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An Expanded Version of the Tiebout Hypothesis: Housing Price Capitalization and the Market System at Work

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Abstract

This investigation of the free market/private enterprise system applies a hedonic pricing model to determine whether, in the spirit of Tiebout (1956), Oates (1969), and Tullock (1971), property taxes and other Tiebout-type factors have been capitalized into housing prices in the Savannah, Georgia metropolitan area housing market. There were sufficient data in this context to study a total of 3,171 single-family houses for the seven-year period 2000-2006; 598 of these houses were located in the Savannah Historic Landmark District. Estimating the model in semi-log form reveals (after allowing for a variety of factors, including 11 spatial variables, two of which are *de facto* Tiebout-type variables) that the natural log of the *real* sales price of a single-family house in the Savannah metropolitan area was in fact negatively affected by the city and county property tax level. In addition, close proximity to public primary, middle, and secondary schools and major hospitals, which are partly funded with local public revenues, also positively impacted real housing prices. Thus, this study provides yet further evidence of the relevance of the Tiebout (1956)/Tiebout (1956)-Tullock (1971) hypothesis and of the efficient working of free market mechanisms.

Keywords: Housing prices; Property tax capitalization; Public goods capitalization; Free market mechanism

JEL classification: R14; R13; R11

I. INTRODUCTION

For years now, hedonic pricing models have been used in a number of studies to assess the impacts of historic district designation, housing traits, environmental forces, and/or other factors on property values of one form or another (Coffin, 1989; Ford, 1989; Garrod and Willis, 1992; Hughes and Sirmans, 1992; Asabere and Huffman, 1994; Clark and Herrin, 1997; Decker,

Nielson, and Sindt, 2005; Cebula, 2009; LaCour-Little and Malpezzi, 2009; Sumell, 2009). The present study seeks to extend the latter literature by applying the hedonic pricing model to the prices of single-family homes in the Savannah, Georgia metropolitan area, with emphasis on the *question of* ***whether property taxes and a variety of Tiebout (1956)-type variables are capitalized into housing prices***.

Sales of single-family houses *per se* within the Savannah metropolitan area for which adequate data were available for the seven-year study period 2000-2006 are included in the study. In all, 598 *single-family homes* sales from the Savannah Historic Landmark District *per se* are included in the analysis, along with 2,573 single-family home sales from the Savannah metropolitan area outside the "Historic Landmark District." The relatively large volume of home sales data available from this historic district vis-à-vis most previous related studies may be interpreted in part as a reflection of the fact that the Savannah Historic Landmark District is in fact the largest such district in the U.S.

In addition to focusing upon the issue of whether property taxes (PROPTX) are capitalized into housing prices (Oates, 1969) in the Savannah metropolitan area, this study considers two additional Tiebout (1956) type variables. These are, as follows: relatively close proximity to *public* primary, middle, and secondary schools (SCHOOL); and relatively close proximity to the primary hospitals in the Savannah metropolitan area (HOSP), which are in fact funded to a significant degree by the *local public tax base*.

This study also accounts for a number of other factors influencing the housing market. For example, it integrates a variable (HISTDES) to reflect whether a home sale involved a building officially designated as a national historic landmark. It also distinguishes between home sales within the Savannah Historic Landmark District on the one hand and other home sales in the

Savannah metropolitan area on the other hand in order to capture any premium may be applied to sales of the former variety. A dummy variable (DISTRICT) is included in the model to reflect this distinction. Furthermore, a separate variable is included in the analysis to reflect whether there was a housing-price premium for location on one of the metropolitan Savannah area's major islands (ISLAND). As in a number of other related studies, several additional spatial control variables are included in the model in addition to the aforementioned variables.

In Section 2 of this study, the Tiebout (1956)/Tiebout (1956)-Tullock (1971) hypothesis is briefly reviewed and then interpreted to include two specific Tiebout (1956) type variables in addition to the property tax. Subsequently in Section 2, the hedonic pricing model is also provided, along with a description of the data. Following conventional practice in the literature, the model is to be estimated in semi-log form. The empirical results are provided and analyzed in Section 3 of the study. Section 4 provides a brief summary of the results.

II. THE FRAMEWORK

This section of the study provides the framework within which the hedonic pricing model is applied to housing sales in the Savannah metropolitan area (hereafter, simply "Savannah"). First, however, given the emphasis on the issue of whether property taxes and two other Tiebout (1956) type factors are capitalized into housing prices in the Savannah housing market, the Tiebout (1956)/ Tiebout (1956)-Tullock (1971) hypothesis is briefly summarized.

According to Tiebout (1956, p. 418), "…the consumer-voter may be viewed as picking that community which best satisfies his set of preferences for public goods…the consumer-voter moves to that community whose local government best satisfies his set of preferences…" As Tullock (1971, p. 917) further observes, this hypothesis effectively can be extended such that it *expressly* holds that, *ceteris paribus*, the "…individual deciding where to live will take into

account the private effects upon himself of the bundle of government services and taxes…" Thus, Tullock (1971), perhaps more explicitly than Tiebout (1956), emphasizes that the consumer-voter evaluates the tax burden at potential locations of choice. Following Oates (1969), a number of studies have investigated whether property taxes are capitalized into housing prices. The present study investigates this same issue for the Savannah metropolitan area, which includes the city of Savannah (and its Historic Landmark District) and a number of adjacent incorporated and unincorporated communities.

Furthermore, two additional variables are considered in this study under the rubric of the Tiebout (1956)/ Tiebout (1956)-Tullock (1971) hypothesis. These include: close proximity to *public* primary, middle and secondary schools (SCHOOL); and close proximity to Savannah's major hospitals (HOSP), which are in fact funded to a significant degree by the *local metropolitan public tax bases (including county)*. Thus, this study considers whether, in addition to city and county property taxes, these two factors, that arguably reflect additional dimensions of *public* services, are also capitalized into housing prices in Savannah.

The basic premise of the hedonic pricing model as applied to housing is that a house represents a bundle of both desirable and undesirable attributes to utility-maximizing consumers, all of which contribute to the market value of the house as revealed through a market transaction, i.e., a home sale. The hedonic pricing model decomposes the transaction price into various components such as interior and exterior features, or other traits of the house (including location, i.e., spatial considerations/traits) that affect the final sale price. The estimated parameters of the model provide information about the relative contribution (statistical significance and magnitude of effect) of any given house feature.

The hedonic pricing model takes the following general form:

$$\ln RSALESPRj = f(Ij, Ej, SCj, Oj) \quad (1)$$

where:

lnRSALESPj = the natural log of the *real* price of house j, where the price of the jth house is expressed in 2006 dollars;

Ij = a vector of interior physical characteristics for house j;

Ej = a vector of external physical characteristics for house j;

SCj = a vector of spatial or spatial *control* variables for house j; and

Oj = a vector of other factors associated with house j, including property taxes and Tiebout (1956) variables.

The present study applies the hedonic pricing model to home sales in Savannah over the six-year period from 2000 through 2006. Data for 3,171 home sales for which there was sufficient information for analysis during this time frame in the Savannah metropolitan area (598 of which were in the Savannah Historic Landmark District) were obtained from the Savannah Board of Realtors' Multiple Listing Service. Property tax data for all of the single-family houses in the study were obtained through the Chatham County Property Tax Assessors Office and the City of Savannah Property Tax Assessment Office. Interestingly, unlike the Savannah metropolitan area outside the Historic Landmark District, where 793 homes sales, i.e., 30.8 percent, involved new homes, the vast majority of the observations for the Savannah Historic Landmark District represent re-sales of existing homes: only 42 Historic District sales (7.02 percent) were newly built structures. In order to permit comparison of sales prices across the study period, all housing prices and property taxes were converted to and expressed in 2006 dollars using the *price index for single-family homes* from the U.S. Census Bureau (2008, Table 703). The mean price of a house sold in the Savannah metropolitan area over the study period was $249,927.

There were a variety of interior and exterior physical characteristics available for each house sold, as well as other factors that were available and expressly included in the analysis. These factors are all listed and formally defined in Table 1. Basic descriptive statistics for each of the variables considered in the analysis are provided in Table 2. Naturally, for each of the impacts of the explanatory variables on housing price in the model, the expected sign is proffered in the discussion provided below under the assumption of *ceteris paribus*.

The interior physical characteristics of house j include the following: BATHS, the *total* listed number of baths (full plus half baths); FIREPLACES, the total number of listed fireplaces; BEDROOMS, the total number of listed bedrooms; and SQFT, the total listed number of square feet of finished interior living space.

As observed in on a variety of other studies, including Ford (1989), Coffin (1989), Clark and Herrin (1997), Decker, Nielsen and Sindt (2005), LaCour-Little and Malpezzi (2009), and Sumell (2009), the real sales price (RSALESPR) of house j is expected to be an increasing function of the number of desirable internal and external physical housing characteristics. For example, RSALESPR is expected to be an increasing function of the number of bathrooms and fireplaces. It also is expected to be an increasing function the number of bedrooms and the square footage of finished living space.

The exterior physical characteristics of house j include the following: BRICK, whether the exterior is made principally of brick; DECK, whether the house has a deck; CRTYD, whether the house has a private courtyard; SPRINKLER, whether the house has an underground sprinkler system; STORIES, the number of stories in the house structure; STUCCO, whether the house exterior is principally of stucco construction; GARAGESP, the number of garage car spaces (not carports) that are included as part of the house; and POOLTUB, whether the house has a hot-tub

and/or a swimming pool. Lot size is not considered as a separate variable in this study. This is because the lot size is very frequently not listed in the Multiple Listing Service for houses in the Savannah Historic Landmark District, as well as for many Savannah houses outside of that district. Moreover, most houses in the Savannah Historic Landmark District, especially those with a private courtyard and/or a pool/hot-tub, constitute the *de facto* entirety of the lot size. In other words, in many such cases, the lot size is already effectively 100 percent accounted reflected in other variables in the analysis, especially SQFT, CRTYD, DECK, and POOLTUB.

Logically, the RSALESPR of house j is also expected to be an increasing function of whether the house exterior is brick and the number of stories of the structure. RSALESPR is also expected to be an increasing function of the presence of a deck, the presence of a pool or hot-tub, and the number of garage spaces. It also is hypothesized here that a stucco exterior (rather than one of wood or vinyl) may enhance RSALESPR. Finally, the presence of a private courtyard is expected to enhance the RSALESPR for house j, as would the presence of an underground sprinkler system.

Another factor associated with house j is NEW, i.e., whether the house was new at the time of sale. As suggested in Clark and Herrin (1997), Decker, Nielsen and Sindt (2005), and Ford (1989), a *new* house is often considered highly desirable because in part it is in need of little or no repair and is generally cleaner and brighter and equipped with new and modern appliances; hence, a *new* house *per se* is expected to command a higher sales price. Accordingly, it is argued here that a "new" house will tend to command a greater market price.

There are 11 spatial control variables are included in the model. Two of these potentially fall under the rubric of Tiebout (1956) variables whereas counterparts to a number of the other spatial variables are found in one or another of the studies included in the related literature

(Weicher and Zerbst, 1973; Sampson and Wooldredge, 1986; Hughes and Sirmans, 1992). Regarding the other nine, we begin first by hypothesizing that houses that are located across from or adjacent to a park or square (PARKSQ) or houses that are located on a corner (CORNER) may be more appealing and hence command a higher price. Similarly, houses located on a cul-de-sac (CUL) or directly on a lake or river (LAKERIV) should also command a higher price. Furthermore, houses located on one of the four principal island communities (ISLAND) in the Savannah metropolitan area, namely, Marsh Island, Tybee Island, Skidaway Island, and Wilmington Island, would likely demand a price premium reflecting the desirability of location on such islands; this is especially likely in view of the popularity of boating and fishing activities in the metropolitan Savannah area. On the other hand, houses located within two blocks of an apartment complex (APCOMP), defined as a rental-only complex consisting of more than four rental units, or on one of Savannah's "busy" streets (BUSYST), Abercorn Street, De Renne Avenue north of Abercorn Street, Montgomery Cross, Habersham, Victory Drive, White Bluff/Coffee Bluff, or Oglethorpe, will command a lower price because of the increased vehicular congestion and accompanying noise and air pollution associated therewith (Hughes and Sirmans, 1992). From yet a different perspective, prospective homeowners presumably are concerned with the possible exposure to property crime associated with house j (Sampson and Wooldredge, 1986). Accordingly, a spatial measure of property crime is considered in this study: (PROPCRIME), which indicates the number of burglaries within a one-half mile radius of house j that were reported to the Savannah Chatham Metropolitan Police Department during the *full calendar year preceding* the sale of house j. Naturally, risk-avoidance behavior would imply that the real sales price of house j would be negatively affected by PROPCRIME.

In the spirit of the Tiebout (1956)/Tiebout (1956)-Tullock(1971) hypothesis, there is the property tax variable, and there are two variables of a Tiebout (1956) variety. Regarding residential property taxes, this study hypothesizes, in the spirit of the Tiebout (1956)/Tiebout (1956)-Tullock (1971) hypothesis and the study by Oates (1969), that these taxes are capitalized into housing prices so that housing prices are expected to be a decreasing function thereof.

Regarding the other pertinent variables, first there is a dummy variable (SCHOOL) indicating whether house j is located within one-half mile radius of a public elementary school, public middle school, or public high school. For families whose children attend (or are expected to do so) such public schools, there presumably may be benefits from close proximity to same, including reduced student transportation costs and easier parent access to school personnel such as teachers, principals, and coaches, as well as easier access to school events (PTA meetings, athletic events, and the like). This would imply that the real sales price of house j would be positively impacted by SCHOOL. Alternatively stated, close proximity to such schools arguably would be positively capitalized into the real price of house j. On the other hand, for families whose children do not attend such schools or families that do not have school-age children residing at home, the direct value of SCHOOL *could* be more modest, although it still might be carry a net positive value to the extent that these would-be or actual homeowners realize that such considerations as are impounded in the SCHOOL variable may have advantages *in the future* should/when the *re-sale* of house j become a pertinent consideration.

In addition, a dummy variable reflecting close proximity, i.e., location within a two-mile radius, of one the Savannah's primary hospitals (HOSP), namely, Memorial Hospital or St. Joseph's/Candler Hospital, which are in fact funded to some significant degree by the local (including county) tax base, is considered. To the extent that such proximity represents a safety

issue and/or a convenience issue in terms of closeness to medical care, both more routine and more serious medical care (such as cancer treatments and surgeries), this consideration should translate into a value that is positively capitalized into the real market price of house j.

In addition, there is the residual category of "other factors" considered in this study. To begin, it is argued here, given the historical culture of Savannah, that if a single family house has received designation as a national historic landmark (HISTDES), it should command a higher market price to reflect an element of "prestige" or "distinction." Then there is the *separate* issue of location in the Savannah Historic Landmark District *per se*. If a house in Savannah is located therein (DISTRICT), it is hypothesized that its market value is greater as a result of the element of "prestige" associated with this location.

III. THE EMPIRICAL ESTIMATION

This section of the study provides the results of empirically estimating the hedonic model outlined above, with the White (1980) procedure adopted to correct for heteroskedasticity. The OLS/semi-log estimation results are provided in Table 3, where terms in parentheses beneath coefficients are signed t-values. In Table 3, estimated coefficients are found in column (a) whereas the associated t-values are found in column (b).

In Table 3, 26 estimated coefficients on *explanatory* variables *per se* are provided, with 16 being statistically significant with the expected sign at the one percent level, seven being statistically significant with the expected sign at the five percent level or beyond, and one being statistically significant at nearly the six percent level. Only the estimated coefficients for the variables POOLTUBj and CORNERj fail to be statistically significant at the ten percent level. The variable TREND is a linear trend variable for the seven-year study period. Not surprisingly, given the general upward tending in housing prices nationally over the 2000-2006 period, it is

positive and statistically significant at the five percent level. The R^2 as well as the adjusted R^2 indicate that the model explains effectively nine-tenths of the variation in the dependent variable (lnRSALESPR). The F-statistic (49.85) is statistically significant beyond the one percent level, providing evidence of the overall strength of the model.

Based on the estimate shown in Table 3, the *real* sales price (expressed in natural log form) of single-family houses in the Savannah metropolitan area is a positive function of the number of bathrooms, fireplaces, bedrooms, garage spaces, stories in structure, and the number of square feet of finished living space in the house. In addition, the presence of a deck, a private courtyard, or an underground sprinkling system adds to the real sales price. An exterior construction of brick or stucco, and "new" construction also tend to increase the real sale price of the house, although the presence of a pool or hot-tub apparently does not (perhaps as a result of opportunity cost or upkeep considerations). Location across from or adjacent to a park or square also appears to enhance real sales price, although corner location does not appear to significantly influence housing price. Location on a cul-de-sac or either on a lake or river also acts to enhance the real housing price, whereas close proximity to a busy street reduces the house price. Location in an area with more burglaries reduces the real price of a house. There is evidence, albeit less compelling, that location near an apartment complex reduces the house price. Designation as a national historic monument apparently is appealing and hence contributes somewhat to a higher sales price. Furthermore, the coefficient on HISTDIST implies that location in the Savannah Historic Landmark District *per se* increases a house's sales price; alternatively, location on one of Savannah's principal islands enhances a house's sales price.

Finally, and most importantly in terms of the objective of this study, are the results for the Tiebout (1956)/Tiebout (1956)-Tullock (1971) hypothesis. As shown in Table 3, the natural log

of the real sales price of house j is found to be (as hypothesized) a decreasing function of the property tax liability associated with the house. In addition, the natural log of the real sales price of house j is found to be positively affected by close proximity to a public primary, middle, or secondary school. Furthermore, close proximity to a major metropolitan hospital (each of which receives public subsidies) also elevates the sales price of house j.

As for the specific contributions of the *statistically significant variables* on LnRSALESPR, there are 24 effects that can be summarized. In a semi-log functional form with the dependent variable being expressed in natural log terms, a one unit change in a *non-binary* independent variable has a percentage effect on the dependent variable that is given by one hundred percent multiplied by the estimated coefficient, *ceteris paribus*. For example, with respect to the interior features of house j, the presence of an additional bathroom causes the real sales price of house j to increase by 10.1 percent. This factor generates the largest positive sales price response for interior features. By comparison, the presence of an additional bedroom yields a positive housing price response of roughly 8.14 percent. This is followed by a more modest price increase for an additional fireplace of roughly 5.4 percent. The effect of the SQFT variable on the real sale price of house j is handled somewhat differently because the scale of measurement is per square foot. In particular, the mean square footage is 1,804. A one standard deviation increase in the square footage (1,297) from the mean implies a roughly 22 percent increase in the real sales price of house j. This translates into a situation in which, on the average, the real housing price rises by approximately $30.67 (in 2006 dollars) for each additional square foot of finished living space.

Regarding the response of the lnRSALESPR of house j to exterior features, we focus first on the number of stories present in house j and the number of garage spaces on the premises of house j. Based on the average of the results in Table 3, one additional story for house j yields a roughly

13.2 percent higher sales price, and one additional garage space yields an approximately 11 percent higher sales price.

Next come the interpretation the coefficients on the dummy (binary) variables (Halvorsen and Palmquist, 1980). Accordingly, to begin, it is observed that the cladding type of house j appears to exercise a large effect. For example, holding other things constant, a house with a brick exterior commands a roughly 24-25 percent higher sales price than one without a brick exterior, whereas a house with a stucco exterior commands a nearly 27 percent higher sales price than one without. Other things held constant, a house with a private courtyard commands an approximately 6.5 percent higher sales price than a house without one, whereas a house with an underground sprinkler system commands a roughly 13 percent higher price than one without one. Furthermore, other things held constant, a house with a deck commands a 9 percent higher sales price than one without one. It is worth observing that the results for each the last three variables considered, namely, courtyard, underground sprinkler system, and deck might seem a bit high. This might be attributable in part to the fact that a variable reflecting lot size (which is unavailable for nearly all of the Historic Landmark District houses and for many of the other houses considered as well) is, of practical necessity, omitted from the analysis. As for the sales-price response of house j to other non-interior and non-exterior features, it appears (other things held the same) that if house j that is of *new* construction *per se*, it sells with a premium of nearly 30 percent.

The results for variables HISTDES, DISTRICT, and ISLAND are next. It appears that a house designated as a national historical landmark secures about a 2.4 percent premium over a house not so designated. This premium is a separate effect from that of whether house j is located is located in the Savannah Historic Landmark District. Indeed, a house located in the Savannah

Historic Landmark District commands a real price premium of about 17-18 percent over a house not located in the "District." Finally, location of a house on one of the principal residential islands in the Savannah metropolitan area yields a roughly 16-17 percent price premium.

Consider now the results for the eight *statistically significant* non-Tiebout (1956) spatial control variables, seven of which are expressed as dummy variables and one of which is not. A house located across from or adjacent to a park or square commands an approximately 12 percent higher price than a house that is not so situated, whereas location on a corner has no significant housing price impact. On the other hand, location on a cul-de-sac results in a housing price premium of 9 percent, while location on a lake or river yields a price premium of roughly 11-12 percent. Next, location within two blocks of an apartment complex *reduces* the price of a house by roughly 3.5 percent (subject to the finding that this coefficient is statistically significant at only about the six percent level), whereas location on a "busy" street *reduces* the price of a house by nearly 8 percent. As for property crime, which is *not* expressed in binary (dummy) variable form, one additional burglary within a half-mile proximity lowers the real sales price of a house by nearly 2 percent.

Next we consider the Tiebout (1956) spatial variables. Location within one-half mile of a public school (primary, middle, or secondary) elevates the real sales price of house j by 3.4 percent. Location of house j in close proximity of one of Savannah's major hospitals elevates the price of house j by nearly 3 percent.

Finally, the estimated coefficient on the property tax variable is negative, as expected, and statistically significant at the one percent level. This finding provides strong empirical support for the Tiebout (1956)/Tiebout (1956)-Tullock (1971) hypothesis that higher property taxation reduces the price of housing, *ceteris paribus*, presumably because the property tax liability is

capitalized into the housing price (Oates, 1969). The mean property tax level for a single-family home in the Savannah housing market is $2,920, while the standard deviation is $1,935. Raising the property tax by one standard deviation would *reduce* the real price of the average house by nearly 6 percent, i.e., by approximately $14,513.

IV. CONCLUSION

The purpose of this study was to investigate, using the metropolitan Savannah, Georgia housing market, the Tiebout (1956)/Tiebout (1956)-Tullock (1971) hypothesis that property taxes and local public goods and services are capitalized into real housing prices. The study focuses on houses sold within this environment for the seven-year period 2000 through 2006. In order to make all housing prices comparable, they are all expressed in 2006 dollars, using an index of *housing price inflation*. Property tax liabilities were similarly adjusted. The basic model consists of 26 potential factors (11 being spatial variables) that arguably could influence *real* housing prices. A linear trend variable was also included in the estimation. The estimation of a semi-log model is presented in this study, which examines 3,171 single family home sales, 598 of which were located in the Savannah Historic Landmark District whereas 2.573 were located elsewhere in the Savannah metropolitan area.

The principal findings of this study, *given its core objective*, include the result that the natural log of the *real* sales price of a single family house in the Savannah metropolitan area over the 2000-2006 period was negatively impacted by higher property taxes, implying that (as hypothesized) property taxes are capitalized into real housing prices. In addition, there is strong empirical evidence that such Tiebout (1956) factors as close proximity to public schools (primary, middle, and secondary) and close proximity to major hospitals (which in fact receive public subsidies) were positively capitalized into the real housing prices of single-family homes in Savannah. This

study provides strong empirical support for the Tiebout (1956)/Tiebout (1956)-Tullock (1971) hypothesis, a finding that also affirms the free market system's efficiency in assessing the impacts governmental actions and policies. Moreover, these findings, along with the remaining findings elaborated upon in Section 3, provide strong empirical evidence of the market mechanism at work.

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Table 1. Variable Definitions

lnRSALESPR= the natural log of the price of house j (expressed in 2006 dollars)

BATHS= the total number of baths (full plus half) in house j

FIREPLACES= the number of fireplaces in house j

BEDROOMS= the total number of bedrooms

SQFT = the total number of square feet of finished living space in house j

BRICK= a binary variable indicating whether house j had a primarily or completely brick exterior (= 1 if yes, = 0 otherwise)

DECK= a binary variable indicating whether house j had an exterior deck (=1 if yes)

CRTYD= a binary variable indicating whether house j had a private courtyard (=1 if yes)

SPRINKLER= a binary variable indicating whether house j had an underground sprinkler system (= 1 if yes)

STORIES= the number of stories/floors present in house j

STUCCO= a binary variable indicating whether house j had a stucco exterior (=1 if yes)

GARAGESP= the number of garages spaces that are part of house j

POOLTUB= a binary variable indicating whether house j had its own hot-tub and/or swimming pool (=1 if yes)

NEW= a binary variable indicating whether house j was new at the time of sale (=1 if yes)

HISTDES = a binary variable indicating whether house j was designated as a National Historic Landmark (=1 if yes)

DISTRICT = a binary variable indicating whether house j was located in the Savannah Historic Landmark District (= 1 if yes)

ISLAND = a binary variable indicating whether house j was located on one of the four principal islands in the Savannah metropolitan area (=1 if yes)

PARK/SQ = a binary variable indicating whether house j was located across from or adjacent to a park or square, i.e., a small park (=1 if yes)

CORNER = a binary variable to indicate whether house j was located on a corner (=1 if yes)

CUL = a binary variable to indicate whether house j was located on a cul-de-sac (=1 if yes)

LAKERIV = a binary variable to indicate house j was located on a lake or river (=1 if yes)

APCOMP = a binary variable to indicate whether house j was located within two blocks of an apartment complex exceeding four rental units (=1 of yes)

BUSYST = a binary variable to indicate whether house j was located on one of Savannah's busy streets, namely, Abercorn Street, De Rene Avenue (north of Abercorn), Montgomery Cross, Habersham, Victory Drive, White Bluff/Coffee Bluff, or Oglethorpe (= 1 if yes)

PROPCRIME = number of burglaries reported within one-half mile of house j during the calendar year preceding the sale of house j

PROPTX = annual property tax (county plus city) for house j paid to city and county governments

SCHOOL = a binary variable indicating that a public elementary, middle, or high school was located within one-half mile of house j (=1 if yes)

HOSP = a binary variable indicating that house j was located within a two-mile radius of a major hospital (=1 of yes)

Table 2. Descriptive Statistics

Variable	Mean	Standard Deviation
RSALESPR	$249,927	$79.824
BATHS	2.258	1.813
FIREPLACES	1.1	1.29
BEDROOMS	2.61	1.63
SQFT	1,824	1,297
BRICK	0.196	0.471
DECK	0.055	0.253
CRTYD	0.062	0.154
SPRINKLER	0.0187	0.2298
STORIES	1.813	0.980
STUCCO	0.191	0.276
GARAGESP	0.214	0.329
POOLTUB	0.017	0.165
NEW	0.263	0.213
PARK/SQ	0.0376	0.204
CORNER	0.0519	0.352
CUL	0.0139	0.032

LAKERIV	0.01	0.01
APCOMP	0.091	0.067
BUSYST	0.008	0.021
PROPCRIME	1.14	1.98
HISTDES	0.009	0.029
DISTRICT	0.15	0.301
ISLAND	0.142	0.176
SCHOOL	0.141	0.132
PROPTX	2,920	1,935
HOSP	0.14	0.11

Table 3. Semi-log Estimation Results

Variable	**Coefficient**	**t-value**
Constant	**10.11**	**1.90**
BATHS	**0.101**	**3.20**
FIREPLACES	**0.054**	**3.56**
BEDROOMS	**0.0814**	**2.70**
SQFT	**0.00017**	**2.69**
BRICK	**0.221**	**3.29**
DECK	**0.088**	**2.74**
CRTYD	**0.063**	**3.35**
SPRINKLER	**0.127**	**2.39**
STORIES	**0.132**	**2.67**
STUCCO	**0.241**	**3.40**
GARAGESP	**0.11**	**3.10**
POOLTUB	**0.099**	**1.61**
NEW	**0.27**	**3.51**
PARK/SQ	**0.109**	**2.04**
CORNER	**0.02**	**0.27**
CUL	**0.082**	**2.35**

LAKERIV	**0.10**	**2.64**
APCOMP	**-0.032**	**-1.88**
BUSYST	**-0.07**	**-2.06**
PROPCRIME	**-0.018**	**-2.09**
HISTDES	**0.023**	**2.03**
DISTRICT	**0.16**	**2.67**
ISLAND	**0.15**	**3.04**
PROPTX	**-0.00003**	**-2.73**
SCHOOL	**0.032**	**2.71**
HOSP	**0.028**	**2.10**
TREND	**0.03**	**1.98**

R^2 = 0.91

adjR^2 = 0.89

F = 49.85

Positive Feedback Trading in the Portuguese Stock Market[1]

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ABSTRACT

The increasing number of active mutual funds, as well as the amounts they invest, justifies the increasing role of institutional investors in the Portuguese Stock Market. Gradually, mutual funds have been catching the attention of economic agents wishing to make indirect investment in financial assets. In the context where institutional investors are becoming more prominent in capital markets, the goal of this paper is to investigate the dynamics of these trading activities, namely the presence of positive-feedback trading. The results present a negative correlation between changes in institutional ownership and returns measured over the same period, which suggest that institutional investors may not follow such strategies, for what they can be considered negative-feedback traders.

Key Words: Financial markets; feedback trading; herding behavior.

JEL: C14; G12; G15

I. INTRODUCTION

The increasing number of active mutual funds, as well as the amounts they invest, justifies the increasing role of institutional investors in the Portuguese Stock Market. Gradually, mutual funds have been catching the attention of economic agents wishing to make indirect investment in financial assets. In the context where institutional investors are becoming more prominent in capital markets, it seems important to investigate the dynamics of these trading activities, namely the eventual presence of positive-feedback trading, while a strategy adopted by such investors.

Mutual funds are organizations of collective investment and, as such, their purpose is to make the investment of private savings in diversified portfolios of financial assets (or other comparable), according to the philosophy of risk spreading. Lakonishok *et al.* (1992a) define institutional investors as firms that use professionals to manage money to the benefit of other investors, companies or individuals.

Barreto (1996), however, has proposed that institutional investors are constituted by the financial institutions, such as banks, mutual funds, pension funds and insurance companies that invest in the capital market. However, literature does not fully agree on what the precise relationship between these investors' trading activities and the volatility of the related asset prices may be.

A recent and vast literature document a strong positive relationship between changes in institutional ownership and returns measured over the same period. The source of this positive correlation could arise from institutional investors´ intra-period positive-feedback trading (Antoniou *et al.* (2005a; 2005b); Kim and Wei (2002a; 2002b); Voronkova and Bohl (2005)).

The positive-feedback traders buy overvalued stocks and, simultaneously, sell undervalued stocks. They believe that lag returns persists on future, so their trades are based on their expectative (Cutler *et al.* (1990); DeLong *et al.* (1990a); Bowe and Domuta (2004); Sias (2004); Do *et al.* (2006)).

The price pressure caused by institutional trades can be an important source of the market's volatility. Related with feedback trading are the glamour and value strategies and the impact that they have in returns. When investors, rational or noise traders, act in the market, their investment decisions can disestablish stock prices. Therefore, to understand the market volatility is essential to analyze the investors trading behavior.

Generically, the literature identifies two styles of investment strategies: (1) glamour strategies and (2) value, or contrarian, strategies (Farmer (2002); De Bondt and Thaler (1985); Mun *et al.* (1999); Jegadeesh and Titman (2001); Kang *et al.* (2002); Wong *et al.* (2003); Strozzi and Zaldívar-Comenges (2005)).

A value strategy consists in a strategy that buys overvalued stocks and sells undervalued stocks. When this trading behaviour is systematic, the literature denominated by positive-feedback

trading (Cutler *et al.* (1990); DeLong *et al.* 1990a)). By contrary, when an investor purchase undervalued and sells overvalued stocks, he adopts a value, or contrarian, strategy (Lakonishok *et al.* (1994); Brouwer *et al.* (1997); Cai, (1997)).

Some authors refer that institutional investors engage in some positive-feedback trading and have a herding behavior[2] what is primarily responsible for destabilizing stock prices (Shiller and Pound (1989); Brennan (1990); DeLong *et al.* (1990a, 1990b); Scharfstein and Stein (1990); Lakonishok *et al.* (1991); Banerjee (1992); Bikhchandani *et al*. (1992); Froot *et al.* (1992); Hirshleifer *et al.* (1994); Bikhchandani and Sharma (2001)).

So, institutional investors can destabilize stock prices if they engage in a positive-feedback trading, what can moves prices toward equilibrium values. However, Lakonishok *et al.* (1991) refers that window dressing is characteristic from institutional investors and stabilize stock prices, by purchasing glamour and selling value stocks.

The remainder of the paper is organized as follows: Section II describes the data and methodology. Section III discusses the empirical results. Concluding remarks are provided in Section IV.

II. DATA AND METHODOLOGY[3]

The time frame chosen for the analysis corresponds to the period of October 2002 to October 2008. The data was collected from the Portuguese Market's Commission (CMVM) and the Portuguese Stock Exchange (Euronext-Lisbon). The CMVM supplied information regarding the fraction of stocks held by institutional investors. We have considered only the national open

[2] The herding behaviour consist on a group of investors trading (buying or selling) the same stock over a period of time and feedback trading results when lag returns act as the common signal (Devenow and Welch (1996); Graham (1999); Hirshleifer and Teoh (2003)).

[3] In this study we follow the methodology suggested by Nofsinger and Sias (1999).

funds in this analysis, excluding closed-end, international and treasury funds, as well as foreign companies and funds of funds. The Euronext-Lisbon provided the remaining data for the considered period, including quoted firms' capital adjustments, issue-dates and amounts of dividends, as well as the daily stock prices. The data related to capital adjustments remitted the amount of shares negotiated every month to be determined. From the dates and amounts of dividends, as well as the daily stock prices, it was possible to calculate the monthly returns (adjusted to dividends). Finally, the monthly stock capitalization was computed from the daily stock prices and the amount of shares traded each month. The stock returns were estimated on a monthly basis.

In such a context, and in order to evaluate the relationship between the change in institutional ownership and the past returns on the stocks traded by mutual funds, a sorting procedure was applied to create, for each month, four portfolios of individual stocks that had similar institutional ownership at the beginning of each month and exhibit large changes in institutional ownership over the month.

At the beginning of every month, the stocks held by mutual funds throughout that month were grouped into four portfolios, reflecting the fraction of stocks held by institutional investors. Thus, stocks in which there is a similar initial fraction of institutional ownership are grouped together. In turn, each of the four portfolios that reflect the fraction of institutional ownership is subdivided into four further portfolios that contain the stocks sorted in accordance with the degree of change in the fraction of ownership of the funds experienced over the following month (the "herding month").

Thus, for each month, four "institutional ownership fraction" portfolios and sixteen "institutional ownership percentage change" portfolios are obtained. Subsequently, for each month, it is

possible to rearrange the sixteen institutional ownership percentage change portfolios according to the increase or decrease experienced relative to the percentage of stocks held by mutual funds. That is, for each month, all the stocks included in the quartile that reflects the higher change in institutional ownership, inside of each original quartile of the initial fraction of institutional ownership, are sorted into a portfolio that exhibits the largest increase in the fraction of institutional ownership.

The same procedure was applied to the stocks in each of institutional ownership percentage change quartile, according to the extent of the change in institutional ownership they experienced. Thus, we obtained, for each month, four institutional ownership percentage change portfolios, whose stocks had a similar initial degree of institutional ownership [portfolio 1 (larger decrease), portfolio 2, portfolio 3, portfolio 4 (larger increase)].

The lag returns can be determinant on investment strategy. Positive-feedback trading consists in purchase overvalued stocks and sells undervalued stocks. Some authors refer that positive-feedback trading pressure price stocks and disestablish market prices.

One way of analyze the positive-feedback trading would be through the relationship between the percentage change in institutional ownership and the returns on the stocks that were traded by the funds in question over a past period. Thus, if the stocks that suffered a decrease (increase) in the level of their institutional ownership also exhibit, negative (positive) returns in the prior period of analysis, this may suggest the existence of positive-feedback trading.

On this basis, in order to evaluate the relationship between institutional ownership percentage change and the returns on the stocks traded by the funds over the three and the six months prior the herding month, the monthly excess returns were calculated for each one of the stocks included in the four “institutional ownership change” portfolios, thereby obtaining four “3 and 6

months past excess returns" portfolios[4] [portfolio 1 (larger decrease), portfolio 2, portfolio 3, and portfolio 4 (larger increase)]. The monthly excess returns for the stocks of firm ***i*** in the month ***t*** are calculated by the difference between the monthly stock returns (adjusted to dividends) of firm ***i*** in the month ***t*** and the mean of the monthly returns (adjusted to dividends) of the total of stocks in the same quartile.

The "prior period" corresponds to the three and six months prior the herding month. for example, the prior period relative to the month of October 2002 is computed with the months of July 2002 to September 2002 (three months) and the months of April 2002 to September 2002 (six months).

The relationship between the changes of institutional ownership and the stock returns traded by the funds is calculated from the monthly excess returns in the three and six months prior the herding month (past-returns) of each stock included in the four "change in institutional ownership" portfolios, thereby giving rise to four portfolios of "past-returns" [portfolio 1 (larger decrease), portfolio 2, portfolio 3, and portfolio 4 (larger increase)]. Thus, it is possible to evaluate the relationship between the percentage change in institutional ownership and the returns of the stocks traded by institutional investors in the prior period. This way, we can examine the institutional feedback trading.

Complementarily, we also run the regression among the percentile change in institutional ownership in the current period, the stocks monthly excess returns obtained in the prior period (six months) and the monthly excess returns achieved to the current period:

$$IO_t = \alpha_i + \beta_{1,i}\, MER_{t-1} + \beta_{2,i} MER_t$$

Where:

4 Note that we do not obtain four new portfolios, but the returns for each of the previous portfolios.

IO_t is the percentile change in Institutional Ownership over the current period;

MER_{t-1} are the monthly excess returns (adjusted to dividends) in the prior period;

MER_t the monthly excess return (adjusted to dividends) for the current period and;

α_i, $\beta_{1,i}$, and $\beta_{2,i}$ are the model parameters.

This regression was applied because the time series combine *pooled time series* and *cross section data*. The regression is computed considering that all observations have the same relative weight and assuming that the residues are independent and normally distributed. Next, different tests were conducted, to the coefficients and to the regression residuals as well, to verify whether the estimated parameters are conforming the model assumptions. Otherwise, the necessary adjustments should be made to validate the resulting estimates.

III. EMPIRICAL RESULTS

Primarily, the main purpose of this study is to verify whether the abnormal returns in the herding (current) month reflect the institutional trading or, instead, are a persistence of a lag trend of abnormal returns. Thus, to examine if institutional investors have a better performance than other investors (if they are better informed than individual investors), we analyze the relationship between the change in institutional ownership and the stock returns.

Table I presents the time-series average of the cross-sectional mean abnormal returns in the three and six months prior to the herding month for the ownership change portfolios, for the stocks with similar initial levels of institutional ownership and large variations throughout the month[5]. The F-statistics are based on the null hypothesis that the time-series averages of cross-sectional

[5] For each one of the portfolios that reflect the change in institutional ownership, the monthly excess returns are calculated for the latter period, more precisely, for the first and second subsequent (prior) quarters (three and six months).

means do not differ across the ownership change portfolios and the t-statistics correspond to the null hypothesis that the time series average will diverge from zero.

From the values observed below, the F-statistics reveal that we fail to reject, at the 95% confidence level, the null hypothesis that time-series average of the cross-sectional mean abnormal returns in the three and six months prior to the herding month do not differ for the ownership change portfolios. The t-statistics test the equality of means within each group, and indicate that the average abnormal returns in the three and six months prior the herding month may not diverge from zero.

Table I

Excess returns in the three and six months prior to the herding month for the ownership change portfolios

	Port. 1 (larger decrease)	Portfolio 2	Portfolio 3	Port. 4 (larger increase)	*F-statistic*	*p-value*
Excess Returns 3 MONTHS	0,351%	-0,450%	0,310%	0,040%	*1,213*	*0,824*
t-statistic	*0,812*	*-0,160*	*0,430*	*0,856*		
p-value	*0,520*	*0,950*	*0,760*	*0,520*		
Excess Returns 6 MONTHS	0,221%	-0,362%	0,226%	0,163%	*0,716*	*0,651*
t-statistic	*0,912*	*-0,113*	*0,432*	*1,314*		
p-value	*0,461*	*1,061*	*0,823*	*0,251*		

With the purpose of analyzing the relationship between the changes in institutional ownership and the stock returns traded by the funds in the herding period, the monthly excess returns were computed for each of the stocks included in the four ownership change portfolios.

Table II presents the time series average of the monthly excess returns[6] for the current period (herding month), calculated from the monthly average values of the cross-sectional series, for the stocks that present similar initial levels of institutional ownership and large changes in that ownership over the current period.

The F-statistics are based on the null hypothesis of the equal means across the four change portfolios, and the t-statistics (72 observations) rely on the null hypothesis that the time series average will be equal to zero.

Table II

Excess returns in herding month

	Port. 1 (larger decrease)	Portfolio 2	Portfolio 3	Port. 4 (larger increase)	*F-statistic*	*p-value*
Excess Returns (Herding Month)	0,412%	-0,649%	0,176%	0,126%	*0,873*	*0,582*
t-statistic	*0,781*	*0,172*	*-1,060*	*-1,056*		
p-value	*0,533*	*0,976*	*0,373*	*0,415*		

The results suggest that the stocks that previously experienced a large decrease in institutional ownership significantly outperform similar stocks that previously displayed a large increase in institutional ownership. Actually, it can be observed that the stocks that are included in the portfolio that reflected the largest decrease in the level of institutional ownership, realizes, on average, a monthly excess return of 0,412%.

In contrast, those that belong to the portfolio that exhibits the largest increase in institutional ownership obtain, on average, a monthly excess return of just 0,126%. Further, if we take into account the fact that the stocks included in the second portfolio exhibit, on average, a monthly excess return of -0,649%, it becomes more difficult to explain the relationship (if there is any)

[6] The monthly excess returns are calculated for each one of the portfolios that reflect the change in institutional ownership.

between the changes in institutional ownership and the monthly stocks excess returns over the current period.

In fact, based on the F-statistics, the null hypothesis of equal means cannot be rejected, showing that, at the 95% confidence level, the time series average of the monthly stock excess returns over the current period does not differ across the four ownership change portfolios. Similarly, the t-statistics reveal that the null hypothesis is not rejected at the 95% confidence level, suggesting that the time series average of the monthly excess returns over the herding month may not diverge from zero.

Thus, we might conclude that neither the changes in institutional ownership nor the monthly excess returns in the herding period, explain the monthly excess returns realized by the stocks in the subsequent period.

Summarizing, the above results suggest that institutional investors do not adopt positive-feedback trading strategies, once, as shown, the portfolio that exhibits the larger decrease in institutional ownership is the same where stocks display the higher abnormal returns in the three and six months prior to the herding month (table I). Moreover, the results also suggest that institutional trading does not have impact in the stock prices, while the abnormal returns in herding month seem a merely lag trend (table II).

In order to improve this analysis, at beginning of each month all stocks were sorted into four portfolios based on their raw performance over the previous six months.

Table III reports the time-series average of the month cross-sectional mean raw returns for the "formation period" (current period), excess returns over the subsequent six months and the change in the fraction of stocks held by institutional investors over the subsequent six months.

The F-statistics reveal that we may not reject the null hypothesis, at the 95% confidence level, that time-series average of the cross-sectional mean abnormal (excess) returns in the herding month is equal to the ownership change portfolios. However, we clearly reject, at the 99% confidence level, the null hypothesis that time-series average of the cross-sectional mean raw returns in the herding month differ for the ownership change portfolios. The t-statistics indicate that the hypothesis that the abnormal returns in the herding month are equal to zero is not rejected at the 95% confidence level.

Table III

Positive-feedback trading

	MER * (losers)	MER 2	MER 3	MER (winners)	*F-statistic*	*p-value*
Formation period raw returns	-6,139%	-1,761%	0,948%	7,086%	*62,812 **	*0,000*
Subsequent period abnormal returns	-0,412%	-0,494%	0,216%	0,639%	*1,261*	*0,682*
t-statistic	*-0,756*	*-1,145*	*0,410*	*0,662*		
p-value	*0,553*	*0,349*	*0,776*	*0,611*		
Change in Institutional Ownership	0,076%	-0,031%	0,041%	-0,124%	*1,376*	*0,324*
t-statistic	*0,951*	*-0,331*	*0,407*	*-1,242*		
p-value	*0,441*	*0,882*	*0,809*	*0,294*		

* MER (Monthly Excess Returns).

** Statistically significant at the 99% confidence level.

Such results reinforce the earlier conclusions, confirming that institutional investors are not positive-feedback traders. The change in institutional ownership of stocks in the quartile of losers (exhibited the largest decrease) is, on average, about 0,076% and the change in institutional ownership of stocks in the quartile of winners (experiencing the largest increase) is, on average,

about -0,124%, which seems to indicate that institutional investors buy "losers" stocks and sell "winners".

Table IV presents the resulting estimates from the *pooled least squares regression* run for the monthly excess returns obtained in the 6 month prior period, the fraction of change in institutional ownership in the current period and the monthly excess return achieved during the current period. Once, the application of this method intends to evaluate the positive-feedback trading. From the values shown below we verify that the hypothesis of the nullity of the parameters is not rejected.

Table IV

Results of the Pooled Least Squares Regression

	Coefficient	Standard Error	t-statistic	p-value
α	-0,0034	0,0016	*-2,0298 **	*0,0816*
β_1	0,0696	0,2041	*0,3672*	*0,7854*
β_2	0,0531	0,0442	*1,4688*	*0,2856*
Durbin - Watson	1,7584			
F-statistic	*1,3284*			
p-value	*0,7700*			

* Statistically significant at the 90% confidence level

The results of the coefficient estimates demonstrate that none of the parameters is statistically significant, at the 95% percent confidence level, in the explanation of the dependent variable. The tests of the residues allow to conclude: (1) it would be reasonable to assume that the assumption of normality is not violated (Bera and Jarque tests for the null hypothesis of the normal distributions); (2) the assumption of homoskedasticity is violated (Bartlett, Levene and Brown-Forsythe tests, applied to the null hypothesis of equal variances); (3) it is confirmed the

correlation of the residuals (Ljung-Box test, for the null hypothesis of the inexistence of autocorrelation in the residuals).

This way, in the presence of heteroskedasticity and autocorrelation of the residuals, other model - *seemingly unrelated regression* - was considered. The results are presented in table V below.

Table V

Results of the Seemingly Unrelated Regression

	Coefficient	Standard Error	t-statistic	p-value
α	-0,00205	0,00065	*-4,07680 **	*0,00001*
β_1	-0,19516	0,24548	*-0,99843*	*0,52801*
β_2	0,04493	0,04234	*1,14241*	*0,31682*

* Statistically significant at the 99% confidence level.

As we can verify, the results of the *seemingly unrelated regression* are similar to those obtained by the *pooled least squares regression.*

In fact, at the 95% confidence level, we cannot reject the hypothesis of the nullity of the parameters, because the results of the coefficients, exception to the constant, show that these are not statistically significant when explaining the dependent variable. We might, this way, to conclude that neither the monthly excess returns realized by the stocks in the prior period nor the monthly excess returns in the current period, explain changes in institutional ownership in the current period.

In the light of the above, the results reinforce the earlier conclusions were we conclude that institutional investors are negative-feedback traders and follow "value strategies", that is, they tend to invest in value stocks.

IV. CONCLUDING REMARKS

This paper analyzes the eventual presence of positive-feedback trading strategies in the Portuguese Stock Market, for the period of October 2002 to October 2008.

A first outcome from this study indicates that institutional trading have not a significant impact on the stock prices, once that neither the changes in institutional ownership, nor the monthly excess returns in the herding period, seem to explain the monthly excess returns exhibited by the stocks in the subsequent periods.

Moreover, the results suggest that institutional investors are not positive-feedback traders. In fact, they seem to follow value strategies, for what can be considered *negative-feedback traders*, buying undervalued stocks (losers) and selling overvalued stocks (winners).

Finally, although our results appear to differ from those of Nofsinger and Sias (1999), such differences can be a consequence, for example, of the sample size. We studied the most representative institutional investors (mutual funds) in the Portuguese market, which are relatively few given the market dimension, while Nofsinger and Sias analyzed all institutional investors, namely pension funds, whose weight in the capital markets is significant. Nevertheless, it should be emphasized that our results seem consistent with most of the studies in the topic.

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