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Muthoka, Sila

University of Nairobi

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Muthoka Sila

muthokajs@students.uonbi.ac.ke/jcbsila@gmail.com

University of Nairobi

Abstract

Previous studies have established that demand pattern for housing identifies with that of a necessary good. The nature of housing goods consumed is highly heterogeneous in dimensions like ownership, size, location and tenure type. In this study I model the probability of household tenure types in Kenya using Household Budget Survey data. Using a Multinomial Logit Model (MNLM) formulation three tenure, household size and age of the household head emerge as significant predictors of household housing choices. Based on the results, the government and firms can rely on household size and age of the household head to approximate demand for housing services in the various tenure types. Furthermore, the ability to interpolate these variables based on occasional population surveys makes it easier to design mechanisms of matching demand and supply for housing services.

JEL Classification: D120, R210

Key words: housing, demand for housing, tenure, multinomial logit, hedonic regression

1.0 Introduction

Kenya's housing sector faces significant levels of movement as tenants and households move to better housing units, as general incomes keep increase (Huchzermeyer, 2008). In most urban centres, the price of housing services varies widely depending on the state and condition of housing units, access to basic services like water, electricity and transport and communication infrastructure. This variation necessarily indicates a variation in average income levels among people living in the different price regions. It is also a variation in welfare across income groups. Huchzermeyer notes that low price dwelling units usually lack electricity, water and toilets. In many cases, toilets are outdoor and shared among neighbours. In order to enjoy better housing, one has, at least, to shift to a new region or pay more.

A significant proportion of people have not embraced common cost-effective housing patterns as alternatives for better housing (Arvanitis, 2013). Instead, they opt to pay the high, and often overstated, rates for the block-built housing units, whose reliability has been proved through experience. As Kenya's middle-income group grows fast, and in the face of rapid urbanization, there has been increasing pressure on existing housing units. The future of housing prices even expected to grow, both due to inflation and increasing urbanization. As noted by Arvanitis, demand for housing units will remain above supply in the urban economy, unless drastic control measures put in place, and, as a result, prices will keep growing.

Block-built accommodation in urban areas takes several forms. One may rent housing units and pay monthly premiums, or buy a housing unit or construct one first-hand. Other forms like inheritance are limited. These are complimented by slum and near-slum, sometimes illegal, housing units which house majority of the urban poor. Slum housing can also be classified in the three forms just mentioned. A household may consume housing in either of these forms, whether in a formal block-built or slum-site unit. The housing market witnesses daily relocations as households change locations as well as the form of housing they occupy. These movements do not reduce the problem of inadequate housing. Instead, they bring to the foresight the characteristics of these markets. It is not uncommon to find that people only swap houses or plan to have the present house occupied by a close friend before one vacates. This off-office arrangement between tenants illustrates how desperate people are when looking for housing space in Kenya.

The government responds by putting strategies in place to upgrade the existing informal settlements. In 2008, Kibera slums was marked for fast upgrading. Several formal houses were built and allocated to the residents. However, a new problem arose in that the people were unwilling to relocate, citing among other reasons, the loss of social connection. Although this plan was well intended, there may have been deeper analyses required to enable the project. The questions that have kept nagging this kind of projects include, and not limited to, is public housing an amicable approach?, what determines how slum dwellers respond to offers of

public housing? and who really wants a better housing than a slum shelter? The present author seeks to answer the last two questions.

Before embarking on blind public housing programmes, there is need to understand the dynamics of housing demand. Housing markets exhibit regional, cultural and ideological heterogeneities. In one region or culture, a given type of housing may be in less demand than another. As we will see a little later, for example, purchased units are not common in urban settings because of high prices but are the dominant type in rural areas. Although the shortage in absolute supply of housing may persist, inconsiderate investment in one type, and neglecting the other types, may lead to a big crisis. In order to match market demand, market supply ought to be guided by a clear understanding and correct prediction of economic patterns. This paper generates a basis to predict market demand for the three types of housing. It studies household mobility across the classes of housing in the context of changing economic times as predicted by income levels, price levels, household demographics and preferences. Key variables are pseudo-exogenous and their trends can be predicted at the economy-wide level.

1.2 Objective

The objective of the study is to determine the factors of household choices for housing types in Kenya.

2.0 Overview of literature

Borsch-Supan, Heiss and Seko (2002) used a mixed multinomial logit model to predict housing demand in Germany and Japan. Using hedonic price index to endogenize heterogeneity in housing characteristics and prices, they found that income and household size increased the chance of house-ownership and that of occupying a bigger house.Ermisch, Findlay and Gibb (1994) also used hedonic price indices on continuous-demand-model based on, beside household characteristics, the neighbourhood of the housing unit. They also showed that these hedonic characteristics enter the demand function independently, together with price and income.

Attanasio, Bottazzi, Low, Nesheim and Wakefield (2011) modeled housing choices over life cycle variables like age, income and mortgage rates and uncertainty. Their work shows that income has a two-way effect on demand for housing. First, it is positively related to house ownership among the youths and less effective among the old. Second, the uncertainty around income affects house ownership negatively among the young. Notably, they found that higher rental rates discourage rental tenure and increase the odds of ownership.

The present work improves on the literature in two ways. First, it introduces a new dimension in housing markets which takes into account the nature of housing in Kenya. In this case, type of tenure is an important feature in domestic housing markets. Borsch-Supan et al. (2002) used types of houses owned. Using that would weaken the relevance of the research in Kenya, where 75% occupancy is rental (Arvanitis, 2013). Second, using a cross-sectional dataset, it allows for introduction of social-cultural and household specific features in the demand model. This suffices as a localised model to explain household choices in housing markets.

2.1 Conceptual framework

Rosen (1974) developed an analytical framework involving differentiated market goods, whose characteristics have a significant influence on consumer utility. Housing services can be analysed in the same framework where consumers derive some additional utility from hedonic characteristics, which may not be measured quantitatively. Follain and Jimenez (1983), Ermisch, Findlay and Gibb (1994), Zabel (2003), Eichholtz and Lindenthal (2009), Galbato and Sarasola (2011) and Albouy and Ehrlich (2014) used the model to study demand for housing.

The objective of the households is to maximize utility $u(X_1, X_2)$, where X_1 = a composite of all non-housing goods and X_2 = housing goods consumed. Assuming local non-satiation, $u'(X_1)>0$ and $u'(X_2)>0$ (households will always improve welfare by consuming more of both housing and non-housing goods). However, the marginal utilities from these goods do not accrue in the same pattern. First, to derive marginal utility from X_1, the household must consume additional unit by spending additional P_1 = Ksh. 1. It is different for X_2, whose marginal utility may relate to some differential characteristics, which have a bearing on households' satisfaction. Examples of such characteristics are size, colour, wall material, in-house facilities and roofing. Presence of these favourable qualities improves utility, without necessarily increasing the number of units

purchased, and at the same time attracts higher rents. By solving the households' optimization problem with a numeraire non-housing composite, we have

$$\text{Max } U = u(X_1, X_2(z)) \text{ subject to } M = X_1 + P_2X_2, \quad \text{(i)}$$

Where M is the disposable money income and P_2 is the price per unit of housing with a vector of hedonic characteristics **z.**

The solution comprises of the bundle of housing and non-housing goods, which maximize household total utility at the given prices and budget (uncompensated or Marshallian demand functions0. These are shown hereafter.

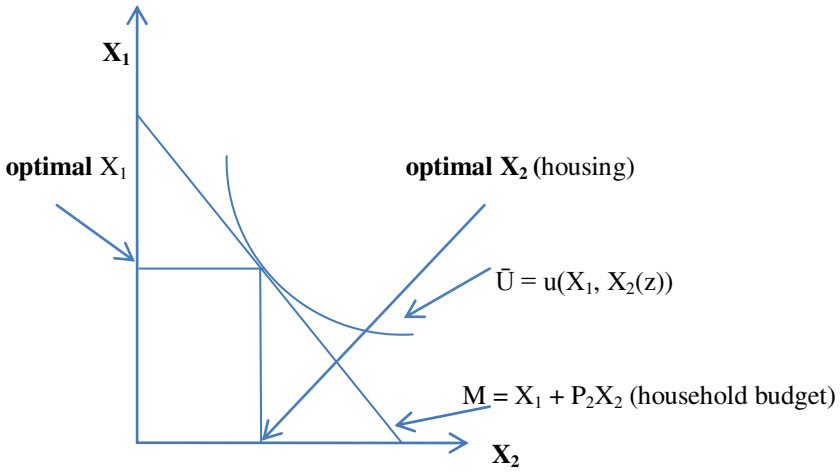

Figure 1: Household's optimization problem

$$X_1 = f(P_1, P_2, M) \quad \text{(ii)}$$

$$X_2 = f(P_1, P_2, M) \equiv f(P_2, M), \text{ because } P_1 = \text{Ksh. } 1. \quad \text{(iii)}$$

In a market with perfect information, "buyers" will match "sellers" efficiently. The price that buyers are willing to offer will be equal to the one sellers are willing to receive and accounts for all utility-bearing characteristics of a housing unit. Therefore, the price of housing unit *i,* P_{2i} *= f(utility-bearing characteristics of house i).* Separating these characteristics from the residual price, we have

$$X_2 = f(P_2, M, \mathbf{z}), \quad \text{(iv)}$$

where z is the vector of utility-bearing hedonic characteristics (Ermisch, et al., 1994).

2.2 Empirical framework

I use a Two-Stage Least Squares (2SLS) which allow price to be endogenously determined then used as an input in the main model..First, I use the variable hedonic characteristics of a housing unit to develop a price index for housing. This is based on the fact that these characteristics are always accounted for in the price of housing units. The hedonic model, which is inherently non-linear, is log-linearised as

$$LnP_2 = \alpha_0 + \alpha_1 ln(size) + \alpha_2(no\_rooms) + \alpha_3(toilet\ dummy) + \alpha_4(wallmaterial) + \alpha_5(location) + \mathcal{E} \quad \textbf{(v)}$$

Where α_0 is the intercept, α_1 is elasticity, α_2 is a parameter, and α_3, α_4 and α_5 are dummy parameters. This gives an objective index for price of housing services, taking into regard the variability in the sample. The region in which a housing unit is located could be significant (Albouy, et al., 2014), but because the data does not have that dimension, I assume it is constant. I, however, keep the rural-urban distinction, which serves the same way, but to a significantly less degree.

In the second stage, I model demand as a choice variable across three common types of housing in Kenya. These are rental, purchased and own-constructed. The choices are mutually exclusive; a household cannot enjoy two of these tenures simultaneously. The decision to consume in any of these tenure is, therefore, predicted using a multinomial logit model (MNLM) as explained by Wulff (2014). The response variable is the probability of consuming in one of the three types.

$$\frac{\rho i}{1-\rho i} = e^{Y\beta i}; \quad \text{(vi)}$$

$$\rho i = \frac{\sum_1^n i}{n},$$

where for all i, $i = \begin{cases} 1 \; if housing\ unit\ is\ (rented) \\ 0 \; otherwise \end{cases}$ (vii)

whereρi is the probability of choosing housing type i, i = rented, purchased, own-constructed, Y is a vector of all explanatory variables, including the hedonic price index, and βi is the vector of parameters.

The explanatory variables are household's disposable income, prices for housing, household size, household head's age, gender and income. Household's disposable income is derived from literature and theory while prices for housing are modified to include variations in housing unit characteristics. Other variables are introduced to test the impact of household's unique decision-making structure and characteristics. In instances where households are consuming future income (loans), I take monthly premium contribution as housing consumption. This makes sense because premiums are paid from the disposable income and no additional expenditure directly related housing after that. In the advanced case where houses were either fully paid for or own-constructed, self-reported rents were used as proxies for price of housing services consumed. Therefore, the empirical model is a multinomial logit with three levels, with rented tenure used as the reference level.

$$\rho i = \frac{\exp(\sum \beta ijXij)}{1+(\exp(\sum \beta ijXij))} \quad \text{(viii)}$$

Where $X_{ij}$are explanatory variables listed as: total household income, hedonic price index,household size, household head's gender, household head's age and household head's income. There is arandom error term and $\boldsymbol{\beta}_i$'s are parameters.

3.0 Data and discussion

I used data from the Kenya Integrated Household Budget Survey 2005/2006. The survey is done in Kenya every 10 years and remains one of the most comprehensive household surveys in the country. It offers information on household demographics, access to housing, health, water and sanitation, employment, education and consumption expenditure. The selection of the respondents is a four-stage random process (International Household Survey Nertwork, 2011). After cleaning the data for missing and incomplete observations, and removing outliers after computing hedonic prices,8408 observations were viable for the study.

It is necessary to discuss some approaches used in the measurement of housing prices in the analysis. Rent provided a basic measure in the case of rented units. However, in cases of ownership, either by purchase or own-construction, self-reported prices were used as proxies. Here, households were asked the amount they would receive or offer for the same/similar housing unit if they rented or leased instead of owning it. This enabled the inclusion of these two types of tenure in the analytical framework. It was also noted that the introduction of self-reported prices implied more of value-of-housing-services approach other than market price. However, in a perfect market, there is no reason why these two should not be as close as possible.

3.1 Descriptive statistics

Table 1 below presents the summary statistics for prices, size and number of rooms. The mean price for housing services per household per month is Ksh. 898.50 with a standard deviation of Ksh. 2307.00. The data indicates presence of extreme values with a maximum price level of Kshs. 100,000 and a minimum of Kshs. 1. The mean size per housing unit in the sample was 23.00 square metres, with a standard deviation of 18.70 squaremetres, a maximum value of 488 square metres and a minimum of 1. This further illustrates the

presence of extreme values in the data.The presence of these extreme values would affect significance tests of the parameters of the hedonic regression if not corrected for. Robust errors were therefore reported and used instead of the usual residuals for purposes of t-tests. Average number of rooms was 2 with a standard deviation of 1.04.

Variable	Obs	Mean	Std. Dev.
Price	8408	898.5419	2306.964
Size	8408	22.97276	18.73871
Rooms	8408	1.987393	1.037919

Table 1: Summary statistics on price, size and rooms

Table 2 below shows the distribution of tenures across types and location of the household, that is, whether rural or urban based. The most prominent tenure is own-constructed occupancy. This arises due to a high number of rural households included in the survey. Out of the 8408 interviewed, over two-thirds were rural-based, of whom over 89.74% dwell in own constructed housing units. The least common tenure type among rural households is purchased with 225 observations which makes only 4% of the total rural households. On the other hand, the most prominent tenure type among urban households is rented with 2, 145 occurrences, making up to 83.11% of the urban observations. The purchased tenure also comes last with a prevalence rate of2%. These statistics report important characteristics of the housing markets. First, the cost of construction in urban areas is very high, reaching US $ 18, 000 per unit (Arvanitis, 2013). The amount, however, reduces as one moves away from the urban centres.

This may explain the high prevalence of own-constructed dwellings among rural sub-samples. It is a contrary experience among the urban dwellers, whose most frequent choice is rental housing tenure. While construction and purchasing remain accessible to high income earners

Location	Rented	Purchased	Own-constructed	Total
Rural	373	225	5,229	5,827
Urban	2,145	45	391	2,581
Total	2,518	270	5,620	8,408

Table 2: Location and tenure of housing unit

and those able to obtain credit, rental space is a very feasible and decent alternative to the middle and lower income classes.

In Table 3 below, I present an interactive description of wall-materials across the tenure types. This shows that actually, 6,509 out of the 8,408dwellings have mud walls, putting further emphasis on the effect of cost of construction in housing tenures. Mud walls are far cheaper than the others, therefore, are more feasible to

Wall material	Rented	Purchased	Own-constructed	Total
Mud	1,451	223	4,835	6,509
Wooden	269	29	608	906
Iron-sheets	213	6	71	290
Brick/stone	585	12	106	703
Total	2,518	270	5,620	8,408

Table 3: Wall-material across tenure types

someone who wants to construct, rather than renting or purchasing housing services.

Also tabulated in Table 4 is the wall-material across location of the housing, which shows that the bulk of mud-walled houses is in the rural areas while that for brick or stone walled houses is in urban areas.

Wall material	Rural	Urban	Total
Mud	4,882	1,627	**6,509**
Wooden	673	233	**906**
Iron-sheets	107	183	**290**
Brick/stone	165	538	**703**

Total	5,827	2,581	8,408

Table 4: Wall-material across location

3.2 Hedonic regression

The non-linear hedonic price determination model was run on house floor size (square metres), location (rural or urban), wall-material (mud walls used as a reference level), number of rooms and availability of toilet within the housing unit. While it is accepted that hedonic regression does not include all price-determining qualities (Bracke, 2013), the present model includes the key and prominent features of houses in the domestic market. It suffices to explain variations in price over majority of regions in the country.Table 5 below reports the fitted model.

lnP	Coefficient	Robust Std. Err.	t	P-value	[95% Conf.	Interval]
Lnsize	.4442312	.0360921	12.31	0.000	.373483	.5149795
Location	.7686793	.0233142	32.97	0.000	.7229785	.8143802
Iron-sheets	.5372735	.0485426	11.07	0.000	.4421196	.6324274
wooden	.1863586	.0308843	6.03	0.000	.1258187	.2468986
Brick/stone	.7133722	.0289206	24.67	0.000	.6566817	.7700627
Rooms	.2674856	.0276312	9.68	0.000	.2133225	.3216488
Toilet	.719308	.0405874	17.72	0.000	.639748	.7988681
Constant	3.994036	.0613083	65.15	0.000	3.873859	4.114214

Table 5: Hedonic regression coefficients

All parameters in the hedonic price regression were significant and positive. The *Adj.* R^2 for the model was 0.5147. The coefficients conform to expectations and theory and suggest that an improvement in these hedonic characteristics of housing units tend to increase price in a non-linear manner. It may be necessary to note again that robust errors are reported because they reduce the effect of outliers in significance tests.

The size elasticity of price of housing units was 0.44%, *ceteris paribus*. Using the postulation of perfect housing markets and without loss of generality, the contribution of a variable to the price of a house is equal to own-contribution to occupants' satisfaction. The size of a housing unit to a household is deemed to influence the value of services derived positively. For instance, a bigger house can accommodate a larger household, enable occasional group meetings as well as give a more satisfactory free space to the occupant. Sophistication of the wall material also increases the price of housing units. Compared to mud walls, prices of housing units are 18.64% more among those with wooden walls. This difference increases to 53.72% in houses with iron-sheet walls and 71.34% in houses with either brick or stone walls.Wall material may be viewed as a weak indicator of security, safety, and proximity to comparatively better living environments in the housing sector. The power of iron-sheet walls over mud walls in explaining housing prices may be deriving from the fact that most iron-sheet-walled houses are in urban areas, where general prices for housing are way higher than rural equivalents.

In urban areas, housing services have prices which are 76.87% more than in rural areas. This shows the impact of rural-urban migration and undersupply of housing units in comparison to the market equilibrium.Number of rooms and presence of in-built toilets also increase prices of housing units.

3.4 The Multinomial Logit Model

Using the hedonic price model above, I predicted a housing price index which accounts for heterogeneity of housing units across the sample. This was used as a predictor in the multinomial logit model (MNLM). The price index captures the varying individual prices and smoothens them over the characteristics of each house yielding to a more stable and exogenous predictor.The MNL model was run on three tenure types: rented, purchased and own-constructed. The probability of choosing a tenure type is modeled against the characteristics of the household. With rented tenure as the reference level, the estimated model takes the following form:

$$\rho i = \frac{\exp(\sum \beta ij Xij)}{1+(\exp(\sum \beta ij Xij))} \qquad \text{(ix)}$$

where reported parameters, β_{ij}, are difference parameters; that is, for **i=purchased,** $\beta_{ij}=(\beta_{\text{purchased, j}}-\beta_{\text{rented, j}})$, and **i=own-constructed,** $\beta_{ij}=(\beta_{\text{own-constructed, j}}-\beta_{\text{rented, j}})$.

For the levels, the reported coefficients are the odds-ratio. This poses difficulties in interpretation of the coefficients. It is advisable to use the marginal effects in the logit model to avoid missing detail while presenting the interpretation (Wulff, 2014).

3.5 Results

The raw regression output is tabulated in Table 6 below. The model converges after five iterations and has a ***Log-likelihood ratio of 3847.38, p-value of 0.0000***and a ***Pseudo R^2 = .3089.***It is clear that the model is significant at 5% level. Based on the p-values, coefficients for total householdand household head's income are not significant at the 5% level among purchase occupants. The significance, however, changes among own-constructed tenures while household head's gender becomes non-significant. All other coefficients are significant in explaining the difference between rented, purchased and own-constructed tenure choices among households.

Given the complexity of multinomial logit coefficients arising from the multilevel categorical outcomes, marginal effects are generally preferred for interpretation. The average marginal effects are reported and discussed in Table 7 and 8 below.

	Coefficient	P-value	Coefficient	P-value
TENURE	PURCHASED		OWN-CONSTRUCTED	
Hedonic price	-.0012812	0.000	-.0018095	0.000
Household income	-1.79e-06	0.921	-.0000231	0.036
Head income	-.000027	0.227	-.0000479	0.000
Head gender	-.3193171	0.036	-.1204809	0.098
Head age	.0776783	0.000	.0757797	0.000
Household size	.499876	0.000	.5072211	0.000
Constant	-6.371945	0.000	-3.022812	0.000

Table 6: Multinomial logit model coefficients – rented tenure is the reference level

Using average marginal effects reported in Table 7 below to interpret, it is found that hedonic prices, total household income, household head's income and household head's gender are not significant in explaining the choice of purchasing a housing unit over that of renting. Only household size and the household head's age are significant at 5% level. If the household size increases by one, the probability of purchasing increases by 0.0030107 over that of renting a housing unit. If the household head's age increases by one year, the probability of purchasing a housing unit increases by 0.0005422 over that of renting a housing unit. The

	dy/dx	P-value
Hedonic price	4.74e-06	0.399
Household income	5.10e-07	0.315
Head income	3.40e-07	0.594
Household size	.0030107	0.000
Head gender	-.0068992	0.112
Head age	.0005422	0.000

[Table 7: Marginal effects for purchased housing tenure]

Table 7: Marginal effects for purchased tenure

significance of these two variables may be related in theory since household size is likely to increase with age of the household head due to nuclear and extended family responsibility, *ceteris paribus*. A unique observation is the positive, though non-significant, coefficient of price. I used a generalized continuous price index over the occupancy types. While reserving from judgmental, price changes affect inter-category adjustments based on satisfaction of the occupants and the ability to obtain a more "classy" tenure type without significant adjustments on the occupant(s)' housing budget. Therefore, if the general hedonic price

index in the market increases by one shilling, rented tenure will be frowned at and a household's probability of adjusting the housing budget and purchasing a unit increases to (4.74e-06)=0.0117.

They would survive in rented houses with increased incomes, even if owning has greater benefit. The size of household has a negative significant coefficient on the probability of rented tenure. If the household size increases by one person, the probability of to rent housing services is 0.0612 lower than that of constructing a housing unit. Considering household decision-making structure, if the household head is male, the probability of renting is 0.0251 over than of constructing a housing unit. On the same aspect, household head's age is negative and significant for rented tenures, generating similarity with Borsch-Supan, Heiss and Seko (2002). If the age of the household age increases by one year, then the probability of renting falls 0.0102 below that of constructing own house. This could relate to lifetime variables like starting family life which affect the size of household as well. The hedonic price index fails significance test at the 5% level.

	dy/dx	P-value
Hedonic price	-.0002228	0.000
Household income	-3.20e-06	0.024
Head income	-6.07e-06	0.000
Household size	.059006	0.000
Head gender	-.0091119	0.334
Head age	.0087424	0.000

Table 8: Marginal effects for own-constructed housing tenure

Table 8: Marginal effects for own-constructed tenure

A small departure from the purchased tenure is evident in Table 8 above. While household gender remains non-significant in explaining the difference of probability of choosing own-constructed and renting, hedonic prices, total household income, household head's income, household size and household head's gender are significant at 5% level. If the general hedonic price index increases by Ksh.1, the probability of constructing a house reduces to 0.0002228 below that of renting. A Kshs.1 increase in total household income leads to a fall in the probability of constructing own house to (3.20e-06) = 0.007932 below that of renting. If the household head's income increases by Kshs. 1 *ceteris paribus,* the probability of constructing fallsto (6.07e-06)=0.01504 below that of renting. If the household size increases by one, the probability of constructing a house increases by 0.059006 over that of renting. Lastly, a one year increase in the age of the household age increases the probability of constructing a house by 0.0087424 over that of renting.

3.6 Salient observations

The most important determinants of purchased tenure are household size, and the age of the household head. Household size and the age of the head have positive significant marginal effects on purchasing, compared to renting.The larger the household, the higher the probability of shifting from rented to a purchased tenure. The older the household head, the higher the probability of occupying on purchased basis over rented.

Considering own-constructed tenure, household head's income and the size of the household have greatest significant coefficients at 0.059 and 0.015 respectively. It appears that, compared to rented tenures, own-constructed tenures may be interpreted as inferior tenures due to the persistent negative coefficients of total household income and household head's income. While this understanding may not represent the greater Kenya, the structure of the sample depicts high inclusion of rural households which cause the understanding to be plausible. Rural incomes are considerably lower than those in the urban areas while own-constructed tenures are most prevalent in rural dwellings. Needless to note, all these observations are reported *ceteris paribus*.

4.0 Conclusions

The paper develops an analytical model which could be used to predict tenures at the policy level, or demand at the firm level. It shows that people will change from rented tenures to purchased only due to increase in household size and age of the household head. The change between rented and purchased tenures, *ceteris paribus*,does not arise from income, price or gender as intuition may assert. Regarding own-constructed tenure, a key and positive factor is household size. If the shift from rented tenure is occasioned by household size, consumers have higher probability of constructing than purchasing an already constructed housing unit.

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