Foresight methodologies. Application to the housing market

Eduardo Anselmo Castro [1], João Lourenço Marques[2], Monique Borges[3]

[1] ecastro@ua.pt, Universidade de Aveiro, Portugal
[2] jjmarques@ua.pt, Universidade de Aveiro, Portugal
[3] monique@ua.pt, Universidade de Aveiro, Portugal

ABSTRACT
The housing market is complex, multidimensional and depends on the variability of exogenous factors and on the amount of information available to the agents involved in it. Despite the challenges associated with this topic, its socioeconomic relevance justifies a greater effort to develop and apply knowledge as a basis for the decision making process that, in turn, depends on the evolution of the factors that influence the housing market. The analytical models that have been applied limit the capacity to deal with the uncertainty of the future, which enhances the contribution of foresight analysis as a strategic tool that fosters the construction of future visions, in order to inform decision making and trigger action. The research project "Drivers Of housiNg demand in Portuguese Urban sysTem" – DONUT, studies the housing market dynamics and analyzes explanatory factors for housing prices in urban areas, combining econometric models and foresight analysis (scenario analysis and Delphi surveys). This paper discusses the importance of applying the foresight methodologies as a decision support tool and presents an exploratory analysis of the scenario exercise. For this purpose, the work is structured in three parts: i) brief description of forecasting models, ii) framework of the housing market in the context of scenarios and presentation of the dimensions chosen for the exercise, iii) brief description of the scenarios.
Keywords: *Foresight, Scenarios, Housing Market*

1. INTRODUCTION

Housing, or more broadly, the housing market plays a central role in the socioeconomic system, the individual quality of life and in the territory structure. Housing is a complex and multidimensional good and is characterized by: i) being heterogeneous, regarding the type of construction, infrastructure and accessibility; ii) being rigid, as it is fixed in space and durable; iii) providing shelter, safety and welfare; iv) being a social distinction instrument, coupled with the image of status; and v) requiring considerable collective and private investments.
This complexity is compounded by the volatility of exogenous factors that the housing market depends on and by the insufficient transparency resulting from scarce and asymmetrically distributed information, as well as agents' inability to use it. On the demand side, there is limited information of what the market offers in terms of the housing type available and their specific location, as well as the quality and price balance; this greatly limits the rationality of decisions. The supply side, in turn, has greater amounts of information, but the decision making process continues to be based more in tacit knowledge that in systematic and accurate information. There is also insufficient information to identify the preferences and expectations of buyers and tenants. Regarding the public sector, the fragmentation of information available from

various sources, rarely crossed, undermines the construction of decision support models and consequently the definition of housing policies.
In short, it is necessary to provide more information, but most of all it has to be better organized to be incorporated in different decision support models.
The information related to the various actors involved directly and indirectly in the housing market can be divided into three categories: i) objective information on demand, concerning the number of families, their disposable income and household structure; ii) objective supply information, regarding the quantitative and qualitative data on the existing housing stock, and its technical and financial constraints; and iii) subjective information on demand corresponding to the buyers preferences and expectations.
There are several formal mathematical models that describe the housing market at a given moment. Lancaster's (1966) theory of consumption, associated with the analysis of composite goods, is the basic principle of the hedonic price model and was first applied to the housing market by Rosen (1974), to assess the determinants of housing prices (Marques, Castro, 2010). Housing is characterized by a set of attributes, chosen according to their specific characteristics and constrains of budget of each buyer (Costa, 2009). The literature at this level is quite diverse (see, for example, Marques, 2012 that presents different hedonic models applications), highlighting at the national level, for example, the work developed by Couto, et al. 2006, Marques et al. 2009, Teixeira et al. 2010, Marques, 2010, Batista et al. 2010).
Although many studies already carried out describe and analyze the present situation, the housing sector importance justifies the increased effort to develop and apply knowledge as a basis for decision making strategies and housing policies. But, to make this possible is essential to understand how will the housing market and the factors that influence it evolve. The predictive capability can be achieved through the use of statistical methods (which conditions of application are discussed in the following section), or when these methods prove to be limited, foresight models appear to be adequate. Thus, the main focus of this paper is to discuss the foresight analysis contribution, as a strategic tool that fosters the construction of future visions, in order to inform decision making and assemble action (Loveridge, 2009); in particular, a discussion of exploratory scenario analysis applied to the housing market will be presented. The work is structured in three sections, in addition to the introduction presented. The second section contrasts the two main forecasting methods: i) formal models arising from the possibility of time series extrapolation, or the definition of dynamic models, and ii) foresight models, based on two fundamental categories, the Delphi method and scenario analysis, pointing out a new perspective suggesting the combination of both. The third section bases the contribution of both techniques (Delphi and Scenarios) in the context of the housing market and describes the dimensions chosen for the scenario analysis. Finally, in the fourth section, although in an exploratory manner, are presented the scenarios selected for the exercise.

2. FORECAST MODELS

2.1 Formal Models

There are analytical models that describe the evolution of a given reality over time, conditional to a number of factors. These models, involve the application of a rigorous formalism, but its feasibility depends on the availability of information about the past and the realism of the assumption that this evolution follows a trend that can be

extrapolated into the future. The formal models considered in this paper can be divided into two groups: i) models for time series extrapolation, and ii) dynamic models.
In the time series extrapolation model the evolutionary trends of the variables, obtained through the analysis of past behaviour, are extended to a point in the future. For this purpose it is assumed that the parameters of time series which generate the time series process are constant or have a steady evolutionary trend which implies that there is no capacity for exogenous variables, in the forecast horizon, to significantly alter the series. Note however that one can build more sophisticated models where the time series are influenced by the behaviour of exogenous variables.
The dynamic models analyze the causal relationships between factors. To make this possible it is necessary to know the parameters that generate the dynamic process, as well as the boundary conditions, which give us the starting point for the simulation. The applicability of these models requires that the fundamental factors for the description of process dynamics are endogenous; in other words, it has to be acknowledged that there are no omitted variables that significantly change the process during the forecast horizon.

2.2 Foresight models

If the necessary conditions to apply these models are not fulfilled, foresight models turn out to be the most adequate.
Foresight involves a systematic process of looking at the future of science, technology, economy or society and then developing strategic options in areas considered relevant. Foresight analysis can be applied in decision making companies or public bodies and it is particularly adequate to identify the areas of strategic research and the emerging generic technologies likely to yield the greatest economic and social benefits (Martin, 1995). Foresight analysis is the discovery of a common space for thinking about the future and the preparation of strategic approaches (Georghiou, Keenan, 2004).
Within the foresight techniques this paper stands out two main categories: i) Delphi method, which allows to parameterize the results based on expert opinions; and ii) scenario analysis, that enables the discussion of strategies in situations of great uncertainty, based on the construction of hypothetical futures. In the following part are described, in summary, the Delphi method and scenario analysis and discussed its application conditions. It is further considered a new approach that combines these two techniques.

2.2.1 Delphi

Delphi exercises are based on a structured communication process of a group of experts, which allows their interaction and consequently the systematization of results, on matters for which there is uncertainty and incomplete knowledge (Alvarenga, 2007, Linstone e Turoff, 2002). The experts' opinion is obtained through a questionnaire, in-person or not, in which experts are asked the expected evolution of the value of a set of variables for a given horizon. The description of this evolution may be limited to the prediction of a simple final value or, preferably, correspond to a time series. The exercise can be performed in several rounds, allowing experts to interact successively and validate their answers until stabilizing their opinions.
This method is appropriate for projections for which it is not possible to extrapolate defined trends. Considering that the method is applicable means recognizing the validity of experts tacit knowledge, and consequently that the average of their answers is an unbiased estimator of the parameters one wants to foresee.

The adoption of an interactive process arises from the assumption that this increases the efficiency of the estimator (decreasing its standard deviation), while not leading to their bias. Thus the interaction is a learning process for the experts, leading to more accurate results; in this process experts are free from the influence of chain interactions that could lead them to opt for more convincing, but less accurate narratives. The efficiency of the estimator also depends on the number of participants.
In summary, the Delphi method is supported by the assumption that the experts' answers average is equivalent to what would be obtained if it were possible to apply formal models and as a result appears as a substitute for these.

2.2.2 Scenarios

If the conditions for applying the Delphi method are not met and there is no information to develop analytical models, then the alternative solution is to use scenario analysis,
Scenarios are descriptions of alternative futures, logically consistent, that influence the decision making process in the present situation (CGEE, 2011); instead of providing predictions of the future, it gives an outlook of possible horizons (Börjesin, et al 2002). The scenario exercise is not an end in itself, serving as a tool that improves the quality of decision making because it organizes, systematizes and limits uncertainties (Wilson, 2000).
A scenario corresponds to the materialization of a possible future, defined by coherent and plausible, not necessarily accurate, embodiments of the variables that make up the state of the system one wants to analyze. For example, if a given exercise is related to the definition of sustainable development strategies for the physical planning of a city, the scenarios chosen should enlighten how the world will be in terms of climate change, energy resources, building techniques, mobility, information and communication technologies and macroeconomic environment (see, for example, Projeto BRIDGE[1], where is developed a Decision Support System).
Scenario analysis, rather than making predictions, aims to raise the discussion in a group of experts on what to do assuming the materialization of hypothetical futures. The action programs outlined by the group of experts have expectedly common elements to all scenarios, defining what is known as a robust set of actions and which should be prepared immediately. At the same time, it is expected that other actions are contingent upon the materialization of a specific scenario; to decide on these actions we must wait for a moment where it is possible to foresee which scenario is going to take place.

2.1.1 Mixed method: Scenarios and Delphi

The Delphi method may be considered inadequate when one discloses expert forecasts as being strongly conditioned by the evolution of exogenous variables that they cannot predict. This means that when unable to make predictions, experts may be able to estimate evolutionary patterns conditional to scenarios. In other words, it is assumed that the average of their answers, conditional to the exogenous elements described in the scenarios, approaches the actual average. If this is the case, the conditions for the mixed method are met. Although uncommon in the reference literature, these methodologies

[1] Chrysoulakis, N., Mitraka, Z., Diamantakis, E., González, A., Castro, E. A., San Josė, R. and I. Blecic, *Accounting for urban metabolism in urban planning. The case of BRIDGE*. In: CD-ROM of Proceedings of the 10th International Conference on Design & Decision Support Systems in Architecture and Urban Planning, organized by the Technical University of Einhoven, in Eindhoven, The Netherlands (2010)

have been developed in some studies (see, for example, Regional Foresight Exercise for the elaboration of the Regional Territorial Plan of the Centro Region [2]).

The combination of both methods can be performed in two ways.

The first consists in considering that the scenarios are an auxiliary instrument of the Delphi method and solve the problem of prediction when setting the exogenous variables. In this case, the main objective is to obtain values for a set of variables over time [X_{1t}, X_{2t}, X_{3t} … X_{it}] that depend on the exogenous variables that structure each scenario. This hypothesis can be translated by:

$$X_{it} = f_i(Y_{1t}, Y_{2t}, \ldots, Y_{kt})$$

where,

X_{it} is the prediction of a variable over time, and
Y_{kt} is the materialization of the scenario i.

In the second case, the scenario exercise and the Delphi questionnaire are combined for assigning weights in multi-criteria analysis of policies and projects (see, for example, the research project BRIDGE, where it was developed a decision and evaluation support system for local governments of five European cities, in the field of urban planning).
This method is suitable for the evaluation of several project alternatives, which depend on the embodiment of the foreseen scenarios. Thus, the evaluation of the multiple alternatives will depend on a multi-criteria function, where experts are invited to assign weights to a set of criteria, conditional to scenarios. In other words, the assessment is carried out according to the expected performance for each criterion (scores) and valuations (weights) assigned to each criterion.

$$V_i = f(Z_{1i}, Z_{2i}, Z_{3i} \ldots Z_{ni}, \alpha_1, \alpha_2, \alpha_3 \ldots \alpha_i)$$

Where,
V_i represents the value of alternative i of the project,
Z_{ni} are the criteria, i.e., corresponds, for each alternative, to the materialization of the several targets and functionalities planned for the project (for example, number of houses built, jobs created, improved aesthetic quality of an urban area), and
α_i defines the valuations, in other words, the weights assigned to each embodiment or feature.

In this case, it is assumed that the weights, i.e., the subjective assessments of the importance of different criteria depend on the materialisation of the scenarios. This hypothesis can be translated as:

$$\alpha_i = f_i(Y_{1t}, Y_{2t}, \ldots, Y_{kt})$$

[2] For additional information: Marques, J., Castro, E., Martins, J., Marques, M., Esteves, C., Simão, R. (2009), *Exercício de prospectiva para a Região Centro* – Análise de Cenários e Questionário Delphi, Revista de Estudos Regionais n.º 19

In short, the scenarios, while possible configurations of the future that integrate the variability of exogenous variables, provide the framework for future actions and can be, as demonstrated in the foregoing cases, a complementary tool of the Delphi method.

3. HOUSING MARKET IN THE CONTEXT OF SCENARIO ANALYSIS

The proposed exercise is based on the research project "Drivers Of housiNg demand in Portuguese Urban sysTem" that combines econometric models and foresight analysis (scenario analysis and Delphi surveys).

In the housing market context, the complexity and volatility of the factors that determine trends create strong barriers to the use of the formal analytical methods, described in section 2. However, it is reasonable to assume that there is a considerable body of information disseminated by different actors and experts involved in the housing market, although distributed in a fragmented and asymmetric manner. This information being insufficient to generate accurate prediction when used individually, could provide better results if experts obtain synergies through an interactive process. This is the aim of the Delphi method, based on the assumption that the experts' answers, supported by partial information and knowledge, have mean values that converge to the actual average. However, the housing market is under pressure from exogenous factors that affect reality and its evolution. The experts' evaluation does not consider the influence of these elements, which makes the traditional application of Delphi unfeasible. If the scenarios are designed to represent particular materialisations of the exogenous variables mentioned above, they can enable experts' predictions and thus make a valid application of the Delphi method. These are the arguments for the mixed method we propose to develop.

In short, the application of this method facilitates the design of alternative futures, through scenario analysis and inform decision making based on expert opinion, using the Delphi questionnaire.

In this foresight exercise both methods are combined in the two ways described above.

First, experts predict the variables evolution under each scenario specification. In this case, experts are confronted with present values of indicators related to housing, to estimate later the values conditional to each scenario's materialization. These indicators may be, for example, the typology of the housing stock, housing and buildings density and dwelling average size.

In the second case, experts are asked to assign weights to a set of criteria, conditional to scenarios. In this context, the fundamental criteria for the definition of housing policies are presented, for experts to identify the most important aspects in the case of each scenario taking place. These criteria may be, for example, sustainable housing, urban regeneration, technological development support, partial financing of housing costs, for specific social groups (market rent / home ownership).

In both cases, the experts' answers depend on scenario analysis. In order to structure this analysis it is presented, in the following section, a brief description of the dimensions of the scenarios.

3.1 Basic dimensions for the scenario exercise

The quality of the scenarios depends on the ability to identify the key elements that reflect the exogenous environment of the case study. Notwithstanding, the parsimony criterion advises that the space of scenarios should be based on a limited set of basic elements.

In the housing market, the scenarios can be defined according to the following basic dimensions: i) socio-economic structure; ii) political and cultural structure; iii) energy, natural environment and spatial planning.

3.1.1 Social and economic dimension

The first dimension focuses on the socio-economic structure which affects housing demand and supply.

On one hand, the demographic component has obvious impacts on the housing market, to the extent that knowing the characteristics of the population, in particular the total population, distribution by age groups, average size and structure of families, it is possible to quantify housing needs. On the other hand, the macroeconomic environment affects economic growth and financial market developments.

Economic growth is a structural element for the definition of total income and therefore disposable income of households and their consumption patterns; disparities in income distribution lead to the segmentation of the housing market. In turn, the evolution of financial markets determines real estate agents' behaviour and households' investment capacity, reinforcing the role of the financial system in determining credit conditions.

Based on the information described above is possible to transform the objective needs of families in effective demand.

3.1.2 Political and cultural dimension

The second dimension focuses on the dominant political environment that induces distinct forms of land use development and planning. The public sectors' role as regulator of market mechanisms depends on the economic situation and the political and ideological context. These determine the influence of the State, regarding the financial strength and the corresponding means to meet social policies, as well as to regulate the market and enforce land-use policies.

The financial situation of the State determines the capacity to promote social housing, provide subsidies, set fiscal policies, intervene in the land market, and as a result influence the construction costs. So, either housing is considered a basic need and the State assumes a central role in supplying housing, or must be viewed under a logic dominated by the market, in which individuals act in accordance with their preferences and capabilities.

State intervention on market regulation is also reflected in the definition of more or less urban design stringent criteria. Regarding these aspects, we highlight measures that restrict the location and aesthetics of buildings and tax policies that influence the behaviour of owners and investors. In short, government intervention consists in applying, to a greater or less extent, urban management regulatory instruments, which determine the ability of society integrating individual preferences in a collective aesthetic and functional standard, as well as taxation and financing strategies that fall within social housing policies, promote urban renewal or combat desertification of city centres.

3.1.3 Energy, natural environment and spatial planning dimension

The third dimension is related to environmental pressures, in particular, the availability of energy resources and the ability to replace fossil energy, ensuring a smooth transition to the use of renewable energy. This dimension raises two main questions. First, the housing and outdoor urbanized areas' thermal efficiency and, secondly, the patterns of dispersion and concentration of built environment.

In a scenario dominated by strong environmental constraints, the need to minimize transportation costs and to optimize the balance between thermal comfort and energy consumption are key elements that necessarily overlap issues related to the aesthetics and to the fruition of space that urban sprawl allows. In this scenario technological developments tend to be directed to creating insulating materials and increasing the use of the built environment as an energy source. There will be also strong pressures related to urban design concerns, such as buildings exposure to sun, the *albedo* of built and unbuilt space and the use of vegetation as a regulator of air quality. Possible consequences of climate change will also be reflected on contracting the increasing trend of soil sealing and controlling overflow areas.
On the contrary, in a scenario with lower energy and environmental constraints, the concerns referred above can be balanced with aesthetic and functional targets.

4. SCENARIOS

The scenarios presented below result from the combination of the dimensions previously described, corresponding, either to, extreme or intermediate situations, symbolized by the +, - and 0 signs, which of course not state any value judgment (see table 1). Usually the scenario dimensions are expressed by extreme situations; however, this particular example shows that scenarios consistency often requires the consideration of intermediate situations.
The combination of these three dimensions generates either twenty seven or nine possible scenarios, depending on whether or not intermediate situations are considered. In both cases this is an excessive number of scenarios, due to the time available to carry out the exercise. Assuming three scenarios as the maximum viable, the choice covered the most contrasting scenarios and consequently those that better stimulate the discussion among experts.
The scenario presentation should balance the need to relate them with the evolution of the housing market and to provide enough openness to the discussion amongst experts. If this balance is not achieved, the implications of the scenarios in the housing market may not be perceived or, on the contrary, it may possibly influence the discussion and bias the answers of experts

Table 1: Scenarios chosen for the exercise

	Scenario 1	Scenario 2	Scenario 3
D1. Economy	+	+	-
D2. State	+	-	0
D3. Energy	+	+	-

4.1 Scenario 1 – housing: collective choice and responsibility in a society that can choose

This scenario describes an utopian and futurism city. The availability of financial resources provided by a thriving economy, allows the development of ambitious housing programs that do not limit populations' choice. In this scenario, rationalism drives spatial planning and people without giving up their freedom to act under a logic of collective interest. This rationalism sees housing as a utilitarian instrument, designed to provide maximum comfort without overspending.

The opportunities for social mobility generated by the good economic performance, combined with the important role of the State in ensuring a fair distribution of income led to a middle class society with high purchasing power. This allows for a housing construction that combines comfort and aesthetic, provided by technological progress, with the urban fabric's functional consistency, resulting from the acceptance of a planning notion based on collective participation and rigour. The environmental awareness, the historical heritage appraisal and the increasing acceptance that public transport, supported by the intensive use of information technology, is the most efficient way to combine mobility, comfort and energy efficiency, are the basis for the acceptance of a strict urban discipline by a society that values personal freedom.
Having managed a gradual transition to the use of renewable energy and overcome the global warming threats, society meets no mobility constraints that require buildings' spatial concentration and terms such as ordered suburbanization and polycentrism become fashionable.

4.2 Scenario 2 – housing: individual choice and responsibility in a society that can choose

This scenario describes the city that attends the success of a market society, where a powerless, but efficient, State merely regulates a decentralized economy driven by private initiative. The strong growth of knowledge, creativity and technology based professions and a substantial investment in education, as a way of social mobility, creates a competitive society that, despite this, did not result in excessive social inequalities.
Under this context, the symbolic functions of housing, seen as a showcase of individual success and as a status assertion instrument, have an increased importance. The enlargement of technology and architectonic creativity led to a strong competition around the futuristic house design where originality, comfort and aesthetics are constantly confronted. The culture of individual responsibility, the environmental awareness and historical heritage appraisal, converged on a logic of self-organization in which the expression of personal freedom coexists with reasonable levels of urban organisation.
Having managed a gradual transition to the use of renewable energy and overcome the global warming threats, society meets no constraints to mobility which is increasingly complemented by the intensive use of information technology and densification of relationships in virtual space. The urban-rural dichotomy is increasingly blurred and the combination of individualism and self-organization of small groups led to the fragmentation of the urban fabric. Demand for urban consistency, without compromising personal freedom, is a goal pursued, but not fully attained.

4.3 Scenario 3 – housing in a society with few options

This scenario describes the city that survives in a context of economic stagnation and growing environmental problems. The disfunctions of the financial system, evidenced by the crisis of the early twenty-first century, have not been solved, which resulted in low economic growth and reduced ability to convert technological progress into production efficiency.
The interaction of economic stagnation with the deepening of social inequality contributes for a reduced purchasing power and to an increased social dualism. The erosion of the middle class had dramatic implications for the housing market and for construction techniques, submitted to the need for controlling costs. The aesthetics and environmental quality are luxuries displayed ostensibly by those that can afford. The

preservation of historical heritage is also a luxury limited to buildings and urban areas of exceptional value.
Adding to the dysfunctions of the financial system are the problems arising from the lack of energy resources, as a consequence of fossil fuel depletion and insufficient capacity of alternative resources to replace them. This results in increasing restrictions on mobility, that the use of telecommunication and computing only partially compensates it.
The social instability, the need to rationalize the use of scarce resources and the lack of expectations in the market economy, unable to regenerate and restore society into a growth dynamic, favoured the emergence of a strong and interventionist State, with regard to the maintenance of public order and macroeconomic system regulation. However, financial constraints difficult the intervention of the State in the housing market, particularly in relation to policies supporting the neediest population segments. The state regulates the urban design, imposes a strict policy of densification of the built environment and strongly promotes the rehabilitation of historic centres, less for reasons of heritage preservation, than for the need to concentrate population and reduce mobility costs.
The State also imposes a strict policy of energy efficiency, whether by strong taxation of fuels or by imposing strict regulation of thermal insulation conditions. This factor, combined with insufficient funding, steered the development of building techniques and architectural design, in terms of efficiency rather than considerations of comfort and aesthetics. As an exception are exclusive clusters, where the richest apply their profits, backed by strong security measures.

5. CONCLUSION

This paper focuses on the validation of the importance of foresight techniques, as a tool for decision support and for the definition of housing policies, and on the discussion of their application. There is an ongoing work regarding the implementation of the principles set out in this paper, applied to the housing market in Portugal. This implies the transformation of the draft version previously presented on real scenarios and a Delphi questionnaire that will be presented to experts. This is certainly an opportunity for future papers.

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