Is there a demographic dividend in the Brazilian housing market?[1]

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INTRODUCTION

This paper deals with a standard applied demography exercise, associated with housing demand projection in Brazil between 2003 and 2020 in addition to some previous projection that goes back until 1992. Housing demand is projected using the sex and age specific headship rate method, combined with population projection by sex and age. After projecting the housing demand following a demographic methodology, a decomposition exercise is performed in order to explain future trends, including issues associated with the demographic dividend and gender relations in housing demand. The results obtained are mixed. There is indeed a small dividend in a decreasing housing demand for young adults, but this is more than compensated by the positive interaction between an aging population and positive headship rate age profile. The role of gender is a surprising result, with females accounting for most of the flow of new housing demand.

POPULATION AND HEADSHIP RATES PROJECTIONS

The housing demand projection is comprised by three stages. First, population by age and sex is projected. Second, the headship rate by age and sex is projected. Finally, an interaction between these two projections will provide an estimate of the demographic housing demand. In addition, this section will provide a methodology for a decomposition of housing demand in terms of total population, age structure, and headship rate effects.

- Population Projection: 2003-2020

Population by age and sex was projected under the main institutional project. The population was projected by national, state, and municipality levels, in this paper we will rely solely on the national projection combining it with previous population projections for the 1990s.

At the national level international migration was ignored, so the population projection assumed a closed population and the population projection was focused on the projection of the two main components: fertility and mortality.

Fertility projection is comprised by a combination of two steps: a level projection of total fertility rate and the projection of age specific fertility rates by accounting for its age structure. The basic scenario of fertility is displayed in Table 1, when the fertility decline trend is extrapolated to a replacement level between 2005 and 2010. TFR would be reaching 1.85 in the 2015-2020.

TABLE 1: BRAZIL - Past and Projected Fertility

YEAR	TFR	YEAR	PROJ. TFR
1970	5.79	2000-2OO5	2.28
1980	4.36	2005-2010	2.11
1991	2.89	2010-2015	1.97
2000	2.44	2015-2020	1.85

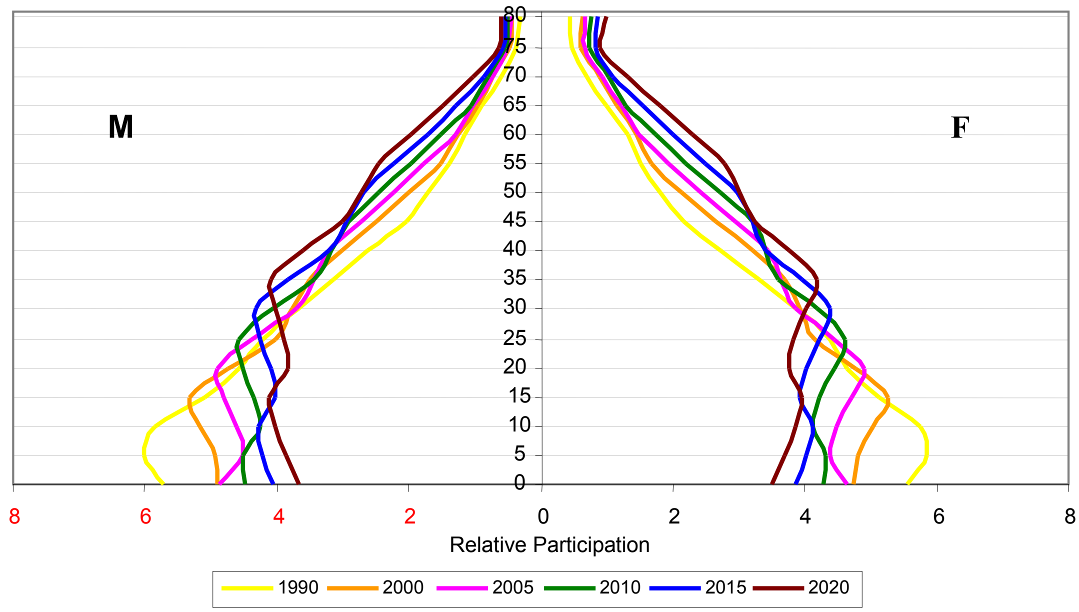
Source: Cedeplar , 2007.

Mortality projection was based on the adjustment of a survival function at exact age x in year 2000 and the determination of a future survival function as well as the time necessary to reach that point. The adjustment of the survival function in year 2000 was based on a combination of indirect estimations of child mortality and the use of Brazilian death registration. Table 2 displays the projected life expectancy that gave basis for the survival functions applied in the population projection. Population projection is displayed in Figure 1.

TABLE 2: BRAZIL - Projected Life Expectancy

YEAR	MALE	FEMALE
2000	66.11	73.43
2000-2005	67.07	74.23
2005-2010	68.90	75.75
2010-2015	70.63	77.20
2015-2020	72.28	78.59

FIGURE 1: Brazil - Population Projection by Age Pyramid



The population projection displayed in Figure 1 clearly presents the age structure effects determined by the observed and predicted steady decline in TFR and the predicted decline in mortality rates. There is a decline in the share of the younger age groups through time, followed by an increase in the share of the elder age groups. This finding gave the motivation for the research question regarding a possible demographic dividend in the housing market. A definitive answer regarding this point will be only possible after estimations of the headship rates by age and sex, when a decomposition exercise will be performed.

- Headship Rate Projection

The headship rate method for housing projection assumes that the number of housing units in a population is the same as number of heads of household, The number household heads can be controlled by several socio-demographic attributes. In this case we control by age and sex of the household heads.

Headship rate (${}_nT_x$ – EQUATION 1) is defined as the percentage of household heads by age group. It should be noted that the headship rate multiplied by the age bracket [${}_nN_x(t)$] gives the number of households by age group. Using this procedure it is possible to derive the stock of houses in each period and its dynamics. For each year it is derived:

(i) the total housing stock and the stock per age group; the total housing stock and the stock per age group; the total housing stock and the stock per age group;

(ii) the number of housing inflow and outflow that feeds the housing stock.

$$ {}_nT_x = \frac{{}_n n_x(t)}{{}_n N_x(t)} \qquad \text{EQUATION 1} $$

Where

${}_nT_x(t)$	Headship ratio in the age group from x to x+n years old in year t, age as of the last birthday
${}_nN_x(t)$	Population in the age group from x to x+n years old in year t, age as of the last birthday
${}_n n_x(t)$	Total household heads in the age group of x to x+n years old in year t, age as of the last birthday

The use of the headship method for housing projection is quite common in the literature. It has drawbacks to the extent that it does not account for the dynamics of household formation and dissolution over the life cycle, but the data requirement for this type of transitions is quite high. The payoff of these methodologies is unclear, while the standard headship methodology is simple and robust.

The crudest type of housing projection under the headship rate model is simply to assume that the headship rate is constant based on the last household survey estimation and to interact these rates with the population vectors by age and sex. We adopt an alternative strategy, namely, to project the headship rates by sex based on a age-period-cohort (APC) estimation procedure.

It is possible to calculate headship rates in a particular period or for a particular cohort depending of the interactions among the three dimensions: age, period and cohort. A model age-period (AP) calculates the headship rates specific for each period. An age-cohort model (AC) calculates the rates for each cohort. A complete age-period-cohort model (APC) allows the decomposition of each dimension's relative importance only if it is identified based on some empirical strategy.

Fitting an APC model to headship rates in a series of household surveys is an interesting strategy, since it is possible to forecast these rates based on the extrapolation of the fitted parameters (RIOS-NETO and OLIVEIRA, 1999). Given a number of cross-section household surveys, they can be assembled such as the age group intervals (for example, five years) equal the period intervals of the household surveys studied. In this case it is possible to follow complete age-period patterns for each survey and incomplete age-cohort paths for several cohorts among all household surveys employed in the analysis. A possible configuration of the APC model is the multiple cross-section surveys by age and period, that makes a matrix I x J, with equal spacing in age and period categories. K matrix diagonals correspond to the birth cohorts, so that K=I+J-1. These are topological components. Following Figure 2, the age (A) dimension is comprised by 12 categories, from 70 and plus to category 1 until 15-19 to category 12. The period (P) dimension is comprised by six categories, index 6 is 2003 and index 1 is 1978. There are 17 cohorts (C) in Figure 2, the youngest cohort is number 1 and the oldest is number 17.

FIGURE 2:

Period Age		1978 6	1983 5	1988 4	1993 3	1998 2	2003 1
15-19	12	C_6	C_5	C_4	C_3	C_2	C_1
20-24	11	C_7	C_6	C_5	C_4	C_3	C_2
25-29	10	C_8	C_7	C_6	C_5	C_4	C_3
30-34	9	C_9	C_8	C_7	C_6	C_5	C_4
35-39	8	C_{10}	C_9	C_8	C_7	C_6	C_5
40-44	7	C_{11}	C_{10}	C_9	C_8	C_7	C_6
45-49	6	C_{12}	C_{11}	C_{10}	C_9	C_8	C_7
50-54	5	C_{13}	C_{12}	C_{11}	C_{10}	C_9	C_8
55-59	4	C_{14}	C_{13}	C_{12}	C_{11}	C_{10}	C_9
60-64	3	C_{15}	C_{14}	C_{13}	C_{12}	C_{11}	C_{10}
65-69	2	C_{16}	C_{15}	C_{14}	C_{13}	C_{12}	C_{11}
70+	1	C_{17}	C_{16}	C_{15}	C_{14}	C_{13}	C_{12}

A generalized linear model is applied to estimate the APC model with count data following the general data matrix designed in Figure 2. A count model using Poisson distribution and the population structure by age as offset is estimated in a rate model. This procedure was developed by (RIOS-NETO e OLIVEIRA, 1999) and GIVISIEZ, RIOS-NETO e SAWYER, 2006).

Assuming that a headship rate (T_{s_0,i_0}) follows a Poisson distribution , with expected value μ and variance also μ. In the case of the three variables A, P, and C, the regression model is as follows:

$$T_{s_0,i_n} = \ln(\mu) = \alpha + \iota.A + \pi.P + \chi.C \qquad \textbf{(2)}$$

Considering

$T_{s_0,i_n}(\mu)$	The link function is a logarithm.
α, ι, π e χ	These are the estimated coefficients for the intercept, age, period, and cohort. .

$$\ln\left(\frac{\mu}{A}\right) = \alpha + \iota.I + \pi.P + \chi.C \qquad \textbf{(3)}$$

Considering:

μ	Expected number of household heads
A	Total Population

With the offset option the model is transformed into what is described in equation 4 as following:

$$\ln(\mu) = \alpha + \iota.I + \pi.P + \chi.C + \ln(A) \qquad \textbf{(4)}$$
$$\mu = \exp\{\alpha + \iota.I + \pi.P + \chi.C + \ln(A)\}$$
$$\mu = A.e^{\alpha} e^{\iota.I} e^{\pi.P} e^{\chi.C}$$

The restriction presented in equation 5 is essential for the model, and given that A,P, and C are part of an identity , there is an identification problem. There are several solutions for this problem. This model is identified assuming equality between the coefficients of the two oldest cohorts.

$$\sum_{I=1}^{I} \iota_I = \sum_{J=1}^{J} \pi_J = \sum_{K=1}^{K} \chi_K \qquad (5)$$

Once the model is fitted to the data, there is a projection of the estimated parameters, α, ι, π, and χ. A logistic function is adopted to fit the estimated parameters. The adjustment follows the formula presented in equation 6.

$$T_{s_0,i_n}(t) = \frac{k_1 + k_2}{1 + e^{a+bt}} \qquad \textbf{(6)}$$

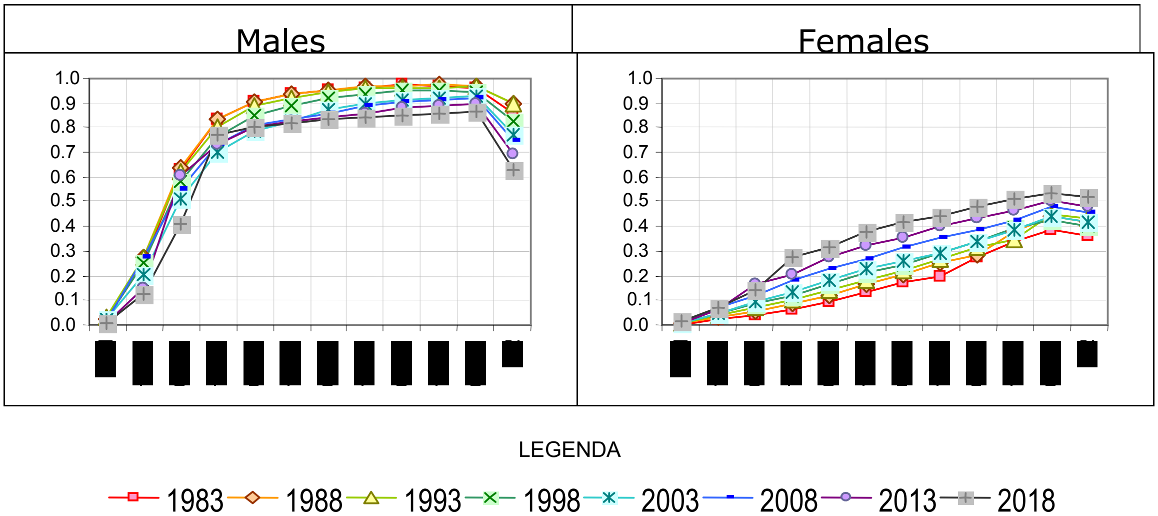
Considering

k_1 e k_2	Mininumand maximum values for the headship rate.
a e b	Estimated Parameters. .

The headship rates estimated and projected are presented in Figure 3. The pattern is clearly determined, there is a steady decline in the headship rates for males and an increase in the rates for females. The age pattern of the rates did not change much during the period, regardless the previously mentioned level shift negative for men and positive for women. The age pattern is also somewhat different for men and women. While the headship rates for men increase until age 35-39, reaching a plateau thereafter, the rates for women are increasing with age during all brackets. Another interesting point that may turn the Brazilian case different from the developed world is the low institutionalization level of the elderly population, which fact leads to a decline in headship rates only in the last age bracket (70 and more).

These findings contribute to qualify any simplistic view of the aging process during the Brazilian demographic transition and its implications to the housing demand. On one hand the rates are lower among the youth, on the other hand these rates across nearly all age groups. Another dimension not considered by the literature is the gender factor, the steady increase in female headship rate during the period is a factor to be considered, perhaps even more important than the age structure effect that had initially motivated this study.

FIGURE 3:
ESTIMATED AND PROJECTED HEADSHIP RATES BY SEX - BRAZIL



ESTIMATED DEMOGRAPHIC DEMAND FOR HOUSEHOLDS

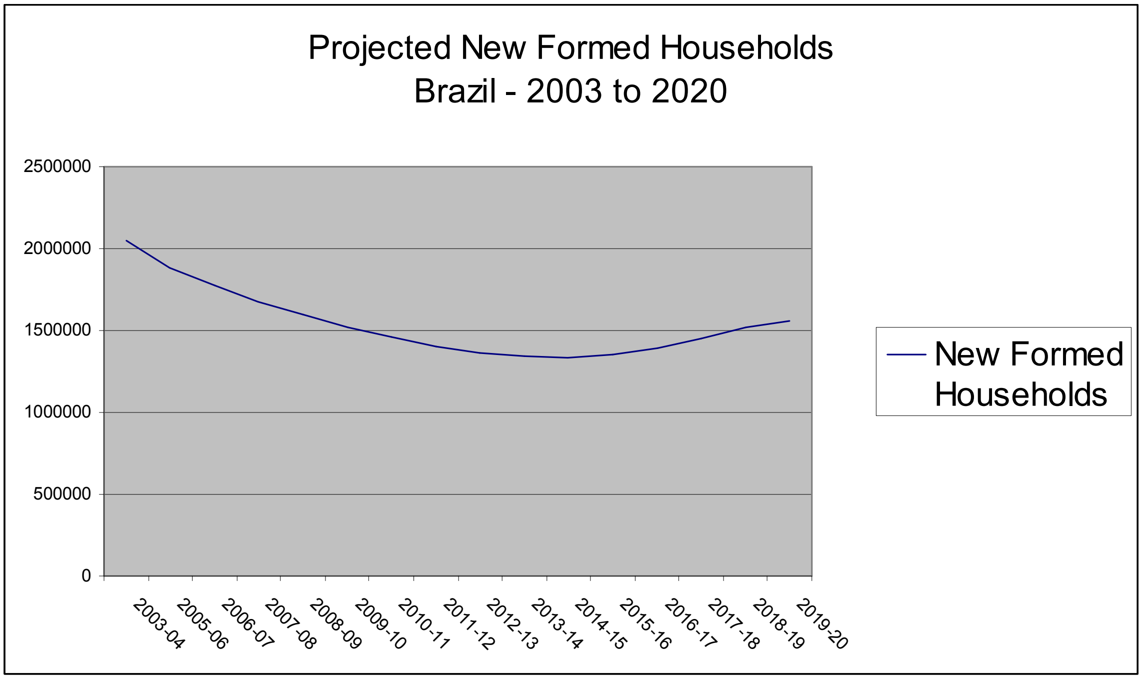
The combination between a population projection by age and sex and the projection of headship rates by age and sex lead to the production of household projections. Table 3 presents the projection of households during selected periods. The Brazilian fertility decline combined with changes in population's age structure did not stop the growing housing demand in Brazil.

TABLE 3:
Housing Demand - Projected Household Heads by Selected Periods - Brazil

Age Groups	1992	1997	2002	2007	2012	2017
15 - 19	258851	284058	307976	204461	173128	172221
20 - 24	2148232	2309624	2170646	3056454	1987492	1609763
25 - 29	4321717	4395043	4466535	5494507	6755818	5015980
30 - 34	5010792	5419157	5479444	6406552	7658596	8901500
35 - 39	4849033	5683728	5955636	6548255	7561379	9016389
40 - 44	4328755	5167782	5798863	6607298	7200124	8251785
45 - 49	3568761	4415701	5202562	6253784	7075020	7749645
50 - 54	3165883	3805290	4443596	5446299	6523914	7426266
55 - 59	2670240	3067653	3617449	4518040	5508340	6584576
60 - 64	2352912	2778740	3024589	3555115	4446336	5420721
65 - 69	1962392	2182773	2503892	2871365	3366056	4225820
70 or more	2775775	3317951	3813320	4413017	5031710	5818975
Total	37413343	42827501	46784509	55375148	63287913	70193642

If we stick to the population and headship projections in the twenty first century, as depicted in Figure 4, then we can observe that the early years of this century were marked by a very high entry of new households in the housing market. Nevertheless, it is projected a relative decline in the absolute number of new entrants from 2003 until approximately 2015. This is the finding that could lead one to speculate whether age structure would not be finally playing a role in the decline of new housing needs, something that could be interpreted as a demographic dividend or a window of opportunity in the housing market. In terms of housing private market this would not be seen as a dividend, the dividend argument could be only stressed if one considers that several households in Brazil are deprived of services and adequacy in terms of housing materials.

FIGURE 4:



It is important to notice that only these figures are not enough to shed light on the demographic dividend question. In order to answer that question we should perform a decomposition exercise. In any case, it is important to conclude that the role of women is increasing in the determination of the flow of new households entering in the housing market. Data in Table 4 clarifies this point, even discarding 1997-2002 due to the fact that it covers two different projections that are not fully compatible. It is safe to conclude that the female share in the flow of new formed households will in increase from less than forty percent in the nineties to nearly seventy percent around 2020.

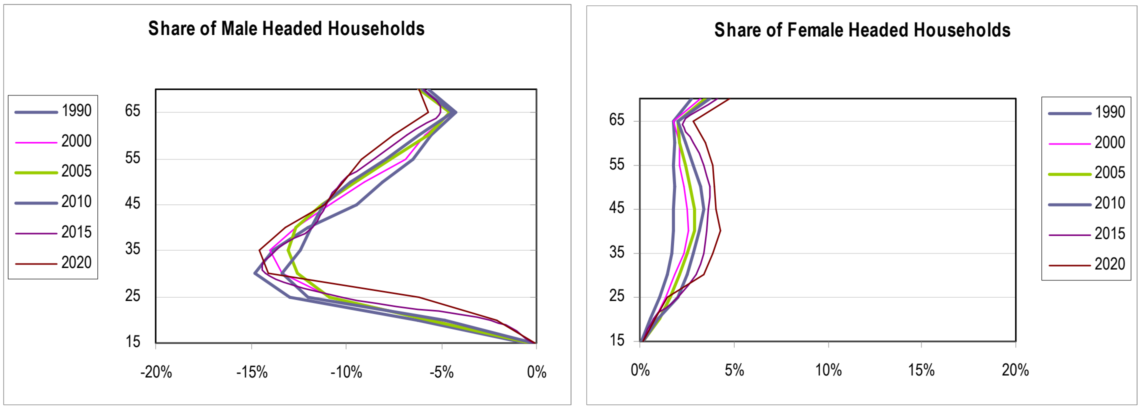
TABLE 4:

Gender Composition of Housing Demand Flow - Brazil

	1992-97	1997-02	2002-07	2007-12	2012-17
MALES	60.78	49.33	56.01	45.34	30.23
FEMALES	39.22	50.67	43.99	54.66	69.77
TOTAL	5414157	3957008	8590639	7912764	6905730

Figure 5 reinforces this gender aspect just mentioned, by depicting the age and sex composition of the household heads between 1990 and 2020. The horizontal axis in the pyramid follows the same scale in both sexes so that the growing participation of female headed households in Brazil could be evaluated.

FIGURE 5: POPULATION PYRAMID OF HOUSEHOLD HEADS



POPULATION, HEADSHIP RATE AND AGE STRUCUTRE EFFECTS

Headship rate was defined in equation 1, an interaction with population size by age and sex composition led to the projection of households previously discussed. The equations described below entail a decomposition of the impact of total population size, headship rate, and age structure in the time variation in the stock of households. The total housing stock in year t can be calculated by equation 7, so that the housing stock can be further decomposed according to the headship rates ($_{n}T_{x}^{t}$) and the age structure ($_{n}E_{x}^{t}$) of the population. In addition, equation 8 can be applied to calculate the total variation of the stock. The formulas below assume a decomposition for a ten year span, but this can also be applied to a five year span as in the case of this paper.

$$\boldsymbol{H}^{t} = \sum_{x=0}^{\omega} {}_{n}\boldsymbol{H}_{x}^{t} = \sum_{x=0}^{\omega} {}_{n}\boldsymbol{T}_{x}^{t} * {}_{n}\boldsymbol{N}_{x}^{t} = \boldsymbol{N}^{t} * \sum_{x=0}^{\omega} {}_{n}\boldsymbol{T}_{x}^{t} * {}_{n}\boldsymbol{E}_{x}^{t}$$ EQUATION 7

$$\Delta H = H^{t} - H^{t-10}$$

$$\Delta H = \sum_{x=0}^{\omega} ({}_{n}T_{x}^{t} * {}_{n}E_{x}^{t} * N^{t} - {}_{n}T_{x}^{t-10} * {}_{n}E_{x}^{t-10} * N^{t-10})$$ EQUATION 8

Where

$\boldsymbol{H}^{t-10}$	Total housing stock in year t-10
$\Delta \boldsymbol{H} = \boldsymbol{H}^{t} - \boldsymbol{H}^{t-10}$	Total variation in the housing stock between year t and year t-10
$\boldsymbol{H}^{t}$	Total housing stock in year t
${}_{n}\boldsymbol{H}_{x}^{t}$	Housing stock, with heads of household between x and x+n years old, age as of last birthday, in year t
${}_{n}\boldsymbol{T}_{x}^{t}$	Headship rate, with heads of household between x and x+n years old in year t, age as of last birthday
${}_{n}\boldsymbol{N}_{x}^{t}$	Population between x and x+n years old in year t, age as of last birthday
$\boldsymbol{N}^{t}$	Total population in year t
${}_{n}\boldsymbol{E}_{x}^{t}$	Percentage of individuals from the total population between x and x+n years old in year t, age as of last birthday

A decomposition of the variation in housing stock in several five year intervals is presented in Table 5. Even if we pay more attention to the last three five year periods, due to comparison problems due to the use of different projections, the results show a decline in the flow of new heads entering the house market. There is not much to say regarding the total population effect, an obviously important component. The headship rate effect is important in opposite directions in two adjacent periods 1997-2002 (negative) and 2002-2007 (positive). The age structure effect is more important in the last two five year intervals, exceeding the role played by the rate effect during this period.

TABLE 5

Decomposition of Housing Demand Flow
Standardization by Headship Rate and Age Structure in the initial Period.

	1992-97	1992-97	1997-02	1997-02	2002-07	2002-07	2007-12	2007-12	2012-17	2012-17
EFFECT	Numbers	% Change	Numbers	% Change	Numbers	% Change	Numbers	% Change	Numbers	% Change
Population	5261305	97.18	5161230	130.43	4297269	50.02	4247001	53.67	4398273	63.69
Rate	-506272	-9.35	-2296325	-58.03	2657668	30.94	1323221	16.72	209174	3.03
Age	659124	12.17	1092103	27.60	1635702	19.04	2342542	29.60	2298283	33.28
Total	5414157	100	3957008	100	8590639	100	7912764	100	6905730	100

The decomposition exercises presented in Tables 6, 7, and 8 clarify several points. The rate and age effects are further decomposed in three age groups representing the young adults, adults, and elderly. Tables 7 and 8 separate male and female by effects just mentioned. The gender analysis is important given the fact that the trends in headship rates go in opposite directions regarding gender.

Table 6 shows that rate effects are negative over the first two periods (covering the nineties), the result holds in terms of headship rates to all three age groups. In the last three periods the rate effects are positive and important to the adults (30-59) age group. The age structure effect shows the precise role of the demographic dividend in terms of a window of opportunity, this effect can only be accounted in terms of the young adults in the 2007-2012 and 2012-2017 periods. On the other hand, the age structure effect accounts for a positive flow in the housing demand both due to adults and the elderly. The positive age structure effect on adults covers the three periods after year 2000, this is probably due to the increasing headship rate age profile. The most striking age structure effect is the role of the elderly population in the flow of housing demand during the last period. This is definitively a market niche that should be taken care by business in the near future, in addition to population aging the Brazilian population is not acquainted to institutional housing to the elderly people.

When we break down the analysis by age and sex then the picture becomes much clearer. Nearly all negative rate effects are accounted for by the steady decline in male headship rates by age. On the contrary, a great deal of the growing flow of housing demand among females is due to an increase in headship rate, most importantly among adults. Finally, the negative age structure effect that could be considered a demographic dividend is observed among both sexes. In the case of an aging population, the positive age structure effect in the flow of housing demand is more powerful among adult males than females. The positive age structure effect in the flow of housing demand among the elderly is equally important for both sexes.

TABLE 6

TOTAL POPULATION - Brazil

Standardization by Headship Rate and Age Structure in Initial Period

Effect	1992-97	1997-02	2002-07	2007-12	2012-17
Population	5261305	5161230	4297269	4247001	4398273
RATE	-506272	-2296325	2657668	1323221	209174
Rate15-29	-154682	-787951	1066180	-34023	-1928842
Rate30-59	-103198	-1247956	1402656	1330684	2100486
Rate60+	-248391	-260419	188831	26560	37530
AGE STRUCTURE	659124	1092103	1635702	2342542	2298283
Age15-29	-531640	-97843	106155	-476460	-809290
Age30-59	751181	864965	1078749	1672293	1416306
Age60+	439583	324982	450798	1146709	1691267
Total	5414157	3957008	8590639	7912764	6905730

TABLE 7

MALES - Brazil

Standardization by Headship Rate and Age Structure in Initial Period

Effect	1992-97	1997-02	2002-07	2007-12	2012-17
Population	4208770	3988760	3211273	3060036	3047116
RATE	-1283071	-2729646	505525	-1031535	-2363653
Rate15-29	-390328	-946075	656602	-413094	-1890412
Rate30-59	-701226	-1516732	-34909	-337023	-66061
Rate60+	-191517	-266839	-116168	-281418	-407179
AGE STRUCTURE	365222	692722	1094982	1559320	1403958
Age15-29	-433125	-33767	146897	-314411	-562969
Age30-59	569624	583774	712855	1221762	1066812
Age60+	228722	142715	235230	651970	900115
Total	3290921	1951836	4811780	3587821	2087421

TABLE 8

FEMALES - Brazil

Standardization by Headship Rate and Age Structure in Initial Period

Effect	1992-97	1997-02	2002-07	2007-12	2012-17
Population	1019379	1134653	1052949	1167656	1349953
RATE	820770	486574	2175249	2309189	2484534
Rate15-29	218073	129708	377070	352893	-56329
Rate30-59	631607	319993	1472787	1637334	2084070
Rate60+	-28910	36873	325392	318961	456793
AGE STRUCTURE	283087	383945	550660	848099	983822
Age15-29	-73376	-27813	-2021	-131773	-228187
Age30-59	170147	255905	353977	494254	432831
Age60+	186316	155853	198705	485618	779178
Total	2123237	2005172	3778859	4324944	4818309

FINAL REMARKS

This paper applied a standard technique for the projection of households. Despite its widespread use, the paper innovates in the projection of headship rates by relying on the application of the APC model and its extrapolation through time.

Regarding the substantive question about the possibility of a demographic dividend in the Brazilian housing market the paper found mixed results. On one hand, there is a relatively important negative impact in housing demand due to a decline in the share of young adults on all adult population. On the other hand, there are many other age structure and rate effects that countervail the youth negative impact and can be related with the demographic transition process. In terms of age structure effects, there are the positive impacts of the growing share of adult (30-59) and elderly (60 or plus) populations on all adult population. In terms of headship rate effects, there is the role of increasing female headship rates through time. This is an incredibly new gender issue in housing demand, something that probably the market is unaware.

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