

## **Housing Tenure and Housing Demand in Colombia**

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### **1 INTRODUCTION**

Housing is an important sector in any economy and a thorough understanding of the determinants of housing demand is essential. In this paper this analysis is undertaken from two different perspectives: (1) the election of tenancy option (i.e. formal vs. informal; purchase vs. rental); (2) the determinants of housing demand. A key element in our analysis is the potential role played by public policy and legislation in the housing industry. Issues such as the regime governing the rental industry and the existence of public subsidies for construction and for acquisition are very relevant to bear in mind.

This paper is divided into 5 sections. After this introduction the second section presents a brief review of the literature related to housing demand. The third section shows the evolution of the housing sector in Colombia and makes a succinct inventory of the main issues regarding public policy with regard to housing, focusing on social housing. The fourth section presents econometric estimations related to housing tenure and housing demand in Colombia. Finally, the fifth section concludes and proposes policy recommendations.

### **2 LITERATURE REVIEW**

#### **Determinants of tenure choice and of housing demand in developing countries**

There is a vast literature regarding the determinants of housing tenure choice in developed countries. In general, these studies do not analyze the informal dimension of housing, as in these countries the choice regarding housing is to a great extent limited to buying or renting

formal dwellings. In developing countries there are, in addition to formal alternatives, different informal options with regard to housing. First, there is the option of purchasing property in an illegal housing project, one in which a promoter sells dwellings located in zones in which housing developments are not allowed. Second, there are owner-build houses in land that has been illegally taken over and in which development norms are not followed (Cocatto, 1996 and Dowall, 2006). In many instances these informal arrangements are explained by people being displaced from rural areas and by local government's inability to promote and control the supply of urban land (Dowall, 2006). An econometric analysis of the determinants of formal and informal housing in developing countries is a useful instrument for the design of policy interventions geared at promoting welfare through the formalization of the housing market.

Unsurprisingly, the main finding of the studies dealing with housing demand in developing countries is that households that demand informal housing are generally low-income households. In the case of Panama, Jacobs and Savedoff (1999) and McCann and Koizumi (2006) find that variables such as the age of the household head or the number of members in the household are important elements in explaining the decision to buy or rent a property, whereas the head of household level of education and the household's permanent level of income are determinants of whether a formal or an informal dwelling is chosen. A similar result has been identified in the case of Brazil, where the variables that proxy for household wealth determine whether a household is able or not to live in a formal dwelling (Morais and Cruz, 2007). In addition, these authors find that the probability of living in informal dwellings is higher in households that are Afro-descendant, in which the head of household is a female with children under 14 years of age.

Several empirical studies on the determinants of housing demand are based on the theoretical framework advanced by Rosen (1979), Gillingham and Hageman (1983), and Goodman (1988). In the case of the decision to purchase a house, these studies highlight the need to analyze the decision to buy or lease jointly with the decision on how much to spend, in case a purchase is the chosen option<sup>1</sup>. The joint estimation of these two decisions allows for the identification of the price-elasticity of the demand function.

For the case of developing countries, in particular for those in Latin America, we are aware of two papers based on Goodman's (1988) methodological proposal. The purpose of

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<sup>1</sup> This framework is based on the notion that if one only takes into account the amount of expenditure undertaken, without due consideration to the choice between housing alternatives, OLS estimates will be biased if, indeed, the two decisions are undertaken simultaneously.

the first step of the Cadena *et al.* (2010) study of the housing market in Guayaquil was to find the implicit prices for rentals and purchases. The results show that there is a significant relationship between rentals and location, quality of floors, number of rooms and access to Internet and cable TV. In the case of house prices, they are explained by the materials used in the roof, the quality of walls, whether or not there is a place to undertake commercial activities, and access to internet and cable TV. The aim of the second stage of the estimation was to identify the factors affecting the decision to rent or to purchase. Results are consistent with the factors identified in the price regressions. Demand for rentals is associated with younger households and with above-average levels of income, and the price elasticity of demand is negative and significant (-0.01). Cadena *et al.* (2010) show that the demand for own-housing is positively related to the household head being a male; the price elasticity of demand is negative and significant (-0.02) and the income elasticity of demand, without differentiating between permanent and transitory, is 0.013.

Fontenla and Gonzalez (2009) look at the case of housing purchases in Mexico. The main results include identifying a price elasticity of demand of -0.3, which is in the range previously identified in studies for developed countries. They also find that permanent income is an important determinant of housing purchases with an elasticity of 0.8. On the other hand, the elasticity to transitory income is only 0.04.

### **Studies on Colombia's housing market**

Colombia's housing sector has been the focus of several recent studies, which can be classified under three topics: housing finance, social housing and housing demand and supply. Most studies have focused on housing finance. Murcia (2007) analyzes the socio-economic determinants of access to mortgage and credit card financing, and reports that the probability of having a mortgage is higher for those living in urban areas, for those receiving a government subsidy and for those in the highest quintile of the income distribution. Cárdenas and Badel (2003) provide evidence that the 1990s financial crisis, which was particularly damaging for mortgage banks, was the result of a sharp rise in the LTV ratio, in turn the consequence of a simultaneous sharp decline in house prices and steep increase in the cost of servicing floating interest rate mortgages.

Rocha *et al.* (2006) and Cuéllar (2006) focus on social housing. The first paper analyzes barriers to accessing credit by poor households. The second one focuses on how regulatory aspects have affected the development of financing for low-income housing. Silva

(2007), on the other hand, assesses the impact of public policy aimed at enhancing credit supply for low-income housing.

There is only scant literature identifying the determinants of housing demand and supply. Two exceptions are Clavijo *et al.* (2005) and Arbeláez (2006). The first paper undertakes an econometric analysis of the short-term determinants of supply and demand using data for 1991-2004, taking into consideration the simultaneity between the two. It reports evidence that housing demand—measured as licensed area to be built—is elastic to the price of new houses, to the real rate of interest and to income. Along the same lines, Arbeláez (2006) estimates supply and demand for the 1997-2003 period and finds that the amount of credit, the real rate of interest, labor income and unemployment are all important determinants of housing demand.

The relationship between the housing industry, GDP growth and the business cycle has always been a matter of debate among economists. While some believe that the changes undergone by the mortgage industry over the last decades might have weakened the link between the housing sector and the business cycle, others suggest precisely the opposite. Dynan *et al.* (2006) argue that better access to financing facilitates consumption smoothing, thereby diminishing the effects of housing industry volatility over the rest of the economy. On the other hand, recent problems triggered by events in the sub-prime mortgage market in the U.S. have led others to believe that the linkages between the housing sector and the business cycle remain very strong. Most research in this regard highlights the fact that a house is deemed to be an important collateral, determining to a great extent a household's ability to borrow and to spend (Mullbauer and Murphy, 2008).

For the case of Colombia, Cárdenas and Badel (2003) estimate correlations and Granger causality tests between the business cycle, the cycle in the construction sector and mortgage financing. They report that correlations have increased through time. The causality tests lead them to argue that during 1977-2002 there was two-way causality between the cycle in the construction sector and the disbursement of mortgages. During that same period, the business cycle Granger-caused the cycle in the construction sector, although for a sub-period (1990 to 2002) the causality worked the other way around. They also report evidence in the sense that the cycle of mortgage disbursements Granger-cause the business cycle. They also illustrate the fact that between December 1997 and June 2002 some 150.000 jobs were lost in the construction sector, increasing the urban unemployment rate by 2 percentage points. This evidence seems to suggest that in Colombia there is a close association between events in the housing sector and overall economic activity.

### **3 THE HOUSING SECTOR IN COLOMBIA**

This section is divided into two parts. In the first we aim to characterize Colombia's housing market. With that purpose in mind, we describe the evolution of construction activity, real estate prices and social housing finance. In the second part we focus on regulatory issues with emphasis on the norms governing the rental market and on public policy aimed at promoting the demand for housing, particularly among the poor.

#### **3.1 Characterization of Colombia's housing market**

Housing activity, particularly social housing, has gone through a slump in the last two decades. This helps explain the qualitative and quantitative housing deficit still characterizing the Colombian economy. The quantitative deficit is in the order of 1.3 million units, placing Colombia's house ownership indicators generally below those of other countries. This deficit is related both to supply considerations associated with the high cost of land and to demand elements, including the lack of credit, which might be a particularly prevalent problem in the case of social housing.

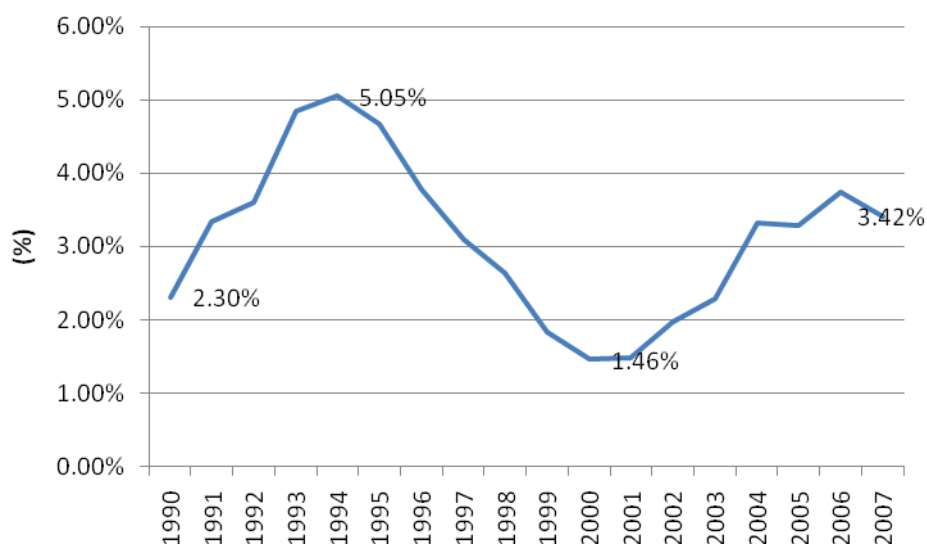
#### **Housing sector performance**

Most indicators regarding construction activity show a sharp deterioration beginning in 1995. After bottoming out in 2000, construction activity has recovered, but by 2008 it had not yet reached the levels observed in the early 1990s. As a percentage of GDP, housing and other construction<sup>2</sup> went from a maximum of 5% in 1994 to 3.42% in 2007, after bottoming out at 2% in 2000 (Graph 1).

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<sup>2</sup> Includes housing construction and other types of buildings (i.e. malls and commercial facilities) and excludes public infrastructure.

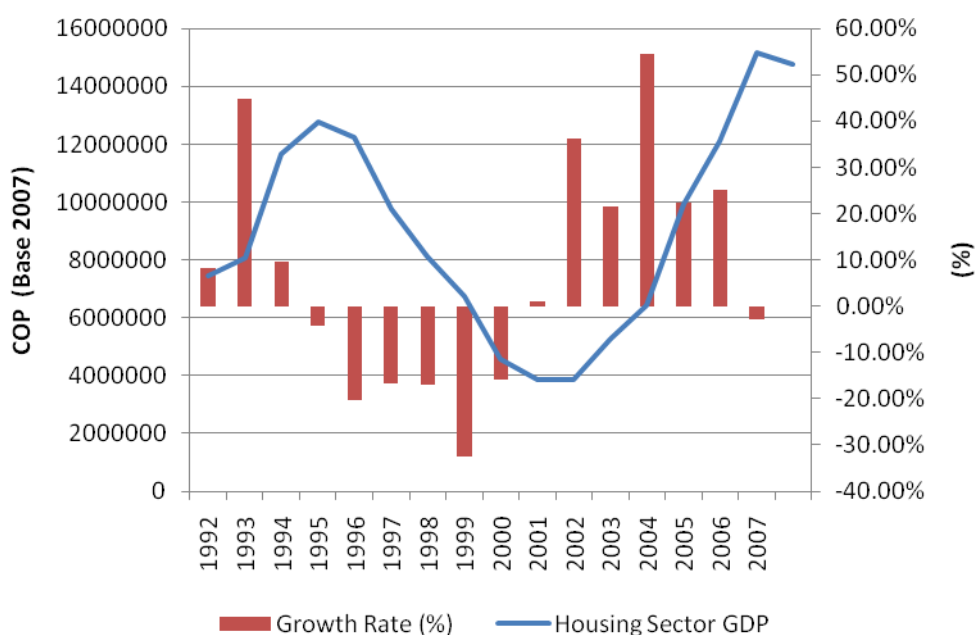
**Graph 1. Housing Sector Share in GDP (1990-2007)**



Source: DANE

Graph 2 shows that in 1994 value added in construction, which includes housing and other construction, reached COP\$ 12 billion (at 2007 prices). It fell to COP\$ 3.8 billion in 2000, and has somewhat recovered, reaching COP\$ 15 billion in 2006. In terms of annual rates of growth, sectoral GDP peaked at 44% in 1993; it became negative in 1995 (-4.5%) and reached -32.2% in 1999. Growth became once again positive in 2000, and reached its highest point of 25% in 2007.

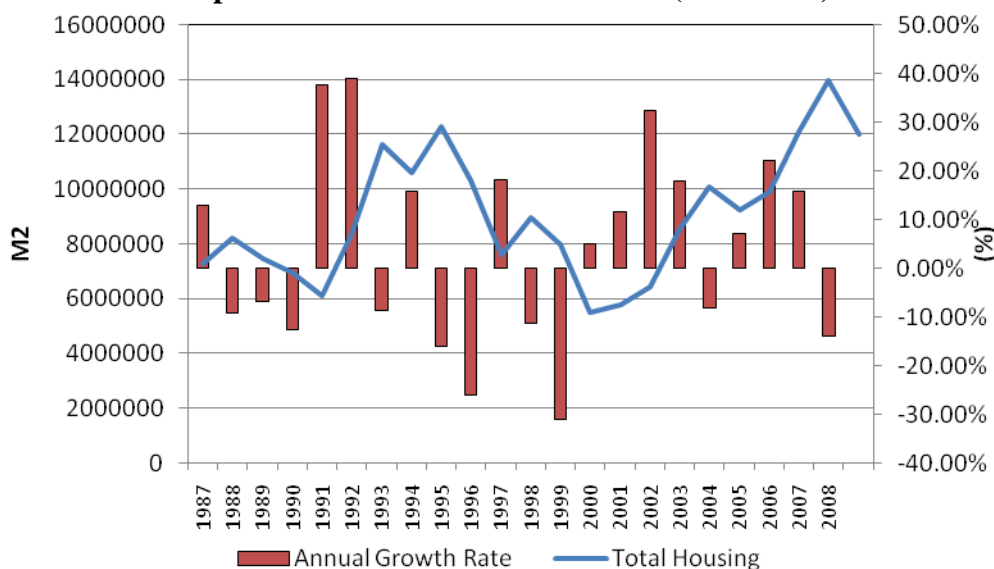
**Graph 2: Housing Sector GDP**



Construction licenses are another relevant indicator of (intended) activity in the construction sector. With regard to total housing, licenses peaked at 12.3 million square meters in 1994.

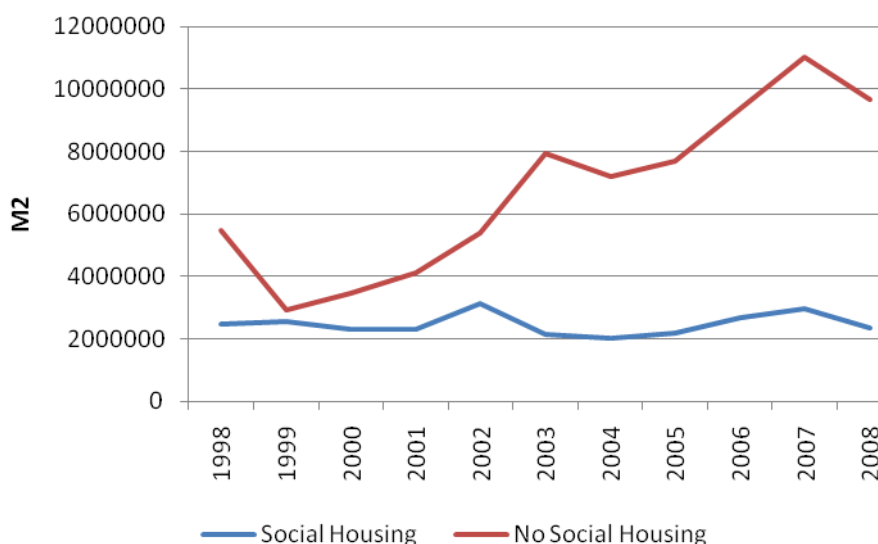
They declined to 5.5 million in 1999 and then recovered, reaching 13.9 million in 2007, even higher than in 1994 (Graph 3). With regard to social housing (VIS for its Spanish acronym), licenses reached a maximum of 3.1 million square meters in 2002. It then declined to 2 million in 2004, and recovered to 2.9 million in 2007 (Graph 4).

**Graph 3: New Construction Licenses (1987-2008)**



Source: DANE

**Graph 4: New buildings licenses by social and non-social housing (1998-2008)**



Source: DANE

### Housing deficit

The relationship between standards of living and dwelling conditions is examined via the quantitative and qualitative deficits. The former shows how many units are needed to achieve a balance between the number of dwellings and the number of housing units. The latter is defined as the proportion of primary housing units with three addressable deficiencies: over-crowdedness<sup>3</sup>, inadequate public utilities, and construction deficiencies.

Table 1 shows that in 2005 the quantitative deficit was 12.4%, meaning that in that year 1.3 million additional units were needed in order for every Colombian household to be sole user of a house. This percentage, although high, has declined by a third since 1993. Likewise, the qualitative deficit has declined, from 37% in 1993 to 24% in 2005. Evidently, the housing deficit in Colombia has more to do with the quality of housing than with household's not owning a dwelling. Many households live in their own houses, but in conditions of over-crowdedness.

**Table 1 : Housing Deficit**

	1993		2005	
	# of households	%	# of households	%
Total Households	7,159,825.00	100%	10,570,899.00	100%
Total Housing Deficit	3,841,300.00	53.7%	3,828,055.41	36.2%
Quantitative Deficit	1,217,056.00	17.0%	1,307,757.24	12.4%
Qualitative Deficit	2,624,244.00	36.7%	2,520,298.16	23.8%

Source: DANE Census

With regard to the percentage of the urban population living in informal settlements in Latin America, in 2005 Chile, Costa Rica, Paraguay and Colombia were the countries that fared better, with Bolivia, Honduras and Brazil in the other extreme (Table 2). According to the 2005 Census, around 80% of dwellings have basic services (electricity, water, sewerage). On the contrary, access to other services that have substitutes (i.e. mobile versus fixed telephone lines) is generally lower (Table 3).

<sup>3</sup> Over-crowdedness is defined as five persons living in one room.



**Table 2: Population in slums (% of urban population)**

Country	1990	2001	2005
Argentina	30	33	26.2
Bolivia	70	61	50.4
Brazil	45	37	28.9
Chile	4	9	9
Colombia	26	22	17.9
Costa Rica	12	13	10.9
Ecuador	28	26	21.5
Honduras	24	18	34.9
Panama	31	31	23
Paraguay	37	25	17.6
Venezuela	41	41	32

Source:UN-HABITAD

**Table 3: Access to Public Services**

	Access	No Access
Electricity	93.61%	6.39%
Sewer system	73.06%	26.94%
Water	83.41%	16.59%
Natural Gas	40.32%	59.51%
Telephone	53.40%	46.05%

Source: DANE, Censo 2005

**Housing tenure**

In 2007 only half of Colombian households owned their house, a lower percentage than in several countries with a lower per capita GDP (Table 4).

**Table 4: House ownership and per capita GDP (2007)**

Country	Owners/Households 2007 (%)	GDP per capita (PPP) per capita GDP (USD)
Bolivia	66.4	4,091
Brazil	73.8	9,854
Colombia	50.3	7,983
Costa Rica	71.7	10,451
Honduras	72.0	4,109
Panama	79.1	10,372
Paraguay	79.7	4,518
Uruguay	65.9	11,529
Venezuela	81.4	12,201
United States*	68.0	46,674
United Kingdom*	70.0	35,512
Spain*	83.0	30,186

\* Clavijo *et al* (2005) and ECLAC.

Interestingly, in Europe in 2003 home-ownership was much higher in peripheral countries than in wealthier France, Sweden and the Netherlands (Table 5).

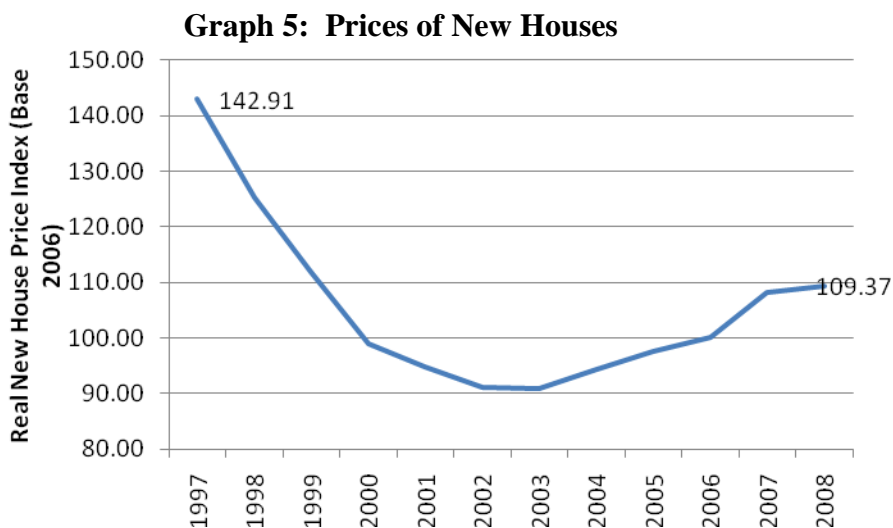
**Table 5: Homeownership rate of selected countries (%), 2003**

Spain	85.3
Greece	83.6
Italy	75.5
Belgium	72.9
Luxembourg	70.8
UK	70.6
US	67.5
Portugal	65
Denmark	65
France	62.7
Sweden	59.9
Netherlands	54.4

Sources: Eurostat and US Census Bureau

**Evolution of land prices, housing prices and housing rent**

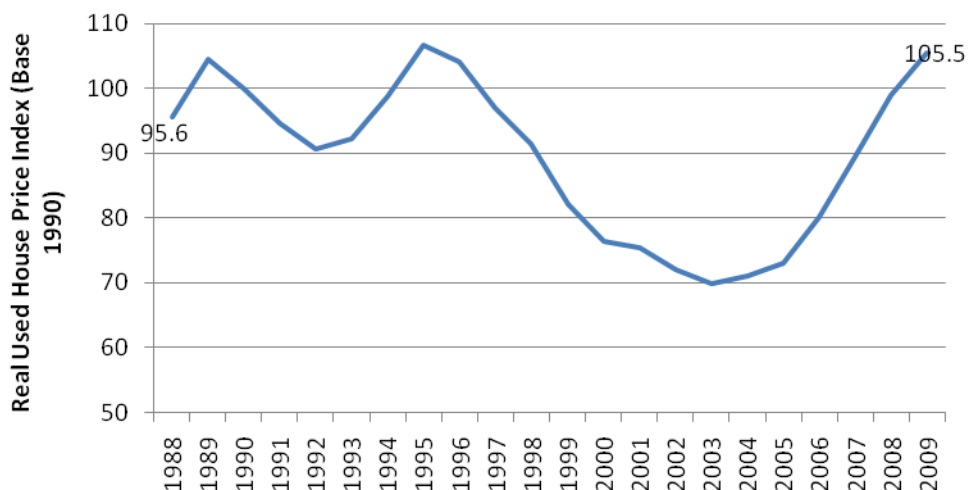
We now describe several stylized facts regarding supply and demand elements that play a role in explaining the housing deficit. Graph 5 shows the real price index for new houses. Prices reached a maximum in 1997; they declined 63% between 1997 and 2003, and have increased 87% since. In 2008 prices were back to their 1999 level, but still 76% lower than in 1997.



Source: DANE

Using the repeated sales methodology, the central bank constructs a price index for used houses. Data comes from assessments by financial institutions at the time of a loan approval. This index reached a maximum in 1995; it consistently declined until 2003 and has persistently recovered since. In 2009 it once again reached the level it had in 1995 (Graph 6).

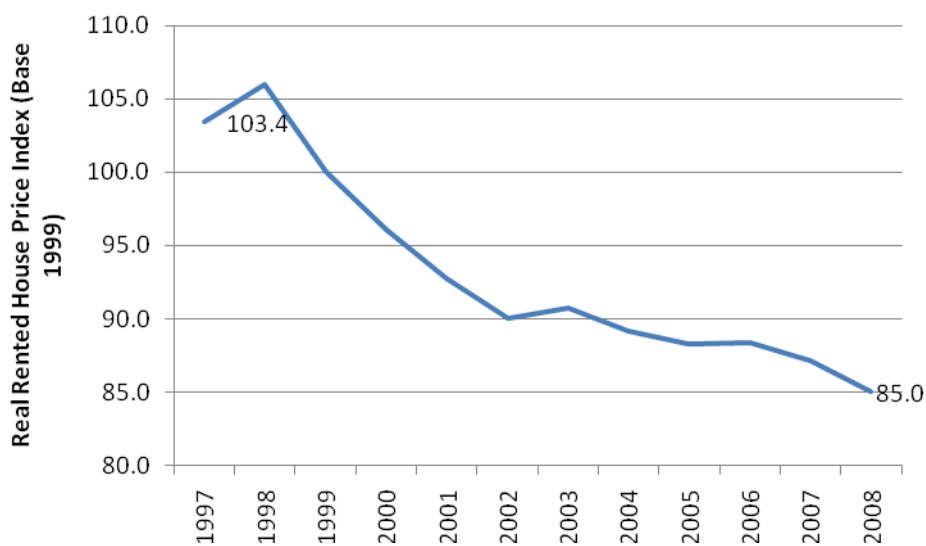
**Graph 6: Prices of Used Houses**



Source: BANREP

Interestingly, rental prices evolved similarly to prices in the downturn (until more or less 2003), but have not witnessed a recovery in the last five years (Graph 7).

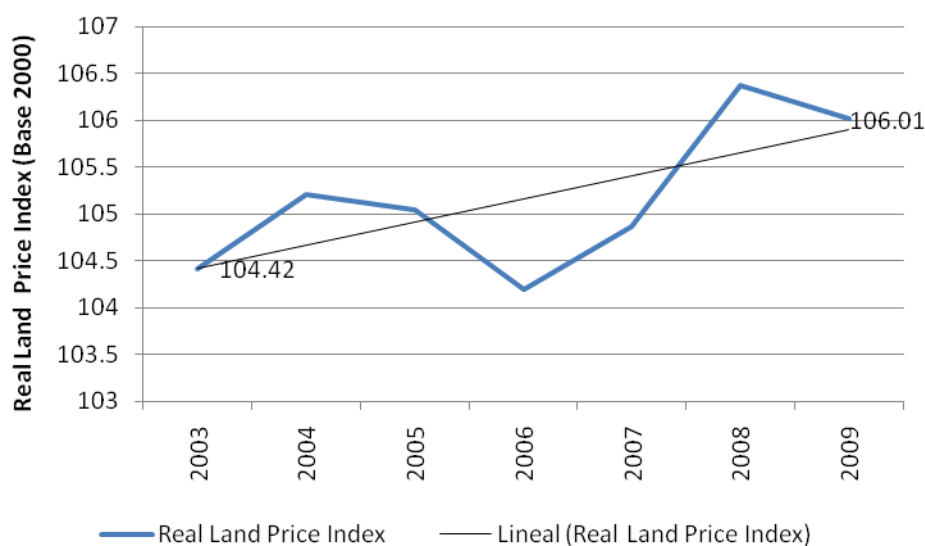
**Graph 7: Rental Price Index**



Source: DANE

With regard to land prices, data is only available for a shorter period and is deemed to be of lesser quality. Between 2003 and 2008 prices have been somewhat volatile, in all increasing by around 1.5% in real terms (Graph 8).

**Graph 8: Land Prices**

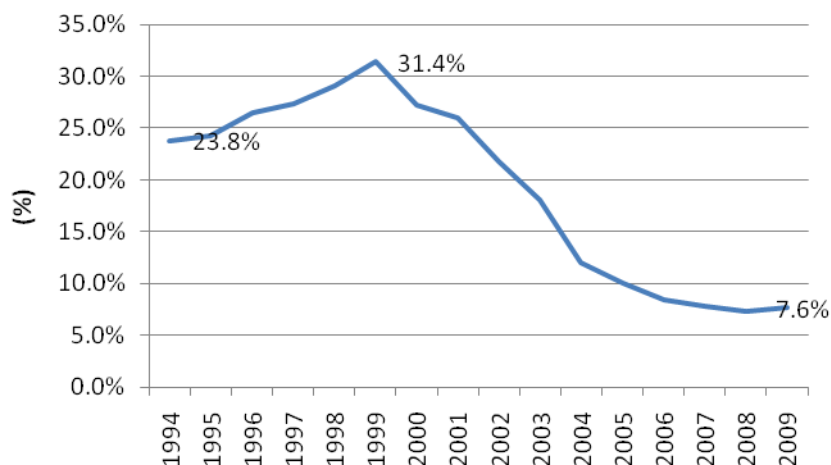


Source: DANE

**Evolution of housing finance**

The ratio of mortgage loans to total financial sector loans went from under 24% in 1994 to over 31% in 2000. The ratio then plummeted and stood at 7.6% in 2009 (Graph 9).

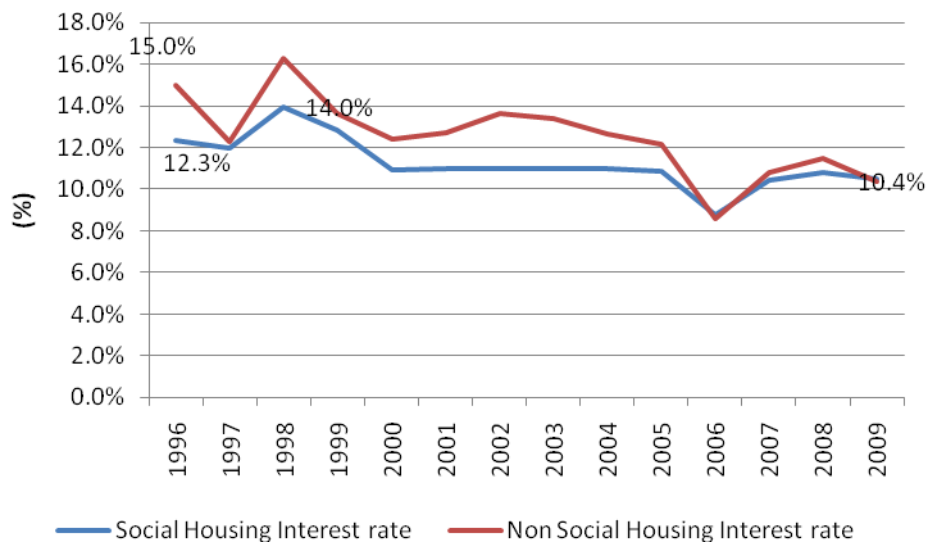
**Graph 9: Mortgage Debt/Total Debt**



Source: Financial Superintendency

With respect to mortgage interest rates, these are expressed in terms of a unit of account indexed to inflation (UVR for its acronym in Spanish). Graph 10 shows interest rates (on top of the annual change in UVR) for social and non-social housing. Both rates peaked in 1997, declined almost continuously until 2006 and have increased since. Interestingly, rates on non-social housing go through periods in which they are roughly equal to rates on social housing.

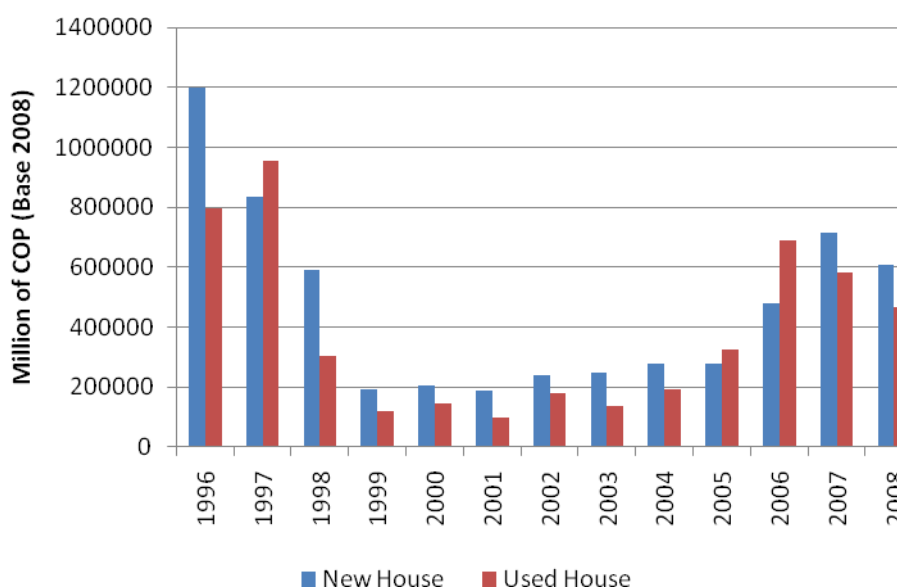
**Graph 10: Interest Rates for Social and Non Social Housing**



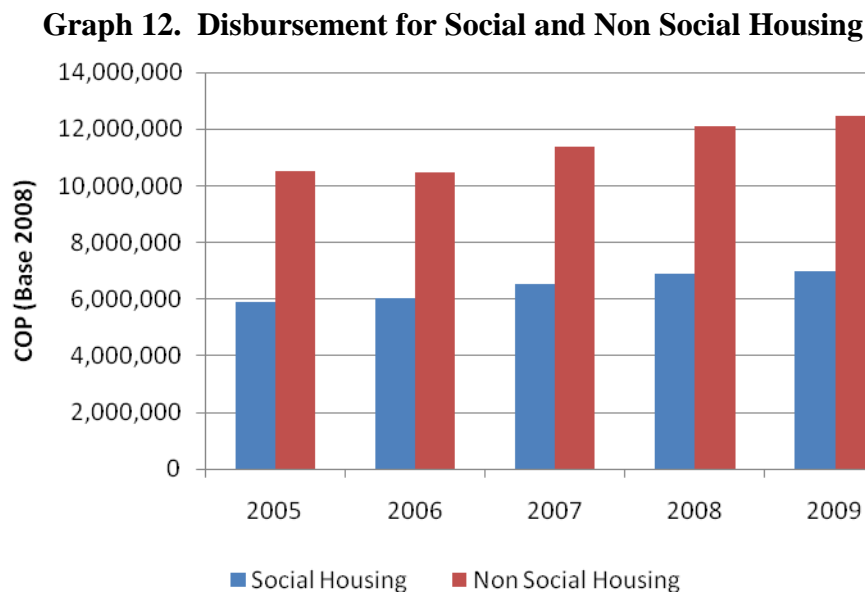
Source: Financial Superintendency

Disbursements by financial institutions can be divided between those financing purchases of new houses and those financing purchases of used houses (Graph 11). Disbursements for new houses went from 60% of total disbursements in 1996 to 41% in 2006, with the total amount of disbursements declining significantly. The recent recovery in disbursements has been led mostly by loans for purchases of new houses. Disbursements for social housing averaged 35% of total disbursements between 2005 and 2009 (Graph 12).

**Graph 11: Disbursement for Purchase of New and Used Houses**



Source: Financial Superintendency



Source: Financial Superintendency

### 3.2 Housing Policy and Institutions

#### 3.2.1 Rental Housing

**Law 820 of 2003 or Housing Lease Act.** The government was concerned about the results reported in the 2001 National Households Survey, according to which, at the time, some 3 million families did not own any housing nor had enough resources to purchase one, despite all the help granted by the government (i.e. loans and subsidies). This implied a failure to comply with Article 51 of the 1991 Constitution, according to which all citizens must have access to decent private housing. One solution that emerged at the time was to eliminate the distortions that were present in the market for urban housing leases. The rule in force at the time, Law 56 of 1985, was generating two distortions. On the one hand, it gave very little incentives to builders of housing for rental purposes. On the other hand, it was not equitable between the parties and granted no warranties with respect to the reinstatement of the property to its original owners at the end of the contract (Castaño 2004). With the expedition of Law 820 of 2003, the urban housing lease regime and the process of reinstatement of the leased property were modified, so as to set equal rights and duties for tenants and landlords (Cuellar 2006). The main reforms were:

- The establishment of solidarity in the leasing contract, so that the obligations may be demanded by or met by all or any of the landlords or tenants, related both to the reinstatement of the property or any financial obligations<sup>4</sup>.
- Elimination of solidarity from the lease contract and reinstatement of the property whenever the tenant fails to comply with obligations derived from domestic public services contracts, provided that: (i) the landlord has previously announced the existence of the lease contract with the respective utilities company, and (ii) the tenant has requested the landlord the underwriting of insurance against the possible nonpayment of domestic public services.
- It was determined that the increase in rental fees would equal 100% of registered inflation in the previous year<sup>5</sup>.
- The grounds for termination of the contract became more flexible.
- Law 820 granted fiscal incentives to social housing renters and authorized the creation of Real Estate Investment Funds in order to develop the real estate business associated with social housing rentals<sup>6</sup>.

Seven years after its enactment, there are still several problems derived from the application of the law. It has been found that renters have taken advantage of several loopholes in the law and have stopped paying the rental fees, administration fees and public services. The latter may be a direct consequence of the troublesome and tedious legal process that landlords must endure. One of the final purposes of the law was to speed up the process of reinstating rented dwellings. A study by Fedelonjas (2006) found that there continues to be delays in the reinstatement process, especially on the police inspector's part, due to the fact that a judicial order is required and this may take several months or even years<sup>7</sup>. According to Durán (2009), these loopholes within the law have actually caused that most landlords prefer settling for amounts smaller than they are actually entitled to according to the contract, in order to speed up the reinstatement process of the property subject to rental.

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<sup>4</sup> According to Cuellar (2006), this implies that landlord may sue the tenant in order to make him responsible for the rental fees and the reinstatement of the property, without the need of summoning both parties in a judicial process.

<sup>5</sup> Law 56 of 1985 established that the increase in the rental fees would be equal to 90% of registered inflation in the previous year.

<sup>6</sup> It is important to point out that as of yet there have not been any projects developing Real Estate Investment funds.

<sup>7</sup> Fedelonjas proposed to adjust the Civil Code in order to allow speeding up the judicial process for the reinstatement of properties.



### 3.2.2 Policy Instruments to Promote Housing Demand

**Direct Subsidies.** Public housing subsidies were created by Law 3 of 1991. According to Jaramillo (2009), before implementing such subsidies policy, a large part of government resources destined towards the construction of housing for low income population were being wasted or were not making it to their final destination.<sup>8</sup> The whole idea behind implementing demand subsidies for housing is that this may be more efficient given that the government hands the resources directly to the users, generating at least two advantages. On the one hand, it would create competition amongst promoters, thus reducing housing prices; on the other hand, someone purchasing a house can now choose the best option according to his (her) needs.

Direct subsidies for the purchase of housing have been managed mainly by four institutions: 1) Fonvivienda (formerly Inurbe); 2) Family Welfare Agencies (FWA); 3) the Military Housing Promotion Agency (MHPA) and; 4) the Public Agricultural Bank. The subsidies granted by these institutions are financed with resources from the National Budget and payroll taxes. During 1991-2009, Fonvivienda and the FWA handed out close to 72% of all subsidies. Targeting the poorest households has been based on two conditions: i) applications for the subsidy are restricted to households earning less than 4 monthly minimum legal wages or households ranked in the lowest living condition levels (according to the SISBEN classification); and ii) subsidies are assigned by a scoring methodology that ranks applicant households according to their saving efforts and socio-economic characteristics. Table 6 shows the scoring criteria and their modifications over time.

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<sup>8</sup> The Territorial Credit Institute was in charge of the state's housing production policy. Its funds came from the National Budget and from the recovery of loans granted; the housing units were financed under favorable conditions.

**Table 6: Social Housing Subsidy Beneficiaries Ranking Criteria 1990-2010**

	Decree 2154/93	Decree 824/99	Decree 2488/02	Decree 4466/07
<b>Socio-economic conditions</b>				
Sisben Level or Score <sup>1</sup>		+	+	+
Basic Unsatisfied Index	+			
Household size		+	+	+
Women headed household		+		
Women headed household, handicapped or senior citizen in the household			+	
Single-parent headed household, handicapped or senior citizens in the household				+
Housing unit value	-	-	-	Eliminated
<b>Effort</b>				
Saving/Housing unit value		+	+	
Saving/Sisben Level or Score <sup>6</sup>				+
Saving time		+	+	+
Number of previous applications		+	+	+

<sup>6</sup>Income level if the granting institution is a Family Welfare Agency.

Source: Ministry of Environment, Housing and Regional Development; Arbeláez *et al.* (2010).

During 1991 – 2009 there have been changes with respect to the maximum value of the awarded subsidy. Initially, the maximum value of the subsidies awarded by Inurbe for the acquisition or construction of housing was set at 25 monthly minimum wages (mlw) for housing whose value is less than 70 mlw. On the other hand, the maximum value of the subsidy granted by the FWA was inversely related to the household's income. In regard to Fonvivienda, Table 7 shows that between 1997 and 2009 the maximum value of the subsidy decreased for all types housing, especially for those whose value exceeds 70 mlw. The sharpest decline was in 2004, year in which the government tried to prioritize its attention on the poorest and informal households.<sup>9</sup> Furthermore, the maximum value of the subsidy was established as a function of the value of the house, the size of the municipality and the granting entity (Fonvivienda, MHPA, and the Public Agricultural Bank). Since 2004 the FWA began applying the methodology used by Fonvivienda, in which the maximum value of the subsidy depends on the value of the house.

<sup>9</sup> An informal household refers to the case where the income of the head of the household is derived from informal economic activities.

**Table 7: Fonvivienda and Family Welfare Agencies (FWA), Maximum Value of the Subsidy (in monthly minimum wages)**

Housing Prices		30-50	50-70	70-100	100-135
Decree 824/99		25	25	25	20
Decree 2620/00		23	16	16	10
Decree 1585/01		25	25	20	20
Decree 2488/02		23	16	16	10
Decree 975/04	Fonvivienda	21	14	7	1
	FWA	17	12	7	1
Dec.1526 & 4429/05 <sup>/1</sup>		21	14	7	1

<sup>/1</sup> Decree 4429 of 2005 increased FWA's maximum value of the subsidy to 10 mw for housing between 70 and 100 mw

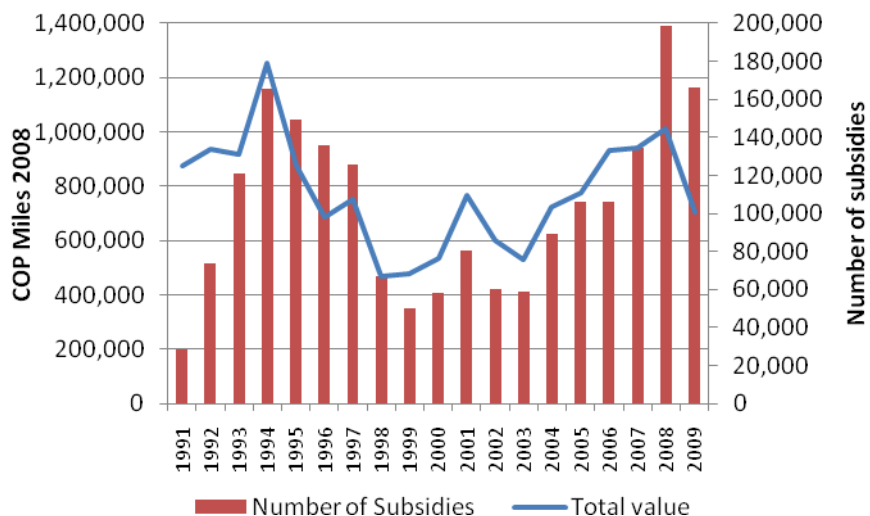
Source: Ministry of Environment, Housing and Regional Development (MAVDT), Arbeláez *et al.* (2010)

In 2007 (Decree 4466) there was a change in the methodology to establish the maximum value of the subsidy, where it was stipulated that the maximum value awarded by Fonvivienda depends on the Sisben score obtained by the household, and in the case of the FWA the maximum value depends on the household's income. Moreover, in 2007 (Law 1151) it was established that all public entities (Fonvivienda, MHPA and the Public Agricultural Bank) may only grant subsidies for the acquisition of housing whose value is less than 70 mlw.<sup>10</sup>

According to the Ministry of Environment, Housing and Regional Development, during 1991 -2009 Fonvivienda, the FWA and the Public Agricultural Bank granted subsidies, on average, for \$776 billion, an amount equivalent to 0.2% of GDP (Graph 13). With regard to the number of subsidies, during 1991-2009 an average of 104.000 households per year received benefits. It is noteworthy to point out that in Colombia there are 9 million households, 50% of which are considered poor.

<sup>10</sup> This does not apply to Family Welfare Agencies as they are ruled by private law.

**Graph 13: Assigned Subsidies**



Source: Ministry of Environment, Housing and Regional Development; Arbeláez *et al.* (2010)

**Programmed Saving Accounts.** In 1991, when the program of subsidies for social housing was created, it was established that as part of the criteria in order to be nominated as a possible beneficiary, households had to prove they had saving capacity in order to access the subsidy. During 1991 and 1992 this criterion acted as an important barrier for the possible beneficiaries of the program. As a result, in 1993 this criterion was eliminated for future applicants (Decree 2154). Nonetheless, in 2000 the government, through the enactment of Decree 2620, once again stipulated that in order to apply for a subsidy for the acquisition of social housing, households must meet some requirements regarding previous savings. Given the latter, programmed saving accounts were created as a means for applying households to gather, through periodic savings, enough resources in order to make an initial down payment. The amount that must be saved during the contract period must be at least 20% of the value of the property. Furthermore, via the programmed saving accounts households are entitled to tax exemptions of taxes withheld at the source.

**Saving Accounts for Housing Purchase (AFC).** Saving accounts for the promotion of construction (sapc) were created in year 2000 (Law 633) as a mechanism similar to the subsidies granted for the acquisition of social housing, but targeted to middle income and high income households. The creation of these accounts had the purpose of redirecting households' savings towards the housing sector. Through these accounts, households have

exemptions regarding taxes withheld at the source; they may transfer the amount of the tax as a contribution to the down payment or the monthly mortgage fees. Law 633 established that the maximum monthly savings a beneficiary may have is the equivalent of 30% of his (her) paycheck. This deposit may only be used in order to purchase housing (new or used).

**Interest rate subsidies.** In 2009 the government established a new policy driven towards increasing housing subsidies awarded to middle and low income households, this time via subsidizing mortgage interest rates. Since April 2009 this subsidy is channeled through banks, who are the ones in charge of processing the credit applications. These types of loans are beneficial for those purchasing housing in the following way:

- The government pays up to 5 percentage points of the interest rate if the value of the house is less than \$70 million.
- The government pays up to 4 percentage points if the price range is within \$70-\$120 million. If the price range is within \$120-170 million, the government covers up 3 to percentage points.

The benefits awarded by these subsidies will only last during the first 7 years of the loan. These measures help reduce the monthly fee by up to a 30%. Although this benefit applies for households of all levels of income, it is expected to have a higher impact on middle income households given that low income households have access to a wide range of alternative assistance programs.

## **4 HOUSING TENURE AND HOUSING DEMAND IN COLOMBIA**

### **4.1 The data**

We use the National Quality of Life Survey (QLS) conducted by the National Department of Statistics (DANE). The survey allows us to consider socioeconomic indicators and has a special module on housing tenure and funding. It was conducted in 2003 and 2008 and is representative at the country level, regional level, Bogota level and socioeconomic stratum level. It includes questions on type of housing and physical conditions, access to public utilities, socio-demographic variables, health, education, and the labor market, among other factors. In this first draft we report estimates using only the 2003 survey. Work is in progress using the 2008 survey.

In the housing module, households self-report the estimated value of their housing units and the type of tenure. Housing can be (i) owned and fully paid when one of the household members has the ownership title and does not have housing financing of any kind; (ii) owned but still being paid for; (iii) rented; (iv) in usufruct, when the household is authorized by the owner to occupy the housing unit without paying rent; and (v) de facto occupied, when a household occupies the housing without being the owner or being authorized.

In addition, if the housing unit was bought during the four years previous to the survey (i.e., between 1998 and 2002 for the 2003 QLS), the survey includes questions about the different sources of funding (including the household's own resources, housing credit, credit from friends and relatives and severance payments, among others), and about whether the household received a subsidy and the value of the housing, among other questions.

## 4.2 Descriptive statistics

According to the Quality of Life Survey (QLS) of 2003, most households own their housing<sup>11</sup> (58%), 28% are renters, 12% live in usufruct arrangements and 1.2% are de facto occupants. Informal settlements are 20% of the sample. Most of the de facto occupants are considered to be living in informal units (almost 60%), followed by housing in usufruct (37%). Informality is also more common among owned housing units in comparison to rented units (Table 8).

**Table 8: Tenure type**

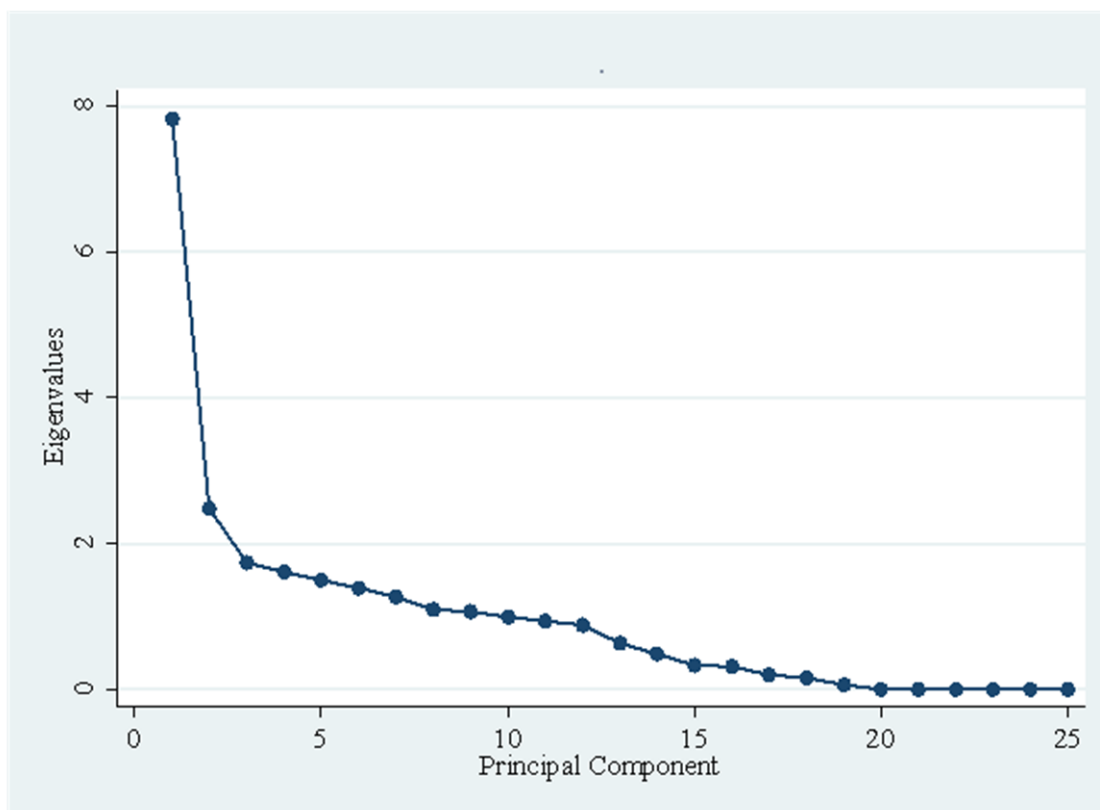
	<b>Freq.</b>	<b>%</b>
Owner	10,774	52.4%
Owing	1,202	5.8%
Renters	5,807	28.2%
Usufruct	2,530	12.3%
De facto Occupant	251	1.2%
	<b>INFORMAL</b>	<b>FORMAL</b>
Owner	23.5%	76.4%
Owing	6.8%	93.1%
Renters	3.7%	96.3%
Usufruct	36.9%	63.0%
De facto Occupants	59.9%	40.0%
<b>Total</b>	<b>19.1%</b>	<b>80.9%</b>

Source: QLS 2003

<sup>11</sup> This group includes fully paid homes and homes still being paid for.

Dowall (2007) suggests that informal housing can be defined according to three main concepts: security of land tenure, access to infrastructure services, and physical characteristics of the settlements and the housing structures. Following this definition, we built a Formal Housing Index (FHI) using information from the Quality of Life Survey (2003), as a weighted average of: i) Households’ self-reported housing tenure: de facto tenure; ii) Access to public services: sewerage availability, access to water, electricity and garbage collection services; and iii) Physical conditions of the settlement and the housing units: floor and wall materials, and known risks in the settlement area. Following Kolenikov S. & G. Angeles (2009) and Hamill (2009), and given that we are working with discrete variables, we conducted a Principal Component Analysis (PCA) using tetrachoric correlations. The first principal component explained 30% of the variance of the data. The optimal number of components was selected by following two criteria: the eigenvalues must be greater than one and the optimal principal components must be located before the “elbow” of their scree plot (Graph 14). Thus, it is clear that the first component is optimal as the basis for the construction of a common multidimensional formal housing index.

**Graph 14: Scree Plot of Principal Components for the FHI**



Source: QLS 2003 and authors’ calculations

In Table 9 we present the coefficients of each variable for the first principal component. The signs are as expected. Ownership of housing reduces the likelihood of being formal and increases the probability of being informal by 17 percentage points. All settlement risks increase informality, with the most important being “flood risk”, “avalanche, landslide or mudslide risk”, and “stream and overflow risk”. Having adequate access to utilities reduces the chance of being informal by around 30 percentage points, depending on the type of public service. Among the wall materials, only bricks and prefabricated materials reduce the probability of informal settlements. Finally, with regard to floor materials, parquet, marble, carpet, vinyl, tiles and bricks reduce housing informality, whereas cement and dirt increase it.

**Table 9: First Component of the FHI**

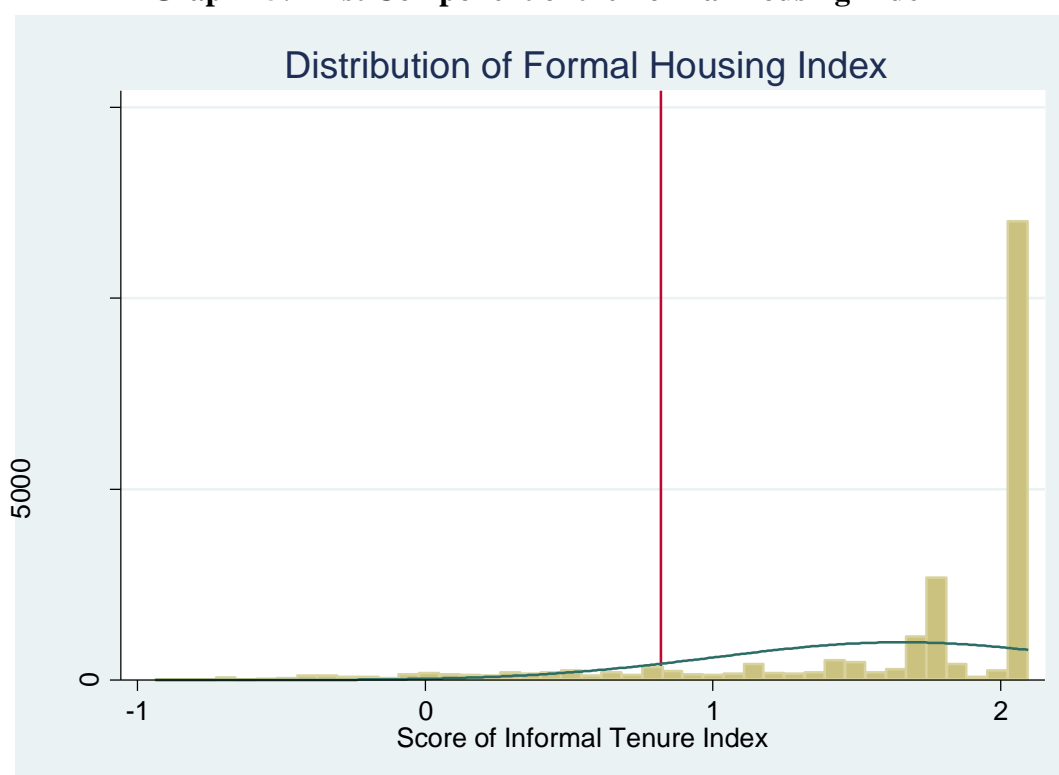
<b>De facto Tenure</b>	-0.1725
<b>Risks</b>	
Risk1: flood	-0.1877
Risk2: avalanches, landslides or mudslides	-0.1678
Risk3: streams and overflows	-0.2128
Risk4: land subsidence	-0.0542
Risk5: geological failure	-0.0475
<b>Utilities</b>	
Electricity	0.31
Adequate Toilet	0.3313
Sewerage	0.3322
Rubbish collection	0.3283
Aqueduct	0.3016
<b>Wall Materials</b>	
Bricks	0.2853
Adobe	-0.0699
Wattle	-0.0861
Wattle and daub	-0.1299
Wood	-0.1679
Prefabricated Material	0.0399
Bamboo, cane, other plants	-0.1409
Zinc, cloth, cardboard, disposable materials	-0.0754
<b>Floor Materials</b>	
Parquet, marble	0.1667
Carpet	0.2067
Vinyl, tiles or bricks	0.1758
Wood or other plant	-0.1485
Cement	-0.0764
Dirt	-0.2149

Source: QLS 2003 and authors' calculations



With respect to the threshold of the FHI, we established that 20% of households<sup>12</sup> are classified as living in informal housing, while the remainder lives in formal housing. This threshold was based on prior information about the percentage of slums reported by UN-Habitat in Colombia (17.9%) and the qualitative housing deficit<sup>13</sup> reported by DANE's census in 2005 (23.8%). Graph 15 shows the FHI distribution and the threshold and illustrates that the number of households on the left side of the red line adds up to 20% of our sample.

**Graph 15: First Component of the Formal Housing Index**



Source: QLS 2003 and authors' calculations

Using the threshold of 20%, we have 17,035 households living in informal settlements and 68,112 living in formal housing.

#### 4.2.1 Characteristics of households

As illustrated in Table 10, head-of-household owners tend to be married or to a lesser degree widowed, older than 35 years of age, and highly educated, and to have a high income level and to belong to households with few members. Head-of-household renters are mostly single,

<sup>12</sup> The percentage corresponds to households registering the lowest score on the IFI distribution.

<sup>13</sup> The qualitative housing deficit is defined as the number of households living in housing units with inadequate physical conditions.

divorced or living in cohabitation, younger (between 25 and 49 years old), have high levels of education, belong to all income levels, have more household members and more commonly have tenure status in urban areas. Households living in usufruct or de facto occupants are more likely to live in cohabitation or be divorced, have lower levels of education, belong to lower income quintiles, and be found in rural areas. Finally, it stands out that owners and renters are more linked to labor formality, while usufruct and de facto occupants are related to informality.

**Table 10: Households' characteristics by housing tenure status**

	OWNER	OWING	RENTERS	USUFRUCT	DE FACTO OCCUPANT	TOTAL
<b>Gender</b>						
Female	34.0%	23.9%	29.7%	25.1%	36.0%	30.9%
Male	66.0%	76.1%	70.3%	74.9%	64.0%	69.1%
<b>Marital Status</b>						
Cohabitation	23.7%	22.3%	36.8%	40.4%	41.4%	30.2%
Married	39.7%	56.8%	28.6%	28.2%	21.5%	35.4%
Widowed	15.8%	6.4%	4.6%	7.0%	10.7%	10.6%
Divorced	13.2%	10.0%	17.7%	14.0%	21.3%	14.6%
Single	7.6%	4.6%	12.4%	10.4%	5.1%	9.2%
<b>Age</b>						
12-17 years	0.1%	0.0%	0.3%	0.6%	0.7%	0.2%
18-24 years	1.4%	0.7%	9.2%	10.5%	5.5%	5.1%
25-34 years	8.8%	12.6%	30.7%	29.4%	21.9%	18.7%
35-49 years	31.7%	56.4%	40.2%	35.4%	40.9%	36.2%
50-64 years	32.9%	25.1%	14.9%	16.1%	19.7%	24.5%
>65	25.0%	5.1%	4.8%	8.0%	11.3%	15.3%
<b>Education Level</b>						
None/Preschool	13.8%	2.9%	4.0%	12.6%	17.5%	10.1%
Primary (1 - 5)	48.0%	22.8%	32.0%	46.1%	51.5%	41.7%
Secondary (6 - 13)	25.3%	35.8%	45.0%	33.9%	24.7%	33.0%
Tertiary (univ/technical)	9.9%	29.0%	15.9%	6.7%	6.3%	12.2%
Graduate	3.0%	9.5%	3.1%	0.7%	0.0%	3.0%
<b>Formality</b>						
Informal	51.7%	43.8%	60.7%	72.0%	63.3%	57.0%
Formal	48.3%	56.2%	39.3%	28.0%	36.7%	43.0%
<b>Income Quintile</b>						
1	19.2%	11.2%	17.3%	30.5%	35.5%	20.0%
2	17.6%	8.6%	22.2%	27.7%	21.1%	20.0%
3	19.1%	13.1%	22.0%	21.4%	17.4%	20.0%
4	20.5%	23.9%	21.2%	14.5%	14.8%	20.0%

	OWNER	OWING	RENTERS	USUFRUCT	DE FACTO OCCUPANT	TOTAL
5	23.5%	43.3%	17.2%	5.9%	11.2%	20.0%
<b>Number of Household Members</b>						
1-3 members	39.2%	33.9%	39.9%	35.3%	28.5%	38.5%
4-6 members	45.0%	58.3%	46.4%	40.0%	50.0%	45.5%
7-9 members	11.7%	6.7%	8.9%	13.1%	14.5%	10.8%
<9 members	4.1%	1.1%	4.8%	11.5%	6.9%	5.2%
<b>Region</b>						
Atlántico	22.9%	9.4%	13.2%	19.1%	35.9%	18.9%
Oriental	17.6%	19.6%	18.6%	22.9%	9.5%	18.7%
Central	11.5%	9.0%	13.8%	16.3%	19.1%	12.8%
Pacífico	9.1%	2.3%	3.9%	8.7%	13.2%	7.2%
Bogotá	14.8%	36.0%	22.7%	8.7%	2.1%	17.3%
Antioquia	13.0%	16.8%	13.5%	12.8%	14.9%	13.3%
Valle	10.0%	5.6%	12.4%	10.5%	4.6%	10.5%
SanAndrés	0.1%	0.1%	0.3%	0.2%	0.3%	0.2%
Orinoquia	1.1%	1.3%	1.6%	0.8%	0.4%	1.2%
<b>Stratum</b>						
Illegal Connection	1.4%	0.5%	0.7%	2.6%	9.5%	1.4%
1	25.9%	6.5%	11.6%	27.4%	42.6%	20.8%
2	41.0%	34.4%	41.1%	42.9%	31.9%	40.9%
3	22.1%	36.8%	36.4%	19.8%	7.5%	26.9%
4	5.3%	15.7%	7.0%	4.4%	0.1%	6.2%
5	1.9%	3.9%	1.9%	0.8%	0.5%	1.8%
6	1.5%	1.9%	1.0%	0.6%	0.0%	1.2%
9	0.8%	0.4%	0.1%	1.5%	8.0%	0.7%
<b>Area</b>						
Rural	29.3%	11.8%	7.9%	46.5%	44.0%	24.6%
Urban	70.7%	88.2%	92.1%	53.5%	56.0%	75.4%
<b>Dependency Ratio</b>						
	70.5%	62.3%	66.0%	80.5%	100.5%	70.4%
<b>Housing Expenditure/ Total Expenditure</b>						
	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Source: QLS 2003 and authors' calculations

According to Table 11 informal housing units tend to be occupied by individuals living in cohabitation, with low education levels, low income quintiles, and a higher dependency ratio, and they are located mainly in rural areas. It is worth noting that there is a high correlation between informal housing and informal labor.

**Table 11: Characteristics of households by formal/informal settlements**

	FORMAL	INFORMAL	TOTAL
<b>Gender</b>			
Female	32.9%	22.0%	30.9%
Male	67.1%	78.0%	69.1%
<b>Marital Status</b>			
Cohabitation	27.1%	44.4%	30.2%
Married	37.2%	26.9%	35.4%
Widowed	10.6%	10.7%	10.6%
Divorced	15.3%	10.9%	14.6%
Single	9.7%	7.1%	9.2%
<b>Age</b>			
12-17 years	0.2%	0.2%	0.2%
18-24 years	5.0%	5.1%	5.1%
25-34 years	18.6%	18.9%	18.7%
35-49 years	36.6%	34.3%	36.2%
50-64 years	24.4%	25.0%	24.5%
>65	15.1%	16.5%	15.3%
<b>Education Level</b>			
None/Preschool	6.2%	28.4%	10.1%
Primary (1 - 5)	38.3%	57.2%	41.7%
Secondary (6 - 13)	37.4%	12.6%	33.0%
Tertiary (univ/technical)	14.5%	1.5%	12.2%
Graduate	3.6%	0.3%	3.0%
<b>Formality</b>			
Informal	52.1%	79.9%	57.0%
Formal	47.9%	20.1%	43.0%
<b>Income Quintile</b>			
1	15.2%	42.0%	20.0%
2	18.3%	28.0%	20.0%
3	20.4%	18.0%	20.0%
4	22.3%	9.4%	20.0%
5	23.8%	2.6%	20.0%
<b>Number of Household Members</b>			
1-3 members	38.9%	36.3%	38.5%
4-6 members	46.0%	42.9%	45.5%
7-9 members	9.9%	15.0%	10.8%
<9 members	5.1%	5.8%	5.2%
<b>Region</b>			
Atlántico	17.0%	27.5%	18.9%
Oriental	18.5%	19.4%	18.7%
Central	12.7%	13.2%	12.8%
Pacífico	4.4%	20.3%	7.2%
Bogotá	20.9%	0.3%	17.3%
Antioquia	13.4%	12.8%	13.3%
Valle	11.4%	6.2%	10.5%
SanAndrés	0.2%	0.1%	0.2%
Orinoquia	1.4%	0.1%	1.2%
<b>Stratum</b>			
Illegal connection	0.8%	5.2%	1.4%
1	15.2%	54.7%	20.8%
2	42.0%	34.0%	40.9%
3	31.1%	1.8%	26.9%
4	7.2%	0.2%	6.2%
5	2.1%	0.0%	1.8%
6	1.4%	0.1%	1.2%
9	0.2%	3.9%	0.7%

	FORMAL	INFORMAL	TOTAL
<b>Area</b>			
Rural	11.76	83.7	24.55
Urban	88.24	16.3	75.45
<b>Dependency Ratio</b>			
	66.1%	90.9%	70.4%
<b>Housing Expenditure/ Total Expenditure</b>			
	6.2%	0.5%	5.0%

Source: QLS 2003 and authors' calculations

The Quality of Life Survey asks whether the household purchased a housing unit during the 5 years prior to the survey. Less than a fifth did purchase a housing unit (Table 12).

**Table 12: Units purchased between 1998 and 2002**

	Freq.	%
Yes	1,473	12.93%
No	9,916	87.07%

Source: QLS 2003 and authors' calculations

With regard to sources of funding used to pay for housing bought between 1998 and 2002, around 80% of households used their own resources, regardless of income (Table 13). The use of credit and severance payments varies substantially among income quintiles. The importance of credit increases with income, attaining 31% in the fifth quintile against 5.8% in the first. Similarly, severance payments are used by 27% of the households in the sample, while the percentage in the lowest income level is only 1.3%. In contrast, credit from relatives is more common in lower income levels, for which they represent the second biggest source of funds. On the other hand, informal housing was bought primarily with own resources, followed by credit from friends and relatives and other resources. Housing credit and severance payments are more common sources in the case of formal housing.

**Table 13: Sources of funds used by households**

INCOME QUINTILE	OWN RESOURCES	HOUSING CREDIT	CREDIT FROM FRIENDS & RELATIVES	SEVERANCE PAYMENTS	OTHER RESOURCES
1	79.9%	5.8%	18.2%	1.3%	11.1%
2	81.2%	3.2%	13.2%	5.8%	14.0%
3	77.1%	8.9%	12.7%	9.6%	12.8%
4	79.8%	20.4%	13.3%	19.2%	9.6%
5	74.0%	31.2%	9.4%	26.8%	13.0%
<b>Informal</b>	85.9%	1.9%	11.5%	1.8%	11.8%
<b>Formal</b>	75.7%	18.6%	14.3%	16.4%	12.1%

Source: QLS 2003 and authors' calculations

In addition, among those households who purchased a unit between 1998 and 2002, around 12% benefited from a subsidy (Table 14).

**Table 14: Number of households who received subsidies**

	Freq.	%
Yes	1,363	11.97%
No	10,026	88.03%

Source: QLS 2003 and authors' calculations

Since we are interested in exploiting the housing market segmentation by stratum, Table 15 displays the average values reported by households. As expected, the average unit value in the higher stratum is twenty-four times higher than in the first stratum and five times the value of the third stratum.

**Table 15: Average housing value by stratum**

STRATUM	VALUE
1	7,440,101
2	2,557,387
3	35,364,275
4	60,432,323

Source: QLS 2003 and authors' calculations

### 4.3 Housing Tenure and Formality

The purpose of this exercise is to identify the variables behind households' decisions whether to own or rent, and whether to live in an informal or formal settlement. We assume that these decisions are simultaneous; therefore, in order to estimate the determinants of these interdependent choices we use a bivariate probit approach with a system of simultaneous equations. The general specification is as follows:

$$Formal_i = \beta_0 + \beta_1 X_i + \beta_2 Policy_i + \varepsilon_i$$

$$Owned_i = \alpha_0 + \alpha_1 X_i + \alpha_2 Policy_i + u_i$$

$$\begin{pmatrix} \varepsilon_i \\ u_i \end{pmatrix} \sim Normal \left[ \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right]$$

Where,  $Formal_i = 1$  if household  $i$ 's unit is formal, 0 otherwise;  $Owned_i = 1$  if household  $i$ 's unit is totally owned or owned and being paid for, 0 if it is rented (we do not consider

dwellings in usufruct or de facto occupied);  $X_i$  is a vector of exogenous household characteristics (which includes household head characteristics such as gender, marital status, age, education level, and labor informality (defined as not having a work contract or not being affiliated with a pension fund), and other household characteristics, such as income, geographical location, number of household members, dependency ratio (which corresponds to the number of employed members in each household), a wealth proxy which is calculated as a composite index of variables showing the possession of durable goods<sup>14</sup>, mortgage debt and eligibility for the housing subsidy.

Table 16 reports the results of three different specifications. Columns (1) and (2) display the results of the bivariate probit described above. We find that the correlation coefficient is negative and high (-0.53). In columns (3) and (4) we estimate independent (univariate) probits in which formality and ownership are the dependent variables, respectively. In each case we introduce the other decision (owned or formal) as an independent variable. Since type-of-funding-related variables are only available for those households who reported being owners, in column (5) we estimate the probability of being formal conditional on being an owner, and we include the different types of funding as determinants of the decision.

The results of the bivariate and univariate probits are very similar, suggesting that the decisions are not very interdependent. We discuss first the results of columns (1) to (4), and then those of column (5). While the effect of ownership on formality is significant but small, the impact of formality on ownership is very important: housing formality reduces the probability of owning the unit by 40 percentage points. The gender of the head of the household is not an important driver of either decision. Married heads have a higher probability of acquiring formal units. Both married and single heads are more likely to own their units. Age has a statistically but not economically significant effect on both decisions. The effect of education differs slightly from one specification to the other. In both cases, it has a positive effect on formality and a negative effect on ownership. However, the magnitude of these effects is larger in the bivariate probit. Labor formality acts in an opposite way from education: it decreases the probability of acquiring a formal unit but increases the probability of owning it. The latter point is interesting because formally employed workers receive severance payments that can be used to finance housing.

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<sup>14</sup> The goods considered were washing machines, refrigerators, stoves, computers, vehicles and blenders.

We found no evidence suggesting that a higher (monthly) income increases the probability of occupying formal dwellings. In contrast, it does increase the probability of home ownership. Larger households (in terms of the number of members) are more likely to own their units, but also to dwell in informal units. The dependency ratio is positively correlated with ownership but uncorrelated with formality. The wealth proxy is positively correlated with both formality and housing ownership. The effect on ownership is high: an increase of one standard deviation of the index (which is 0.64) increases the probability of owning the house by 7 to 12 percentage points. Last but not least, subsidy eligibility has a small negative effect on formality. More interestingly, it has a positive effect on home ownership. Eligible households are more likely to own their unit by 5.5 percentage points.

Conditional on being an owner, we find that the use of housing credit has a significant (at 5%) effect on housing formality. Housing credit increases the probability of inhabiting formal housing by 3 percentage points. The use of severance payments or the housing subsidy also has an effect (significant at 10%) on the likelihood of acquiring a formal dwelling. The effect of both variables is close to 2 percentage points.



**Table 16: Probit Estimations**

VARIABLES	Bivariate Probit (Marginal Effects)		Univariate Probits (Marginal Effects)		Conditional on Being Owner
	(1) Formal	(2) Owned	(3) Formal	(4) Owned	(5) Formal
Formal Housing				-0.391*** (0.0100)	
Owned			-0.00650*** (0.00158)		
Gender	-0.00170* (0.000921)	-0.0182 (0.0142)	-0.000978** (0.000489)	-0.0308** (0.0144)	-0.000912 (0.0123)
<i>Marital Status (Cohabitation is omitted)</i>					
Married	0.00172** (0.000802)	0.0992*** (0.0114)	0.000819* (0.000431)	0.109*** (0.0115)	0.0381** (0.0169)
Widowed	0.00204* (0.00111)	0.102*** (0.0240)	0.000869 (0.000589)	0.109*** (0.0239)	0.0159 (0.0119)
Divorced	0.00160 (0.00106)	0.0121 (0.0180)	0.000598 (0.000580)	0.0241 (0.0182)	0.00680 (0.0123)
Single	0.00161 (0.00112)	0.0889*** (0.0178)	0.000617 (0.000604)	0.0987*** (0.0180)	0.0213* (0.0115)
Age	-5.30e-05* (2.89e-05)	0.0142*** (0.000456)	4.25e-05** (1.79e-05)	0.0147*** (0.000466)	-6.34e-05 (0.000342)
<i>Education (None/preschool is omitted)</i>					
Primary (1 - 5)	0.00602*** (0.00145)	-0.104*** (0.0255)	0.00261*** (0.000780)	-0.0107 (0.0267)	0.0208 (0.0145)
Secondary (6 - 13)	0.0110*** (0.00241)	-0.218*** (0.0262)	0.00483*** (0.00136)	-0.0915*** (0.0281)	0.0353** (0.0174)
Tertiary (univ/technical)	0.00710*** (0.00171)	-0.195*** (0.0295)	0.00334*** (0.000998)	-0.0991*** (0.0309)	0.0263* (0.0147)
Graduate	0.000512 (0.00306)	-0.173*** (0.0354)	0.000470 (0.00154)	-0.0974*** (0.0366)	0.00914 (0.0305)
Formal Worker	-0.000989*** (0.000362)	0.0166*** (0.00533)	-0.000366** (0.000186)	0.0154*** (0.00548)	-0.00511 (0.00423)
Income	0.000271 (0.000369)	0.0234*** (0.00601)	0.000244 (0.000200)	0.0214*** (0.00613)	0.00391 (0.00436)
<b>Region Controls</b>					
Household Members	<b>Yes</b> -0.000989*** (0.000362)	<b>Yes</b> 0.0166*** (0.00533)	<b>Yes</b> -0.000366** (0.000186)	<b>Yes</b> 0.0154*** (0.00548)	<b>Yes</b> -0.00511 (0.00423)
Dependency ratio	0.000271 (0.000369)	0.0234*** (0.00601)	0.000244 (0.000200)	0.0214*** (0.00613)	0.00391 (0.00436)
Wealth Proxy	0.0156*** (0.00313)	0.118*** (0.0103)	0.00632*** (0.00166)	0.192*** (0.0111)	0.0905** (0.0358)
Own Resources					0.00751 (0.0123)
Housing credit					0.0305** (0.0140)
Credit from friends/relatives					0.0115 (0.00837)
Severance payments					0.0211* (0.0116)
Other resources					0.0157 (0.00990)
Subsidy					0.0179* (0.00977)
Eligibility	-0.00495*** (0.00127)	0.0547*** (0.0115)	-0.00266*** (0.000808)	0.0572*** (0.0115)	0.00139 (0.00748)
Rho	-0.543*** (0.0363)				
Observations	13511	13511	12725	13511	1088
Robust standard errors in parentheses					
*** p<0.01, ** p<0.05, * p<0.1					

#### 4.4 Housing Demand

For estimating housing demand we adapted a model proposed by Fontela and Gonzalez (2008) for the Mexican market. The general model is as follows: let  $q_{ij} = q(p_j, m_{ij}, X_i)$  be the demand function for housing of household  $i$  in market  $j$ <sup>15</sup>. The model specification is:

$$q_{ij} = \alpha_0 + \alpha_1 p_j + \alpha_2 m_{ij} + \alpha_3 mt_{ij} + \alpha_4 X_i + \alpha_5 Y_i + \varepsilon(1)$$

Where  $q_{ij}$  is the housing quantity demanded by household  $i$  in market  $j$ ;  $p_j$  is the housing price index in market  $j$ ;  $m_{ij}$  is the permanent income of household  $i$  in market  $j$ ;  $mt_{ij}$  is the transitory income of household  $i$  in market  $j$ ;  $X_i$  is a vector of exogenous household characteristics, including the household head's characteristics (gender, marital status, age, education level, labor informality defined as not having a work contract or not being affiliated with a pension fund) and other household characteristics (geographical location, number of household members, number of dependants); and  $Y_i$  is a vector of variables related to the source of funding of the unit (own resources, housing credit, credit from friends/ relatives, severance payments, other resources, subsidy and eligibility for housing subsidies, which is calculated as a household with income less than 4 times the minimum wage or that belongs to the lower levels of SISBEN).

##### 4.4.1 Permanent and temporary income

Temporary and permanent income are key determinants of housing demand. In order to distinguish between the two components, we assume that temporary income may be explained by a set of observable characteristics. The part of the salary that is not explained by these variables will be attributed to the transitory component. To estimate the permanent and transitory income components we will use household demographic characteristics and control variables. The model specification is:

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<sup>15</sup> The markets are defined according to the geographical location of the housing units. Since the Quality of Life Survey is representative only for the city of Bogotá and for a group of 8 regions, we will take those regions as markets. The regions are: Atlantic, Eastern, Central, Pacific, Antioquia, Valle, San Andrés and Orinoquia-Amazonas.

$$m_i = \theta_0 + \theta_1 X_i + \varepsilon_i \quad (2)$$

Where,  $X_i$  is a vector of exogenous household head characteristics such as gender, marital status, age, education level and employment status (formally/informally employed, unemployed, inactive); and other characteristics which are geographical location, number of household members and dependency ratio. The regression is estimated at the individual level, and then we aggregate the results in order to construct the permanent and transitory income at the household level. Results are displayed in Table 17.

Surprisingly, in our sample there is not a significant difference in monthly earnings between men and women. With that exception, all the variables have the expected sign and significance. Married and single individuals earn 20% more than those living in cohabitation, while the salary of divorced individuals is 6% higher. As expected, income increases monotonically with age and education. For instance, an average individual with tertiary education earns 150% more than one with no education. With regard to labor status, we find that informal workers earn 20% less than formal employees, the unemployed earn 50% less and the inactive population's income is similar to the average earnings of informal employees. Finally, as expected, households with a higher dependency ratio have lower salaries and larger households have higher ones.

**Table 17: Income Estimation**

	(1)
VARIABLES	OLS
<i>Gender (female is omitted)</i>	
Male	-0.00758
	(0.0116)
<i>Marital Status (Cohabitation is omitted)</i>	
Married	0.209***
	(0.0226)
Widowed	0.0443
	(0.0401)
Divorced	0.0598**
	(0.0274)
Single	0.174***
	(0.0242)
Age	0.00420**
	(0.00207)
Age^2	6.89e-05***
	(2.27e-05)
<i>Education Level (None/preschool is omitted)</i>	
Primary (1 - 5)	0.358***
	(0.0288)
Secondary (6 - 13)	0.859***
	(0.0329)
Tertiary (univ/technical)	1.524***
	(0.0391)
Graduate	2.000***
	(0.0498)
<i>Labor classification (Formal worker is omitted)</i>	
Informal worker	-0.230***
	(0.0190)
Unemployed	-0.518***
	(0.0328)
Inactive	-0.193***
	(0.0217)
Region Controls	Yes
Depandancy Ratio	-0.222***
	(0.0161)
Number of Household Members	0.0572***
	(0.00509)
Constant	12.76***
	(0.0702)
Observations	62881
R-squared	0.290
Robust (clustered) standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

#### 4.4.2 Hedonic prices

Since our objective is to estimate a housing demand and therefore to identify the effect of prices, we need to construct different prices for similar housing. This can be done assuming that the prices of houses do not depend only on their physical characteristics, but also on the characteristics of their environment (Fontenla and Gonzalez, 2009). Consequently, the latter segments the housing market. Colombia is an interesting case study given that housing environmental characteristics are taken into account in defining housing strata, a measure that is used to focus cross subsidies on public services payments. Moreover, the data we use are representative at strata levels, which allows us to identify each stratum in a different market and to estimate the price of average housing in each of these markets. Based on these prices, we are able to construct a measure of the quantity of housing demanded.

Given that  $q_{ij}$ , the quantity of housing demanded by household  $i$  in market  $j$ , is not observable, but that we do observe a housing unit's value at the moment of its purchase, we will use a hedonic price estimation to obtain  $q_{ij}$ . The hedonic price technique specifies a model in which the dependent variable is the housing unit's market value and the independent variables are the characteristics of the housing unit and some control variables. We define the value of housing unit  $n$  in market  $j$  as:

$$v_{nj}^i = v(H_n, D_n, \beta_j) \quad (3)$$

The specification of the econometric model is:

$$v_{nj}^i = \beta_j H_n + \delta_j D_n + \varepsilon \quad (4)$$

Where  $v_{nj}^i$  is the price that household  $i$  in market  $j$  paid for the unit  $n$  at the moment of its purchase;  $H_n$  is a vector of the housing unit's characteristics and controls for housing demand determinants. Housing characteristics include construction materials, number of bedrooms, number of bathrooms, access to utilities and amenities, geographical location, occurrence of floods, avalanches, land subsidence, etc., and nearby risk locations such as landfills, airports,

communication antennas, etc. To control for housing demand determinants, we include the household's permanent and transitory income, and the education level, age, civil status and gender of the household's head.  $\beta_j$  is the vector of the marginal contributions of each housing attribute to the price of the housing unit. This vector of parameters varies across markets for each of the housing unit characteristics in  $H_n$ .

Table 18 displays the most relevant determinants of housing value. The results of the complete set of regressors can be seen in the Appendix. We observe that better quality wall materials such as bricks increase housing value more than other materials, such as wattle, daub, coarse wood, prefabricated material, plants or disposable materials. Access to utilities increases the housing value as well. Among housing amenities, houses with a terrace are more valued, especially in higher strata. The middle income group (strata 2 and 3) highly values having garages. Quite surprisingly, household heads' permanent and transitory income plays an important role in increasing housing value only in market segments 2 and 3. Finally, the effect of age, although statistically significant, is not economically convincing.

**Table 18: Hedonic Regressions (Relevant Variables)**

VARIABLES	<i>Stratum</i>				
	(1)	(2)	(3)	(4)	(5 and 6)
<b>Wall Materials (bricks omitted)</b>					
Adobe	-0.671*** (0.118)	-0.437*** (0.0903)	0.0852 (0.148)	0.620*** (0.209)	
Wattle	-0.545*** (0.0891)	-0.514*** (0.110)	-0.262 (0.200)		
Wattle and Daub	-0.893*** (0.130)	-0.730*** (0.194)	0.431*** (0.153)		
Coarse Wood	-0.377*** (0.0951)	-0.864*** (0.171)	0.0440 (0.309)	0.421* (0.240)	
Prefabricated Material	0.0621 (0.193)	-0.295*** (0.0881)	-0.150* (0.0905)	0.589*** (0.136)	-1.489*** (0.403)
Bamboo, Cane, Another Plant	-1.067*** (0.211)	-1.089*** (0.391)			
Zinc, Cloth, Cardboard, Disposable Materials	-0.152 (0.190)	-1.029*** (0.334)			
<b>Housing Utilities</b>					
Natural gas	0.220*** (0.0804)	0.121** (0.0472)	0.115** (0.0476)	0.111 (0.0718)	0.350** (0.156)
Aqueduct	0.228*** (0.0629)	0.130* (0.0696)	0.333* (0.194)	0.320 (0.402)	-1.652** (0.677)
Sewerage	0.231 (0.188)	-0.0716 (0.270)	0.183 (0.241)	1.483** (0.605)	-1.226*** (0.416)
Rubbish collection	0.387*** (0.0813)	0.255*** (0.0611)	0.222 (0.172)	2.178*** (0.410)	-0.788* (0.475)
<b>Housing Ammenities</b>					
Garden or courtyard	-0.0468 (0.0641)	0.0797** (0.0379)	0.115*** (0.0389)	0.200*** (0.0564)	0.518*** (0.147)
Garage or parking place	-0.0756 (0.361)	0.183** (0.0932)	0.156*** (0.0399)	0.108* (0.0653)	0.105 (0.119)
Rooftop or terrace	0.0905 (0.0834)	0.150*** (0.0451)	0.211*** (0.0510)	0.299*** (0.103)	0.297** (0.146)
<b>Household Head's Characteristics</b>					
Permanet Income	0.187* (0.102)	0.304*** (0.0578)	0.203*** (0.0586)	-0.0529 (0.132)	-0.184 (0.244)
Temporary Income	0.212 (0.184)	0.593*** (0.0903)	0.331*** (0.0700)	0.0682 (0.120)	0.258** (0.110)
Age	0.00642*** (0.00195)	0.00646*** (0.00155)	0.00886*** (0.00197)	-0.000462 (0.00451)	-0.0102** (0.00481)
Observations	1884	3622	3307	1093	575
R-squared	0.522	0.483	0.329	0.229	0.475
Standard errors in parentheses.					
*** p<0.01, ** p<0.05, * p<0.1					

Once we have estimated  $\beta_j'$  of implicit prices for each characteristic, we are able to calculate the price of an average housing unit (a unit with average characteristics).

Market  $j$  price index  $p_j$  is constructed as:

$$p_j = 100 * \frac{v(H_n^*, \beta_j)}{v(H_n^*, \beta_3)} \quad (5)$$

where the value of stratum 3 ( $j=3$ ) index is set equal to 100. The price index is reported in Table 19.

**Table 19: Price Index by Stratum**

Stratum	Price	Log(Price)
1	53.2	16.6
2	62.4	16.8
3	100.0	17.3
4	147.8	17.7
5 and 6	436.3	18.7

Source: QLS 2003 and authors' calculations

The value of the housing unit  $n$  in market  $j$  consumed by household  $i$  can be expressed as  $v_{nj}^i = q_{ij} * p_j$ . Therefore, the quantity of housing for each household equals the ratio between the housing unit value and the estimated relevant price index:

$$q_{ij} = \frac{v_{nj}^i}{p_j} \quad (6)$$

#### 4.4.3 Results of the housing demand estimation

To estimate the housing demand we followed equation (1) and the above-defined variables. We report five different specifications (Table 20). The first column is the baseline specification, and is estimated by restricting the sample to households who purchased a unit between 1998 and 2002. In the survey, all housing owners are asked what they consider the



price of their housing unit to be. The second column is an estimate using the entire sample, but we do not include the types of funding used to purchase the house, since this information is only available for those household who bought a housing unit between 1998 and 2002. In the third column we control for subsidy eligibility (which is closely related to income level). In the fourth column we introduce income quintile dummies. Finally, in columns five and six we explore the heterogeneous effects of the kinds of funding variables, considering whether the household is a social housing type (eligible for a housing subsidy) or a non-social housing type.

As expected, prices have a negative impact on the quantity of housing demanded. It is significant in all regressions, with the notable exception of the first estimation (in which we do not control for eligibility for housing subsidies). An increase of one percentage point in the price reduces the quantity demanded by between 0.14 and 0.39 percentage points. Our result is in line with Fontenla and Gonzalez (2009) who found a price elasticity of -0.3 for Mexico. Elasticities in developed countries are higher, ranging between -0.5 and -0.8 (see Ermisch *et al.* 1996 for a review). We find that both permanent and transitory incomes have a positive (and important) effect on the demand for housing. Nonetheless, the impact of permanent income is higher than that of transitory income. In fact, we find a permanent income elasticity of about 1.1 in the first three estimations. It falls to 0.7 when we include income quintile controls and to 0.08 when we introduce heterogeneous effects (seldom included in previous works). Income elasticities for developing countries are between 0.6 and 1.2 (Fontenla and Gonzalez 2009), and between 0.8 and 1.0 for developed economies (Ermisch *et al.* 1996). With respect to transitory income elasticity our results are sensible to the specification strategy, ranging between 0.2 (not significant) when we include income quintile dummies to 3.5 when heterogeneous effects are considered. In the baseline estimation, we find a transitory income elasticity of 0.8, substantially higher than the 0.04 found by Fontenla and Gonzalez (2009) for Mexico. Nevertheless, our result is in line with a stylized fact: permanent income elasticities tend to be higher than transitory income elasticities.

The age and gender of the household's head have a small and not always significant impact. Married couples and single individuals tend to demand a greater quantity of housing, but this effect disappears when we control for subsidy eligibility. The education level of the household's head has an important but not monotonical effect on the demand. Secondary and tertiary education increase the demand more in comparison not only to no education and

primary education, but also to graduate education, which may be explained by the fact that there are few observations of graduate education level in the sample.

With respect to the sources of funding, we find that households who use their own resources to buy their unit bought 30% more housing. This effect does not change across households that are eligible and not eligible for housing subsidies. Using housing credit also increases the demand for housing, by almost 40%. Interestingly, in this case the effect is not homogenous: the effect among eligible households (50%) is twice that among ineligible ones (25%). While receiving credit from friends and relatives increases the housing demand for the entire population, it does not have any significant effect among eligible households. In addition, severance payments do not have any effect on the population as a whole, but they do have an important impact among eligible (poor) households. Finally, we obtain the expected positive impact of subsidies on demand: households who received a subsidy bought on average 25% more housing.

**Table 20: Housing Demand Estimation**

VARIABLES		<i>Entire Sample</i>			<i>Heterogeneous Effects</i>	
<b>Standard Demand Variables</b>						
Ln(Price)	-0.153	-0.163***	-0.298**	-0.390***	-0.135	
	(0.119)	(0.0513)	(0.126)	(0.127)	(0.120)	
Ln(Permanent Income)	1.136***	1.087***	1.141***	0.679***	0.0782***	
	(0.153)	(0.0642)	(0.154)	(0.165)	(0.0191)	
Ln(Transitory Income)	0.758***	0.274***	0.725***	0.203	3.519***	
	(0.151)	(0.0677)	(0.154)	(0.164)	(0.637)	
<b>Household's Head Characteristics</b>						
Age	0.00585	0.00766***	0.00682*	0.00826**	0.0203***	
	(0.00382)	(0.00168)	(0.00377)	(0.00366)	(0.00375)	
Gender	-0.126	-0.155**	-0.131	-0.115	-0.0578	
	(0.145)	(0.0624)	(0.143)	(0.137)	(0.141)	
<i>Marital Status (Cohabitation is omitted)</i>						
Married	0.136	0.138***	0.136	0.200**	0.310***	
	(0.0941)	(0.0422)	(0.0926)	(0.0917)	(0.0902)	
Widowed	-0.241	0.0853	-0.208	-0.0959	-0.253	
	(0.244)	(0.0813)	(0.249)	(0.256)	(0.205)	
Divorced	-0.133	0.0910	-0.117	0.0101	-0.0543	
	(0.223)	(0.0935)	(0.215)	(0.196)	(0.199)	
Single	0.327**	0.0986	0.334**	0.359**	0.516***	
	(0.163)	(0.0761)	(0.164)	(0.158)	(0.180)	
<i>Education (None/preschool is omitted)</i>						
Primary (1 - 5)	0.116	0.437***	0.166	0.150	0.323	
	(0.202)	(0.0725)	(0.211)	(0.209)	(0.213)	
Secondary (6 - 13)	0.449**	0.788***	0.490**	0.327	0.836***	
	(0.222)	(0.0756)	(0.233)	(0.229)	(0.226)	
Tertiary (univ/technical)	0.435*	0.732***	0.475*	0.291	0.976***	
	(0.259)	(0.0920)	(0.266)	(0.254)	(0.249)	
Graduate	0.208	0.418***	0.261	0.312	1.102***	
	(0.282)	(0.103)	(0.290)	(0.286)	(0.272)	
Informal	-0.142	-0.179***	-0.119	0.0515	-0.126	
	(0.0987)	(0.0344)	(0.0983)	(0.101)	(0.0957)	
<b>Other Household Characteristics</b>						
Household Members	-0.0811***	-0.0862***	-0.0738***	-0.0736***	-0.0340	
	(0.0277)	(0.0108)	(0.0279)	(0.0269)	(0.0254)	
<b>Sources of Funding</b>						
Own Resources	0.313***		0.331***	0.313***	0.220*	0.142
	(0.116)		(0.114)	(0.111)	(0.132)	(0.237)
Housing credit	0.394***		0.390***	0.377***	0.269**	0.468**
	(0.110)		(0.110)	(0.113)	(0.129)	(0.222)
Credit from friends/ relatives	0.237**		0.244**	0.273***	0.214*	0.0613
	(0.106)		(0.106)	(0.101)	(0.125)	(0.209)
Severance payments	0.165*		0.157	0.132	0.0480	0.469**
	(0.0959)		(0.0961)	(0.0894)	(0.111)	(0.193)
Other resources	0.129		0.0865	0.0874	0.0896	-0.267
	(0.156)		(0.155)	(0.148)	(0.154)	(0.383)
Subsidy	0.244*		0.232*	0.245**	0.267**	
	(0.130)		(0.121)	(0.123)	(0.120)	
Eligibility		-0.342***	-0.287***	-0.251***	-0.451*	
		(0.0398)	(0.0959)	(0.0911)	(0.257)	
<b>Income Quintile Controls</b>	<b>No</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>No</b>	

**Interaction  
with Social  
Housing Type**

## PRELIMINARY VERSION

Constant	-16.42***	-7.107***	-13.55***	3.189	0.190
	(3.459)	(1.731)	(3.674)	(4.439)	(2.682)
Observations	918	6861	918	918	918
R-squared	0.306	0.357	0.318	0.376	0.326

Robust standard errors in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## 5 CONCLUSIONS AND POLICY RECOMMENDATIONS

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## Appendix

<b>Hedonic Regression</b>					
	<i>Stratum</i>				
VARIABLES	(1)	(2)	(3)	(4)	(5 and 6)
<b>Wall Materials (bricks omitted)</b>					
Adobe	-0.671*** (0.118)	-0.437*** (0.0903)	0.0852 (0.148)	0.620*** (0.209)	
Wattle	-0.545*** (0.0891)	-0.514*** (0.110)	-0.262 (0.200)		
Wattle and Daub	-0.893*** (0.130)	-0.730*** (0.194)	0.431*** (0.153)		
Coarse Wood	-0.377*** (0.0951)	-0.864*** (0.171)	0.0440 (0.309)	0.421* (0.240)	
Prefabricated Material	0.0621 (0.193)	-0.295*** (0.0881)	-0.150* (0.0905)	0.589*** (0.136)	-1.489*** (0.403)
Bamboo, Cane, Another Plant	-1.067*** (0.211)	-1.089*** (0.391)			
Zinc, Cloth, Cardboard, Disposable Materials	-0.152 (0.190)	-1.029*** (0.334)			
<b>Floor Materials (Parquet, Marble omitted)</b>					
Cement	-0.278 (0.245)	-0.319*** (0.0961)	-0.339*** (0.0668)	0.849* (0.462)	-0.612** (0.288)
Dirt	-0.595** (0.254)	-0.466*** (0.127)	0.0384 (0.120)		
<b>Housing Utilities</b>					
Natural gas	0.220*** (0.0804)	0.121** (0.0472)	0.115** (0.0476)	0.111 (0.0718)	0.350** (0.156)
Aqueduct	0.228*** (0.0629)	0.130* (0.0696)	0.333* (0.194)	0.320 (0.402)	-1.652** (0.677)
Sewerage	0.231 (0.188)	-0.0716 (0.270)	0.183 (0.241)	1.483** (0.605)	-1.226*** (0.416)
Rubbish collection	0.387*** (0.0813)	0.255*** (0.0611)	0.222 (0.172)	2.178*** (0.410)	-0.788* (0.475)
<b>Housing Amenities</b>					
Garden or courtyard	-0.0468 (0.0641)	0.0797** (0.0379)	0.115*** (0.0389)	0.200*** (0.0564)	0.518*** (0.147)
Lot or plot	-0.103* (0.0597)	-0.0197 (0.0538)	-0.159* (0.0852)	0.479* (0.276)	0.414** (0.165)
Garage or parking place	-0.0756 (0.361)	0.183** (0.0932)	0.156*** (0.0399)	0.108* (0.0653)	0.105 (0.119)
Rooftop or terrace	0.0905 (0.0834)	0.150*** (0.0451)	0.211*** (0.0510)	0.299*** (0.103)	0.297** (0.146)
Green areas or areas of common property	0.295 (0.384)	0.0547 (0.0757)	-0.160*** (0.0419)	0.0894 (0.0826)	-0.0548 (0.114)

PRELIMINARY VERSION

<b>Household Head's Characteristics</b>					
<i>Education (None/preschool is omitted)</i>					
Primary (1 - 5)	-0.0241 (0.0666)	0.151*** (0.0576)	0.0594 (0.0728)	0.120 (0.225)	
Secondary (6 - 13)	0.259*** (0.0866)	0.318*** (0.0670)	0.178** (0.0877)	0.502*** (0.121)	-0.166 (0.355)
Tertiary (univ/technical)	0.211 (0.189)	0.495*** (0.0824)	0.355*** (0.0897)	0.544*** (0.106)	-0.143 (0.370)
Graduate	0.404 (0.284)	0.600*** (0.113)	0.310*** (0.108)	0.535*** (0.120)	0.0478 (0.369)
Permanet Income	0.187* (0.102)	0.304*** (0.0578)	0.203*** (0.0586)	-0.0529 (0.132)	-0.184 (0.244)
Temporary Income	0.212 (0.184)	0.593*** (0.0903)	0.331*** (0.0700)	0.0682 (0.120)	0.258** (0.110)
Age	0.00642*** (0.00195)	0.00646*** (0.00155)	0.00886*** (0.00197)	-0.000462 (0.00451)	-0.0102** (0.00481)
Observations	1884	3622	3307	1093	575
R-squared	0.522	0.483	0.329	0.229	0.475
Standard errors in parentheses.					
*** p<0.01, ** p<0.05, * p<0.1					