601,522 households in Brazil, 74 percent of which were owner occupied and 26 percent were renters. Of the 34,736,129 heads of household who declared themselves owners, 52 percent live in standard housing.[15] This proportion is about the same for renters, 55 percent of renters live in standard conditions. The majority of householders are between the ages of 35 and 44 (25 percent), followed closely by the 25 to 34 year old group (23 percent). Seven percent of householders are under 25 years old and 13 percent are older than 65. For the 45 to 54 and 55 to 64 age groups the proportions are 19 and 13 percent respectively.

Households with one or two persons represented 23 percent of the total, while those with three and four represented 21 and 23 percent respectively. The largest percentage of households, 33 percent, had five or more persons. The majority of Brazil's population is low-income. Forty-six percent of all households earn less than three Monthly Minimum Wages. Less than a third (30 percent) of all households earn more than six Monthly Minimum Wages (m.m.w.): 16 percent earn between 6 and 12 m.m.w. and 12 percent earn more than 12 m.m.w. Almost 12 percent earn less than one Monthly Minimum Wage.

GRAPH 1
Number of households by income – Brazil, 2000



Source: IBGE, Census microdata, 2000.
Author´s calculations.

Although the ratio between owners and renters is constant across age categories, a higher percentage of standard owners (and lower of substandard owners) can be

15. The definition of "standard" used here is the one developed by the methodology, which is explained in detail in the third section of the report.

observed as householders age. While 60 percent of households whose head is between 15 and 24 years-old is standard, that percentage increases to 68 percent for households with heads 65 and older. For both owners and renters, the older the householder the lower the percentage of households occupying substandard housing.

4.1.2 Population projections

The population projections for Brazil were provided to Florida researchers by CEDEPLAR. Additional projections were developed by Shimberg Center programmers. Brazil had 169,799,170 inhabitants in 2000 (IBGE, 2002). The projected population for 2010 is over 190 million and almost 211 million for 2020, which represents an increase of about 20 percent in the next 17 years.

4.1.3 Household Estimates and projections: the demand-side of housing

Based on 2000 Census data, Brazil had 44,601,522 households. The total number of housing units needed to accommodate additional families spinning-off due to overcrowded conditions would add more than two million new households for a total of 46,689,818.

Most additional households came from the owner tenure category (over 1.5 million families), which indicates that 73 percent of families that would potentially form a new household live in households in the owner tenure category. Of the 2,088,296 potentially new households, 561,669 live in rented housing. In terms of housing condition, 54 percent of families share substandard, overcrowded households. Including both owners and renters, 956,596 families live in standard conditions, while over 1.1 million live in substandard conditions.

4.1.3.1 Tenure

Of the total estimated number of households needed in Brazil (46,689,818), 34,736,129 households would be owner occupied. According to the criteria developed for the Brazil model, 24,473,628 households would be standard, and 48 percent of the households, including owners and renters, would be substandard.

The projection of tenure status to 2020 reveal that owners will continue to represent about 74 percent of households while renters will account for the remainder 26 percent. In absolute numbers, it is estimated that in the next 17 years there will be 17,368,103 additional owner-occupied households and 5,135,632 renter-occupied households. As for condition, by 2020 there should be an additional 10,715,879 standard households and 9,358,183 substandard households.

TABLE 1
Household projections by tenure – Brazil, 2003-2020

Tenure	Year				
	2003	2005	2010	2015	2020
owner standard	19,117,470	20,028,460	22,422,340	24,760,781	26,959,838
owner substandard	17,884,553	18,716,465	20,911,166	23,023,660	24,980,615
renter standard	7,002,447	7,335,948	8,213,024	9,069,908	9,875,958
renter substandard	5,722,921	5,988,794	6,689,502	7,362,695	7,985,042
Total	**49,727,391**	**52,069,667**	**58,236,032**	**64,217,044**	**69,801,453**

Source: Author´s calculations.

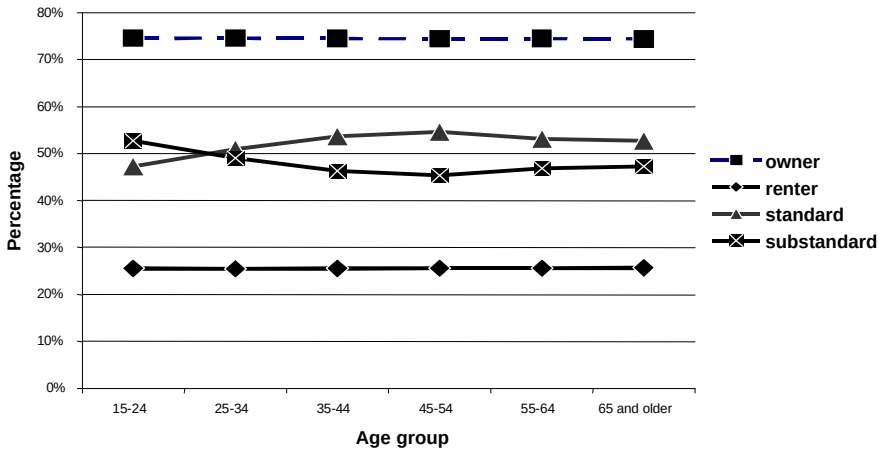
4.1.3.2 Age

The number of households with heads in the 15 to 24 age group is relatively low when compared to the other age groups, which confirms a cultural trend. In Brazil most children live with their parents until they finish college, and often until they get married. Younger households represent about seven percent of all households. The age groups with higher household formation rates are the 25 to 34 and 35 to 44 groups.

Most households whose head is between the ages of 15 and 24 are owners (74 percent). In this age category, more households live in substandard areas (54 percent) than in standard areas. The overall owner-renter proportions are similar across all age categories, increasing slightly with age. The number of standard housing units increases for each age group up to 44 years old, then decreases for older groups.

GRAPH 2

Proportion of owners to renters and standard to substandard units by age group – Brazil, 2000



Source: IBGE, Census microdata, 2000.

Author´s Cauculations.

In the 20-year projections, the tendency is for the percentage of young heads of household to decrease. By 2020, less than five percent of all households will have a head younger than 24 years-old. Percentages will decrease four percentage points for heads of household between 25 and 34 and increase somewhat (about three percentage points) for those between 55 and 64 and 65 and older. Proportions of householders between 35 and 54 will vary slightly, but not significantly.

TABLE 2

Household projections by age – Brazil, 2003-2020.

Age	Year				
	2003	2005	2010	2015	2020
15 - 24 years old	6.86%	6.60%	5.87%	5.29%	4.81%
25 - 34 years old	22.32%	22.19%	22.37%	20.91%	18.47%
35 - 44 years old	24.43%	24.17%	22.73%	22.84%	23.74%
45 - 54 years old	19.92%	20.37%	21.16%	21.04%	20.44%
55 - 64 years old	13.51%	13.75%	14.93%	16.16%	17.39%
65 and older	12.96%	12.92%	12.93%	13.76%	15.15%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Source: Author´s calculations.

4.1.3.3 Size

More than 20 percent of all households in Brazil have one or two persons and 44 percent have three or four persons. Households with five or more persons represent over 30 percent of the total number of households. Households with three persons make up the smallest group, 21 percent of the total. Among households with one and two persons, the majority (26 percent) is in the higher income category, 12 Monthly Minimum Wages (m.m.w.) or higher. The same happens, albeit in slightly different proportions, for households with three and four persons; however, a significant proportion of larger households (40 percent) makes less than one m.m.w. Larger households also have the highest proportion (36 percent) of those making between one and two m.m.w. In addition, most households making up to three m.m.w., 37 percent, have five or more persons.

As far as tenure and condition of the household, the proportion of owners to renters is practically constant for all household sizes, around 72 to 28. Large households make up the majority of owners in substandard housing. Only 4.7 percent of the total number of households are overcrowded.

Future trends reveal a slight increase in the percentage of households with one or two persons, less than one percent increase by 2020. Household with three and four persons will decrease slightly, but there will be a slight decrease in the number of households with five or more persons. The total number of households in the country will increase by over 20 million in the next 17 years, from an estimated 49,727,391 in 2003 to a projected 69,801,453 in 2020. The more significant increase will be of households with one or two persons. The number of households with one and two persons will increase by 44 percent in the next 17 years.

TABLE 3
Household projections by household size – Brazil, 2003-2020

Household size	Year				
	2003	2005	2010	2015	2020
1 or 2 persons	11,336,349	11,875,763	13,365,675	14,853,829	16,292,388
3 persons	10,520,071	11,000,920	12,290,917	13,475,534	14,522,627
4 persons	11,419,445	11,956,019	13,327,732	14,640,174	15,841,149
5 or more persons	16,451,526	17,236,965	19,251,708	21,247,507	23,145,289
Total	**49,727,391**	**52,069,667**	**58,236,032**	**64,217,044**	**69,801,453**

Source: Author´s calculations.

4.1.3.4 Income

The largest number of households in Brazil (70 percent) earns less than six Monthly Minimum Wages. Most low-income housing programs are for families earning less than 3 Monthly Minimum Wages. In Brazil, 46 percent of households fall into this income category. The new housing programs that are designed for families with incomes up to 6 Monthly Minimum Wages could benefit 70 percent of the total number of households. Programs that facilitate financing for families with incomes above 12 Monthly Minimum Wages would benefit 14 percent of the total number of households.

TABLE 4

Households by income – Brazil

Tenure	Income in monthly minimum wages				
	up to 3	3 to 6	6 to 12	over 12	Total
owners standard	4,947,457	4,613,064	4,085,413	4,261,567	17,847,490
owners substandard	10,435,369	3,672,430	1,743,812	977,018	16,724,860
renters standard	2,304,689	1,810,800	1,353,384	1,097,255	6,537,562
renters substandard	3,649,750	1,091,447	437,066	209,298	5,352,258
Total	**21,337,265**	**11,187,741**	**7,619,675**	**6,545,138**	**46,689,819**

Source: IBGE, Census microdata, 2000.

Author´s calculations.

There is a correlation between income and dwelling condition. While 66 percent of the households with incomes below three Monthly Minimum Wages (m.m.w.) live in substandard conditions, 82 percent with incomes over 12 m.m.w. live in standard conditions. These differences are significant for both owners and renters. While 80 percent of owners and 20 percent of renters have incomes over 12 m.m.w., those households with incomes below three m.m.w. show a predominance of substandard owners (49 percent). Therefore, it is evident that households with higher incomes have more access to ownership and are more likely to occupy standard housing.

Projections for the year 2020 indicate that there will be 2.3 million additional households with incomes below one Monthly Minimum Wage. An additional nine million households will earn less than three Monthly Minimum Wages. Almost five million earning between three and six Monthly Minimum Wages will be added in the next 17 years.

TABLE 5

Household projections by income level – Brazil, 2003-2020.

Income in monthly minimum wages (m.m.w.)	Year				
	2003	2005	2010	2015	2020
up to 1 m.m.w.	5,797,904	6,068,241	6,783,628	7,476,251	8,122,003
1-1.99 m.m.w.	9,614,213	10,063,218	11,247,552	12,391,692	13,455,617
2-2.99 m.m.w.	7,220,018	7,558,349	8,449,569	9,312,030	10,115,345
3-5.99 m.m.w.	11,965,299	12,528,738	14,009,575	15,442,909	16,778,032
6-11.99 m.m.w.	8,154,335	8,540,887	9,555,717	10,541,271	11,462,507
more than 12 m.m.w.	6,975,622	7,310,234	8,189,991	9,052,891	9,867,949
Total	**49,727,391**	**52,069,667**	**58,236,032**	**64,217,044**	**69,801,453**

Source: Author´s calculations.

4.1.4 Housing supply

There is a total of 54,337,670 housing units in Brazil according to the 2000 Census. Of all non-occupied units, 65 percent are vacant, 29 percent are seasonal and six percent were closed at the time the Census conducted the interview. The vacancy rate for the country is 12.7 percent. Group quarters are included in this total for the reasons outlined in the methodology. They represent 0.13 percent of the total number of households in Brazil.

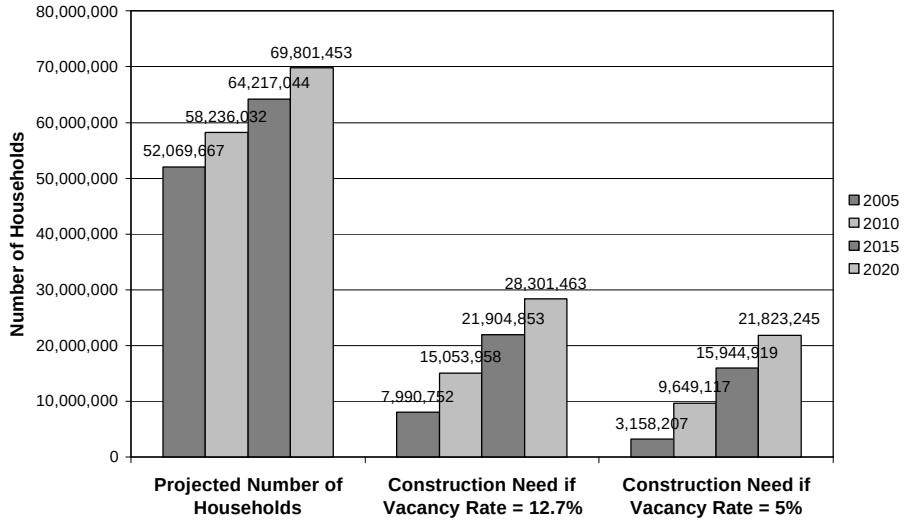
Brazil has a high vacancy rate if compared to Florida and the US as a whole. In the Florida model, the vacancy rate considered as average and used in the construction need calculations is five percent.

4.1.5 Construction need

Based on the 2000 housing supply and subtracting seasonal housing units, Brazil's housing stock amounts to 51,651,969 units. The estimated number of households for 2005 is 52,069,667. As explained in the methodology section, construction need is a function of demand and vacancy rates. If the current vacancy rate were maintained (12.7 percent), the total number of additional housing units needed to accommodate the projected 2005 demand would be 59,642,721, that is, an additional 7,990,752.

Since this vacancy rate is rather high and because the Census Bureau (IBGE) does not qualify vacant units, as explained in the introduction of this project, we decided to also apply a rate of five percent to the Brazil model to obtain an additional estimate for construction need. If the vacancy rate in Brazil were lowered to five percent, an additional 3,158,207 housing units would be needed by 2005.

GRAPH 3
Projected households and construction need – Brazil



Source: Author's calculations.

Projections for the year 2010 show that Brazil will need to add 15,053,958 housing units to its stock if the 12.7 percent vacancy rate is maintained. If it is lowered to five percent, an additional 9,649,117 housing units will be needed. By the year 2020, projections show a total of 69,801,453 households, which would mean an additional 28 million with a vacancy rate of 12.7 or an additional 21 million for a vacancy rate of five percent.

4.2 METROPOLITAN REGION OF CURITIBA, PARANÁ

Curitiba is the state capital of Paraná, the sixth largest state in Brazil. The Metropolitan Region of Curitiba (RMC), the eighth largest among metropolitan regions, had the highest growth rate of all regions between 1991 and 1996, even though the state of Paraná had one of the lowest growth rates in the same period. While other metropolitan regions had an average growth rate of 1.8 percent, RMC's reached 3.3 percent. Growth rates for all metropolitan regions, including Curitiba, averaged 3.6 percent between 1996 and 2000. Paraná, with 9.5 million inhabitants, has 80 percent of its population living in urban areas. Seventeen percent of the state's total population is concentrated in Curitiba, and its metropolitan region contains 32 percent of the state's urban population. The Metropolitan Region of Curitiba is highly urbanized, with 92 percent of its total population living in urban areas (IBGE, 2002).

FIGURE 3
Metropolitan region of Curitiba

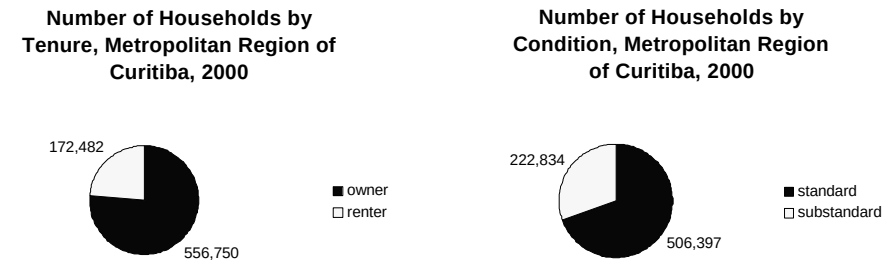
Sources: IBGE and ESRI/Data & Maps CD.

4.2.1 Housing profile

According to the 2000 Census, there were 729,232 households in the metropolitan region of Curitiba, 76 percent of which were owner occupied and 24 percent were renters. Of the 556,750 heads of household who declared themselves owners, 69 percent live in standard housing. This proportion is the same for renters.

GRAPH 4

Households by tenure and conditon, metropolitan region of Curitiba, 2000



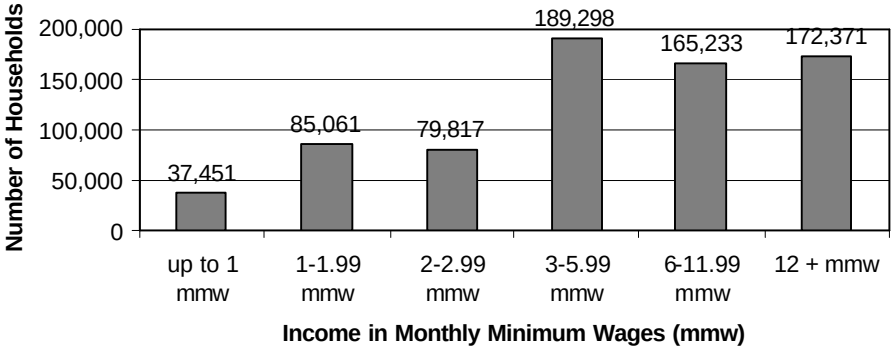
Source: IBGE, Census microdata, 2000.

Author´s calculations.

Households with one or two persons represented 28 percent of the total, while those with three, four or five or more persons averaged 24 percent each. More than half of the households, 54 percent, earn less than six Monthly Minimum Wages and 28 percent of the total number of households earns less than three Monthly Minimum Wages. However, only five percent earn less than one Monthly Minimum Wage.

GRAPH 5

Number of households by income, metropolitan region of Curitiba, 2000.



Source: IBGE, Census microdata, 2000.

Author´s calculations.

Although the ratio between owners and renters is constant across age categories, a higher percentage of standard owners (and lower of substandard owners) can be observed as householders age. While 63 percent of households whose head is between 15 and 24 years-old is standard, that percentage increases to 74 percent for households with heads 65 and older. For both owners and renters, the older the householder the lower the percentage of households occupying substandard housing.

4.2.2 Population projections

The population projections for the Metropolitan Region of Curitiba, henceforth referred to as RMC, were developed by programmers working with the research team

from state population projections to 2020 and population counts for 1990, 2000, and 2003.[16]

Curitiba's metropolitan region had 2,768,394 inhabitants in 2000 (IBGE, 2002). The projected population for 2010 is 3.5 million and over 4 million for 2020, which represents an increase of 50 percent in the next 17 years.

4.2.3 Household estimates and projections: the demand-side of housing

The criteria developed to incorporate the need of families that were sharing a house revealed interesting facts. Based on 2000 Census data, the total number of housing units needed to accommodate the additional families spinning-off due to overcrowded conditions went from 729,232 to 749,938, adding over 20 thousand new households to the total.

Most additional households came from the owner tenure category (15 thousand families), which indicates that 73 percent of families that would potentially form a new household live in households in the owner tenure category.

4.2.3.1 Tenure

Of the total estimated number of households needed in the metropolitan area of Curitiba (749,938), 571,836 households would be owner occupied. According to the criteria developed for the Brazil model, 518,665 households are standard, and 41 percent of the households, including owners and renters, are substandard.

The projection of tenure status to 2020 does not reveal a major change, nor should it, given the model assumptions. Unless there were substantive changes to the underlying age composition of the population, we would expect these relative proportions to hold true across the entire projection horizon.

TABLE 6
Household projections by tenure, metropolitan region of Curitiba, 2003-2020

Tenure	Year				
	2003	2005	2010	2015	2020
Owner standard	431,755	462,191	539,137	616,011	689,551
Owner substandard	193,937	207,263	240,736	273,772	304,995
Renter standard	135,739	145,334	169,758	194,318	218,004
Renter substandard	59,598	63,690	74,031	84,179	93,666
Total	**821,029**	**878,478**	**1,023,662**	**1,168,280**	**1,306,216**

Source: Author´s calculations.

4.2.3.2 Age

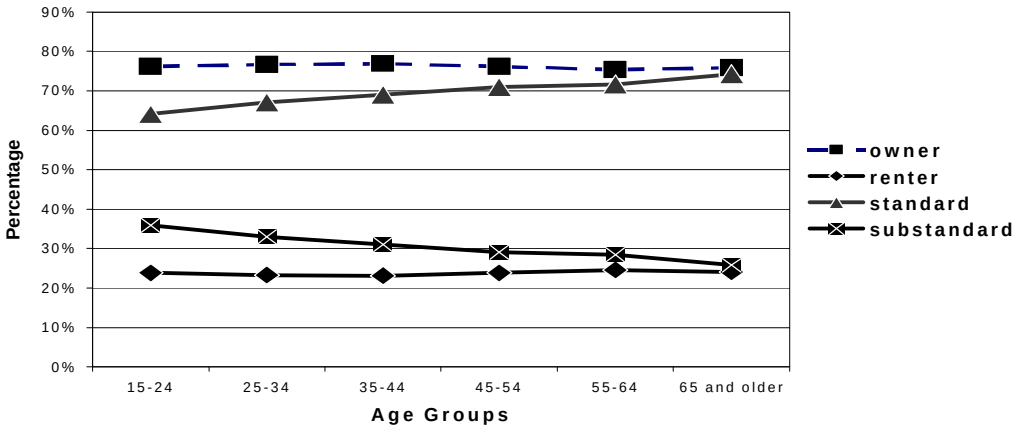
The number of households with heads in the 15 to 24 age group is very low when compared to the other age groups, representing about seven percent of all households. The household formation rates for the age group 15 to 24 are also lower than for any other age group, which confirms the perception that young people tend to stay in their parents homes longer than would be expected. Nonetheless, the proportion of owners to renters is similar to all other age categories, about three-

16. The state population projections were provided by CEDEPLAR. The population count for 1990, 2000 and 2003 were provided by IPEA through special tabulations from Census and DATASUS data.

quarters owners and one-quarter renters. The groups with higher household formation rates are the 35 to 44 and 45 to 54 groups. The age group with the highest percentage of owners is the 35 to 44 group.

GRAPH 6

Proportion of owners to renters and standard to substandard units by age group – RMC, 2000



Source: IBGE, Census microdata, 2000.

Author´s calculations.

In the 15 to 24 age category, more households live in standard areas (63 percent) than in substandard areas (37 percent). The overall owner-renter proportions are similar across all age categories; however, the older the head of the household, the higher the percentage living in standard housing and the lower the percentage living in substandard housing. In the 25 to 34 age category, for example, more than half of households own a standard house. The percentage of renters decreases slightly for the 35 to 44 age category: 23 percent are renters. Also, the number of standard households increases for this age category while the number of substandard decreases.

This trend continues into the 45 to 54, 55 to 64 and 65 and older categories. It is interesting to note that as heads of households get older their numbers increase in the standard tenure categories, which would indicate a correlation between age and opportunity to occupy adequate housing.

In the 20-year projections, the tendency is for the percentage of young heads of household to decrease. By 2020, only 4.7 percent of all households will have a head younger than 24 years old. Percentages will decrease somewhat for heads of household between 25 and 44 and increase significantly for those between 55 and 64. There is a noticeable increase for the age group 65 and older as well.

TABLE 7

Household projections by age, metropolitan regions of Curitiba, 2003-2020

Age	Year				
	2003	2005	2010	2015	2020
15 - 24 years old	6.44%	6.21%	5.53%	5.17%	4.73%
25 - 34 years old	23.96%	23.57%	23.53%	22.00%	19.93%
35 - 44 years old	26.26%	26.18%	24.50%	24.05%	24.70%
45 - 54 years old	20.49%	20.89%	21.82%	22.18%	21.43%
55 - 64 years old	12.40%	12.75%	14.13%	15.29%	16.57%
65 and older	10.45%	10.41%	10.48%	11.32%	12.63%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Source: Author´s calculations.

4.2.3.3 Size

Almost 29 percent of all households in the metropolitan area of Curitiba have one or two persons and 48 percent have three or four persons. Households with five or more persons represent 23 percent of the total number of households. These proportions do not change significantly within tenure or income categories.

Concerning the overcrowding of shared households, some interesting differences can be pointed out. Only five percent of households in the metropolitan area of Curitiba have more than one family, although 11 percent of the total number of households are overcrowded. Among standard households, nine percent of the total is overcrowded, while 19 percent of the substandard households are overcrowded. Renters present more overcrowding than owners; 17 percent of renter households are overcrowded, compared to ten percent of owners.

TABLE 8
Household projections by size, metropolitan region of Curitiba, 2003-2020

Household size	Year				
	2003	2005	2010	2015	2020
1 or 2 persons	237,181	253,900	296,234	338,689	379,450
3 persons	200,782	214,817	250,234	285,555	319,319
4 persons	195,663	209,335	243,876	278,219	310,920
5 or more persons	187,403	200,426	233,318	265,817	296,527
Total	**821,029**	**878,478**	**1,023,662**	**1,168,280**	**1,306,216**

Source: Author´s calculations.

Future trends reveal a slight increase in the percentage of households with one or two persons, less than one percent increase by 2020. Household with three and four persons will remain constant and there will be a slight decrease in the number of households with five or more persons. The total number of households will increase by almost 500 thousand in the next 17 years, from an estimated 821,029 in 2003 to a projected 1,306,216 in 2020. The more significant increase will be of households with one or two persons, which indicates that programs should target this cohort. The number of households with one and two persons will increase by 60 percent in the next 17 years.

4.2.3.4 Income

The largest number of households in the metropolitan region of Curitiba (54 percent) earns less than six Monthly Minimum Wages. Most low-income housing programs are for families earning less than 3 Monthly Minimum Wages. In the metropolitan area of Curitiba, 28 percent of households fall into this income category. The new housing programs that are designed for families with incomes up to 6 Monthly Minimum Wages could benefit 54 percent of the total number of households. Programs that facilitate financing for families with incomes above 12 Monthly Minimum Wages would benefit 24 percent of the total number of households.

TABLE 9

Households by income level, metropolitan region of Curitiba, 2000

Tenure	Income in monthly minimum wages				
	up to 3	3 to 6	6 to 12	over 12	Total
owners standard	72,885	93,581	100,340	128,150	394,956
owners substandard	75,928	51,500	31,411	18,040	176,879
renters standard	31,127	35,479	30,926	26,176	123,708
renters substandard	30,145	14,530	6,764	2,954	54,393
Total	**210,085**	**195,090**	**169,441**	**175,320**	**749,936**

Source: IBGE, Census microdata, 2000.

Author´s calculations.

As it would be expected, there are more owners living in substandard conditions in the lower income categories. The higher the income, the higher the percentage of households living in standard conditions. Also, the higher the income, the higher the percentage of owner-occupied households as compared to renters.

TABLE 10

Household projection by income level, metropolitan region of Curitiba, 2003-2020

Income in monthly minimum wages (m.m.w.)	Year				
	2003	2005	2010	2015	2020
less than 1 m.m.w.	42,742	45,697	53,180	60,579	67,603
1-1.99 m.m.w.	95,694	102,297	118,936	135,267	150,552
2-2.99 m.m.w.	90,091	96,304	111,903	127,302	141,838
3-5.99 m.m.w.	215,965	231,026	269,102	307,034	343,370
6-11.99 m.m.w.	186,689	199,760	232,728	265,563	296,880
more than 12 m.m.w.	189,848	203,394	237,813	272,535	305,973
Total	**821,029**	**878,478**	**1,023,662**	**1,168,280**	**1,306,216**

Source: Author´s calculations.

Projections for the year 2020 indicate that there will be almost 25 thousand additional households with incomes below one Monthly Minimum Wage. More than 130 thousand additional households will earn less than three Monthly Minimum Wages. Another 130 thousand earning between three and six Monthly Minimum Wages will be added in the next 17 years. By the year 2020, almost 360,000 households will be earning less than three Monthly Minimum Wages so, low-income housing programs targeting this income level will be needed to provide housing to 28 percent of households.

4.2.4 Housing supply

The Metropolitan Region of Curitiba (RMC) has a total of 897,380 housing units according to the 2000 Census. The vacancy rate for Curitiba is 11 percent. Of all non-occupied units, 79 percent are vacant, 17 percent are seasonal and three percent were closed at the time the Census conducted the interview. Group quarters are included in this total for the reasons outlined in the methodology. They represent 0.11 percent of the total number of households in the RMC.

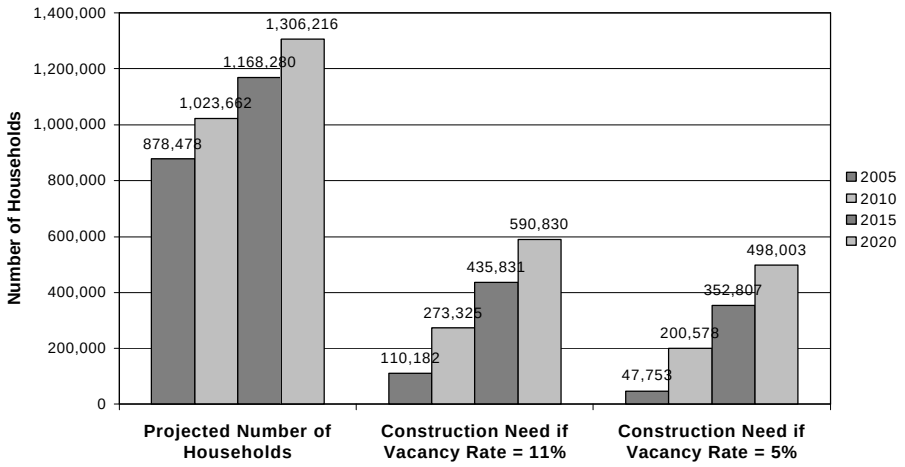
4.2.5 Construction need

Based on the 2000 housing supply and subtracting seasonal housing units, Curitiba's (RMC) housing stock amounts to 876,961 units. The estimated number of households for 2005 is 878,478. As explained in the methodology section,

construction need is a function of demand and vacancy rates. If the current vacancy rate were maintained (11 percent), the total number of additional housing units needed to accommodate the projected 2005 demand would be 987,143, that is, an additional 110,182.

GRAPH 7

Projected households and construction need, metropolitan region of Curitiba



Source: Author´s calculations.

Since this vacancy rate is rather high and because the Census Bureau (IBGE) does not qualify vacant units, as explained in the introduction of this project, we decided to also apply a rate of five percent to the Brazil model to obtain an additional estimate for construction need. If the vacancy rate in the RMC were lowered to five percent, an additional 47,753 housing units would be needed by 2005.

Projections for the year 2010 show that the Metropolitan Region of Curitiba will need to add 273,325 housing units to its stock if the 11 percent vacancy rate is maintained. If it is lowered to five percent, an additional 200,578 housing units will be needed. By the year 2020, projections show a total of 1,306,216 households, which means an additional 590,830 units with the current vacancy rate of 11 percent or an additional 498,003 units for a vacancy rate of five percent.

4.3 METROPOLITAN REGION OF RECIFE, PERNAMBUCO

Recife, the eighth-largest city in Brazil, is the state capital of Pernambuco. A major port city in northeastern Brazil, its metropolitan region is the fifth-largest in the country. The city is divided by waterways into separate districts, and for this reason is sometimes called the Venice of Brazil. Its economy is based on trade and tourism. Recife's population in 2000 was 1,422,905 (IBGE, 2002).

The Metropolitan Region of Recife (RMR) had 1.13 percent growth rate between 1991 and 1996. Growth rates for all metropolitan regions averaged 3.6 percent between 1996 and 2000, but RMR's was only 1.96 percent in that period. The metropolitan region of Recife had the third lowest growth rate of all metropolitan regions between 1991 and 2000, only behind Rio de Janeiro and São Paulo, the two largest cities in Brazil (IBGE, 2002).

FIGURE 4
Metropolitan region of Recife

Sources: IBGE and ESRI/Data & Maps CD.

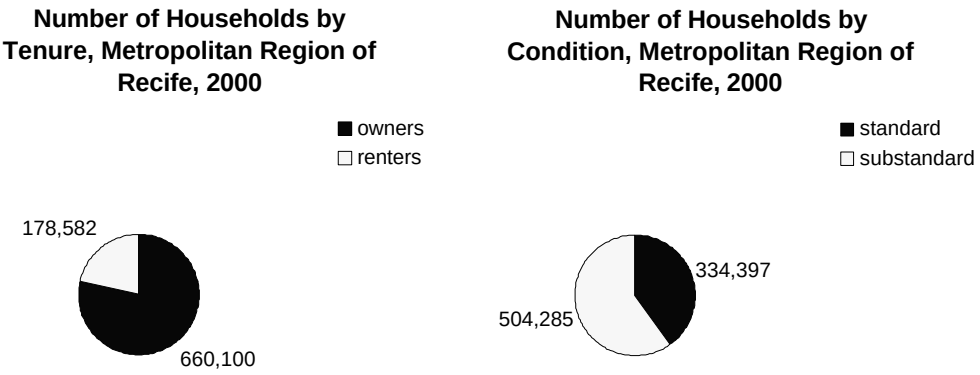
The State of Pernambuco, the seventh largest state in Brazil, has 7.9 million inhabitants, 18 percent of the state's total population is concentrated in the city of Recife and the metropolitan region contains 43 percent of the state's population (IBGE, 2002). The RMR, comprising 14 jurisdictions, has a total area of 2,742 square kilometers. The population of 3,3 million is 97 percent urban and represents almost half of the State's population. The city has one of the highest densities in all of Brazil: 1,217 persons per square kilometer (Moreira, 2001).

4.3.1 Housing profile

According to the 2000 Census, there were 838,682 households in the metropolitan region of Recife, 79 percent of which were owner occupied and 21 percent were renters. Of the 660,100 heads of household who declared themselves owners, only 39 percent lived in standard housing. This proportion is almost the same for renters, only 42 percent of renters are in the standard category. Overall, 60 percent of households in Recife are substandard.

GRAPH 8

Households by tenure and condition, metropolitan region of Recife, 2000



Source: IBGE, Census microdata, 2000.

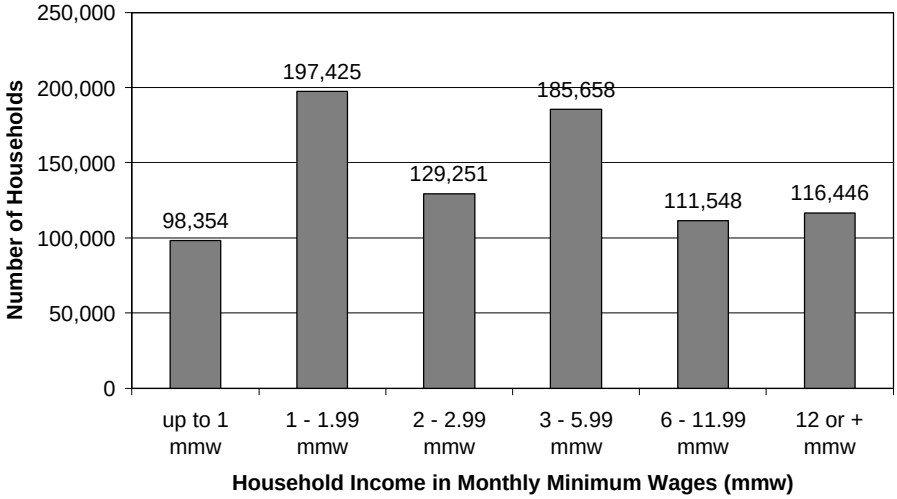
Author´s calculations.

Large households predominate in Recife; 40 percent have up to three persons and 60 percent have four or more persons. Households with one or two persons and with three persons each represented 20 percent of the total, while those with four represented 24 percent and those with five or more persons represented 35 percent.

Low-income households are predominant in Recife. Almost three-quarters of households, 73 percent, earn less than six Monthly Minimum Wages and more than half, 51 percent, earn less than three Monthly Minimum Wages. For all age groups, at least 50 percent of households earn less than three Monthly Minimum Wages. Heads of households between 15 and 24 years of age have a larger percentage earning less than one Monthly Minimum Wage than other age groups, 13 percent.

GRAPH 9

Number of households by income, metropolitan region of Recife, 2000



Source: IBGE, Census microdata, 2000.

Author´s calculations.

The ratio between owners and renters is constant across age categories. However, as heads of household age, the percentage of standard households increases. While 36 percent of households whose head is between 15 and 24 years-old is standard, that percentage increases to 41 percent for households with heads 45 and older.

4.3.2 Population projections

The population projections for the Metropolitan Region of Recife were developed from state population projections to 2020 and population counts for 1990, 2000, and 2003 by programmers working with the research team.[17]

Recife's metropolitan region had 3,291,349 inhabitants in 2000 (IBGE, 2002). The projected population for 2010 is 3,7 million and four million for 2020, which represents an increase of almost 20 percent in the next 17 years.

4.3.3 Household estimates and projections: the demand-side of housing

The criteria developed to incorporate the need of families that were sharing a house revealed interesting facts. Based on 2000 Census data, the total number of housing units needed to accommodate the additional families spinning-off due to overcrowded conditions increased by 62,059 new households. There were 838,682 households in the metropolitan area of Recife in 2000, however, considering that the shared households that presented overcrowded conditions represented a need for a new unit, the estimated demand is 900,741 households.

Most additional households originated from the owner tenure category (47,376 families), which indicates that 76 percent of families that would potentially form a new household live in households in the owner tenure category. However, the majority lives in substandard conditions (30,392 families). Including both owners and renters, 64 percent of potential new households would come from substandard housing conditions.

4.3.3.1 Tenure

There are an estimated 764,956 households in the metropolitan area of Recife that declared themselves owners, representing 79 percent of the total number of households. According to the criteria developed for the Brazil model, 385,518 households are standard, and 60 percent of the households, including owners and renters, are substandard.

The projection of tenure status to 2020 does not reveal a major change. Owners will continue to represent about 79 percent of households while renters will account for the remainder 21 percent. For both owners and renters, there is a general propensity that the number of standard households will increase, while the number of substandard households will decrease, but this variation is not very significant (less than one percent).

17. The state population projections were provided by CEDEPLAR. The population count for 1990, 2000 and 2003 were provided by IPEA through special tabulations from Census and DATASUS data.

TABLE 11

Household projections by tenure, metropolitan region of Recife, 2000-2003

Tenure	Year				
	2003	2005	2010	2015	2020
owner standard	299,228	314,005	353,803	394,409	433,861
owner substandard	465,728	488,333	548,831	609,937	668,254
renter standard	86,290	90,563	102,076	113,882	125,429
renter substandard	120,718	126,535	142,064	157,700	172,567
Total	**971,964**	**1,019,436**	**1,146,774**	**1,275,928**	**1,400,111**

Source: Author´s calculations.

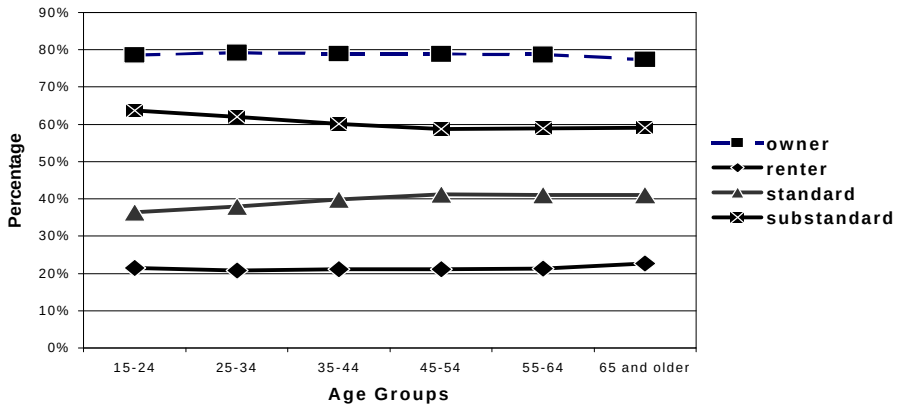
4.3.3.2 Age

The number of households with heads in the 15 to 24 age group is very low when compared to the other age groups, representing about seven percent of all households. The household formation rates for the age group 15 to 24 are also lower than for any other age group, which confirms the perception that young people tend to stay in their parents' homes longer than would be expected. The groups with higher household formation rates are the 35 to 44 and 45 to 54 groups.

Most households whose head is between the ages of 15 and 24 are owners, only 21 percent of householders in this age category are renters. In this age category, more households live in substandard areas (64 percent) than in standard areas (36 percent). The overall owner-renter proportions are similar across all age categories; however, the older the head of the household, the higher the percentage living in standard housing and the lower the percentage living in substandard housing, which would indicate a correlation between age and opportunity to occupy adequate housing. Nonetheless, there are more substandard households for all age categories, an average 60 to 40 percent ratio.

GRAPH 10

Proportion of owners to renters and standard to substandard units by age group – RMR, 2000



Source: IBGE, Census microdata, 2000.

Author´s calculations.

In the 20 year projections, the tendency is for the percentage of young heads of household to decrease. By 2020, only 4.3 percent of all households will have a head younger than 24 years-old. Percentages will also decrease for heads of household between 25 and 44 and increase by four percent for those between 55 and 64. There is also an increase for the age group 65 and older as well.

TABLE 12

Household projections by age, metropolitan region of Recife, 2002-2020

Age of householder	Year				
	2003	2005	2010	2015	2020
15-24	6.74%	6.45%	5.62%	4.86%	4.26%
25-34	22.55%	22.41%	22.20%	20.82%	18.24%
35-44	24.88%	24.75%	23.58%	23.79%	24.48%
45-54	19.80%	20.03%	21.32%	21.54%	21.28%
55-64	13.43%	13.71%	14.65%	15.50%	17.13%
65 and older	12.60%	12.65%	12.64%	13.49%	14.61%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Author´s calculations.

4.3.3.3 Size

Only 20 percent of all households in the metropolitan area of Recife have one or two persons and 44 percent have three or four persons. Households with five or more persons represent 35 percent of the total number of households. These proportions do not change significantly within tenure or income categories.

Concerning the overcrowding of shared households, some interesting differences can be pointed out. Seven percent of households in the metropolitan area of Recife are shared and overcrowded. Of the more than 62 thousand households in this condition, 47,376 are in the owner tenure category, only 24 percent are renters. Among standard households, 36 percent of the total number of shared households is overcrowded; the remaining 64 percent of overcrowded households are substandard. Renters present a slightly higher rate of overcrowding than owners; 16 percent of renter households are overcrowded, compared to 14 percent of owners.

Future trends do not indicate much change in the percentage of households with one or two persons by 2020. There will be a slight decrease in the number of households with three and four persons. Households with five or more persons will present a slight increase. The total number of households will increase by more than 400 thousand in the next 17 years, from an estimated 971,964 in 2003 to a projected 1,400,111 in 2020. The more significant increase will be of households with five or more persons, an additional 155 thousand households, which indicates that programs should target larger households. The lowest increase will be of households with three persons, 41 percent. The number of households with one and two persons will increase by 46 percent in the next 17 years.

TABLE 13

Household projection by household size, metropolitan region of Recife

Household size	Year				
	2003	2005	2010	2015	2020
1 or 2 persons	199,361	209,231	236,054	263,622	291,299
3 persons	194,664	203,947	228,740	253,091	275,318
4 persons	234,415	245,851	276,011	306,585	334,860
5 or more persons	343,524	360,407	405,969	452,630	498,634
Total	**971,964**	**1,019,436**	**1,146,774**	**1,275,928**	**1,400,111**

Source: Author´s calculations.

4.3.3.4 Income

The largest number of households in the metropolitan region of Recife (73 percent) earns less than six Monthly Minimum Wages. Most low-income housing programs are for families earning less than three Monthly Minimum Wages. In the metropolitan area of Recife, 51 percent of households fall into this income category. The new housing programs that are designed for families with incomes up to 6 Monthly Minimum Wages could benefit 73 percent of the total number of households. Programs that facilitate financing for families with incomes above 12 Monthly Minimum Wages would only benefit 13 percent of the total number of households. As would be expected, as income levels rise, the number of households occupying substandard units decreases considerably.

TABLE 14
Households by income level, metropolitan region of Recife, 2000

Tenure	Income in monthly minimum wages				
	Up to 3	3 to 6	6 to 12	over 12	Total
owners standard	91,622	64,125	52,432	70,070	278,249
owners substandard	269,242	96,358	41,236	26,774	433,610
renters standard	26,981	17,054	16,452	19,734	80,221
renters substandard	74,944	22,828	9,246	5,429	112,447
Total	**462,789**	**200,365**	**119,366**	**122,007**	**904,527**

Source: IBGE, Census microdata, 2000.
Author´s calculations.

Projections for the year 2020 indicate that there will be almost 50 thousand additional households with incomes below one Monthly Minimum Wage. More than 210 thousand additional households will earn less than three Monthly Minimum Wages. Another 95 thousand earning between three and six Monthly Minimum Wages will be added in the next 17 years.

TABLE 15
Household projections by income level, metropolitan region of Recife, 2003-2020

Income in monthly minimum wages	Year				
(m.m.w.)	2003	2005	2010	2015	2020
less than 1 m.m.w.	115,050	120,598	135,397	150,311	164,488
1-1.99 m.m.w.	232,272	243,548	273,773	304,273	333,366
2-2.99 m.m.w.	149,725	157,012	176,499	196,287	215,324
3-5.99 m.m.w.	215,314	225,833	254,020	282,703	310,365
6-11.99 m.m.w.	128,364	134,697	151,784	169,102	185,789
more than 12 m.m.w.	131,239	137,748	155,301	173,252	190,779
Total	**971,964**	**1,019,436**	**1,146,774**	**1,275,928**	**1,400,111**

Source: Author´s calculations.

By the year 2020, more than 700,000 households will be earning less than three Monthly Minimum Wages so, low-income housing programs targeting this income level will be needed to provide housing to half of all households.

4.3.4 Housing supply

The Metropolitan Region of Recife (RMR) has a total of 1,004,198 housing units according to the 2000 Census. The vacancy rate for Recife is 11.1 percent. Of all non-occupied units, 70 percent are vacant, 22 percent are seasonal and eight percent were closed at the time the Census conducted the interview. Group quarters are included in this total for the reasons outlined in the methodology. They represent 0.09 percent of the total number of households in the RMR.

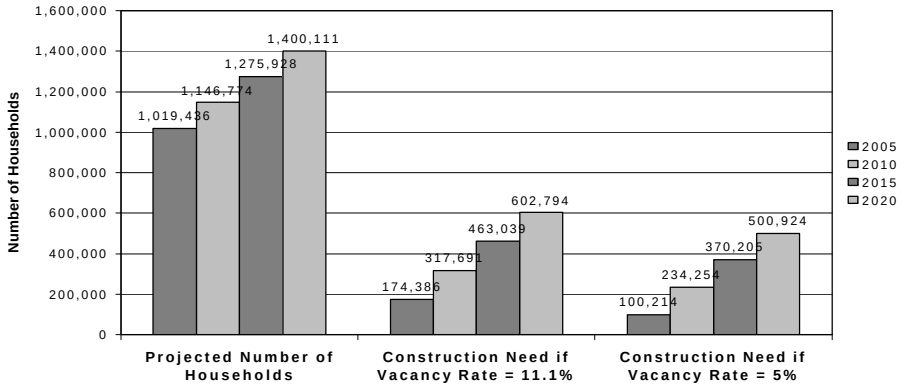
4.3.5 Construction need

Based on the 2000 housing supply and subtracting seasonal housing units, Recife's (RMR) housing stock amounts to 972,877 units. The estimated number of households for 2005 is 1,019,436. As explained in the methodology section, construction need is a function of demand and vacancy rates. If the current vacancy rate were maintained (11.1 percent), the total number of additional housing units needed to accommodate the projected 2005 demand would be 1,147,263, that is, an additional 174,386.

Since this vacancy rate is rather high and because the Census Bureau (IBGE) does not qualify vacant units, as explained in the introduction of this project, we decided to also apply a rate of five percent to the Brazil model to obtain an additional estimate for construction need. If the vacancy rate in the RMR were lowered to five percent, an additional 100,214 housing units would be needed by 2005.

GRAPH 11

Projected households and construction need, metropolitan region of Recife



Source: Author's calculations.

Projections for the year 2010 show that the Metropolitan Region of Recife will need to add 317,691 housing units to its stock if the 11.1 percent vacancy rate is maintained. If it is lowered to five percent, an additional 234,254 housing units will be needed. By the year 2020, projections show a total of 1,400,111 households, which would mean an additional 602,794 units with the current vacancy rate of 11.1 percent or an additional 500,924 units for a vacancy rate of five percent.

4.4 FEDERAL DISTRICT INTEGRATED DEVELOPMENT REGION (RIDE OF DF)

The Federal District comprises the city of Brasília plus 18 satellite cities called Administrative Regions (RAs). The Integrated Development Region of the Federal District (Região Integrada de Desenvolvimento do Distrito Federal e Entorno - RIDE) comprises the Federal District, 20 municipalities in the state of Goiás and two municipalities in the state of Minas Gerais.

Brasília and RIDE offer different characteristics from the other two metropolitan areas in this study. Brasília was built in the late 1950s to be the new capital of Brazil so, the evolution of its urban development followed the pattern of New Cities as opposed to Curitiba and Recife which developed over a period of about 400 years. Given its remote location, the construction of Brasília had an enormous regional impact bringing roads and railways to an undeveloped area of the country.

FIGURE 5
Federal District Integrated Development Region (RIDE OF DF)

Sources: IBGE and ESRI/Data & Maps CD.

During the implementation of the Federal District's Pilot Plan and the establishment of satellite cities, from 1956 to 1973, growth rates were extremely high, about 15 percent a year. The population went from 12,283 in 1957 to 64,314 in 1959, and by 1970 the area had 537,492 inhabitants. During the 1970s and 1980s growth rates decreased to about eight percent a year, nonetheless, by the 1980 Census, the population had almost doubled to 1.2 million inhabitants. During the 1980/1991 period, growth rates were 2.8 percent a year, and by the1991 Census the

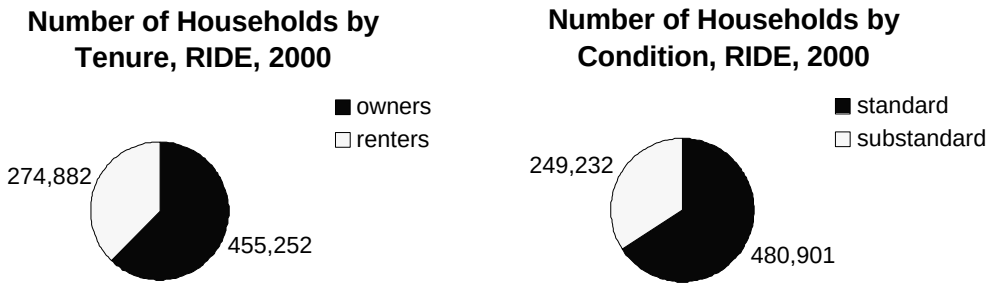
Federal District had 1.6 million inhabitants. Growth rates remain high to this date compared to the national average (1.9 percent). The 2000 Census registered over 2 million people.

The RIDE was created in 1998. Between 1970 and 2000, while growth rates decreased in the Federal Districts, they increased in the jurisdictions around the Pilot Plan. A total of 342,647 people were added to the surrounding area between the 1991 and the 2000 Census. The 22 jurisdictions that comprise the RIDE had a total population of 907 thousand people in 2000. Together with the Federal District's two million, it is estimated that the RIDE has a population of more than three million today. Most households in the 22 municipalities surrounding the Federal District live in precarious conditions; only 13 percent of them is connected to the sewerage network and 40 percent do not have a potable water supply.

4.4.1 Housing profile

According to the 2000 Census, there were 730,134 households in the RIDE, 62 percent of which were owner occupied and 38 percent were renters. Of the 455,252 heads of household who declared themselves owners, 66 percent live in standard housing.

GRAPH 12
Households by tenure and condition, RIDE of DF, 2000



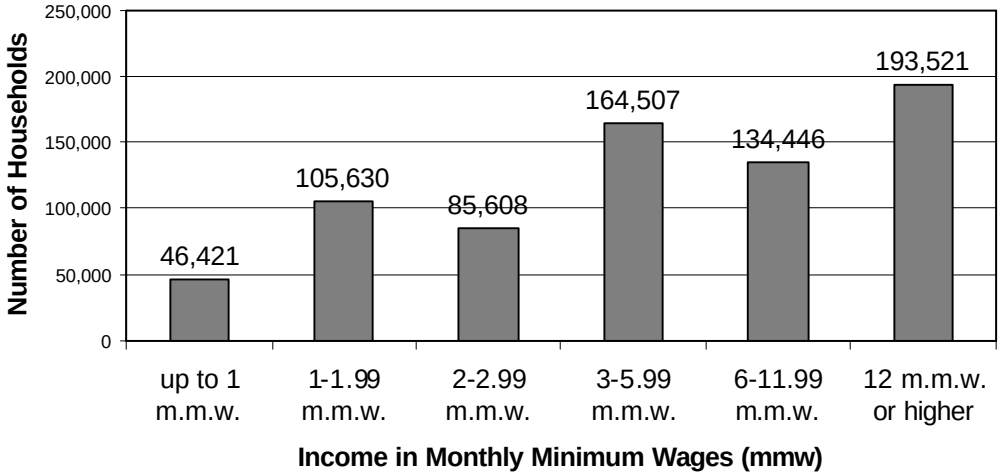
Source: IBGE, Census microdata, 2000.
Author's calculations.

This proportion is the same for renters. The majority of householders are between the ages of 25 and 34 (28 percent), followed by the 35 to 44 years-old group (27 percent). Nine percent of householders are under 25 years-old and seven percent are over 65 years-old. For the 45 to 54 and 55 to 64 age groups the proportions are 19 and 11 percent respectively.

Households with one or two persons represented 25 percent of the total, while those with three and four represented 21 and 24 percent respectively. The largest percentage of households, 29.5 percent, had five or more persons. The majority of the Federal District's population is middle- to high-income. Forty-five percent of all households earn more than six Monthly Minimum Wages (m.m.w.): 18 percent earn between 6 and 12 m.m.w. and 27 percent earn more than 12 m.m.w. A third of all households, 33 percent, earns less than three Monthly Minimum Wages. However, only six percent earn less than one Monthly Minimum Wage.

GRAPH 13

Number of households by income – RIDE, 2000



Source: IBGE, Census microdata, 2000.

Author´s calculations.

Although the ratio between owners and renters is constant across age categories, a higher percentage of standard owners (and lower of substandard owners) can be observed as householders age. While 46 percent of households whose head is between 15 and 24 years-old is standard, that percentage increases to 53 percent for households with heads 65 and older. For both owners and renters, the older the householder the lower the percentage of households occupying substandard housing.

4.4.2 Population projections

The population projections for RIDE were developed by programmers working with the research team from state population projections to 2020 and population counts for 1990, 2000, and 2003.[18] The population projections for the metropolitan area of Brasília required the research team to make an exception. Only 21 of the 24 jurisdictions that comprise the RIDE were included in the calculations for the model. The three municipalities in the state of Minas Gerais were not included in the housing needs assessment for the RIDE to avoid extensive calculations that were not justified given the percentage of population they represent. The number of households in those three areas represents only 3.2 percent of the total number of households in the RIDE. Given all the calculations required to develop the model, which had to be based on the entire population of the state of Minas Gerais, including over 800 municipalities, the research team decided to compromise and consider only the Federal District and the 20 municipalities in Goiás for the RIDE calculations.

The RIDE had 1,980,520 inhabitants in 2000 (IBGE, 2002). The projected population for 2010 is 3.7 million and 4.5 million for 2020, which represents an increase of almost 50 percent in the next 17 years.

18. The state population projections were provided by CEDEPLAR. The population count for 1990, 2000 and 2003 were provided by IPEA through special tabulations from Census and DATASUS data.

4.4.3 Household estimates and projections: the demand-side of housing

The criteria developed to incorporate the need of families that were sharing a house revealed interesting facts. Based on 2000 Census data, the total number of housing units needed to accommodate the additional families spinning-off due to overcrowded conditions went from 730,134 to 762,843, adding over 30 thousand new households to the total.

Most additional households came from the owner tenure category (almost 18 thousand families), which indicates that 54 percent of families that would potentially form a new household live in households in the owner tenure category. Of the 32,709 potentially new households, 15,048 live in rented housing. In terms of housing condition, 37 percent of families share substandard, overcrowded households. The majority (20,458 families), including both owners and renters, lives in standard conditions.

4.4.3.1 Tenure

Of the total estimated number of households needed in the RIDE (762,843), 472,913 households would be owner occupied. According to the criteria developed for the Brazil model, 501,360 households would be standard, and 34 percent of the households, including owners and renters, would be substandard.

The projection of tenure status to 2020 does not reveal a major change. Owners will continue to represent about 62 percent of households while renters will account for the remainder 38 percent. In absolute numbers, it is estimated that in the next 17 years there will be 405,467 additional owner-occupied households and 196,213 renter-occupied households. As for condition, by 2020 there should be an additional 373,637 standard households and 228,043 substandard households.

TABELA 16
Household projections by tenure – RIDE, 2000

Tenure	Year				
	2003	2005	2010	2015	2020
owner standard	351,909	380,430	454,181	528,109	602,984
owner substandard	182,955	197,316	234,244	269,949	305,517
renter standard	216,524	234,043	279,352	324,842	370,916
renter substandard	111,343	120,014	142,238	163,688	184,994
Total	**862,731**	**931,803**	**1,110,015**	**1,286,588**	**1,464,411**

Source: Author´s calculations.

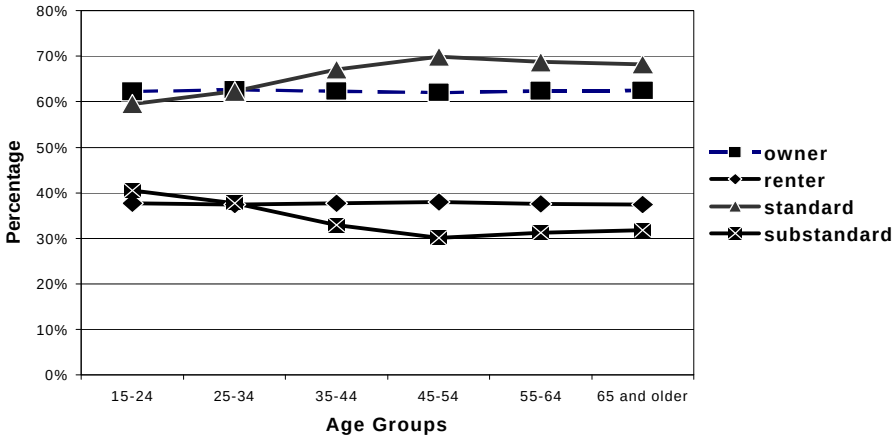
4.4.3.2 Age

The number of households with heads in the 15 to 24 and in the 65 and older age groups is relatively low when compared to the other age groups. Younger households represent about nine percent of all households and elderly households represent seven percent of all households. The household formation rates for the age group 15 to 24 are also lower than for any other age group, which confirms the perception that young people tend to stay in their parents homes longer than would be expected. The age groups with higher household formation rates are the 25 to 34 and 35 to 44 groups.

Most households whose head is between the ages of 15 and 24 are owners (62 percent) and 38 percent of householders in this age category are renters. In this age category, more households live in standard areas (60 percent) than in substandard areas (40 percent). The overall owner-renter proportions are similar across all age categories, increasing slightly with age. The number of standard housing units increases for each age group up to 54 years-old, then decreases slightly for older groups. For example, 60 percent of 15 to 24 year-olds, 70 percent of the 45 to 54 year-olds, and 68 percent of 65 and older live in standard housing.

GRAPH 14

Proportion of owners to renters and standard to substandard units by age group – RIDE, 2000



Source: IBGE, Census microdata, 2000.

Author´s calculations.

In the 20 year projections, the tendency is for the percentage of young heads of household to decrease. By 2020, only 6.5 percent of all households will have a head younger than 24 years-old. Percentages will decrease six percentage points for heads of household between 25 and 34 and increase somewhat (about three percentage points) for those between 55 and 64 and 65 and older. Proportions of householders between 35 and 54 will vary slightly, but not significantly.

TABLE 17

Household projections by age – RIDE, 2003-2020

Age	Year				
	2003	2005	2010	2015	2020
15 - 24 years old	8.89%	8.44%	7.36%	6.82%	6.45%
25 - 34 years old	28.26%	28.05%	27.75%	25.15%	22.19%
35 - 44 years old	26.17%	26.17%	25.39%	25.83%	26.50%
45 - 54 years old	18.24%	18.44%	19.06%	19.77%	19.95%
55 - 64 years old	10.66%	10.89%	11.92%	12.77%	13.78%
65 and older	7.78%	8.02%	8.53%	9.66%	11.14%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

Source: Author´s calculations.

4.4.3.3 Size

More than 25 percent of all households in the RIDE have one or two persons and 45 percent have three or four persons. Households with five or more persons represent

30 percent of the total number of households. Households with three persons make up the smallest group, 22 percent of the total. Among households with one and two persons, the majority (31 percent) is in the higher income category, 12 Monthly Minimum Wages (m.m.w.) or higher. The same happens, albeit in slightly different proportions, for households with three and four persons; however, a significant proportion of larger households (24 percent) makes between three and six m.m.w. Larger households also have the highest proportion (seven percent) of the poorest, those making less than one m.m.w. In addition, most households making up to three m.m.w., 35 percent, have five or more persons.

As far as tenure and condition of the household, the proportion of owners to renters is practically constant for all household sizes, around 62 to 38. Large households make up the majority of owners in standard housing, while most renters in standard housing are one or two person households. In fact, the proportion of standard housing is higher for both owners and renters in one to two person households. Most owners and renters who live in substandard housing are large households.

Only 4.5 percent of the total number of households are overcrowded. Among standard households, 4.3 percent of the total is overcrowded, while 4.9 percent of the substandard households are overcrowded. Renters are slightly less overcrowded than owners; only 2.1 percent of renter households are overcrowded, compared to 2.4 percent of owners.

Future trends reveal a slight increase in the percentage of households with one or two persons, less than one percent increase by 2020. Household with three and four persons will remain constant and there will be a slight decrease in the number of households with five or more persons. The total number of households will increase by over 600 thousand in the next 17 years, from an estimated 862,731 in 2003 to a projected 1,464,411 in 2020. The more significant increase will be of households with one or two persons, which indicates that programs should target this cohort. The number of households with one and two persons will increase by 70 percent in the next 17 years.

TABLE 18
Household projections by household size, RIDE, 2003-2020

Household size	Year				
	2003	2005	2010	2015	2020
1 or 2 persons	199,900	215,636	256,808	297,398	338,857
3 persons	176,741	190,383	225,653	258,699	291,225
4 persons	200,729	216,970	258,371	298,836	338,928
5 or more persons	285,361	308,814	369,183	431,655	495,401
Total	**862,731**	**931,803**	**1,110,015**	**1,286,588**	**1,464,411**

Source: Author's calculations.

4.4.3.4 Income

The largest number of households in the RIDE (55 percent) earns less than six Monthly Minimum Wages. Most low-income housing programs are for families earning less than 3 Monthly Minimum Wages. In the RIDE, 33 percent of households fall into this income category. The new housing programs that are designed for families with incomes up to 6 Monthly Minimum Wages could benefit 55 percent of the total number of households. Programs that facilitate financing for

families with incomes above 12 Monthly Minimum Wages would benefit 26.5 percent of the total number of households.

TABLE 19
Households by income level, RIDE of DF, 2000

Tenure	Income in monthly minimum wages				
	up to 3	3 to 6	6 to 12	over 12	Total
owners standard	55,820	58,774	67,751	128,456	310,801
owners substandard	76,655	43,293	24,890	17,273	162,111
renters standard	56,192	47,594	38,763	48,009	190,558
renters substandard	63,337	22,939	8,207	4,889	99,372
Total	**252,004**	**172,600**	**139,611**	**198,627**	**762,842**

Source: IBGE, Census microdata, 2000.
Author´s calculations.

As income levels rise, so does the number of households in living in standard conditions. The number of households living in rental units decreases as income level rises, which shows a correlation between income and tenure. There is also a correlation between income and dwelling condition. While 55.5 percent of the households with incomes below three Monthly Minimum Wages (m.m.w.) live in substandard conditions, 88.8 percent with incomes over 12 m.m.w. live in standard conditions. These differences are significant for both owners and renters. While 73 percent of owners and 27 percent of renters have incomes over 12 m.m.w., those households with incomes below three m.m.w. are more evenly divided, 53 percent owners to 57 percent renters. Still, it is evident that households with higher incomes have more access to ownership.

Projections for the year 2020 indicate that there will be almost 38 thousand additional households with incomes below one Monthly Minimum Wage. More than 193 thousand additional households will earn less than three Monthly Minimum Wages. Another 132 thousand earning between three and six Monthly Minimum Wages will be added in the next 17 years.

By the year 2020, almost 500,000 households will be earning less than three Monthly Minimum Wages so, low-income housing programs targeting this income level will be needed to provide housing to one-third of all households.

TABLE 20
Household projections by income level, RIDE, 2003-2020

Income in monthly minimum wages (m.m.w.)	Year				
	2003	2005	2010	2015	2020
less than 1 m.m.w.	55,658	60,034	71,277	82,238	93,198
1-1.99 m.m.w.	127,209	137,197	162,887	187,937	212,992
2-2.99 m.m.w.	102,615	110,714	131,551	151,977	172,442
3-5.99 m.m.w.	194,601	209,946	249,387	287,860	326,294
6-11.99 m.m.w.	157,998	170,644	203,193	235,439	267,794
more than 12 m.m.w.	224,650	243,268	291,720	341,137	391,691
Total	**862,731**	**931,803**	**1,110,015**	**1,286,588**	**1,464,411**

Source: Author´s calculations.

4.4.4 Housing Supply

The RIDE has a total of 889,849 housing units according to the 2000 Census. The vacancy rate for the Federal District's Metropolitan Region is 12.9 percent. Of all non-occupied units, 70 percent are vacant, 15 percent are seasonal and 15 percent

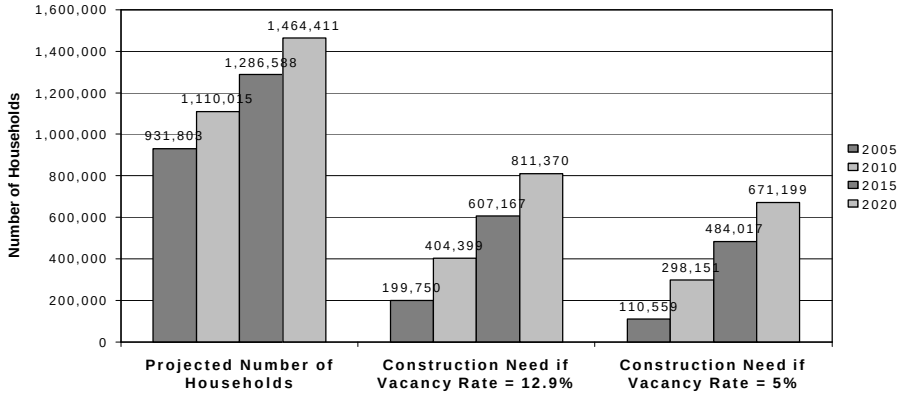
were closed at the time the Census conducted the interview. Group quarters are included in this total for the reasons outlined in the methodology. They represent 0.1 percent of the total number of households in the RIDE.

4.4.5 Construction Need

Based on the 2000 housing supply and subtracting seasonal housing units, Brasília's (RIDE) housing stock amounts to 972,877 units. The estimated number of households for 2005 is 931,803. As explained in the methodology section, construction need is a function of demand and vacancy rates. RIDE vacancy rates are higher than the national average. If the current vacancy rate were maintained (12.9 percent), the total number of additional housing units needed to accommodate the projected 2005 demand would be 1,070,036, that is, an additional 199,750.

GRAPH 15

Projected households and construction need, integrated development region of the Federal District



Source: Author's calculations.

Since this vacancy rate is rather high and because the Census Bureau (IBGE) does not qualify vacant units, as explained in the introduction of this project, we decided to also apply a rate of five percent to the Brazil model to obtain an additional estimate for construction need. If the vacancy rate in the RIDE were lowered to five percent, an additional 110,559 housing units would be needed by 2005.

Projections for the year 2010 show that the Integrated Development Region of the Federal District will need to add 404,399 housing units to its stock if the 12.9 percent vacancy rate is maintained. If it is lowered to five percent, an additional 298,151 housing units will be needed. By the year 2020, projections show a total of 1,464,411 households, which would mean an additional 811,370 units with the current vacancy rate of 12.9 percent or an additional 671,199 units for a vacancy rate of five percent.

5 COMPARATIVE ANALYSIS AND CONCLUSIONS

This housing needs assessment confirms some of the stark regional differences that exist in Brazil. The metropolitan regions of Curitiba (RMC), Recife (RMR) and Brasília (RIDE) represent three very different contexts for enlightening comparisons.

Although the differences among the three regions reveal interesting facts, some similarities are also revealing.

A fact that holds true for all regions is the constant proportion of owners to renters across all age categories. In the United States, the expected results would be that young households would rent and as they age and their incomes increase and household size increases, they become homeowners. However, in Brazil, the percentage of young households who own is almost the same as the percentage of older households who own. Some explanations could be considered in light of cultural aspects. First, most young people remain in their parents' homes until they have the means to acquire a house of their own. This custom is rooted in the country's Portuguese tradition of the relationship among social ascension, security and home ownership. Whereas in some countries home ownership is related to a gradual process of affluence related to increasing professional stability, in Brazil the importance of home ownership is related to cultural values. Most people in Brazil associate paying rent with "throwing money down the drain," so the effort put into acquiring a home is intense from an early age. Second, young people have difficulty renting rooms or apartments because of legal and contractual requirements exercised by landlords. In the 1980s, some housing authorities heeded the need for affordable single-person housing units and built studios to be sold to low-income singles and childless couples, but that practice has not continued. Still, single persons under 30 years old are a majority of the households on waiting lists for low-income housing.

Another constant for all regions is income. It is noticeable that income levels do not vary significantly for the different age groups. As with home ownership, in Florida, generally, the more mature the householder, the higher the income. In Brazil, one possible explanation is that income is more related to access to education and professional opportunities than to seniority. The uniformity of incomes across age categories could be related to the lack of professional opportunities for more mature individuals and the fact that younger people with more education will have higher incomes than older people without college degrees. In addition, there are complexities related to the enormous informal economy in Brazil, which may skew official data.

One noticeable difference among the three metropolitan regions is the number of households projected to be earning less than three Monthly Minimum Wages (m.m.w.) by 2020. This income level is significant because most low-income housing programs tie eligibility to earnings up to three m.m.w. We project that the metropolitan region of Curitiba (RMC) will have 28 percent of its households earning under three m.m.w., and therefore qualifying for low-income housing programs, by 2020. The metropolitan region of Recife (RMR) will have half of its households in that condition and the metropolitan region of Brasília (RIDE) will have one-third. This is a clear indication that housing programs targeting low-income populations will need to expand to serve households that need assistance.

Another noticeable contrast is related to the proportion of owners to renters and standard to substandard conditions. In the metropolitan region of Curitiba (RMC), the proportion of owners to renters in constant across all age categories, while as householders get old, they tend to occupy standard housing. The proportion of families living in standard housing in the RMC increases by almost 10 percentage points when comparing the youngest householders with the oldest (see graph on page 22). In the metropolitan region of Recife (RMR), ownership peaks between 25 and 34 and decreases slightly for older householders (see graph on page 31). The RMR has the highest proportion of substandard housing of all three regions. The number of households living in standard housing increases five percentage points between the youngest and the oldest age groups. However, more than half of the population lives in substandard conditions regardless of

age. The metropolitan region of Brasília (RIDE) is somewhat similar to the RMC, except for the youngest households (see graph on page 39). The number of households living in standard conditions peaks for the 45 to 54 age group, however, the proportion decreases for both the youngest and the oldest households.

The projected total demand for housing in Brazil is not simply a function of increasing demand resulting from population growth and the need to address the problem of overcrowded, shared households. High vacancy rates in Brazil as a whole and in each of the metropolitan regions included in this study also presents a challenge to policy makers. Construction need is a function of demand and vacancy rates. If vacancy rates in Brazil were lowered, construction need could be diminished. Another important factor is the substandard condition of some households, particularly in the Metropolitan Region of Recife. Construction need numbers could be reduced by addressing adequacy of housing units, including basic sanitation needs and overcrowding, without necessarily having to build a new unit. In addition, the way in which land tenure issues are addressed might modify the way in which construction need is estimated, including the manner in which the methodology for this project was developed.

Further research addressing these questions could provide policy makers with an even better picture of the need for affordable housing in Brazil. Improvements to Census questionnaires and data collection on housing condition, such as the reason why units are vacant and land tenure status, for instance, would greatly contribute to research efforts and aid in the development of new methodologies. As existing methodologies are adapted to developing countries or as new methodologies are created to address the peculiarities of each system, better input can be given to governments, policy makers, housing authorities and citizens interested in improving housing and making more housing available to everyone.

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TECHNICAL APPENDIX

HOUSING DEMAND – AN AFFORDABLE HOUSING NEEDS ASSESSMENT MODEL FOR BRAZIL

A. POPULATION AND POPULATION BY AGE PROJECTIONS – THE BASIC BUILDING BLOCK

While the variables of greatest interest in the Affordable Housing Needs Assessment (AHNA) are the household estimates, those estimates are an outgrowth of a more fundamental and dynamic building block – population by age. Since the Assessment methodology assumes a constant household formation rate by age over the projection horizon the dynamic component of the household estimation process is population.

The data limitations for the Brazilian AHNA are similar to those of the Florida AHNA: population by age projections for the three metropolitan areas of interest – Brasilia, Recife and Curitiba – are not available so they must be created. The population projections for all jurisdictions in the states of Pernambuco, Paraná, Goiás and the Federal District are based on extrapolation of trends since 1990 and controlled to the state projections made available by IPEA and CEDEPLAR.[19] The 2003 population estimate for each jurisdiction is used as the launch year population and projections are made for the years 2005-2020 in five-year intervals. To estimate and project housing demand, the next step is to divide the population into households. Finally, these households are allocated across tenure classes, age, size, income groups and cost burden.

The methodology assumes that household formation rates and the distribution of household characteristics remain constant in their 2000 proportions across the projection horizon. However, changes in the age distribution of the population would be expected to lead to shifts in average household size as different age groups have different propensities to form households. Therefore, the number of households is estimated using age-specific headship rates to reflect the projected changing age structure.

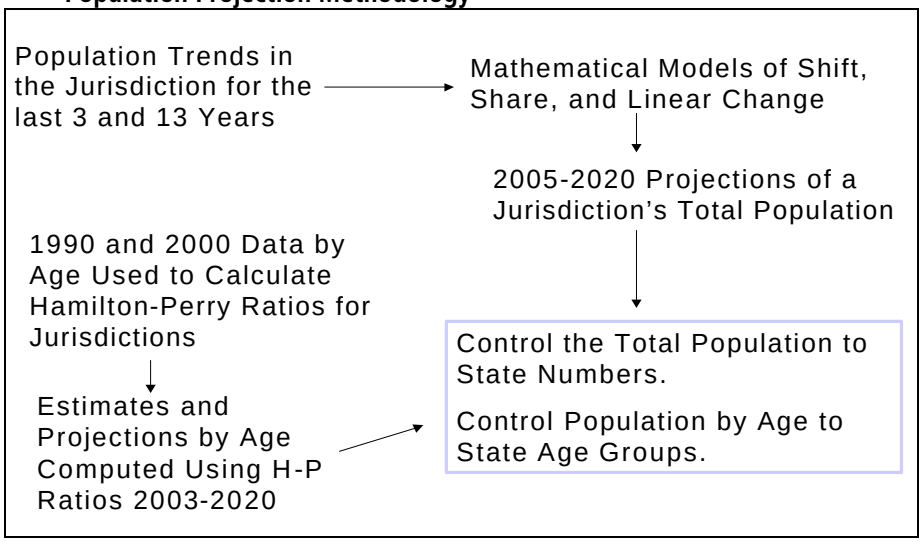
A.1 POPULATION PROJECTIONS

A.1.1 General Overview

Following the University of Florida's Bureau of Economic and Business Research (BEBR) approach to small area population forecasts, six methods are used to project the population of jurisdictions in the state. The highest and lowest of the results of these six methods is dropped, and the remaining four are averaged. Finally, the results are adjusted to sum to the state projection. The population projections form the basis for the projection of population by age and ultimately the projection of households by age of householder.

19. The jurisdictions that comprise each metropolitan area are then summed to create a metropolitan projection.

FIGURE A.1
Population Projection Methodology



A.1.2 Assumptions

The methodology uses 2003 as the benchmark or launch year and develops projections for the years 2005-2020 in five-year increments. IPEA provided the launch year population for each jurisdiction and county as well as the 2005-2020 county projections. Population for the 1990 base year comes from the Ministry of Health and the 2000 base year from the Brazilian Census. State population projections prepared by CEDEPLAR control the population projections for each jurisdiction within a state.

Population projections are based on previous trends in a jurisdiction, and as such are not able to account for a particular community having limited land availability. Other local conditions not reflected in the estimates would be recent commencement of large development projects, or dramatic and recent changes in local institutional facilities with large populations such as prisons.

A.1.3 Description of Population Projections

The most important base data for preparing estimates and projections of housing demand is population data. Population is the basis of estimates and projections of households, and the difference between households and housing inventory, when adjusted for the need for vacancies to allow a smoothly functioning housing market, is equal to the basic construction need for housing units.

Population estimates and projections for small areas such as cities, as compared to the nation or a state, are difficult because of the influence of in- and out-migration of population, annexation, land availability, zoning, infrastructure availability, and other factors that have a large impact at the local level. In addition, in a smaller city the impact of growth is magnified under certain projection techniques. To overcome this problem, four techniques are used to project population. In addition, in the application of two of these techniques two different time periods are used. The highest and lowest estimates are dropped to eliminate extreme numbers, and the remaining four are averaged.

The four approaches to population projection consist of two ratio techniques, relating one area to a larger area, and two mathematical extrapolation techniques that project population based on historical trends. We use the following terminology to describe each technique in the methodology:

1. Base year – the year of the earliest observed population used to make a projection;
2. Launch year – the year of the latest observed population used to make a projection;
3. Target year – the year for which population is projected;
4. Base period – the interval between the base year and the launch year; and
5. Projection horizon – the interval between the launch year and the target year.

Data requirements include jurisdiction and total state population for base and launch years (1990, 2000 and 2003) using census data or other appropriate estimates. For target years (2005 etc.) CEDEPLAR projections are used.

The four basic projection techniques used in the methodology include the linear, exponential, share and shift methods. The linear and exponential techniques use the mathematical extrapolation approach; they take the jurisdiction's population from the base period and extrapolate it into the future. The shift and share methods use the ratio approach; they express the data as ratios or shares of the larger, parent population, for which a projection already exists. Therefore, these techniques require a county or parent population projection. The linear and share techniques use both 3 and 13-year base periods, resulting in a total of six projections. The base periods change over time as the launch year moves forward in time; the current base periods reflect the 1990 and 2000 base years and the 2003 launch year. A more detailed account of each technique is provided below.

There is one final twist to the projection methodology. It is only the resident population of the jurisdiction that we want to project, so institutional populations such as prison inmates, military personnel or college students are removed from total populations prior to the calculations. The institutional population is derived from the Brazilian census.

A.1.4 Linear (Amount of Change)

The population change between the two base years and the launch year is divided by the difference in the two periods to compute an average annual population increase (or decrease). This annual increase is multiplied by the number of years in the projection horizon to generate the total population growth for the area. This growth is added to the area's launch year population to establish its population.

A.1.5 Exponential (Percent of Change)

The template breaks this equation into two parts: a) computation of an average growth rate (using natural logarithms), and b) extrapolation of this rate to produce projected population. The former calculates the average rate of change in population between the oldest base year and the launch year. This rate is applied to the launch year population to project the population in the target year. The technique divides

the area's launch year population by that for the base year to compute the percent change. This is multiplied by the projection period adjustment: (target year – launch year)/(launch year – base year).

A.1.6 Share

This method computes the area's share of the county's population growth between launch year and the two base years, and then allocates to it an equal share of the county's projected population growth over the projection period.

A.1.7 Shift

The shift method combines elements of the linear and share methods, making a linear extrapolation of the change in each area's share of the county population between the oldest base year (1990) and launch year.

A.1.8 Average

The accuracy of the four previously discussed techniques will vary according to the time period of the projection and the size of the area. No single technique is the most accurate, and certain techniques may yield rather explosive projections. To avoid producing the largest possible error we subtract the lowest and highest of the six projections and take the average of the remaining four.

A.1.9 Adjusted Average

The population projections for the individual jurisdictions in the state must sum to the total state projection. This step adjusts the projections to the state total.

The shift and share methods use apportionment techniques that generate county totals consistent with the overall state projections. However, the linear and exponential techniques ignore the state population projection, relying instead on extrapolation of the historic area trends. Since the Average includes the results of all four techniques, it is unlikely that it will produce county totals identical to the CEDEPLAR state projection. The Controlled Average computes the ratio of the CEDEPLAR projected state population to the Average state total and then applies the ratio to each jurisdiction Average projection. The sum of the jurisdictions' Controlled projections equals the state projection.

A.1.10 Population Projection Formulas

The four projection techniques are patterned after the University of Florida Bureau of Economic and Business Research's (BEBR) county population projections. The trends established during a particular base period (e.g. 1990-2003) are measured and continued through a growth period or projection horizon (e.g. 2005-2010) to establish the population projection. Though the techniques are simple, more sophisticated projection methodologies do not necessarily produce more accurate results.

A.1.11 Attributes of each of the four techniques are as follows

Technique Attributes

Mathematical Extrapolation	
Linear	Bottom-up Approach
Exponential	Extrapolation of Small-Area Population
Ratio	
Shift	Top-down Approach
Share	Ratio of Parent Population Projection

Formulas for each of the techniques are as follows:

A.1.12 Linear (Amount of Change)

Linear projection = (((launch year pop – base year pop)/(launch year – base year) * (target year – launch year)) + launch year pop

Using two different base years creates two linear projections. The population change between each base year and the launch year is divided by the difference in the two periods to compute an average annual population increase (or decrease). This annual increase is multiplied by the number of years in the projection horizon to generate the total population growth for the area. This growth is added to the area's launch year population to establish its population.

Exponential (Percent of Change)

Exponential = launch year pop *EXP(LN(percent pop change))
where: LN(percent pop change) = LN(launch year pop/base year pop) * ((target year – launch year) / (launch year – base year))

The template breaks this equation into two parts: a) computation of an average growth rate (using natural logarithms), and b) extrapolation of this rate to produce projected population. The former calculates the average rate of change in population between the oldest base year and the launch year. This rate is applied to the launch year population to project the population in the target year. The technique divides the area's launch year population by that for the base year to compute the percent change. This is multiplied by the projection period adjustment: (target year – launch year)/(launch year-base year).

A.1.13 Share

Share = ((area's launch year pop – area's base year pop)/(state launch pop – state base year pop) * (state target year pop – state launch year pop)) + area's launch year pop

Again, two different base years creates two share projections. This method computes the area's share of the county's population growth between launch year and

the two base years, and then allocates to it an equal share of the county's projected population growth over the projection period.

A.1.14 Shift

Shift = state's target year pop * ((launch year area pop/launch year county pop) + ((target year – launch year)/launch year – base year) * ((area's launch year pop/state's launch year pop) – (area's base year pop/state's base year pop)))

The shift method combines elements of the linear and share methods, making a linear extrapolation of the change in each area's share of the state population between the oldest base year (1990) and launch year.

A.1.15 Average

Average = (linear proj.1 + linear proj.2 + exponential projection + share proj.1 + share proj.2 + shift proj. – highest proj. – lowest proj.)/4

The accuracy of the four previously discussed techniques will vary according to the time period of the projection and the size of the area. No single technique is the most accurate, and certain techniques may yield rather explosive projections. To avoid producing the largest possible error we sum the six projections minus the lowest and highest of the six and take the average of the remaining four.

A.1.16 Adjusted Average

Adjusted Average = area projection * (state projection/sum of area average projections)

The shift and share methods use apportionment techniques that generate state totals consistent with the overall state projection. However, the linear and exponential techniques ignore the state population projection, relying instead on extrapolation of the historic area trends. Since the Average includes the results of all four techniques, it is unlikely that it will produce county totals identical to the CEDEPLAR's state projection. The Adjusted Average computes the ratio of the projected state population to total area averages and then applies the ratio to each area average projection. The sum of the adjusted projections equals the county projection.

A.2 POPULATION BY AGE

A.2.1 Background

The age distribution of the population serves as the basis for projecting the number of households and other aspects of housing demand. This is a fundamental assumption and the estimates and projections of population by age are a crucial component of the Assessment methodology. Several avenues are closed off to a method that must project an age distribution at the jurisdiction (or other small area) level. Cohort-component and econometric techniques require detail generally lacking at this geographic level. Small area techniques appropriate to total population

projection are not so for age projections. Similarly, extrapolating trends in age groups may not be appropriate for rapidly growing areas like Brazil. The Assessment's methodology produces sub-state estimates and projections with age detail, using data sources and techniques that are readily available, reliable, and relatively inexpensive.

Since Brazil conducts its population census every ten years, there is a substantial need for current information in the years between censuses. Population estimation techniques have been created to fill this need. Methods fall into three broad categories: 1) extrapolation of past trends, 2) allocation of current trends from other geographic areas, and 3) use of symptomatic data about the particular geographic area of interest.

Extrapolation methods utilize data previously collected about an area to calculate a trend over time and then carry that trend forward to the present. Estimates can be created easily using extrapolation methods since the calculations are often simple and census data is commonly available. Extrapolation techniques do not work well in places that are increasing or decreasing in population at an unpredictable rate. Also, extrapolation techniques are not applicable for geographic areas whose boundaries are defined by the user (such as a 2 mile radius around a bank) rather than by a typical political and analysis geography for which data are regularly collected (such as cities or counties).

Allocation methods produce population estimates by applying trends in one area to a second area. For example, if a reliable estimate exists for a state in 2003, then a 2003 estimate could be produced for a sub-region by applying the state's average annual growth rate since 2000 to the 2000 population of the sub-region. Ratios are often used to allocate population change from larger areas to smaller areas. For example, the absolute increase in population that occurred in the state since the last census can be divided among the constituent cities based on their share of the state's population at some prior point. Similar to extrapolation, allocation methods are fairly easy to calculate, but allocation is limited in that it requires data for two places, not just one. Also, allocation of trends is only reliable if there is continuity over time in the relationship between the two places. If the underlying ratios change over time, but there is no data available to detect that change, then an estimate produced by an allocation method will be unreliable.

Collection of symptomatic data about the place of interest is going to produce the most reliable estimates of population, but this approach has the highest costs. Data sources for small areas vary greatly in terms of availability, cost, and precision. Some researchers use data on vital statistics (births and deaths), housing units, water usage, special surveys, and property appraiser parcels. Any consistent series that reflects the underlying demographic change occurring in the area is useful in calculating a trend and updating the results from the last census.

Once an estimate is created for the total population, detail can be generated for different segments of the population and the current trends can be projected into the future. Since projections are based on historical data and trends in an area, projection methods fall into the extrapolation classification. For national estimates and projections, numerous data sources are available that generate quality results. Data availability and reliability are roughly proportionate to the size of place under investigation. There are far fewer options for calculating estimates and projections for counties than for the nation as a whole–and even fewer are available for sub-state areas. In general, the arduousness of a calculation and its potential error are increased

by adding levels of detail (total population vs. age, sex, and income detail), decreasing the size of the place (nation vs. city vs. census tract), and increasing the time since the last base point (estimate for 5 years since the last census vs. 20 year projection vs. 50 year projection). Estimating and projecting a population's composition is especially problematic for small geographic areas. That objective crosses all three areas of difficulty – detail, size, and horizon.

No single method has been the authoritative choice for detailed sub-state population estimates and projections. Cohort-component techniques (which fall into the extrapolation classification) have been the primary method used for national and state-level projections of the population by age. Cohort-component applies historical fertility, mortality, and migration patterns to a base population to produce a detailed depiction of the population at some subsequent point. Since fertility, mortality, and migration do not happen on a daily basis to all age segments of the population, accurate measurement of those demographic events in smaller populations is nearly impossible. Cohort-component has been used successfully for sub-national areas, such as states or metropolitan areas, but rarely for cities due to its data requirements. In the next section we examine the usefulness of a variation of the cohort-component method employed in the Assessment.

A.2.2 Hamilton-Perry Ratios

There are no population by age estimates or projections available at the local level. In fact there are no population projections for Brazilian cities generally, so development of these numbers was a critical first step in the methodology.[20] The population age projection used in the housing needs assessment is a technique in which survival rates (births and deaths) are combined with net migration rates into a single ratio for each age group. This survival/net migration ratio is then used to project the age group into the future. This methodology is, in turn, a simplified application of the cohort-component method of projection in which births, deaths, and migration (the components of population change) are projected separately for each age-sex group in the population (Hamilton and Perry, 1962; Smith and Shahidullah, 1995).

The choice of this approach for use in the Assessment is notable, in part, because of what can't reasonably be done at a small geographic level that meets the objectives of low cost and accessibility. The conventional cohort-component approach requires individual detail for births, deaths, and migration not available at the jurisdiction level; for econometric modeling the jurisdiction is generally too small a unit of measure; typical small area population projection techniques like shift and share are not appropriate for age projections; and extrapolating trends in age groups is not appropriate for rapidly growing areas with volatile migration patterns.

To calculate population by age, a net migration/survival ratio is determined for each age group. Two points in time are needed to construct the survival/net migration ratio – in our case the jurisdiction's population by age group for 1990 and 2000. The sources for this data are the respective census counts or other creditable sources. The third set of data needed for this methodology is the jurisdiction's population for each of the projection years.

20. Certainly a portion of the total error in the age estimate is contributed by the total population estimate itself.

Since we are interested in projecting our resident population we subtract out the institutional population to give us an adjusted population. It is the adjusted population that we will project.

The Hamilton-Perry ratio is the change in the population of a particular set of birth years between two dates (an age cohort). The ratio is designed to capture the change in the size of an age cohort over a ten-year period. For example, the population aged 10-14 in 2000 is divided by the population ten years earlier, that is, the population aged 0-4 in 1990. The ratio is then applied to the population aged 0-4 in 2000 to project the population aged 10-14 in 2010 and to the population aged 0-4 in 2010 to project population aged 10-14 in 2020. The population in a cohort changes as a result of both the survival of the population in the cohort at the beginning of the ten-year period and the in- or out-migration of population in the particular set of birth years. In most age groups, migration is the dominant factor affecting changes in the population of an age group. Further, many parts of Brazil have experienced large net in-migration.

Calculation of the migration/survival ratio reflects the past impact of migration on various age groups and uses that trend as a basis to project the population by age group, with the total adjusted to the previously calculated jurisdiction total. Finally, the projections are "tweaked" slightly by making an adjustment to the projections of the population age 0-9 and 65+. To accomplish this slight adjustment, the CEDEPLAR estimates and projections of age group totals for each state are employed.

A.2.3 Adjustment To The 0 - 4 And 5 - 9 Age Ranges

Two age groups require a modification to the general calculation, children aged 0-9 and persons aged 65 and older. To create the ratio for population aged 65+, divide that population in 2000 (65+) by the sum of populations age 55 to 65+ in 1990. The population less than ten years old is projected by calculating the ratio of children age 0-9 to the population age 15-44 in 2000 (0-9/15-44) and applying that ratio to the population age 15-44 ten years later. We still have to divide the population age 0-9 into the two population groups age 0-4 and 5-9. To do that we make an assumption that the share of children age 0-4 to those age 0-9 in the jurisdiction is the same as that of the state as a whole.

A.2.4 Finalize the population by age projections

The preceding calculations have given us a preliminary projection for the year 2010. But the total jurisdiction population projected using this methodology may be inconsistent with that of the population projection methodology in Part 1. So, to complete the projection for 2010, the population of each age group is adjusted to reflect the total jurisdiction population calculated previously. The controlled age projection for 2010 computes the ratio of the projected jurisdiction population (control total) to the sum of age group populations (the jurisdiction's total uncontrolled population) and applies that ratio to each age group population.

Age group projections for 2020 are calculated in the same fashion. The survival/net migration ratio is applied to the age group population in the year 2010 (using the final or controlled age projection figure, rather than the uncontrolled

figure) to produce a 2020 projection and that step is repeated again for the 2030 projection using 2020 as a base. The preliminary (or uncontrolled) age group projection is then adjusted using the ratio of the projected population (from the preceding methodology -- Part 1) to the sum of age group populations (total controlled population) to produce a final (or controlled) projection. We derive the projections for the launch year (2003), and the mid-decade points, 2005, etc., by using the compound growth rate between decades. The function is:

Pop of year 2000+n = pop2000 * e ^ (n/10 * ln(pop2000/pop2010))

(n = 2 or n = 5)

Pop of year 2015 = pop2010 * e ^ (5/10 * ln(pop2010/pop2020))

Pop of year 2025 = pop2020 * e ^ (5/10 * ln(pop2020/pop2030))

The Hamilton-Perry ratios seem less able to capture the volatility in young adult and elderly populations. The use of the CEDEPLAR state age projections provides a way to recapture that important shift. So, the last step in the population by age projection methodology is to control the sum of jurisdictions by age group to the CEDEPLAR state age group projection. This is an iterative mathematical procedure that produces a best fit between the jurisdiction's total population and the state age group total.

POPULATION PROJECTION TABLES

TABLE A.1

The following population projection tables were used in this project: population by age estimates and projections 1990-2020 for Brazil

	Brazil						
Age Groups	**1990**	**2000**	**2003**	**2005**	**2010**	**2015**	**2020**
0-4	16,499,637	17,385,827	17,376,862	17,370,889	16,849,526	16,476,951	16,335,886
5-9	17,116,572	16,444,381	16,803,322	17,046,962	17,107,798	16,640,724	16,313,841
10-14	16,719,108	15,954,745	16,221,456	16,401,912	17,009,145	17,070,642	16,611,090
15-19	14,837,465	16,981,798	16,318,646	15,891,038	16,348,647	16,954,750	17,029,898
20-24	13,448,798	16,141,515	17,114,373	17,795,383	17,152,899	16,347,403	15,908,205
25-29	12,340,029	13,849,665	15,097,174	15,990,901	17,644,531	17,019,231	16,240,997
30-34	10,713,142	13,028,944	13,426,251	13,697,842	15,833,157	17,483,617	16,883,514
35-39	9,102,089	12,261,529	12,614,502	12,855,444	13,538,912	15,665,384	17,319,906
40-44	7,509,751	10,546,694	11,422,547	12,046,561	12,655,750	13,349,534	15,469,186
45-49	5,977,161	8,721,541	9,630,465	10,288,507	11,779,647	12,397,677	13,103,148
50-54	5,019,133	7,062,601	7,847,579	8,419,039	9,961,849	11,433,761	12,064,104
55-59	4,159,381	5,444,715	6,173,740	6,713,217	8,033,591	9,536,850	10,982,433
60-64	3,498,713	4,600,929	4,873,288	5,063,833	6,269,831	7,534,983	8,981,941
65+	6,814,729	9,935,100	10,598,703	11,067,480	12,386,048	14,539,634	17,393,112

Source: Author´s calculations

TABLE A.2

Population by age estimates and projections 1990-2020 for three metropolitan areas

Age Groups	1990	2000	2003	2005	2010	2015	2020
Brasilia (RIDE)							
0-4	234,483	311,107	330,800	342,027	361,302	376,468	390,662
5-9	239,833	275,165	293,621	310,338	347,439	367,925	382,609
10-14	233,324	252,443	266,076	279,796	313,342	341,704	361,293
15-19	218,126	285,961	283,380	282,289	311,884	346,225	381,912
20-24	217,710	319,402	344,710	360,121	355,765	370,228	389,623
25-29	196,057	281,138	317,699	345,165	391,915	388,632	399,722
30-34	158,894	250,261	270,268	286,273	352,306	393,331	385,413
35-39	132,435	212,789	232,735	249,465	285,975	347,962	391,514
40-44	104,033	167,307	191,424	210,318	245,409	278,672	340,347
45-49	78,195	133,978	151,702	163,887	203,865	237,579	270,536
50-54	60,864	101,490	118,155	129,147	156,901	196,263	227,609
55-59	43,260	71,525	86,254	96,589	123,096	150,142	186,044
60-64	31,438	56,572	63,111	66,688	89,734	114,180	138,588
65+	49,312	92,155	109,295	120,185	152,307	199,968	262,401
Curitiba (RMC)							
0-4	213,989	268,705	279,071	284,064	290,725	302,626	315,140
5-9	216,926	245,582	259,482	273,638	295,152	303,989	314,752
10-14	215,460	241,128	251,124	262,650	290,586	303,274	306,349
15-19	201,363	262,793	266,988	268,130	282,388	307,883	325,372
20-24	203,011	270,477	293,733	307,546	315,197	328,939	326,921
25-29	190,774	247,967	269,841	289,053	333,414	339,453	344,692
30-34	167,486	232,926	242,962	256,734	301,527	337,989	341,639
35-39	141,893	214,971	229,985	244,674	265,424	305,164	347,477
40-44	112,642	182,599	206,854	221,090	242,612	263,900	306,099
45-49	87,297	151,041	171,972	183,837	221,391	249,252	267,444
50-54	69,944	116,302	134,574	147,496	181,992	218,740	238,090
55-59	57,649	84,664	98,774	110,719	142,872	173,191	207,520
60-64	47,111	66,522	74,522	80,518	104,169	131,780	162,034
65+	80,448	133,435	150,471	156,214	183,242	225,868	281,830
Recife (RMR)							
0-4	307,687	297,342	286,831	278,656	270,090	267,566	263,100
5-9	324,775	298,280	295,094	289,560	271,015	265,050	263,504
10-14	330,465	296,733	297,312	299,436	295,050	280,133	275,055
15-19	318,736	338,821	322,330	312,742	313,757	307,541	289,759
20-24	292,400	335,780	356,545	367,503	352,713	334,495	327,468
25-29	256,698	299,955	328,643	345,902	378,277	373,517	353,253
30-34	217,160	272,304	286,384	289,331	329,560	365,091	356,716
35-39	181,045	251,704	264,222	270,350	291,494	339,903	377,040
40-44	150,115	212,477	235,004	246,207	261,963	281,367	324,466
45-49	116,188	172,671	189,339	201,801	239,580	260,010	283,476
50-54	98,798	140,959	150,344	162,771	196,817	230,632	248,465
55-59	76,510	102,999	114,624	129,786	152,415	180,193	216,815
60-64	67,464	87,769	90,895	96,534	119,804	140,121	171,753
65+	127,198	183,555	196,009	208,903	234,770	278,915	331,405

Source: Author´s calculations

B. HOUSEHOLDER BY AGE AND TENURE

B.1 A fundamental assumption: headship rates

Households are the basic unit of demand for housing. They are the way in which the population divides itself to occupy housing units. One member of a household is considered the representative of that household and is referred to as the householder. The percentage of the population in a given age group that are householders is the headship rate in that age group, or the propensity of persons in that age group to be

household heads. Therefore, headship rates allow the conversion of the population of an age group into households. Different age groups have different propensities for forming households, so that as the age structure of the population shifts, the number of households that a given population would yield would also change.

Estimates and projections of households are therefore based on age-specific householder (headship) rates. These headship rates are applied to the age-specific population projections described in the previous section.

The projection of householder by age, tenure, size, income, etc., builds on the age group projections. Three data sets are needed: the cross-tabulation of householder by tenure, age (at a minimum) and other household characteristics, population by age from the 2000 Census for each jurisdiction and the age group projections previously calculated. A headship rate is calculated from the 2000 census data by dividing the number of householders in each tenure/age group by the total population of that age group. The projection of householder by age/tenure is then calculated by applying that ratio (headship rate) to the age group projections of population for each projection period.

However, to meet the twin objectives of housing plan- and housing program-friendly formats in conjunction with more accurate household projections, the AHNA model requires complex cross-tabulations.

B.2 HOUSEHOLD PROJECTION METHODOLOGY

In order to produce a complex cross-tabulation of household characteristics such as – Tenure X Age X Size X Income X Cost Burden projections (for a projection horizon of 2005-2020) – the data requirements of the methodology are:

1. Population by age projections (2000-2020); and
2. 2000 Household Count of Tenure X Age X Size X Income X Cost Burden

B.2.1 Methodology

Step 1:

Calculate the household formation rate for year 2000 (or the most recent census).

$$\text{Household formation rate} = \frac{\text{Household Count of Tenure X Age X Size X Income X Cost Burden}}{\text{Population by age}}$$

For example, the household formation rate for the following household type:

owner/15-24years old/1person per household/Income of <1 minimum wage/cost burden less than 30% =

$$\frac{\text{\# of households: owner/15-24 years old/1pph/<1mw/<30\% cb (year 2000)}}{\text{\# of persons: 15-24 years old (year 2000)}}$$

Step 2:

The 2005 projection of the example household type is:

Household formation rate X population of persons 15-24 years of age in 2005

B. 2.2 Example

In the tables below is an example from the calculation of household formation rates for the Metropolitan Region of Curitiba. Table 1 shows the population by age for the year 2000. Table 2 shows the complex cross-tabulation of the four household characteristics: age of householder, tenure, family size and household income. The household formation rate is then calculated. For instance, a household whose head is between the ages of 15 and 24, who owns a standard housing unit, whose family comprises 1 or 2 persons, and who has an income of up to 1 Monthly Minimum Wage (m.m.w.) has a household formation rate of 0.000831. This household formation rate is arrived at by dividing the number of households with those characteristics (448) from Table 2 by the total population in the 15 to 24 age group (539,379) from Table 1. Examples of calculated household formation rates are found in Table 3.

TABLE A.3
Population by age, metropolitan region of Curitiba, 2000

Age groups						
15 – 24	**25 – 34**	**35 – 44**	**45 – 54**	**55 – 64**	**65 or older**	**Total**
539,379	480,893	397,610	267,875	151,328	132,781	1,969,866

Source: IBGE, Census microdata, 2000.
Author´s calculations.

TABLE A.4

Number of "Owner Standard" households by age of householder, family size and family income in monthly minimum wages, metropolitan region of Curitiba, 2000

Family size	Income in monthly minimum wages (m.m.w.)	Age groups					
		15 - 24	25 - 34	35 - 44	45 - 54	55 - 64	65 or older
1 or 2 persons	up to 1 m.m.w.	448	844	451	589	447	553
1 or 2 persons	1 - 1.99 m.m.w.	611	1,565	1,259	1,131	982	1,727
1 or 2 persons	2 - 2.99 m.m.w.	807	2,123	1,253	1,154	1,158	1,691
1 or 2 persons	3 - 5.99 m.m.w.	2,401	5,487	4,066	3,287	3,990	4,824
1 or 2 persons	6 - 11.99 m.m.w.	2,761	6,099	4,411	3,956	4,107	5,415
1 or 2 persons	more than 12 m.m.w.	3,475	8,976	7,242	6,248	6,060	10,129
3 persons	up to 1 m.m.w.	224	840	685	465	306	242
3 persons	1 - 1.99 m.m.w.	657	2,500	1,569	1,350	645	476
3 persons	2 - 2.99 m.m.w.	832	2,291	1,871	1,200	881	632
3 persons	3 - 5.99 m.m.w.	2,105	7,324	5,023	3,747	2,703	1,555
3 persons	6 - 11.99 m.m.w.	2,188	7,495	5,743	4,418	2,515	1,884
3 persons	more than 12 m.m.w.	2,392	8,007	7,154	5,713	3,824	3,104
4 persons	up to 1 m.m.w.	97	738	1,010	517	178	93
4 persons	1 - 1.99 m.m.w.	314	2,211	2,610	1,490	613	308
4 persons	2 - 2.99 m.m.w.	222	2,050	2,696	1,682	614	386
4 persons	3 - 5.99 m.m.w.	929	6,421	7,827	4,528	2,051	926
4 persons	6 - 11.99 m.m.w.	944	6,075	8,346	5,219	2,668	1,121
4 persons	more than 12 m.m.w.	801	5,932	10,000	7,359	2,742	2,039
5 or more persons	up to 1 m.m.w.	141	594	909	657	361	130
5 or more persons	1 - 1.99 m.m.w.	429	1,740	2,516	1,761	758	381
5 or more persons	2 - 2.99 m.m.w.	474	1,716	2,749	2,038	856	386
5 or more persons	3 - 5.99 m.m.w.	1,462	4,842	7,865	6,401	2,540	1,277
5 or more persons	6 - 11.99 m.m.w.	1,523	4,666	8,157	6,700	2,677	1,251
5 or more persons	more than 12 m.m.w.	984	4,775	8,252	7,831	3,338	1,772

Source: Author´s calculations.

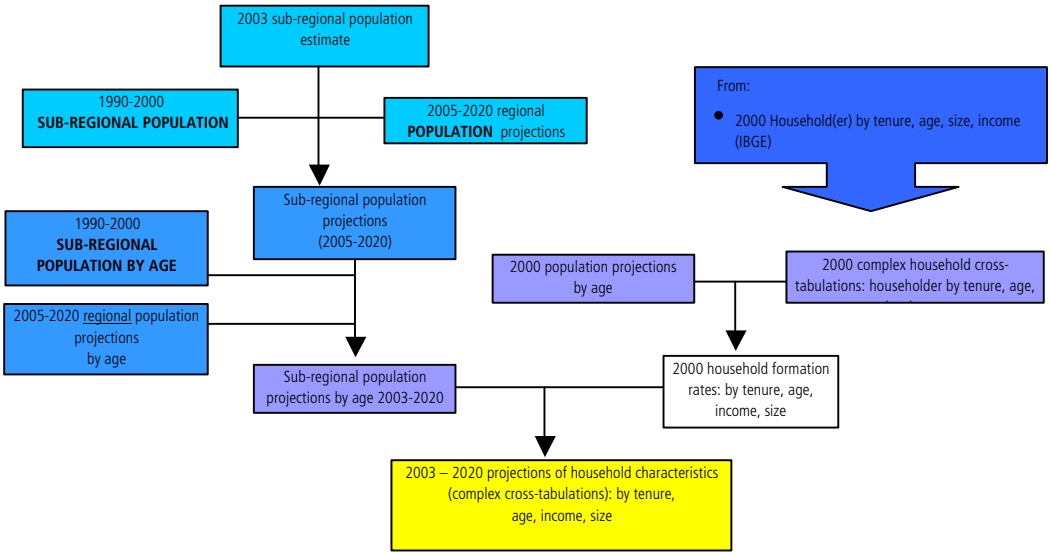
TABLE A.5

Household formation rates for "Owner Standard" households by age of householder, family size and family income in monthly minimum wages, metropolitan region of Curitiba, 2000

Family size	Income in monthly minimum wages (m.m.w.)	Age groups					
		15 - 24	25 - 34	35 - 44	45 - 54	55 - 64	65 or older
1 or 2 persons	up to 1 m.m.w.	0.000831	0.001756	0.001135	0.002200	0.002954	0.004165
1 or 2 persons	1-1.99 m.m.w.	0.001132	0.003253	0.003166	0.004223	0.006491	0.011415
1 or 2 persons	2-2.99 m.m.w.	0.001496	0.004414	0.003152	0.004308	0.007651	0.011173
1 or 2 persons	3-5.99 m.m.w.	0.004452	0.011410	0.010225	0.012272	0.026366	0.031880
1 or 2 persons	6-11.99 m.m.w.	0.005118	0.012683	0.011094	0.014770	0.027141	0.035782
1 or 2 persons	more than 12 m.m.w.	0.006443	0.018665	0.018213	0.023325	0.040047	0.066936
3 persons	up to 1 m.m.w.	0.000416	0.001747	0.001723	0.001736	0.002023	0.001597
3 persons	1-1.99 m.m.w.	0.001217	0.005199	0.003947	0.005040	0.004261	0.003148
3 persons	2-2.99 m.m.w.	0.001542	0.004763	0.004704	0.004481	0.005825	0.004176
3 persons	3-5.99 m.m.w.	0.003903	0.015231	0.012632	0.013989	0.017859	0.010273
3 persons	6-11.99 m.m.w.	0.004057	0.015585	0.014445	0.016494	0.016621	0.012448
3 persons	more than 12 m.m.w.	0.004435	0.016650	0.017992	0.021327	0.025268	0.020512
4 persons	up to 1 m.m.w.	0.000180	0.001534	0.002541	0.001931	0.001179	0.000615
4 persons	1-1.99 m.m.w.	0.000582	0.004598	0.006563	0.005561	0.004048	0.002032
4 persons	2-2.99 m.m.w.	0.000412	0.004263	0.006780	0.006280	0.004058	0.002548
4 persons	3-5.99 m.m.w.	0.001723	0.013353	0.019684	0.016902	0.013552	0.006120
4 persons	6-11.99 m.m.w.	0.001751	0.012632	0.020990	0.019482	0.017630	0.007407
4 persons	more than 12 m.m.w.	0.001486	0.012336	0.025150	0.027473	0.018118	0.013475
5 or more persons	up to 1 m.m.w.	0.000261	0.001235	0.002286	0.002454	0.002386	0.000862
5 or more persons	1-1.99 m.m.w.	0.000796	0.003618	0.006328	0.006574	0.005010	0.002517
5 or more persons	2-2.99 m.m.w.	0.000879	0.003567	0.006914	0.007609	0.005657	0.002550
5 or more persons	3-5.99 m.m.w.	0.002710	0.010069	0.019781	0.023896	0.016786	0.008440
5 or more persons	6-11.99 m.m.w.	0.002824	0.009704	0.020514	0.025012	0.017693	0.008269
5 or more persons	more than 12 m.m.w.	0.001825	0.009929	0.020754	0.029233	0.022060	0.011707

Source: Author´s calculations.

FIGURE A.2
Simplified brazilian needs assessment model



Source: IBGE, Census microdata, 2003.
Author's calculations.

B.3 PRELIMINARY LIST OF DATA SOURCES:

Population and household characteristics

- 1990 state level, population by age estimates: DATASUS
- 1991 jurisdiction level, population by age estimates: IBGE
- 2000 jurisdiction level, population by age estimates: IBGE
- 2003 jurisdiction level, population by age estimates: IPEA
- 2005-2020 state level, population by age projections: CEDEPLAR
- 2000 complex cross-tabulations of household characteristics: IBGE
- 2001 complex cross-tabulations of household characteristics: PNAD

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