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Living Standards
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The Demand for Urban Housing in the Ivory Coast

Christiaan Grootaert and Jean-Luc Dubois

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The Demand for Urban Housing in the Ivory Coast

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The Demand for Urban Housing in the Ivory Coast

Christiaan Grootaert and Jean-Luc Dubois

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ABSTRACT

During recent years the large African cities have known a very strong population growth. The satisfaction of housing needs has therefore become a policy priority in many countries. Yet there is virtually no empirical work on African countries to provide estimates of the basic parameters of the demand for housing. This paper contains the first systematic estimates of the income and price elasticities of the demand for urban housing in the Ivory Coast. An integrated model of the choice of tenancy status and the demand for housing is presented and estimated. Also estimated is a multinomial logit model of the choice of type of accommodation.

The paper also addresses two methodological issues: (i) is there any evidence of selectivity bias in the estimation of housing demand equations, and, if so, to what extent does a correction of this bias affect estimated elasticities; and (ii) how sensitive are estimated elasticities to the functional form chosen for demand equations?

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1. INTRODUCTION

During recent years the large African cities have witnessed a very strong population growth. In the Ivory Coast, more than 42 percent of the country's population currently lives in cities, up from 19 percent in 1960. This corresponds to an annual population growth rate of 8.2 percent since 1970 (World Bank, 1984). In 1980, Abidjan, the economic capital and largest city, contained 1.6 million inhabitants or 20 percent of the country's population and 50 percent of the urban population. Forecasting studies on the development of Abidjan indicate that this growth will not slow down in the coming years (Massein, 1984).

As the provision of water, electricity, sewage, and transport has not kept pace with population growth, the urban housing stock has become inadequate, especially in Abidjan, where the influx of people has been the greatest. This is in spite of the fact that two thirds of urban public investment went to that city. The satisfaction of housing needs has therefore become a policy priority in the Ivory Coast.

Urban planners are concerned with predicting future housing needs in the light of population projections, taking into account the changing socioeconomic composition of households. About 20 percent of urban housing in the Ivory Coast currently is provided through the public sector. The proper planning of the future supply of public housing requires information about the important parameters of housing demand and of preferences for different types of housing and tenancy status. The questions to be addressed include: What is the impact on housing demand of the trend towards reduced household size and towards greater employment in the modern sector? What is the impact of a

changing level and distribution of household income on the demand for housing? What level of services will be required and to what extent are people willing to pay for these services? (Massein, 1984)

The purpose of this paper is to provide part of the answer to these questions. In particular we address three issues:

(i) What are the determinants of tenancy status?

(ii) What are the price and income elasticities of the demand for housing?

(iii) What determines the household's choice of type of accommodation?

Although these issues are important for urban policy in many developing countries, the available empirical work is very limited. Elasticity estimates are available for less than a dozen developing countries, none of which is a Sub-saharan African country (see the reviews by Jimenez and Keare, 1984, and Malpezzi, Mayo, and Gross, 1985). Estimated tenancy choice models are even rarer. The main culprit is presumably the lack of suitable data sets.

To the best of our knowledge, this paper contains the first attempt at estimating systematically the income and price elasticity of the demand for housing in a Sub-saharan African country. The paper is also the first developing country application of which we know of an integrated model of the choice of tenancy and the demand for housing.

The paper also examines two methodological issues:

(i) Is there any evidence of selectivity bias in the estimation of housing demand equations, and, if so, to what extent does a correction of this bias affect estimated elasticities? In the literature on United States housing, this problem has received

explicit treatment (see e.g. Lee and Trost, 1978, and Rosen, 1979), but this is not the case for housing studies on developing countries.[1]

(ii) How sensitive are estimated elasticities to the functional form chosen for demand equations? This issue has received a lot of attention in the housing literature, and it turns out that the answer depends a great deal on the country in question. Differences in the results between functional forms are typically larger in developing countries, presumably because the range of observed income and price values is wider (Mayo, 1981). It is thus useful to check the sensitivity of our results in the case of the Ivory Coast.

The plan of the paper is as follows. In section 2 the data used for this study are described briefly. Section 3 contains a crosstabular presentation of the housing situation in the Ivory Coast. The tables are organized in a supply and demand framework so that the presentation is consistent with the multivariate analysis. In section 4 we describe and in section 5 we estimate models of household behavior that pertain to the choice of tenancy status and type of housing, and the demand for housing. Income and price elasticities of the demand for housing are estimated with full attention to the methodological points mentioned in the preceding paragraph. A concluding section sums up the major findings of the study.

1/ One exception is Jimenez and Keare (1984) who test for selectivity bias in a sample of recent movers.

2. THE DATA

The data used in this study originate from a socioeconomic survey that was done in 1979 by the Direction de la Statistique of the Ivory Coast, over a sample of 1,930 households.[2/] The housing information, however, was collected only for 1,367 households of which 671 were in urban areas (295 households in Abidjan and 376 households in the other cities of the country). The survey was a multi-stage stratified design with unequal sampling fractions in the strata. A series of weights were constructed that are the inverse of the selection probabilities, corrected for incidence of missing values within each stratum, in order to make the resulting crosstabulations representative for the nation.

Rural households were visited once every two weeks over the entire survey year. During the first visit, the demographic and economic background information on the household was obtained and a retrospective module of the household's income and major expenditures was filled out. This module was repeated during each of the two-weekly visits. In addition, once every quarter, households were visited for seven consecutive days during which detailed information was obtained on the household's frequent expenditures, meals and activities. Since in urban areas seasonality in income and expenditures is much less than in rural areas, urban households were surveyed only in one quarter, and for the next quarter new households were brought into the sample.

The module on housing was asked of the head of household on the first day of interviewing. The questions covered tenancy status, amenities

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[2/] Non-African households were not covered by the survey.

available in the living quarter, duration of stay in the premises, rent paid, and recent history of rent increases.

3. TABULAR DESCRIPTION OF THE HOUSING MARKET

This section contains a description of the urban housing market in the Ivory Coast in a strict crosstabular format. The reason for this presentation is that often a survey's first data report produced by the statistical office is in this format.[3/],[4/]

The housing situation in Abidjan is very different from that in the other cities of the Ivory Coast. The sheer population difference means that urban problems exist on a much larger scale: in 1980 Abidjan contained 1.6 million people, while Bouaké, the next largest city, had a mere 268,500. All other cities are much smaller (Massein, 1984). We shall therefore distinguish Abidjan from the other cities in all crosstabulations. The limited number of available observations prevents a further breakdown for the other cities.

We begin by showing the frequency distributions and means of the major variables of interest that were retained for this study: tenancy status, rent, and housing type (section 3.1). These are the endogenous variables in the models of section 4. The explanatory variables are organized in a demand

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3/ All crosstabulations in this paper are based on weighted data. Consequently, totals may not equal exactly the sum of the components. Also, absolute numbers are rounded to the nearest integer, while percentages are not. Except in tables containing complete distributions, cells with fewer than three sample points are indicated by a " - ".

4/ Crosstabulations are useful to describe a data set. Care must be exercised in using them as a means for reading relationships inherent in the data, because tables often cannot contain all the necessary control variables. Hence, multivariate analysis is an essential follow-up to tables.

and supply framework. A first series of tables describes the characteristics of urban households that are thought to influence their demand for housing (section 3.2), and a second series describes the existing supply of urban housing (section 3.3).

Since we consider the stock of housing as given for this paper, equilibrium in the housing market is achieved through three choices in which households express their demand: the choice of tenancy status, the choice of type of housing, and the amount of housing they want to consume, expressed by the rent or imputed rent of the housing unit they chose to occupy.

A study of the city of Abidjan has shown that households choose first their tenancy status in function of their social, economic, and financial situation, and next the type and amount of housing they wish to live in. The first decision indeed has a longer time horizon, and the second decision can be revised several times within the context of a given tenancy status. For example, as the income of the household rises, it may decide to move to a larger or better equipped house, while remaining a renter; only when the household reaches a certain threshold of financial security, can it afford to switch tenancy status to ownership (Ministère de l'Economie, 1978).

The results from housing studies in developing countries indicate that the parameters of housing demand are different for renters and owners (Malpezzi, Mayo and Gross, 1985). Since the 1979 socioeconomic survey did not collect information on the value of owned housing, we can only estimate housing demand functions for renters. As Table 1 shows, about 80 percent of households in Abidjan and about 40 percent of households in other cities rent their premises.

Crosstabulations pertaining to the relation between the household's characteristics and the tenancy status choice are shown in section 3.4, and tables pertaining to the relation between the household's characteristics and type of housing in section 3.5. Lastly, section 3.6 documents the relationship between the amount of rent paid and the households' characteristics (demand side) and the characteristics of the housing stock (supply side). The behavioral models estimated in section 4 follow the same approach and are thus consistent with the tabular presentation. As will be seen these models are derived from the conventional theory of the utility maximizing consumer.

3.1 The decision variables

The household has three decisions to make with respect to housing: tenancy status, amount of housing, and type of housing.

Tenancy status indicates the way a living quarter is obtained by a household. In the Ivory Coast, six situations need to be distinguished:

(1) The household owns the housing unit in which it lives.

(2) The household rents the housing unit from the owner.

(3) The household rents from a person who him/herself is a renter but who does not live in the unit. This situation is referred to as subrenting.

(4) Housing is provided by the employer as salary-in-kind. No additional rent is paid by the household.

(5) Housing is provided rent free by a member of the extended family of the household.

(6) A housing unit is occupied without title, based only on the right of first arrival (for example, squatters).

Almost 80 percent of all households in Abidjan rent their premises. Even though in most large cities in developing countries renters are the majority (see, for example, Table 22 in Malpezzi, Mayo and Gross, 1985, and Table 6 in United Nations, 1980), Abidjan has an exceptionally low rate of home ownership. This fact is an important market outcome that will have to be kept in mind when designing policies for the provision of new housing. In other Ivorian cities, ownership is still the most widespread tenancy status. Subrenting is largely confined to Abidjan, while the provision of housing by the employer or by the extended family is predominant in other cities (Table 1).[5/]

Only the cases of renting and subrenting involve the explicit payment of rent. In the case of housing provided by the employer the rent is an implicit part of the salary received by the employee, but it does not show up in the expenditures of the household. Rent in this study refers to net annual rent, excluding expenses for repair, water and electricity. The average rent in Abidjan is about 40 percent higher than in other cities (Table 1).

Our main focus in this paper is the first three modes of tenancy: owning, renting and subrenting. This is imposed by two considerations. First, there are insufficient observations in categories (4) to (6) to allow separate modeling. Second, aggregation is not warranted because the

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5/ It is worth noting that in rural areas in the Ivory Coast there is virtually no diversity of tenancy status: 98 percent of all households own their homes.

TABLE 1: **Distribution of Tenancy Status**

	Abidjan		Other Cities		Total	
	n	%	n	%	n	%
Owner	34,754	16.02	102,446	45.14	137,200	30.91
Renter	158,584	73.10	92,236	40.64	250,820	56.50
Sub-renter	13,630	6.28	442	0.19	14,072	3.17
Lodged by family	2,812	1.30	17,762	7.83	20,574	4.63
Lodged by employer	4,524	2.09	13,126	5.78	17,650	3.98
Without title	2,638	1.22	962	0.42	3,600	0.81
ALL	216,942	100.00	226,974	100.00	443,916	100.00
Average Rent (CFA/year)	119,693		84,087		107,236	

households in these three categories are quite different from one another. Housing provided by the employer is a modality that follows directly from the employment choice, unlike the other tenancy statuses. A look at the data showed that families whose housing is provided by relatives are in a very different situation from regular renters. Consequently, analysis of the determinants of tenancy status (4) to (6) will have to await future, larger data sets. In this paper we restrict our sample to households in tenancy status (1) to (3). All following tables and analyses are based on those households only.

The 1979 socioeconomic survey does not contain a lot of detail on the physical characteristics of the housing units, such as type of construction material, number of rooms, etc. Rather, housing units were classified according to a typology that summarizes the physical quality of the housing units, and indicates whether the living quarter forms part of a compound.[6/] A compound (called "concession" or "cour" in the Ivory Coast) is a housing complex consisting of several adjacent houses or rooms around a courtyard to which there is a common entrance from the street. Each housing unit, however, has a private door on to the courtyard. A compound is usually occupied by several related or unrelated households. The typology is used by urban planners in the Ivory Coast and permits comparison with other housing surveys

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6/ This classification was done in the field by sociologists who accompanied the pre-survey teams during the establishment of the household listing from which the survey sample was drawn. This information, however, was missing for about 15 percent of the observations in the data file we used (see Table 2).

TABLE 2: **Distribution of Type of Housing**

	Abidjan		Other Cities		Total	
	n	%	n	%	n	%
House	339	0.16	1,979	1.01	2,318	0.58
Apartment, high quality	1,808	0.87	409	0.21	2,217	0.55
Apartment, medium and low quality	61,661	29.79	12,529	6.42	74,190	18.45
Compound, high quality	32,649	15.77	113,540	58.19	146,189	36.36
Compound, medium quality	57,281	27.68	576	0.30	57,857	14.39
Compound, low quality	8,194	3.96	1,121	0.57	9,315	2.32
Traditional	18,732	9.05	33,727	17.28	52,459	13.05
Not classified	26,304	12.71	31,243	16.01	57,547	14.31
ALL	206,968	100.00	195,124	100.00	402,092	100.00

(see Babut, Dubois and Odounfa, 1984 for details). There are seven categories:

(1) Modern residential houses, high quality.

(2) Apartments and similar living quarters in a modern building, high quality.

(3) Apartments and similar living quarters in a modern building, medium or low quality.

(4) Housing units in a compound, high quality.

(5) Housing units in a compound, medium quality.

(6) Housing units in a compound, low quality.

(7) Traditional housing.

The first two types constitute the most modern urban living style, which is found, for example, in the villas in Cocody, or the modern high-rises on the Plateau in Abidjan. The third type contains a lot of modern but often quite modest apartment units that were built by private and parastatal construction companies. There is a very wide quality range among housing units in compounds: the best are quite akin to modern housing units, while the low quality units can be simple makeshift structures on lots with almost no infrastructure. Traditional housing was originally only found in rural areas, but is now also seen in cities because of the territorial expansion of cities.

The housing stock in Abidjan is very different from that in other cities (Table 2). In Abidjan the number of housing units in modern buildings is much higher. This is a result of government efforts to improve living conditions which has reduced compound housing, although the latter still makes up almost 50 percent of all living quarters. In the other cities, all but

about 8 percent of housing units are either in compounds (high quality) or are of the traditional type.

3.2 Variables that affect the demand for housing

In this section we discuss the socioeconomic category of the household, its annual expenditures, demographic variables such as household size, age, sex, and nationality of the head of household, and the duration of stay in the housing unit.

The socioeconomic status of a household has been defined by the characteristics of the main employment of the head of household. The typology reflects the sector of activity (traditional, agriculture, modern, or government), the activity status (employee or self-employed), and, in the case of employees, whether the individual has managerial responsibility. This gives eight categories in total: (i) employee in the traditional sector; (ii) self-employed in the traditional sector; (iii) employee in the modern sector; (iv) employee in the public sector; (v) manager in the private sector; (vi) manager in the public sector; (vii) self-employed in the modern sector; (viii) farmer. A ninth category contains the households whose head is inactive or for whom the occupation is unknown.

As one might expect, the socioeconomic composition of the population in Abidjan is very different from the other cities (Table 3). Abidjan is primarily characterized by a large incidence of employees, both in the private and in the government sector, while in the other cities self-employed people in the traditional sector and farmers are predominant.

TABLE 3: **Distribution of Households by Socioeconomic Category**

	Abidjan		Other Cities		Total	
	n	%	n	%	n	%
Employee, Traditional Sector	6,912	3.34	5,468	2.80	12,380	3.08
Self-employed, Traditional Sector	25,969	12.55	48,349	24.78	74,318	18.48
Employee, Modern Private Sector	84,528	40.84	27,947	14.32	112,475	27.97
Employee, Government	9,014	4.36	977	0.50	9,991	2.48
Manager, Modern Private Sector	47,131	22.77	33,571	17.20	80,702	20.07
Manager, Government	8,159	3.94	2,430	1.25	10,589	2.63
Self-employed, Modern Private Sector	11,310	5.46	11,902	6.10	23,212	5.77
Farmer	1,795	0.87	44,495	22.80	46,290	11.51
Inactive or Unknown Occupation	12,150	5.87	19,985	10.24	32,135	7.99
ALL	206,968	100.00	195,124	100.00	402,092	100.00

The household's annual expenditures in urban areas are a good proxy for their annual consumption since consumption of home grown or home-made items is not very important. The expenditure level in Abidjan is much higher than in the other cities (Table 4). In part this is related to the socioeconomic differences, since modern sector employees who are in the majority in Abidjan tend to have high expenditure levels.

The criteria used in the survey to establish household membership tried to reflect effective presence in the household: household members needed to be related to the head of household, to contribute to the household budget, and to participate in the household's consumption and activities. The average household size in urban areas of the Ivory Coast is 6.7 members, with little difference between Abidjan and the other cities.

The average age of the household head is 41 years, but households in Abidjan have slightly younger heads. Households headed by women are only 5 percent of households in Abidjan but that incidence is twice as high in the other cities.

The nationality of the household is determined by that of its head. Here we only distinguish Ivorian from non-Ivorian African households. The urban population in the Ivory Coast contains 28 percent of non-Ivorian households, but that proportion is larger in Abidjan. We might note that Ivorian households have a higher level of expenditures than non-Ivorian households, but their expenditure per capita level is almost the same.

The duration of occupation is the time in years that a household has lived in the same housing unit. In other cities households stay on the average 3.5 years longer in their living quarters than households in Abidjan. Mobility in Abidjan is thus much greater. Managers and employees in

TABLE 4: Selected Characteristics of Urban Households

	Abidjan	Other Cities	Total
Average Household Expenditures (CFA/year)	838,394	550,393	700,489
Average Household Size	6.5	6.9	6.7
Average Expenditures Per Capita (CFA/year)	161,036	99,299	131,474
Average Age of Household Head	39.5	42.6	41.0
Percent of Households headed by Women	4.64	9.41	6.93
Percent of Non-Ivorian Households	32.01	24.55	28.49
Average Stay in Living Quarter (years)	6.8	10.3	8.4

the government and private modern sector have a stronger mobility than the self-employed or the workers in the traditional and agricultural sectors.

3.3 The existing stock of housing

The stock of housing can be described by the physical quality of the housing units, the geographic dispersion of the units, and the amenities available. The first of these, the quality, has already been described in section 3.1 because it is one of the decision variables. As to geographic dispersion, Abidjan has been subdivided into a number of districts (some of these had to be grouped together in order to obtain sufficient sample size) (Table 5):

(1) Treichville;

(2) Adjamé;

(3) Koumassi, Port-Bouet, Zone 4, Vridi;

(4) Cocody, Williamsville;

(5) Marcory;

(6) Yopougon, Locodjoro, Banco;

(7) Abobo.[7/]

7/ While maintaining geographic proximity, this grouping unfortunately reduces the homogeneity of certain districts. For example, Cocody is a residential zone while Williamsville is a less elegant district. The same holds true for Zone 4 which is primarily residential and has been grouped with the lower rent districts of Koumassi, Port-Bouet and Vridi.

TABLE 5: **Geographic Distribution of Housing Units**

	Abidjan	
	n	%
Treichville	17,087	8.26
Adjamé	21,568	10.42
Koumassi, Port-Bouet, Zone 4, Vridi	45,317	21.90
Cocody, Williamsville	31,673	15.30
Marcory	12,876	6.22
Yopougon, Locodjoro, Banco	43,423	20.98
Abobo	35,024	16.92
TOTAL	206,968	100.00
	Other Cities	
	n	%
Less than 30,000 inhabitants	77,868	39.91
More than 30,000 inhabitants	84,106	43.10
Bouaké	33,150	16.99
TOTAL	195,124	100.00

For the other cities we distinguish:

(1) Towns with less than 30,000 inhabitants;

(2) Larger cities (Man, Gagnoa, Daloa, Divo, Korhogo, Abengourou and Yammoussoukro), which have between 30,000 and 100,000 inhabitants;

(3) Bouaké, the second largest city in the Ivory Coast, with about 268,500 inhabitants.

We have information available on only two housing amenities, water supply and source of lighting, both of which are, however, among the most important. Water supply can come from a personal or collective tap on the national system of water distribution (SODECI), households can purchase water from a merchant, or fetch water from a public standpipe, a well, or directly from a river or lake. In Abidjan 38 percent of households are hooked up to the national supply system, and 47 percent of them buy from water vendors. By contrast, in other cities wells are the prime source of water provision (59 percent), while only 18 percent of households have a private tap.

The most common source of lighting in Abidjan (68 percent) is a hook-up to the national electricity distribution grid (EECI), but 32 percent of households still rely on other means such as a household generator, petroleum/kerosene lamps, flashlights, or candles. In the other cities, 51 percent of households have electricity in their homes.

3.4 Relation between household characteristics and tenancy status

The two-way relationships between tenancy status and some of the household characteristics that can influence the choice of status are pictured in Tables 6 and 7. There is a clear relation between tenancy status and size of household: owners have the largest families, followed by renters, and subrenters have the smallest families. This coincides with a declining age of head: owners have the oldest household heads, subrenters the youngest. Thus it appears that households switch tenancy status as they move through different phases of their life cycle: they start out as subrenters and end up as owners.

TABLE 6: **Characteristics of Households by Tenancy Status**

	Abidjan	Other Cities	All
	----------Average Household Size----------		
Owner	7.6	8.1	8.0
Renter	6.4	5.5	6.1
Sub-renter	4.5	-	4.8
	------Average Expenditures (CFA/year)------		
Owner	801,355	471,448	558,463
Renter	878,628	624,962	785,987
Sub-renter	477,329	-	553,421
	Average Expenditures Per Capita (CFA/year)		
Owner	124,646	71,267	85,346
Renter	173,041	129,113	156,998
Sub-renter	117,913	-	122,489
	------Average Age of Head of Household------		
Owner	47.2	48.6	48.2
Renter	38.2	36.0	37.4
Sub-renter	35.5	-	36.1
	---------Average Duration of Stay---------		
Owner	14.9	16.1	15.8
Renter	5.5	5.0	5.3
Sub-renter	5.6	-	5.5
	----Percent of Female Headed Households---		
Owner	2.45	11.87	9.42
Renter	4.89	6.72	5.56
Sub-renter	7.45	-	7.22
	----Percent of Non-Ivorian Households-----		
Owner	21.93	9.97	12.76
Renter	28.92	40.76	33.07
Sub-renter	85.66	-	82.85

TABLE 7: **Distribution of Households by Socioeconomic Group and Tenancy Status**

	Employee Traditional	Self-Employed Traditional	Employee Modern	Employee Government	Manager Modern	Manager Government	Self-employed Modern	Farmer	Inactive or Unknown	All
					Abidjan					
Owner	2.92	15.20	32.05	2.31	28.81	3.98	2.92	-	11.81	100.00
Renter	3.54	11.38	42.80	5.05	21.52	4.14	6.49	1.13	3.94	100.00
Sub-renter	2.02	19.35	40.50	1.53	21.89	1.53	-	-	13.17	100.00
					Other Cities					
Owner	4.41	16.67	8.49	-	9.68	1.08	7.46	37.10	15.11	100.00
Renter	1.03	33.90	20.87	1.06	25.65	0.96	4.62	7.03	4.89	100.00
Sub-renter	-	-	-	-	-	100.00	-	-	-	100.00
					All					
Owner	4.03	16.30	14.46	0.59	14.52	1.81	6.31	27.70	14.27	100.00
Renter	2.62	19.66	34.73	3.58	23.04	2.97	5.80	3.30	4.29	100.00
Sub-renter	1.96	18.74	39.23	1.49	21.21	4.63	-	-	12.76	100.00

The relation between expenditure level and tenancy status is at first sight puzzling, since owners have a lower average total and per capita expenditure level than renters. This seems to go counter to what the life cycle model would predict, but actually does not. The reason is that in modern Ivory Coast age and income level are not positively correlated over the entire age range. The younger generation has had good access to education and consequently has obtained many high paying modern sector jobs. They often earn more than their parents do or did at the end of their active life. At the same time, as a result of Abidjan's rapid population growth which has outpaced the growth in housing stock, the young now face higher house prices than their parents did at the time they purchased their homes. As a result, the younger people must be content to rent even though they have high incomes. In other words, the threshold of financial means to purchase a home, and thus the age at which this can be done, has moved up over time. In addition, preferences may have shifted: the younger generation may be less inclined than their parents to become owners, especially in Abidjan where commuting problems are severe, and prefer the rental housing which is located in the center of the city close to modern enterprises and government offices. Table 7 indeed shows that households whose heads work in the modern and government sectors have a somewhat higher tendency to become renters. When we only look at households with heads younger than 40, we find a much smaller proportion of owners (less than 10 percent) than for all households. Among these younger families though, the owners do have a higher level of per capita expenditures than the renters, which is consistent with the normal life cycle pattern.

The subrenter status, a phenomenon limited to Abidjan, is a tenancy status primarily chosen by young non-Ivorian households, many of whom are probably recent migrants, and also to some extent by households headed by women.

3.5 Relation between household characteristics and type of housing

Tables 8 and 9 show the distribution of selected household characteristics that are expected to have an impact on the household's choice of housing type. The larger the households are, the more often they live in higher quality living quarters. This phenomenon is quite clear in Abidjan and less so in other cities. It merely reflects the progress of households over their life cycle, and parallels the move from renting to owning that we discussed in the previous section. The highest incidence of owning occurs indeed in the high quality compound and traditional housing units. The higher age of the household head and the longer duration of stay in the high quality compound units confirm that these are the "end points" in many households' aspirations for upgrading their housing condition.

The presence of two generations in our data is shown by the fact that households in medium and low quality apartments are smaller and younger than those in high quality compound housing, but nevertheless have a higher expenditure level. This suggests that apartments are not considered "the next step" - when income rises - for those currently living in high quality compound housing, but rather a starting point for a younger generation that has a higher income to begin with. The socioeconomic group data confirm this

TABLE 8: **Selected Household Characteristics by Type of Housing**

	Abidjan	Other Cities	Total
	--------Average Household Size----------		
House	-	-	10.5
Apartment, high quality	-	-	8.0
Apartment, medium & low quality	6.8	6.3	6.7
Compound, high quality	6.9	7.0	7.0
Compound, medium quality	6.4	-	6.4
Compound, low quality	4.1	-	4.7
Traditional	6.7	6.9	6.8
	Average Household Expenditures (CFA/year)		
House	-	-	1,757,790
Apartment, high quality	-	-	1,436,656
Apartment, medium & low quality	1,107,787	936,254	1,078,101
Compound, high quality	869,744	578,689	645,298
Compound, medium quality	648,117	-	643,755
Compound, low quality	362,912	-	388,952
Traditional	619,423	382,112	468,924
	Average Household Expenditures Per Capita (CFA/year)		
House	-	-	205,604
Apartment, high quality	-	-	186,984
Apartment, medium & low quality	220,269	161,019	210,015
Compound, high quality	158,483	101,417	114,477
Compound, medium quality	124,240	-	123,421
Compound, low quality	108,324	-	102,671
Traditional	103,912	74,240	85,095
	------Average Age of Household Head------		
House	-	-	37.0
Apartment, high quality	-	-	37.6
Apartment, medium & low quality	40.3	31.6	38.8
Compound, high quality	44.8	43.7	43.9
Compound, medium quality	36.7	-	36.8
Compound, low quality	31.0	-	34.0
Traditional	41.3	43.3	42.5

Continued

Table 8 continued

	-----Average Duration of Stay (years)-----		
House	-	-	5.4
Apartment, high quality	-	-	10.9
Apartment, medium & low quality	6.3	3.5	5.9
Compound, high quality	11.4	11.9	11.8
Compound, medium quality	4.3	-	4.8
Compound, low quality	7.5	-	9.9
Traditional	7.0	10.0	8.9
	----Percent of Female Headed Households----		
House	-	-	-
Apartment, high quality	-	-	-
Apartment, medium & low quality	8.49	-	8.37
Compound, high quality	7.73	12.32	11.28
Compound, medium quality	-	-	-
Compound, low quality	-	-	-
Traditional	-	-	-
	------Percent Non-Ivorian Households-------		
House	-	-	-
Apartment, high quality	-	-	-
Apartment, medium & low quality	17.49	18.70	17.69
Compound, high quality	49.57	29.80	34.26
Compound, medium quality	29.26	-	28.97
Compound, low quality	87.61	-	77.07
Traditional	34.91	10.10	19.06
	----------Percent Owners----------		
House	-	-	33.33
Apartment, high quality	-	-	-
Apartment, medium & low quality	5.33	-	5.56
Compound, high quality	23.08	48.55	42.70
Compound, medium quality	10.98	-	11.43
Compound, low quality	-	-	-
Traditional	43.48	81.81	68.75

TABLE 9: **Distribution of Households by Socioeconomic Group and Type of Housing**

	Employee Traditional	Self-Employed Traditional	Employee Modern	Employee Government	Manager Modern	Manager Government	Self-Employed Modern	Farmer	Inactive or Unknown	Total
					Abidjan					
House	-	-	-	33.33	-	66.67	-	-	-	100.00
Apartment, high quality	-	-	21.63	-	65.93	12.44	-	-	-	100.00
Apartment, medium & low quality	5.08	7.04	38.22	11.41	23.99	9.43	1.65	-	3.18	100.00
Compound, high quality	7.62	22.78	30.72	1.87	13.74	4.91	6.45	-	11.91	100.00
Compound, medium quality	0.48	9.60	45.18	-	31.92	0.20	9.48	-	3.13	100.00
Compound, low quality	-	-	56.20	-	21.89	-	-	21.91	-	100.00
Traditional	5.42	29.50	37.97	-	16.27	-	10.84	-	-	100.00
					Other Cities					
House	-	29.06	-	16.42	16.42	22.33	-	-	15.77	100.00
Apartment, high quality	66.75	-	-	-	33.25	-	-	-	-	100.00
Apartment, medium & low quality	-	9.99	29.40	-	49.19	6.01	-	-	5.41	100.00
Compound, high quality	3.40	27.84	15.24	0.07	15.05	-	6.62	21.79	9.99	100.00
Compound, medium quality	-	-	-	-	-	-	-	100.00	-	100.00
Compound, low quality	-	24.26	-	-	-	-	-	-	75.74	100.00
Traditional	-	14.85	12.16	-	16.07	1.70	5.72	42.06	7.43	100.00
					All					
House	-	24.81	-	18.90	14.02	28.82	-	-	13.46	100.00
Apartment, high quality	12.31	-	17.64	-	59.90	10.15	-	-	-	100.00
Apartment, medium & low quality	4.22	7.54	36.73	9.49	28.24	8.86	1.37	-	3.55	100.00
Compound, high quality	4.35	26.71	18.70	0.47	14.76	1.10	6.58	16.93	10.42	100.00
Compound, medium quality	0.48	9.51	44.73	-	31.60	0.20	9.39	1.00	3.10	100.00
Compound, low quality	-	2.92	49.44	-	19.26	-	-	19.27	9.11	100.00
Traditional	1.94	20.08	21.37	-	16.14	1.10	7.55	27.04	4.78	100.00

since the apartments are primarily occupied by government and modern private sector employees and managers. The self-employed households and also the lower paid employees in the private modern sector tend to live in compound housing.

The positive correlation between housing quality and level of expenditures is no surprise of course, but the range of average expenditure levels is certainly noteworthy. The total expenditures of families that live in high quality houses is 4.5 times that of residents of low quality compound housing. On a per capita basis the ratio is about 2:1.

Non-Ivorian households are over-represented in the low quality units in Abidjan, but not in the other cities. Female headed households, perhaps surprisingly, are mostly found in the apartments and high quality compound housing.

3.6 Rent

As a market price, rent is affected by demand and supply factors. Consequently, we shall first discuss the relationship between rent paid and those household characteristics that can affect the demand for housing, and then the relation between rent and the characteristics of the stock of housing that constitutes the current supply.

3.6.1 Rent and household characteristics

As Table 10 indicates, of all the demand factors considered, household expenditures have the most direct relationship with rent. Household size is also positively related to rent except for small households. This exception occurs because of the indivisibility of housing: there is typically

TABLE 10: **Average Rent (CFA/year): Demand Factors**

	Abidjan	Other Cities	Total
Household Expenditures (CFA/year)			
0-250,000	45,998	32,463	37,351
250,001-500,000	62,765	73,441	67,477
500,001-1,000,000	111,717	96,099	107,527
1,000,001-2,000,000	166,904	170,131	167,551
>2,000,000	221,358	224,650	222,303
Household Size			
1-3	115,889	38,088	75,865
4-7	108,989	101,037	106,474
8-12	136,514	104,469	128,682
>12	154,040	170,616	161,349
Age of Head			
<30	115,673	81,143	101,887
30-39	124,880	101,401	116,647
40-49	107,924	69,079	95,220
>49	128,084	74,548	114,274
Sex of Head			
M	117,757	86,162	106,938
F	136,096	77,247	111,953
Nationality			
Ivorian	132,353	103,912	123,577
Non-Ivorian	95,859	71,222	86,635
Socioeconomic Group			
Employee, traditional	129,250	-	129,201
Self-employed, traditional	90,185	73,784	80,315
Employee, modern private	106,274	71,068	98,959
Employee, government	175,617	-	171,072
Manager, modern private	127,392	117,203	123,426
Manager, government	272,952	-	245,197
Self-employed, modern private	97,159	91,236	95,426
Farmer	-	44,983	40,433
Inactive or Unknown Occupation	139,510	61,047	111,337
All Households	119,693	84,087	107,236

Averages calculated over renting and subrenting households only.

a minimum amount of housing that must be purchased or rented regardless of household size and needs. Rent paid does not seem to rise systematically with age of household head, so the life cycle effect that we observed earlier on choice of tenancy status and type of housing is not necessarily reflected in the amount of rent paid. The generation effect can, however, play a role again in disguising the true relationship. The multivariate analysis will reveal the net correlation between age and rent.

There are some marked differences between the rents paid by different socioeconomic groups. The self-employed pay considerably less rent than all other groups. We saw earlier that the self-employed also have a preference for owning their living quarters. Not surprisingly, government employees and managers pay the most in rent since they like to live in apartments, which demand a high rent, and they also have a high income.

Non-Ivorian households pay less rent, in part because they are more frequently subrenters, who pay lower rents on the average. Women headed households pay more rent in Abidjan, but less in other cities.

An alternative way to present the rent data is as percentages of the households' total expenditures (Table 11). Seen as market outcomes, these percentages indicate the households' willingness to spend their income on (rental) housing. The average for urban Ivory Coast is 16.2 percent, with a slightly lower percentage in Abidjan. Rent shares decline with income level, as is generally found (Mayo and Gross, 1985). Households with average yearly expenditures below CFA 500,000 spend larger fractions on rent when they live in other cities compared to Abidjan, but the reverse is true for households with higher expenditure levels.

TABLE 11: **Share of Rent in Household Expenditures (%)**

	Abidjan	Other Cities	Total
Household Expenditures (CFA/year)			
0-250,000	22.5	24.2	23.6
250,001-500,000	16.7	19.0	17.7
500,001-1,000,000	15.8	14.1	15.3
1,000,001-2,000,000	13.2	11.5	12.9
>2,000,000	8.8	7.2	8.3
Household Size			
1-3	18.3	21.0	19.7
4-7	15.5	16.3	15.7
8-12	14.1	14.9	14.3
>12	15.2	19.0	16.9
Age of Head			
<30	15.9	18.0	16.9
30-39	15.6	20.8	17.5
40-49	14.8	13.0	14.3
>49	16.0	13.1	15.2
Sex of Head			
M	15.5	17.7	16.3
F	15.6	16.6	16.0
Nationality			
Ivorian	15.4	17.5	16.0
Non-Ivorian	17.1	17.6	17.2
Socioeconomic Group			
Employee, traditional	17.3	-	23.4
Self-employed, traditional	17.6	16.2	16.7
Employee, modern private	15.1	20.7	16.3
Employee, government	18.7	-	18.9
Manager, modern private	14.4	18.2	15.9
Manager, government	16.4	-	15.0
Self-employed, modern private	13.3	18.2	14.7
Farmer	-	10.8	9.6
Inactive or Unknown Occupation	20.6	10.0	17.5
All Households	15.5	17.6	16.2

Shares calculated over renting and subrenting households only.

The rent share declines with household size (except for very large households), probably because of the same indivisibility mentioned earlier. As was the case for rent paid, we observe no clear life cycle effect in the relationship between rent share and age of household head.

The percentage of expenditures devoted to rent is higher for government employees and managers than for their private sector colleagues. In Abidjan, the modern sector self-employed have rent shares below average, but in other cities above average. People in traditional occupations in Abidjan spend above average percentages on rent.

Non-Ivorian households, who pay less rent than Ivorian households, have nevertheless a higher rent share in Abidjan. Male and female headed households devote the same share of expenditures to rent.

The percentage of income devoted to housing is an important parameter in the design of housing projects. In that context it is generally referred to as the affordability ratio. Housing projects designed with too high an affordability ratio will not be able to reach fully their intended beneficiaries, unless the difference between real and assumed willingness to pay is made up with subsidies. Often it is assumed that households are willing to pay between 20 and 25 percent of their income on housing (Mayo and Gross, 1985). As Table 11 indicates, this is clearly too high for most urban households in the Ivory Coast (at least for renters - owners generally spend a slightly higher fraction of their income on housing).

3.6.2 Rent and the characteristics of the housing stock

The supply of housing, that is, the existing housing stock, affects the rent in two ways: through the quality of the housing unit and the

contractual aspects of the rent agreement. Quality is of course positively related to the amount of rent: houses require more rent than apartments, and the latter require more rent than compound housing (Table 12). Within each type, the rent also rises with the quality level and with the available amenities. There are high rent premiums associated with the availability of a private water tap and electricity, particularly in the other cities where these features are relatively rarer. Table 12 also shows that rents differ a great deal between districts in Abidjan, although the multivariate analysis will be needed to show whether these are true location effects or merely the results of differences in the composition of the housing stock. Outside Abidjan, the size of the city has no effect on rent, except in Bouaké.

The contractual arrangements are quite important in determining the rent. Subrenters pay significantly less rent than those who rent from owners, but a large part of this effect is probably due to quality differences of the units in question. A long lasting tenancy is associated with lower rents, particularly in Abidjan which has known sharp rent increases in recent years, especially affecting new tenants.

This concludes our crosstabular presentation of the data on urban housing in the Ivory Coast. We now turn to multivariate analysis which can serve as the empirical basis for the formulation of housing policies.

TABLE 12: **Average Rent (CFA/year): Supply Factors**

	Abidjan	Other Cities	Total
Housing Type			
House	395,310	456,000	446,547
Apartment, high quality	190,472	319,951	218,655
Apartment, medium & low quality	173,467	170,361	172,939
Compound, high quality	104,161	68,370	79,268
Compound, medium quality	84,953	-	84,953
Compound, low quality	42,368	-	42,368
Traditional	75,600	54,497	67,654
District			
Treichville	120,028		
Adjamé	110,261		
Koumassi, Port-Bouet, Zone 4, Vridi	159,949		
Cocody, Williamsville	98,735		
Marcory	113,811		
Yopougon, Locodjoro, Banco	122,521		
Abobo	91,349		
City Type			
Less than 30,000 inhabitants		79,988	
More than 30,000 inhabitants		74,211	
Bouaké		111,208	
Amenities			
Private water tap	170,174	167,441	169,649
Other source	88,085	67,008	79,217
Electricity	142,819	118,565	135,198
No electricity	74,977	39,983	60,657
Tenancy Status			
Renter	123,328	83,627	108,729
Sub-renter	77,406	-	80,628
Duration (years)			
0-2	150,894	83,219	116,255
3-5	113,739	89,727	106,310
6-8	116,044	67,132	107,610
>8	97,084	85,864	92,690

Averages calculated over rented and subrented units only.

4. MODELLING THE DEMAND FOR HOUSING

The demand for housing can be derived within the standard household utility maximization framework. The household's utility U depends on the consumption of housing H and other goods Z:

$$U = U(H,Z) \qquad (1)$$

The household maximizes U subject to a budget constraint $Y = p_h H + p_z Z$ where Y is income, p_h is the unit price of housing, and p_z is a price index for all non-housing goods. With p_z as a numeraire, the maximization exercise yields a demand function for housing:

$$H = h(Y,p_h) \qquad (2)$$

The basic problem for estimating this equation is that none of the variables is directly observable.[8/] Housing price and quantity are observed jointly either as rent paid or as the value of a home purchased, that is, in both cases, as a household expenditure. In addition, housing is not a very divisible good - usually, one extra unit of housing cannot be purchased or consumed - and is very heterogeneous in nature. Various solutions have been proposed in the literature. A simple but appealing - and frequently used - approach is to estimate (2) as an expenditure equation with either actual or imputed rent as dependent variable (see the reviews in Mayo, 1981, and

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8/ See Quigley (1979) for a good review of problems in the estimation of housing demand models.

Malpezzi, Mayo and Gross, 1985). If a double log specification is used, the estimated equation yields directly the price and income elasticities e_p and e_y, of the demand for housing:

$$\ln(p_h H) = \alpha + e_y \ln Y + (e_p + 1)\ln p_h$$

Demographic and other variables can be added to improve the specification.

The calculation of a housing price variable is a major challenge, and Mayo (1981) lists the four ways this has been accomplished in United States housing studies: (1) based on household budget data containing relative price information; (2) based on housing production functions which transform land and other housing input prices into output prices; (3) based on hedonic indexes of housing services, and (4) based on the data from the Housing Allowance Demand Experiment, which simulated variations in relative housing prices by variable rent rebates. For developing country studies, the base information is much scarcer and most studies either do not estimate price elasticities at all or derive them in indirect ways, for example, from an expanded linear expenditure system (Malpezzi, Mayo and Gross, 1985). The production function approach has been applied to Korean data by Follain, Lim and Renaud (1980) and the hedonic approach has been used by Ingram (1981) on Colombian data.

In this paper we follow the basic approach of estimating the housing demand equation with rent as dependent variable, but we test various functional forms. The data do not allow the calculation of relative prices and we derive the price elasticity of the demand for housing using the Stone-Geary utility framework. Since we have some, albeit limited, information on

housing attributes, we also estimate an hedonic price index, use it to reestimate the demand equations with a price variable, and compare the results. This exercise, however, is presented in an appendix because the results turned out less robust than those presented in the main part of the paper.

Consumption theory holds that quantities demanded are determined by permanent income, which is unobserved, rather than current income. The use of the latter in demand functions is, however, often necessitated by data limitations. The purchase or the renting of a home is an infrequent event with high transaction costs and thus with a long time horizon. It is therefore essential to use a measure of permanent income in a housing demand equation. In the literature, this has been approximated by taking the average of several years income, if such longitudinal information is available (Jimenez and Keare, 1984; Lee and Trost, 1978; Rosen, 1979), by estimating an instrumental variable based on long-run characteristics such as education and age that are deemed to be determinants of permanent income (Goodman and Kawai, 1982, 1984), or by using expenditures as a proxy (Follain, Lim and Renaud, 1980, 1982; Jimenez and Keare, 1984). In this paper we use this last approach.

A household can satisfy its housing demand in two ways, that is by purchasing or renting living quarters. Consider the latent variable R^* which measures a household's tendency to rent:

$$R_i^* = \alpha W_i + u_i \qquad (3)$$

where W is the vector of variables that determines the choice. In practice, we observe only the dichotomous variable R_i:

$$R_i = 1 \quad \text{if} \quad \alpha W_i > -u_i$$
$$R_i = 0 \quad \text{if} \quad \alpha W_i \leq -u_i$$

For the households that have chosen to rent, we observe a rent payment:

$$H_i = \beta X_i + \varepsilon_i \quad \text{if } R_i = 1 \qquad (4)$$

where X is the vector of household attributes that determines the demand for housing. The distribution of H_i is truncated and conditional upon $R_i = 1$ or $\alpha W_i > -u_i$ so that

$$E(H_i | X_i, R_i = 1) = \beta X_i + E(\varepsilon_i | \alpha W_i > -u_i).$$

OLS estimates of (4) will be biased if the covariance $\sigma_{\varepsilon_i, u_i} \neq 0$. This will occur if there are variables not explicitly specified in the choice equation that tend to systematically increase or decrease the amount of rent paid. However, it can be shown that:

$$E(\varepsilon_i | \alpha W_i > -u_i) = \frac{\sigma_{\varepsilon_i, u_i}}{\sigma_{\varepsilon_i}} \frac{f\dfrac{\alpha W_i}{\sigma_{\varepsilon_i}}}{F\dfrac{\alpha W_i}{\sigma_{\varepsilon_i}}}$$

$$= \partial \lambda_i$$

where f(.) and F(.) are the standard normal probability density function and cumulative density function, respectively (Heckman, 1976, 1979). The inclusion of λ_i as regressor in (4) will correct for biases due to the "selectivity" of the observations on which the rent equation is estimated. Since λ_i is not known, estimates $\hat{\lambda}_i$ must be obtained and this can be done from a maximum likelihood probit estimation of (3). Then, the estimation of:

$$H_i = \beta X_i + \partial\hat{\lambda}_i + v_i \qquad (5)$$

yields consistent coefficient estimates. Since the error structure of this equation is heteroscedastic, only asymptotically valid standard errors can be computed.

A parallel equation exists for home owners, with the left hand side referring to the annualized value of the consumption of housing services derived from the purchased home. No information was gathered in the 1979 socioeconomic survey on the value of the purchased home or other variables that would allow for calculation of an annual consumption value, here therefore, we cannot pursue the estimation of the demand for owned housing.

The last housing decision made by households is the choice of housing type. We assume that for each alternative type T_j a choice function can be written

$$T_{ij} = \gamma_j Z_{ij} + \eta_{ij} \text{ for } j = 1,..,J \qquad (6)$$

If we assume the η_j to have independent and identical Weibull distributions, the probability of household i choosing housing type j is

$$P_{ij} = \frac{e^{\gamma_j Z_{ij}}}{\sum_{k=1}^{J} \varepsilon^{\gamma_k Z_{ik}}}$$

This so-called multinomial logit model is consistent with utility maximization and can be estimated by maximum likelihood (McFadden, 1974; Domencich and McFadden, 1975).

As discussed earlier, we take the type of housing choice to be recursive with respect to the tenancy decision, hence R_i will be an element of Z_i. Note that W_i, the determinant of the tenancy decision, and Z_i may have common elements. They cannot, however, overlap completely, since in that case the two choices are not identifiable and would have to be modeled as a joint decision.

5. ESTIMATION

5.1 The tenancy choice equation

Consistent with the tabular presentation, we consider the following variables to determine a household's choice of tenancy: expenditure level, demographic characteristics, socioeconomic group, and mobility. A household's wealth and position in the life cycle can be expected to have a major influence on the choice of tenancy status. This is captured here by expenditure level as proxy for permanent income, household size and the age of the household head. The "unusual" character of female headed households may also have implications on the desirability of renting versus owning, so we included a dummy variable for these households.

The socioeconomic group variables essentially reflect taste differences due to social status, customs, etc. Likewise, non-Ivorian households may have different preferences regarding tenancy status, determined by their own cultures and their degree of integration into the Ivorian society. They may also have less easy access to credit for home purchases. Mobility was captured by the number of years a household has lived in its current living quarters, with a stay of more than eight years being labeled low mobility, and a stay of five years or less high mobility. In other words, we assume that actual behavior in the past with respect to mobility is a

suitable indicator of current and anticipated mobility which may affect tenancy choice.[9/]

One important determinant of the choice between owning and renting that we were unfortunately not able to include in the equation is the relative cost of the two tenancy modes. The main cost for renters is the amount of rent, while for owners the costs include maintenance and repair, financing costs if they took out a mortgage, and property taxes. These costs can be offset by appreciation of the property, the expectation of which also enters into the decision. The data set we use does not contain enough information to calculate the costs of home ownership. To some extent, several of the socioeconomic variables can also act as proxies for relative prices. Government employees and managers for example, have customarily had access to subsidized credit to assist them in purchasing a home.

We estimated equation (3) separately for Abidjan and other cities by means of maximum likelihood probit (Table 13). The results confirm the presence of a life cycle effect that makes ownership more likely as the age of the head of household increases.[10/] Increasing household size works in the same direction, although statistically the coefficient of the size-variable is not significant. A major determinant of tenancy choice is the household's

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9/ This is clearly a less than ideal treatment. Mobility and tenancy status are often jointly determined: highly mobile people may rent more frequently than they own, but renters may also exhibit higher degrees of mobility in the future by the mere fact that they do not own a home and that thus their moving transaction costs are less. Such joint modeling, for example, using simultaneous equations or using a multinomial logit model, will have to await future and better data sets.

10/ This effect is mostly linear: The square term of age of household head was not significant in the regressions for both Abidjan and other cities.

TABLE 13: **Owning/Renting Choice Equation**

	Abidjan		Other Cities	
Expenditures ('000 CFA)	.352 E-3	(1.77)	.546 E-3	(2.91)
Household Size	-.044	(1.20)	-.033	(1.04)
Employee, traditional	-.290	(0.45)	-1.020	(1.51)
Self-employed, traditional	.179	(0.45)	-.103	(0.29)
Employee, modern private (omitted)				
Employee, government	.359	(0.60)	-.442	(0.58)
Manager, modern private	.071	(0.23)	.312	(0.83)
Manager, government	-1.151	(2.70)	- 2/	
Self-employed, modern private	.148	(0.21)	-1.033	(1.91)
Farmer	- 1/		-1.227	(3.33)
Inactive or Unknown Occupation	-.337	(0.54)	-.745	(1.35)
Age head	-.027	(2.28)	-.033	(3.00)
Female head	.20	(0.04)	-.206	(0.48)
Non-Ivorian	.796	(2.50)	1.638	(5.16)
Medium mobility	-.424	(1.32)	-.688	(2.14)
Low mobility	-1.168	(3.78)	-1.207	(4.23)
Constant	2.450	(4.75)	1.811	(3.70)
n	227		253	
Log likelihood	-77.72		-86.91	
χ^2	61.99		175.17	
Significance level	0.1 E-6		0.1 E-6	
Percent correct predictions	85		85	

Coefficients estimated with owning as base category.
Asymptotic $|t|$-statistics in parenthesis.

1/ Included in self-employed, traditional.

2/ Included in employee, government.

mobility: the less mobile the household, the more likely it is to purchase a home. Non-Ivorian households are more likely to become renters than Ivorian households.

A high expenditure level is associated with a higher likelihood of renting. This confirms what the tabular analysis had indicated (section 3.4) and, as we explained there, it is not inconsistent with the life cycle model but rather a reflection of the presence of two distinct generations of households in our data, each with different preferences and facing different economic realities with respect to their tenancy decision. Ideally, we would want to do the analysis separately for each generation but this would require the availability of cohort data.

The direction of the effects of the household characteristics discussed so far on tenancy choice is the same in Abidjan as in the other cities, although the magnitudes differ. This is not so for the relation between a household's tenancy and its socioeconomic status. In Abidjan, the correlation is almost non-existent, except for a tendency of managers in the public sector to become owners. In the other cities, relative to employees in the modern private sector, every socioeconomic group is more likely to choose ownership (except for managers in the private sector). The strongest pro-ownership tendencies are among the self-employed in the modern sector, and among farmers.

The statistical fit of the choice model is fairly good as indicated by the 85 percent correct predictions of both equations.

5.2 The rent equation

The OLS estimation of equation (5) will indicate whether there is any selectivity bias present in the model, and yield coefficients corrected for any such bias. However, as yet, an unaddressed issue is the functional form for equation (5). One can approach this issue from the empirical or from the theoretical side. Empirically, one can look at the joint distribution of rent and household expenditures. Plots of this distribution indicated that a linear relationship becomes less appropriate at higher values of both rent and expenditures. A semi-log transformation resulted in a clearly non-linear relationship. A double-log transformation, on the other hand, yielded a close to linear relationship and on first sight appears to be the best fitting model.

Theoretically, the linear form has the advantage of being consistent with and derivable from an explicit utility function such as that of the Stone-Geary type. Also, one can use the linear form to derive a price-elasticity without the need to calculate a price variable. This can be done by using the formula

$$e_p = -e_y \frac{y - \theta_{nh}}{y}$$

where e_p and e_y are the price and income elasticities, and θ_{nh} are "subsistence minimum" expenditures on non-housing goods (Mayo, 1981).

The linear form yields elasticities that differ for each rent-income combination where it is evaluated. The semi-log model allows the elasticity to vary only with expenditures, while the double-log model holds the elasticity constant. Mayo (1981) found that for the United States linear

equations fit no worse than double-log, and produce similar results, which is to be expected if the range of income and price variability is limited. Developing country results tend to be more sensitive to functional form because there is more income and price variability in these countries. Ingram (1981) and Jimenez and Keare (1984) contain results for two or three functional forms. Other developing country studies used only double-log (Follain, Lim and Renaud, 1980, 1982; Malpezzi, Mayo and Gross, 1985).

In this paper we use the three most widely used functional forms - linear, semi-log, and double-log (Table 14). The double-log model clearly fits the data better than the semi-log model, for Abidjan as well as the other cities. We shall limit out further attention to the linear and the double-log models (the R^2's between these models are not comparable). The double log model implies an income elasticity of the demand for rental housing of .64 in Abidjan and .60 in other cities (expenditures are used here as proxy for permanent income). This also implies that the income elasticities of the rent share are respectively -.36 and -.40. In other words, the willingness-to-pay for rental housing declines with income. The income elasticities of demand (at the mean) implied by the coefficients of the linear equations are .55 for Abidjan and .54 for other cities.[11/] The demand for rental housing in urban Ivory Coast is thus clearly very inelastic.

Because, to our knowledge, there exist in the literature virtually no estimates of the elasticity of the demand for housing for Sub-saharan African

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11/ Strictly speaking, the coefficients of the linear equations trace an Engel expansion path and yield income elasticities only if prices and incomes are completely orthogonal or if no price variation occurs in the sample.

TABLE 14: **Rent Equation**

	Linear				Semi-Log				Double Log 1/			
	Abidjan											
Household Expenditures ('000 CFA)	79.597	(8.32)	78.334	(8.25)	.445 E-3	(8.13)	.438 E-3	(8.07)	.64720	(11.46)	.64277	(11.46)
Household Size	74.959	(0.03)	557.72	(0.24)	.01405	(1.06)	.01655	(1.25)	-.00194	(0.03)	.00988	(0.15)
Age of head	-1679.1	(2.25)	-1209.5	(1.41)	-.00706	(1.66)	-.00463	(0.94)	-.32046	(2.11)	-.22764	(1.30)
Female head	12660	(0.45)	15484	(0.55)	.09448	(0.58)	.10910	(0.68)	-.01117	(0.08)	.00270	(0.02)
Lambda	-		-36799	(1.05)	-		-.19055	(0.95)	-		-.18292	(1.05)
Constant	.131 E+6	(4.48)	.119 E+6	(3.88)	11.412	(68.38)	11.352	(64.54)	4.0347	(4.43)	3.7812	(4.03)
R^2	.30		.31		.31		.31		.45		.45	
F	19.72		15.99		19.81		16.01		36.89		29.72	
n	185		185		185		185		185		185	
Mean Dependent Variable	156210		156210		11.737		11.737		11.737		11.737	
Income Elasticity	.56		.55		.49		.49		.65		.64	
	Other Cities											
Household Expenditures ('000 CFA)	84.830	(5.61)	84.172	(5.45)	.656 E-3	(5.94)	.671 E-3	(5.94)	.58312	(6.55)	.59961	(6.72)
Household Size	10125	(3.71)	10252	(3.66)	.07859	(3.94)	.07573	(3.70)	.24498	(2.24)	.22739	(2.09)
Age of head	-3382.4	(3.22)	-3314.5	(2.95)	-.02078	(2.71)	-.02230	(2.71)	-.56366	(2.08)	-.66833	(2.31)
Female head	-11295	(0.29)	-10132	(0.26)	.07395	(0.26)	.04791	(0.17)	-.09537	(0.35)	-.14670	(0.54)
Lambda	-		-3716.6	(0.15)	-		.08323	(0.45)	-		.14912	(0.89)
Constant	.106 E+6	(3.02)	.105 E+6	(2.97)	10.937	(42.57)	10.964	(42.50)	5.1219	(3.42)	5.2433	(3.55)
R^2	.42		.42		.44		.45		.48		48	
F	20.15		15.98		22.15		17.63		25.67		20.65	
n	116		116		116		116		116		116	
Mean Dependent Variable	103133		103133		11.114		11.114		11.114		11.114	
Income Elasticity	.55		.54		.43		.45		.58		.60	

t -statistics in parenthesis.

1/ Explanatory variables are: ln (expenditure), ln (household size), ln (age of head), female head.

cities, it is difficult to judge the "plausibility" of our figures. Malpezzi, Mayo, and Gross (1985) report an income elasticity of .33 for renters in Kumasi, Ghana, using a double-log specification. They also estimate elasticities for cities in seven other developing countries, and find values from .31 to .88. Their literature review reports that two-thirds of developing country estimates fall within the .4 to .8 range. Our estimates for Ivorian cities are thus not out of line with findings elsewhere.[12/]

The range of our estimated elasticities is narrower than that found in the few other developing country studies that test alternative specifications. Jimenez and Keare (1984) find that elasticities vary from .27 to .43 and from .50 to .64 for renters in two cities in El Salvador. Ingram (1981) finds differences of .08 to .31 in the elasticities for renters in Bogota and Cali, Colombia, if the specification is changed.

The coefficient of lambda is not significant in any of the functional forms used, indicating there is little selectivity bias in the rent equations. This is confirmed by the fact that the coefficients change very little if we re-estimate the equations without lambda. The selectivity correction affects the elasticities at most by .02.

12/ For policy purposes, the range of income and price elasticities found empirically, both in developed and in developing countries, is disturbing. There is no agreement on how to determine the correct figure, or even how to explain the divergence of figures theoretically. An interesting argument is made by Kent (1983) who postulates a series of income and price elasticities of the demand for housing because this demand is a result of three decisions made by the household, that is, household formation, tenancy choice, and how much housing to consume. Kent works out the relationships between elasticities based on one, two, or all three decisions. His empirical evidence to reconcile existing estimates is unfortunately weak. In this paper we consider the last two decisions, and take household size as given.

In Abidjan from the demographic composition of the household, there is not much impact on rent paid. Rent is almost solely determined by permanent income. By contrast, in the other cities, the age of the household head exerts a negative influence on rent paid, while household size has a strong positive effect.[13/] Combining this result with that of the tenancy choice equation, we can get a picture of the decision making process. The tenancy choice is in the first place a life cycle related decision, where the probability to become an owner increases with the age of the household head. Once the choice to rent has been made, in Abidjan, permanent income becomes the prime determinant of the amount of housing demanded and the rent paid accordingly. In other cities, the household size exerts an independent positive influence on the demand for housing.

As we indicated earlier, the linear form of the rent equation can be used to estimate a price-elasticity of the demand for housing without calculating a price term. When we use the intercept of a non-housing expenditures equation (with the same explanatory variables as the rent equation) to approximate the minimum non-housing expenditures, e_p equals -.47 in Abidjan and -.46 in other cities (evaluated at $\bar{y}$). Using the smallest value of expenditures on non-housing observed in the sample, the elasticities

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13/ Estimates of the household size elasticity vary widely. Follain, Lim, and Renaud (1980) find .14 for Korea, Jimenez and Keare (1984) report a range of -.12 to +.30 for El Salvador, and Ingram (1981) finds a range of -.11 to +.42 in Colombia.

are, respectively, -.51 and -.54. They are higher in absolute value than those found by Follain, Lim, and Renaud (1980) for renters in Korean cities (+.03 to -.06), and than those reported by Ingram (1981) for renters in Bogota and Cali (-.08 to -.48).

5.3 The choice of type of housing

The last part of our analysis pertains to the determinants of the choice of housing type. Although households in the Ivory Coast face a choice of seven housing types, the sample frequency of some types was too low to be maintained separately for the estimation. For Abidjan, we aggregated the choices to four: houses and apartments, compound housing of high quality, compound housing of medium and low quality, and traditional dwellings. For the other cities, all compound housing was put in one category. We then estimated equation (6) by maximum likelihood multinomial logit. Because logit coefficients are difficult to interpret - they pertain to the logarithm of the odds of making a particular choice - in Table 15 we prefer to show the probability derivatives of the estimated coefficients. As traditional housing was the base category for the estimation, the derivatives for it were normalized to zero.

From the numbers emerge some distinct choice patterns made by different types of households. These patterns are not the same in Abidjan as in other cities. Apartment living seems to be the top of the line for renters in Abidjan. It is primarily chosen by high income households and those whose heads work in the public sector. Apartments are not, however, the preferred accommodation for households who have chosen to own their home. They choose in the first place compound housing, especially the high quality units. These

TABLE 15: **Type of Housing: Choice Equation**

	Houses, Apartments	Compound High Quality	Compound, Medium and Low Quality	Traditional Housing
	Abidjan			
Expenditures ('000 CFA)	.00023	-.00003	-.00016	-.00004
Household Size	-.00975	.00748	.00224	.00003
Traditional Sector and Farming	-.16277	.18602	-.02853	.00527
Employee, Modern Private (omitted)	-	-	-	-
Employee, Government	.80740	-.05655	-.64511	-.10573
Manager, Modern Private	.04022	-.05342	.01608	-.00288
Manager, Government	.16746	-.03250	-.11596	-.01900
Self-Employed, Modern Private	-.53550	.43098	.07853	.02599
Inactive or Unknown Occupation	-.06434	.23723	-.07539	-.09750
Age of Head	.00038	.00424	-.00410	-.00052
Female Head	.04373	.14807	-.16479	-.02701
Non-Ivorian	-.18166	.18478	.00370	-.00682
Owner	-.24507	.13689	.07600	.03217
Constant	.12488	-.40875	.25314	.03072
Log Likelihood	-211.25			
χ^2	126.06			
Significance Level	.1 E-6			
Percent correct preditions (modal probability)	83	32	43	28

Continued

Table 15 continued

	Houses, Apartments	Compound Housing	Traditional Housing
		Other Cities	
Expenditures ('000 CFA)	.00002	.00006	-.00008
Household Size	.00078	.00700	-.00778
Traditional Sector	.00194	.10663	-.10857
Employee, Modern Private (omitted)	-	- -	
Government	.04683	-.03748	-.00935
Manager, Modern Private	.01743	.07727	-.09470
Self-Employed, Modern Private	-.01703	.22278	-.20575
Farmer	-.00055	.00722	-.00667
Inactive or Unknown Occupation	.02219	.15049	-.17268
Age of Head	-.00194	.00245	-.00051
Female Head	-.01556	.20349	-.18794
Non-Ivorian	-.00568	.11352	-.10785
Owner	-.02732	-.16228	.18960
Constant	.02009	.06195	-.08204
Log Likelihood		-160.61	
χ^2		90.49	
Significance Level		.1 E-6	
Percent Correct Preditions (modal probability)	39	92	28

units are also preferred by households who work in the traditional sector or who are self-employed in the modern sector. There is a life cycle effect in the choice of type of accommodation. Older households in Abidjan leave low and medium quality compound housing behind in favor of high quality compound housing and apartments. Two perhaps unexpected findings are that private sector managers and self-employed have the highest likelihood to live in low quality compound housing, and that female headed households have a strong tendency to live in high quality compound housing and apartments. Clearly, manager status is not necessarily associated with high income, while a woman's responsibility as head of household is not inconsistent with having a high income position.

In other cities, the overall preferred accommodation is compound housing. It is associated with high income, with the later stages of the life cycle, and all socioeconomic groups but one express a relative preference for it. The exception is government workers who choose mostly apartments.

6. SUMMARY AND CONCLUSION

The starting point for the design of housing policy is the existing conditions in the housing market. We therefore presented in this paper, in an easy to read tabular format, the situation in the urban housing market in the Ivory Coast. The tables were set in a supply and demand framework. Next, within the same framework, we estimated three equations of household behavior of key relevance in implementing housing policy. Each equation addresses a question that is currently foremost in the minds of urban planners in the Ivory Coast: What types of housing units must be built in the coming years, and in what proportions, to meet the housing needs of a growing urban population? What distribution of tenancy status can one foresee for these housing units, and what is the amount of rent that households would be willing to pay when they decide to rent?

The link between urban models and policy rests on two assumptions: first, that the behavior of households as it was captured in the estimated models will not appreciably change over time, and, second, that an estimation can be made for particular years in the future of the magnitude and principal socioeconomic characteristics of the urban population. Such estimation needs to come from a demographic model that predicts household formation, and from a macroeconomic model that predicts income, its distribution, and the composition of the labor force. In particular, a prediction of urban employment creation in the different sectors is needed. The estimated housing models then translate this information into answers to the aforementioned urban planning questions.

Worldwide experience with housing projects suggests that knowledge of the housing demand parameter is one of the critical elements in designing

projects and in accurately foreseeing their impact. In particular, the establishment of correct affordability criteria, that is, the percent of their income households are willing to devote to housing expenditures, has a major impact on the success of urban planning and housing projects. Over-estimating this willingness-to-pay will result in housing projects not reaching their intended beneficiaries. Lower income households will require subsidies to participate in the project, and even with those they may have high default rates and/or a strong tendency to sell out to higher-income groups. Mayo and Gross (1985) show that the subsidy requirements of sites-and-services projects are very sensitive to misestimation of the affordability ratio. For example, an error of a mere five percentage points can mean the difference between zero and 40 percent subsidy needed to induce participation. Alternatively, if no subsidies are given, the same error could raise the entry income-level from the 10th to the 60th percentile of the urban income distribution, thereby possibly cutting-out most of the intended beneficiaries. The results from this paper should permit a more accurate assessment of the affordability ratio and other parameters useful in the design of urban projects and plans.

The rapid population growth in Abidjan and the resulting upward pressure on housing prices has resulted in only 16 percent of households being able to afford home ownership. By contrast, in the other cities 45 percent of households own the homes they live in. Owners in Abidjan are mostly older households - the average age of the head is 47 years - who have lived in their homes an average of 15 years, that is, they purchased their homes prior to the big upswing in migration (and housing prices) during the seventies. Abidjan's growth has also resulted in a decline of the average housing quality: more than two thirds of all housing units are of low or medium quality. In the

other cities, such units make up less than 10 percent of the total. Because of so many recent migrants, the population in Abidjan is also younger than in the other cities of the Ivory Coast. Households have fewer children, and their heads work primarily in the modern private sector and for the government.

The tenancy choice model we estimated in this paper indicated that stage in the life cycle and mobility are the two prime determinants of tenancy status. This means that as urban households pass through the consecutive stages of their life cycle, and their families grow, their expected mobility will diminish, and the demand for owned housing will increase, adding to already existing pressures. Although one-third of non-Ivorian households in Abidjan primarily choose to rent, the longer they reside in the country, the more they too will want to become owners, given the strong negative association between owning and mobility.

Housing projects and urban planning efforts often emphasize the promotion of home ownership. Given the tendencies identified above, this is warranted in urban Ivory Coast. However, in Abidjan, 80 percent of households rent their accommodation. This is a market outcome that should not be ignored, and urban planners in the Ivory Coast should also pursue strategies consistent with it. In large and rapidly growing cities, it is often easier to reach the low income population with projects designed to provide rental housing. Such projects permit higher density structures and lower but adequate standards of amenities than in owner-occupied housing. These projects are therefore feasible at a lower total cost and are more affordable to lower income groups (Mayo and Gross, 1985; The Urban Edge, 1984).

The demand for rental housing in the Ivory Coast is both income and price inelastic. The income elasticity is around .5 in Abidjan and around .4 in other cities. Even though these values are not out of the range of what is usually found for developing countries, they are very low values and they indicate the extent to which housing is a necessity good in the consumption basket of urban households in the Ivory Coast. It is remarkable that the income elasticity for food has a higher value, that is, .74 in Abidjan and .83 in other cities (calculated from a double-log Engel function with the same explanatory variables as the rent function). The own price elasticity of the demand for rental housing is about -.6 in Abidjan and about -.5 in other cities. This suggests that the steep rent increases of recent years in Abidjan are likely to continue if demand for housing continues to rise at its current pace as a result of urban migration.

The housing type choice equations we estimated have shown that in Abidjan apartments are the preferred rental accommodation, and that the demand for these units will increase with rising income and with rising employment in the modern sector, especially the public sector. Demand for owned housing focusses on compound housing, particularly the high quality units. Since, as we indicated earlier, these units have become relatively rarer, above average price increases are likely in the future. In addition, the life cycle effect is such that it will shift an increasing fraction of the demand towards high quality compound housing.

We addressed in this paper two methodological issues: selectivity bias and functional form. We found that there is no evidence of selectivity bias in the rent equation: OLS estimation was adequate to calculate accurate elasticities. As to functional form, we found that for the rent equation the

statistical fit of the semi-log specification was inferior to the double-log model. The linear and double-log models, however, yielded similar elasticities. Obviously, these findings are data specific.

There is an acute need for housing models to address the problems of the large cities in Sub-saharan Africa. This paper provides a first such model for the cities in the Ivory coast. Although the model was kept simple because of data limitations, the results are consistent with economic theory, and in line with findings elsewhere. We trust, this will add significantly to the empirical basis for the design of housing policy in the Ivory Coast. Current data collection efforts in the Ivory coast make us look forward to the estimation of an enhanced housing model in the near future.

APPENDIX

Hedonic Approach

Since no direct data on relative housing prices are available in the 1979 Socioeconomic Survey, the equations in the paper did not include a price variable, and price elasticities were derived indirectly, by relying on the Stone-Geary utility framework. Nevertheless, the data contain limited information on housing characteristics which makes it possible to apply the hedonic price index method to construct a price variable (for a recent survey of this method, see Follain and Jimenez, 1983b). The procedure consists of two steps. First, an hedonic rent equation is estimated in which rent is regressed on a set of explanatory variables thought to determine rent from the supply side. The predicted values from this regression are interpreted as a measure of the price of housing. Second, expenditures on housing divided by this price term is regressed on a set of housing demand determinants including the price term itself. The coefficients of the expenditures and price variables in this equation allow calculation of income and price elasticities of the demand for housing.

The hedonic equation can be seen as a reduced form of housing supply and demand equations, an interpretation which requires that the housing market be in equilibrium. Thus the equation should be estimated in principle separately for each submarket where prices and quantities clear (Goodman 1978; Malpezzi 1984). In this paper, the available number of observations limit us to do the estimation separately for Abidjan and the other cities. A less extreme way of dealing with submarkets is to include dummy variables for each submarket (Malpezzi, Ozanne, and Thibodeau, 1980). We use this approach for

districts within Abidjan and for city types and Bouaké in the other cities equation. This approach can be justified on the grounds that there is good mobility on the part of consumers between the various districts and cities.

The hedonic equation normally contains three types of variables that determine a dwelling price from the supply side (Goodman and Kawai 1984; Malpezzi, Ozanne, Thibodeau 1980; Malpezzi 1984). First, location characteristics indicate the overall quality of the neighbourhood, access to facilities, distance from the central business district, and so on. For Abidjan, the series of district dummy variables are seen as reflecting summarily all the location features. For other cities, we do not have information on the location of a dwelling within a city, but we include the size of the city as variable assuming that size gives an indication of the level of facilities in the city. Second, the characteristics of the dwelling itself are rental value determinants. We have information on the type of housing and the availability of water and electricity (see sections 3.1 and 3.2). Lastly, contractual arrangements and discrimination may affect rent. We therefore distinguish subrenters from renters, non-Ivorian households from others, and we include the time the household has lived in the dwelling. These are characteristics of dwellers that affect prices faced for housing, that is, supply prices. Long term renters for example often face lower prices because of lower turnover costs. Income level, on the other hand, does not belong in an hedonic equation because it determines demand.

We calculated the predicted value from the hedonic equation for every observation and divided the corresponding expenditures on housing by that number in order to obtain a measure of the quantity of housing. This procedure allows each household to face different prices for housing, and thus

imposes the least equilibrium requirements on the market. An alternative procedure is to define a typical or standard housing unit for each submarket, calculate the price index for that unit, and use it to deflate the expenditures of all households in that submarket (for example, Goodman and Kawai, 1984; Ingram, 1981). Then there is only one deflator per submarket as opposed to one per observation, which assumes that each submarket is in equilibrium.

Since it is a reduced form, there are no theoretical grounds to specify the functional form of an hedonic equation. The literature has used mostly a linear and semi-log form, with mixed results. Some authors express a preference for the semi-log specification because it allows the value of a housing attribute to vary with size and quality of the overall unit (Malpezzi, Ozanne, Thibodeau, 1980; Follain, Lim and Renaud, 1982). The more general form proposed by Box and Cox (1964) has also been used frequently, also with mixed results (Goodman 1978; Goodman and Kawai 1984). In some cases the three most commonly used forms - linear, semi-log, and double-log - are all rejected (for example, Halvorsen and Pollakowski 1981, on U.S. data), while in others the semi-log was found to be a good approximation (Follain and Jimenez, 1983a; Jimenez 1984). We shall use both the linear and semi-log forms and compare the results.

Table A1 indicates that both specifications are quite consistent with one another in terms of signs and relative magnitudes of coefficients, but the semi-log model produces a larger number of significant coefficients. In Abidjan, the quality index is clearly the main determinant of rent. There is a fairly steep duration gradient, reflecting large rental increases in recent

TABLE A1: **Hedonic Rent Equations**

	Linear		Semi-log	
	Abidjan			
Treichville (omitted)				
Adjamé	-28952	(0.93)	-.10314	(0.64)
Koumassi, Port-Bouet, Zone 4, Vridi	-43498	(1.29)	-.21070	(1.20)
Williamsville, Cocody	-29279	(0.80)	-.16087	(0.84)
Marcory	-27033	(0.56)	-.36064	(1.44)
Yopougon, Locodjoro, Banco	-94842	(2.64)	-.36308	(1.94)
Abobo	-37069	(0.76)	-.04883	(0.19)
House	133692	(1.70)	.43722	(1.07)
Apartment, high quality	84227	(1.43)	.37660	(1.23)
Apartment, medium and low quality (omitted)				
Compound, high quality	-69872	(2.06)	-.43375	(2.46)
Compound, medium quality	-107105	(3.52)	-.63550	(4.02)
Compound, low quality	-113139	(2.14)	-1.0767	(3.92)
Traditional	-54184	(1.25)	-.45711	(2.04)
Private water tap	2820	(0.10)	.06152	(0.42)
Private electricity hookup	46417	(1.98)	.38171	(3.13)
Duration	-7603	(4.49)	-.02952	(3.35)
Sub-renter	-4987	(0.17)	-.17407	(1.14)
Non-Ivorian	-16921	(0.97)	-.07824	(0.87)
Constant	250819	(5.77)	12.075	(53.39)
R^2	.41		.51	
F	6.57		9.87	
n	179		179	
Mean dependent variable	156686		11.739	

Continued

Table A1 continued

	Linear		Semi-log	
	Other Cities			
<30,000 inhabitants (omitted)				
>30,000 inhabitants	10064	(0.59)	.32034	(2.60)
Bouaké	28967	(1.15)	.43577	(2.39)
House	395950	(6.62)	1.3831	(3.18)
Apartment, high quality	97838	(1.60)	.56610	(1.27)
Apartment, medium and low quality (omitted)				
Compound	-34644	(1.37)	-.39648	(2.16)
Traditional	-41835	(1.27)	-.59990	(2.50)
Private water tap	112470	(4.97)	.60151	(3.66)
Private electricity hookup	45176	(2.60)	.67882	(5.38)
Duration	-2134	(1.34)	.00306	(0.26)
Non-Ivorian	-15147	(0.93)	-.32526	(2.75)
Constant	86255	(2.86)	10.839	(49.45)
R^2	.63		.64	
F	17.17		18.40	
n	113		113	
Mean Dependent Variable	103057		11.112	

|t|-statistics in parenthesis

years and some protection from these for long-term tenants. None of the districts in Abidjan carries a significant location premium. The rent differences we observed between districts in the tabular description in section 3.6 are thus accounted for by the differences in the quality of the housing stock. In the other cities, next to the quality index, a private water tap and electricity carry high rental premiums. These features are relatively rarer than in Abidjan, which is why they are worth additional rent. Looking at the coefficient of duration, it appears other cities have not known the recent rent increases of Abidjan. There is no indication of discrimination against non-Ivorian households, since they pay lower rent for comparable units.[1/]

The predicted values of the linear equations and the anti-log of the predicted values of the semi-log equations in Table A1 were used to deflate actual rent expenditures in order to obtain a measure of quantity of housing. This quantity is the dependent variable in the demand equation for housing, with the same regressors as in the rent equation (see Table 14) but adding the predicted price variable. We estimated three functional forms for the demand equation. The semi-log was again found inferior to the double-log specification, and now the linear equation also provided a very poor fit. Consequently we report only the results from the double-log specification in Table A2, both with and without correction for selectivity bias.[2/] The corrected double-log model yields income elasticities of

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1/ To the extent, however, that the quality index does not capture all aspects of housing quality, this coefficient could reflect lower quality housing for non-Ivorians.

2/ According to Mayo (1981), the double-log functional form was used by all but four of 27 recent U.S. housing demand studies surveyed. Malpezzi, Mayo, and Gross (1985) report that about half of the developing country studies rely on this specification.

demand for rental housing of .49 and .37, and price elasticities of -.58 and -.25 for Abidjan. The corresponding values for other cities are .39, .28, -.49 and -.25. Based on statistical goodness of fit, we would be inclined to put more faith in the values derived from the linear hedonic model. It is clear that the elasticities derived by means of hedonic price procedures are much more sensitive to changes in functional form (of both the hedonic price equation itself and the rental demand equation) than those derived from the "ordinary" rent equations estimated in the main text of the paper.

The values of the price elasticities in Table A2 are in the same range as those computed with the formula derived from the Stone-Geary utility function which used information only on income elasticity and minimum non-housing expenditures.

The income elasticities, however, are significantly lower than those calculated from the equations without a price term. In Abidjan, this difference is in the order of .05 to .15, and in the other cities about .15 to .20. Polinsky (1977) has discussed the bias resulting from the omission of a price-term in the United States context. If the covariance between household income and housing price is negative within a city, that is, if high income households tend to live in suburbs where the price of housing

TABLE A2: **Housing Demand Equation with Price Term (Double-log)**

	Linear Hedonic				Semi-log Hedonic			
	Abidjan							
ln (expenditure)	.48287	(8.21)	.48598	(8.39)	.37664	(6.59)	.37250	(6.63)
ln (household size)	-.01648	(0.26)	-.01357	(0.21)	-.02737	(0.47)	-.01623	(0.28)
ln (age of head)	-.16835	(1.16)	-.15427	(0.94)	-.16149	(1.22)	-.08263	(0.55)
Female head	-.03387	(0.26)	-.03092	(0.24)	-.03531	(0.29)	-.02385	(0.20)
Price of Housing	-.56958	(8.70)	-.58113	(8.98)	-.25019	(3.05)	-.25334	(3.13)
Lambda	-		-.0382	(0.19)	-		-.15277	(1.04)
Constant	.66737	(0.67)	.71322	(0.72)	-1.5975	(1.60)	-1.7721	(1.76)
R^2	.38		.39		.21		.22	
F	20.56		17.67		9.11		7.76	
n	176		176		176		176	
Mean Dependent Variable	-.09784		-.09784		-.00728		-.00728	
Income Elasticity	.48		.49		.38		.37	
Price Elasticity	-.56		-.58		-.25		-.25	
	Other Cities							
ln (expenditure)	.36733	(4.48)	.38947	(4.83)	.27238	(3.57)	.28066	(3.69)
ln (household size)	.18832	(2.02)	.16176	(1.76)	.14042	(1.66)	.13369	(1.60)
ln (age of head)	-.31163	(1.33)	-.47434	(1.91)	-.22003	(1.04)	-.26682	(1.18)
Female head	-.21659	(0.95)	-.29117	(1.32)	-.20307	(0.99)	-.22227	(1.10)
Price of Housing	-.49851	(6.93)	-.49121	(7.08)	-.24874	(3.05)	-.25188	(3.16)
Lambda	-		.22846	(1.67)	-		.06116	(0.48)
Constant	1.51704	(1.11)	1.6709	(1.23)	-.21666	(0.17)	-.13878	(0.11)
R^2	.38		.39		.21		.21	
F	12.91		11.40		5.70		4.75	
n	112		112		112		112	
Mean Dependent Variable	-.10755		-.10755		-.00009		-.00009	
Income Elasticity	.37		.39		.27		.28	
Price Elasticity	-.50		-.49		-.25		-.25	

|t|-statistics in parenthesis.

is relatively low, then the omission of a price-term in micro-data demand equations will cause a downward bias in the estimated income elasticity. The reason is that typically the demand for housing is price-inelastic, so that, ceteris paribus, lower prices will correspond with lower housing expenditures. Consequently, when price is not held constant, the change in housing expenditures with respect to the change in income is understated. In the Ivory Coast the opposite is true because the intra-city covariance is positive: high income people, particularly younger households who work in the modern sector, prefer locations close to the central business district where housing prices are high. Hence, the omission of a price term causes an upward bias to the estimated income elasticity.[3/]

Lastly, we note that, as in the equations without price-term, no evidence of selectivity bias is present. The omission of lambda from the equation affects the estimated elasticities by at most .02. Equally, demographic effects are again found to be very weak in Abidjan and more important in the other cities.

3/ Although the direction of the bias is according to expectations, the magnitude is cause for some concern. Using Polinsky's formula for this bias $(1 + e_p) \frac{\text{covar } (y,p)}{\text{var } (y)}$, we would expect the bias in the Abidjan equations not to exceed .02 and in the other cities equations to be around .03 to .04. Jimenez and Keare (1984) expect a bias of only .005 from the omission of a price term in their renter equations. The "larger-than-expected" bias we have found is not uncommon though in actual estimation. Malpezzi, Mayo and Gross (1985), for example, find changes in the estimated income elasticity of .09 to .31 when price and some demographic variables are dropped from the equation.

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