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Econometric analysis applied to urban property transactions in Havana between 1994-2007

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Making Cities Work

Econometric analysis applied to urban property transactions in Havana between 1994-2007

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Introduction

This research allows me to corroborate and demonstrate my judgment about urban transactions in Havana with more credible and consistent information. It is one thing to observe a process, and another to prove where the thinking was accurate or mistaken. The determination of the price per square meter of urban land and buildings, that is quite a routine in other places, is complex in the Cuban context where there is a strong central government presence, which combines arbitrary answers with very discretionary actions and where there is very a restricted private environment.

I decided to apply an econometric analysis and try to go further than the traditional descriptive methods used in Cuba, in order to determine the relevance of variables that appear relevant to the valorization process, for both the formal and the informal transactions. In this way I expect to discover the regularities and the distortions in the processes and to understand their various effects.

I use the hedonic price theory to obtain mathematical models that enrich and support the analysis of the way property prices are determined in Havana: by extension it could be in Cuba. Unlike other cities and countries in the world that use econometric analysis to comprehend land and building markets, this is the first time this method has been applied in the Cuban context.

My starting point is the expectation that, despite the differences between the public environment (state agencies, institutions and international firms) and the private (individuals),

the price of an urban asset in the registered transactions shares the same logic for formal and informal mechanisms.

The development of the two econometric models, one for the public and another for the private transactions, allows me to enrich the discussion about the ways of allocating land when there might be a conflict between economic efficiency and equitable distribution of the benefits of a certain land use, and to understand the things in common to, the contradictions between, and the imperfections of both mechanisms. At first I expected more radical differences, but these are found more in the process than in the value definition. There are interesting aspects to both mechanisms that, with better connection to each other and fewer restrictions, could produce much better land management results. The debate on the land price variations for the private and the public transactions could, by using market tools, administrative procedures or combinations of both approved by the government authority, lead to a fresher vision of land management in order to achieve better social and economic policies.

The results of this research allows me to identify variables which have a strong influence on the formation of land and building prices. From here I can work to improve the information structure and think how to connect the legal and planning structures with the price creation and the possibilities of capturing the value, so that public agencies and private individuals can work to increase the economic and social efficiency of our city. The possibility of applying sound models with adequate statistical accuracy, allows the introduction of new variables in the future that may contribute to a more comprehensive understanding of the process of valorisation of urban properties in Cuba. The determination of models and standard variables that influence the land price formation could allow the creation of city price monitoring systems, thus obtaining maps of city values very useful for developing land policies and for planning land use.

In connection with this, it is essential to understand the mechanisms which have arisen among the population who face the restrictions on buying, selling or transferring properties - the property swapping process among households. Going deep into this process is quite unique, as the references to this process are usually superficial and not demonstrated.

The careful consideration of the results can improve also the administrative process behind formal valuations. At present, that does not recognize the existence of market segments. Recognizing the potentials of the diversity between the market segments and giving them legal space for action would help improve the performance of public agencies by providing more inputs to the valuation process which has been developed with foreign partners, for this latter at times applies international methods without knowledge of the real developer

expectations and even the real urban rents in Havana city. We can now demonstrate that there has been an undervaluation of many land uses, including hotels. This research offers the possibility of reconsidering the central government role in regard to land and buildings value. It suggests modifying the discretionary criteria which distort the price formation in the urban matrix, and it encourages the application of variables to improve the valuation process and increase the efficiency in land management.

This research is limited to Havana city for three main reasons: Havana is the largest and most complex area of the country in terms of social structure, population density, institutional framework, planning, regulations and urban diversity. It has the main records of real estate exchange (15 thousand units), the most reliable statistics of real estate valuations for projects with foreign investors, and a diversity of financial sources. The access to up to date urban and financial information about land and housing has been one of the determining factors for this methodological choice. Having regard to that availability of information, I assumed that if I could analyse and understand the creation of land and building value in a city of 2.1 million inhabitants with such a diversity of urban environments, infrastructure quality, building typologies, among other aspects, then I would be making a contribution which would be easy to replicate in other urban settlements in Cuba..

Improving the understanding of price formation

One of the principal weaknesses of existing research into the price, value and transactions of urban properties - land both undeveloped and developed - is the lack of systematic documentation and the predominance of qualitative information. This weakness limits the introduction of, and the improvement to, policy and policy mechanisms, and contributes to the lack of success at both local and international levels in producing more significant and probing studies on these topics. Even rarer are studies that apply an econometric analysis[1] to urban property transactions, even when the essential information for this type of analysis is available. "Econometrics is an analytical tool to compare different price theories as mathematical constructions[2], " and can be understood in this case as a way to explain and simulate, in a concrete and realistic manner, the reality of urban property transactions. The

1 Econometrics is the science that links the economic theory with mathematical and statistical analysis to understand the complexities of society. It has the objective to understand the interrelation and influence among variables, make predictions and develop empirical analysis based on statistical interference. It consists on the application of mathematical statistics to a set of data with the objective to provide empirical support to the models built with mathematical economics and to obtain numerical results. (Gerhard Tintner, pag74)

2 Dr. Joseph Roca," Los precios del suelo en el ámbito metropolitano" Corporación Metropolitana de Barcelona, 1994.

application of econometric models to the study of urban property markets improves the quality of studies in the field, by refining the relevant variables and promoting a better understanding of how human behavior and activity affect a city.

There is a general belief that urban properties possess distinctive elements that make them financially comparable. However, this statement is subject to debate, the debate being that properties in and within the urban matrix are very different because of the diversity of locations, type of rights and property attributes. Econometric modeling can take this diversity into account if sufficient data are available. Nevertheless, the literature recognizes that one of the biggest problems facing the development of the econometric model in the urban field is that there are many market transactions and processes that do not reveal visible evidence[3], thus forcing a consideration of possible bias in selecting what information to use.

When applying econometric models, it is important to obtain a "high" or "best fit" result. This implies requiring a squared error below a certain minimum, which signifies that the level of statistical significance between the dependent variable and the independent ones is acceptable. The statistical techniques are well-known and, with the advance of information technology, a number of econometric programs exist which can produce results rapidly. These programs apply diverse statistical tests to the information, and if the tests are satisfied, that provides credibility to the results. The success of econometric analysis depends to a great extent on the availability and quality of the information, be it quantitative or qualitative. If the necessary information is not available or not credible[4], the application of the model can be limited or suspended.

To study urban property transactions in Havana, we have applied this instrument in order to identify the attributes that are most influential in the appraisal of urban properties in the city between 1994 and 2007. In keeping with the peculiarities of the information and operational logic, two econometric models have been developed. One is for those transactions undertaken when evaluations were formal, understood as an assessment process controlled and mediated by state institutions. The other model is for those exchanges registered in the permuta (swap operation), when informal mechanisms to arbitrate financial agreements[5] are present.

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3 Barrie Needham," How the city of Amsterdam is using econometric modeling to value real estate" , 1997/98, Journal of Property Assessment and Administration. Page 27

4 Barrie Needham," How the city of Amsterdam is using econometric modeling to value real estate" , 1997/98, Journal of Property Assessment and Administration. Page 29

5 Ricardo Núñez, La Permuta: an effective instrument for housing transactions in Cuba, 2007, IHS Erasmus University and Nijmegen University, Holland, PhD Research.

1- The Econometric Model

The technique starts by defining a mathematical function which allows for consideration and measurement of the degree of correlation between explanatory variables and the dependent variable. In this case, the dependent variable is the transaction price of the property (land plus any building works) when this is traded. It is necessary to correct for the size of the property being transacted, so transaction price is dividing by the area of the plot. I did this because the *potential* value of the property is greatly influenced by plot size.

These models estimate the particular effect of each independent variable on the dependent variable. The Model comes from the following equation (expression):

Value of the Transaction $\ln V_i = c + \sum_{j=1}^{k} b_j X_{ij} + u_i$

Where Vi is the price of property (i) per m^2 of plot, and the X_j are the **k** explanatory variables for this property, the b_j are the coefficients associated with each explanatory variable in order to estimate the regression, c is the constant term and u is the stochastic error term of the model. This is a linear regression model and, in order to estimate the coefficients, we applied the Ordinary Least Squares estimators (OLS).

The dependent variable is transformed into a logarithm. (That is not done with the independent variables, as some of them are qualitative and some have values of zero or one.) As we used the logarithmic transformation on the dependent variable, the coefficients express the relative effect of each attribute on the price. So if, for example, the coefficient of the independent variable Xj is 0.02 –where Xj is a binary variable 0 or 1 - this means that the presence of the attribute Xj will have a 2% effect on the dependent variable. The complexity of the model is better understood if the coefficients are seen as a "marginal contribution", which when there is a change in the quantity of a specific attribute, produces an effect on the price of the transaction"[6].

Expressing the coefficients as percentages allows international comparisons of the results. If the coefficients were interpreted in CUC which is an unknown currency outside Cuba, or even in US dollars, the results would be subject to inflation, price levels and other particular aspects of the Cuban economy. It is then very convenient to have the coefficients in percentages.

There is a second reason for transforming the (dependent) variable into a logarithm. This reduces the variance of the series and helps to avoid problems with heteroscedasticity. With the logarithm it is easier to achieve homoscedasticity in the model residual.

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6 Dr. Joseph Roca," Los precios del suelo en el ámbito metropolitano" Corporación Metropolitana de Barcelona, 1994.

The independent variables which are put into the model are described, and justified, in a following section. There it will be seen that we use many qualitative variables. Because the model can use only quantitative variables, the qualitative variables have to be translated into *Dummy*[7] variables. Here we used the Centered or Orthogonal Dummies[8] that according to the literature[9] allow a better estimation of the coefficient without affecting the estimation of the constant or interceptor.

When using centered dummies, the coefficient has a particular meaning. This can be illustrated by the independent variable: presence or absence of an intermediary or agent. This is the easiest case because it is represented by only one dummy and not by a group of dummies. When there is an intermediary, the dummy is 1 (existence of attribute) and without intermediary is 0 (absence of attribute). The estimated coefficient is 0.30 and it is interpreted as a 30% increase in the average price of the transaction because of the presence of intermediary. We can see that the price increases because the result is positive, if it were negative the price would decrease. The interpretation as percentage is a consequence of applying the logarithm to the dependent variable.

In the case of a group of centred dummies or in the case of orthogonal dummies, the coefficients refer to the average price of the whole data set, because the most interesting aspect is the comparison among coefficients. This can be illustrated as follows, using the independent variable 'year of transaction'.

Years	1998 (y98)	1999 (y99)	2000 (y00)	2001 (y01)	2002 (y02)
Coefficient	0,26223	0,016806	-0,123036	-0,100379	-0,055621

7 It is not absolutely essential that Dummy variables take 0 and 1 value. The numeric pair (0,1) could be transformed as a linear numeric pair according to the formula Z= a+bD. Damodar N. Gujarati, pag 368.

8 Orthogonal Dummies provide a better estimation of the coefficient without affecting the estimation of the constant or interceptor.

9 Doan, T. A. (2000). Rats Version 5 User's Guide. Estima, Evanston. 2) Enders, W. (1995) "Applied Econometric Time Series" Wiley Series in Probability and Mathematical Statistics. 3) Gujarati, Damodar. (2004) "Econometría" McGraw-Hill, cuarta edición

From the coefficients, we interpret that in 1998 certain events led to higher prices than the rest of the period, while in the year 2000 other events led to lower prices. In comparing the coefficients we observe the evolution of prices as follows: in 1999 the prices fell with respect to 1998 with 24.5% (0.26223-0.016806). In 2000 there is another decrease in respect to previous years (-0.123030<0.016806< 0.26223). However, in 2001 the prices go up, in this case by 2.3% with respect to the previous year and in 2002 they keep an ascending trend of 4.4% with respect to the previous year.

The general rule in the application of Dummy models is the following: if a qualitative variable has **m** categories, then **m-1** dichotomy variables must be introduced"[10]. Dummy orthogonal are used, or better put, are assigned -1 to the category that is excluded[11].

In keeping with this, the equation would become:

Ln Vi = (b2X1i + b3X2i + b4X3i + b5X4i)+ (b5X6i + b6X7i+ b7X8i + b8X9i) +... + c

Where the variable **Xi** has four possible values (x1i, x2i, x3i, x4i) and determines 3 Centered Dummies (b2, b3, b4) in order to fulfill the following criteria for this qualitative variable *(b2X1i + b3X2i + b4X3i + b5X4i)*:

If (X1i=0 , X2i=1, X3i=0) then = b3

If (X1i=1 , X2i=0, X3i=0) then = b2

If (X1i=0 , X2i=0, X3i=1) then = b4

If (X1i=-1 , X2i=-1, X3i=-1) then = b5=-(b2+b3+b4)

We illustrate this with the land use variable (Us) in the Formal Transaction model is:

Land Uses	Hotel	Industrial	Residential	Office	Other Uses
Variables (n=5)	Us1	Us2	Us3	Us4	Us5

10 Ibiden7

11 The Dummy Orthogonal follows the Dummy logic, it means to assign 0 or 1 value to the m-1 category. So in this short example: Land Use has 4 categories Hotel, Residential, Office, and Industrial. So Dummy always determines 3 categories (exclude Industrial), but the way in which the missing category is referred to is as follows:

Hotel, Residential, Office

-1 -1 -1

In the traditional Dummy (no orthogonal) the value assigned will be:

Hotel, Residential, Office

0 0 0

Coefficient (n=4)	b2	b3	b4	b5	b6 (this coefficient is expressed in terms of the other coefficients)

If (Us1=0 , Us2=1, Us3=0, Us4=0) then = b3

If (Us1=1 , Us2=0, Us3=0, Us4=0) then = b2

If (Us1i=0 , Us2=0, Us3=1, Us4=0) then = b4

If (X1i=-1 , X2i=-1, X3i=-1, Us4=0) then = b6=-(b2+b3+b4+b5)

Taking into account the various groups of dummies, it is essential to make an overall test of significance with each group to determine the relevance of including that group in the equation, that is to say, to deduce the explanatory weight of each group on the dependent variable. Additionally, this test will examine the effect that each variable produces within each group. The level of influence will be reflected in each estimated coefficient (refers to the "t test" that appear in annexes 1.1 and 2.1)

The model, when tested and calibrated using observed data, includes a conventional procedure, such as the Null Hypothesis, that the coefficients of each variable in the regression model are equal to zero. The application tests whether the coefficient of at least one independent variable is statistically different from zero.

In texts regarding econometric models applied to the topic of price or value of real estate in the 1980's, it is said that the coefficient of determination (R^2) should lie between a range of 0.6 and 0.8 (see Butler/1982). In the 1990's, other studies by Rothenberg[12] raise the issue of finding R^2 values which are higher than 70 %. To obtain the R^2 or an adjusted R^2, one must add, test and adjust additional analyses and criteria before and during the run of the model. One must monitor for the assumption of statistical errors such as: normality, and homoskedasticity.

12 Rotherberg J., Glaster, G., Butler, R., and Pitkin, J. "The maze of urban housing markets: theory, evidence and policy", University of Chicago Press, Chicago, USA,1991.

With these two econometric models (the formal and informal) one tries to replicate, as closely as possible, the pattern of value formation of the urban land in Havana City. By way of various independent variables, the models attempt to account for the complexity of the process.

It should be understood that when using this method of prediction, any simulation will determine a value which lies within a statistically significant range of property prices, subject to the determined values in the explanatory variables. To raise its effectiveness as a mechanism of prediction (that is, to reduce the statistically significant range within which the value lies, which means that the prediction has been made more precise), it may be necessary to introduce new variables.

2-Transaction Information database: Peculiarities and data preparation

When preparing the data for the econometric model, the initial information must satisfy two conditions. The first one is factual, and it has to do with the availability of data that must be analytically documented and verifiably objective. The second condition has to do with the relevance of the information chosen after analyzing existing literature about price theory and models developed by other experts on this area. It is based also upon my knowledge of the public framework and type of land right, type of real estate, different urban factors and upon my reasoned expectations about the negotiation logics for more than a decade. This logic takes account of such things as financial capacity, frameworks and type of land right, the nature of the project, the type of real estate, a knowledge of urban growth factors, location and its corresponding status, level of services available, and urban accessibility, and so on. Work with econometric models demonstrates that increasing the number of independent variables will raise the explanatory capacity. But such efforts cost time and money. The R^2 is increased by adding more variables, but the improvement in R^2 is less the more variables are added.

When obtaining information for this study, two sources were indispensable: government agencies and individuals[13]. For the maximum accuracy of this information, the errors possibly made during observation must be as small as possible, the measuring criteria must be suitable, selective bias must be avoided and any type of predominance in compiling of information, restrictions on confidence etc. must be allowed for.

In the use of econometric and statistical models, it is recognized that "the research results will only be as good as the quality of information used" [14]. Hence the need to provide a matrix of

13 There are at least five key sources in general: the government agencies, the international agencies, the private organizations, the ngo´s and the individuals.

14 Damodar N. Gujarati, "Econometría Básica", Second edition,printed by Havana University,First edition, Spain,1978

homogenized data for each urban property, for only in this way can one obtain conclusions based on strong statistical criteria. One must be stringent about the quality of the information that is put into the model. If the data are not credible, or are distorted or incoherent, the model results will be calibrated incorrectly. All inputs should be confirmed and verified through diverse sources.

Another key aspect regarding the quality of the information and its management during the model preparation is that the functional attributes, socio-economic context, legal situation etc. are measured at around the same time as the transaction takes place.

3- Preparing the Data

The model is applied to two types of transaction. One is the appraisal carried out of state projects with foreign capital investment for new investment initiatives, the other is transactions between families or individuals through the permute mechanism (swap operation)[15]. So, two registers of land transactions were constructed. The first is when Cuban companies using public land and buildings are involved in a business relation with foreign enterprises or investment: those transactions are considered as official (formal transactions) and cover a period 1998-2002[16].

The second is of the permuta process (informal transactions) between 1994 and 2006, where housing or land is exchanged between families or individuals, and ad-hoc financial agreements are reached with the frequent assistance of an informal "permuta" expert[17].

For this study, appraisals for social housing have been excluded, given that the current appraisal mechanism for this housing sector contains so many discretionary and arbitrary elements. The theory behind the econometric model assumes a certain logic between actors when negotiating (see above), a logic which is absent when social housing is appraised.

Both sets of data (formal and informal) refer to transactions in the overall period 1994 to 2007. In the case of permuta operations, although the researcher possesses information dating from the 1970's, the majority of data compiled comes from the period 1994 – 2006.

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15 See paper Ricardo Núñez, La Permuta: an effective instrument for housing transactions in Cuba, PhD Project, IHS/Erasmus University, Internal Publication, 2007, Holland & Ricardo Núñez, Land and building valuation in Cuba: from land without value to land as financial asset., PhD Project, IHS/Erasmus University, Internal Publication, 2007, Holland

16 The Cuban state partner contributes to the joint venture with land and buildings and with the respective assestments. This value is approved by a state agency of the Ministry of Finance, which is the fundamental source of the Formal Transaction database,

17 In the case of the Informal Transaction information, the author used different mechanisms –formal and informal-- to obtain detailed information about the transactions. To gather this informal information (where non written agreetment among swappers existed) implied a time cost and different difficulties due to the lack of suitable records.

During this period 1994 - 2006, two important changes took place:

1- The monetary duality, introducing the convertible peso and the US dollar was authorized for both business and household transactions.

2 - The opening to foreign investment but with institutional gaps regarding property rights. This started between 1989 and 1993, but the significant opening of the economy took place during the economic and institutional reforms between 1994 and 2000. The opening of the economy was accompanied, until 1997, by major changes in formal rules focused on introducing land and building assessment methods and new legal and institutional framework [18].

During the study period, the exchange rate of National currency to the Convertible Peso (USD to CUC) changed only a little, as shown in the following table:

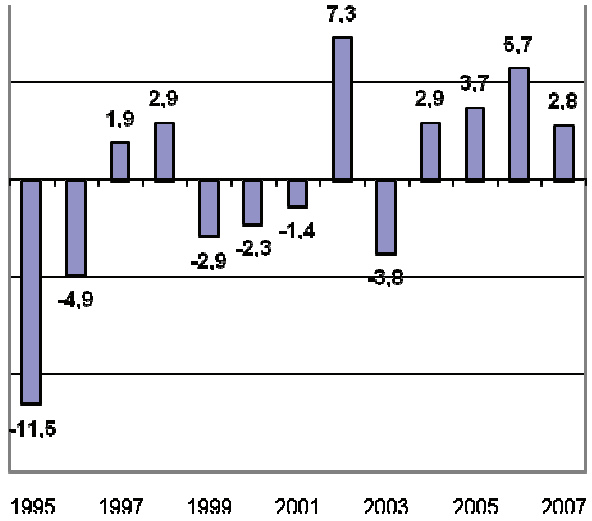
Exchange Rate by Year		
usd: American Dollar	Hard Currency	Cuban Peso Convertible
Años		Peso (Nacional Currency)
1995	1 usd	35
1996	1 usd	18
1997	1 usd	22
1998	1 usd	25
1999	1 usd	22
2000	1 usd	22
2001	1 usd	26
2002	1 usd	25
2003	1 usd	24
2004	1 cuc	25
2005	1 cuc	25
2006	1 cuc	25
2007	1 cuc	24

In the period 1995-2007, the value of money both increased and decreased:

18 Editing by Jorge I. Dominguez, Omar Everleny y Lorena G. Barberia "La economía cubana a principios del siglo XXI, El Colegio de Mexico-The David Rockefeller Center for Latin American Studies and Harvard University, 2007.

Graph No. 1.1 Consumer price index

(Variation percentage with respect to the previous year)



Source: Economic Report of the Central Bank of Cuba and ONE data.

For these reasons (changes in exchange rates and inflation), we have not assumed that the money value had a constant significance. However, the Property Price Data (prxsqm) in the Formal and Informal databases were not corrected to a specific base year or subjected to any other financial adjustment. Instead, the year of the valuation is included as an independent variable.

3.1- Formal Transactions

The values registered in this database of formal transactions are not realized sales prices: these values do not represent a direct payment of money from the foreign party to the Cuban party to recognize the value of the urban asset. There is no Document of Sale. Rather, the transaction is a contribution, equal to the value of the surface right, to the social capital of the project, which once agreed upon, becomes a monetary contribution (equity) by the foreign partner. Usually, there is a joint partnership (50/50 %) with a Cuban partner, which contributes the same amount to the project.

This contribution to the business deal, in the form of land or real estate, requires that the real estate is appraised by a process, the final approval of which is in the hands of the Directorate of Heritage of the Ministry of Finances and Pricing (MFP). Although teams of Cuban expert appraisers conduct appraisals for each case, sometimes applying different internationally

recognized methodologies, the MFP is the final authority with the power to check, approve and register the appraisals and grant the correspondent certifications[19].

This research examined the MFP appraisal data base, of which 272, out of 500 in the whole of Cuba, were in the City of Havana. From this, 178 were extracted for econometric analysis, eliminating those properties that were duplicated or appraised more than once in the same year.[20]

The following information on each appraisal or transaction was available:

Variable	Description
No. Of Certificate DVA-C	Number of Certificate of MFP Appraisal
Petitioner	Cuban State Entity
Body	Central Administration Body (Ministry of the Petitioner)
Province	Province where the valued asset is located
Municipality	Municipality where the valued asset is located
Location of the goods appraised	Address of Real Estate or Land Parcel
Area (m^2)	Total Area of land
Estimated Value (USD)	Value of the Land or the Installations
Price per m^2	Price of the land, construction or real estate per M^2 of land
Right granted	Duration of Right to Use by the Joint Enterprise in Years (leasing term)
Appraisal Body	Appraisal Body who conducted the Appraisal
Number of the Report	Number of the Report given the File at the Direction of Heritage
Method of Calculating Used	Type of international Appraisal Method Used in the Appraisal
New property Use	Proposed use of land or buildings

It was decided to order and filter the official database because the initial information which included different types of data (qualitative and quantitative) was affecting any arithmetic calculation. The data were also rearranged to avoid duplications, to verify the calculations of both addition and division, and to eliminate the variables that – it is expected - do not make a

19 The Formal Transactions during 1998-2004 were recorded by the Cuban Ministry of Finance and published in 2004 by the Patrimony Direction.

20 When one property was valued more than once in the same year, only one valuation was included in the analysis.

substantial contribution, such as the name of the Cuban body requesting the appraisal, the number of the report or the name of the petitioner. The new database is thus organized in the following way:

Variable	Description
RNID	Identification number in the Data Base
Year	Year of Appraisal
Muncipality	Municipality where the valued asset is located
Address	Address of Real Estate or Land Parcel
Area (m^2)	Total Area of land
Value of the Land (1)	Appraised Value of the Land
Value of Buildings (2)	Appraised Value of Existing Constructions
Total Value	Sum of (1) + (2)
Price / M2 of Total Goods	Price per square meter of land
Right granted	Duration of Right to Use by the Joint Enterprise in Years (leasing term)
Appraisal Body	Appraisal Body who conducted the Appraisal
Method of Calculation Used	Type of international Appraisal Method Used in the Appraisal
Asset Use	Proposed use of land or installations with the new investment

The **total value** is the value of the urban good (value of the land plus the value of the building); this value allows us to arrive at the **price per m^2** of the total transaction.

With this new data base, the information - dependent and independent variables with a respective opening for the dummy's - was ready to feed into the econometric model.

The variables formulated for the model are:

Dependent Variable	DEFINITION	
Pr / M^2	Pr x M^2 Price per square meter	
Independent Variable	Dummy	DEFINITION
Year (4) Base 2002	Year 1998	Appraisals Registered in 1998
	Year 1999	Appraisals Registered in 1999
	Year 2000	Appraisals Registered in 2000
	Year 2001	Appraisals Registered in 2001
Municipality (15) Base: Cotorro	M1	Playa
	M2	Plaza
	M3	Centro Habana
	M4	Habana Vieja
	M5	Regla
	M6	Habana Este
	M7	Guanabacoa
	M8	San Miguel
	M9	10 de Octubre
	M10	Cerro
	M11	Marianao
	M12	Lisa
	M13	Boyeros
	M14	A. naranjo
Right Granted / Leasing term Base: over 51 years	D1	0-10 years
	D2	11-20 years
	D3	21-30 year
	D4	31-50 years
Method of Calculation (5) Base: Replacement Cost	Md1	Comparative Market
	Md2	Dynamic Residual
	Md3	Static Residual

	Md4	Capitalization Rent
Use (5) Base: Other Uses	Us1	Hotel
	Us2	Industrial
	Us3	Residential Real Estate
	Us4	Office Real Estate

Annex 3 presents Havana City Map that shows the municipalities into which Havana is divided

By way of illustration, the next table (partially shown) indicates the effects on the dependent variable of a dichotomous model or Dummy, in this case presenting the variable Right Granted / Leasing term (D) and Method of Calculation (Md). The first transaction reached 740,5 pr x sqm, in which the Right Granted / Leasing term covers a period of 30 years (= D3) and the Method of Calculation applied was Dynamic Residual (=Md2).

Price per square meter	D1i	D2i	D3i	D4i	Md1	Md2	Md3	Md4
740.5	0	0	1	0	0	1	0	0
174.0	1	0	0	0	1	0	0	0
143.1	1	0	0	0	0	1	0	0
236.3	0	1	0	0	1	0	0	0
55.0	1	0	0	0	1	0	0	0
404.3	0	0	0	1	0	1	0	0
105.0	0	0	0	0	0	1	0	0
19.6	0	1	0	0	0	1	0	0
45.4	0	1	0	0	1	0	0	0
129.0	0	1	0	0	1	0	0	0
66.4	1	0	0	0	0	1	0	0
134.4	0	1	0	0	0	1	0	0
210.1	0	0	0	0	1	0	0	0
310.4	1	0	0	0	1	0	0	0
585.4	0	1	0	0	0	0	0	1
2,030.8	0	1	0	0	0	1	0	0
263.7	0	0	0	1	1	0	0	0
480.6	0	0	0	0	1	0	0	0
84.4	1	0	0	0	0	1	0	0
200.0	0	0	0	0	1	0	0	0
323.0	0	0	0	0	1	0	0	0
233.4	0	0	0	0	1	0	0	0
215.8	0	0	0	0	1	0	0	0

3.2- Informal Transactions

In the case of the Permuta Database, the sources are diverse and are the result of interviews, exchanges with families and friends, and participation in potential deals regarding property to be inherited from relatives. The information has been compiled from all these sources. None of the municipal or provincial housing institutions compiled information regarding the financial aspect of the agreements, because they essentially take place illegally and informally.

The database contains 153 property values related to 62 swoop operations. For each case, the following information was available:

Variable	Description
RN Code	Identification Number in the Database
Year of Exchange	Year of the Exchange
Municipality	Municipality where the Permuta asset is located
Address	Address of the property or parcel
Constructed Area (m^2)	Building Area (m^2)
Total Area of Property (m^2)	Total Housing Area (land and building)
Property	Type of Property: House, Apartment, Room, Roof etc.
State of Construction	State of Construction (Good, Regular, Bad)
Existente of an Intermediary	Participation of a Permutero o Corredor / swap expert
Type of exchange	Simple (1x1) or Multiple (more than 3 assets)
Operation Conducted or Proposed	If the operation was conducted or in proposition
Compensation in Moneda Nacional (1)	Payment in Moneda Nacional
Compensation in CUC (2)	Payment in Convertible Currency
Compensation in Goods (3)	Payment in Goods (TV, CVR, Furniture, Auto)
Total Value	Sum of (1) + (2) + (3)
Price / M2 of Total Property	Total Value per M^2 of Land
Declared Motive	Principle legal reason for claiming need for Permutar

Next is presented the structure of the Informal Transactions Database, using the Dummy criteria:

Dependent Variable	DEFINITION	
Pr / M^2	Pr / M^2 Total Value of Housing per square metre of land	
Independent Variables	Dummy	DEFINITION
Year (14) Base 2007	Year 1994	Exchanges in 1994
	Year 1995	Exchanges in 1995
	Year 1996	Exchanges in 1996
	Year 1997	Exchanges in 1997
	Year 1998	Exchanges in 1998
	Year 1999	Exchanges in 1999
	Year 2000	Exchanges in 2000
	Year 2001	Exchanges in 2001
	Year 2002	Exchanges in 2002
	Year 2003	Exchanges in 2003
	Year 2004	Exchanges in 2004
	Year 2005	Exchanges in 2005
	Year 2006	Exchanges in 2006
Municipality (15) Base: Cotorro	Mp1	Playa
	Mp2	Plaza
	Mp3	Centro Habana
	Mp4	Habana Vieja
	Mp5	Regla
	Mp6	Habana Este
	Mp7	Guanabacoa
	Mp8	San Miguel
	Mp9	10 de Octubre
	Mp10	Cerro
	Mp11	Marianao
	Mp12	Lisa
	Mp13	Boyeros
	Mp14	A. naranjo

State of Construction Base: Very Critical	**Et1**	Good
	Et2	Regular
	Et3	Bad
Type of Property Base: Others	**b1**	House
	b2	Apartment
	b3	Duplex
	b4	Single Room
Intermediary Base: There is no Intermediary	**Pt1**	Participation of an intermediary (permutero)

By way of illustration, the following table (partially shown) indicates the effect on the dependent variable of a dichotomous model or Dummy, in this case the variables Year (Y) and Type of property (b). In this case the first transaction recorded a value of 156,9 per sqm, done in year 1995 (= y95) and the Type of property was a Duplex House (= b3).

Precio CUC/ m2	y1995	y1996	y1997	y1998	y1999	y2000	y2001	y2002	y2003	y2004	y2005	b1i	b21	b31	b41
156.9	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
220.6	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
136.4	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
235.3	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
145.2	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
138.9	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	1	0	0
277.8	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
235.3	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0
166.7	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
206.9	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
134.6	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0
209.0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0
150.0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	1	0	0

4- Results of the Econometric Model: Statistical Results.

Here we describe the statistical results obtained for each of the two models used. In order to assess the results of the models, each has been checked to see if all the OLS assumptions were met - for normality in the residuals and to confirm the constant variance in the residual

(homoskedasticity). As we are working with cross-section data it is not necessary to check autocorrelation in the residual[21].

First the features of the model are shown and then the statistical results - explanation - between the independent and dependent variables.

4.1- Formal Transaction/ Appraisal for Businesses with Foreign Investor

Model Validation.

One can see the model in use in Annex Table No. 1.1; it demonstrates compliance with the criteria of normality (see annex 1.2) and the criteria of heteroskedacity. Regarding compliance with normality, a dummy variable was included, specifically for observation 40 (an outlier), because of an atypically high valued transaction. Following this adjustment, the model parameters behaved satisfactorily.

The homoskedacity (constant variance) test for the Model uses White's test, which is a test of the null hypothesis of no heteroskedasticity against heteroskedasticity

White Heteroskedasticity Test:

F-statistic	2.415012	Probability	0.000212
Obs*R-squared	61.88539	Probability	0.001177

Heteroskedasticity is not rejected, which means that homoskedacity is rejected up to 5 %. So some parameters that were deemed significant are, in reality, not, in which case an estimation is required for the variance corrected for the heteroskedacity. For this reason, we choose the robust standard errors option to correct the standard errors (Heteroskedasticity Consistent Covariance (White). See annex 4

The Model shows a significant result with regard to the adjusted R^2 result, which exceeds 70 % (see table below). With an adjusted R^2 of 70% it is evident that independent variables included in the model can explain most of the variation in the dependent variable. That is to say, such elements can explain the difference in price appraisals conducted on buildings and lands in

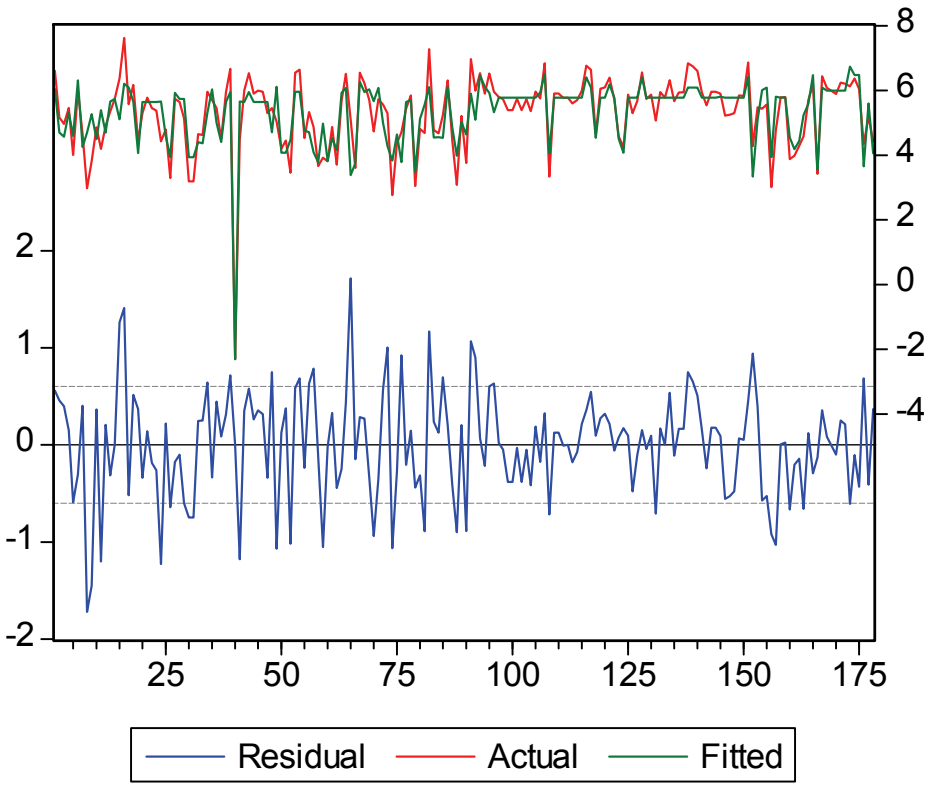
[21] The correlation in the residual occurs more often in Time Series models rather than in the Transversal ones (Cross-section data). In the case of Transversal database, the observations recorded were randomly selected for a specific moment in time, so usually there are not elements to expect that variables be related. In real terms it means that the residual value of one observation does not affected the residual value of another observation.

Havana. 30% depends on factors that the model does not or could not capture. The following table presents the behavior of estimations found in the model

R-squared	0.760684	Mean dependent var	5.315025
Adjusted R-squared	**0.711844**	S.D. dependent var	1.123542
S.E. of regression	0.603119	Akaike info criterion	1.983559
Sum squared resid	53.47163	Schwarz criterion	2.537690
Log likelihood	-145.5368	F-statistic	15.57502
Durbin-Watson stat	1.810590	Prob(F-statistic)	**0.000000**

An important criterion is the probability of the F test. In this case, the value indicates that the model is valid, or at least that the independent variables can explain the dependent one.

Next, we demonstrate how the model fits with respect to the real behavior of the residual statistics test. The prices estimated by the model (green line) are very similar to the real prices or transaction value of every appraisal conducted for projects with foreign investors (color red). Graphically this relationship can be observed in the following way"



:

Each case analyzed has a position on the Y-Axis and it is possible to conclude that the model is statistically satisfactory and can be used to explain behavior and predict future appraisals.

The significant explanatory variables

The effect that each variable produces within each group or the relevance of each Dummy´s measured by the performance of F probability: the result is acceptable if the probability lies below the 5% o 10% significance. The results obtained are as follows:

Years:

C(2)=C(3)=C(4)=C(5)=0

Wald Test:

Equation: FORMALTESISSINHETERO

Test Statistic	Value	df	Probability
F-statistic	1.276145	(4, 147)	0.2820

Conclusion: The Years of the transaction –and therefore changes in the value of money- has Little significant effect on price

Municipalities:

C(6)=C(7)=C(8)=C(9)=C(10)=C(11)=C(12)=C(13)=C(14)=C(15)=C(16)=C(17)=C(18)=0

Wald Test:

Equation: FORMALTESISSINHETERO

Test Statistic	Value	df	Probability
F-statistic	11.40413	(13, 147)	0.0000

Conclusion: Municipalities do explain Price conformation (below 5%)

Surface Rights /Right Granted:

C(19)=C(20)=C(21)=C(22)=0

Wald Test:

Equation: FORMALTESISSINHETERO

Test Statistic	Value	df	Probability
F-statistic	3.097025	(4, 147)	0.0175

Conclusion: Right granted do explain Price conformation (below 5%)

Method of Calculation:

C(23)=C(24)=C(25)=C(26)=0

Wald Test:

Equation: FORMALTESISSINHETERO

Test Statistic	Value	df	Probability
F-statistic	2.124926	(4, 147)	0.0806

Conclusion: method of calculation do explain Price conformation (below 10%). In this case the analysis can be refined by using the "T" Test included in the annexes 1.1 in which the method of Evaluation 3 (Static residual) and 4 (Capitalization Rent) obtained a suitable category of probability.

Proposed Use

C(27)=C(28)=C(29)=C(30)=0

Wald Test:

Equation: FORMALTESISSINHETERO

Test Statistic	Value	df	Probability
F-statistic	2.983777	(4, 147)	0.0210

Conclusion: Proposed Use do explain Price conformation (below 5%)

Next, we show the relationships between the dependent variable and the various independent variables structured as Dummy's according to the previous analysis. For each analyzed variable we discuss whether the results are consistent with the expectations of the real estate valuation specialist about the formal operations between state entities with foreign investors.

Variable: Municipalities (M) presents information about the effect on appraised value of the municipalities. The results of the model show the following:

Municipality	Variables	Coefficient
Playa	M1	0.684111
Plaza	M2	0.995038
Centro Habana	M3	0.928306
Habana Vieja	M4	0.733805
Regla	M5	-0.033576
Habana Este	M6	-0.985539
Guanabacoa	M7	-0.582355
San Miguel	M8	0.106112
Cerro	M10	0.019098
Marianao	M11	1.056371
Lisa	M12	-0.571997
Boyeros	M13	-0.803020
A. Naranjo	M14	-0.083782
Cotorro	M15	-1.46257

In the model, the main positive influence on prices comes from the municipalities of Plaza, Centro Havana, Havana Vieja, Playa and Marianao. The opposite effect (reduction) is seen in the municipalities of Habana del Este, Boyeros, Guanabacoa and la Lisa, in this order. Note that the municipality 10 de Octubre (M9) does not have indicators in the table because no appraisals were registered for this area. The municipality which reduces urban property values most is Cotorro.

The effect of most municipalities meets the expectations: there is a positive effect from those municipalities with high urban and functional centrality and good accessibility namely Central and Old Havana, as well as others where the proven urban and architectural quality also makes them highly desirable like Plaza and Playa. The peripheral municipalities confirm the tendency

to value reduction, which was to be expected. One unexpected result is the strong positive effect of the municipality of Marianao (M11) on prices, a situation that may be explained by the fact that this is a large municipality with many neighborhoods, some with a very good level of urban infrastructure. Therefore it is recommended to deepen the study of this municipality.

Variable: Surface Rights (D), this variable represents the effect that the duration of the surface rights has on the value of urban properties.

Surface Rights	Rights 0-10 years	Rights 11-20	Rights 21-30	Rights 31-50	Rights 51-200
Coefficient	-0.543067	0.073616	0.175025	0.433343	-0.138917

The duration of granted Surface Rights is an important factor on real estate prices in Havana. For example, when rights are granted between 31 – 50 years, a 43% increase with respect to the average is evident; rights between 21 – 30 years result in a 17% increase. A granted surface right of less than 10 years has the impact of reducing the appraisal value by 54%. This also is the case of granted surface rights of more than 51 years; although this would not be expected, because one would assume that the longer the duration, the greater the rise in price.

With this variable, the model turned out as expected. The fact that the longer the usufruct rights, the larger the investor's acceptance of the potential value of land or building, matches perfectly with the interviews made with the investors: these expressed their willingness to pay more if they had the possibility of full ownership. The tendency becomes contradictory only in the cases where the property rights are over the 51 years: this may be explained by the small number of cases present in the data base, or by the potential irrationality of the values\prices presented to the investors in respect with the time of usufruct.

Variable: Method of Appraisal (MT), represents the influence of the method of calculating prices used by appraisal institutions in Cuba. The results provided by the model are:

Method of Calculation	Comparative Market	Residual Dynamic	Residual Static	Capitalization Rent	Replacement Cost
Coefficient	0.159857	0.128719	0.556060	-0.712915	-0,131721

In this variable, the model shows that three valuation methods raise the price: the price influence is highest with the Residual Static, second with the Comparative Market and finally with the Residual Dynamic, with coefficients of 55.0, 15.6 and 12.8% respectively. On the other hand, the application of the Capitalization Rent and Replacement Cost methods decreases land and building values by 71% -13% respectively.

The model results show that the residual method (Dynamic and Static) produced the most advantageous results for the Cuban public context, and it takes account of value trends of land and building valuation with a logic of value increment. This becomes evident with the fact that it is the method most often applied, that it is preferred by the Cuban authorities and foreign parties for its transparency, and that it allows the price formation in the absence of an official real estate market.

The comparative method also has a positive effect on prices, for two main reasons. First it has often been chosen by the valuation entities, who collect records of land and building valuations approved by new projects. This is useful for new negotiations that depart least from these previous examples of *real prices*. Additionally, on different occasions the valuers have departed from regional prices for comparable uses, and the investors have accepted the fact that in Havana the real estate prices will increase in the future because of the competitive advantages of the city in the region.

The capitalization rent method has a negative effect when applied to the valuation of real estate. The reason is that Cuban valuers are not always capable of dealing with financial issues. Also, the expected rate of return of the business and the actualization rate (discount rate) are used incorrectly because discretional commercialization criteria are imposed by the Cuban Financial Ministry authorities, while the lack of information about similar investments leads to assumptions being made about the interest rate on loans for similar projects.

Variable: Proposed Use (U), this variable indicates the authorized urban use of the land (with or without buildings) on which foreign capital investment takes place. The model registers the following results:

Proposed Use	Hotel	Industrial	Residential Real Estate	Office Real Estate	Other
Coefficient	-0.390153	-0.140748	-0.250692	0.063549	0,718044

It would appear from this that land use proposed for hotels, residential areas and industrial uses, in that order, diminishes the value of the property (with respect to the average). In particular, the result for the proposed Hotel uses contradicts the appraisal by experts, as this land use has always been considered a major source of revenue. Office real estate shows a positive influence on the value of land (+ 6%), and 'other uses' (warehouses, educational facilities, agricultural uses and so on) have a large positive effect on the price.

In this case, the model results contradict totally the initial expectations that the commercial uses and CBD Central Business District functions would be the generators of high land rents.

The results show that the land use is not generating the usual effects on land value. It would appear that there are important distortions in the land use references applied to the formal transactions. In the future, if adequately articulated, this variable should play an important role in land valuation in Havana.

4.2- Informal Transactions / Permutas.

Model Validation

The model can be referred to in the Annex Table 2.1, and it should be acknowledged that to obtain these results it was necessary to make various adjustments, since the normality and heteroskedacity criteria were not fulfilled in the first round.

White Heteroskedasticity Test:

F-statistic	1.779223	Probability	0.014646
Obs*R-squared	47.86422	Probability	0.027116

To correct the heteroskedacity, two dummy variables were introduced, specifically in observations 104 and 131, because the transaction prices in these cases were much lower than expected (an outlier). After that intervention, the heteroskedasticity test gave satisfactory results, in so far as the homoskedacity was not rejected at 5%. The test after interventions (outlier) is presented in the following model results:

White Heteroskedasticity Test:

F-statistic	1.210532	Probability	0.227292
Obs*R-squared	38.44331	Probability	0.236539

See Anex 4

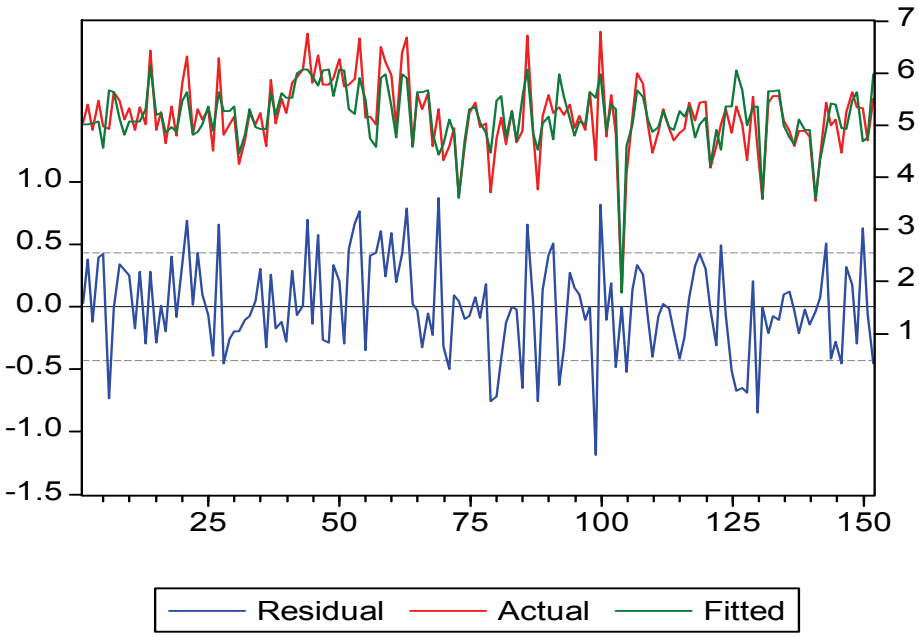
The Normality of the Permuta model showed a suitable behavior, as normality was not rejected at 5% probability. The adjusted R^2 is fairly high at 0.60. This is considered satisfactory in these types of studies, as was explained at the beginning of the paper.

R-squared	0.690027	Mean dependent var	5.174817
Adjusted R-squared	**0.603340**	S.D. dependent var	0.682253
S.E. of regression	0.429690	Akaike info criterion	1.342666
Sum squared resid	21.78672	Schwarz criterion	2.019060
Log likelihood	-68.04259	F-statistic	7.959956
Durbin-Watson stat	1.957236	Prob(F-statistic)	**0.000000**

The F Test indicates that the model is valid, or at least confirms that the independent variable explain the dependent one.

With adjusted R^2 at 0.60, we know that the independent variables included in the model explain 60 % of the variance in the dependent variable. There is 40 % that depends on factors and information not gathered in the model.

The prices estimated by the model (green line) are close to the observed prices (red line). Graphically, we can observe this fit in the following manner:



All 150 cases were analyzed (plotted along the Y-Axis) and it is possible to conclude that the model is statistically satisfactory and can be used to explain behavior and predict future appraisals (within certain statistical limits).

The significant explanatory variables

The effect that each variable produces within each group or the relevance of each Dummy is determined by the performance of F probability whose result is acceptable if the probability lies below the 5% or 10% significance. The obtained results are as follows:

Years:

C(21)=C(22)=C(23)=C(24)=C(25)=C(26)=C(27)=C(28)=C(29)=C(30)=C(31)=0

Wald Test:

Equation: EQ02

Test Statistic	Value	df	Probability
F-statistic	6.755064	(11, 118)	0.0000

Conclusion: Years do explain Price conformation (below 5%)

Municipalities:

C(9)=C(10)=C(11)=C(12)=C(13)=C(14)=C(15)=C(16)=C(17)=C(18)=C(19)=C(20)=0

Wald Test:

Equation: EQ02

Test Statistic	Value	df	Probability
F-statistic	2.732500	(12, 118)	0.0027

Conclusion: Municipalities do explain Price conformation (below 5%)

Type of Property:

C(2)=C(3)=C(4)=C(5)=0

Wald Test:

Equation: EQ02

Test Statistic	Value	df	Probability
F-statistic	1.096946	(4, 118)	0.3614

Conclusion: The Type of Property does not explain Price conformation (below 5%), so too little significant effects on price

This is a surprising result, because according to the opinions of intermediaries, one of the main aims of families want to swop is to get a house (detached or semi-detached) or an apartment.

State of Construction:

C(6)=C(7)=C(8)=0

Wald Test:

Equation: EQ02

Test Statistic	Value	df	Probability
F-statistic	0.572980	(3, 118)	0.6339

Conclusion: State of Construction does not explain Price conformation

This too is a surprising result. But it could be caused by the fact that people know that the general state of construction of the existing housing stock is moderate or bad, so they always expect to get a property that will require much repairing.

Intermediary:

In the case of this Dummy variable the F test will match with the T-test results of the Permuta Estimated Transactions Model, where the probability result was 0.0000. It means that the variable does explain Price conformation (below 5%). See Annex No 2.1

We can now look at the information that the model offers regarding the effect of each independent variable on the dependent variable:

Variable: Year of Operation (Y), gives us the effect that the year has on the price or value of the transaction. Here are the results of the coefficients.

	Year	Co-efficient
Y1	1995	-0.083970
Y2	1996	-0.395101
Y3	1997	-1.158990
Y4	1998	0.046711
Y5	1999	-0.028733
Y6	2000	-0.000393
Y7	2001	0.088677
Y8	2002	-0.060419
Y9	2003	0.617836
Y10	2004	0.034413
Y11	2005	0.293423
Y12	2006	0,64655

One can see that the years 2003 to 2006 raise prices; the most significant are years 2003 and 2006, which show a rise in prices (with respect to the average) reaching 61% and 64 % respectively.

According to the original expectations, the model should show a reduction of real estate prices in the permute operations registered during the hardest years of the crisis (special period) 1995-2000, because of the diminished financial capacity of Cuban families. In the years post 2000 we expected a gradual increase in real estate prices caused by economic improvements. However, between 1997 and 2002, the government introduced new legal and regulatory instruments to control the permute operations. This affected prices, which were stable (2001) or declined (2002). In 2003 there was a change, with the introduction of new regulations and the ability of the permute mechanisms to adapt or evade the imposed regulations.[22]

22 La Permuta: an effective instrument for housing transactions in Cuba, By Msc. Ricardo Núñez Fernández, IHS Publication Web SiteCuba, Decembre 2007

Variable: Municipalities (M), reflects the effect of the municipal location of the permuta. The model results are :

Municipality		Coefficient
Playa	M1	0.143428
Plaza	M2	0.124813
Centro Habana	M3	-0.235674
Habana Vieja	M4	-0.143693
Regla	M5	0.262135
Habana Este	M6	-0.163547
Guanabacoa	M7	0.835206
San Miguel	M8	0.410270
10 Octubre	M9	-0.072859
Cerro	M10	-0.251998
Lisa	M12	0.347744
Boyeros	M13	-0.595611
Cotorro	M15	-0,660214

It should be pointed out that two of the Municipalities were not included because there were no transactions recorded in the Date Base. These are M11 (Marianao) and M14 (Arroyo Naranjo).

The municipalities with the biggest positive effect on prices are: Guanabacoa, San Miguel and la Lisa, all on the periphery. Playa and Plaza also show positive effects with 14% and 12% respectively, but these effects are smaller than in the three peripheral municipalities previously mentioned. The municipalities with a value reduction are Cotorro and Boyeros, with an influence of 66% and 59% respectively. Other municipalities such as Centro Habana, Cerro, Habana del Este y Habana Vieja also reduce the value, but less.

The model results are in general plausible and match the experts' opinions about the higher prices in the municipalities of Plaza and Playa, as well as the lower prices in the central municipalities of Centro Habana, Cerro and Habana Vieja that, despite their good urban accessibility, have very deteriorated building stocks and are therefore not very suitable for permuta operations. The price reduction in the case of the municipality Habana del Este may be explained by the deficient transportation, the lack of services and the little functional

diversity, although the building stock is in good state of repair. A deeper analysis is required in the municipalities of Guanabacoa, San Miguel and la Lisa, where the prices are higher than the rest despite the lack of centrality and the not so good level of urban services: this is probably the result of attractive internal micro areas that may be better serviced than elsewhere in the municipality.

Variable: Intermediary (PT) represents the presence of a middleman in the analyzed transactions, with a coefficient of 0.377496 and a resulting rise in price of 37.7%.

Comparing the outcomes of the two models

The empirical results obtained with these two models as applied to urban property transactions in the City of Havana show that most of the analyzed variables are statistically significant and influence the price per m2 (Pr/m2). With these observed results, one can be assured that in both models the dependent variable can be (largely) explained as a function of the combined presence and absence of diverse attributes of independent variables, although these are mostly qualitative. It is plausible that the vast majority of these variables could be considered independent variables pertinent to both models, or possibly that the variables of one model should not per se be ruled out for the other, since all of them can explain the value of the land and properties within the urban context.

In order to compare the outcomes of the models, we need to distinguish between the explanatory variables which occur in both models, and the explanatory variables which are specific to each model

The variables that occur in both models are municipalities and year of transaction. One can compare the effect of these by looking for each variable at the Positive (+) or Negative (-) Signs and the level of the effect :

High	***	more than 60 %
Moderate	**	between 30% and less than 60%
Low	*	less than 30%

	Effect on the Independent Variable	
Municipality	Formal Transactions	Informal / Permuta
Playa	+ ***	+ *
Plaza	+ ***	+ *
Centro Habana	+ ***	- *
Habana Vieja	+ ***	- *
Regla	- *	+ *
Habana Este	- ***	- *
Guanabacoa	- **	+ ***
San Miguel	+ *	+ **
10 Octubre		- *
Cerro	+ *	- *
Marianao	+ ***	
Lisa	- **	+ **
Boyeros	- ***	- **
A. Naranjo	- *	
Cotorro	- ***	- ***

The fact that we are dealing with only one city means that municipalities with positive values in both models are the most active territorial entities influencing land and building values. Nine of the fifteen municipalities have this positive effect, to a higher or lesser degree. Despite the importance granted to the municipality variable in the statistical models, it is necessary to consider that the actual political and administrative division dates from 1976 and was not made according to urban, functional or socio-cultural logics. We expect that the 106 repartitions that form the traditional city neighborhoods may be more influential than the division into municipalities in determining the advantages and disadvantages that have a direct influence on the value and urban prices. To increase the statistical accuracy and the explanation potential of the model, the municipality variable should be replaced by a variable

that articulates the similarities and differences between city neighborhoods, obtaining a structure that we call **homogenous micro districts**.

In the same way, we can analyze the Variable of Years for both models. The year variable is very relevant in the informal model as it reflects macroeconomic and political trends which affect the degree of action of the Cuban family.

	Effect on the Independent Variable	
Years	Formal Transactions	Informal / Permuta
1995		- *
1996		- **
1997		- ***
1998	+ **	+ *
1999	+ *	- *
2000	- *	- *
2001	- *	+ *
2002	- *	- *
2003		+ ***
2004		+ *
2005		+ **
2006		+ **

Even when the variable 'years' was not statistically significant for the Formal Transaction Model, it is interesting to compare the year performance between both Models. The downturn of real estate investments with foreign partners after 2002 reduced our information to only four years which can be compared, and for those 4 years the effects are different between the two models.

Although there is no information about the formal transactions during 1995, 1996 and 1997 it can be assumed that the year-variable showed an increasing trend during the worst recession years between1994 and 2000, because Real Estate became a fresh and positive economic initiative launched by the Government that foreign investors at the time perceived as the beginning of a major economic and property reform. The informal sector of the permutes on the contrary had a price reduction during these years due to the economic crisis in which family revenues were oriented to basic needs. After 2001, the year variable shows a trend to higher prices in the informal market.

Other explanatory variables are either exclusive to one model (e.g. method of calculation) or occur in both models but in a different way. Variables considered independent and pertinent to both models are:

Variables	Formal Transaction Model	Informal Transaction Model
Method of Calculation	applicable	Not Applicable
Type of Right	applicable (Years of Usufruct)	Applicable (Different type of property right)
Use	applicable	Applicable (housing with permission to rent or engage in commercial activity)
Type of Property	Applicable in Residential Cases	applicable
State of Construction	Applicable	applicable

General conclusions

An important conclusion is that in both cases the models are statistically robust and stable. So we can conclude that the way in which urban property is appraised (formal model) and exchanged (informal model) is systematic and in general does not contradict urban economic theory on price formation. This can be concluded even though, in the case of the formal transactions, the actors are limited or, in the case of the informal transaction, the information is less than perfect.

Moreover, in spite of the fact that land and property transactions in Cuba always include the participation of the state entities and different local institutions (which regulate foreign investment and authorize permutes), both models indicate recognition of rules of land and property markets, such as accessibility, neighborhood prestige and infrastructure conditions.

Where there are differences between the two models, these may be caused by the different logics between involved actors, assessment criteria and the socio-economic peculiarities at the given moment of the transaction. In short, the effect of the available variables depends on the specific formal or informal environment . A good example to clarify these different logics may be the changing trajectory of the Cuban government strategies in facing the economic downturns: first the opening of the 90s, then a few years after the hasty decision to reverse the opening when there were a few signs of improvements after new links with Venezuela and China, all these changes accompanied by their respective institutional re-accommodation. The informal context on the other hand is very sensitive to improvement or tightening of the legal aspects of the housing policy and to monetary policies as one of its financial sources are remittances, but is also sensitive to the overall economy changes.

These models can be improved. This can be done by including other indicators which one might expect to be relevant to urban property price formation: the proliferation of commercial activities both formal and informal and the preference for certain sites, the distance to city center and to transportation hubs; the existence of urban parks or green belt systems; the population density, the environmental contamination index; the safety or danger indicators. The grouping of urban areas according to homogeneous functionality, accessibility and quality of infrastructure might explain better urban property price formation (Homologue Micro Districts). The use of information technology, in particular Geographic Information System (GIS), could be a key instrument in incorporating these aforementioned variables, giving a visual demonstration of their distribution and incidence on land price/value across the urban matrix.

Part of the irregularities observed in each model, which on occasion causes contradictory tendencies for similar variables such as the case of the **municipalities**, can be explained by

different locational requirements, discretionary application and limited information. Both of these are found in the formal appraisal process and in the imperfect framework of the informal permute operations.

This technical analysis demonstrates that the application of econometric models to the study of urban property transactions – beyond the theoretical complexities – is a useful tool and results in information that can raise the level of analysis, in particular demonstrating relationships which on many occasions contradict the descriptive criteria. The interpretation of patterns of urban land value formation by a combination of diverse variables that take part in a complex process is made more clearly visible.

ANNEXES

Annex 1.1: Table of the Formal Transactions Estimated Model

Dependent Variable: LOG(PR)

Method: Least Squares

Date: 01/23/08 Time: 22:00

Sample (adjusted): 1 178

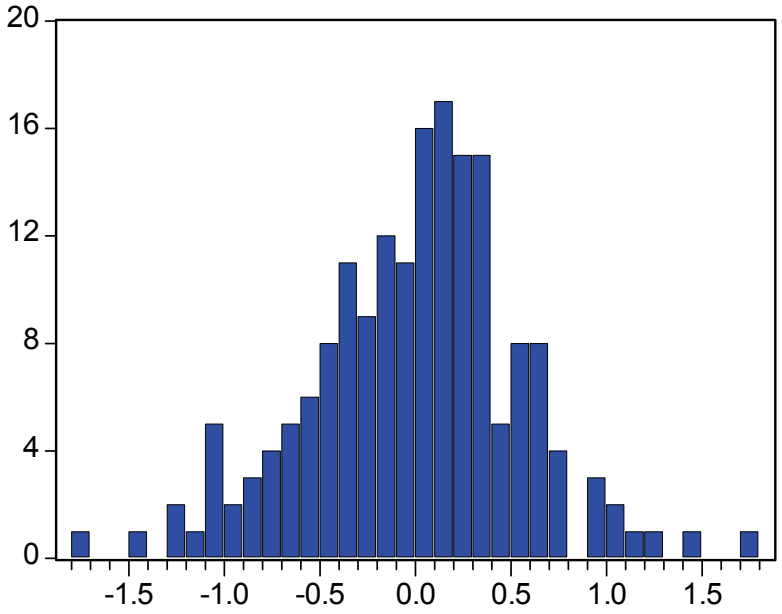
Included observations: 178 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.305829	0.165498	32.05978	0.0000
Y98	0.262230	0.152381	1.720879	0.0874
Y99	0.016806	0.102569	0.163848	0.8701
Y00	-0.123036	0.094343	-1.304130	0.1942
Y01	-0.100379	0.142474	-0.704546	0.4822
M1	0.684111	0.134954	5.069209	0.0000
M2	0.995038	0.169040	5.886406	0.0000
M3	0.928306	0.285324	3.253513	0.0014
M4	0.733805	0.248115	2.957515	0.0036
M5	-0.033576	0.294498	-0.114011	0.9094
M6	-0.985539	0.191603	-5.143656	0.0000
M7	-0.582355	0.276291	-2.107758	0.0367
M8	0.106112	0.422757	0.251000	0.8022
M10	0.019098	0.301144	0.063419	0.9495
M11	1.056371	0.589723	1.791299	0.0753
M12	-0.571997	0.226776	-2.522299	0.0127
M13	-0.803020	0.286901	-2.798943	0.0058
M14	-0.083782	0.262120	-0.319634	0.7497

DR1	-0.543067	0.152051	-3.571613	0.0005
DR2	0.073616	0.155266	0.474131	0.6361
DR3	0.175025	0.168576	1.038256	0.3009
DR4	0.433343	0.173522	2.497342	0.0136
MT1	0.159857	0.119422	1.338588	0.1828
MT2	0.128719	0.136107	0.945719	0.3458
MT3	0.556060	0.274898	2.022792	0.0449
MT4	-0.712915	0.223917	-3.183830	0.0018
U1	-0.390153	0.183071	-2.131152	0.0347
U2	-0.140748	0.172168	-0.817501	0.4150
U3	-0.250692	0.212866	-1.177698	0.2408
U4	0.063549	0.207455	0.306328	0.7598
D40	-6.845353	0.719419	-9.515120	0.0000

R-squared	0.760684	Mean dependent var	5.315025
Adjusted R-squared	**0.711844**	S.D. dependent var	1.123542
S.E. of regression	0.603119	Akaike info criterion	1.983559
Sum squared resid	53.47163	Schwarz criterion	2.537690
Log likelihood	-145.5368	F-statistic	15.57502
Durbin-Watson stat	1.810590	Prob(F-statistic)	**0.000000**

Annex 1.2 Graphic: Normality Model Test of the Formal Transactions



Series: Residuals	
Sample 1 178	
Observations 178	
Mean	1.04e-15
Median	0.069262
Maximum	1.715096
Minimum	-1.719510
Std. Dev.	0.549636
Skewness	-0.179912
Kurtosis	3.569591
Jarque-Bera	3.366480
Probability	0.185771

Annex 2.1: Table of the Informal/Permuta Estimated Transactions Model

Dependent Variable: LOG(PR)

Method: Least Squares

Date: 12/01/07 Time: 19:56

Sample(adjusted): 1 152

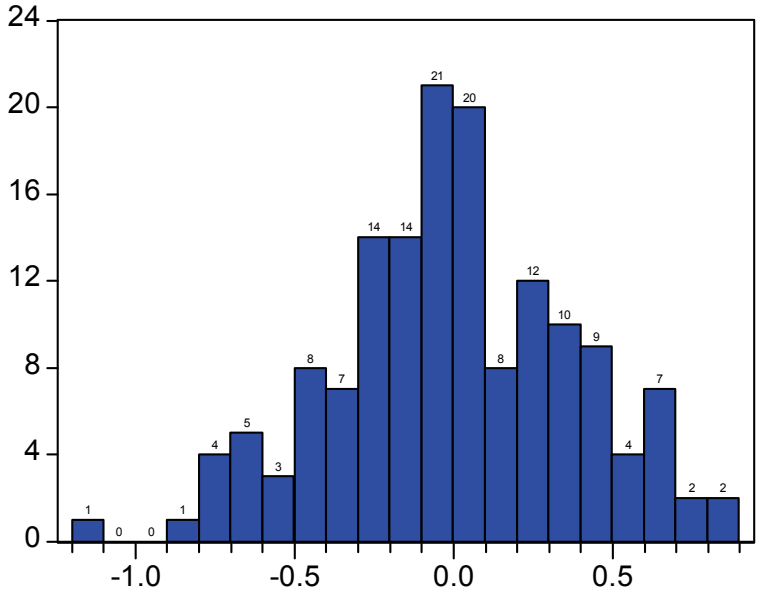
Included observations: 152 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.700445	0.149190	31.50653	0.0000
B1	0.014311	0.111694	0.128127	0.8983
B2	0.077643	0.101896	0.761984	0.4476
B3	0.158572	0.167740	0.945344	0.3464
B4	-0.421042	0.229871	-1.831641	0.0695
E1	0.113561	0.103183	1.100586	0.2733
E2	0.014440	0.112466	0.128391	0.8981
E3	-0.050922	0.187731	-0.271249	0.7867
M1	0.143428	0.124526	1.151796	0.2517
M2	0.124813	0.092072	1.355600	0.1778
M3	-0.235674	0.139577	-1.688482	0.0940
M4	-0.143693	0.210997	-0.681017	0.4972
M5	0.262135	0.262391	0.999023	0.3198
M6	-0.163547	0.143818	-1.137186	0.2578
M7	0.835206	0.434512	1.922169	0.0570
M8	0.410270	0.419726	0.977471	0.3303
M9	-0.072859	0.152865	-0.476625	0.6345
M10	-0.251998	0.222570	-1.132220	0.2598
M12	0.347744	0.321707	1.080933	0.2819
M13	-0.595611	0.196402	-3.032614	0.0030
Y1	-0.083970	0.136178	-0.616622	0.5387

Y2	-0.395101	0.199316	-1.982283	0.0498
Y3	-1.158990	0.318351	-3.640601	0.0004
Y4	0.046711	0.227200	0.205593	0.8375
Y5	-0.028733	0.162424	-0.176903	0.8599
Y6	-0.000393	0.113837	-0.003451	0.9973
Y7	0.088677	0.149807	0.591943	0.5550
Y8	-0.060419	0.220852	-0.273571	0.7849
Y9	0.617836	0.148535	4.159543	0.0001
Y10	0.034413	0.125846	0.273452	0.7850
Y11	0.293423	0.106918	2.744383	0.0070
AO104	-3.001950	0.518703	-5.787412	0.0000
AO131	-1.800135	0.460558	-3.908599	0.0002
PT	0.377496	0.088820	4.250097	0.0000

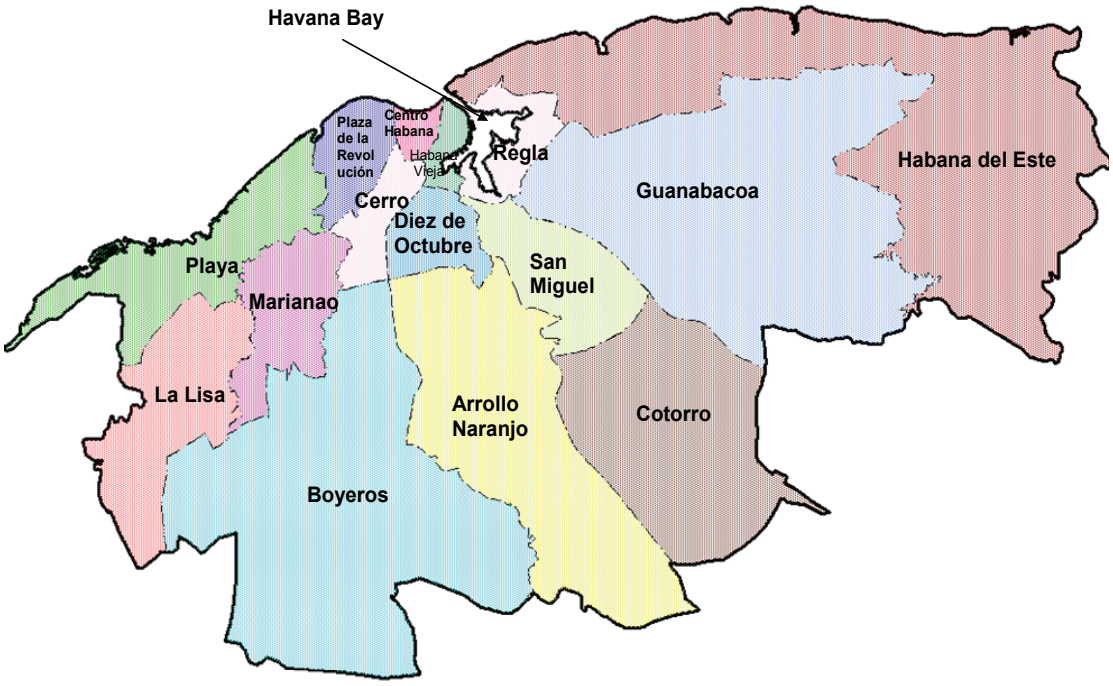
R-squared	0.690027	Mean dependent var	5.174817
Adjusted R-squared	**0.603340**	S.D. dependent var	0.682253
S.E. of regresión	0.429690	Akaike info criterion	1.342666
Sum squared resid	21.78672	Schwarz criterion	2.019060
Log likelihood	-68.04259	F-statistic	7.959956
Durbin-Watson stat	1.957236	Prob(F-statistic)	**0.000000**

Annex 2.2 Graphic: Normality Model Test of the Permuta



Series: Residuals	
Sample 1 152	
Observations 152	
Mean	1.42E-16
Median	-0.018963
Maximum	0.864510
Minimum	-1.188437
Std. Dev.	0.379846
Skewness	-0.102801
Kurtosis	2.974285
Jarque-Bera	0.271910
Probability	0.872882

Annex 3: Havana City Map by Municipality



Annex 4: Estimation for the variance correct for the heteroskedacity: formal model

Dependent Variable: LOG(PR)

Method: Least Squares

Date: 07/21/08 Time: 12:45

Sample (adjusted): 1 178

Included observations: 178 after adjustments

White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.305829	0.166376	31.89064	0.0000
Y98	0.262230	0.139974	1.873422	0.0630
Y99	0.016806	0.095895	0.175250	0.8611
Y00	-0.123036	0.099575	-1.235615	0.2186
Y01	-0.100379	0.203658	-0.492882	0.6228
M1	0.684111	0.153197	4.465556	0.0000
M2	0.995038	0.218962	4.544332	0.0000
M3	0.928306	0.282163	3.289963	0.0013
M4	0.733805	0.349871	2.097359	0.0377
M5	-0.033576	0.438894	-0.076501	0.9391
M6	-0.985539	0.230752	-4.270987	0.0000
M7	-0.582355	0.234604	-2.482291	0.0142
M8	0.106112	0.268031	0.395893	0.6928
M10	0.019098	0.352602	0.054164	0.9569
M11	1.056371	0.258127	4.092444	0.0001
M12	-0.571997	0.315022	-1.815736	0.0714
M13	-0.803020	0.327799	-2.449736	0.0155
M14	-0.083782	0.316398	-0.264800	0.7915
DR1	-0.543067	0.205672	-2.640452	0.0092
DR2	0.073616	0.200389	0.367368	0.7139
DR3	0.175025	0.180124	0.971692	0.3328
DR4	0.433343	0.169960	2.549683	0.0118
MT1	0.159857	0.128112	1.247788	0.2141
MT2	0.128719	0.141403	0.910299	0.3642
MT3	0.556060	0.248970	2.233441	0.0270
MT4	-0.712915	0.290912	-2.450616	0.0154
U1	-0.390153	0.177209	-2.201652	0.0292
U2	-0.140748	0.198265	-0.709895	0.4789

U3	-0.250692	0.194546	-1.288604	0.1996
U4	0.063549	0.216683	0.293281	0.7697
D40	-6.845353	0.428613	-15.97093	0.0000

R-squared	0.760684	Mean dependent var	5.315025
Adjusted R-squared	0.711844	S.D. dependent var	1.123542
S.E. of regression	0.603119	Akaike info criterion	1.983559
Sum squared resid	53.47163	Schwarz criterion	2.537690
Log likelihood	-145.5368	F-statistic	15.57502
Durbin-Watson stat	1.810590	Prob(F-statistic)	0.000000

Annex 5:

Informal Transaction

White Heteroskedasticity Test:

F-statistic	1.210532	Probability	0.227292
Obs*R-squared	38.44331	Probability	0.236539

homoskedacity is not rejected up to 5 %,

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