HOUSE PRICE DYNAMICS IN ITALY*

1. Introduction

In many OECD countries house prices in real terms have been rising sharply since the mid '90s. Morana and Beltratti (2009) show that since 1999 (up to 2007) house prices have increased at a yearly average real rate of about 5% in the US, Euro Area and Canada, and at an even higher rate in the UK (close to 9%). Over the same time period, average real income growth has been in the range 2% to 3%, whereas nominal interest rates and inflation have been low (3% to 5% and 2% to 2.6%, respectively) and broad liquidity has grown at generous rates (6% to 8%). Compared with previous house price cycles going back to the 1960s, the latest expansion phase has been exceptional for three reasons (Andrè, 2010). Firstly, during the recent boom, house prices rose by 120% on average. The average real price increase during earlier expansions had been around 45% (Girouard *et al*., 2006). In only two preceding expansions did real prices more than double: in Finland in the 1980s, with an acceleration of the price increase rate towards the end of the decade, and in Spain immediately after it joined the European Community in 1986. There are three other episodes characterized by house price revaluation almost doubling: in Italy and the Netherlands in the 1970s and in the United Kingdom in the 1980s. Secondly, the expansion has been exceptionally long. Historically, the duration of the house price cycle has been around 10 years, roughly similar to the business cycle, with which it used to be synchronized. The average expansion phase previously lasted around six years. In contrast, the latest upturn lasted about twelve years on average across countries. The exceptional length of the latest

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expansion means that the house price cycle has become disconnected from the business cycle. In previous cycles, peaks in house prices roughly coincided with peaks in the business cycle. As shown by Andrè (2010), the turnaround in the business cycle at the beginning of the current decade was not matched by a slowdown in house prices. Thirdly, most countries in the sample experienced a house price boom simultaneously (Terrones *et al.*, 2004). Synchronized booms were even more uncommon in the seventies when the proportion of countries in a boom never reached a third of the sample.

Thus the last exceptional housing market expansion started in the mid-1990s and developed into a boom in many countries. The housing market has started turning negative since 2007 in many OECD countries, as real prices have started decreasing in the US with the collapse of the US subprime mortgage market in 2007.

During the first phase of the upturn, improvements in financing conditions, as well as other fundamental factors, seem to have been the main driving force behind house price appreciation in most OECD countries[1]. So is there really any need to worry?

The answer obviously depends on the circumstances. In fact, in the second phase of the last house price revaluation, many housing markets seem to have overshot, as expectations of future capital gains on houses became entrenched.

Thus, the last global housing price 'revaluation phase' may be justified by fundamental dynamics but it could be related to non-fundamental based mechanisms such as 'extravagant expectations' or 'irrational exuberance' of future price increases (Shiller, 2005; 2007; 2008), or mispricing related to the combination of inflation and money illusion (Brunnermeier and Julliard, 2008)[2]. According to

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[1] The term 'fundamentals' refers to the size of the market, consumer characteristics (household income, preferences – as measured by socioeconomic and demographic characteristics – and expectations) and housing production variables (operating and capital costs, land prices, and geographic and government growth constraints). In the absence of a speculative bubble, a substantial portion of house price dynamics could be explained by fundamental economic variables.

[2] Shiller in a recent publication (2008) identifies the causes of the recent US crisis. He blames the subprime crisis on the irrational exuberance that drove the economy's two most recent bubbles: in stocks in the 1990s and in housing between 2000 and 2007. He shows how these bubbles led to the dangerous overextension of credit now resulting in foreclosures, bankruptcies and write-offs, as well as a global credit crunch. He underlines that, at the moment, one of the major troubles is the credit rationing which rapidly propagates the crises to the real sector.

Stiglitz (1990), a 'speculative bubble' is a continuing rise in the price of an asset sustained by the belief that the asset's price will continue to rise, although it is already high in comparison to fundamentals. This 'irrational exuberance' may lead to an exponential increase in house prices to levels significantly higher than the fundamental ones (Shiller, 2005; 2008). The greater the mismatch vis-à-vis the long-term trend, the more likely it is that the bubble will be followed by a sudden and sharp contraction in demand, with an associated price drop[3].

Many economists analyzed the recent boom and the empirical evidence is mixed. Some studies underline the cumulated overvaluation in housing prices of about 30% since 2004, not only for the US, but also for some other OECD member countries (Girouard *et al*., 2006; Finicelli, 2007; Gros, 2007). However Jacobsen and Naug (2005) did not find any evidence of housing price overvaluation in the US at national level, compared with fundamental values determined by interest rates, household income, unemployment and housing supply. On the contrary McCarthy and Peach (2004) analyse US housing market in recent years and find little evidence to support the existence of a national home price bubble, nevertheless it appears that home prices have risen in line with increases in personal income and declines in nominal interest rates. Himmelberg *et al*. (2005) analyze, unlike the previous cases, US real estate market at local level (46 metropolises) and, although a speculative bubble in all US metropolitan areas considered does not emerge, the US cumulative house price increases are relevant in many metropolises, suggesting a house price boom in many cities. Nevertheless, most academic studies on the real estate market focus on house price dynamics at national level in order to evaluate the existence of a house price boom[4]. House prices are inherently a local phenomenon, however, and therefore national-level data may obscure important economic differences between cities. At this local level, for Italy, Caliman (2006; 2008; 2009) did not find any evidence of housing price overvaluation, compared with fundamental values[5].

[3] Inker, the GMO chief investment officer for quantitative equities in global developed markets, has analyzed many bubbles that have occurred in the last 80 years, identifying 28 bubbles. Every one of the 28 bubbles went back to trend, no exceptions, but this recent bubble is different from the previous ones (Inker, 2006; 2008).

[4] For Italy see for example Nucci (1996).

[5] Although some authors provide disaggregate information on the influence of some spatial or geographical variables on Italian house prices (see, for example,

The main aim of this paper is to investigate the Italian exposure to house price bust developing the previous works by Caliman (2006; 2008; 2009) on the Italian real estate sector. According to IMF procedure, in order to test whether such a bubble effectively exists, a comparison between current prices and estimates of the trend values compatible with fundamentals is necessary. If the difference is slight, the discrepancy between the two values could be put down to uncertainty in the accuracy of estimates whereas if there is a big difference, the danger of a speculative bubble is real. To achieve this goal, first of all we updated the data until 2008 in order to consider also the last negative phase of the housing market. Secondly, we analyzed different spatial specifications of house price models in order to select the best formulation of the spatial house price model. Finally we performed the selected spatial model in order to verify the lesser Italian exposure to house price bust.

The remainder of the paper is organized as follows. Section 2 describes the alternative spatial model and the estimation procedure suggested by spatial econometrics. Section 3 analyzes the selected model. In section 4 the dataset employed in the empirical analysis is described and summary statistics are discussed. Section 5 comments the empirical findings. Finally section 6 concludes the paper.

2. The spatial modelling

The typology of models which will be used in this work to structure the Spatial Dependence in Panel Data must take into account both the problem of spatial dependence and the problem of serial error dependence (Anselin, 1999).

Elhorst (2004; 2008; 2009) developed an iterative two-step procedure to obtain the full maximum likelihood estimates of the parameters in a space-time model with first-order serial and spatial autocorrelation (Cliff *et al.*, 1975; Bartels, 1979; Bennet, 1979; Pfeifer and Deutsch, 1980; Bronars and Jansen, 1987). However, first-order serial and spatial autocorrelation is not the only way to model serial and spatial error dependence. Other models suggested in literature are the typical panel data models with both space and time effects

Cannari *et al.*, 2000), no paper (with the exception of Caliman 200; 2009), to the best of our knowledge, has ever considered the presence of a speculative bubble over time.

(Anselin, 1988), and a variant of the Zellner Model (Hordijk and Nijkamp, 1977; Anselin, 1988). In these models, serial and spatial error dependence are not expressed in terms of a particular parameterized function, but left unspecified as a general covariance. Restricting attention to 'lag' dependence, and with $f(z)$ as a generic designation for the regressors (which may be lagged in time and/or space), four types of models can be distinguished: *pure space-recursive* (in which the dependence pertains to neighbouring locations in a different period), *time-space recursive* (in which the dependence relates to the same location as well as the neighbouring locations in another period), *time-space simultaneous* (with both a time-wise and a spatially lagged dependent variable) and *time-space dynamic* (with all forms of dependence).

Spatial autocorrelation, which has received huge attention in the real estate literature, can be formally expressed by the moment condition:

$$\mathrm{Cov}[y_i, y_j] = \mathrm{E}[y_i, y_j] - \mathrm{E}[y_i]\,\mathrm{E}[y_j] \neq 0 \text{ for } i \neq j \qquad (1)$$

where i, j refer to individual observations (locations) and y_i is the value of a random variable of interest at the i-th location (Suriatini, 2005; Des Rosiers *et al*. 2000; Malpezzi, 2003). Spatial lag and spatial error dependence can be introduced into the cross-sectional dimension of traditional panel data models in a straightforward way. An important issue to consider when incorporating spatial dependence in panel data models is the extent to which fixed effects may be allowed. Since estimation of the spatial process models requires asymptotics in the cross-sectional domain ($N \rightarrow \infty$), fixed effects (i.e. a dummy variable for each location) would suffer from the incidental parameter problem and no consistent estimator exists. Hence, fixed cross-sectional effects are incompatible with spatial processes and instead a random effects specification must be considered. Specifically for the context of the present work the model chosen is the *time-space recursive* one:

$$y_{it} = \lambda y_{i\,t-1} + \rho[Wy_{t-1}]_i + f(z) + \varepsilon_{it} \qquad (2)$$

where $[Wy_{t-1}]$ is the i-th element of the spatial lag vector applied to the observations on the dependent variable in the previous time period (using an N by N spatial weights matrix for the cross-sectional units).

2.1 Parameter Estimation

Two main approaches have been suggested in the literature to estimate parameters in spatially dependent panel data models: the maximum likelihood estimation (see, among others, Ord, 1975;

Mardia and Marshall, 1984; Anselin, 1988; Anselin and Bera, 1998; Anselin *et al*., 2004; Arbia and Baltagi, 2008; Kelejian and Prucha, 1999b; Getis *et al*., 2004) and the method of moments (e.g., Anselin, 1988, 1990; Anselin *et al*., 2004; Arbia and Baltagi, 2008; Kelejian and Robinson, 1993; Kelejian and Prucha, 1999a, 1999b). The theoretical framework for maximum likelihood estimation of spatial models in the single cross-section setup is now well developed (see, among others, Ord, 1975; Mardia and Marshall, 1984; Anselin, 1988; Cressie, 1993; Anselin and Bera, 1998). While the regularity conditions are non-standard, and require a consideration of triangular arrays (Kelejian and Prucha, 1999b), the results for error terms with a Gaussian distribution are fairly well established. In practice, estimation consists of applying a non-linear optimization to the log-likelihood function, which (in most circumstances) yields a consistent estimator from the numerical solution to the first order conditions. Asymptotic inference is based on asymptotic normality, with the asymptotic variance matrix derived from the information matrix. This requires the second order partial derivatives of the log-likelihood, for which analytical solutions exist in many of the models considered (for technical details, see the *review* in Anselin and Bera, 1998).

As an alternative to reliance on an often unrealistic assumption of normality and to avoid some of the computational problems associated with the Jacobian term in ML estimation, instrumental variables and GMM methods have been suggested for single cross-section spatial regression models (e.g., Anselin, 1988a; 1990; Kelejian and Robinson., 1993; Kelejian and Prucha, 1999a, 1999b). These can be extended to the panel data setting as an application of general principles underlying the method of moments (see, among others, Kelejian and Prucha, 1999a, 2004, 2005; Lee, 2003).

2.2 Testing for Spatial Dependence

Testing for spatial effects in spatial panel models centres on the null hypotheses $H_0 : \rho = 0$ in the various models that include spatial lag terms or spatial error autocorrelation. Arguably, the preferred approach is based on Lagrange Multiplier (LM) or Rao Score (RS) tests, since these only require estimation of the model under the null, avoiding the complexities associated with ML estimation (Anselin, 2001). Testing using panel data models has also been extensively studied, see Hsiao (1986) and Baltagi (2001), but these models ignore the spatial correlation. Heterogeneity across the cross-sectional units is usually modelled with an error component model. A Lagrange multiplier test for random effects is derived by Breusch and Pagan (1980) and an extensive Monte Carlo on testing in this error component model is performed by Baltagi *et al*. (1993). In this work we test the spatial autocorrelation through the use of an extended version of the Breusch and Pagan LM test obtained by Baltagi *et al*. (2003).

The cross-sectional dependence is tested using the Pesaran CD test for cross-sectional dependence in panels and the Scaled LM test for cross-sectional dependence in panels (Pesaran, 2004) based on an average of pair-wise correlation coefficients of the OLS residuals from the individual regressions in the panel. These tests are applicable to a variety of panel data models, including stationary and unit root dynamic heterogeneous panels with short time dimension of the panel and a large cross section dimension and can be used to test for cross section dependence of any fixed order p, as well as the case where no *a priori* ordering of the cross section units is assumed. Pesaran (2004) derives the asymptotic distribution of these tests and their power function analyzed under different alternatives studying the degree of dependence in *per capita* output innovations across countries within a given region and across countries in different regions. He shows that these tests are correctly centred for fixed N and T, are robust to single or multiple breaks in the slope coefficients and/or error variances and that they have the correct size in very small samples and satisfactory power robust to the presence of unit roots and structural breaks.

3. The adopted model

The adopted model considers as house price drivers all the ‘classical’ explanatory variables or fundamentals adding persistency and reversibility. According to Capozza *et al*. (2004) the persistency factor is used to determine how well the past price of an asset predicts the future price. In other words the persistency gives the tendency for real house prices to rise tomorrow if they rise today, whereas reversibility denotes the capability of re-establishing the original condition after a change; in this context, reversibility means stability of the long-run trend, the so-called ‘dynamic equilibrium’ or ‘equilibrium path’. The equilibrium path is the locus of house prices which are compatible with fundamentals. Thus, house price reversibility implies that a house price increase, which creates a misalignment in house price indicators (such as price/rent ratio, affordability ratio, etc.), will be followed by a house price reduction. Unlike the previous works by Caliman (2006; 2008; 2009) we include spatial effects (Aten, 1996, 1997; Meen, 1996, 2001; Meen and Andrew, 1998) which are important when the statistical unit, each province, is characterized by a specific geographic location (which can generate migration flows and ripple effects)[6]. The model that has been applied postulates that residential house prices at provincial level are determined by the following factors:

i) past real house price growth measures the persistency of the revaluating house price process; i.e. the current rise is serially correlated with the past growth;
ii) past affordability ratio (the ratio of house prices to *per capita* income) considering reversibility: if the house prices show long-run reversion to fundamentals, then house prices tend to drop when they are out of line with respect to income levels. Thus, its coefficient must be negative;
iii) economic Fundamentals: the house price dynamic is positively influenced by rental growth trends (higher rents guarantee higher housing investment returns, inducing a house price revaluation and vice versa) and negatively affected by interest rates (lower interest rates increase households' capacity to borrow);
iv) other fundamentals influencing house prices: the credit dynamics (credit market evolution and liberalization, e.g., a rise in LTV to 100%, and an extension of credit access to 'atypical' workers), the past growth of real stock prices (Mibtel, that is the main Italian Stock Market Index, in terms of volume growth and bust dummy, introduced to account for partial substitution between houses and shares in investment portfolios), the population growth in local house submarkets (as proxy for the growth rate of households), the number of employees (as individuals prefer to purchase a house in areas with high job opportunities) and

[6] The submarkets' existence causes heterogeneous diffusion of the revaluation process with local propagations like wildfire, the so-called ripple effect. The ripple effects denote the existence of some cities, metropolises or provinces which anticipate housing booms (busts) propagating the revaluation (devaluation) process to neighbouring areas, in this case to neighbouring provinces (in fact when house prices increase substantially in a certain city then more individuals become commuters and choose to live away from their city of work, in the suburbs or in the neighbouring provinces). The propagation magnitude tails off as the distance from the 'drawing' city increases.

residential population growth, some dummies reflecting the evolution of the sector-related Italian legislation, the other user costs of housing (i.e. ICI, mortgage interest)[7].

The proposed model is therefore a semilog-model[8], similarly to the Terrones model (2004), described by the following equation:

$$log(HP_t) = \alpha + \gamma Gr\_HP_{t-1} + \rho\ SAR_{t-1} + AR_t\beta_1 + {}_1X_t\ \beta_1 + log({}_2X_t)\beta_2 + {}_2X_t\ \beta_2 + \varphi_t \quad (3)$$

$$SAR_{t-1} = Wlog(Gr\_HP_{t-1}) \quad (4)$$

Where W is the spatial weight matrix (inverse distance matrix) and:

$$\varphi_t = \delta W \varphi_{t-1} + \varepsilon_t; \qquad \varepsilon_t \sim N(0, \sigma^2 I_N); \qquad HP_t = (HP_{1t}, \dots, HP_{Nt})' \quad (5)$$

$${}_1X_t = (Gr\_RENT_t, Gr\_LOAN_t, Gr\_EMPLOYEES_t, Gr\_POPULATION_t,\ Gr\_INCOME_t) \quad (6)$$

is the $iT\times5$ matrix of the quantitative variables, whereas:

$${}_2X_t = (INTER_t, Mean\_Volume\_MIB30_{t-1}) \quad (7)$$

is the $iT\times2$ matrix of the quantitative variables, whereas:

$${}_3X_t = (MIB30\_Bust_t, RE\_NEGOTIATION_t, EURO_t, ICI_{first_t}, \Delta CONSTR\_COST_t) \quad (8)$$

is the $iT\times4$ matrix of the dummy variables and of the ICI for the first-buyer. A detailed description of the variables is given in Appendix A.

4. The database

The dataset used in this study is the panel of the 103 Italian provinces on the residential house prices and the rents over the period

[7] For a definition of user cost see Poterba (1992).

[8] Chronologically, four classes of price model may be identified in real estate literature: *ad hoc* models with a limited theoretical structure (panel model, autoregressive model, etc.); mark-up models linking house prices to construction costs; reduced form models (derived from housing demand and supply equations) and life cycle models (dynamic optimisation problem of consumer utility); 'hedonic' models (Meese and Wallace, 2003). In this work, as in the previous ones (Caliman, 2006; 2009), we adopt an *ad hoc* model. There are several functional forms, used in the literature (for spatial literature see Pace *et al*., 2000). In this work we select the semi-log form because it improves the goodness of fit but this specification produces coefficient estimates that are not elasticities (unlike the log-linear model).

1995-2008 (1994 values have been gathered for the computing of the autoregressive component and house price long-term parameters)[9]. The main source of housing data is the "Consulente Immobiliare" (CI) published by *Il Sole 24 Ore* and updated twice a year. The house prices estimated using CI data refer to unoccupied 'standard' residential properties between 60 and 120 square metres (645.85-1291.71 square feet) with a set of correction factors if the physical characteristics of the properties are not 'standard' (e.g., the presence of a garden, terrace, penthouse typology, etc.). Although CI classifies prices as functions of location (downtown, inner city or outskirts) and obsolescence (new and recent houses), models (2) and (3) have been estimated using only the downtown values because they were more reactive to the independent variable changes. Moreover important compensative effects between downtown, inner city and outskirts has been observed, pointing to evidence of a strong inter-area migration.

The rents, obtained from the same source, are expressed in thousands of euro per square metre, annually based, and refer to 60-120 square metre (645.85-1291.71 square feet) houses.

House values have been deflated using the annual Consumer Price Index (FOI[10]) relative to families of workers and employees, elaborated by ISTAT at provincial level. In this way the provincial house prices have been expressed in base year 1995 (real terms) becoming comparable among the provinces (so that the inflation differences among the provinces are considered).

The absence of many variables describing housing supply locally and the delay in the publication of these variables (3-5 years) made possible the inclusion of only one index, i.e. the annual construction cost of residential property index, provided by ISTAT at regional capital city level.

The Tagliacarne Institute and Unioncamere provided the data related to real household disposable income *per capita* (annual) in each province, which has been used to compute the affordability ratio. Some difficulties have been overcome to ensure uniformity of

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[9] Italian provinces are the second of the three local government administrative levels in Italy: regions, provinces, municipalities. Consulente Immobiliare (the real estate data source, used in this work) processes house prices for the municipalities which are capitals of each province.

[10] ISTAT releases two other CPI indexes: IPCA (based on EU Directives) and NIC (a Laspeyres consumers' price index only at the national level).

the two different time series coming from these two Institutions.

The dataset also included the number of employees and the population growth in the province. The residential population has been provided by HFA (Health For All) by ISTAT and the employed population has been provided by Istituto Tagliacarne. Due to the geographical location of the houses and the fact that house benefits are not geographically movable, a strong linkage between the housing market and the labour market is a reflection of the limited mobility of workers. The population growth is generally used as a proxy of house buyer dynamics.

The dataset also contained two variables qualifying the credit market: interest rates and credit dynamics. Concerning the first variable, the long-term loan interest rate (disaggregated by region as provided by the Bank of Italy) is preferred to mortgage interest rates because the latter has been calculated for too short a period. On the contrary, if the buyer exclusively purchases the house as an investment, his choices are influenced by the cost of money and by the dynamics of rents, as renting is a measure of the return of the investment. The main Italian Stock Market Index, the Mib30 (computed as the annual average of the daily volumes, and the bust dummy) has been introduced as it can be considered an investment choice alternative to house buying. The second variable qualifying the credit market is the flow of long-run loans towards households in order to purchase properties (annual series of data which are provided at a provincial level by the Bank of Italy). The inclusion of this regressor is justified because loan flow does not only depend on the interest rate, it is also a function of how the credit market changes over the years modifying the household accessibility to credit.

The last group of the variables included in the dataset are the ones which can be included in the user cost. This also contains the ICI (a local tax on properties). An online database (ANCI, National Association of Italian Municipalities) which incorporates three time series for each province (annual data) is available: the rate of ICI for first-time buyers; the rate of ICI for second-time buyers; the deductibility of ICI for first-time buyers.

Missing values have been treated using the traditional statistical techniques (among others, Allison, 2002; Rubin, 2002).

Appendix B contains the descriptive statistics (average value, standard deviation, minimum, maximum, skewness, kurtosis, median and 10%-trimmed mean) for the main variables analysed.

5. Econometric issues and empirical results

The model adopted is a Spatial Lag (SAR) and Spatial Error (SEM) model (or *time-space recursive*) in order to take into account a spatial lag and spatially autocorrelated (and possibly not spherical) innovations. The house price spatial autocorrelation has been confirmed through the Baltagi *et al*. (2003) LM test (see Table 1).

Table 1 - *Spatial Autocorrelation Tests*

TEST	Statistic Value	p-value	Alternative Hypothesis
Baltagi, Song and Koh LM*-lambda conditional LM test	LM*-λ = 16.8799	< 2.2*e*-16	Spatial autocorrelation
Pesaran CD test for cross-sectional dependence in panels	z = 38.5675	< 2.2*e*-16	Cross-sectional dependence
Scaled LM test for cross-sectional dependence in panels	z = 104.1123	< 2.2*e*-16	Cross-sectional dependence

The spatial autoregressive model with spatial error term has been estimated through the Maximum Likelihood technique (ML)[11] using the SPLM library for spatial panel data models elaborated by Millo and Piras (2008; 2009) in R.

Two models have been estimated: a spatial model containing a spatial autoregressive component (Model 1), and a SER model in which spatial effects are captured only in the spatially delayed error term (Model 2). We have estimated other panel models with Fixed Effect and Random Effect, used as based models in order to capture the improved goodness of fit. The empirical results (Table 2) confirmed, first of all, the improvement of goodness of fit (measured in terms of squared correlation between the estimated values and observed values) of the Model 1 with respect to the Model 2. These models captured in any case the spatial effects, whereas the other panel models show that many estimated coefficients are insignificant and the signs are incoherent. Secondly, empirical results for the Models 1 and 2 are robust (the coefficients have always been stable

[11] The previous works used GMM techniques. Some authors sustain the greater efficiency of the ML estimator over the GMM estimator. Egger *et al*. (2009), through some Monte Carlo simulations, gave a validation of that idea.

in these two models and their sign is consistent with the theoretical model). The results, finally, confirmed the fundamental justification of Italian house prices. The reversibility factor implies a gradual but significant realignment of market prices at levels compatible with fundamentals and controls for the persistency factor, reducing the risk of a sudden fall in property prices. According to the procedures adopted by IMF researchers

> "the increase in house prices during the expansion phase are compared with the model's predictions" (Terrones *et al.*, 2004).

The differences between observed increases in house prices (registered for 103 Italian provinces during the expansion phase, 2000-2007) and their estimated values (based on house prices from 1994 to 2008, a period which also contains a contraction phase), divided by observed values, are satisfying (an average fitting error of 0.073% of the actual values). The increases reported during the expansion phase are quite large but not exceptional. Secondly, the real house price dynamics in the Italian provinces are weakly persistent with a serial correlation coefficient of 0.5 which implies that there is a slight tendency in real house prices to rise after they have risen the previous year. Moreover, the real house prices have shown a reversion towards the prices which are compatible with the fundamentals. If house prices are out of line with income, there is a gradual tendency towards this realignment. The economic fundamentals and the time variant dummies (describing the evolution of sector-related Italian legislation) show the expected sign of the coefficient and are significant. For instance, the mortgage renegotiation possibility introduced in 1998 caused an increment of 0.087 on average. Unlike Caliman (2009) the introduction of the Euro has determined a positive global effect. This dummy has a bivalent effect: on the one hand there is the revaluation effect of euro introduction, on the other hand its introduction produced stabilization of the interest rate and interest convergence to lower levels (this had radically modified expectations). Thus the inclusion of spatial effects and the dataset updating seem to have modified the global effect of the EURO dummy: it seems that the revaluation effect prevails on the change in expectations. A positive correlation of house prices with respect to the growth of employees is confirmed. A florid job market, which characterizes some provinces, produces individual migration flows to these provinces and therefore sustains their house prices. The population growth has also a positive effect on house prices. In fact this variable can be considered as a proxy of the demand growth (or the possible buyers). An increase in income *per capita* growth induces a house price increase, too. This variable, in fact, measures the accessibility of house purchase. The index of the construction cost of a residential building is not significant in all the estimations, therefore it is neglected. This is consistent with the majority of the studies on the British real estate market, and inconsistent with the analyses on the American real estate market. Empirical results show also that the elasticity of house prices with respect to credit dynamics is statistically significant and positive; and the elasticity with respect to interest rate is 0.5, hence a rate reduction of 1% leads to increases of 0.5% in the real house prices. The ICI first buyer elasticity has a negative effect. The stock market crash dummy is significant and negative, i.e. a stock exchange bust induces an upsurge in house prices. The rent dynamics positively and significantly affect house prices. Thus higher housing investment returns induce a house price revaluation. Finally, empirical results confirm that the SAR regressor is significant and its inclusion allows the best goodness of fit, i.e. the house price spatial autoregressive component constitutes a relevant regressor for the model.

TABLE 2 - *Spatial Panel Random Effects ML Model*

	Model 1			Model 2		
Coefficients	Estimate	(*t*-value)	Sign.	Estimate	(*t*-value)	Sign.
(Intercept)	4.588189	9.212	***	4.48442	9.266	***
Gr_HP_{t-1}	0.481011	4.7495	***	0.476179	4.7068	***
AR_t	-0.414872	-10.448	***	-0.395822	-10.2944	***
Gr_INCOME_t	0.575204	1.9253	.	0.544786	1.8397	.
$log(INTER_t)$	0.496269	11.6029	***	0.494023	11.7531	***
Gr_LOAN_t	0.058159	2.2986	*	0.05925	2.3446	*
MIB30_BUST	-0.077071	-3.8428	***	-0.076374	-3.8886	***
$log(Mean\_Volume\_MIB30_t)$	0.117751	4.8536	***	0.118061	4.964	***
$Gr\_POPULATION_t$	0.80851	3.1671	**	0.79752	3.1231	**
$Gr\_EMPLOYEES_t$	1.054551	3.5783	***	1.056798	3.5868	***
EURO	0.221317	10.0859	***	0.220043	10.2341	***
Gr_RENT_t	0.397344	5.2455	***	0.398541	5.2623	***
ICI_first_t	-0.04249	-3.2176	**	-0.04276	-3.2341	**
RE_NEGOTIATION	0.086745	2.514	*	0.085373	2.5237	*
$log(SAR_{t-1})$	0.04482	1.7162	.			

Significance codes: 0 '***', 0.001 '**', 0.01 '*', 0.05 '.', 0.1 ' ', 1.
Model 1: Spatial panel random effects ML model.
Model 2: Spatial panel random effects ML model.
Model 3: Oneway (individual) effect within Model.

The analysis of residuals (Appendix C) denotes a good fitting of the model, in comparison with similar analyses performed in the same framework (Terrones *et al*., 2004). Although the normality assumption of residuals is not completely fulfilled (Table 3), this violation is quite common and very difficult to get over as the software routines and the consistency properties of estimators are actually available only under this sphericity assumption. This topic can be further analyzed in subsequent works.

TABLE 3 - *Residual Normality Distribution Tests*

TEST	Statistic Value	p-value	Alternative Hypothesis
Lilliefors (Kolmogorov-Smirnov) normality test	D = 0.0502	4.661*e*-09	Not normal
Cramer-von Mises normality test	W = 0.7847	1.751*e*-08	Not normal

6. Concluding remarks

Recently, housing markets have played a crucial role in macroeconomic developments. For a large part of the 2000s, buoyant housing markets have contributed to sustained economic activity in most OECD countries. However, many markets overheated and the collapse of the US subprime mortgage market has been at the epicentre of a deep financial and economic crisis. Against this background, this paper analyzes the Italian exposure to house price bust. In order to achieve this goal, the paper develops and performs a *time-space recursive* model for the Italian housing market. In this way it is possible to capture spatial effects which can affect the Italian exposure evaluation to house price bust. This formulation allowed us to simultaneously consider the spatial lag and spatially autocorrelated (and possibly non-spherical) innovations.

Thus, we considered house price dynamics at provincial level because national-level data could obscure important economic differences between cities. Three main insights emerge from our analysis:

i) first, Italian house price dynamics show spatial dependence and autocorrelation;
ii) second, Italian house price dynamics are justified by fundamentals;
iii) third, the spatial model improves the goodness of fit and confirms the majority of the previous empirical results (Caliman, 2008; 2009).

Coherently with Moran's and Geary's analysis, performed in the previous works (Caliman, 2009; 2008), the house price spatial autocorrelation has been confirmed through the Baltagi *et al*. (2003) LM test. According to Caliman (2009), Italian house price increases are justified by fundamentals. In the estimated model, only two fundamentals, i.e. the interest rate drop and the consistent rent increase, explain the bulk of Italian house price increases during the expansion phase (2000-2005). Furthermore the differences between the house prices reported by the Italian provinces during this expansion phase and the model's estimates (based on house prices from 1994 to 2008, a period which also contains two contraction phases), normalized through the observed values, are very small: an average fitting error of 0.073% of the actual values. Therefore, not only does the model explain most of the increases in house prices during this expansion period, but these increases are in the main justified by fundamentals. Furthermore the estimated reversibility factor controls the persistency and shows a gradual and partial realignment with the long-run affordability ratio. These facts constitute further evidence of the low Italian exposure to a possible house price bust.

Furthermore, the Italian structural factors – financial and economic – reduce exposure to the risk of a dramatic fall in house prices: debt levels are low; home ownership rates are high; most indebted households belong to medium-high income brackets with a strong propensity to save (there have recently been increased levels of indebtedness also amongst lower income households, but the volumes remain comparatively low); the LTV is low (Caliman, 2009). Therefore Italian structural factors, the fundamental dynamics and the current economic situation make a sharp fall in house prices impossible.

Nevertheless recent events call for a reappraisal of housing-related policies. It clearly emerges that monetary policy probably has a limited ability to deal with asset price booms and fiscal policy could play a little role in moderating aggregate demand during booms. Regulation and supervision of the financial system assumes a crucial role in avoiding house price boom/bust and these aspects have been clearly deficient in many countries.

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ABSTRACT

Recently housing markets have played a crucial role in macroeconomic developments. Optimistic housing markets have contributed to sustained economic activity in most OECD countries during the first years of the 2000s. Nevertheless many markets overheated and the collapse of the US subprime mortgage market has been at the epicentre of a deep financial and economic crisis. Against this background, this paper analyses the Italian exposure to a possible house price bust. A Spatial Autoregressive and Spatial Error Model (SAR-SE Model) was used to investigate Italian house price dynamics. House prices in real terms were modelled for the period 1994-2008 in all Italian provinces along with affordability ratio, persistency term, some social-economic variables and credit market variables. This prevented national-level data hiding important differences between housing submarkets. In other words the house price booms in many cities could have been mitigated by the dynamics in other cities, resulting in a biased global national effect. House prices are inherently a local phenomenon and, therefore in order to evaluate the existence of a house price boom at national level, data must be analysed at local level. The results of the paper support the evidence on house price spatial autocorrelation, verified through the Baltagi *et al.* (2003) LM test. Hence the decision to use the spatial model is correct. No evidence of housing price overvaluation in Italy was found, in comparison with the fundamental values determined by interest rates, household income, rents, employment and construction cost.

Keywords: House Prices, Fundamentals, Mean Reversion, Serial Correlation, Spatial Dependence

JEL Classification: C21, G12, R31

RIASSUNTO

La dinamica delle quotazioni immobiliari in Italia

Recentemente il settore immobiliare ha rivestito un ruolo cruciale nello sviluppo macroeconomico, avendo sostenuto dal 2000 al 2005 l'economia in molti paesi OECD. Tuttavia le rivalutazioni in alcuni casi hanno determinato un notevole disallineamento delle quotazioni rispetto all'andamento dei fondamentali, potendosi dunque configurare una bolla immobiliare. La crisi innescata dai mutui *subprime* statunitensi ha rappresentato l'epicentro della crisi globale finanziaria ed economica che ha travolto numerosi paesi e in molti casi si è accompagnata allo scoppio delle rispettive bolle immobiliari. A fronte di questo background, il presente lavoro analizza l'esposizione dell'Italia al crollo dei valori immobiliari. A tal fine si è sviluppato un modello auto regressivo spazialmente ritardato con errori spaziali (*SAR-SE Model*) per indagare la dinamica dei prezzi delle abitazioni in Italia. Le quotazioni delle province italiane in termini reali dal 1994 al 2008 sono state regredite sull'*affordability ratio*, un fattore di persistenza, nonché alcune variabili socio-economiche e taluni regressori che caratterizzano il settore creditizio. L'utilizzo di tali dati, a livello disaggregato, permette di evitare che si trascurino le rilevanti differenze che contraddistinguono i sottomercati immobiliari. In altre parole, il boom immobiliare potrebbe configurarsi solo in alcune città e, qualora si utilizzassero dati nazionali aggregati, suddetti boom facilmente sarebbero mitigati dalla dinamica registrata in altre città, generando un errore nella stima dell'effetto globale. Le quotazioni immobiliari sono infatti un fenomeno prettamente locale: pertanto, onde valutare l'esistenza o meno di un boom a livello nazionale, le dinamiche dei prezzi devono essere analizzate a livello locale. I risultati del paper confermano l'esistenza di autocorrelazione spaziale dei valori immobiliari, verificata attraverso il *Lagrange Multiplier* test sviluppato da Baltagi *et al.* (2003). Ne deriva che l'utilizzo di un modello spaziale risulti corretto. I risultati empirici inoltre confermano l'assenza di sopravvalutazione delle quotazioni immobiliari rispetto all'andamento dei fondamentali come tasso di interesse, reddito, dinamica degli affitti, occupazione e costo di costruzione.

APPENDIX A

All the economic variables have been actualized at 1995 values through the Consumer Price Index (FOI) produced by ISTAT at provincial level; in this way the provincial house prices have been expressed in base year 1995 (real terms) becoming comparable among the provinces (so that the inflation differences among the provinces are considered):

$HP_{i,t}$	are the real house prices of the i provinces at time t (t = 1995, 1996, …, 2003);
$SAR_{i,t-1}$	is the spatial autoregressive component, computed in the i-th province at time t-1 multiplying the lag-house price growth by the spatial weight matrix;
$Gr\_HP_{i,t-1}$	is the persistency factor, in growth terms, for residents in the i-th province at time t-1;
$AR_{i,t-1}$	are the affordability ratios for residents in the i-th province at time t-1;
$SAR_{i,t-1}$	is the spatial autoregressive component in the i-th province at time t-1;
$Gr\_RENT_{i,t}$	are the real rent growth rates for residents in the i-th province at time t-1;
$Gr\_LOAN_{i,t}$	are the growth rates of the long-run period bank loans borrowed by consumers in order to purchase houses for individuals lived in the the i-th province at time t-1;
$INTER_{it}$	are the interest rates on long-term loans to families in the i-th province at time t;
$Mean\_Volume\_MIB30_t$	is the average closing volumes in year t;
$Gr\_EMPLOYEES_{i,t}$	are the growth rates of the number of employees in the i-th province at time t;
$Gr\_POPULATION_{i,t}$	are the growth rates of residents in the i-th province at time t;
$Gr\_INCOME_{i,t}$	are the growth rates of income *per capita* in the i-th province at time t;
$ICI\_first_{i,t}$	is the rate of ICI taxation for first-time buyers for residents in the i-th province at time t;
$EURO_t$	is a temporal dummy variable which considers many events that occurred in

	2002, legislative evolution (suppression of INVIM[12], law December 28th 2001 No. 488), introduction of the Euro;
$RE\_NEGOTIATION_t$	is a dummy variable introduced to take into account the recent possibility of mortgage renegotiation (agreement signed on May 11th 1998 between ABI, the banking association, and consumer associations);
$\Delta COSTR\_COST_t$	are the regional construction cost variations from time t-1 to time t reported in every province included in the region considered;
$MIB30\_Bust_t$	is a dummy variable introduced to consider the Stock Exchange bust[13].

[12] The INVIM - Imposta Incremento Valore Immobili was a capital gains tax.

[13] The bust dummy is a dichotomic variable which takes value one if the annual negative variation of MIB 30 is bigger than 15% and 0 otherwise.

APPENDIX B

VARIABLES		lHP_{it}		lAR_{it-1}		$lRENT_{it}$		$lLOAN_{it}$		$lINTER_{it}$		$lICI\_F_{it}$	
1995	(a) & (b)	7.285	0.338	-1.154	0.525	3.964	0.240	7.891	1.073	2.173	0.104	1.628	0.124
	(c) & (d)	6.685	8.430	-2.631	0.025	3.482	4.724	5.121	11.652	1.970	2.394	1.386	1.946
	(e) & (f)	0.753	1.278	-0.272	0.160	0.784	0.673	0.499	1.295	0.283	-0.993	-0.093	0.035
	(g) & (h)	7.249	7.267	-1.190	-1.145	3.904	3.952	7.702	7.874	2.152	2.172	1.609	1.628
1996	(a) & (b)	7.279	0.330	-1.145	0.556	3.980	0.257	7.872	1.001	2.006	0.104	1.630	0.117
	(c) & (d)	6.649	8.281	-2.742	0.095	3.381	4.734	5.351	11.313	1.803	2.227	1.386	1.825
	(e) & (f)	0.507	0.675	-0.386	0.297	0.631	0.400	0.596	1.681	0.283	-0.993	-0.338	-0.511
	(g) & (h)	7.272	7.267	-1.125	-1.129	3.949	3.970	7.731	7.848	1.985	2.005	1.609	1.634
1997	(a) & (b)	7.271	0.320	-1.174	0.560	4.006	0.279	8.031	1.012	1.818	0.094	1.612	0.124
	(c) & (d)	6.611	8.217	-2.881	0.080	3.343	4.725	5.553	11.564	1.619	2.042	1.386	1.946
	(e) & (f)	0.421	0.517	-0.412	0.442	0.226	-0.294	0.784	1.787	0.258	-0.657	-0.225	-0.465
	(g) & (h)	7.263	7.260	-1.164	-1.157	3.981	4.002	7.865	7.994	1.805	1.818	1.609	1.613
1998	(a) & (b)	7.268	0.304	-1.211	0.581	4.041	0.304	8.205	0.987	1.563	0.089	1.611	0.123
	(c) & (d)	6.734	8.186	-3.005	0.043	3.333	4.876	5.957	11.588	1.374	1.776	1.386	1.946
	(e) & (f)	0.499	0.678	-0.458	0.393	0.109	-0.306	0.646	1.537	0.461	-0.572	-0.248	-0.449
	(g) & (h)	7.277	7.255	-1.171	-1.193	4.036	4.039	8.074	8.178	1.547	1.561	1.609	1.611
1999	(a) & (b)	7.253	0.311	-1.199	0.581	4.140	0.316	8.498	1.006	1.316	0.098	1.600	0.123
	(c) & (d)	6.709	8.236	-2.915	0.144	3.367	5.002	6.059	12.088	1.171	1.537	1.386	1.946
	(e) & (f)	0.548	0.646	-0.394	0.353	0.086	0.162	0.670	1.699	0.433	-0.948	-0.144	-0.493
	(g) & (h)	7.270	7.239	-1.149	-1.183	4.151	4.137	8.346	8.469	1.288	1.313	1.609	1.600
2000	(a) & (b)	7.275	0.314	-1.184	0.572	4.174	0.324	8.455	1.036	1.530	0.094	1.592	0.126
	(c) & (d)	6.680	8.243	-2.877	0.108	3.580	5.178	6.222	11.889	1.352	1.770	1.386	1.841
	(e) & (f)	0.455	0.445	-0.419	0.415	0.376	0.312	0.735	1.341	0.316	-0.492	-0.207	-0.911
	(g) & (h)	7.269	7.263	-1.159	-1.169	4.173	4.164	8.301	8.418	1.509	1.529	1.609	1.592
2001	(a) & (b)	7.311	0.312	-1.197	0.559	4.170	0.327	8.594	1.044	1.459	0.083	1.582	0.128
	(c) & (d)	6.736	8.252	-2.909	0.062	3.555	5.152	6.392	12.213	1.300	1.653	1.253	1.833
	(e) & (f)	0.460	0.451	-0.457	0.699	0.416	0.263	0.817	1.462	0.395	-0.237	-0.143	-0.664
	(g) & (h)	7.305	7.298	-1.174	-1.180	4.152	4.159	8.400	8.548	1.443	1.458	1.609	1.582
2002	(a) & (b)	7.415	0.307	-1.098	0.551	4.232	0.343	8.743	1.072	1.409	0.080	1.587	0.137
	(c) & (d)	6.855	8.346	-2.746	0.177	3.591	5.233	6.527	12.520	1.131	1.588	1.253	1.946
	(e) & (f)	0.507	0.541	-0.455	0.718	0.529	0.512	0.800	1.697	-0.133	0.280	0.009	-0.516
	(g) & (h)	7.404	7.402	-1.049	-1.082	4.213	4.218	8.604	8.699	1.408	1.410	1.609	1.585
2003	(a) & (b)	7.436	0.344	-1.081	0.524	4.246	0.380	8.840	1.058	1.278	0.064	1.592	0.139
	(c) & (d)	6.752	8.493	-2.658	0.175	3.612	5.443	6.769	12.642	1.098	1.410	1.253	1.946
	(e) & (f)	0.571	0.739	-0.383	0.522	0.885	1.393	0.912	1.846	-0.399	1.267	-0.042	-0.558
	(g) & (h)	7.435	7.423	-1.037	-1.069	4.237	4.222	8.710	8.792	1.281	1.280	1.609	1.591
2004	(a) & (b)	7.492	0.366	-1.030	0.523	4.258	0.411	8.896	1.008	1.296	0.019	1.597	0.122
	(c) & (d)	6.762	8.669	-2.649	0.233	3.396	5.499	6.983	12.825	1.264	1.338	1.253	1.792
	(e) & (f)	0.733	1.040	-0.357	0.412	0.754	1.094	0.907	2.169	0.521	-0.126	-0.473	-0.446
	(g) & (h)	7.450	7.474	-0.975	-1.018	4.217	4.236	8.797	8.854	1.292	1.295	1.609	1.599

VARIABLES		lHP_{it}		lAR_{it-1}		$lRENT_{it}$		$lLOAN_{it}$		$lINTER_{it}$		$lICI\_F_{it}$	
2005	(a) & (b)	7.569	0.383	-0.953	0.524	4.337	0.393	9.016	1.045	1.296	0.015	1.594	0.125
	(c) & (d)	6.780	8.754	-2.628	0.301	3.601	5.523	6.816	13.403	1.274	1.337	1.253	1.841
	(e) & (f)	0.654	0.815	-0.346	0.581	0.847	1.089	1.040	2.994	1.000	0.990	-0.393	-0.465
	(g) & (h)	7.538	7.554	-0.936	-0.942	4.301	4.315	8.884	8.970	1.295	1.295	1.609	1.595
2006	(a) & (b)	7.613	0.372	-0.938	0.533	4.356	0.378	9.162	1.037	1.453	0.013	1.584	0.131
	(c) & (d)	6.939	8.817	-2.659	0.351	3.606	5.533	7.076	13.115	1.431	1.486	1.253	1.833
	(e) & (f)	0.758	0.958	-0.310	0.471	0.821	1.090	0.739	1.856	0.685	0.731	-0.289	-0.433
	(g) & (h)	7.568	7.594	-0.910	-0.926	4.331	4.335	9.036	9.128	1.452	1.452	1.609	1.586
2007	(a) & (b)	7.634	0.377	-0.922	0.529	4.360	0.373	9.251	1.063	1.679	0.013	1.583	0.139
	(c) & (d)	6.927	8.889	-2.644	0.379	3.628	5.565	6.978	13.309	1.652	1.707	1.253	1.946
	(e) & (f)	0.722	0.989	-0.274	0.501	0.758	1.110	0.830	2.055	-0.378	0.231	-0.023	-0.362
	(g) & (h)	7.610	7.616	-0.938	-0.910	4.332	4.341	9.119	9.212	1.682	1.679	1.609	1.582
2008	(a) & (b)	7.651	0.381	-0.909	0.527	4.366	0.376	9.301	1.086	1.773	0.011	1.586	0.140
	(c) & (d)	6.905	8.904	-2.612	0.380	3.686	5.529	6.826	13.459	1.757	1.801	1.253	1.946
	(e) & (f)	0.678	0.890	-0.247	0.424	0.667	0.874	0.836	2.237	1.000	0.320	-0.076	-0.361
	(g) & (h)	7.627	7.634	-0.933	-0.897	4.345	4.348	9.175	9.257	1.769	1.772	1.609	1.585

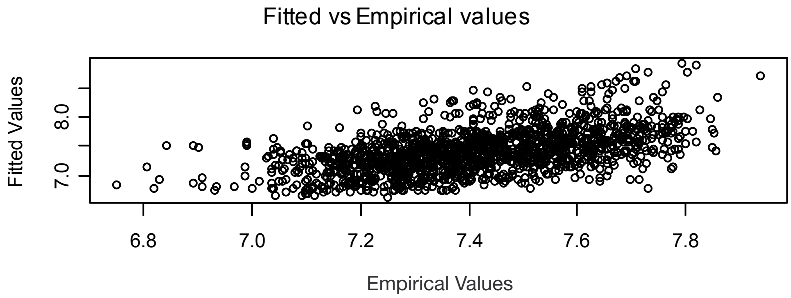
(a) – Average value, (b) – Standard deviation, (c) – Minimum, (d) – Maximum, (e) – Skewness, (f) – Kurtosis, (g) – Median, (h) – 10% trimmed mean.

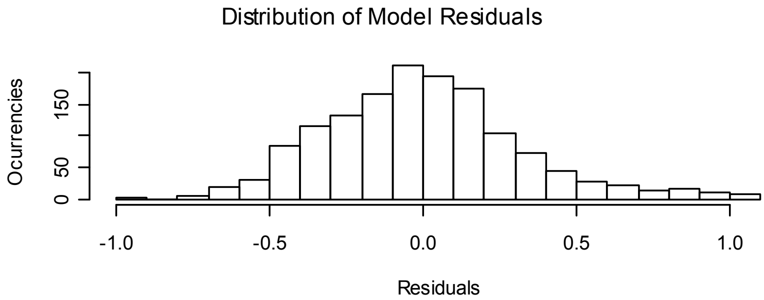
VARIABLES		lE_RATIO_{it-1}		$lICI\_S_{it}$		$lICI\_D_{it}$		$\Delta CONST_{it}$		lY_DEF	
1995	(a) & (b)	-1.068	0.208	1.642	0.125	4.532	0.000	1.839	1.626	8.439	0.747
	(c) & (d)	-1.931	-0.787	1.386	1.946	4.532	4.532	-1.968	3.986	6.782	10.958
	(e) & (f)	-1.278	2.202	-0.149	-0.103	1.015	-2.040	-0.657	-0.286	0.768	1.339
	(g) & (h)	-0.993	-1.053	1.609	1.643	4.532	4.532	2.198	1.928	8.349	8.407
1996	(a) & (b)	-1.038	0.182	1.691	0.103	4.532	0.000	1.948	1.255	8.424	0.745
	(c) & (d)	-1.566	-0.742	1.386	1.856	4.532	4.532	-0.183	5.042	6.767	10.941
	(e) & (f)	-0.840	-0.041	-0.869	0.507	1.015	-2.040	0.548	0.046	0.761	1.339
	(g) & (h)	-0.974	-1.028	1.705	1.699	4.532	4.532	2.000	1.896	8.331	8.392
1997	(a) & (b)	-1.033	0.175	1.728	0.125	1.262	4.229	2.331	0.948	8.445	0.743
	(c) & (d)	-1.548	-0.772	1.386	1.946	-3.912	5.043	0.025	4.321	6.801	10.959
	(e) & (f)	-0.775	-0.194	-0.478	0.388	-0.421	-1.857	-0.515	0.807	0.767	1.347
	(g) & (h)	-0.968	-1.024	1.723	1.732	4.638	1.338	2.492	2.348	8.357	8.412
1998	(a) & (b)	-1.028	0.174	1.742	0.134	0.185	4.323	-1.109	0.863	8.480	0.744
	(c) & (d)	-1.540	-0.759	1.386	1.946	-3.912	5.331	-2.523	0.326	6.835	11.017
	(e) & (f)	-0.806	-0.131	-0.536	0.114	0.101	-2.027	0.125	-1.298	0.788	1.418
	(g) & (h)	-0.971	-1.019	1.775	1.748	-3.912	0.140	-1.108	-1.116	8.390	8.447
1999	(a) & (b)	-1.015	0.179	1.762	0.139	4.696	0.151	1.268	0.937	8.452	0.743
	(c) & (d)	-1.555	-0.751	1.386	1.946	4.638	5.379	0.017	3.679	6.800	11.003
	(e) & (f)	-0.872	0.009	-0.640	0.113	3.057	9.302	0.565	0.094	0.794	1.476
	(g) & (h)	-0.957	-1.006	1.792	1.770	4.638	4.671	1.314	1.206	8.367	8.419
2000	(a) & (b)	-1.005	0.177	1.788	0.136	4.634	0.869	2.441	1.195	8.459	0.744
	(c) & (d)	-1.556	-0.712	1.386	1.946	-3.912	5.554	0.030	4.397	6.809	11.003
	(e) & (f)	-0.858	0.060	-0.946	0.873	-9.466	94.147	-0.917	0.223	0.795	1.467
	(g) & (h)	-0.940	-0.996	1.792	1.799	4.638	4.687	2.690	2.472	8.377	8.427
2001	(a) & (b)	-0.976	0.167	1.804	0.128	4.300	1.871	1.936	1.312	8.508	0.746
	(c) & (d)	-1.495	-0.692	1.386	1.946	-3.912	5.554	0.022	4.711	6.863	11.065
	(e) & (f)	-0.854	0.059	-1.035	1.191	-4.204	16.188	0.521	-0.099	0.798	1.479
	(g) & (h)	-0.920	-0.968	1.792	1.815	4.638	4.688	1.788	1.890	8.419	8.476
2002	(a) & (b)	-0.965	0.165	1.829	0.121	4.225	2.042	3.271	2.144	8.513	0.740
	(c) & (d)	-1.474	-0.689	1.386	1.946	-3.912	5.554	-3.792	5.814	6.856	11.049
	(e) & (f)	-0.865	0.090	-1.432	2.682	-3.776	12.662	-1.821	2.792	0.794	1.486
	(g) & (h)	-0.920	-0.957	1.856	1.841	4.638	4.603	3.829	3.501	8.417	8.481
2003	(a) & (b)	-0.973	0.170	1.851	0.119	4.392	1.687	2.824	2.545	8.518	0.737
	(c) & (d)	-1.453	-0.677	1.386	1.946	-3.912	5.554	-0.067	12.089	6.852	11.039
	(e) & (f)	-0.641	-0.259	-1.871	4.206	-4.749	21.321	1.769	4.682	0.785	1.465
	(g) & (h)	-0.931	-0.967	1.872	1.866	4.638	4.694	2.314	2.551	8.439	8.486
2004	(a) & (b)	-0.967	0.162	1.781	0.142	4.700	0.154	4.189	1.914	8.522	0.739
	(c) & (d)	-1.354	-0.760	1.386	1.946	4.638	5.379	0.030	7.478	6.839	11.052
	(e) & (f)	-0.790	-0.553	-0.868	0.355	2.894	8.300	-0.120	-0.105	0.781	1.464
	(g) & (h)	-0.899	-0.958	1.792	1.791	4.638	4.675	4.620	4.237	8.430	8.491

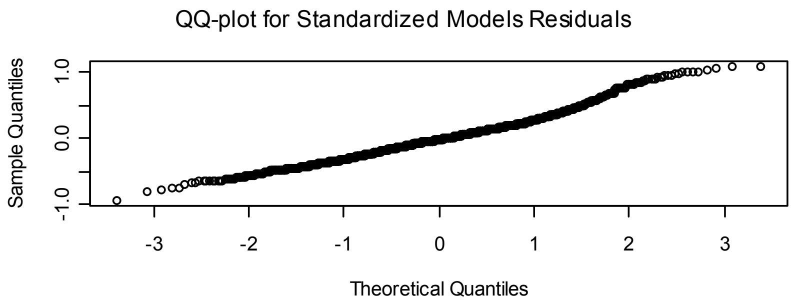
VARIABLES		lE_RATIO_{it-1}		$lICI\_S_{it}$		$lICI\_D_{it}$		$\Delta CONST_{it}$		lY_DEF	
2005	(a) & (b)	-0.969	0.162	1.804	0.137	4.634	0.869	3.535	2.223	8.523	0.739
	(c) & (d)	-1.323	-0.764	1.386	1.946	-3.912	5.554	-0.986	9.980	6.840	11.060
	(e) & (f)	-0.760	-0.762	-1.174	1.270	-9.469	94.174	0.415	1.439	0.783	1.458
	(g) & (h)	-0.893	-0.961	1.792	1.817	4.638	4.688	3.796	3.468	8.432	8.491
2006	(a) & (b)	-0.952	0.159	1.822	0.129	4.377	1.682	2.919	1.323	8.550	0.743
	(c) & (d)	-1.313	-0.749	1.386	1.946	-3.912	5.554	0.031	4.714	6.854	11.111
	(e) & (f)	-0.780	-0.723	-1.279	1.697	-4.766	21.424	-0.525	-0.440	0.765	1.382
	(g) & (h)	-0.885	-0.944	1.856	1.834	4.638	4.681	2.919	2.977	8.449	8.520
2007	(a) & (b)	-0.941	0.174	1.841	0.121	4.303	1.873	3.639	1.737	8.555	0.745
	(c) & (d)	-1.337	-0.582	1.386	1.946	-3.912	5.554	0.039	7.290	6.827	11.113
	(e) & (f)	-0.675	-0.552	-1.621	3.245	-4.197	16.154	-0.103	-0.281	0.749	1.365
	(g) & (h)	-0.874	-0.937	1.872	1.855	4.638	4.689	3.789	3.651	8.488	8.525
2008	(a) & (b)	-0.943	0.170	1.858	0.120	4.389	1.686	3.276	1.394	8.561	0.745
	(c) & (d)	-1.375	-0.690	1.386	1.946	-3.912	5.554	0.028	5.219	6.831	11.121
	(e) & (f)	-0.919	-0.383	-1.999	4.585	-4.751	21.332	-0.543	-0.227	0.748	1.356
	(g) & (h)	-0.863	-0.934	1.902	1.874	4.638	4.691	3.139	3.346	8.491	8.531

(a) – Average value, (b) – Standard deviation, (c) – Minimum, (d) – Maximum, (e) – Skewness, (f) – Kurtosis, (g) – Median, (h) – 10% trimmed mean.

APPENDIX C


Fitted vs Empirical values
Fitted Values
7.0
8.0
6.8
7.0
7.2
7.4
7.6
7.8
Empirical Values


Distribution of Model Residuals
Ocurrencies
0
50
150
-1.0
-0.5
0.0
0.5
1.0
Residuals


QQ-plot for Standardized Models Residuals
Sample Quantiles
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0.0
1.0
-3
-2
-1
0
1
2
3
Theoretical Quantiles